Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AP42 Section:	11.20
Reference:	9
Title:	Sulfur Dioxide Emission Measurements, Lightweight Aggregate Kiln No. 5 (Outlet), Carolina Solite Corporation, Aquadale, North Carolina, Sholtes & Koogler Environmental Consultants, Inc., Gainesville, FL, May 1991.

AP-42 Section 11.20
Reference 9
Report Sect. 4
Reference 7

SULFUR DIOXIDE EMISSION MEASUREMENTS

LIGHTWEIGHT AGGREGATE KILN NO. 5

CAROLINA SOLITE
AQUADALE, NORTH CAROLINA

MAY 16, 1991

KOOGLER & ASSOCIATES
ENVIRONMENTAL SERVICES

RECEIVED
JUN 4 1991
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SULFUR DIOXIDE EMISSION MEASUREMENTS

LIGHTWEIGHT AGGREGATE
KILN NO. 5

CAROLINA SOLITE
AQUADALE, NORTH CAROLINA

MAY 16, 1991

KOOGLER & ASSOCIATES
ENVIRONMENTAL SERVICES
4014 N.W. 13TH STREET
GAINESVILLE, FL 32609
(904) 377-5822

KOOGLER & ASSOCIATES

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KOOGLER & ASSOCIATES

To the best of my knowledge and in my professional judgement, all applicable field and analytical procedures comply with modern engineering principles and all test data and plant operating data are true and correct.

John B. Koogler, Ph.D., P.E.

5/5/91

Date

KOOGLER & ASSOCIATES

1.0 INTRODUCTION

Carolina Solite owns and operates a lightweight aggregate production facility near Aquadale, North Carolina. Shale is quarried on site, hauled to the lightweight aggregate facility, and calcined in rotary kilns to produce a lightweight aggregate used in the construction industry.

On May 16, 1991, Koogler & Associates Environmental Services of Gainesville, Florida, conducted sulfur dioxide emission measurements in the stack exhausting Kiln No. 5 in accordance with EPA Method 8 as described in 40CFR60, Appendix A. The purpose of the testing was to demonstrate compliance with the sulfur dioxide emission limiting standard of the air permit for the kiln.

Prior to the test date, the North Carolina Department of Environment, Health and Natural Resources, Division of Environmental Management (NCDEM) was notified of the test schedule and the test method. Mr. Mike Landis of NCDEM was present during the test period to observe plant operations and test procedures.

During the period of testing, the No. 5 lightweight aggregate kiln was operating at a production rate of 8.0 tons of product per hour. The kiln was being fired with coal at a rate of 1.3 tons per hour; or at a heat input of 34.8 million BTU per hour.

The sulfur dioxide emission rate was calculated using two procedures. One

procedure involved the use of the "F" factor as described in EPA Method 19, 40CFR60, Appendix A and the second method involved calculating the mass emission rate of sulfur dioxide (pounds per hour) and dividing by the measured heat input to the kiln. The concentration of sulfur dioxide measured in the stack gas and used in both methods of calculating sulfur dioxide emissions was 8.19×10^{-5} pounds of sulfur dioxide per dry standard cubic foot of stack gas. The "F" factor for bituminous coal is 9780 dscf per million BTU heat input at zero percent oxygen in the stack gas. The average oxygen concentration measured in the stack gas during the three test runs was 11.3 percent resulting in an oxygen corrected "F" factor of 21,359 dscf per million BTU heat input. The sulfur dioxide emission rate based on the corrected "F" factor was 1.75 pounds per million BTU heat input.

To calculate the sulfur dioxide mass emission rate, a stack gas flow of 9797 dry standard cubic feet per minute was measured. This stack gas flow rate and the measured sulfur dioxide concentration resulted in a mass sulfur dioxide emission rate of 48.14 pounds per hour. Based on measured heat input of 34.8 million BTU per hour, the calculated sulfur dioxide emission rate was 1.38 pounds per million BTU heat input.

The sulfur dioxide emission rates calculated using both methods are less than the sulfur dioxide emission limit for Kiln No. 5 of 2.3 pounds per million BTU heat input.

2.0 PROCESS DESCRIPTION

Shale is quarried on site and hauled to the lightweight aggregate production facility. The shale is crushed to size and fed to rotary kilns where it is calcined to produce lightweight aggregate. As the shale is heated, it expands approximately doubling in volume. The lightweight aggregate is then discharged from the kiln, cooled and sized. The resulting product is a strong lightweight aggregate used in the construction industry.

During the test period of May 16, 1991, Kiln No. 5 was fired with coal at the rate of 1.3 tons per hour. The heating value of the coal averaged 13,397 BTU per pound resulting in a heat input to Kiln No. 5 of 34.8 MMBTU per hour; or 4.35 MMBTU per ton of product (at a lightweight production rate of 8.0 tons per hour). The data sheets used for determining the coal feed rate to the kiln are included in the Appendix of this report.

The gas stream leaving the kiln passes through a scrubber system and is discharged to the atmosphere through a 32-inch diameter stack at a height of approximately 90 feet above grade.

3.0 SAMPLING POINT LOCATION

Two sampling ports are located in a 32-inch diameter stack 25 feet above the duct leading from the scrubber to the stack and 60 feet below the top of the stack. The two sampling ports are located 90 degrees to one another. Using criteria of EPA Method 1, 40CFR60, Appendix A, 12 traverse points were used for measuring the stack gas flow rate. The sampling for sulfur dioxide was conducted at a single point near the center of the stack as mutually agreed by Koogler & Associates and the NCDEM representative.

Figure 1 is a schematic diagram of the stack showing the sample ports and traverse point locations for measuring the stack gas flow rate.

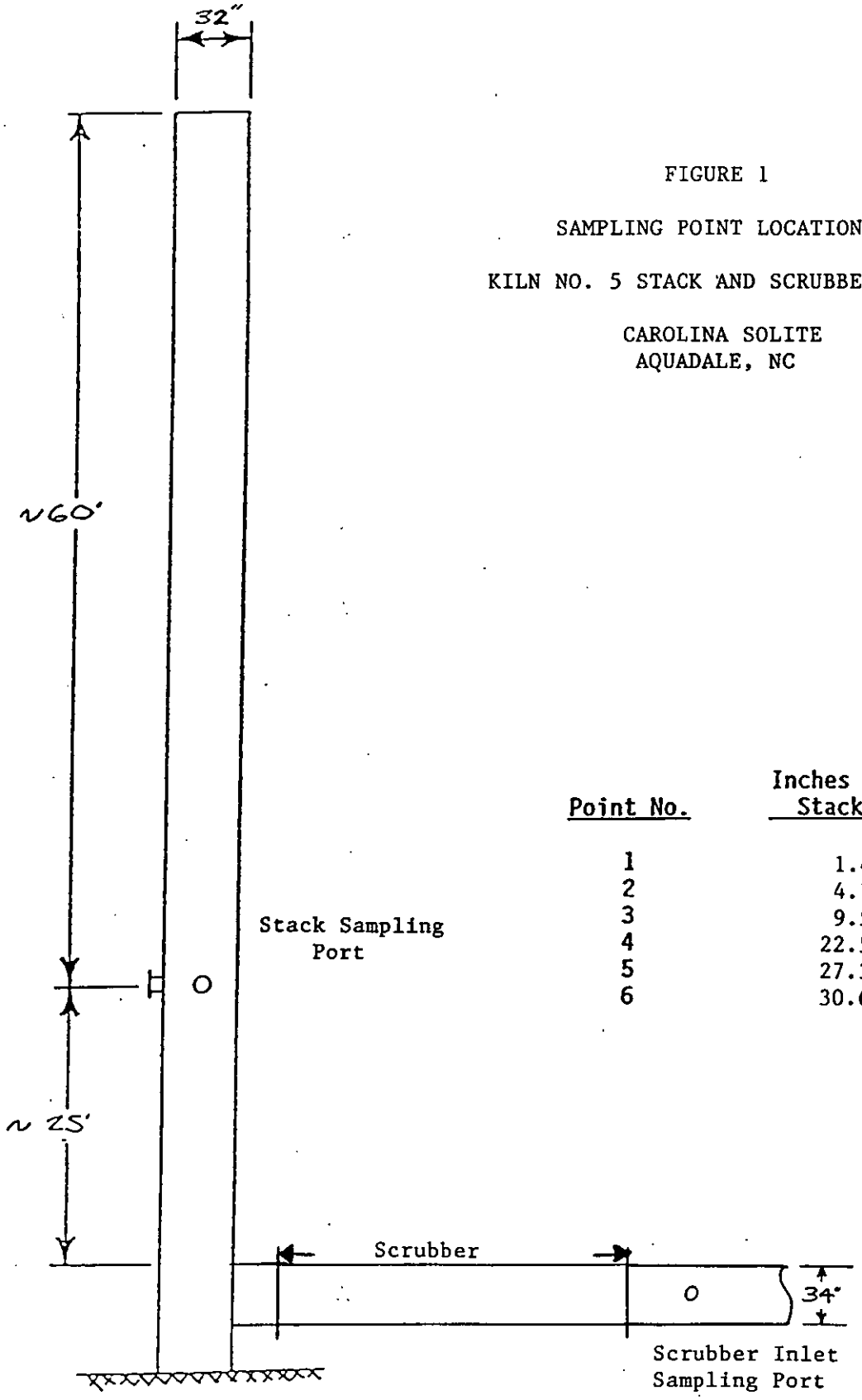

FIGURE 1

SAMPLING POINT LOCATIONS

KILN NO. 5 STACK AND SCRUBBER INLET

CAROLINA SOLITE
AQUADALE, NC

Point No.	Inches Inside Stack Wall
1	1.4
2	4.7
3	9.5
4	22.5
5	27.3
6	30.6

4.0 FIELD AND ANALYTICAL PROCEDURES

The sulfur dioxide sampling was conducted in accordance with EPA Method 8 as described in 40CFR60, Appendix A. This test method with sampling at a single point in the stack was recommended by NCDEM personnel.

The stack gas velocity measurements were made in accordance with EPA Methods 1 and 2 and stack gas moisture measurements were made in accordance with EPA Method 4, both as described in 40CFR60, Appendix A. The condensate volume collected in the Method 8 sampling train was used for the Method 4 moisture determination.

5.0 SUMMARY OF RESULTS

During the test period of May 16, 1991, Kiln No. 5 at Carolina Solite was operating under normal conditions at a lightweight aggregate production rate of 8.0 tons per hour. The measured heat input during the time of testing was 34.8 MMBTU per hour based on a coal feed rate of 1.3 tons per hour and a coal heating value of 13,397 BTU per pound.

The stack gas flow rate measured during the test period was 9797 dry standard cubic feet per minute at a temperature of 128°F, a moisture content of 14.4 percent and an oxygen content of 11.3 percent. The measured sulfur dioxide concentration in the gas stream was 8.19×10^{-5} pounds per dry standard cubic foot.

Using the "F" factor method of calculating sulfur dioxide emissions as described in EPA Method 19, 40CFR60, Appendix A, the emission rate was 1.75 pounds per million BTU heat input.

Based on the sulfur dioxide concentration in the stack gas, a gas flow of 9797 dry standard cubic feet per minute and a measured heat input of 34.8 million BTU per hour, the calculated sulfur dioxide emission rate was 1.38 pounds per million BTU heat input.

The permitted sulfur dioxide emission rate from Kiln No. 5 is 2.3 pounds per million BTU heat input. Based upon the tests conducted on May 16, 1991, it can be concluded that Kiln No. 5 was operating in compliance with

the permitted sulfur dioxide emission rate.

The field and analytical data sheets, all calculations, documentation of plant operating data, equipment calibration sheets and project participants are included in the Appendix of this report.

TABLE 1
SUMMARY OF STACK GAS FLOW DATA

SOLITE / AQUADALE, N.C.
NO. 5 SCRUBBER STACK
MAY 16, 1991

Run No.	Process Weight Rate (Tons/Hr)	Stack Gas Flow Rate (SCFMD)	Stack Gas Temperature (Deg F)	Stack Gas Moisture (%)	STACK GAS Oxygen (%)	STACK GAS CO2 (%)
1	0.0	10105	127.3	14.0	10.6	8.8
2	0.0	9687	128.0	14.4	11.2	8.1
3	0.0	9598	129.3	14.8	12.2	7.6
Average	0.0	9797	128.2	14.4	11.33	8.17

TABLE 2

SO2 EMISSION CALCULATIONS

PLANT : SOLITE / AQUADALE, N.C.
NO.5 SCRUBBER OUTLET DATE : MAY 16 1991

Std. Temp. : 68 DEG. F
F-Factor : dscf/MMBtu

Run No.	Vm(std), dscf	lb/dscf	lb/MMBtu	ppm	ppm @3.0 %O2	lb/hr
1A	43.111	7.70E-05		464.12	928.24	46:71
1B						
Run Average	43.111	7.70E-05		464.12	928.24	46.71
2A	43.311	8.84E-05		532.69	948.78	51.40
2B						
Run Average	43.311	8.84E-05		532.69	948.78	51.40
3A	43.910	8.03E-05		483.57	989.25	46.23
3B						
Run Average	43.910	8.03E-05		483.57	989.25	46.23
Test Average	43.444	8.19E-05		493.46	955.42	48.11

CALCULATIONS :

Vm(std) = [T(std) + 460 / 29.92] x Vm x Y x (Pb + (dH / 13.6)) / (Tm + 460) ..... dscf

CSO2 = 7.061e-5 x [(Vt - Vtb) x N x (Vsoln / Va)] / Vm(std) .....lb/dscf

CSO2 = F-Factor x (lb SO2/dscf) x [20.9 / (20.9 - %O2)] ..... lb/MMBtu

CSO2 = lb/dscf x (6.024e6) ..... ppm

CSO2 = ppm x [(20.9 - Oxygen Corr.) / (20.9 - %O2)] ..... ppm @ 3.0 % O2

ESO2 = lb/dscf x dscfm x (60 min/hr) ..... lb/hr

APPENDIX

1. Calculations
2. Field and Laboratory Data Sheets
3. Plant Information
4. Equipment Calibrations
5. Project Participants

CALCULATIONS

GENERAL DATA

DATA FILE NAME: EPA_58

Company : SOLITE / AQUADALE, N.C.
Source/Unit : NO.5 SCRUBBER OUTLET
Date : MAY 16, 1991
Stack dia. : 32.00 inch OR :
Oxygen Corr.: 0.0 percent

Cp : 0.840
Duct Length : 0.00 inch
Duct Width : 0.00 inch
Std. Temp. : 68 dF

FUEL ANALYSIS DATA,
(for calculating F-Factor)

			Process Wt.
Hydrogen,wt% :	0.00	Run 1 :	0.0 tons/hr
Carbon, wt% :	0.00	Run 2 :	0.0
Sulfur, wt% :	0.00	Run 3 :	0.0
Nitrogen,wt% :	0.00		
Oxygen, wt% :	0.00		
Btu/lb :	0		

F-Factor : dscf/MMBtu; enter this value or (F9) for result.

FIELD DATA	RUN 1	RUN 2	RUN 3
Meter Temp., Tm (dF)	97.30	94.00	90.90
Stack Temp., Ts (dF)	127.30	128.00	129.30
Sq.Rt. dP	0.65	0.63	0.62
dH (in. H2O)	1.83	1.83	1.83
Meter Vol.,Vm (ft3)	45.33	45.27	45.64
Meter Y	1.00	1.001	1.001
Bar. Press.,Pb (in.Hg.)	29.87	29.87	29.87
Vol. H2O, Vlc (ml)	246.00	1398.0	1577.0
Static Press.,Ps (in.H2O)	-0.22	-0.22	-0.22
Test Time (min.)	60.00	60.0	60.0
Nozzle Dia.,Dn (in.)	0.25	0.250	0.250
Oxygen, O2 (%)	11.95	10.85	12.15
Carbon Dioxide, CO2 (%)	8.85	8.05	7.55
Carbon Monoxide, CO (%)	0.00	0.00	0.00

Is this Method 5 or Method 5/8 ? (5 or 58) : 58

LABORATORY RESULTS	RUN 1	RUN 2	RUN 3	
GRAVIMETRIC ANALYSIS :				
Front Half Wash (FHW)	0.00000	0.00000	0.00000	grams
Filterable Particulate (MF)	0.00000	0.00000	0.00000	
Condensible Particulate (BHW)	0.00000	0.00000	0.00000	
SO2 ANALYSIS :				
SO2 Analysis (H2O2 impingers)	0.00	0.00	0.00	mg H2SO4
Sample Volume, ml	1000	2000	2000	
Sample Aliquot, ml	2	2	2	
Volume of Titer, ml	10.00	5.85	5.40	
Volume of Titer Blank, ml	0.20	0.20	0.20	

Normality of BaCl 0.0000000

SOURCE TEST CALCULATIONS

PLANT : SOLITE / AQUADALE, N.C.
NO.5 SCRUBBER OUTLET

RUN NO.: 1
DATE : MAY 15, 1991

STD.TEMP, Tstd	= 68 DEG. F	STATIC PRESS.,Ps	=	-0.22	in. H20
METER TEMP, Tm	= 97.3 DEG. F	PITOT COFF., Cp	=	0.840	
STACK TEMP, Ts	= 127.3 DEG. F	STACK I.D.	=	32.00	inch
AVG.VEL.HEAD,dP	= 0.43 in. H20	DUCT LENGTH	=		inch
METER ORIFICE,dH	= 1.83 in. H20	DUCT WIDTH	=		inch
METER VOL., Vm	=45.334 Cu.Ft.	STACK AREA, As	=	5.585	Sq.Ft.
METER COFF., Y	= 1.001	TEST TIME	=	60.00	min.
BAR. PRESS., Pb	= 29.87 in.Hg	NOZZLE DIA.	=	0.250	inch
COND.(Vlc)	= 246.0 ml	NOZZLE DIA., An	=	3.4E-04	Sq.Ft.

GAS ANALYSIS = 11.95 % O2 0.00 % CO
8.85 % CO2 79.20 % N2

****

Vm(std) = [T(std) + 460 / 29.92] x Vm x Y x
(Pb + (dH / 13.6)) / (Tm + 460)..... = 43.115 dscf

Vw(std) =(8.9148 x 10e-5) x (Tstd + 460) x Vlc = 11.579 scf

Bws = Vw(std) / (Vm(std) + Vw(std))..... = 0.212 ¦ Lower Bws value used.

Bws @ Saturated Conditions = Vapor Press. of H20
@ Dew Point Temp. / (Ps, in.Hg.) ..... = 0.140

%EA =(%O2 - 0.5%CO)/(0.264%N2 - (%O2-0.5%CO)) x 100 = 133.39

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.89

Ms = (Md x (1-Bws)) + (18.0 x Bws)..... = 28.23

P(stack) = Pbar + (Ps / 13.6) ..... = 29.85 in. Hg

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts + 460)
/ (Ms x P(stack))] ..... = 39.09 ft/sec

Qs = vs x As x 60 ..... = 13,098 acf/min

Qs(std) = Qs x (1-Bws)x((Tstd + 460)/(Ts + 460))
x (P(stack)/29.92) ..... = 10,105 dscf/min

I = (Ts+460) x [(0.002669 x Vlc) + (Vm(std) /
(T(std) + 460) / 29.92] x 100 / [Time x
P(stack) x An x vs x 60] ..... =

SOURCE TEST CALCULATIONS

PLANT : SOLITE / AQUADALE, N.C.
NO.5 SCRUBBER OUTLET

RUN NO.: 2
DATE : MAY 16, 1991

STD.TEMP, Tstd	= 68 DEG. F	STATIC PRESS.,Ps	= -0.22 in. H20
METER TEMP, Tm	= 94.00 DEG. F	PITOT COFF., Cp	= 0.840
STACK TEMP, Ts	= 128.0 DEG. F	STACK I.D.	= 32.00 inch
AVG.VEL.HEAD,dP	= 0.39 in. H20	DUCT LENGTH	= inch
METER ORIFICE,dH	= 1.83 in. H20	DUCT WIDTH	= inch
METER VOL., Vm	=45.265 Cu.Ft.	STACK AREA, As	= 5.585 Sq.Ft.
METER COFF., Y	= 1.001	TEST TIME	= 60.00 min.
BAR. PRESS., Pb	= 29.87 in.Hg	NOZZLE DIA.	= 0.250 inch
COND.(Vlc)	=1398.0 ml	NOZZLE DIA., An	= 3.4E-04 Sq.Ft.

GAS ANALYSIS = 10.85 % O2 0.00 % CO
8.05 % CO2 81.10 % N2

********** **********

Vm(std) = [T(std) + 460 / 29.92] x Vm x Y x (Pb + (dH / 13.6)) / (Tm + 460)..... = 43.306 dscf

Vw(std) =(8.9148 x 10e-5) x (Tstd + 460) x Vlc = 65.804 scf

Bws = Vw(std) / (Vm(std) + Vw(std))..... = 0.603 | Lower Bws value used.

Bws @ Saturated Conditions = Vapor Press. of H20 @ Dew Point Temp. / (Ps, in.Hg.) ..... = 0.144

%EA =(%O2 - 0.5%CO)/(0.264%N2 - (%O2-0.5%CO)) x 100 = 102.74

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.72

Ms = (Md x (1-Bws)) + (18.0 x Bws)..... = 28.04

P(stack) = Pbar + (Ps / 13.6) ..... = 29.85 in. Hg

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts + 460) / (Ms x P(stack))] ..... = 37.68 ft/sec

Qs = vs x As x 60 ..... = 12,626 acf/min

Qs(std) = Qs x (1-Bws)x((Tstd + 460)/(Ts + 460)) x (P(stack)/29.92) ..... = 9,687 dscf/min

I = (Ts+460) x [(0.002669 x Vlc) + (Vm(std) / (T(std) + 460) / 29.92] x 100 / [Time x P(stack) x An x vs x 60] ..... =

SOURCE TEST CALCULATIONS

PLANT : SOLITE / AQUADALE, N.C.
NO.5 SCRUBBER OUTLET

RUN NO.: 3
DATE : MAY 16, 1991

STD.TEMP, Tstd	= 68 DEG. F	STATIC PRESS.,Ps	= -0.22 in. H20
METER TEMP, Tm	= 90.90 DEG. F	PITOT COFF., Cp	= 0.840
STACK TEMP, Ts	= 129.3 DEG. F	STACK I.D.	= 32.00 inch
AVG.VEL.HEAD,dP	= 0.39 in. H20	DUCT LENGTH	= inch
METER ORIFICE,dH	= 1.83 in. H20	DUCT WIDTH	= inch
METER VOL., Vm	=45.644 Cu.Ft.	STACK AREA, As	= 5.585 Sq.Ft.
METER COFF., Y	= 1.001	TEST TIME	= 60.00 min.
BAR. PRESS., Pb	= 29.87 in.Hg	NOZZLE DIA.	= 0.250 inch
COND.(Vlc)	=1577.0 ml	NOZZLE DIA., An	= 3.4E-04 Sq.Ft.

GAS ANALYSIS = 12.15 % O2 0.00 % CO
7.55 % CO2 80.30 % N2

********** *********

Vm(std) = [T(std) + 460 / 29.92] x Vm x Y x
(Pb + (dH / 13.6)) / (Tm + 460)..... = 43.914 dscf

Vw(std) =(8.9148 x 10e-5) x (Tstd + 460) x Vlc = 74.230 scf

Bws = Vw(std) / (Vm(std) + Vw(std))..... = 0.628 | Lower Bws value used.

Bws @ Saturated Conditions = Vapor Press. of H20
@ Dew Point Temp. / (Ps, in.Hg.) ..... = 0.148

%EA =(%O2 - 0.5%CO)/(0.264%N2 - (%O2-0.5%CO)) x 100 = 134.27

Md =(.44 x %CO2)+(.32 x %O2)+[.28 x (%N2 + %CO)] = 29.69

Ms = (Md x (1-Bws)) + (18.0 x Bws)..... = 27.97

P(stack) = Pbar + (Ps / 13.6) ..... = 29.85 in. Hg

vs = 85.49 x CP x (Sq.Rt.dP) x [Sq.Rt.(Ts + 460)
/ (Ms x P(stack))] ..... = 37.59 ft/sec

Qs = vs x As x 60 ..... = 12,595 acf/min

Qs(std) = Qs x (1-Bws)x((Tstd + 460)/(Ts + 460))
x (P(stack)/29.92) ..... = 9,598 dscf/min

I = (Ts+460) x [(0.002669 x Vlc) + (Vm(std) /
(T(std) + 460) / 29.92] x 100 / [Time x
P(stack) x An x vs x 60] ..... =

GENERAL DATA

DATA FILE NAME: SOLNC5SO

Company : SOLITE / AQUADALE, N.C.
Source/Unit : NO.5 SCRUBBER OUTLET
Date : NAY 16 1991
Oxygen Corr.: 3.0 percent
F-Factor : dscf/MMBtu
Std. Temp. : 68 dF

PRINT_MENU Place a 1 next to the pages to be printed, then select PRINT from program menu.

INPUT 1 Data Input.
SUMMARY 1 SO2 Calculations & Summary Page.

FIELD DATA	RUN 1A	RUN 1B	RUN 2A	RUN 2B	RUN 3A	RUN 3B
Meter Temp., Tm (dF)	97.30	0.00	94.00	0.00	90.90	0.00
Stack Temp., Ts (dF)	127.3	0.0	128.0	0.0	129.3	0.0
dH (in. H2O)	1.83	1.83	1.83	1.83	1.83	1.83
Meter Vol.,Vm (ft3)	45.330	0.000	45.270	0.000	45.640	0.000
Meter Y	1.001	1.001	1.001	1.001	1.001	1.001
Bar. Press.,Pb (in.Hg.)	29.87	29.87	29.87	29.87	29.87	29.87
Static Press.,Ps (in.H2O) ..	-0.22	-0.22	-0.22	-0.22	-0.22	-0.22
Test Time (min.)	60.0	60.0	60.0	60.0	60.0	60.0
Oxygen, O2 (%)	11.95	11.95	10.85	10.85	12.15	12.15
Carbon Dioxide, CO2 (%)	8.85	8.85	8.05	8.05	7.55	7.55
Carbon Monoxide, CO (%)	0.00	0.00	0.00	0.00	0.00	0.00
Gas Flow Rate, dscfm	10105	0	9687	0	9598	0

LABORATORY RESULTS	RUN 1A	RUN 1B	RUN 2A	RUN 2B	RUN 3A	RUN 3B
Sample Volume, ml	1000	0	2000	0	2000	0
Sample Aliquot, ml	2	0	2	0	2	0
Volume of Titer, ml	10.00	0.00	5.85	0.00	5.40	0.00
Volume of Titer Blank, ml ..	0.20	0.00	0.20	0.00	0.20	0.00

Barium Perchlorate
Normality :

0.00960

SO_2 Emission Calculations

Method 19, 40 CFR 60, Append. A

"F" Factor

$C_{SO_2} = 8.19 \times 10^{-5}$ lb/dscf (Table 2)

"F" = 9780 dscf / MMBTU

$O_2 = 11.33\%$ (Table 1)

$$E_{SO_2} = \left(9780 \frac{ft^3}{MMBTU}\right)\left(8.19 \times 10^{-5} \frac{lb}{ft^3}\right)\left(\frac{20.9}{20.9 - 11.33}\right)$$

$$= 1.75 \text{ lb } SO_2 / MMBTU$$

SO_2 Mass Emission Rate and Measured Heat Input

$C_{SO_2} = 8.19 \times 10^{-5}$ lb/dscf (Table 2)

Q = 9797 dscfm (Table 1)

Heat Input = 34.8 MMBTU/hr (Appendix)

$$E_{SO_2} = \left(9797 \frac{ft^3}{min}\right)\left(60 \frac{min}{hr}\right)\left(8.19 \times 10^{-5} \frac{lb}{ft^3}\right)\left(1 / 34.8 \text{ MMBTU/hr}\right)$$

$$= 1.38 \text{ lb } SO_2 / MMBTU$$

FIELD AND LABORATORY DATA SHEETS

KOOGLER & ASSOCIATES, Environmental Services
4014 N.W. 13th Street • Gainesville, Florida 32609 • 904/377-5822

SOURCE SAMPLING FIELD DATA SHEET

Plant Carolina Solite
Sampling Location #5 Kiln
Type of Control Scrubber outlet
Type of Samples SO_2
Date 5-16-91 Run No. 1
Time Start 1143 Time End 1243
Sample Time 5 min/pt 60 Total min
DB ____ °F, WB ____ °F, VP @ DP ____ "Hg
Bar. Press. 29.87 "Hg, Stack Press. 29.85 "Hg
Moisture ____ %, FDA ____, Gas Density Factor ____
Temp. 85 °F, W/D SE, W/S 3-8
Weather Clear Thermocouple Readout KA-1
Sample Box No. KA-1 Meter Box No. KA-1
Meter ΔH@ 1.83 Pitot Corr. Factor 0.84
Nozzle Dia. — in., Probe Length 4 ft
Probe Heater Setting 4 Nomograph C_f 1.83
Stack Dimensions 32" in
Stack Area 5.56 ft^2
Effective Stack Area 5.56 ft^2
Stack Height ____ ft

Purged for 15 min at 1.83 end of run
PS = -0.22

Stack Dimensions

Umbilical Cord 100'
Thermocouple Probe No. KA-50
Pitot Tube No. KA-51

Mat'l Processing Rate ____
Final Gas Meter Reading 1043.542 ft^3 45.334
Initial Gas Meter Reading 998.208 ft^3
Condensate Increase in Impingers 216 ml 246
Moisture in Silica Gel 30 gm
Silica Gel Container No. 23 Filter No. ____

Orsat:				
%CO_2	9.0	8.7		
%O_2	11.8	12.1		
%CO				
%N_2				

Test Conducted By: R Paul

Stack Test Observers: ____

Leak Check Meter Box Initial 0.013 cfm @ 15 In H_2 Final 0.016 cfm @ 10 In Hg

Pitot Tubes —
Impact 3 In H_2O for 15 sec. Stable Leak
Static 3 In H_2O for 15 sec. Stable Leak

Port and Traverse Point No.	Distance From Inside Stack Wall (in.)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) Calc.	Actual	Stack Gas Temp. (°F)	Sample Box Temp. (°F)	Last Imp. Temp. (°F)	Meter Temp. (°F)	Vacuum on Sample Train ("Hg)	O_2 %
				0.652	1.83		127.3			97.3		
1	1.4		98.2	0.28 0.23		1.83	126	242	76	87	10	10.6
2	4.7		1.9	0.42 0.30		1.83	126	259	67	90	10	11.0
3	9.5		5.7	0.54 0.38		1.83	127	250	64	92	10	11.0
4	22.5		9.5	0.57 0.50		1.83	127	246	62	96	10	10.7
5	27.3		13.3	0.55 0.51		1.83	128	256	61	97	10	10.0
6	30.6		17.1	0.42 0.50		1.83	128	246	59	99	10	
7			21.1			1.83	128	245	60	101	8	
8			24.7			1.83	128	251	61	101	9	

KOOGLER & ASSOCIATES, Environmental Services
4014 N.W. 13th Street • Gainesville, Florida 32609 • 904/377-5822

SOURCE SAMPLING FIELD DATA SHEET

Plant Carolina Solite
Sampling Location #5 Kiln
Type of Control Scrubber outlet
Type of Samples SO2
Date 5-16-91 Run No. 2
Time Start 1441 Time End 1541
Sample Time 5 min/pt 60 Total min.
DB ____ °F, WB ____ °F, VP @ DP ____ "Hg
Bar. Press. 29.87 "Hg, Stack Press. 29.85 "Hg
Moisture ____ %, FDA ____, Gas Density Factor ____
Temp. 85 °F, W/D Vari, W/S 5-10
Weather Clear Thermocouple Readout KA-1
Sample Box No. KA-1 Meter Box No. KA-1
Meter ΔH@ 1.83 Pitot Corr. Factor 0.84
Nozzle Dia. — in., Probe Length 4 ft
Probe Heater Setting 4 Nomograph C_f 1.83
Stack Dimensions 32" in
Stack Area 5.56 ft^2
Effective Stack Area 5.56 ft^2
Stack Height ____ ft

Purged for 15 min at 1.83

Stack Dimensions

Umbilical Cord 100'
Thermocouple Probe No. KA-50
Pitot Tube No. KA-SI

Mat'l Processing Rate ____
Final Gas Meter Reading 107.765 ft^3 45.265
Initial Gas Meter Reading 62.500 ft^3
Condensate Increase in Impingers 1372 ml 1398
Moisture in Silica Gel 26 gm
Silica Gel Container No. 37 Filter No. ____

Orsat:				
$\%CO_2$	8.0	8.1		
$\%O_2$	10.8	10.9		
%CO				
$\%N_2$				

Test Conducted By: R Paul

Stack Test Observers: ____

Leak Check Meter Box Initial 0.018 cfm @ 15 In H_2 Final 0.011 cfm @ 10 In Hg

Pitot Tubes —
Impact 3 In H_2O for 15 sec. Stable, Leak
Static 3 In H_2O for 15 sec. Stable, Leak

Port and Traverse Point No.	Distance From Inside Stack Wall (in.)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O) 0.626	Meter Orifice Press. Diff. ("H_2O) 1.83 Calc.	Actual	Stack Gas Temp. (°F) 128	Sample Box Temp. (°F)	Last Imp. Temp. (°F)	Meter Temp. (°F) 94	Vacuum on Sample Train ("Hg)	CO_2 % / O_2 %
1			62.5	0.28 0.27	1.83	1.83	128	257	69	95	7	11.5
2			66.4	0.40 0.28		1.83	128	267	68	95	8	11.5
3			70.1	0.48 0.35		1.83	128	248	65	94	8	11.2
4			73.9	0.47 0.46		1.83	129	246	65	92	8	11.6
5			77.7	0.49 0.50		1.83	127	247	65	91	8	11.6
6			81.3	0.30 0.49		1.83	129	243	64	92	9	
7			84.8			1.83	129	251	61	93	9	
8			88.6			1.83	130	248	61	93	9	

Port and Traverse Point No.	Distance From Inside Stack Wall (in.)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O)		Stack Gas Temp. (°F)	Sample Box Temp (°F)	Last Imp. Temp. (°F)	Meter Temp. (°F)	Vacuum on Sample Train ("Hg)	O_2 %
					Calc.	Actual						
9			92.5		183	183	128	267	62	95	9	12.5
10			96.4			183	128	256	63	96	9	12.5
11			100.3			183	127	244	63	96	9	12.5
12			4.2			183	129	245	64	96	10	12.5

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SOURCE SAMPLING FIELD DATA SHEET

Plant Carolina Solite
Sampling Location #5 Kiln
Type of Control Scrubber outlet
Type of Samples SO2
Date 5-16-91 Run No. 3
Time Start 1653 Time End 1758
Sample Time 5 min/pt 60 Total min.
DB ____ °F, WB ____ °F, VP @ DP ____ "Hg
Bar. Press. 29.87 "Hg, Stack Press. 29.85 "Hg
Moisture ____ %, FDA ____, Gas Density Factor ____
Temp. 85 °F, W/D Vare, W/S 3-8
Weather Clear Thermocouple Readout KA-1
Sample Box No. KA-1 Meter Box No. KA-1
Meter ΔH@ 1.83 Pitot Corr. Factor 0.84
Nozzle Dia. — in., Probe Length 4 ft
Probe Heater Setting 4 Nomograph C_f 1.83
Stack Dimensions 32" in
Stack Area 5.56 ft^2
Effective Stack Area 5.56 ft^2
Stack Height ____ ft

Purged for 15 min at 1.83

Stack Dimensions

Umbilical Cord 100'
Thermocouple Probe No. KA-50
Pitot Tube No. KA-52

Mat'l Processing Rate ____
Final Gas Meter Reading 1166.345 ft^3 45.644
Initial Gas Meter Reading 120.701 ft^3
Condensate Increase in Impingers 1548 ml
Moisture in Silica Gel 29 gm 1577
Silica Gel Container No. 7 Filter No. ____

Orsat:				
%CO_2	7.6	7.5		
%O_2	12.2	12.1		
%CO				
%N_2				

Test Conducted By: R Paul

Stack Test Observers: ____

Leak Check Meter Box
Initial 0.009 cfm @ 15 In H_2
Final 0.013 cfm @ 10 In Hg

Pitot Tubes
Impact 3 In H_2O for 15 sec Stable, Leak
Static 3 In H_2O for 15 sec. Stable, Leak

Port and Traverse Point No.	Distance From Inside Stack Wall (in.)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O) 1.83 Calc.	Actual	Stack Gas Temp. (°F)	Sample Box Temp. (°F)	Last Imp. Temp. (°F)	Meter Temp. (°F)	Vacuum on Sample Train ("Hg)	
				0.623			129.3			90.9		
1			20.7	0.28 0.25	1.83	1.83	130	249	72	93	9	12.2
2			24.5	0.37 0.33		1.83	130	251	65	93	9	12.5
3			28.2	0.46 0.38		1.83	130	256	63	90	9	12.5
4			32.1	0.47 0.45		1.83	130	261	63	90	9	12.0
5			35.8	0.49 0.47		1.83	130	245	63	90	9	12.3
6			39.7	0.33 0.43		1.83	129	243	63	90	10	12.2
7			43.7			1.83	130	241	64	90	10	
8			47.7			1.83	129	244	64	91	9	

O_2 %

Port and Traverse Point No.	Distance From Inside Stack Wall (in.)	Clock Time	Gas Meter Reading (ft^3)	Stack Velocity Head ("H_2O)	Meter Orifice Press. Diff. ("H_2O)		Stack Gas Temp. (°F)	Sample Box Temp (°F)	Last Imp. Temp. (°F)	Meter Temp. (°F)	Vacuum on Sample Train ("Hg)	
					Calc.	Actual						
9												O_2 %
10			51.6		1.83	1.83	129	244	64	91	9	12.5
11			55.1			1.83	128	238	64	91	10	12.5
12			58.8			1.83	128	258	64	91	10	12.5
			62.7			1.83	128	243	65	91	10	12.5

KOOGLER & ASSOCIATES

CHAIN OF CUSTODY RECORD

Project Number: 150-91-

Project Name: Carolina Solite

Sample Location: Aquadale N.C.
#5 Scrubber Outlet

Sample Identification	Remarks
1-CA-I	2&3 Imp catch for SO2 Run 1
2-CA-I	" " " " " 2
3-CA-I	" " " " " 3
23	Silica Gel Run 1
37	" " " 2
7	" " " 3

Sampled By: (Signature) RC Paul Date: 5-16-91 Time: See data

Relinquished By: (Sign) _____ Date: _____ Time: _____

Received By: (Sign) _____ Date: _____ Time: _____

Relinquished By: (Sign) _____ Date: _____ Time: _____

Received By: (Sign) _____ Date: _____ Time: _____

Relinquished By: (Sign) RC Paul Date: 5-17-91 Time: 1700

Received By Lab: (Sign) RC Paul Date: 5-17-91 Time: 1700

Sample Shipped VIA: _____ UPS _____ Fed Express _____ Bus

Shipping Bill Number: _____

KOOGLER & ASSOCIATES

SO_2
LAB DATA

Plant Name Solite Aquadale Date Analyzed 5-20-91
Analyzed By RC Paul

Stack	Sample No.	V.T.	V.T.B.	N.	V.Soln.	V.A.
# Silo	1-1	10.0	0.2	0.0096	1000ml	2
scrubber	2	10.0			"	"
outlet						
	2-1	5.9			2000ml	52
	2	5.8			"	"
	3-1	5.4			2000ml	52
	2	5.4			"	"

V.T. = Volume of Barium perchlorate titrant used for sample (ml)
V.T.B. = Volume of Barium perchlorate titrant used for blank (ml)
N. = Normality of Barium perchlorate
V.Soln. = Total solution volume
V.A. = Volume of sample aliquot titrated (ml)

PLANT INFORMATION

KOOGLER & ASSOCIATES

Post-It™ brand fax transmittal memo 7671 | # of pages ▸ 1

To RODNEY PAUL	From STEVE HOLT
Co. KOOGLER & A.	Co. CSC
Dept.	Phone #
Fax #	Fax #

5 Kiln · Comp. Test

COAL usage

966 loader Empty wght = 37920 LB

966 loader Loaded wght = 43,120 LB
" " " " = 43,300 LB
" " " " = 42,440 LB

TOTAL gross wght = 129,360 LB

TOTAL Empty wght = 113,760 LB

TOTAL Net wght = 15,600 LB

COAL BIN FULL - 11:15AM

COAL BIN refilled 5:15 pm

TOTAL run time = 6:00hr

$$\frac{15,600 \text{ LB}}{6.00 \text{ hr}} \times \frac{1 \text{ Ton}}{2000 \text{ LB}} = 1.3 \text{ Tons/hr}$$

1.3 Tons/hr × 26,794,000 BTU/Ton = 34,832,200 BTU

EQUIPMENT CALIBRATIONS

PITOT TUBE CALIBRATION MEASUREMENTS

PITOT TUBE IDENTIFICATION NO. KA-SI

DATE CALIBRATED 8-9-90

PITOT TUBE ASSEMBLY LEVEL ? ✓ YES _____ NO

PITOT TUBE OPENINGS DAMAGED ? ____ YES (EXPLAIN BELOW) ✓ NO

α_1= 2.0 ° (<10°) α_2= 1.5 ° (<10°)

β_1= 2.5 ° (<5°) β_2= 2.0 ° (<5°)

Y= 2.5 °, 0= 1.0 °, A= 0.928 IN. = (PA+PB)

Z = A SIN Y = 0.0405 IN. (<0.125 IN.)

W = A SIN θ = 0.0162 IN. (<0.031 IN.)

P_A 0.465 IN. P_b 0.463 IN.

D_t 0.374 IN. (≥ 0.1875 IN. ≤ 0.3750 IN.)

COMMENTS: _____

CALIBRATION REQUIRED? _____ YES ✓ NO

CALIBRATED BY: RC Paul

PTCMFORM 1/8/87

KOOGLER & ASSOCIATES

POST TEST THERMOCOUPLE
CALIBRATION

DATE 5-16-9

PLANT NAME Carolina Solite

LOCATION Aquadale, N.C.

SOURCE #5 Scrubber outlet

Thermocouple Readout # KA-1

Umbilical Cord # 100'

Switch Box # KA-1

Thermocouple # KA-56

Average Stack Temperature °F 128

*Observed Mercury in Glass (ASTM) °F 128

Observed Thermocouple Reading °F 127

Percent Difference $\frac{(ASTM + 460) - (Thermo + 460)}{(ASTM + 460)} \times 100 =$ 0.17 %

Tolerance ≤ 1.5%

* Observed temperature must be within ten percent of the average stack temperature.

RC Paul
Signature

KOOGLER & ASSOCIATES

KOOGLER & ASSOCIATES, ENVIRONMENTAL SERVICES
ANNUAL THERMOCOUPLE CALIBRATIONS

Umbilical Cord No. 100 FT TC No. 63	BOX 1						BOX 2					
	STACK		BOX		IMP		STACK		BOX		IMP	
	TC[1]	ASTM[2]	TC	ASTM	TC	ASTM	TC	ASTM	TC	ASTM	TC	ASTM
Ice Bath	32	32	32	32	33	32	32	32	33	32	33	32
Ambient	83	84	82	84	83	84	81	84	81	84	82	84
212°	211	212	210	212	211	212	211	212	210	212	211	212
400°	412	414	413	414	413	413	413	414	414	414	413	414

Thermocouple Readout No. KA-1	UMBILICAL CORD NO. 100 FT						UMBILICAL CORD NO. 200 FT					
	STACK		BOX		IMP		STACK		BOX		IMP	
	TC	ASTM	TC	ASTM	TC	ASTM	TC	ASTM	TC	ASTM	TC	ASTM
Ice Bath	32	32	33	32	32	32	32	32	33	32	32	32
Ambient	83	84	82	84	83	84	84	84	83	84	83	84
212°	211	212	212	212	211	212	211	212	211	212	210	212
400°	413	414	414	414	414	414	412	413	413	414	414	414

Thermocouple Probe No.	TEMPERATURE							
	ICE BATH		AMBIENT		212°		400°	
	TC	ASTM	TC	ASTM	TC	ASTM	TC	ASTM
61	32	32	84	84	211	212	409	409
62	32	32	84	84	211	212	410	412
63	32	32	84	84	211	212	412	414
64	33	32	82	84	210	212	413	414
126	32	32	83	84	212	212	404	407
50	33	32	82	84	211	212	404	406
90	33	32	82	84	211	212	401	402
70	32	32	81	84	210	212	404	406
108	33	32	83	84	210	212	400	401

[1] Thermocouple reading (°F)
[2] American Society of Testing Materials
Mercury in glass thermometer (°F)

Signature Stephen Bell
Date 9-28-90

KOOGLER & ASSOCIATES

POST-TEST DRY GAS METER CALIBRATION FORM

Date: May 20-91 Meter Box No.: KA-1 Plant: Carolina Solite

Barometric Pressure, P_b = 30.04 in Hg Test Meter No.: KA-1 Pretest Y: 1.001

Orifice Manometer Setting, (ΔH) in. H_2O	Gas Volume: Test Meter (V_{T_3}), Ft.	Gas Volume: Dry Gas Meter (V_{d_3}), Ft.	Dry Gas Meter Temperature: Test Meter (t_T), °F	Dry Gas Meter Temperature: Inlet (t_{d_i}), °F	Dry Gas Meter Temperature: Outlet (t_{d_o}), °F	Dry Gas Meter Temperature: Average (t_d), [a] °F	Time (θ), Min.	Vacuum Setting in. Hg.	Y_i	Y_i $\frac{V_T P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6})(t_T + 460)}$
1.83	7.948	7.891	80			79	10	10	1.001	
1.83	7.954	7.901	81			80	10	10	1.001	
1.83	7.951	7.896	81			80	10	10	1.001	
									Y=1.001	

[a] If there is only one thermometer on the day gas meter, record the temperature under t_d

where:

V_T = Gas volume passing through the test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_T = Temperature of the gas in the test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in. H_2O

Y_i = Ratio of accuracy of test meter to dry gas meter for each run.

Y = Average ratio of accuracy of test meter to dry gas meter for all three runs; tolerance = pretest Y $\pm$0.05Y.

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

KOOGLER & ASSOCIATES

METER CALIBRATION FORM

GAS METER METHOD

DATE: 5-14-91

METER BOX NO: KA-1

BAROMETRIC PRESSURE: 30.04

TEST Δ HD	ORI-FICE Δ HD	TEST GAS METER VOLUME FINAL	TEST GAS METER VOLUME INITIAL	TEST GAS METER VOLUME ACTUAL FT3	DRY GAS METER VOLUME FINAL	DRY GAS METER VOLUME INITIAL	DRY GAS METER VOLUME ACTUAL FT3	TEMP OF TEST METER °F	TEMP OF DRY METER °F	RUN TIME MINUTES
-0.25	0.5	45.150	36.469	8.681	80.237	71.628	8.609	88	87	20.5
-0.23	1.0	53.445	45.150	8.295	88.445	80.237	8.208	88	86	14.0
-0.25	1.5	20.181	12.007	8.174	55.428	47.333	8.095	88	87	11.5
-0.27	2.5	62.833	53.445	9.388	97.798	88.445	9.353	88	86	10.0
-0.30	3.5	36.469	20.181	16.288	71.628	55.428	16.200	88	87	15.0

GAS METER THERMOMETER CALIBRATION

N.B.S. MERCURY °F	METER BOX °F
32	34
45	46
75	75
90	90
110	111

SIGNATURE: Rodney C Paul

DRY GAS METER AND ORIFICE CALIBRATION

CONTROL BOX NO. KA-1 BAROMETRIC PRESS. 30.04 IN. HG.

DATE 05/14/91 PERFORMED BY ROC

	RUN 1	RUN 2	RUN 3	RUN 4	RUN 5
VACUUM ("Hg)	0	0	0	0	0
dHw ("H2O)	-0.25	-0.23	-0.25	-0.27	-0.3
dHd ("H2O)	0.5	1	1.5	2.5	3.5
INITIAL WTM	636.469	645.15	612.007	653.445	620.181
FINAL WTM	645.15	653.445	620.181	662.833	636.469
INITIAL DGM	971.628	980.237	947.333	988.445	955.428
FINAL DGM	980.237	988.445	955.428	997.798	971.628
TEMP. WTM (F)	88	88	88	88	88
TEMP. DGM (F)	87	86	87	86	87
TEST TIME (MIN.)	20.5	14	11.5	10	15

****

NET VOLUME WTM	8.681	8.295	8.174	9.388	16.288
NET VOLUME DGM	8.609	8.208	8.095	9.353	16.200
Y	1.006	1.005	1.005	0.995	0.996
dH@	1.615	1.653	1.720	1.646	1.720

****

AVERAGE Y = 1.001

ACCEPTABLE Y RANGE = 0.981 TO 1.021

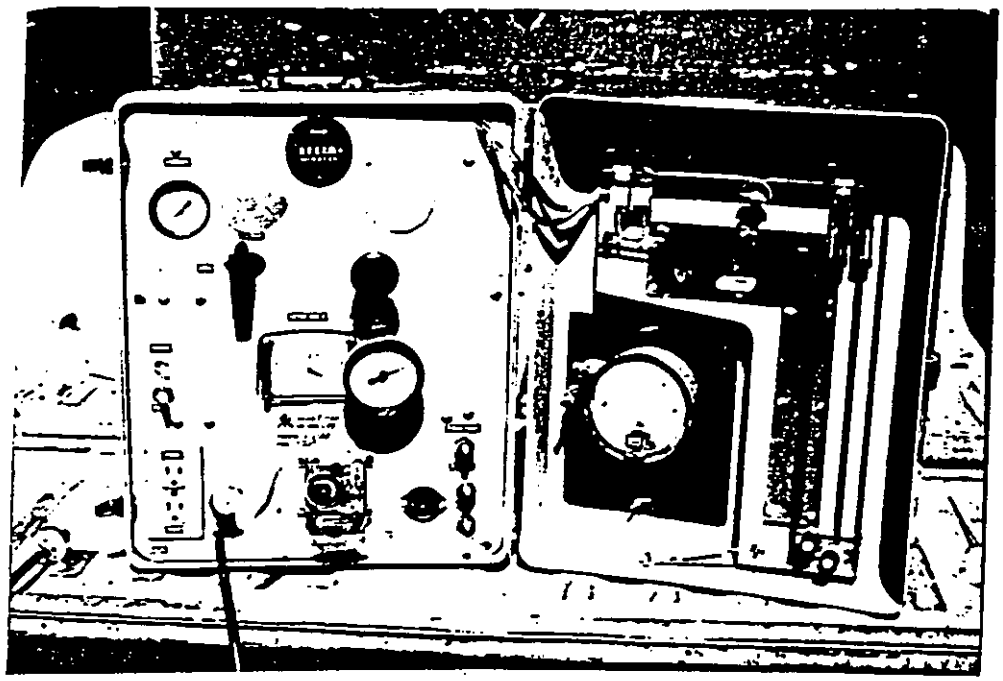
AVERAGE dH@ = 1.671

Y = (Vw (Pb - (dHw / 13.6)) x (Td + 460)) / (Vd (Pb + (dHd / 13.6)) x (Tw + 460)

dH@ = 0.0317 x dHd / (Pb (Td + 460)) x ((Tw + 460) x time) / Vw)^2

KOOGLER & ASSOCIATES
ENVIRONMENTAL SERVICES

SOURCE SAMPLING EQUIPMENT



METER BOX

Equipment used in Source Sampling is either manufactured by or assembled by Koogler & Associates. The guidelines followed are A.P.T.D. 0581, Details of Isokinetic Source Sampling Equipment, and A.P.T.D. 0576, Maintenance, Calibration and Operation of Isokinetic Source Sampling Equipment.

KOOGLER & ASSOCIATES

PROJECT PARTICIPANTS

KOOGLER & ASSOCIATES

PROJECT PARTICIPANTS

Koogler & Associates

John B. Koogler, Ph.D., P.E.	Project Advisor
Rodney C. Paul	Project Supervisor
Stephen Bell	Field Test Crew

Carolina Solite

Steven Holt

North Carolina Department of Environmental Management

Mike Landis

KOOGLER & ASSOCIATES

Carolina Solite Corporation
Aquadale, Stanly County, North Carolina
Kiln No. 5 Inlet
May 16, 1991

		1	2	3	
METER TEMP. DEG F	TmF	92	100	95	
METER TEMP. DEG R	TmR	552	560	555	
METER VOLUME CF	Vm	46.065	47.490	47.663	
BAROMETRIC PRESSURE in Hg	Pbar	29.98	29.98	29.98	
GAS METER CAL FACTOR	Y	0.991	0.991	0.991	
METER VOLUME DSCF	VmSTD	43.740	44.449	45.013	
NORMALITY/TITRANT meq/ml	N	0.0096	0.0096	0.0096	
VOL. OF TITRANT/SAMPLE ml	Vt	12.2	12.7	12.25	
VOL. OF TITRANT/BLANK ml	Vtb	0.2	0.2	0.2	
VOL. OF SAMPLE SOLN. ml	Vsoln	1000	1000	1000	
VOL. OF ALIQUOT ml	Va	2	2	2	
SO2 CONC. lb/DSCF	CSO2e	0.00009298	0.00009531	0.00009073	0.0000931
SO2 CONC. mg/DSCM	CSO2m	1489.44	1526.76	1453.36	
SO2 CONC. ppm	PPM SO2	559.88	573.91	546.32	
PERCENT O2	%O2	11.95	10.85	12.15	
PERCENT CO	%CO	0	0	0	
		8.85	8.05	7.55	
PERCENT N2	%N2	79.2	81.1	80.3	
DRY "F" FACTOR	F	9780	9780	9780	
EMISSION RATE lb/MM BTU	e	2.124	1.939	2.119	Reported = 1.98 lb/MMBtu
			2.061		
VOLUMETRIC AIR FLOW	Qstd	~~10100~~	9687	9598	
		10105			
EMISSION RATE, LB/HR		56.35	55.40	52.25	54.67 Reported 54.63 lb/hr

Carolina Solite Corporation
Aquadale , Stanly County, North Carolina
Kiln 5 Scrubber Stack
May 16, 1991

		1	2	3
METER TEMP. DEG F	TmF	97	94	91
METER TEMP. DEG R	TmR	557	554	551
METER VOLUME CF	Vm	45.33	45.27	45.64
BAROMETRIC PRESSURE in Hg	Pbar	30.00	30.00	30.00
GAS METER CAL FACTOR	Y	1.001	1.001	1.001
METER VOLUME DSCF	VmSTD	43.117	43.293	43.885
NORMALITY/TITRANT meq/ml	N	0.0096	0.0096	0.0096
VOL. OF TITRANT/SAMPLE ml	Vt	10	5.85	5.4
VOL. OF TITRANT/BLANK ml	Vtb	0.2	0.2	0.2
VOL. OF SAMPLE SOLN. ml	Vsoln	1000	2000	2000
VOL. OF ALIQUOT ml	Va	2	2	2
SO2 CONC. lb/DSCF	CSO2e	0.0000770	0.0000885	0.0000803
SO2 CONC. mg/DSCM	CSO2m	1233.96	1417.05	1286.61
SO2 CONC. ppm	PPM SO2	463.85	532.67	483.63
PERCENT O2	%O2	11.95	10.85	12.15
PERCENT CO	%CO	0	0	0
PERCENT N2	%N2	79.2	81.1	80.25
DRY "F" FACTOR	F	9780	9780	9780
EMISSION RATE lb/MM BTU	e	1.759	1.799	1.876 > 1.81 AVG.
PERCENT EXCESS AIR	%EA	1.334	1.027	1.345

Carolina Solite Corporation
Aquadale , Stanly County, North Carolina
Kiln 5 Scrubber Stack
May 16, 1991

	RUN NUMBER	1	2	3
	RUN DATE			
	RUN START TIME			
	RUN FINISH TIME			
N	NUMBER OF SAMPLE POINTS	12	12	12
Theta	TEST RUN TIME, MINUTES	60	60	60
Dn	NOZZLE DIAMETER, INCHES	0.250	0.250	0.250
An	NOZZLE AREA, SQ. IN.	0.0491	0.0491	0.0491
Cp	PITOT TUBE COEFFICIENT	0.840	0.840	0.840
Y	GAS METER CAL. FACTOR	1.001	1.001	1.001
Pbar	BAROMETRIC PRESSURE, IN. HG	29.87	29.87	29.87
Delta H	AVG. PRESS. DIFFERENTIAL OF ORIFICE METER, IN. H2O	1.830	1.830	1.830
Vm	ACTUAL METERED GAS VOL. CF	45.330	45.270	45.640
TmF	GAS METER TEMP,. DEG. F	97	94	91
Vm(std)	METERED GAS VOLUME AT DRY STANDARD CONDITIONS, DSCF	43.117	43.293	43.885
Vwc	VOLUME OF WATER COLLECTED IN IMPINGERS & DESICCANT, ML	246.0	1398.0	1577.0
Vwc(std)	VOLUME OF WATER VAPOR, SCF	11.579	65.804	74.229
%M	MOISTURE, % BY VOLUME @SAT	14	14.4	14.8
	MOISTURE, % BY VOLUME	21.2	60.3	62.8
fm	MOLE FRACTION OF DRY GAS	0.860	0.856	0.852
%CO2	CO2, % BY VOLUME, DRY	8.9	8.1	7.6
%O2	O2, % BY VOLUME, DRY	12.0	10.9	12.2
%CO	CO, % BY VOLUME, DRY			
%N2	N2, % BY VOLUME, DRY	79.2	81.1	80.3
Md	DRY MOLECULAR WT., #/#-MOLE	29.89	29.72	29.70

Carolina Solite Corporation
Aquadale , Stanly County, North Carolina
Kiln 5 Scrubber Stack
May 16, 1991

	RUN NUMBER	1	2	3
Ms	WET MOLECULAR WT., #/#-MOLE	28.23	28.03	27.97
Pstatic	GAS STATIC PRESS,. IN. H2O	-0.22	-0.22	-0.22
Ps	ABSOLUTE GAS PRESS, IN. HG.	29.85	29.85	29.85
TsF	STACK GAS TEMP., DEG. F	127	128	129
SSR DP	SUM OF SQUARE ROOTS OF VELOCITY PRESS. VALUES	7.8240	7.5120	7.4760
vs	FLUE GAS VELOCITY, FT/SEC	39.1	37.7	37.6
Ds	DUCT DIAMETER, INCHES	32.0	32.0	32.0
As	DUCT AREA, SQUARE INCHES	804.2	804.2	804.2
AsF	DUCT AREA, SQUARE FEET	5.585	5.585	5.585
Qs	GAS FLOW RATE, WET ACFM	13093	12625	12590
Qstd	GAS FLOW RATE, DRY SCFM	10102	9679	9591
mn	SAMPLE WEIGHT, GRAMS			
cs	PART. CONCENTRATION GR/DSCF	0.0000	0.0000	0.0000
pmrc	POLLUTANT MASS RATE CALC. FROM CONCENTRATION, #/HR	0.00	0.00	0.00
pmra	POLLUTANT MASS RATE CALC. FROM AREA RATIO, #/HR	0.00	0.00	0.00
%I	% ISOKINETIC	ERR	ERR	ERR
pmr avg	AVERAGE OF pmra & pmrc	0.00	0.00	0.00
%EA	% EXCESS AIR	133.4	102.7	134.5
F	"F" FACTOR, CU FT/MIL BTU			
q	HEAT INPUT RATE, MIL BTU/HR	ERR	ERR	ERR
E	EMISSION RATE, #/MIL BTU	0.000	0.000	0.000
AVERAGE	EMISSION RATE, #/MIL BTU		0	

Carolina Solite Corporation
Aquadale, Stanly County, North Carolina
Kiln No. 5 Inlet
May 16, 1991

		1	2	3	
METER TEMP. DEG F	TmF	92	100	95	
METER TEMP. DEG R	TmR	552	560	555	
METER VOLUME CF	Vm	46.065	47.490	47.663	
BAROMETRIC PRESSURE in Hg	Pbar	29.98	29.98	29.98	
GAS METER CAL FACTOR	Y	0.991	0.991	0.991	
METER VOLUME DSCF	VmSTD	43.740	44.449	45.013	
NORMALITY/TITRANT meq/ml	N	0.0096	0.0096	0.0096	
VOL. OF TITRANT/SAMPLE ml	Vt	12.2	12.7	12.25	
VOL. OF TITRANT/BLANK ml	Vtb	0.2	0.2	0.2	
VOL. OF SAMPLE SOLN. ml	Vsoln	1000	1000	1000	
VOL. OF ALIQUOT ml	Va	2	2	2	
SO2 CONC. lb/DSCF	CSO2e	0.00009298	0.00009531	0.00009073	0.0000931
SO2 CONC. mg/DSCM	CSO2m	1489.44	1526.76	1453.36	
SO2 CONC. ppm	PPM SO2	559.88	573.91	546.32	
PERCENT O2	%O2	11.95	10.85	12.15	
PERCENT CO	%CO	0	0	0	
		8.85	8.05	7.55	
PERCENT N2	%N2	79.2	81.1	80.3	
DRY "F" FACTOR	F	9780	9780	9780	
EMISSION RATE lb/MM BTU	e	2.124	~~1.939~~ 2.061	2.119	Reported = 1.98 lb/mmBtu
VOLUMETRIC AIR FLOW	Qstd	~~10100~~ 10105	9687	9598	
EMISSION RATE, LB/HR		56.35	55.40	52.25	54.67 Reported 54.63 lb/hr

Carolina Solite Corporation
Aquadale , Stanly County, North Carolina
Kiln 5 Scrubber Stack
May 16, 1991

		1	2	3
METER TEMP. DEG F	TmF	97	94	91
METER TEMP. DEG R	TmR	557	554	551
METER VOLUME CF	Vm	45.33	45.27	45.64
BAROMETRIC PRESSURE in Hg	Pbar	30.00	30.00	30.00
GAS METER CAL FACTOR	Y	1.001	1.001	1.001
METER VOLUME DSCF	VmSTD	43.117	43.293	43.885
NORMALITY/TITRANT meq/ml	N	0.0096	0.0096	0.0096
VOL. OF TITRANT/SAMPLE ml	Vt	10	5.85	5.4
VOL. OF TITRANT/BLANK ml	Vtb	0.2	0.2	0.2
VOL. OF SAMPLE SOLN. ml	Vsoln	1000	2000	2000
VOL. OF ALIQUOT ml	Va	2	2	2
SO2 CONC. lb/DSCF	CSO2e	0.0000770	0.0000885	0.0000803
SO2 CONC. mg/DSCM	CSO2m	1233.96	1417.05	1286.61
SO2 CONC. ppm	PPM SO2	463.85	532.67	483.63
PERCENT O2	%O2	11.95	10.85	12.15
PERCENT CO	%CO	0	0	0
PERCENT N2	%N2	79.2	81.1	80.25
DRY "F" FACTOR	F	9780	9780	9780
EMISSION RATE lb/MM BTU	e	1.759	1.799	1.876 > 1.81 AVG.
PERCENT EXCESS AIR	%EA	1.334	1.027	1.345

Carolina Solite Corporation
Aquadale , Stanly County, North Carolina
Kiln 5 Scrubber Stack
May 16, 1991

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Qstd	GAS FLOW RATE, DRY SCFM	10102	9679	9591
mn	SAMPLE WEIGHT, GRAMS			
cs	PART. CONCENTRATION GR/DSCF	0.0000	0.0000	0.0000
pmrc	POLLUTANT MASS RATE CALC. FROM CONCENTRATION, #/HR	0.00	0.00	0.00
pmra	POLLUTANT MASS RATE CALC. FROM AREA RATIO, #/HR	0.00	0.00	0.00
%I	% ISOKINETIC	ERR	ERR	ERR
pmr avg	AVERAGE OF pmra & pmrc	0.00	0.00	0.00
%EA	% EXCESS AIR	133.4	102.7	134.5
F	"F" FACTOR, CU FT/MIL BTU			
q	HEAT INPUT RATE, MIL BTU/HR	ERR	ERR	ERR
E	EMISSION RATE, #/MIL BTU	0.000	0.000	0.000
AVERAGE	EMISSION RATE, #/MIL BTU		0	

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03/30/92 1

DATA RATING: B
REF: 9 (AP-42)
REF 4-8

Emission Test Report
Review Checklist

Reviewer: R. MARINSHAW
Review Date: 11/17/92

A. Background Information

1. Facility name: FLORIDA SOLITE CORP.

   Location: GREEN COVE SPRINGS, FL

2. Source category: LIGHTWEIGHT AGGREGATE

3. Test date: 6/19/82

4. Test sponsor: PLANT (COMPLIANCE)

5. Testing contractor: SHELTES & KOOGLER ENVIR. CONSULTANTS

6. Purpose of test: COMPLIANCE

7. Pollutants measured

   (PM) PM-10 CO SO_2 NO_x VOC Pb CO_2

   Others (list):

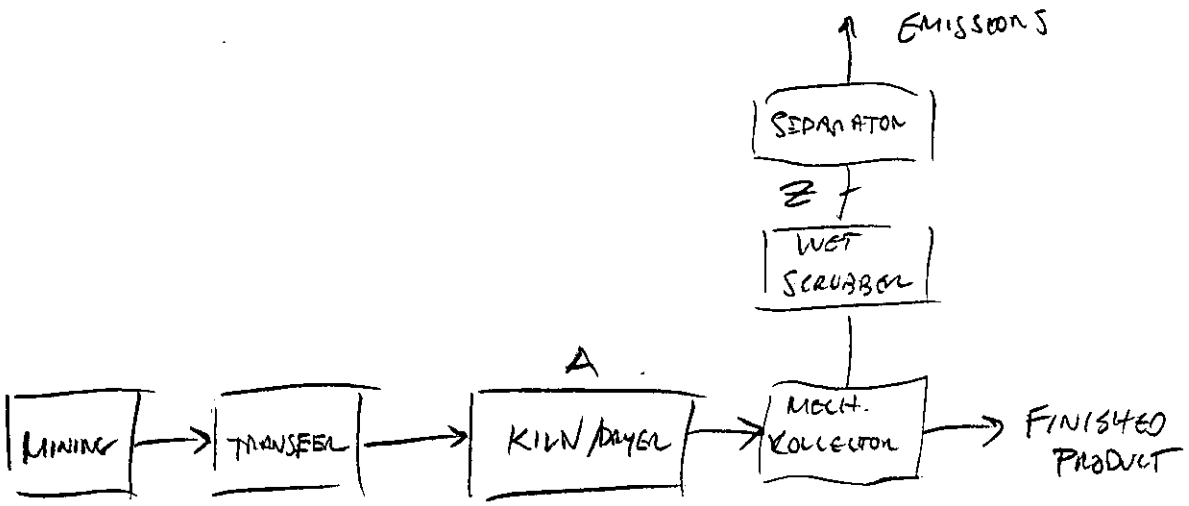
8. Process overview: On an attached page provide a block diagram of the unit operations and associated air pollution control systems at the facility. Identify process tested with letters from the beginning of the alphabet (A, B, C, etc.) and APC systems with letters from end of alphabet (V, W, X, etc.). Also identify test locations with Arabic numerals (1,2,3, ...). Using the ID symbols from that sketch complete the table below that identifies processes or unit operations tested.

Test ID	Process	Process ID	Emissions tested		APCD (controlled emissions only)
			Uncontrolled	Controlled	
1	DRYER/ KILN (COKE)	A		✓	SCRUBBER

B. Process Information

1. Provide a brief narrative description of the process. With as much detail as possible, (e.g., if a furnace or conveyor system is used, identify the type of unit) describe the equipment used for those operations tested. (Note: If process description provided in test report is adequate, attach copy or reproduce here.)

SEE PG. 2 FOR PROCESS DESCRIPTION



Florida Solite Corporation own and operate a mining and material processing facility located near Green Cove Springs, Florida. The material that is mined is a clay mineral which is then dried into a lightweight, very strong aggregate called solite.

2. For each process tested list feedstock materials and products. Indicate if activity factors are for feed (F) rate or product (P) rate.

Process ID	Feedstock materials	Products	Basis for activity factor	F/P
A	CLAY + COKE	LWA	CLAY FEED	F

Basis for data: TABLE 1
(Indicate page/table Nos. in test report)

3. For each process or operation tested and each test run note process capacity and operating rate during test.

Process ID	Capacity	Units	Test run	Process rate	Units
A	–	~~TONS~~	1	13.43 (CLAY)	TONS/HR
			2	13.43 (CLAY)	"
			3	13.43 (CLAY)	"
			4		
			1		
			2		
			3		
			4		
			1		
			2		
			3		
			4		
			1		
			2		
			3		
			4		

= 15.23 TPH
+ 1.8 TONS/HR (COKE)
"
"

Basis for data: TABLE 1

C. Air Pollution Control Systems Tested

1. For each air pollution control system pollution control system identified in A.8, note the following

ID	Type of APCD	Manufacturer	Model No.
2	WET SCRUBBER		

Note: Be as specific as possible in identifying APCD. For example, indicate "pulse jet fabric filter" rather than simply "fabric filter."

2. For each system identified above, provide a narrative description. For fugitive systems describe capture techniques as well as the removal techniques (use a separate page if necessary)

NO DATA PROVIDED

3. Using the attached parameter list for guidance complete the table below. (Use additional pages as needed.)

APCD ID	Parameter	Units	Readings			
			Run 1	Run 2	Run 3	Run 4
Type of APCD:						
Type of APCD:						
Type of APCD:						

NO DATA PROVIDED

D. Sampling and Analysis Methods

1. Complete the following table

Test location	Pollutant	S & A method	Reference/ conditional method	Deviations noted
A-KILN	PM (FILT.	5	Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N
			Y/N	Y/N

2. If a method used was not a reference or conditional method, provide a narrative discussion including any data manipulation needed to make results correspond to reference or conditional method results.

3. Describe any deviations identified above.

None

E. Emission Data Documentation

1. Tabulate the following stack gas data from the test report. (Use additional pages as needed.)

Test ID	Parameter	Units	Values reported			
			Run 1	Run 2	Run 3	Run 4
2	Stack temperature	°F	146	141	149	
	Moisture	%	22.9	20.1	23.0	
	Oxygen					
	Volumetric flow, actual		22380	20852	20183	
	Volumetric flow, standard	DSCFM	15020	14611	13426	
	Percent isokinetic		105.3	100.8	103.9	
	Pollutant concentration:					
		gr/scf	0.0675	0.1464	0.1136	
	Stack temperature					
	Moisture					
	Oxygen					
	Volumetric flow, actual					
	Volumetric flow, standard					
	Percent isokinetic					
	Pollutant concentration:					
	Stack temperature					
	Moisture					
	Oxygen					
	Volumetric flow, actual					
	Volumetric flow, standard					
	Percent isokinetic					
	Pollutant concentration:					

2. Tabulate pollutant mass flux rates

Test ID	Pollutant	Units	Mass flux rates			
			Run 1	Run 2	Run 3	Run 4
2	PM	LBS/HR	8.72	18.37	13.10	

3. Present example emission factor calculations below.

MASS FLUX / PROCESS RATE = EMISSION FACTOR

MASS FLUX	PROCESS RATE	EF
8.72	13.43	0.65
18.37	13.43	1.37
13.10	13.43	0.98
lbs/hr	tons/hr	

AVERAGE 1.0 lbs/ton

4. Tabulate emission factors

Process	Pollutant	Units	Average emission factor	
			Uncontrolled	Controlled
KILN	PM	lbs/ton		1.0
		kg/Mg		0.50

ATTACHMENT A
APCD PARAMETERS

Type of APCD	Parameters
Fabric filter	Cleaning mechanism Bag type Cleaning frequency Air to cloth ratio (A/C) Pressure drop Inlet temperature
ESP	Type (wet or dry) Number of fields Rapping cycle (if dry) Specific Collection Area (SCA) Particulate resistivity (if known) Spark rate Current and power levels
Venturi (or other high energy) scrubber	Pressure drop Liquid/gas (L/G) ratio Mist eliminator type
Packed-bed scrubber	Packing depth L/G ratio Caustic use (Y/N) pH Mist eliminator type
Carbon absorber	Bed depth Superficial gas velocity Bed temperature Desorption mechanism (media) Flue-gas moisture Cycle length Time-on-line after breakthrough