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:	13
Title:	Particulate Emission Source Test Conducted On No. 2 Kiln Wet Scrubber At Tombigbee Lightweight Aggregate Corporation, Livingston, Alabama, Resource Consultants, Brentwood, TN, November 12, 1981.

AP-42 Section 11.20
Reference 13
Report Sect. 4
Reference 13

Enclosed are:

- [ ] Blueprints
- [X] Manufacturer's Literature
- [ ] Emission Test of Existing Installation
- [ ] Fan Curves
- [ ] Particle Size Distribution
  - [ ] Physical [ ] Aerodynamic
- [ ] Size-Efficiency Curves
- [ ] Other _____

9. *Provide a sketch of device, if it is of unusual design.*

Attached

#2

0. List below the important operating parameters for the device. (For example: air/cloth ratio and fabric type, weight, and weave for a baghouse; throat velocity and water use rate for a venturi scrubber; etc.)

Water use rate = 8½ gals. per 1000 cfm
Static pressure drop through system = 14 inches W.G.
Compressed air pressure = 9 psi
Compressed air capacity = 1,875 scfm

1. By-pass (if any) is to be used when: Existing multiclones to be used during scrubber upset conditions.

Kiln feed rate will be reduced to one-half the normal rate.

PARTICULATE EMISSION SOURCE TEST
CONDUCTED ON
NO. 2 KILN WET SCRUBBER

AT

TOMBIGBEE LIGHTWEIGHT AGGREGATE CORPORATION
Livingston, Alabama

November 11, 1981

RESOURCE CONSULTANTS
environmental engineers and scientists

November 19, 1981

Mr. Clem Blackburn
Tombigbee Lightweight Aggregate Corp.
P. O. Drawer V
Livingston, AL 44101

Dear Clem:

The enclosed report presents the results of the particulate emission source test conducted November 11, 1981 on the Fuller wet scrubber controlling emissions from the No. 2 rotary kiln. The test results indicate that the average particulate mass rate of the three test runs was 32.5 pounds per hour. The allowable emission rate based on the Alabama Air Pollution Control Rules and Regulations is 43.1 pounds per hour.

We again appreciate this opportunity to be of service to Tombigbee Lightweight Aggregate Corporation. Thank you for the cooperation and assistance provided to us during the course of our work. Should you require additional information or if we may be of further assistance, please let us know.

Sincerely,

RESOURCE CONSULTANTS, INC.

J. R. Reehl
Pollution Control Specialist

Billy R. Nichols, P.E.
Director, Air Services Section

JRR:BRN/jd
enclosure

P.O. Box 498 • Two Maryland Farms • Suite 340 • Brentwood, Tennessee 37027 • 615-373-5040
a tennessee corporation

PARTICULATE EMISSION SOURCE TEST
CONDUCTED ON
NO. 2 KILN WET SCRUBBER

AT

TOMBIGBEE LIGHTWEIGHT AGGREGATE CORPORATION
Livingston, Alabama

On

November 11, 1981

By

RESOURCE CONSULTANTS, INC.
Two Maryland Farms, Suite 340
Brentwood, Tennessee 37027

RESOURCE CONSULTANTS INC.

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INTRODUCTION

This report presents the results of the particulate emission source test conducted November 11, 1981, on the wet scrubber system controlling emissions from the No. 2 rotary kiln at Tombigbee Lightweight Aggregate Corporation in Livingston, Alabama. Three isokinetic test runs were conducted to determine the amount of particulate matter being emitted into the atmosphere from the cyclonic separator stack. Test results are to be used to determine compliance with the Rules and Regulations of the Alabama Air Pollution Control Commission.

Exhaust gases from the processing of raw clay in the rotary kiln were drafted directly from the kiln to a Fuller compressed air atomizing scrubber system. Testing was conducted in the cyclonic separator stack, which included a rectangular grid of flow straightening vanes. Two sampling ports were located at a right angle from each other in the 70-inch diameter stack. The ports were situated at a point 2.0 stack diameters downstream from the separator outlet and 0.5 stack diameters upstream from the stack outlet. During each test run, sampling was conducted over two traverses of the stack with each traverse having 24 sampling points. Sampling time at each point was two minutes for a total sampling time of 96 minutes per test run.

Mr. James Colburn of Tombigbee Lightweight Aggregate Corporation arranged testing facilities, programmed desired process operations and documented production records. For the Alabama Air Pollution Control Commission, Mr. Freddie Thomas observed the process operations and Mr. Timothy Owen observed source testing procedures. For Resource Consultants, Inc., Messrs. Larry Garner, John Marino and Roger Reehl conducted the source test; Mr. Billy Nichols supervised the testing program.

RESULTS

The results of the series of three test runs conducted November 11, 1981, on the No. 2 kiln wet scrubber are presented in the following table:

	Run 1	Run 2	Run 3	Average
Sampling Period (CST)	0838-1035	1350-1543	1648-1834	--
Gas Stream Temperature (°F)	136	138	139	138
Moisture Content (% by Volume)	17.2	17.8	18.4	17.8
Gas Stream Velocity (ft/sec)	42.3	43.1	44.3	43.2
Volumetric Flow Rate (acfm)	67,800	69,100	71,100	69,300
Volumetric Flow Rate (dscfm)	49,800	50,300	51,200	50,400
Particulate Concentration (gr/dscf)	0.0779	0.0690	0.0784	0.0751
Particulate Mass Rate (lb/hr)	33.25	29.74	34.43	32.5
Process Weight Rate (tons/hr)	--	--	--	42.6 40.0 tph clay 2.6 tph coal
Allowable Emission Rate (lb/hr)	--	--	--	43.1
Isokinetic Rate (%)	97.2	95.5	97.3	--

The amount of particulate matter collected during each test run may be gravimetrically differentiated with respect to the point of collection within the sampling train as follows:

Run No.	Particulate Collected in Probe and Front Half of Filter Holder (mg / % of total)	Particulate Collected on Filter (mg / % of total)	Total Particulate Collected (mg)
1	75.9 / 25%	225.6 / 75%	301.5
2	76.0 / 29%	189.1 / 71%	265.1
3	100.9 / 32%	211.7 / 68%	312.6

Because of the potential for the existence of cyclonic flow in the cyclonic separator stack, the pitot tube rotational angles were determined at each point by the null technique of Method 1 to verify the extent of cyclonic flow. As a result of the installation of a rectangular grid of flow straightening vanes, the rotational angles at all points were measured to be less than 10 degrees from parallel flow relative to the stack wall, indicating suitable conditions for conducting a source test. However, the short downstream length of stack from the vane outlet to the sampling ports may not have allowed the flow profile to stabilize resulting in a less than ideal sampling site.

Because of the high moisture content of the gas stream, the pitot lines were routinely purged to eliminate plugging from condensed moisture.

During the testing program, the No. 2 kiln was operating at an average process weight rate of 42.6 tons per hour. As directed in Section 4.4.2 of the Alabama Air Pollution Control Commission Rules and Regulations, particulate matter shall not be emitted from this source in excess of 43.1 pounds per hour based on the indicated process weight rate as calculated by the equation:

$$E = (55.0)P^{0.11} - 40, \qquad P \geq 30 \text{ tons/hour}$$

where E = emissions in pounds per hour
P = process weight rate in tons per hour.

The test results indicate that the average particulate emission rate during the source test was 32.5 pounds per hour.

SAMPLING AND ANALYTICAL PROCEDURES

All testing was performed using procedures described in the Federal Register, Volume 42, Number 160, dated August 18, 1977, as ammended in Volume 43, Number 57, dated March 23, 1978, and as approved by the Alabama Air Pollution Control Commission.

Sampling sites were selected using Method 1; stack gas velocity and volumetric flow rates were determined by using Method 2. Determination of the gaseous components of the stack effluent was performed using the Fyrite sampling technique described in Method 3. The determinations of particulate emissions and associated moisture content of the stack effluent were accomplished using Method 5.

Gas flow rates were calculated using the gas temperature, density, pressure, velocity, and the cross-sectional area of the stack. The gas velocity was calculated from velocity head measurements made with a Type S pitot tube and an inclined manometer using standard traverse procedures.

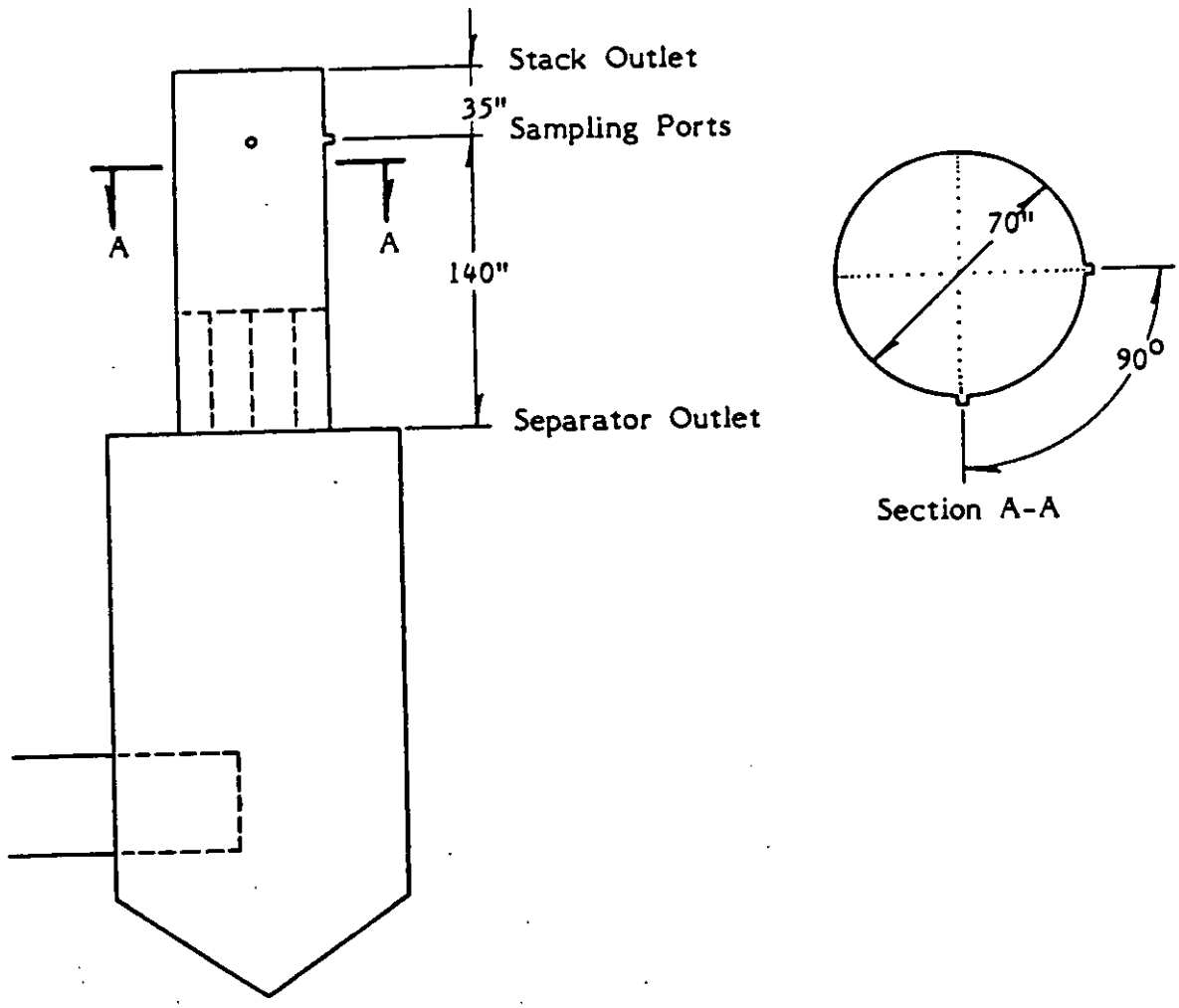
Continuous gas samples were taken under isokinetic conditions during each test. The samples were passed through a heated probe and filter, and four Greenburg-Smith impingers (all, except No. 2, modified by removal of the impinger shield) charged in the following manner:

Impinger No. 1 - 100 ml deionized water
Impinger No. 2 - 100 ml deionized water
Impinger No. 3 - Dry
Impinger No. 4 - 250 grams silica gel

At the end of each test, the volume of the impinger solutions was measured to determine the amount of condensate collected. The amount of vapor in the gas sample was calculated using the condensate measurement and data on the gases that passed through the meter.

The amount of particulate matter collected by the probe and front half of the filter holder was determined by placing washings from these components into crucibles tared to a constant weight and evaporating to dryness. The filter and crucibles from each test run were then desiccated for a minimum of 24 hours, weighed to a constant weight, and the results reported to the nearest 0.1 milligram.

Number of Inches from Stack Wall			
Point	Inches	Point	Inches
1	1.0	13	42.1
2	2.3	14	47.4
3	3.9	15	51.0
4	5.5	16	53.9
5	7.3	17	56.4
6	9.2	18	58.7
7	11.3	19	60.8
8	13.6	20	62.7
9	16.1	21	64.5
10	19.0	22	66.1
11	22.6	23	67.7
12	27.9	24	69.0



Location of Sampling Ports and Traverse Points

No. 2 Kiln Wet Scrubber System

Tombigbee Lightweight Aggregate Corporation
Livingston, Alabama

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NOMENCLATURE

A_s = Cross-sectional area of stack or duct, ft^2

A_n = Cross-sectional area of the nozzle, ft^2

B_{ws} = Water vapor in the gas stream, proportion by volume

$B_{ws(sat)}$ = Water vapor in the gas stream at saturation, proportion by volume

C_p = Pitot tube assembly coefficient, dimensionless

c_s = Particulate concentration, dry basis, standard conditions, gr/dscf

c_{si} = Particulate concentration including non-filterable condensable fraction, gr/dscf

I = Percent of isokinetic sampling, %

K_p = Pitot tube constant, 85.49 ft/sec $\left[(lb/lb\text{-}mole)(in.\ Hg)/(^oR)(in.\ H_2O)\right]^{1/2}$

L_a = Maximum acceptable leakage rate for either a post-test leak check or for a leak check following a component change; equal to 0.02 cfm or 4 percent of the average sampling rate, whichever is less.

L_i = Individual leakage rate observed during the leak check conducted prior to the "i^{th}" component change (i=1, 2, 3...n), cfm

L_p = Leakage rate observed during the post-test leak check, cfm

M_{CO_2} = Molecular weight of CO_2, 44.01 lb/lb-mole

M_d = Molecular weight of gas stream, dry basis, lb/lb-mole

m_n = Total weight of particulate collected, mg

m_{ni} = Particulate collected including non-filterable condensable fraction, mg

$M_{N_2 \text{ or } CO}$ = Molecular weight of N_2 or CO, 28.01 lb/lb-mole

M_{O_2} = Molecular weight of O_2, 32.00 lb/lb-mole

M_s = Molecular weight of gas stream, wet basis, lb/lb-mole

M_w = Molecular weight of water, 18.02 lb/lb-mole

P_{bar} = Barometric pressure at the sampling site, in. Hg

P_g = Static pressure of gas stream, in. H_2O

P_s = Absolute pressure of gas stream, in. Hg

P_{std} = Standard absolute pressure, 29.92 in. Hg

PMR = Particulate mass rate, lb/hr

PMR_i = Particulate mass rate, including non-filterable condensable fraction, lb/hr

Q_s = Actual volumetric flow rate of gas stream, acfm

$Q_{s(std)}$ = Dry volumetric flow rate of gas stream, standard conditions, dscfm

R = Ideal gas constant, 21.85 in. Hg-$ft^3/^oR$-lb-mole

t_m = Average dry gas meter temperature, ^oF

T_m = Absolute average dry gas meter temperature, ^oR

t_s = Average gas stream temperature, ^oF

NOMENCLATURE (Continued)

T_s = Absolute average gas stream temperature, ^oR

T_{std} = Standard absolute temperature, 527.7^oR

V_{lc} = Total volume of liquid collected in impingers and silica gel, ml

V_m = Volume of gas sample as measured by the dry gas meter, dcf

$V_{m(std)}$ = Volume of gas sample, corrected to standard conditions, dscf

v_s = Average gas stream velocity, ft/sec

Y = Dry gas meter calibration factor, dimensionless

ΔH = Average pressure differential across the orifice meter, in. H_2O

Δp = Velocity head of gas stream, in. H_2O

$\sqrt{\Delta p}$ = Average of square roots of gas stream velocity heads, $\sqrt{\text{in. } H_2O}$

%CO = Percent CO in gas stream by volume, dry basis, %

$\%CO_2$ = Percent CO_2 in gas stream by volume, dry basis, %

$\%N_2$ = Percent N_2 in gas stream by volume, dry basis, %

$\%O_2$ = Percent O_2 in gas stream by volume, dry basis, %

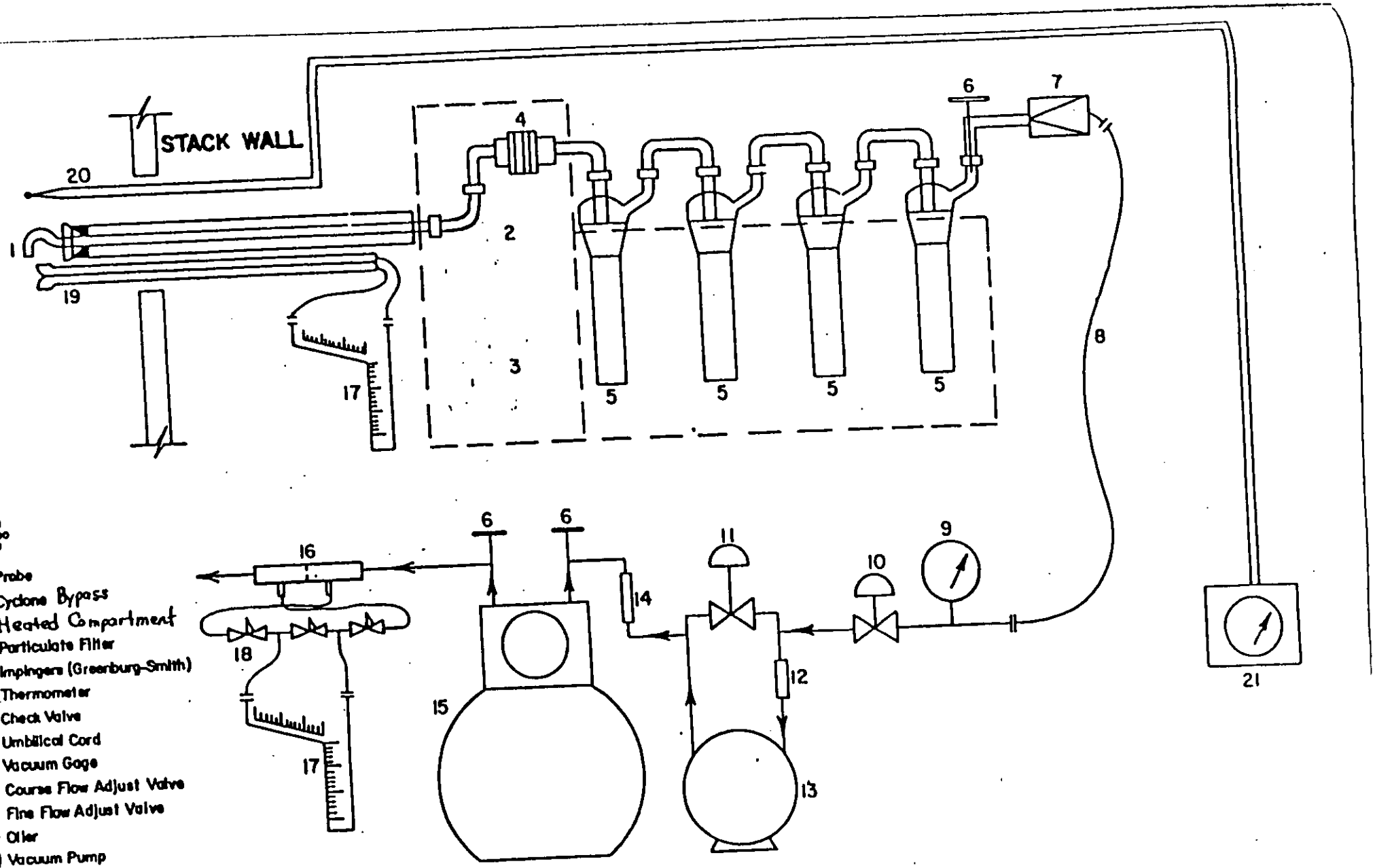
ρw = Density of water, lb/ml

θ = Total sampling time, min

θ_1 = Sampling time interval, from beginning of run until the first component change, min

θ_i = Sampling time interval, between two successive component changes, beginning with the interval between the first and second changes, min

θ_p = Sampling time interval, from the final (n^{th}) component change until the end of the sampling run, min



1) Probe
2) Cyclone Bypass
3) Heated Compartment
4) Particulate Filter
5) Impingers (Greenburg-Smith)
6) Thermometer
7) Check Valve
8) Umbilical Cord
9) Vacuum Gage
10) Course Flow Adjust Valve
11) Fine Flow Adjust Valve
12) Oiler
13) Vacuum Pump
14) Filter
15) Dry Gas Meter
16) Orifice Tube
17) Incline Manometer
18) Solenoid Valves
19) Pitot
20) Thermocouple
21) Pyrometer

SAMPLING TRAIN
USED FOR ISOKINETIC SAMPLING

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environmental engineers and scientists

APPENDIX A

CALCULATIONS, LABORATORY AND FIELD DATA

SUMMARY OF PARTICULATE EMISSIONS SOURCE TEST DATA

Company Tombigbee Lightweight Aggregate Test Date 11/11/81

Source No. 2 Kiln Wet Scrubber Run No. 1

Determination of Dry Standard Gas Sample Volume		
Average pressure differential across the orifice meter, in. H_2O	ΔH	1.40
Barometric pressure at the sampling site, in. Hg	P_{bar}	30.02
Absolute average dry gas meter temperature, ^oR	T_m	527.7
Dry gas meter calibration factor, dimensionless	Y	1.00
Volume of gas sample as measured by the dry gas meter, dcf	V_m	59.327
Volume of gas sample, corrected to standard conditions, dscf	$V_{m(std)}$	59.73
Determination of Moisture Content of Gas Stream		
Total volume of liquid collected in impingers and silica gel, ml	V_{lc}	263.8
Volume of water vapor in gas sample, standard conditions, scf	$V_{w(std)}$	12.42
Water vapor in the gas stream, proportion by volume	B_{ws}	0.172
Water vapor in the gas stream at saturation, proportion by volume	$B_{ws(sat)}$	0.176
Determination of Gas Stream Molecular Weights		
Percent CO_2 in gas stream by volume, dry basis	$\%CO_2$	4.5
Percent O_2 in gas stream by volume, dry basis	$\%O_2$	15.5
Molecular weight of gas stream, wet basis, lb/lb-mole	M_s	27.4
Determination of Gas Stream Velocity and Volumetric Flow Rates		
Average of square roots of gas stream velocity heads, $\sqrt{\text{in. } H_2O}$	$\sqrt{\Delta p}$	0.691
Static pressure of gas stream, in. H_2O	P_g	-0.50
Absolute average gas stream temperature, ^oR	T_s	595.6
Pitot tube assembly coefficient, dimensionless	C_p	0.84
Cross-sectional area of stack or duct, ft^2	A_s	26.73
Absolute pressure of gas stream, in. Hg	P_s	29.98
Average gas stream velocity, ft/sec.	v_s	42.3
Actual volumetric flow rate of gas stream, acfm	Q_s	67,800
Dry volumetric flow rate of gas stream, standard conditions, dscfm	$Q_{s(std)}$	49,800
Determination of Particulate Emission Data		
Total weight of particulate matter collected, mg	m_n	301.5
Total sampling time, min.	θ	96
Cross-sectional area of the nozzle, ft^2	A_n	0.000344
Particulate concentration, dry basis, standard conditions, gr/dscf	c_s	0.0779
Particulate mass rate, lb/hr	PMR	33.25
Percent of isokinetic sampling, %	I	97.2

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Run No. 1 Source No. 2 Kiln Wet Scrubber Test Date 11/11/81

DETERMINATION OF DRY STANDARD GAS SAMPLE VOLUME
(Method 5)

ΔH = 1.40 in. H_2O, average pressure differential across the orifice meter

P_{bar} = 30.02 in. Hg, barometric pressure at the sampling site

P_{std} = 29.92 in. Hg, standard absolute pressure

T_m = 527.7 °R, absolute average dry gas meter temperature

T_{std} = 527.7 °R, standard absolute temperature

Y = 1.00 dimensionless, dry gas meter calibration factor

V_m = 59.327 dcf, volume of gas sample as measured by the dry gas meter

$$V_{m(std)} = V_m \, Y \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + (\Delta H/13.6)}{P_{std}}\right)$$

$V_{m(std)}$ = 59.73 dscf, volume of gas sample, corrected to standard conditions

DETERMINATION OF MOISTURE CONTENT OF GAS STREAM
(Method 5)

R = 21.85 in. Hg-ft^3/°R-lb-mole, ideal gas constant

ρ_w = 0.002201 lb/ml, density of water

M_w = 18.02 lb/lb-mole, molecular weight of water

V_{lc} = 263.8 ml, total volume of liquid collected in impingers and silica gel

$$V_{w(std)} = V_{lc}\left(\frac{\rho_w}{M_w}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$V_{w(std)}$ = 12.42 scf, volume of water vapor in gas sample, standard conditions

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

B_{ws} = 0.172 proportion by volume, water vapor in the gas stream

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Run No. 1 Source No. 2 Kiln Wet Scrubber Test Date 11/11/81

DETERMINATION OF THEORETICAL MOISTURE CONTENT AT SATURATED CONDITIONS
(Method 5)

In addition to the calculation of the moisture content of the gas stream from the impinger analysis, a second calculation from the assumption of saturated conditions is made whenever there is the probability that the gas stream is saturated or laden with water droplets.

A = 6.691, water vapor constant for Antoine's vapor pressure equation

B = 3144, water vapor constant for Antoine's vapor pressure equation

C = 68.84, water vapor constant for Antoine's vapor pressure equation

T_s = 595.6 ^oR, absolute average gas stream temperature

P_g = -0.50 in. H_2O, static pressure of gas stream

$$B_{ws(sat)} = \frac{\text{antilog}_{10}\left[A - (B/(T_s - C))\right]}{P_{bar} + (P_g/13.6)}$$

$B_{ws(sat)}$ = 0.176 proportion by volume, water vapor in gas stream at saturation

$B_{ws(sat)}$ shall be considered correct if this value is less than the value calculated from the impinger analysis; accordingly, $B_{ws(sat)}$ and the following values calculated for $V_{w(std)}$ and V_{lc}, based upon $B_{ws(sat)}$, shall be used in all subsequent calculations.

$$V_{w(std)} = \frac{B_{ws(sat)}\ V_{m(std)}}{1 - B_{ws(sat)}}$$

$V_{w(std)}$ = N/A scf, volume of water vapor in gas sample, standard conditions, not exceeding saturated gas stream conditions.

$$V_{lc} = V_{w(std)} \left(\frac{M_w}{\rho_w}\right)\left(\frac{P_{std}}{R\ T_{std}}\right)$$

V_{lc} = N/A ml, Volume of liquid collected in impingers and silica gel, not exceeding saturated gas stream conditions.

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Run No. 1 Source No. 2 Kiln - Wet Scrubber Test Date 11/11/81

DETERMINATION OF GAS STREAM MOLECULAR WEIGHTS
(Method 3)

M_{CO_2} = 44.01 lb/lb-mole, molecular weight of CO_2

M_{O_2} = 32.00 lb/lb-mole, molecular weight of O_2

$M_{N_2 \text{ or } CO}$ = 28.01 lb/lb-mole, molecular weight of N_2 or CO

$\% CO_2$ = 4.5 %, percent CO_2 in gas stream by volume, dry basis

$\% O_2$ = 15.5 %, percent O_2 in gas stream by volume, dry basis

$\% N_2 + \% CO_2$ = 80.0 %, percent N_2 and CO in gas stream by volume, dry basis

$$M_d = 44.01 \frac{\% CO_2}{100} + 32.00 \frac{\% O_2}{100} + 28.01 \frac{\% N_2 + \% CO}{100}$$

M_d = 29.3 lb/lb-mole, molecular weight of gas stream, dry basis

$$M_s = M_d \left(1 - B_{ws}\right) + M_w B_{ws}$$

M_s = 27.4 lb/lb-mole, molecular weight of gas stream, wet basis

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Run No. 1 Source No 2 Kiln Wet Scrubber Test Date 11/11/81

DETERMINATION OF GAS STREAM VELOCITY AND VOLUMETRIC FLOW RATES
(Method 2)

P_g = -0.50 in. H_2O, static pressure of gas stream

K_p = 85.49 ft/sec $\left[(lb/lb\text{-}mole)(in.\ Hg)/(^oR)(in.\ H_2O)\right]^{1/2}$, pitot tube constant

C_p = 0.84 dimensionless, pitot tube assembly coefficient

$\sqrt{\Delta p}$ = 0.691 $\sqrt{in.\ H_2O}$, average of square roots of gas stream velocity heads

T_s = 595.6 ^oR, absolute average gas stream temperature

A_s = 26.73 ft^2, cross-sectional area of stack or duct

$$P_s = \frac{P_g}{13.6} + P_{bar}$$

P_s = 29.98 in. Hg, absolute gas stream pressure

$$v_s = K_p C_p \sqrt{\Delta p} \sqrt{\frac{T_s}{P_s M_s}}$$

v_s = 42.3 ft/sec, average gas stream velocity

$$Q_s = (60\ sec/min)\ A_s v_s$$

Q_s = 67,800 acfm, actual volumetric flow rate of gas stream

$$Q_{s(std)} = (60\ sec/min)\ (1-B_{ws})\ A_s v_s \left(\frac{T_{std}}{T_s}\right)\left(\frac{P_s}{P_{std}}\right)$$

$Q_{s(std)}$ = 49,800 dscfm, dry volumetric flow rate of gas stream, standard conditions

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Run No. 1 Source No. 2 Kiln Wet Scrubber Test Date 11/11/81

Determination of Particulate Emission Data (Method 5)

m_n = 301.5 mg, total weight of particulate matter collected

θ = 96 min, total sampling time

A_n = 0.000344 ft^2, cross-sectional area of the nozzle

K_1 = 0.002669 in. Hg-ft^3/ml-^oR

$c_s = (0.01543 \text{ gr/mg})\left(m_n/V_{m(std)}\right)$

c_s = 0.0779 gr/dscf, particulate concentration, dry basis, standard conditions

$PMR = (60 \text{ min/hr})(0.0001428 \text{ lb/gr})\ c_s\ Q_{s(std)}$

PMR = 33.25 lb/hr, particulate mass rate

$$I = 100\ \frac{T_s\left[K_1\ V_{lc} + (V_m\ Y/T_m)(P_{bar} + \Delta H/13.6)\right]}{(60 \text{ sec/min})\ \theta\ v_s\ P_s\ A_n}$$

I = 97.2 %, percent of isokinetic sampling

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LABORATORY ANALYSIS

Client Tombigbee Lightweight Aggregate Source #1 Kiln Wet Scrubber

Date 11/12/81 Run No. 1 Sample Box No. 5

MOISTURE CONDENSATE

Impinger No.	1. Deionized H_2O	2. Deionized H_2O	3. Dry	4. Silica Gel
Gross Volume, ml or g	355	163	7	274.5
Tare Volume, ml or g	100	100	0	250.0
Net Volume, ml or g	255	63	7	24.5

Total Moisture Condensate Collected: 349.5 ml

PARTICULATE COLLECTED

Component	Glass-Fiber Filter	Acetone Rinse	Acetone Blank	Impinger Condensate	Impinger Blank
I.D. No.	2225	68	189		
Volume, ml		390	250		
Gross Weight, g	0.9245	89.8771	91.1923		
Gross Weight, g	0.9244	89.8771	91.1923		
Average Gross, g	0.9244	89.8771	91.1923		
Tare Weight, g	0.7362	89.8401	91.1914		
Residue, g		0.0014			
Net Weight, g	0.1882	0.0356	0.0009		

Residue in Acetone Rinse: $\frac{(0.0009 \text{ g blank})(390 \text{ ml rinse})}{(250 \text{ ml blank})}$ = 0.0014 g

Allowable Rinse Residue: (0.00001 of acetone weight)(0.7857 g/ml)(390 ml rinse) = 0.0031 g

Residue in Impinger Condensate: $\frac{(\_\_\_\_ \text{ g blank})(\_\_\_\_ \text{ ml condensate})}{(\_\_\_\_ \text{ ml blank})}$ = _____ g

Particulate Collected (excluding impinger catch): 0.2238 g

Particulate Collected (including impinger catch): g

The particulate collected in each component was weighed to a constant weight, meaning a difference of no more than 0.5 mg or 1 percent of total weight less tare weight, whichever is greater, between two consecutive weighings, with no less than 6 hours of dessication time between weighings.

Comments:

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Laboratory Analyst J. Roger Reell

Statement of Process Weight Rate Data

On November 11, 1981, during the course of the source testing program conducted on the No. 2 wet scrubber, the process weight rate data was recorded for the purpose of calculating the allowable particulate emission rate. The weights of coal fired and raw clay fed to the kiln were totalized over known periods encompassing the source test. Coal was fired at an average rate of 2.6 tons per hour; raw clay was fed at an average rate of 40.0 tons per hour. The average total process weight rate during the testing period was 42.6 tons per hour.

TOMBIGBEE LIGHTWEIGHT AGGREGATE CORP.

James Colburn

James Colburn, Vice President

APPENDIX D

SAMPLE CHAIN OF CUSTODY

SAMPLE CHAIN OF CUSTODY

Plant Tombigbee Lightweight Aggregate Corporation / No. 2 Kiln Wet Scrubber
Date Sampled 11/11/81 Test Number
Run Number(s) 1, 2, 3

Sample Recovery

Container Code	Description
Log # 20228, Run 1	Filter, Acetone Rinse, Impinger Condensate
Log # 20229, Run 2	" " "
Log # 20230, Run 3	" " "

Person Engaged in Sample Recovery

Signature J. Roger Roell

Title Poll. Ctrl. Spec.

Location at which Recovery was done on-site

Date and time of Recovery 11/11/81

Sample(s) Recipient, Upon Recovery if not Recovery Person

Signature

Title

Date and Time of Receipt

Laboratory Person Receiving Sample

Signature J. Roger Roell

Title Poll. Ctrl. Spec.

Date and Time of Receipt 11/12/81 2300 CST

Sample Storage in lab

Analysis

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
Log # 20228	Method 5	11/13-17/81	J. R. Roell
Log # 20229	Method 5	11/13-17/81	J. R. Roell
Log # 20230	Method 5	11/13-17/81	J. R. Roell

Run No. 2 Source No. 2 Kiln Wet Scrubber Test Date 11/11/81

DETERMINATION OF DRY STANDARD GAS SAMPLE VOLUME
(Method 5)

ΔH = 1.46 in. H_2O, average pressure differential across the orifice meter

P_{bar} = 30.02 in. Hg, barometric pressure at the sampling site

P_{std} = 29.92 in. Hg, standard absolute pressure

T_m = 548.5 °R, absolute average dry gas meter temperature

T_{std} = 527.7 °R, standard absolute temperature

Y = 1.00 dimensionless, dry gas meter calibration factor

V_m = 61.209 dcf, volume of gas sample as measured by the dry gas meter

$$V_{m(std)} = V_m \, Y \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + (\Delta H/13.6)}{P_{std}}\right)$$

$V_{m(std)}$ = 59.30 dscf, volume of gas sample, corrected to standard conditions

DETERMINATION OF MOISTURE CONTENT OF GAS STREAM
(Method 5)

R = 21.85 in. Hg-ft^3/°R-lb-mole, ideal gas constant

ρ_w = 0.002201 lb/ml, density of water

M_w = 18.02 lb/lb-mole, molecular weight of water

V_{lc} = 272.5 ml, total volume of liquid collected in impingers and silica gel

$$V_{w(std)} = V_{lc}\left(\frac{\rho_w}{M_w}\right)\left(\frac{R \; T_{std}}{P_{std}}\right)$$

$V_{w(std)}$ = 12.83 scf, volume of water vapor in gas sample, standard conditions

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

B_{ws} = 0.178 proportion by volume, water vapor in the gas stream

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Run No. 2 Source No. 2 Kiln Wet Scrubber Test Date 11/11/81

DETERMINATION OF THEORETICAL MOISTURE CONTENT AT SATURATED CONDITIONS
(Method 5)

In addition to the calculation of the moisture content of the gas stream from the impinger analysis, a second calculation from the assumption of saturated conditions is made whenever there is the probability that the gas stream is saturated or laden with water droplets.

A = 6.691, water vapor constant for Antoine's vapor pressure equation

B = 3144, water vapor constant for Antoine's vapor pressure equation

C = 68.84, water vapor constant for Antoine's vapor pressure equation

T_s = 597.7 °R, absolute average gas stream temperature

P_g = -0.50 in. H_2O, static pressure of gas stream

$$B_{ws(sat)} = \frac{\text{antilog}_{10}\left[A - (B/(T_s - C))\right]}{P_{bar} + (P_g/13.6)}$$

$B_{ws(sat)}$ = 0.186 proportion by volume, water vapor in gas stream at saturation

$B_{ws(sat)}$ shall be considered correct if this value is less than the value calculated from the impinger analysis; accordingly, $B_{ws(sat)}$ and the following values calculated for $V_{w(std)}$ and V_{lc}, based upon $B_{ws(sat)}$, shall be used in all subsequent calculations.

$$V_{w(std)} = \frac{B_{ws(sat)}\ V_{m(std)}}{1 - B_{ws(sat)}}$$

$V_{w(std)}$ = N/A scf, volume of water vapor in gas sample, standard conditions, not exceeding saturated gas stream conditions.

$$V_{lc} = V_{w(std)} \left(\frac{M_w}{\rho_w}\right)\left(\frac{P_{std}}{R\ T_{std}}\right)$$

V_{lc} = N/A ml, Volume of liquid collected in impingers and silica gel, not exceeding saturated gas stream conditions.

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Run No. 2 Source No 2 Kiln Wet Scrubber Test Date 11/11/81

DETERMINATION OF GAS STREAM MOLECULAR WEIGHTS
(Method 3)

M_{CO_2} = 44.01 lb/lb-mole, molecular weight of CO_2

M_{O_2} = 32.00 lb/lb-mole, molecular weight of O_2

$M_{N_2 \text{ or } CO}$ = 28.01 lb/lb-mole, molecular weight of N_2 or CO

$\% CO_2$ = 4.5 %, percent CO_2 in gas stream by volume, dry basis

$\% O_2$ = 15.5 %, percent O_2 in gas stream by volume, dry basis

$\% N_2 + \% CO_2$ = 80.0 %, percent N_2 and CO in gas stream by volume, dry basis

$$M_d = 44.01 \frac{\% CO_2}{100} + 32.00 \frac{\% O_2}{100} + 28.01 \frac{\% N_2 + \% CO}{100}$$

M_d = 29.3 lb/lb-mole, molecular weight of gas stream, dry basis

$$M_s = M_d \left(1 - B_{ws}\right) + M_w B_{ws}$$

M_s = 27.3 lb/lb-mole, molecular weight of gas stream, wet basis

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Run No. 2 Source No. 2 Kiln Wet Scrubber Test Date 11/11/81

DETERMINATION OF GAS STREAM VELOCITY AND VOLUMETRIC FLOW RATES
(Method 2)

P_g = -0.50 in. H_2O, static pressure of gas stream

K_p = 85.49 ft/sec $\left[(\text{lb/lb-mole})(\text{in. Hg})/(^{o}\text{R})(\text{in. } H_2O)\right]^{1/2}$, pitot tube constant

C_p = 0.84 dimensionless, pitot tube assembly coefficient

$\sqrt{\Delta p}$ = 0.703 $\sqrt{\text{in. } H_2O}$, average of square roots of gas stream velocity heads

T_s = 597.7 ^{o}R, absolute average gas stream temperature

A_s = 26.73 ft^2, cross-sectional area of stack or duct

$$P_s = \frac{P_g}{13.6} + P_{bar}$$

P_s = 29.98 in. Hg, absolute gas stream pressure

$$v_s = K_p C_p \sqrt{\Delta p} \sqrt{\frac{T_s}{P_s M_s}}$$

v_s = 43.1 ft/sec, average gas stream velocity

$$Q_s = (60 \text{ sec/min})\ A_s v_s$$

Q_s = 69,100 acfm, actual volumetric flow rate of gas stream

$$Q_{s(std)} = (60 \text{ sec/min})\ (1-B_{ws})\ A_s v_s \left(\frac{T_{std}}{T_s}\right)\left(\frac{P_s}{P_{std}}\right)$$

$Q_{s(std)}$ = 50,300 dscfm, dry volumetric flow rate of gas stream, standard conditions

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Run No. 2 Source No 2 Kiln Wet Scrubber Test Date 11/11/81

Determination of Particulate Emission Data (Method 5)

m_n = 265.1 mg, total weight of particulate matter collected

θ = 96 min, total sampling time

A_n = 0.000344 ft^2, cross-sectional area of the nozzle

K_1 = 0.002669 in. Hg-ft^3/ml-^oR

c_s = (0.01543 gr/mg)$\left(m_n/V_{m(std)}\right)$

c_s = 0.0690 gr/dscf, particulate concentration, dry basis, standard conditions

PMR = (60 min/hr)(0.0001428 lb/gr) c_s $Q_{s(std)}$

PMR = 29.74 lb/hr, particulate mass rate

$$I = 100 \frac{T_s\left[K_1 V_{lc} + (V_m Y/T_m)(P_{bar} + \Delta H/13.6)\right]}{(60 \text{ sec/min})\ \theta\ v_s\ P_s\ A_n}$$

I = 95.5 %, percent of isokinetic sampling

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LABORATORY ANALYSIS

ıient Tombigbee Lightweight Aggregate Source #1 Kiln Wet Scrubber

ıate 11/12/81 Run No. 2 Sample Box No. 1

MOISTURE CONDENSATE

ıpinger No.	1. Deionized H_2O	2. Deionized H_2O	3. Dry	4. Silica Gel
;ross Volume, ml or g	384	143	6	272.7
;are Volume, ml or g	100	100	0	250.0
ıet Volume, ml or g	284	43	6	22.7

ɔtal Moisture Condensate Collected:	355.7 ml

PARTICULATE COLLECTED

Component	Glass-Fiber Filter	Acetone Rinse	Acetone Blank	Impinger Condensate	Impinger Blank
.D. No.	2226	154	189		
ɔlume, ml		365	250		
;ross Weight, g	0.9306	90.2399	91.1923		
;ross Weight, g	0.9306	90.2399	91.1923		
ıverage Gross, g	0.9306	90.2399	91.1923		
;are Weight, g	0.7355	90.1774	91.1914		
;esidue, g		0.0013			
ıet Weight, g	0.1951	0.0612	0.0009		

ıesidue in Acetone Rinse: $\frac{(0.0009 \text{ g blank})(365 \text{ ml rinse})}{(250 \text{ ml blank})}$ = 0.0013 g

ıllowable Rinse Residue: (0.00001 of acetone weight)(0.7857 g/ml)(365 ml rinse) = 0.0029 g

ıesidue in Impinger Condensate: $\frac{(\quad \text{g blank})(\quad \text{ml condensate})}{(\quad \text{ml blank})}$ = _____ g

;articulate Collected (excluding impinger catch):	0.2563 g
;articulate Collected (including impinger catch):	g

ıe particulate collected in each component was weighed to a constant weight, meaning a ifference of no more than 0.5 mg or 1 percent of total weight less tare weight, whichever greater, between two consecutive weighings, with no less than 6 hours of dessication ıme between weighings.

ɔmments:

RESOURCE CONSULTANTS

Laboratory Analyst J. Roger Reell

FIELD DATA LOG

PLANT Tombigbee Lightweight Aggregate SOURCE #2 Kiln Wet Scrubber

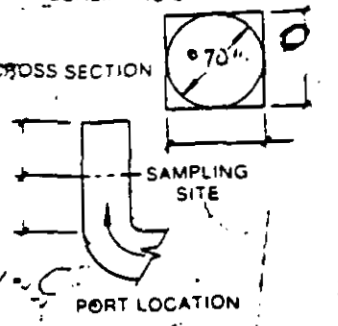
NOMOGRAPH VALUES	
ΔH@	C FACTOR
Tm	AVG. ΔP
H2O	Ts
REFERENCE	

FINAL VOLUME 078.957
INITIAL VOLUME 017.748
NET VOLUME 61.209

RUN NO 2
DATE 11/11/81
OPERATORS REEH & MARINO
METER BOX NO #2
SAMPLE BOX NO. 4
FILTER NO. 2223
IMPINGER GAUGE NO. 2
STACK GAUGE NO 7-1
PITOT COEFFICIENT 0.84 (7-1)
PROBE HEATER SETTING 98%

BAROMETRIC PRESSURE 30.02
STATIC PRESSURE -0.50
AMBIENT TEMPERATURE
PROBE LENGTH 90"
PROBE LINER SS
PORT LENGTH 3"
PORT DIAMETER 3"
METER SYSTEM LEAK-CHECK 0.0
ORSAT LEAK-CHECK N/A
SAMPLE BAG LEAK-CHECK N/A

SCHEMATIC OF STACK



TRAVERSE POINT NUMBER	SAMPLING TIME CLOCK	SAMPLING TIME SAMPLE	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	ORIFICE METER (ΔH) in. H2O ACTUAL	ORIFICE METER (ΔH) in. H2O DESIRED	GAS SAMPLE VOLUME (Vm), ft³	GAS SAMPLE TEMP. AT DRY GAS METER INLET ($T_{m_{in}}$) °F	GAS SAMPLE TEMP. AT DRY GAS METER OUTLET ($T_{m_{out}}$) °F	SAMPLE BOX TEMP °F	TEMP. OF GAS LEAVING LAST IMPINGER °F	PUMP VACUUM GAUGE in. Hg
	1350	0						017.748					
A-1		2	138	0.48		1.40		019.00	71	70	270	54	2
2		4	138	0.50		1.40		020.22	73	70	270	54	2
3		6	138	0.49		1.40		021.42	76	70	270	53	2
4		8	138	0.50		1.40		022.66	79	71	265	52	2
5		10	138	0.52		1.50		023.92	83	71	265	50	2
6		12	138	0.53		1.55		025.22	86	72	265	50	2
7		14	138	0.53		1.55		026.54	89	73	270	51	2
8		16	138	0.56		1.65		027.86	91	73	270	52	2
9		18	138	0.57		1.65		029.19	93	74	270	52	2
10		20	138	0.56		1.65		030.53	94	75	265	53	2
11		22	138	0.54		1.60		031.89	95	75	270	54	2
12		24	138	0.50		1.45		033.17	96	75	270	55	2
13		26	138	0.49		1.45		034.44	95	76	270	55	2
14		28	138	0.53		1.55		035.73	95	76	270	55	2
15		30	138	0.51		1.50		037.03	96	77	275	55	2
16		32	138	0.52		1.50		038.34	97	77	270	56	2
17		34	138	0.50		1.45		039.60	98	77	265	56	2
18		36	138	0.49		1.45		040.88	99	78	260	57	2
19		38	138	0.47		1.40		042.14	100	78	265	57	2
20		40	138	0.43		1.25		043.38	99	78	260	57	2
21		42	138	0.42		1.25		044.60	99	79	265	57	2
22		44	138	0.38		1.10		045.70	99	79	270	57	2
23		46	138	0.35		1.00		046.84	99	79	270	57	2
24	1438	48	138	0.30		0.88		047.865	98	79	265	58	2
TOTAL													
AVERAGE													

STATIC PITOT LEAK-CHECK @ 15 sec:	0.0
IMPACT PITOT LEAK-CHECK @ 15 sec:	0.0
TRAIN LEAK RATE @ 60 sec:	0.001 cfm @ 4 in.

STACK GAS ANALYSIS

ORSAT ☐ FYRITE ☒

TIME	CO_2	O_2	CO	N_2
	4	16		
	5	15		

NOZZLE CALIBRATION-I.D. NO. 04

PRETEST	POST-TEST
DIA. 1	DIA. 1
DIA. 2	DIA. 2
DIA. 3	DIA. 3
AVERAGE 0.251	AVERAGE

RESOURCE CONSULTANTS INC

SIGNATURE [signature]
TEST TEAM CHIEF

FIELD DATA LOG

PLANT Tombigbee Lightweight Aggregate SOURCE #2 Kiln Wet Scrubber RUN NO 2

TRAVERSE POINT NUMBER	SAMPLING TIME CLOCK	SAMPLING TIME SAMPLE	STACK TEMP (Ts) °F	VELOCITY HEAD (Δ Ps)	(√Δ Ps)	ORIFICE METER (ΔH) in. H2O ACTUAL	DESIRED	GAS SAMPLE VOLUME (Vm) ft³	GAS SAMPLE TEMP AT DRY GAS METER INLET (Tm_in) °F	OUTLET (Tm_out) °F	SAMPLE BOX TEMP °F	TEMP. OF GAS LEAVING LAST IMPINGER °F	PUMP VACUUM GAUGE in. Hg
	1455	48											
A-1		50	138	0.38		1.10		049.00	84	81	260	60	2
2		52	138	0.42		1.25		050.16	86	81	265	60	2
3		54	138	0.42		1.25		051.33	89	81	270	58	2
4		56	138	0.44		1.30		052.50	92	81	270	56	2
5		58	138	0.45		1.30		053.73	93	82	270	57	2
6		60	138	0.44		1.30		054.95	95	82	265	58	2
7		62	138	0.44		1.30		056.15	96	83	265	58	2
8		64	138	0.44		1.30		057.37	97	83	260	58	2
9		66	138	0.48		1.40		058.62	99	84	270	59	2
10		68	138	0.46		1.35		059.83	100	85	270	59	2
11		70	138	0.45		1.35		061.06	102	85	270	59	2
12		72	138	0.45		1.35		062.29	103	85	275	60	2
13		74	138	0.54		1.60		063.60	105	86	275	60	3
14		76	138	0.59		1.75		065.30	107	87	275	60	3
15		78	138	0.66		1.95		066.80	110	88	275	60	3
16		80	138	0.67		2.00		068.80	110	89	275	61	3
17		82	138	0.66		1.95		069.27	111	89	265	60	3
18		84	138	0.64		1.90		070.74	111	90	270	60	3
19		86	138	0.60		1.80		072.30	112	90	270	60	3
20		88	138	0.58		1.75		073.62	112	90	265	60	3
21		90	138	0.52		1.55		074.98	112	91	260	60	3
22		92	138	0.51		1.55		076.32	118	91	260	61	3
23		94	138	0.52		1.55		077.65	108	91	260	61	3
24	1543	96	138	0.46		1.40		078.957	109	91	255	61	3
TOTAL		96	6624		33.760	70.28		61.209	4653	3868			MAX
AVERAGE		--	138.0		0.703	1.46		--	96.9	80.6			3

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SUMMARY OF PARTICULATE EMISSIONS SOURCE TEST DATA

Company Tombigbee Lightweight Aggregate Test Date 11/11/81

Source No. 2 Kiln Wet Scrubber Run No. 3

Determination of Dry Standard Gas Sample Volume		
Average pressure differential across the orifice meter, in. H_2O	ΔH	1.51
Barometric pressure at the sampling site, in. Hg	P_{bar}	30.02
Absolute average dry gas meter temperature, ^oR	T_m	548.0
Dry gas meter calibration factor, dimensionless	Y	1.00
Volume of gas sample as measured by the dry gas meter, dcf	V_m	63.448
Volume of gas sample, corrected to standard conditions, dscf	$V_{m(std)}$	61.50
Determination of Moisture Content of Gas Stream		
Total volume of liquid colle ted in impingers and silica gel, ml	V_{lc}	294.5
Volume of water vapor in gas sample, standard conditions, scf	$V_{w(std)}$	13.86
Water vapor in the gas stream, proportion by volume	B_{ws}	0.184
Water vapor in the gas stream at saturation, proportion by volume	$B_{ws(sat)}$	0.192
Determination of Gas Stream Molecular Weights		
Percent CO_2 in gas stream by volume, dry basis	$\%CO_2$	4.5
Percent O_2 in gas stream by volume, dry basis	$\%O_2$	15.5
Molecular weight of gas stream, wet basis, lb/lb-mole	M_s	27.3
Determination of Gas Stream Velocity and Volumetric Flow Rates		
Average of square roots of gas stream velocity heads, $\sqrt{\text{in. } H_2O}$	$\sqrt{\Delta p}$	0.721
Static pressure of gas stream, in. H_2O	P_g	-0.50
Absolute average gas stream temperature, ^oR	T_s	598.9
Pitot tube assembly coefficient, dimensionless	C_p	0.84
Cross-sectional area of stack or duct, ft^2	A_s	26.73
Absolute pressure of gas stream, in. Hg	P_s	29.98
Average gas stream velocity, ft/sec.	v_s	44.3
Actual volumetric flow rate of gas stream, acfm	Q_s	71,100
Dry volumetric flow rate of gas stream, standard conditions, dscfm	$Q_{s(std)}$	51,200
Determination of Particulate Emission Data		
Total weight of particulate matter collected, mg	m_n	312.6
Total sampling time, min.	θ	96
Cross-sectional area of the nozzle, ft^2	A_n	0.000344
Particulate concentration, dry basis, standard conditions, gr/dscf	c_s	0.0784
Particulate mass rate, lb/hr	PMR	34.43
Percent of isokinetic sampling, %	I	97.3

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Run No. 3 Source No. 2 Kiln Wet Scrubber Test Date 11/11/81

DETERMINATION OF DRY STANDARD GAS SAMPLE VOLUME
(Method 5)

ΔH = 1.51 in. H_2O, average pressure differential across the orifice meter

P_{bar} = 30.02 in. Hg, barometric pressure at the sampling site

P_{std} = 29.92 in. Hg, standard absolute pressure

T_m = 548.0 °R, absolute average dry gas meter temperature

T_{std} = 527.7 °R, standard absolute temperature

Y = 1.00 dimensionless, dry gas meter calibration factor

V_m = 63.418 dcf, volume of gas sample as measured by the dry gas meter

$$V_{m(std)} = V_m \, Y \left(\frac{T_{std}}{T_m}\right)\left(\frac{P_{bar} + (\Delta H/13.6)}{P_{std}}\right)$$

$V_{m(std)}$ = 61.50 dscf, volume of gas sample, corrected to standard conditions

DETERMINATION OF MOISTURE CONTENT OF GAS STREAM
(Method 5)

R = 21.85 in. Hg-ft^3/°R-lb-mole, ideal gas constant

ρ_w = 0.002201 lb/ml, density of water

M_w = 18.02 lb/lb-mole, molecular weight of water

V_{lc} = 294.5 ml, total volume of liquid collected in impingers and silica gel

$$V_{w(std)} = V_{lc}\left(\frac{\rho_w}{M_w}\right)\left(\frac{R\,T_{std}}{P_{std}}\right)$$

$V_{w(std)}$ = 13.86 scf, volume of water vapor in gas sample, standard conditions

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

B_{ws} = 0.184 proportion by volume, water vapor in the gas stream

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Run No. 3 Source No. 2 Kiln Wet Scrubber Test Date 11/11/81

DETERMINATION OF THEORETICAL MOISTURE CONTENT AT SATURATED CONDITIONS
(Method 5)

In addition to the calculation of the moisture content of the gas stream from the impinger analysis, a second calculation from the assumption of saturated conditions is made whenever there is the probability that the gas stream is saturated or laden with water droplets.

A = 6.691, water vapor constant for Antoine's vapor pressure equation
B = 3144, water vapor constant for Antoine's vapor pressure equation
C = 68.84, water vapor constant for Antoine's vapor pressure equation
T_s = 598.9 °R, absolute average gas stream temperature
P_g = -0.50 in. H_2O, static pressure of gas stream

$$B_{ws(sat)} = \frac{\text{antilog}_{10}\left[A - (B/(T_s - C))\right]}{P_{bar} + (P_g/13.6)}$$

$B_{ws(sat)}$ = 0.192 proportion by volume, water vapor in gas stream at saturation

$B_{ws(sat)}$ shall be considered correct if this value is less than the value calculated from the impinger analysis; accordingly, $B_{ws(sat)}$ and the following values calculated for $V_{w(std)}$ and V_{lc}, based upon $B_{ws(sat)}$, shall be used in all subsequent calculations.

$$V_{w(std)} = \frac{B_{ws(sat)}\ V_{m(std)}}{1 - B_{ws(sat)}}$$

$V_{w(std)}$ = N/A scf, volume of water vapor in gas sample, standard conditions, not exceeding saturated gas stream conditions.

$$V_{lc} = V_{w(std)} \left(\frac{M_w}{\rho_w}\right)\left(\frac{P_{std}}{R\ T_{std}}\right)$$

V_{lc} = N/A ml, Volume of liquid collected in impingers and silica gel, not exceeding saturated gas stream conditions.

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Run No. 3 Source No. 2 Kiln Wet Scrubber Test Date 11/11/81

DETERMINATION OF GAS STREAM MOLECULAR WEIGHTS
(Method 3)

M_{CO_2} = 44.01 lb/lb-mole, molecular weight of CO_2

M_{O_2} = 32.00 lb/lb-mole, molecular weight of O_2

$M_{N_2 \text{ or } CO}$ = 28.01 lb/lb-mole, molecular weight of N_2 or CO

$\% CO_2$ = 4.5 %, percent CO_2 in gas stream by volume, dry basis

$\% O_2$ = 15.5 %, percent O_2 in gas stream by volume, dry basis

$\% N_2 + \% CO_2$ = 80.0 %, percent N_2 and CO in gas stream by volume, dry basis

$$M_d = 44.01 \frac{\% CO_2}{100} + 32.00 \frac{\% O_2}{100} + 28.01 \frac{\% N_2 + \% CO}{100}$$

M_d = 29.3 lb/lb-mole, molecular weight of gas stream, dry basis

$$M_s = M_d \left(1 - B_{ws}\right) + M_w B_{ws}$$

M_s = 27.3 lb/lb-mole, molecular weight of gas stream, wet basis

RESOURCE CONSULTANTS

Run No. 3 Source No. 2 Kiln Wet Scrubber Test Date 11/11/81

DETERMINATION OF GAS STREAM VELOCITY AND VOLUMETRIC FLOW RATES
(Method 2)

P_g = -0.50 in. H_2O, static pressure of gas stream

K_p = 85.49 ft/sec $\left[(\text{lb/lb-mole})(\text{in. Hg})/(^{o}\text{R})(\text{in. } H_2O)\right]^{1/2}$, pitot tube constant

C_p = 0.84 dimensionless, pitot tube assembly coefficient

$\sqrt{\Delta p}$ = 0.721 $\sqrt{\text{in. } H_2O}$, average of square roots of gas stream velocity heads

T_s = 598.9 ^{o}R, absolute average gas stream temperature

A_s = 26.73 ft^2, cross-sectional area of stack or duct

$$P_s = \frac{P_g}{13.6} + P_{bar}$$

P_s = 29.98 in. Hg, absolute gas stream pressure

$$v_s = K_p C_p \sqrt{\Delta p} \sqrt{\frac{T_s}{P_s M_s}}$$

v_s = 44.3 ft/sec, average gas stream velocity

$$Q_s = (60 \text{ sec/min})\ A_s v_s$$

Q_s = 71,100 acfm, actual volumetric flow rate of gas stream

$$Q_{s(std)} = (60 \text{ sec/min})\ (1-B_{ws})\ A_s v_s \left(\frac{T_{std}}{T_s}\right)\left(\frac{P_s}{P_{std}}\right)$$

$Q_{s(std)}$ = 51,200 dscfm, dry volumetric flow rate of gas stream, standard conditions

RESOURCE CONSULTANTS

Run No. 3 Source No. 2 Kiln Wet Scrubber Test Date 11/11/81

Determination of Particulate Emission Data (Method 5)

m_n = 312.6 mg, total weight of particulate matter collected

θ = 96 min, total sampling time

A_n = 0.000344 ft^2, cross-sectional area of the nozzle

K_1 = 0.002669 in. Hg-ft^3/ml-^oR

c_s = (0.01543 gr/mg)$\left(m_n/V_{m(std)}\right)$

c_s = 0.0784 gr/dscf, particulate concentration, dry basis, standard conditions

PMR = (60 min/hr)(0.0001428 lb/gr) c_s $Q_{s(std)}$

PMR = 34.43 lb/hr, particulate mass rate

$$I = 100 \frac{T_s\left[K_1 V_{lc} + (V_m Y/T_m)(P_{bar} + \Delta H/13.6)\right]}{(60 \text{ sec/min})\ \theta\ v_s\ P_s\ A_n}$$

I = 97.3 %, percent of isokinetic sampling

RESOURCE CONSULTANTS

Client Tombigbee Lightweight Aggregate Source # 1 Kiln Wet Scrubber
Date 11/12/81 Run No. 3 Sample Box No. 4

MOISTURE CONDENSATE

Impinger No.	1. Deionized H_2O	2. Deionized H_2O	3. Dry	4. Silica Gel
Gross Volume, ml or g	366	168	6	273.4
Tare Volume, ml or g	100	100	0	250.0
Net Volume, ml or g	266	68	6	23.4

Total Moisture Condensate Collected:	363.4 ml

PARTICULATE COLLECTED

Component	Glass-Fiber Filter	Acetone Rinse	Acetone Blank	Impinger Condensate	Impinger Blank
I.D. No.	2227	181	189		
Volume, ml		395	250		
Gross Weight, g	0.9248	93.3571	91.1923		
Gross Weight, g	0.9248	93.3571	91.1923		
Average Gross, g	0.9248	93.3571	91.1923		
Tare Weight, g	0.7337	93.2936	91.1914		
Residue, g		0.0014			
Net Weight, g	0.1911	0.0621	0.0009		

Residue in Acetone Rinse: $\frac{(0.0009 \text{ g blank})(395 \text{ ml rinse})}{(250 \text{ ml blank})}$ = 0.0014 g

Allowable Rinse Residue: (0.00001 of acetone weight)(0.7857 g/ml)(395 ml rinse) = 0.0031 g

Residue in Impinger Condensate: $\frac{(\quad \text{g blank})(\quad \text{ml condensate})}{(\quad \text{ml blank})}$ = _____ g

Particulate Collected (excluding impinger catch):	0.2532 g
Particulate Collected (including impinger catch):	g

The particulate collected in each component was weighed to a constant weight, meaning a difference of no more than 0.5 mg or 1 percent of total weight less tare weight, whichever is greater, between two consecutive weighings, with no less than 6 hours of dessication time between weighings.

Comments:

RESOURCE CONSULTANTS

Laboratory Analyst J. Roger Powell

FIELD DATA LOG

PLANT Tombigbee Lightweight Aggregate SOURCE #2 Kiln Wet Scrubber

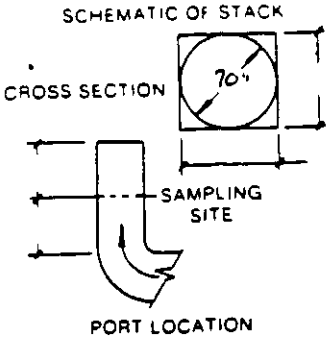
NOMOGRAPH VALUES	
ΔH@	C FACTOR
Tm	AVG ΔP
%H2O	Ts
REFERENCE	

FINAL VOLUME	142.560
INITIAL VOLUME	79.142
NET VOLUME	63.418

RUN NO 3
DATE 11/11/81
OPERATORS REEHL & MARINO
METER BOX NO 2
SAMPLE BOX NO 3
FILTER NO 224
IMPINGER GAUGE NO 4
STACK GAUGE NO. 7-1
PITOT COEFFICIENT 0.84 (7-1)
PROBE HEATER SETTING 98%

BAROMETRIC PRESSURE 30.02
STATIC PRESSURE -0.50
AMBIENT TEMPERATURE
PROBE LENGTH 90"
PROBE LINER SS
PORT LENGTH 3"
PORT DIAMETER 3"
METER SYSTEM LEAK-CHECK 0.0
ORSAT LEAK-CHECK N/A
SAMPLE BAG LEAK-CHECK N/A

SCHEMATIC OF STACK



TRAVERSE POINT NUMBER	SAMPLING TIME CLOCK	SAMPLING TIME SAMPLE	STACK TEMP. (Ts) °F	VELOCITY HEAD (ΔPs)	VELOCITY HEAD ($\sqrt{\Delta Ps}$)	ORIFICE METER (ΔH) in. H2O ACTUAL	ORIFICE METER (ΔH) in. H2O DESIRED	GAS SAMPLE VOLUME (Vm) ft³	GAS SAMPLE TEMP AT DRY GAS METER INLET (Tm in) °F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET (Tm out) °F	SAMPLE BOX TEMP. °F	TEMP OF GAS LEAVING LAST IMPINGER °F	PUMP VACUUM GAUGE in. Hg
	4:48	0						79.142					
A-1		2	137	0.47		1.35		80.4	78	78	275	52	1.0
2		4	138	0.47		1.35		81.6	78	78	275	51	1.0
3		6	139	0.52		1.50		82.9	78	78	270	51	1.0
4		8	139	0.53		1.50		84.3	82	78	270	51	1.0
5		10	139	0.48		1.35		85.3	86	78	270	52	1.0
6		12	139	0.46		1.35		86.7	88	78	270	52	1.0
7		14	139	0.45		1.30		87.9	89	78	270	52	1.0
8		16	139	0.46		1.35		89.1	90	78	270	52	1.0
9		18	139	0.47		1.35		90.3	92	78	275	52	1.0
10		20	139	0.44		1.25		91.6	94	79	270	52	1.0
11		22	139	0.45		1.30		92.9	95	78	270	52	1.0
12		24	139	0.46		1.35		94.2	96	78	270	52	1.0
13		26	140	0.54		1.55		95.4	98	78	270	52	1.0
14		28	140	0.60		1.70		97.0	98	78	275	52	2.0
15		30	140	0.67		1.90		98.3	98	78	275	52	2.0
16		32	140	0.67		1.90		99.8	100	78	265	53	2.0
17		34	140	0.65		1.85		101.7	100	78	265	53	2.0
18		36	139	0.64		1.85		102.8	100	78	260	53	2.0
19		38	139	0.58		1.70		104.1	104	80	260	53	2.0
20		40	139	0.57		1.65		105.5	104	80	265	54	2.0
21		42	139	0.53		1.55		106.9	104	80	265	55	2.0
22		44	139	0.49		1.45		108.1	104	80	265	56	2.0
23		46	139	0.45		1.30		109.4	104	80	270	56	2.0
24	5:36	48	138	0.45		1.30		110.67	104	80	270	56	2.0
								110.675					
TOTAL													
AVERAGE													

STATIC PITOT LEAK-CHECK @ 15 sec.	0.0
IMPACT PITOT LEAK-CHECK @ 15 sec.	0.0
TRAIN LEAK RATE @ 60 sec.	0.000 cf @ 6 in.

STACK GAS ANALYSIS

ORSAT ☐ FYRITE ☒

TIME	CO2	O2	CO	N2
	5	7.5		
	4	7.6		

NOZZLE CALIBRATION-I.D. NO. 04

PRETEST		POST-TEST	
DIA. 1		DIA. 1	0.250
DIA. 2		DIA. 2	0.251
DIA. 3		DIA. 3	0.251
AVERAGE	0.251	AVERAGE	0.251

SIGNATURE Roger Reehl
TEST TEAM CHIEF

RESOURCE CONSULTANTS

FIELD DATA LOG

PLANT Tombigbee Lightweight Aggregate SOURCE #2 Kiln Wet Scrubber RUN NO 3

TRAVERSE POINT NUMBER	SAMPLING TIME CLOCK	SAMPLING TIME SAMPLE	STACK TEMP (T_s) °F	VELOCITY HEAD (ΔP_s)	VELOCITY HEAD ($\sqrt{\Delta P_s}$)	ORIFICE METER (ΔH) in H_2O ACTUAL	ORIFICE METER (ΔH) in H_2O DESIRED	GAS SAMPLE VOLUME (V_m), ft^3	GAS SAMPLE TEMP AT DRY GAS METER INLET ($T_{m_{in}}$)°F	GAS SAMPLE TEMP AT DRY GAS METER OUTLET ($T_{m_{out}}$)°F	SAMPLE BOX TEMP °F	TEMP OF GAS LEAVING LAST IMPINGER °F	PUMP VACUUM GAUGE in. Hg
	5:46	48											
B-1		50	139	0.52		1.50		112.1	86	80	270	48	2.0
2		52	139	0.53		1.55		113.4	88	80	270	48	2.0
3		54	139	0.53		1.55		114.7	90	80	270	48	2.0
4		56	139	0.54		1.55		116.0	90	80	270	48	2.0
5		58	139	0.57		1.65		117.4	94	80	270	48	2.0
6		60	139	0.58		1.65		118.9	98	80	270	48	2.0
7		62	139	0.55		1.60		120.1	98	80	265	49	2.0
8		64	139	0.61		1.80		121.7	100	80	265	49	2.0
9		66	139	0.62		1.80		123.0	100	80	265	49	2.0
10		68	139	0.58		1.70		124.4	102	80	270	50	2.0
11		70	139	0.55		1.60		125.9	102	80	270	50	2.0
12		72	139	0.50		1.45		127.3	102	80	270	50	2.0
13		74	140	0.54		1.55		128.5	102	80	275	52	2.0
14		76	140	0.55		1.60		129.8	104	80	275	53	2.0
15		78	140	0.57		1.65		131.1	105	80	275	53	2.0
16		80	140	0.56		1.60		132.5	105	80	275	53	2.0
17		82	140	0.58		1.70		133.9	105	80	270	54	2.0
18		84	140	0.54		1.55		135.3	106	80	275	54	2.0
19		86	140	0.50		1.45		136.6	106	80	275	54	2.0
20		88	140	0.48		1.40		137.9	106	80	275	54	2.0
21		90	139	0.43		1.25		139.1	106	80	275	54	2.0
22		92	139	0.41		1.20		140.3	105	80	270	55	2.0
23		94	139	0.37		1.10		141.4	105	80	270	56	2.0
24	1634	96	139	0.36		1.05		142.5	105	80	270	56	2.0
TOTAL		96	6681		34.607	72.50		63.418	4674	3805			MAX
AVERAGE		--	139.2		0.721	1.51		--	97.4	79.3			2

88.3

RESOURCE CONSULTANTS

APPENDIX B

EQUIPMENT CALIBRATIONS

ORIFICE MANOMETER SETTING ΔH, in. H_2O	GAS VOLUME WET TEST METER V_w, ft^3	GAS VOLUME DRY GAS METER V_d, ft^3	TEMPERATURE WET TEST METER T_w, ^oF	TEMPERATURE DRY GAS METER INLET T_{di}, ^oF	TEMPERATURE DRY GAS METER OUTLET T_{do}, ^oF	TEMPERATURE DRY GAS METER AVERAGE T_d, ^oF	TIME θ MIN.	γ	$\Delta H@$
0.5	5	5.305	76.50	111.5	101.0	106.25	12.69	0.994	1.759
1.0	5	5.299	77.00	114.0	101.0	107.50	9.22	0.995	1.855
1.5	10	10.540	77.00	120.0	101.5	110.75	15.56	1.005	1.971
2.0	10	10.602	77.00	122.5	102.0	112.25	13.43	1.000	1.954
3.0	10	10.541	76.75	126.0	103.0	114.50	10.76	1.008	1.870
4.0	10	10.560	76.50	127.5	103.5	115.50	9.61	1.006	1.984
							AVERAGE	1.00	1.90

CALCULATIONS		γ	$\Delta H@$
ΔH	$\frac{\Delta H}{13.6}$	$\frac{V_w \; P_b \; (T_d + 460)}{V_d \; (P_b + \frac{\Delta H}{13.6})(T_w + 460)}$	$\frac{0.0317 \, \Delta H}{P_b \, (T_d + 460)} \left[\frac{(T_w + 460)\,\theta}{V_w} \right]^2$
0.5	0.0368	1.010	1.781
1.0	0.0737	1.008	1.885
1.5	0.110	1.009	1.873
2.0	0.147	1.011	1.968
3.0	0.221	1.006	1.962
4.0	0.294	1.004	1.995

ORIFICE AND DRY GAS METER CALIBRATION - FULL RANGE

CALIBRATED BY Roger Reed DATE 10/30/81

BAROMETRIC PRESSURE, P_b = 29.51 in. Hg, BOX NO. 2

VACUUM = 0 in. Hg

γ = Ratio of accuracy of wet test meter. Tolerance = $\pm$ 0.01

$\Delta H@$ = Orifice pressure differential that giv 0.75 cfm of air at 68 ^oF and 29.92 inches of mercury, in. H_2O. Tolerance = $\pm$ 0.15

RESOURCE

ORIFICE MANOMETER SETTING ΔH, in. H_2O	GAS VOLUME WET TEST METER V_w, ft^3	GAS VOLUME DRY GAS METER V_d, ft^3	TEMPERATURE WET TEST METER T_w, ^oF	TEMPERATURE DRY GAS METER INLET T_{di}, ^oF	TEMPERATURE DRY GAS METER OUTLET T_{do}, ^oF	TEMPERATURE DRY GAS METER AVERAGE T_d, ^oF	TIME θ MIN.	γ	$\Delta H@$
1.45	10	10.025	75.75	98.0	80.5	89.25	15.12	1.019	1.882
1.45	10	10.246	75.25	106.0	85.0	95.50	15.50	1.009	1.953
1.45	10	10.276	75.00	115.0	86.0	100.50	15.30	1.016	1.884
							AVERAGE	1.01	1.91

CALCULATIONS		γ	$\Delta H@$
ΔH	$\frac{\Delta H}{13.6}$	$\frac{V_w \; P_b \; (T_d + 460)}{V_d \; (P_b + \frac{\Delta H}{13.6})(T_w + 460)}$	$\frac{0.0317 \, \Delta H}{P_b \, (T_d + 460)} \left[\frac{(T_w + 460)\,\theta}{V_w} \right]^2$
1.45	0.107	1.019	1.882
1.45	0.107	1.009	1.953
1.45	0.107	1.016	1.884

ORIFICE AND DRY GAS METER CALIBRATION - POST TEST

CALIBRATED BY John Marino DATE 11/17/81

BAROMETRIC PRESSURE, P_b = 29.16 in. Hg BOX NO. 2

VACUUM = 4 in. Hg

γ = Ratio of accuracy of wet test meter. Tolerance = $\pm$ 0.01

$\Delta H@$ = Orifice pressure differential that gives 0.75 cfm of air at 68 ^oF and 29.92 inches of mercury, in. H_2O. Tolerance = $\pm$ 0.15

RESOURCE CONSULTANTS

TYPE S PITOT TUBE ASSEMBLY CALIBRATION

IDENTIFICATION 7-1 CALIBRATED BY [illegible]

LENGTH 7 ft. DATE 4/23/80

P_A = 0.462 in. D_t = 0.375 in.

P_B = 0.462 in. γ = 1.0 °

P_{A+B} = 0.924 in. θ = 1.0 °

α_1 = 0.5 °(<10°) β_1 = 1.0 °(< 5°)

α_2 = 0.5 °(<10°) β_2 = 0.5 °(< 5°)

$Z = P_{A+B} \sin\gamma$ = 0.016 in. (< 0.125 in.)

$W = P_{A+B} \sin\theta$ = 0.016 in. (< 0.031 in.)

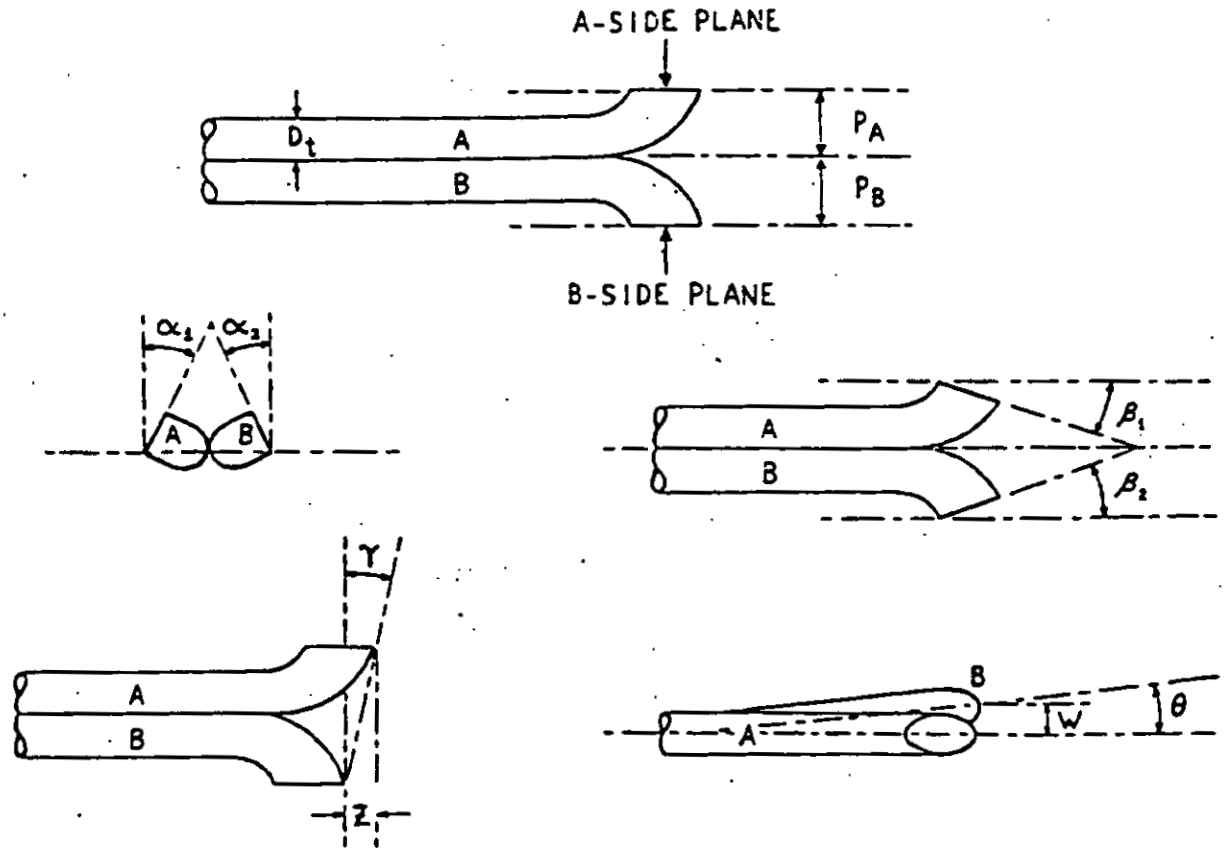
$1.05\ D_t$ = 0.394 $\leq P \leq 1.5\ D_t$ = 0.562

0.188 in. $\leq D_t \leq$ 0.375 in.

Distance between pitot tube and sampling nozzle ≥ 0.75 in.

Distance between pitot tube and thermocouple ≥ 0.75 in.

In accordance with 40 CFR Part 60, Appendix A, Method 2, Calibration Paragraph 4.1, the pitot tube assembly is assigned a coefficient of 0.84.



RESOURCE CONSULTANTS

TEMPERATURE GAUGE CALIBRATIONS

Temperature Gauge	No.	Test Run(s) Used	Average Temperature During Test	Gauge Reading (Calibration)	Reference Reading (Calibration)	Difference
Impinger Outlet (Pretest)	1	2	57	75	75	0
	2			75	75	0
	3			75	75	0
	4	1, 3	50	74	75	-1
	5			74	75	-1
Meter Inlet (Pretest)	1	1,2,3	91	75	75	0
	2			75	75	0
	3					
Meter Outlet (Pretest)	1	1,2,3	73	75	75	0
	2			75	75	0
	3					
Filter Heating System (Pretest)	1	1	265	250	250	0
	2			250	250	0
	3	3	270	250	250	0
	4	2	270	250	250	0
	5			250	250	0
	6			250	250	0
In-Stack (Post Test)	7-1	1,2,3	138	140	140	0

Pretest Calibrations by J Roger Reell — Title Poll Ctrl Spec — Date 10/30/81

Post Test Calibrations by J Roger Reell — Title " — Date 11/17/81

Barometer Calibration by J Roger Reell — Title " — Date 11/6/81

Company Tombigbee Lightweight Aggregate — Source No. 2 Kiln Wet Scrubber

Test Team Chief J Roger Reell — Test Date 11/11/81

RESOURCE CONSULTANTS

APPENDIX C

STATEMENT OF PROCESS WEIGHT RATE DATA

Statement of Process Weight Rate Data

On November 11, 1981, during the course of the source testing program conducted on the No. 2 wet scrubber, the process weight rate data was recorded for the purpose of calculating the allowable particulate emission rate. The weights of coal fired and raw clay fed to the kiln were totalized over known periods encompassing the source test. Coal was fired at an average rate of 2.6 tons per hour; raw clay was fed at an average rate of 40.0 tons per hour. The average total process weight rate during the testing period was 42.6 tons per hour.

TOMBIGBEE LIGHTWEIGHT AGGREGATE CORP.

James Colburn

James Colburn, Vice President

APPENDIX D

SAMPLE CHAIN OF CUSTODY

SAMPLE CHAIN OF CUSTODY

Plant Tombigbee Lightweight Aggregate Corporation / No. 2 Kiln Wet Scrubber
Date Sampled 11/11/81 Test Number
Run Number(s) 1, 2, 3

Sample Recovery

Container Code	Description
Log # 20228, Run 1	Filter, Acetone Rinse, Impinger Condensate
Log # 20229, Run 2	" " "
Log # 20230, Run 3	" " "

Person Engaged in Sample Recovery

Signature J. Roger Roell

Title Poll. Ctrl. Spec.

Location at which Recovery was done on-site

Date and time of Recovery 11/11/81

Sample(s) Recipient, Upon Recovery if not Recovery Person

Signature

Title

Date and Time of Receipt

Laboratory Person Receiving Sample

Signature J. Roger Roell

Title Poll. Ctrl. Spec.

Date and Time of Receipt 11/12/81 2300 CST

Sample Storage in lab

Analysis

Container Code	Method of Analysis	Date and Time of Analysis	Signature of Analyst
Log # 20228	Method 5	11/13-17/81	J. R. Roell
Log # 20229	Method 5	11/13-17/81	J. R. Roell
Log # 20230	Method 5	11/13-17/81	J. R. Roell

DRAFT/WP
d3006-4/971130
03/30/92 1

DATA RATING: B
REF 13 (AP-42)
REF 4 - 13

Emission Test Report
Review Checklist

Reviewer: R. MARINSHAW
Review Date: 11/18/92

A. Background Information

1. Facility name: TOMBIGBEE LIGHTWEIGHT AGGREGATE CORP.

   Location: LIVINGSTON, AL

2. Source category: LIGHTWEIGHT AGGREGATE

3. Test date: 11/11/81

4. Test sponsor: PLANT

5. Testing contractor: RESOURCE CONSULTANTS

6. Purpose of test: COMPLIANCE

7. Pollutants measured

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

   Others (list):

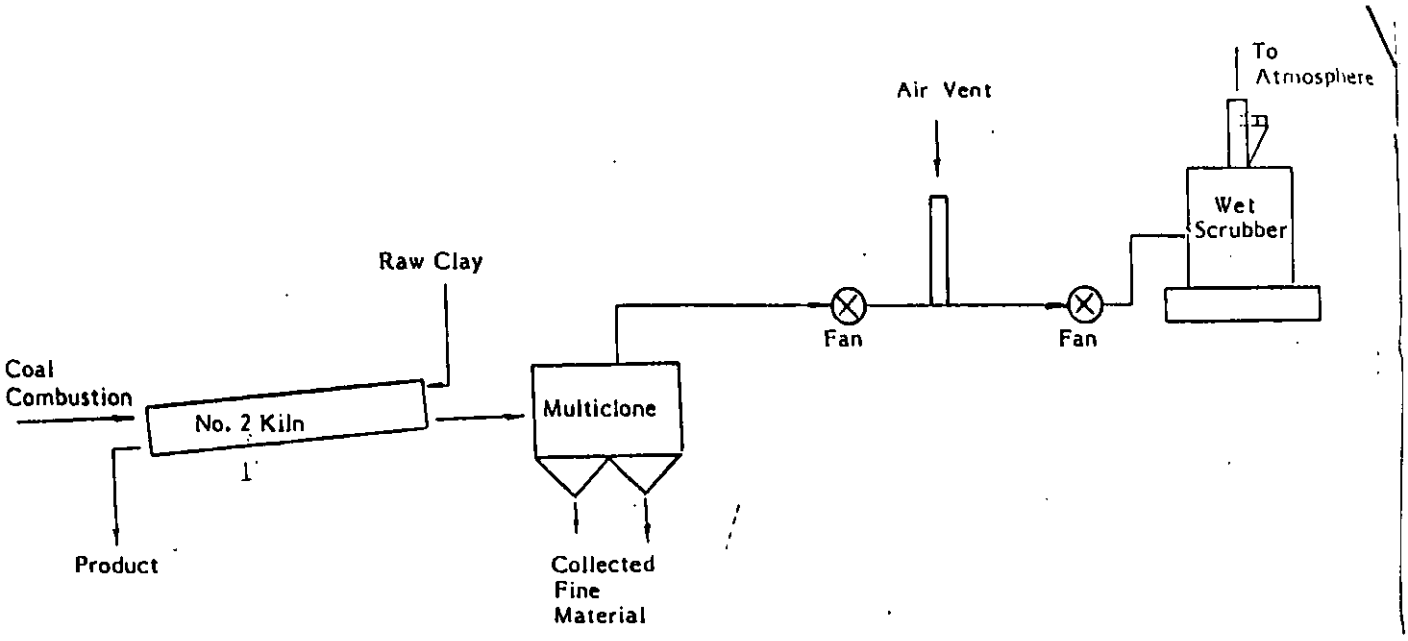
8. Process overview: On an attached page provide a block diagram of the unit operations and associated air pollution control systems at the facility. Identify process tested with letters from the beginning of the alphabet (A, B, C, etc.) and APC systems with letters from end of alphabet (V, W, X, etc.). 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	COAL FIRED ROTARY				WET SCRUBBER
	KILN (No. 2)				

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.)

Exhaust gases from the processing of raw clay in the rotary kiln were drafted directly from the kiln to a Fuller compressed air atomizing scrubber system. Testing was conducted in the cyclonic separator stack, which included a rectangular grid of flow straightening vanes.



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
	COAL + CLAY	LWA	CLAY	F

Basis for data: APPENDIX C
(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	
			1	40 (CLAY)	TONS/HR	+ 2.6 TONS/HR (COAL)
			2	40 (CLAY)	"	"
			3	40 (CLAY)	"	"
			4			
			1			
			2			
			3			
			4			
			1			
			2			
			3			
			4			
			1			
			2			
			3			
			4			

Basis for data: APPENDIX C

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.
	COMPRESSED AIR ATOMIZING SCRUBBER	FULLER	

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 INFO.

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
	PRESSURE	INCHES OF H_2O	14	14	14	
Type of APCD:	DROP					
	L/G RATIO	GAL/CFM	0.0085	0.0085	0.0085	
WET SCRUBBER						
Type of APCD:						
Type of APCD:						

NO INFO

D. Sampling and Analysis Methods

1. Complete the following table

Test location	Pollutant	S & A method	Reference/ conditional method	Deviations noted
	PM	5	Y/N (circled)	Y/N (circled)
	CO_2	Orsat	Y/N (circled)	Y/N (circled)
			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.

Because of the potential for the existence of cyclonic flow in the cyclonic separator stack, the pitot tube rotational angles were determined at each point by the null technique of Method 1 to verify the extent of cyclonic flow. As a result of the installation of a rectangular grid of flow straightening vanes, the rotational angles at all points were measured to be less than 10 degrees from parallel flow relative to the stack wall, indicating suitable conditions for conducting a source test. However, the short downstream length of stack from the vane outlet to the sampling ports may not have allowed the flow profile to stabilize resulting in a less than ideal sampling site.

Because of the high moisture content of the gas stream, the pitot lines were routinely purged to eliminate plugging from condensed moisture.

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
	Stack temperature	°F	136	138	139	
	Moisture	%	17.2	17.8	18.4	
	Oxygen	%	15.5	15.5	15.5	
	Volumetric flow, actual	CFM	67800	69100	71100	
	Volumetric flow, standard	DSCFM	49800	50300	51200	
	Percent isokinetic		97.2	95.5	97.3	
	Pollutant concentration:					
	PM	gr/dscf	0.0779	0.0690	0.0784	
	CO_2	%	4.5	4.5	4.5	
	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
A	PM (FILT)	LBS/HR	3325	22.74	34.43	
	CO_2	LBS/HR	15,449	15,605	15,884	

3. Present example emission factor calculations below.

PM (FILT)

33.25/40 = 0.83

29.74/40 = 0.74

34.43/40 = 0.86

AVERAGE = 0.81

CO_2

15,449/40 = 386

15,605/40 = 390

15,884/40 = 397

AVERAGE = = 391

4. Tabulate emission factors

Process	Pollutant	Units	Average emission factor	
			Uncontrolled	Controlled
	FILTERABLE PM	lbs/ton		0.81
	CO_2	lbs/ton	390	~~390~~

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