EMISSION TESTING REPORT
ETB TEST NUMBER 71-MM-15

Emissions From
Wet Process Cement Kiln
at

FINAL

FINAL

OREGON PORTLAND CEMENT
LAKE OSWEGO, OREGON

FINAL

FINAL

Project Officer
Clyde E. Riley

ENVIRONMENTAL PROTECTION AGENCY
Office of Air Programs
Research Triangle Park, North Carolina 27711

Source category:	Portland Cement	Date:	01/15/93
Plant name :	Oregon Portland Cement	Location:	Lake Oswego, OR
Test date :	10/5 - 10/8/71	Ref. No.:	7
Process :	wet	Basis for process rate :	slurry feed

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	Volumetric flow rate, DSCFM	Concen. ppm
rotary kiln (gas-fired)	fabric filter	filt. PM	1	12.87	52.1	0.124	0.247		
		filt. PM	2	17.67	57	0.155	0.310		
		filt. PM	3	15.12	58	0.130	0.261		
					average	0.136	0.273	Rating:	C
		con. inorg. PM	1	14.99	52.1	0.144	0.288		
		con. inorg. PM	2	2.9	57	0.0254	0.0509		
		con. inorg. PM	3	1.78	58	0.0153	0.0307		
					average	0.0615	0.123	Rating:	C
		SOx	1	27.1	55.7	0.244	0.487	52,417	52
		SOx	2	11.5	55.7	0.103	0.206	52,417	22
		SOx	3	8.35	55.7	0.0750	0.150	52,417	16
		SOx	4	5.74	55.7	0.0516	0.103	52,417	11
					average	0.118	0.237	Rating:	C

Notes:
1. SOx emission factors based on average flow and process rates.
2. All data rated C due to lack of documentation and recurrence of upsets.

PREFACE

The work reported herein was conducted by the Environmental Protection Agency (EPA), Office of Air Programs, Emission Testing Branch (ETB), Metallurgical and Mechanical Section. Mr. Clyde Riley served as the Project Officer and directed the ETB field team consisting of Mr. Howard Crist and Mr. Allan Riley. Mr. Philip K. York and Mr. James C. Herlihy served as Project Engineers. Mr. Howard Crist and Mr. Allan Riley performed the particulate analyses at the EPA laboratories.

Approved:

Environmental Protection Agency

Gene W. Smith
Chief, Metallurgical

March 29, 1972

Data Rating: B

TP- kiln blower (wet)
Gas- Fired
SO_2- continuous monitor

(16) FINAL

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FINAL

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II. INTRODUCTION

Under the Clean Air Act, as amended, the Environmental Protection Agency is charged with the establishment of performance standards for new installations or modifications of existing installations in stationary source categories which may contribute significantly to air pollution.

The development of realistic performance standards requires accurate data on pollutant emissions within the various source categories. In the cement industry, the Oregon Portland Cement plant located in Lake Oswego, Oregon was designated by EPA as representative of a well controlled operation, and was thereby selected for emission testing. This report presents the results of tests conducted at that plant.

The Oregon Portland Cement plant operates at a production rate of approximately 4000 barrels per day. The plant recently (July, 1967), installed a 135,000 ACFM baghouse.

The gases from the rotating kiln are directed through the 10 compartment baghouse prior to emission to the atmosphere.

Three particulate runs were conducted at the baghouse stack. Also two cumulative gas samples were collected during two of the particulate runs.

The following sections of this report treat (1) a summary of results, (2) a description of the process, (3) the location of sampling points, (4) process operating conditions, and (5) sampling and analytical procedures.

III. SUMMARY OF RESULTS

Tables I and II present a summary of results from the particulate and gas emission testing.

The kiln baghouse emissions collected in the front-half catch (probe and filter) ranged from 0.247 to 0.309 pounds per ton of kiln feed. The total catch (includes impinger portion) ranged from 0.291 to 0.535 pounds per ton of kiln feed.

Presented in Table III are SO_2 summary results recorded during continuous monitoring of SO_2 concentrations by an electrochemical SO_2 sensing analyzer.

TABLE I
SUMMARY OF PARTICULATE TESTING

Run Number	4	5	6
Date	10-7,10-8-71	10-8-71	10-8-71
Percent Excess Air	33.0	34.3	34.3
Percent Isokinetic	106.7	101.2	101.6
Stack Flow Rate - SCFM* dry	46,976	54,699	55,577
Stack Flow Rate - ACFM wet	120,135	133,718	135,988
Volume of Dry Gas Sampled - SCF	73.449	78.702	80.246
Feed Rate - tons/hr	52.1	57.0	58.0
Particulates			
Probe, Cyclone, & Filter Catch			
mg	152.6	192.9	165.4
gr/SCF* dry	0.0319	0.0377	0.0317
gr/CF @ Stack Conditions	0.0125	0.0154	0.0129
lbs/hr.	12.87	17.67	15.12
lbs/ton feed	0.247	0.309	0.261
Total Catch			
mg	330.2	224.4	185.4
gr/SCF* dry	0.0692	0.0439	0.0356
gr/CF @ Stack Conditions	0.0270	0.0179	0.0145
lbs/hr	27.86	20.57	16.90
lbs/ton feed	0.535	0.361	0.291
% Impinger Catch	53.8	14.0	10.8

* 70°F, 29.92" Hg

TABLE II

SUMMARY OF GASEOUS TESTING

Run	Gas Composition (Vol. % Dry)			
	CO_2	O_2	CO	N_2
1	18.6	5.0	<1	76.4
2	17.6	5.2	<1	77.2

TABLE III

SO_2 CONTINUOUS MONITORING SUMMARY RESULTS

Date	Began	Ended	Elapsed Time(min)	Avg. ppm SO_2
10-5-71	13:10	13:50	50	52
10-6-71	09:30	11:38	128	22
10-7-71	14:35	14:40	5	16
10-8-71	09:00	09:50	50	11

IV. PROCESS DESCRIPTION

Limestone (81 percent) and sand (12 percent) are brought to the plant by barge from British Columbia, Canada and clay (6 percent) is trucked from a quarry about 15 miles from the plant. These materials are ground and blended with (1) percent iron oxide in a rotating ball mill to form a slurry of about 32 percent water.

The blended slurry is fed into the upper end of a sloping, slowly revolving (one revolution per minute) kiln. This gas-fired kiln (No. 4) is 450 feet long, 13 1/2 feet in diameter at the feedend and 12 feet at the front end. Fuel consumption is approximately 1,000,000 BTU per barrel of cement produced. During passage through the kiln, the raw materials are heated to about 2500°F to produce calcium and aluminum silicate known in the trade as "clinker". This marble-sized clinker material is discharged from the lower end of the kiln at temperatures exceeding 2000°F and fed immediately into an air-quenching cooler unit which reduces the clinker temperature to about 150°F. The newly-formed clinker material is conveyed to a storage silo from the cooler.

A small amount of gypsum (4.45 percent by weight) is added to the clinker material and this mixture is fed to the finish grinding mill. The dust-laden air leaving the mill (air sweep) is fed to an air-separator or classifier where the coarse material is returned to the mill and the finished cement (90 percent through 325 mesh screen) is conveyed to storage silos. Kiln No. 4 can produce about 4000 barrels of cement in a day.

The control equipment of interest in this report consists of a Wheelabrator baghouse collector which was installed in 1967 at an approximate cost of $705,000.00. The flow of dust-laden gases is downward to a manifold between the collector hoppers. From the manifold the gases move upward through the collector, then downward through a duct to a fan and are exhausted into an 87 feet high stack with a velocity cone at the top.

The basic unit of the baghouse collector is a compartment which contains 96 graphite impregnated glass-fiber bags with a surface area of 90 ft^2 per bag. There are ten (10) compartments in the baghouse, and each compartment is cleaned sequentially by reverse air flow. The particulate matter is collected on the inside of the glass-fiber bags and falls by gravity to the hopper below where the material is removed by a screw conveyor and returned to the kiln by scoop feeders located in front of the chain system approximately 60 to 80 percent of the dust collected is normally returned to the kiln.

The Wheelabrator baghouse collector is designed to handle an air volume of 135,000 ACFM @ 410°F. The equipment manufacturer would not guarantee the efficiency of this baghouse, since this unit was the first one they had installed on a wet process plant. The effective collecting surface area of the baghouse is 86,400 ft^2 which gives an air-to-cloth ratio of 1.62:1 or 1.8:1 ft per minute when one compartment is being cleaned. The pressure drop across a bag filter is 3 to 4 inches of water. The expected life of the bags is from 2 1/2 to 3 years and each bag costs about $25.00. The expected life of the collector is 20 years and the annual operating cost averages about $22,500.00.

V. LOCATION OF SAMPLING POINTS

The sampling ports located on the effluent stack were positioned approximately 32 feet (4.6 stack diameters) above the breeching inlet and 18 feet (2.6 stack diameters) below the section of the cone-shaped cap. The number and locations of the sampling points within the stack cross-section used for the three particulate runs were determined from the Federal Register, "Standards of Performance for New Stationary Sources,) (23 December, 1971).

For the gaseous and SO_2 sampling the probes were positioned at one of the two existing particulate sampling ports and extended approximately two feet into the stack.

VI. PROCESS OPERATION

Process operation was interrupted several times during the coarse of the particulate and gaseous sampling. During each of these interruptions sampling was stopped until normal operation could be resumed, at which time sampling was continued. Several conditions contributing to these interruptions were: (1) excessive pressure drop across baghouse,(2) visible emissions from leaking bags, and (3) breakdown of dust removal equipment.

The stack emissions were constantly being monitored during the particulate testing, and when visible emissions were noticed sampling again was discontinued until normal operation could be resumed.

VII. SAMPLING AND ANALYTICAL PROCEDURES

Particulate samples were collected with the train specified in Method 5 of the Federal Register, "Standards of Performance For New Stationary Sources" (3 December, 1971) including impingers as described.

The procedures for sampling and analyzing the particulate and gaseous samples are described in Methods 1 through 5 of the December 23, 1971 Federal Register. In addition, the impinger catch was analyzed for particulate residue including organic matter. For the continuous monitoring of SO_2 concentrations an electrochemical sensing analyzer was used.

APPENDIX A

PARTICULATE RESULTS

Table A - I lists the complete results for the particulate and gaseous runs. Table A - II lists the equations used for the calculations. Also shown in Table A - II are example calculations from Run No. 1.

Presented in Table A - III are SO_2 results recorded during continuous monitoring of SO_2 concentrations by an electrochemical SO_2 sensing analyzer.

Standard conditions are taken as 70°F and 29.92 in. Hg.

TABLE A-I

PARTICULATE AND GASEOUS EMISSION DATA

Run No.		4	5	6
Test Date		10-7,8-71	10-8-71	10-8-71
D_n	Sampling nozzle diameter, in.	0.250	0.250	0.250
T_t	Net time of test, min.	165	160	160
P_b	Barometric pressure, in. Hg absolute	29.93	29.90	29.85
P_m	Average Orifice pressure drop, in. H_2O	0.776	0.999	1.033
V_m	Volume of dry gas sampled, ft^3 at meter conditions	76.497	84.082	85.656
T_m	Average gas meter temperature, °F	92.8	106.8	105.4
$V_{m_{std}}$	Volume of dry gas sampled at standard conditions*, SCF	73.449	78.702	80.246
V_w	Total H_2O collected in impingers and silica gel, ml	1046.0	1006.0	1013.8
$V_{w_{gas}}$	Volume of water vapor collected at standard conditions*, SCF	49.58	47.68	48.05
% M	% Moisture in the stack gas by volume	40.30	37.73	37.45
M_d	Mole fraction of dry gas	0.597	0.623	0.625
% CO_2		18.6	17.6	17.6
% O_2		5.0	5.2	5.2
% CO		i	i	i
% N_2		76.4	77.2	77.2
% EA	Excess Air Percent	33.0	34.3	34.3
MW_d	Molecular weight of stack gas, dry basis	31.17	31.02	31.02
MW	Molecular weight of stack gas, wet basis	25.86	26.11	26.14
C_p	Pitot tube coefficient	0.85	0.85	0.85
ΔP_s	Average velocity head of stack gas, in. H_2O	0.496	0.620	0.638
T_s	Average stack temperature, °F	353	351	353
N_p	Net sampling points	33	32	32
P_{st}	Static pressure of stack gas in. Hg	0.13	0.16	0.16
P_s	Stack gas pressure in. Hg absolute	30.06	30.06	30.01
V_s	Stack gas velocity at stack conditions fpm	3122	3475	3534
A_s	Stack area, $in.^2$	5542	5542	5542
Q_s	Dry stack gas volumetric flow rate at standard conditions*, SCFM	46,976	54,699	55,577
Q_a	Stack gas volumetric flow rate at stack conditions, ACFM	120,135	133,718	135,988
% I	Percent isokinetic	106.7	101.2	101.6

* 70°F, 29.92 in. Hg

TABLE A-I (concluded)
PARTICULATE AND GASEOUS EMISSION DATA

Run No.		4	5	6
T_c	Unit Feed Rate-Tons/hr	52.1	57.0	58.0
m_f	Particulate - probe, cyclone and filter, mg	152.6	192.9	165.4
m_t	Particulate - total, mg	330.2	224.4	185.4
I_c	% impinger catch	53.8	14.0	10.8
C_{an}	Particulate - probe, cyclone, and filter, gr/SCF*	0.0319	0.0377	0.0317
C_{ao}	Particulate - total, gr/SCF*	0.0692	0.0439	0.0356
C_{at}	Particulate - probe, cyclone, and filter, gr/cf at stack conditions	0.0125	0.0154	0.0129
C_{au}	Particulate - total, gr/cf at stack conditions	0.0270	0.0179	0.0145
C_{aw}	Particulate - probe, cyclone, and filter, lb/hr.	12.87	17.67	15.12
C_{ax}	Particulate - total, lb/hr.	27.86	20.57	16.90
P_{tf}	Particulate - probe, cyclone, and filter, lb/ton feed	0.247	0.309	0.261
P_{tt}	Particulate - total, lb/ton feed	0.535	0.361	0.291

*70°F, 29.92 in. Hg, dry basis

TABLE A-II
PARTICULATE CALCULATIONS

1. Volume of dry gas sampled at standard conditions: 70°F, 29.92 in. Hg, SCF

$$V_{m_{std}} = \frac{17.7 \times V_m \left(P_b + \frac{P_m}{13.6}\right)}{(T_m + 460)} = \frac{17.7 \times 76.497 \left(29.93 + \frac{726}{13.6}\right)}{(92.8 + 460)} = 73.449 \text{ ft}^3$$

2. Volume of water vapor at 70°F and 29.92 in. Hg, SCF

$$V_{w_{gas}} = 0.0474 \times V_w = 0.0474 \times 1046 = 49.58 \text{ft}^3 \text{ SCF}$$

3. Percent moisture in stack gas

$$\%\ M = \frac{100 \times V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} = \frac{100 \times 49.58}{73.449 + 49.58} = 40.30$$

4. Mole fraction of dry gas

$$M_d = \frac{100 - \%M}{100} = \frac{100 - 40.30}{100} = 0.597$$

5. Average molecular weight of dry stack gas

$$MW_d = (\%CO_2 \times \frac{44}{100}) + (\%O_2 \times \frac{32}{100}) + \left[(\%CO + \%N_2) \times \frac{28}{100}\right] =$$

$$(18.6 \times \frac{44}{100}) + (5.0 \times \frac{32}{100}) + (76.4 \times \frac{28}{100}) = 31.17$$

6. Molecular weight of stack gas

$$MW = MW_d \times M_d + 18\ (1 - M_d) = 31.17 \times 0.597 + 18\ (1 - 0.597) = 25.86$$

7. Stack gas velocity at stack conditions, fpm

$$V_s = 4{,}360 \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times MW}\right]^{1/2} =$$

$$4{,}360 \times 19.97 \left[\frac{1}{30.06 \times 25.86}\right]^{1/2} = 3722 \text{fpm}$$

8. Stack gas volumetric flow rate at standard conditions*, SCFM

$$Q_s = \frac{0.123 \times V_s \times A_s \times M_d \times P_s}{(T_s + 460)} = \frac{0.123 \times 3122 \times 5542 \times 0.597 \times 30.06}{(353 + 460)} = 46,976 \text{ SCFM}$$

9. Stack gas volumetric flow rate at stack conditions, ACFM

$$Q_a = \frac{.05645 \times Q_s \times (T_s + 460)}{P_s \times M_d} = \frac{.05645 \times 46,976 \times (353 + 460)}{30.06 \times 0.597} = 120,135 \text{ ACFM}$$

10. Percent isokinetic

$$\%I = \frac{1,032 \times (T_s + 460) \times V_{mstd}}{V_s \times T_t \times P_s \times M_d \times (D_n)^2} = \frac{1,032 \times (353 + 460) \times 73.449}{3122 \times 165 \times 30.06 \times .597 \times (.250)^2} = 106.7\%$$

11. Particulate: probe, cyclone and filter, gr/SCF* Dry Basis

$$C_{an} = 0.0154 \times \frac{m_f}{V_{mstd}} = 0.0154 \times \frac{152.6}{73.449} = 0.0319 \text{ gr/SCF}$$

12. Particulate total, gr/SCF* Dry Basis

$$C_{ao} = 0.0154 \times \frac{m_t}{V_{mstd}} = 0.0154 \times \frac{330.2}{73.449} = 0.0692 \text{ gr/SCF}$$

13. Particulate: probe, cyclone and filter, gr/CF at stack conditions

$$C_{at} = \frac{17.7 \times C_{an} \times P_s \times M_d}{(T_s + 460)} = \frac{17.7 \times .0319 \times 30.06 \times .597}{(353 + 460)} = 0.0125 \text{ gr/CF}$$

14. Particulate: total, gr/CF at stack conditions

$$C_{au} = \frac{17.7 \times C_{ao} \times P_s \times M_d}{(T_s + 460)} = \frac{17.7 \times .0692 \times 30.06 \times .597}{(353 + 460)} = 0.0270 \text{ gr/CF}$$

15. Particulate: probe, cyclone, and filter, lb/hr

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = 0.00857 \times 0.0319 \times 46,976 = 12.87 \text{ lb/hr}$$

16. Particulate: total, lb/hr

$$C_{ax} = 0.00857 \times C_{ao} \times Q_s = 0.00857 \times 0.0692 \times 46,976 = 27.86 \text{ lb/hr}$$

17. Particulate: probe, cyclone, and filter, lb/ton feed

$$P_{tf} = \frac{C_{aw}}{T_c} = \frac{12.87}{52.1}$$ lb/ton feed

18. Particulate: total, lb/ton

$$P_{tt} = \frac{C_{ax}}{T_c} = \frac{27.86}{52.1}$$ lb/ton feed

* 70°F, 29.92 in. Hg

TABLE A-III

SO_2 CONTINUOUS MONITORING RESULTS*

Date	Time of Reading	ppm SO_2	Avg. ppm SO_2
10-5-71	13:10	33	
	13:20	30	
	13:30	42	52
	13:40	72	
	13:50	81	
10-6-71	09:30	12	
	09:57	9	
	10:10	12	
	10:15	15	22
	11:30	33	
	11:35	39	
	11:38	36	
10-7-71	14:35	18	16
	14:40	15	
10-8-71	09:00	12	
	09:10	12	
	09:15	14	
	09:30	9	11
	09:40	9	
	09:45	9	
	09:50	12	

*Readings of ppm recorded directly from instrument scale.

APPENDIX B

OPERATION RESULTS

Presented in this section is a summary prepared from the process log located in the plant control room and the particulate field data sheets.

On Thursday afternoon (10-7-71), kiln operating smoothly with average feed rate of 52.1 tons per hour during sampling period of 1346 to 1540 for part of Run No. 4. At 1600 kiln was shut down since pressure drop across baghouse was becoming excessive (9 inches of water) due to failure of dust removal system.

Run No. 4 completed on Friday (10-8-71) morning, Run No. 5 obtained from 1200 to 1450 with kiln operating smoothly at an average feed rate of 57.0 tons per hour. Run No. 6 obtained from 1545 to 1834 with kiln operating smoothly at an average feed rate of 58.0 tons per hour.

During these three runs, about 60 percent of the dust collected in the baghouse was returned to the kiln.

Several other runs were attempted on Wednesday and Thursday but had to be discarded due to leaks in the bag filters. These leaks were detected when visible emissions were observed at the velocity cone on the stack.

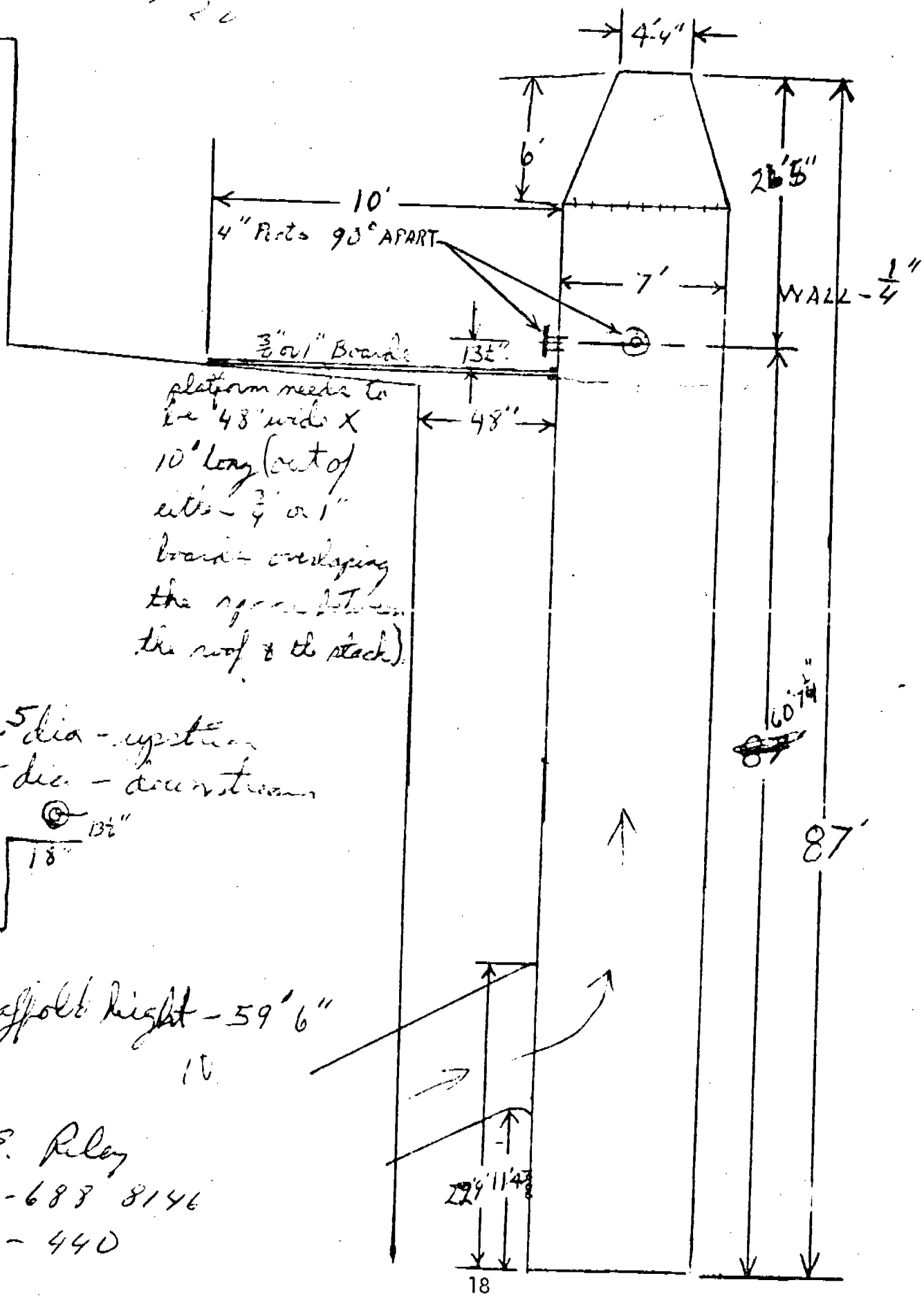
The particulate and gaseous results described in this report represent sampling during normal kiln operation only.

APPENDIX C

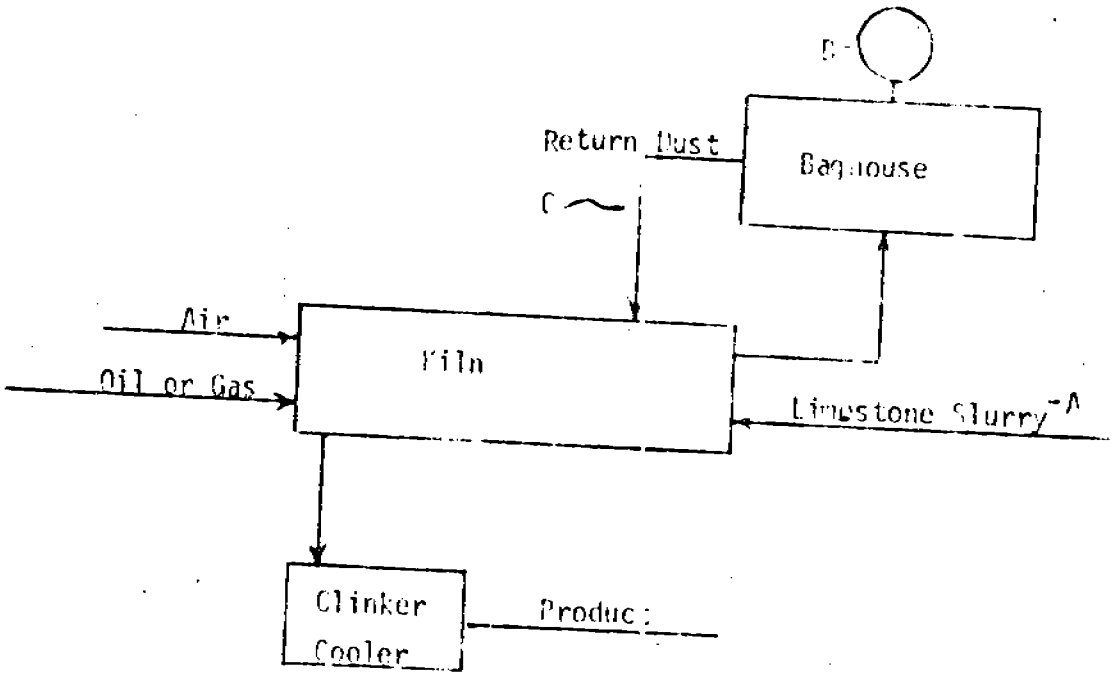
FIELD DATA

This section presents the actual field data recorded during the testing.

2. Projection 8'



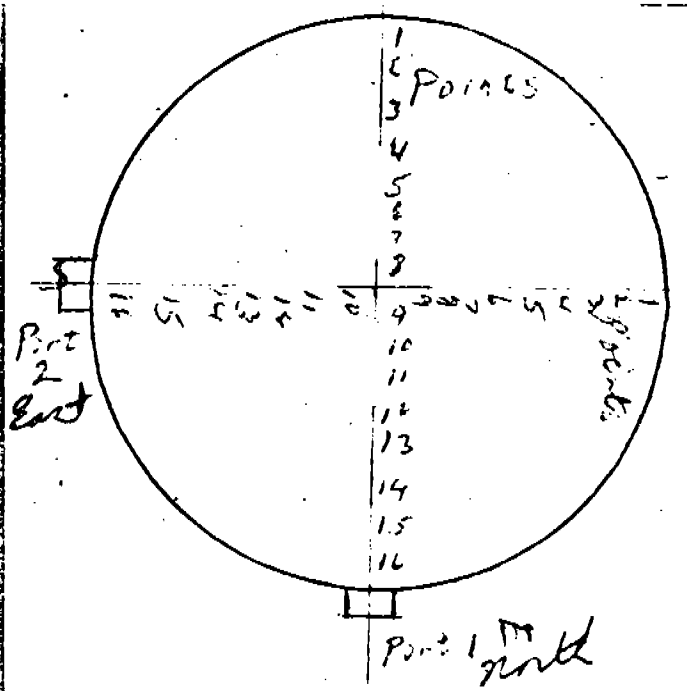
OREGON PORTLAND CEMENT COMPANY



Sampling Point	Type of Sample	Initial Analysis: No. of Samples	Analysis	Organization
A	Slurry	1		
B	Part.	3	Mass	Howard Crist
C	Return Dust	1		
B	Excess Air	2-1	CO_2,O_2,CO	Ray Mobley

PRELIMINARY FIELD DATA

Stack Geometry



Plant Oregon Portland Cement

Test No. 1

Location Kiln Stack

Date 8-25-71

A. Dist. from inside of far wall to outside of near wall, in., = 87 1/4"

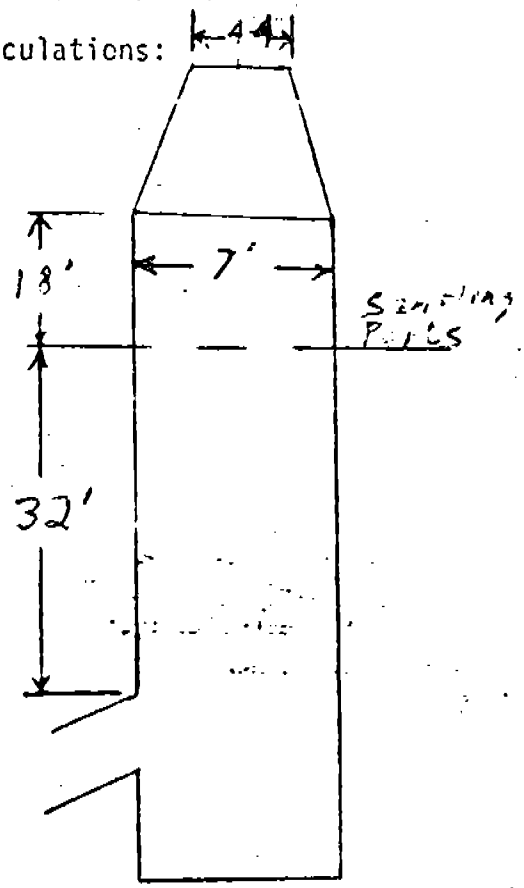
B. Wall thickness, in., = 3 1/4"

Inside diameter of stack = A-B 84"

Stack Area = 5539

Comments: 4.5 dia upstream
2.5 dia downstream

Sketch of stack cross-section showing sampling holes



Calculations:

Calculator C. E. Riley

Point	% Dia. for circular stack	Dist. from outside of sample port, in.
16	1.6	1.34+3.25=4 5/8
15	4.9	4.11 = 7 3/8
14	8.5	7.13 = 10 3/8
13	12.5	10.5 = 13 1/4
12	16.9	14.2 = 17 1/2
11	22.0	18.5 = 21 3/4
10	28.3	23.8 = 27 1/8
9	37.5	31.4 = 34 3/4
8	62.5	52.5 = 55 3/4
7	71.7	60.1 = 63 3/8
6	78.0	65.5 = 68 3/4
5	83.1	69.7 = 73
4	87.5	73.5 = 76 3/4
3	91.5	76.7 = 80
2	95.1	79.9 = 83 1/4
1	98.4	82.5 = 85 3/4

NOAP-28 (12/67)

VELOCITY TRAVERSE FIELD DATA

Plant Oregon Portland Cement

Test 2

Location Kiln Baghouse Stack

Date 10-5-71

Operator C E Riley

Meter ΔH 2.03

Clock Time	Point	(1) ΔP, in. H_2O North	(1) $\sqrt{\Delta P}$, in. H_2O	(2) ΔP, in. H_2O East	(2) $\sqrt{\Delta P}$, in. H_2O	Stack Temp. °F (1)	Stack Temp. °F (2)
1100	1	.50		1	.40	350	360
	2	.59		2	.50		
	3	.65		3	.56		
	4	.64		4	.54		
	5	.70		5	.60		
	6	.70		6	.60		
	7	.72		7	.60		
	8	.74		8	.63		
	9	.74		9	.73		
	10	.75		10	.75		
	11	.77		11	.77		
	12	.70		12	.74		
	13	.65		13	.70		
	~~14~~						
	14	.62		14	.60 ~~.60~~		
	15	.54		15	.58		
	16	.38		16	.55		

(1) ΔP, in. H_2O Average .60

(2) ΔP, in. H_2O Average .60

Comments:

Plant Oregon Portland Cement Date 10-5-71 Sheet 2

Sampling location Kiln Baghouse Stack

STACK DATA FOR NOMOGRAPH:

1. Meter ΔH 2.03 in H_2O

2. Avg. meter temp (ambient + 20° 90 °F

3. Moisture (volume) 40 %

4. Avg. static press. ⊖ ~~.1~~ in. H_2O × .073 = ⊖ .15 in. Hg.

5. Bar. press sampling point 29.98 in. Hg ⊖ .15 (static press in. Hg)
29.83 in. Hg.

6. Bar press of meter 29.98 in. Hg.

7. P_s/P_m = $\frac{5.\ 29.83 \text{ in. Hg}}{6.\ 29.98 \text{ in. Hg}}$ = 1.04

8. Avg. stack temperature 375 °F.

9. Avg. stack velocity (ΔP) .66 in H_2O. MAX. VELOCITY .80

C factor (1) ~~.57~~ .54 (2)

10. Probe Tip size .250

Run 4 On [illegible]

PARTICULATE FIELD DATA

Plant Oregon Portland Cement

Run No. 4

Location Kiln Stack

Date 10-7-71

Operator C. E. Riley

Sample Box No. 1

Meter Box No. NC-9

Meter ΔH 2.03

C Factor .56

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

PATHOLOGICAL INCINERATORS-
read and record every 5 minutes.

Test was started 10-7-71
Completed 10-8-71

Ambient Temp °F 80

Bar. Press. "Hg 29.96

Assumed Moisture % 40

Heater Box Setting, °F 250

Probe Tip Dia., In. .250

Probe Length 8 ft

Probe Heater Setting 70

Avg. ΔP .6 Avg. ΔH .92

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum In. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press in. Hg	Stack Temp °F
1-0 1345	0	690.60	—	—	—	—	—	—	—	—	—	—
1	5	692.56	.34	.53	.53	90	98	2	250	79		340
2	10	—	.43	.67	.67	89	98	3	240	78		342
3	15	696.92	.45	.69	.69	88	98	3	255	75		344
4 test	20	699.14	.45	.69	.69	89	100	3	270	75		345
5 [illegible]	25	—	.43	.69	.69	90	102	3	240	75		346
6 [illegible]	30	703.65	.44	.70	.70	92	104	3	260	76		348
7	35	705.90	.48	.76	.76	93	104	3	240	75		348
8	40	708.19	.46	.73	.73	94	105	3	240	75		349
9	45	710.68	.56	.88	.88	95	106	3	260	77		345
10	50	713.13	.52	.83	.83	96	107	3	240	79		345
11	55	715.58	.53	.85	.85	97	108	3	255	77		342
12	60	717.99	.52	.82	.82	98	109	3	250	77		340
13	65	720.43	.53	.85	.85	99	109	3	250	76		336
14	70	722.83	.53	.85	.85	99	110	3	250	75		336
15	75	725.22	~~.5~~ .48	.76	.76	99	110	3	255	78		332
16 1505	80	727.165	.31	.49	.49	100	109	3	260	78		315

Comments:

RCAP-37 (12/67) Av. T(stack) 364°F

$V_{std} = (17.71)(76.497)\left(\frac{30.02}{512.5}\right) = 73.57\ f^3$

23

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H2O ΔP	Orifice ΔH in H2O Desired	Actual	Dry Gas Temp Inlet	Outlet	Pump Vacuum in. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press in. Hg	Stack Temp °F	
~~0~~ 1	0 1518	729.22	.35	.58	.58	100	105	2	250	89		331	
1 2	5	731.30	.38	.62	.62	100	105	3	250	80		331	
2 3	10	733.37	~~.39~~ .37	.61	.61	100	107	3	250	79		336	
3 4	15	735.43	.36	.59	.59	100	107	3	250	79		337	
4 5	20 Jim called	737.48	.35	.58	.58	100	108	3	250	79		340	
5 6	25	739.65	.40	.65	.65	101	108	3	260	79	Shut off	340	
6 7	30 [illegible]	741.746	.37	.61	.61	101	108	3	260	79		338	10-7
7 8	35 [illegible]	744.17	.58	.88	.88	64	64	4	250	69		384	10-8
8 9	40	746.78	.66	1.00	1.00	64	68	4	260	69		382	29.90
9 10	45	749.48	.70	1.05	1.05	65	73	4	250	69		382	
10 11	50	752.10	.69	1.05	1.05	67	77	4	250	69		381	
11 12	55	754.78	.70	1.06	1.06	69	80	4	240	69		385	
12 13	60	757.40	.68	1.02	1.02	70	83	4	245	70		383	
13 14	65	760.14	.68	1.04	1.04	72	85	4	250	70		390	
14 15	70	762.44	0.58	.88	0.88	~~83~~ 74	~~74~~ 87	4	260	70		390	
15 16	75	764.70	0.48	0.73	0.73	76	88	4	250	70		380	
Point 7 → 16	80 0946	767.097	.58	.88	.88	77	89	4	250	70		394	
	85				[illegible]	80.1	96.6						
		78.497	[illegible] .512				92.8						
	(85)											353	
			37.40 / 20										
	165					88.1	97.5						
							92.8						

(33)

24

80
3
11 MIN at 49.2 tons/hr production

50 MIN at 57.9 tons/hr production.

Avg 52.1

10-7-71 1548 – Notice dust coming from stack! 1548 Shut off train.
10-8-71 Started at point 8 – 0850 – emmission very light! C2R Should have started at Point 8.

NATIONAL CENTER FOR AIR POLLUTION CONTROL

ORSAT DATA AND CALCULATION SHEET

Orsat Analysis - Burner Only (From bag sample)

Sampling Point Location _____

Date _____ Time _____

	Analysis 1	Analysis 2	Analysis 3	Avg	x = Mole Wt	Wt/Mole Dry Basis
CO_2, % Vol. (Dry basis), V_{bb}					44/100	
CO, % Vol. (Dry basis), V_{bc}					28/100	+
O_2, % Vol. (Dry basis), V_{bd}					32/100	+
N_2, % Vol. (Dry basis), V_{be}					28/100	+
				M_{bk} = Avg. Molecular Wt. of Dry Stack Gas =		=

Orsat Analysis for Test - Waste and Burners (From bag sample)

Date 10-7-71 Time 1200-1400 Run No. #4

Sampling Point Location Rk. Stack

	Analysis 1	Analysis 2	Analysis 3	Avg	x = Mole Wt	Wt/Mole Dry Basis
CO_2, % Vol. (Dry Basis), V_{bf}	18.6				44/100	8.18
CO, % Vol. (Dry Basis), V_{bg}	—				28/100	+
O_2, % Vol. (Dry Basis), V_{bh}	5.0				32/100	+1.60
N_2, % Vol. (Dry Basis), V_{bi}	76.4				28/100	+21.39
				M_{bj} = Avg. Molecular Wt. of Dry Stack gas =		=31.17

(28) A. Excess Air, % = $\dfrac{100 \times (V_{bh} - V_{\frac{bg}{2}})}{0.264 \times V_{bi} - (V_{bh} - V_{\frac{bg}{2}})}$ = V_{bl} = 33.0

(Transfer All Answers to Summary of Results)

(19) B.* CO_2 Contributed by burner, % by vol. of stack gas corrected to test conditions.

$$V_{bn} = V_{bb} \times \frac{V_{bl}}{V_{db}} \times G_{bm} = \_\_\_\_\_$$

Run 5 on report 0111S

PARTICULATE FIELD DATA

Plant Oregon Portland Cement

Run No. 5

Location Kiln Baghouse stack

Date 10-8-71

Operator C E Riley

Sample Box No. 2

Meter Box No. NC-9

Meter ΔH@ 2.03

C Factor .56

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

PATHOLOGICAL INCINERATORS- read and record every 5 minutes.

started on East Port

Ambient Temp °F 80

Bar. Press. "Hg 29.90

Assumed Moisture % 40

Heater Box Setting, °F 250

Probe Tip Dia., In. .250

Probe Length 8 ft

Probe Heater Setting 70

Avg. ΔP ____ Avg. ΔH ____

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H2O ΔP	Orifice ΔH in H2O Desired	Orifice ΔH in H2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum In. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press In. H2O	Stack Temp °F
0	1200	767.30	—	—	—	—	—	—	—	—	—	—
1	5	769.29	.41	.62	.62	87	96	2	240	85	-2.2	337
2	10	771.52	.44	.72	.72	87	97	2	275	80		348
3	15	773.40	.40	.77	.77	87	99	2	270	79		348
4	20	776.28	0.5[illegible]	[illegible]	[illegible]	[illegible]	10[illegible]	2	250	80		352
5	25	778.80	.56	.92	.92	91	105	2	250	79		352
6	30	781.40	.60	.97	.97	92	106	2	250	80		352
7	35	784.04	.62	1.00	1.10	94	109	2	250	80		352
8	40	786.70	~~.60~~ .62	~~.85~~ 1.00	~~.67~~ 1.10	94	110	2	260	70		352
9	45	789.53	.75	1.2	1.2	95	112	2	260	78		352
10	50	792.43	.78	1.25	1.25	97	113	2	260	77		352
11	55	795.33	.75	1.21	1.21	97	114	2	250	77		344
12	60	798.27	.77	1.26	1.26	99	115	3	250	77		344
13	65	801.20	.74	1.20	1.20	100	116	3	250	78		344
14	70	804.07	.70	1.14	1.14	101	117	4	265	80		345
15	75	806.70	.60	.97	.97	102	118	4	270	80		342
16	1320 80	808.667	.39	.45	.45	102	117	4	250	78		337

Comments: 1200 - stack OK
1300 - stack OK

V_m = 17.7 (94.0 ...) (29.9? / ...) = 78.74

NCAP-38 (12/67)

Run 5 Comments	Clock Time	Dry Gas Meter, CF	Pitot in. H2O ΔP	Orifice in H2O Desired	Actual	Inlet	Outlet	in. Hg Gauge	Temp. °F	°F	in. Hg	°F
0	~~1330~~ 0	811.02	.50	.88	.88	103	112	2	250	85	2.2	345
1	1330 5	813.57	.52	.85	.85	102	112	2	260	80		345
2	10	816.19	.59	.96	.96	102	114	2	250	79		352
3	15	818.88	.66	1.08	1.08	103	116	2	260	83		353
4	20	821.52	0.64	1.05	1.05	104	118	2	260	82		355
5	25	824.275	0.66	1.08	1.08	105	119	3	230	78		355
6	30	827.02	0.67	1.09	1.09	106	119	3	250	79		356
7	35	829.77	0.66	1.08	1.08	107	120	3	260	83		358
8	40	832.54	0.73	1.18	1.18	107	120	3	260	80		358
9	45	835.31	.70	1.1	1.1	108	121	3	260	83		358
10	50	838.05	.67	1.06	1.06	108	120	3	240	78		358
11	55	840.80	0.70	1.1	1.1	108	119	4	260	79		361
12	60	843.53	.71	1.11	1.11	107	118	4	265	77		362
13	65	846.23	.65	1.02	1.02	106	118	4	260	78		360
14	70	848.84	.60	.94	.94	107	118	4	250	78		356
15	75	851.	.57	.90	.90	107	118	4	250	80		351
16	1450 80	851.382	[illegible]		[illegible]	[illegible]	113.4				[illegible]	[illegible]
		84.08	[illegible]			[illegible]						
	160											
	1400	fair stack										

NATIONAL CENTER FOR AIR POLLUTION CONTROL

ORSAT DATA AND CALCULATION SHEET

Orsat Analysis - Burner Only (From bag sample)

Sampling Point Location _____

Date _____ Time _____

	Analysis 1	Analysis 2	Analysis 3	Avg	x = Mole. Wt	Wt/Mole Dry Basis
CO_2 % Vol. (Dry basis), V_{bb}					44/100	
CO, % Vol. (Dry basis), V_{bc}					28/100	+
O_2, % Vol. (Dry basis), V_{bd}					32/100	+
N_2, % Vol. (Dry basis), V_{be}					28/100	+
			M_{bk} = Avg. Molecular Wt. of Dry Stack Gas =			=

Orsat Analysis for Test - Waste and Burners (From bag sample)

Date 10-8-71 Time 1200-1500 Run No. 5

Sampling Point Location Kiln Stack

	Analysis 1	Analysis 2	Analysis 3	Avg	x = Mole Wt	Wt/Mole Dry Basis
CO_2, % Vol. (Dry Basis), V_{bf}	17.6				44/100	7.74
CO, % Vol. (Dry Basis), V_{bg}	—				28/100	+
O_2, % Vol. (Dry Basis), V_{bh}	5.2				32/100	+1.66
N_2, % Vol. (Dry Basis), V_{bi}	77.2				28/100	+21.62
			M_{bj} = Avg. Molecular Wt. of Dry Stack gas =			=31.02

(28) A. Excess Air, % = $\frac{100 \times (V_{bh} - \frac{V_{bg}}{2})}{0.264 \times V_{bi} - (V_{bh} - \frac{V_{bg}}{2})}$ = V_{bl} = 34.3

(Transfer All Answers to Summary of Results)

(15) *B. CO_2 Contributed by burner, % by vol. of stack gas corrected to test conditions.

$V_{bn} = V_{bb} \times \frac{V_{bh}}{V_{db}} \times C_{bm}$ = _____

Reen 6 on report

PARTICULATE FIELD DATA

Plant Oregon Portland Cement

Run No. 6

Location # Kiln Baghouse Stack

Date 10-8-71

Operator HC

Sample Box No. 1

Meter Box No. NC.9

Meter ΔH 2.03

C Factor 0.56

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

PATHOLOGICAL INCINERATORS-read and record every 5 minutes.

stacks on north side

Ambient Temp °F 80°

Bar. Press. "Hg 29.85

Assumed Moisture % 40

Heater Box Setting, °F 250

Probe Tip Dia., In. .250

Probe Length 8 ft

Probe Heater Setting 80

Avg. ΔP .66 Avg. ΔH 1.00

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum In. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press. In. Hg	Stack Temp °F
0	15450	851.800	—	—	—	—	—	—	—	—	—	—
1	5	854.21	.50	.82	.82	100	101	2	260	80		349
2	10	856.76	.59	.95	.95	100	103	2	255	76		352
3	15	859.43	.65	1.06	1.06	100	107	2	260	77		352
4	20	862.16	.66	1.08	1.08	101	109	3	270	80		350
5	25	864.94	.70	1.14	1.14	101	111	3	250	79		350
6	30	867.75	.70	1.14	1.14	102	113	3	270	79		350
7	35	870.55	.72	1.15	1.15	102	113	3	260	80		350
8	40	873.37	.74	1.19	1.19	103	113	3	260	79		350
9	45	876.24	.74	1.19	1.19	104	114	3	250	79		350
10	50	879.20	.75	1.2	1.2	104	115	4	255	80		350
11	55	882.06	.77	1.26	1.26	105	115	4	260	80		351
12	60	884.93	.70	1.13	1.13	105	115	4	260	80		350
13	65	887.66	.65	1.05	1.05	105	115	4	260	81		350
14	70	890.35	.62	1.00	1.00	105	114	4	260	81		350
15	75	893.88	.54	.87	.87	104	113	4	250	80		350
16	1705 80	895.013	.38	.62	.62	104	113	4	250	81		345

Comments:

K... ... (...) ... - 80.464

... (7/67)

Run 6

Comments	Clock Time	Dry Gas Meter, CF	Pi in. H2O ΔP	Orifice in. H2O Desired	Orifice in. H2O Actual	Pump °F Inlet	Pump °F Outlet	Vac. in. Hg Gauge	Temp. °F	Temp. °F	Probe in. H2O	°F
-1	1714 6	897.86	.40	.65	.65	102	106	3	250	80	2.2	348
2	10	899.67	.50	.82	.82	102	106	3	260	82	2.2	353
3	15	902.16	~~.56~~ .55	.91	.91	101	107	3	250	80		352
4	20	904.59	.54	.88	.88	100	108	3	240	80		355
5	25	907.22	.60	.97	.97	100	108	3	250	79		355
6	30	909.85	.60	.97	.97	99	108	3	250	81		356
7	35	912.47	.60	.97	.97	99	108	3	230	78		358
8	40	915.19	.65	1.06	1.06	99	108	3	250	78		360
9	45	918.02	.73	1.18	1.18	94	109	4	250	80		360
10	50	920.49	.75	1.20	1.20	99	109	4	250	77		360
11	55	923.85	.77	1.25	1.25	99	109	4	260	76		360
12	60	926.75	.75	1.2	1.2	99	109	4	250	76		360
13	65	929.59	.74	1.19	1.19	98	109	4	240	76		360
14	70	932.35	.70	1.12	1.12	98	109	4	250	76		360
15	75	934.93	.58	.94	.94	98	108	4	250	77		356
16	1834 80	937.456	.55	.89	.89	98	107	4	260	77		356
					1.033	101.1	109.1					
			.638			105.4						
												353
	160	25.656			1.033							
			✓ =22.71									

30

NATIONAL CENTER FOR AIR POLLUTION CONTROL

ORSAT DATA AND CALCULATION SHEET

Orsat Analysis - Burner Only (From bag sample)

Sampling Point Location _____

Date _____ Time _____

	Analysis 1	Analysis 2	Analysis 3	Avg	x = Mole Wt	Wt/Mole Dry Basis
CO_2 % Vol. (Dry basis), V_{bb}					44/100	
CO, % Vol. (Dry basis), V_{bc}					28/100	+
O_2, % Vol. (Dry basis), V_{bd}					32/100	+
N_2, % Vol. (Dry basis), V_{be}					28/100	+
			M_{bk} = Avg. Molecular Wt. of Dry Stack Gas =			=

Orsat Analysis for Test - Waste and Burners (From bag sample)

Date 10-3-71 Time 1200-1500 Run No. 6 from 5

Sampling Point Location Kiln Stack

	Analysis 1	Analysis 2	Analysis 3	Avg	x = Mole Wt	Wt/Mole Dry Basis
CO_2, % Vol. (Dry Basis), V_{bf}	17.6				44/100	7.74
CO, % Vol. (Dry Basis), V_{bg}					28/100	+
O_2, % Vol. (Dry Basis), V_{bh}	5.2				32/100	+1.66
N_2, % Vol. (Dry Basis), V_{bi}	77.2				28/100	+21.62
			M_{bj} = Avg. Molecular Wt. of Dry Stack gas =			=31.02

(28) A. Excess Air, % = $100 \times \frac{(V_{bh} - \frac{V_{bg}}{2})}{0.264 \times V_{bi} - (V_{bh} - \frac{V_{bg}}{2})}$ = V_{bl} = 34.3

(Transfer All Answers to Summary of Results)

(15) B.* CO_2 Contributed by burner, % by vol. of stack gas corrected to test conditions.

$$V_{bn} = V_{bb} \times \frac{V_{bh}}{V_{db}} \times G_{bx} = \_\_\_\_$$

void

PARTICULATE FIELD DATA

Plant Oregon Portland

Run No. 1

Location Kiln Baghouse Stack

Date 10-5-71

Operator C E Riley

Sample Box No. 1

Meter Box No. NC-9

Meter Δ H 2.03

C Factor .56

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

PATHOLOGICAL INSTRUCTIONS-
read and record every 5 minutes.

Void

Void Kiln shut down

Ambient Temp °F 75°

Bar. Press. "Hg 29.96

Assumed Moisture % 40

Heater Box Setting, °F 250

Probe Tip Dia., In. .250

Probe Length 8'

Probe Heater Setting 60

Avg. Δ P .8 Avg. ΔH 1.25

Point	Clock Time	Dry Gas Meter, CF	Pitot in. H_2O ΔP	Orifice ΔH in H_2O Desired	Orifice ΔH in H_2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum In. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press in. Hg	Stack Temp °F
0 1310	—	586.100	—	—	—	—	—	—	—	—	T	—
1	5	587.440	.15	.24	.24	97	105	1	140	98		395
2	10	589.740	.58	.86	.86	95	105	2	240	80		370
3	15	592.470	.66	1.00	1.00	95	107	3	240	78		378
4	20	595.290	.70	1.12	1.12	96	109	4	240	78		379
5	25	579.880	.40	.65	.65	96	113	4	240	78		378
6	30	599.740	.30	.49	.49	98	114	3	240	78		379
7	35	601.640	.32	.51	.51	99	112	3	255	77		377
8	40	603. ~~344~~ 89	.70	1.10	1.10	99	111	3	255	77		377
9	45	606.650	.70	1.10	1.10	100	112	3	255	77		379
10	50	608.890	.40	.63	.63	100	114	3	250	76		379
11	55	611.120	.43	.68	.68	101	114	3	250	80		375
12	60	613.380	.43	.67	.67	103	115	3	240	80		375
13	65	615.480	.40	.63	.63	104	116	3	240	80		373
14	70	617.450	.36	.57	.57	105	115	3	240	79		373
15	75	619.320	.30	.47	.47	105	~~115~~ 113	3	240	80		374
16 1430	80	620.877	.20	.31	.31	104	111	2	245	75		374
AVERAGE:		34.777			.689	99.8	104.4					376

102.10

32

RORM-31 (12/67)

ORSAT FIELD DATA

Location Oregon Portland Cement Comments:

Date 10-5-71 Run 1

Time 1310 – 1430

Operator Allen Riley

Test	(CO_2) Reading 1	(O_2) Reading 2	(CO) Reading 3
1	18.6	5.6	less than 1

Void

18.6
5.4
<3.0

100
13
77

NATIONAL CENTER FOR AIR POLLUTION CONTROL

ORSAT DATA AND CALCULATION SHEET

Orsat Analysis - Burner Only (From bag sample)

Sampling Point Location _____

Date _____ Time _____

	Analysis 1	Analysis 2	Analysis 3	Avg	x = Mole. Wt	Wt/Mole Dry Basis
CO_2 % Vol. (Dry basis), V_{bb}					44/100	
CO_2 % Vol. (Dry basis), V_{bc}					28/100	+
O_2, % Vol. (Dry basis), V_{bd}					32/100	+
N_2, % Vol. (Dry basis), V_{be}					28/100	+
			M_{bk} = Avg. Molecular Wt. of Dry Stack Gas =			=

Orsat Analysis for Test - Waste and Burners (From bag sample)

Date 10-5-71 Time 1310 - 1430 Run No. 1

Sampling Point Location Kiln Baghouse Inlet

	Analysis 1	Analysis 2	Analysis 3	Avg	x = Mole Wt	Wt/Mole Dry Basis
CO_2, % Vol. (Dry Basis), V_{bf}	18.6				44/100	8.18
CO, % Vol. (Dry Basis), V_{bg}	—				28/100	+
O_2, % Vol. (Dry Basis), V_{bh}	5.6				32/100	+1.79
N_2, % Vol. (Dry Basis), V_{bi}	77.0				28/100	+21.56
			M_{bj} = Avg. Molecular Wt. of Dry Stack gas =			=31.53

(28) A. Excess Air, % = $100 \times \frac{V_{bi} - \frac{V_{bg}}{2}}{0.264 \times V_{bi} - (V_{bh} - \frac{V_{bg}}{2})}$ = V_{bl} = _____

(Transfer All Answers to Summary of Results)

Void

(15) B.* CO_2 Contributed by burner, % by vol. of stack gas corrected to test conditions.

$$V_{bn} = V_{bb} \times \frac{V_{bk}}{V_{bb}} \times C_{bm} = \text{_____}$$

EPA-22 (12/67)

PARTICULATE FIELD DATA

Plant: Oregon Portland Cement
Run No.: 2
Location: Kiln Baghouse Stack
Date: 10-6-71
Operator: C. E. Riley
Sample Box No.: 1
Meter Box No.: N.C. 9
Meter ΔH@: 2.03
C Factor: .55

VERY IMPORTANT - FILL IN ALL BLANKS

Read and record at the start of each test point.

PATHOLOGICAL INCOHERENCIES - read and record every 5 minutes

Void

Baghouse door open / Kiln in ~~[illegible]~~ down

Ambient Temp °F: 70
Bar. Press. "Hg: 29.96
Assumed Moisture %: 40
Heater Box Setting, °F: 250
Probe Tip Dia., In.: .250
Probe Length: 8 ft
Probe Heater Setting: 70
Ref. ΔP: .66 ... 1.00

Point	Clock Time	Net Dry Gas Meter, CF	Pitot in. H2O ΔP	Orifice ΔH in H2O Desired	Orifice ΔH in H2O Actual	Dry Gas Temp. °F Inlet	Dry Gas Temp. °F Outlet	Pump Vacuum In. Hg Gauge	Box Temp. °F	Impinger Temp °F	Stack Press. In. Hg	Stack Temp °F
0900	0	621,100	—	—	—	—	—	—	—	—	—	—
1	5	622.790	.20	.31	.31	63	65	2	250	65		345
2	10	625.150	.20	1.00	1.00	64	67	4	250	70		352
3	15	627.500	.60	.92	.92	65	72	4	250	70		352
4	20	629.860	.56	.85	.85	67	76	4	250	72		357
5	25	632.180	.52	.78	.78	67	79	4	250	72		368
6	30	634.400	.48	.72	.72	70	81	4	250	70		368
7	35	636.660	.50	.76	.76	72	83	4	240	64		370
8	40	638.850	.48	.73	.73	73	84	4	240	64		378
9	45	641.300	.59	~~.79~~ .90	~~.79~~ .90	75	85	4	260	64		378
10	50	643.250	.56	.85	.85	74	86	4	250	65		382
11	55	646.230	.60	.90	.90	77	87	5	250	65		386
12	60	648.920	.67	1.00	1.00	77	88	5	250	64		390
13	65	651.450	.60	.90	.90	78	90	6	240	65		392
14	70	653.940	.64	.96	.96	79	90	6	250	65		394
15	75	656.180	.48	.73	.73	79	89	6	250	65		394
16 1020	80	658.270	.35	.56	.51	79	89	6	250	65		385

Comments:

NCAP-37 (12/67)

Comments		Clock Time	Dry Gas Meter, CF	in. H_2O ΔP	in H_2O Desired	in H_2O Actual	°F Inlet	°F Outlet	Gauge	°F	°F	in. Hg	
	1	5 1039	659.960	.30	.45	.45	77	84	4	250	75		385
	2	10	616.840	.35	.53	.53	79	84	4	250	73		383
	3	15	664.280	.60	.90	.90	79	85	5	250	72		385
	4	20	666.340	.64	.96	.96	79	88	7	250	70		382
	5	25	669.340	.60	.90	.90	80	90	7	250	70		376
	6	30	671.830	.60	.90	.90	80	91	8	250	70		380
	7	35	674.400	.64	.95	.95	80	91	9	250	70		380
	8	40	676.970	.64	.96	.96	81	92	9	250	70		326
	9	45	679.530	.60	.90	.90	81	93	10	240	70		325
	10	50	681.360	.50	.76	.76	82	94	9	250	72		375
	11	55	684.290	.57	.87	.87	82	93	9	260	70		375
	12	60	686.670	.52	.79	.79	83	94	10	245	71		375
1137	13	65	689.090	.54	.85	.85	73	94	11	250	72		360
K; in	14	~~2066.5~~	689.800	.53	.83	.83	83	95	11	250	73		360
stopped	15	~~—~~				24.42	1294	2579					
	16	~~30~~		16.16									11257
Beg w/ Std				.539			77.5	85.97					
		66.5					163.47						3752
							81.74						
		146.5											
							76.5	85.97					
							81.2						

30 36

30

ORSAT FIELD DATA

Location Oregon Portland Cement Comments:

Date 10-6-71

Time 0900 - 1137

Operator Allan Rieg

Test	(CO_2) Reading 1	(O_2) Reading 2	(CO) Reading 3
1	18.6	4.4	less than 1

Void

100
230
77

NATIONAL CENTER FOR AIR POLLUTION CONTROL

ORSAT DATA AND CALCULATION SHEET

Orsat Analysis - Burner Only (From bag sample)

Sampling Point Location _____

Date _____ Time _____

	Analysis 1	Analysis 2	Analysis 3	Avg	x = Mole. Wt	Wt/Mole Dry Basis
CO_2 % Vol. (Dry basis), V_{bb}					44/100	
CO, % Vol. (Dry basis), V_{be}					28/100	+
O_2, % Vol. (Dry basis), V_{bd}					32/100	+
N_2, % Vol. (Dry basis), V_{be}					28/100	+
				M_{bk} = Avg. Molecular Wt. of Dry Stack Gas =		=

Orsat Analysis for Test - Waste and Burners (From bag sample)

Date 10-6-71 Time 0900 → 1137 Run No. 2

Sampling Point Location Organic Portland Cement

	Analysis 1	Analysis 2	Analysis 3	Avg	x = Mole Wt	Wt/Mole Dry Basis
CO_2, % Vol. (Dry Basis), V_{bf}	18.6				44/100	8.18
CO, % Vol. (Dry Basis), V_{bg}	—				28/100	+
O_2, % Vol. (Dry Basis), V_{bh}	4.4				32/100	+ 1.41
N_2, % Vol. (Dry Basis), V_{bi}	77				28/100	+ 21.56
				M_{bj} = Avg. Molecular Wt. of Dry Stack gas =		= 31.15

(28) A. Excess Air, % = $\frac{100 \times (V_{bh} - \frac{V_{bg}}{2})}{0.264 \times V_{bi} - (V_{bh} - \frac{V_{bg}}{2})}$ = V_{bl} = _____

(Transfer All Answers to Summary of Results)

(15) B.* CO_2 Contributed by burner, % by vol. of stack gas corrected to test conditions.

$$V_{bn} = V_{bb} \times \frac{V_{bh}}{V_{db}} \times C_{bk} = \text{_____}$$

PARTICULATE CLEANUP SHEET

Date: 10-7-71 Plant: Oregon Portland Cement

Run number: Run 4 Location of sample port: Kiln Bighouse

Operator: C P Rly Barometric pressure: 2 9 9 6

Sample box number: 1 Ambient temperature: 80

Impinger H_2O

Volume after sampling 210 ml Container No. 3 Ether-chloroform extraction of impinger water ____ mg

Impinger prefilled with 800 ml Extra No. ____

Volume collected 1010 ml Impinger water residue ____ mg

Impingers and back half of filter, acetone wash: Container No. ____ Extra No. ____ Weight results ____ mg

Dry probe and cyclone catch: Container No. 3 Extra No. ____ Weight results ____ mg

Probe, cyclone, flask, and front half of filter, acetone wash: Container No. 3 Extra No. ____ Weight results ____ mg

Filter Papers and Dry Filter Particulate

Filter number	Container no.	Filter number	Container no.
011966	3		

Filter particulate weight ____ mg

Total particulate weight ____ mg

Silica Gel

	1.	2.	3.	4.
Weight after test:	436.0			
Weight before test:	400			
Moisture weight collected:	36.0			
Container number:				

1010
36
1046

Moisture total 1046 gm

Sample number: 4 Analyze for: ____

Method determination: ____

Comments: Sampling conducted over 10-7-71 and 10-8-71

PARTICULATE CLEANUP SHEET

Date: 10-8-71 Plant: Portland, O

Run number: 5 Location of sample port: Outlet

Operator: Howard Grist Barometric pressure: 29.90

Sample box number: 2 Ambient temperature: 90

Impinger H_2O

Volume after sampling 1160 ml Container No. 4A Ether-chloroform extraction

Impinger prefilled with ~~400~~ 385 ml Extra No. 4A2 of impinger water ____ mg

Volume collected ~~762~~ 775 ml Impinger water residue ____ mg

Impingers and back half of filter, acetone wash: Container No. 4B

Extra No. ____ Weight results ____ mg

Dry probe and cyclone catch: Container No. ____

Extra No. ____ Weight results ____ mg

Probe, cyclone, flask, and front half of filter, acetone wash: Container No. 4C

Extra No. ____ Weight results ____ mg

Filter Papers and Dry Filter Particulate

Filter number	Container no.	Filter number	Container no.
4D			
11968	4D		

Filter particulate weight ____ mg

Total particulate weight ____ mg

Silica Gel

	1	2	3	4	
Weight after test:	216.4	214.6	____	____	31.0
Weight before test:	200	200	____	____	
Moisture weight collected:	16.4	14.6	____	____	
Container number:	1. ____	2. ____	3. ____	4. ____	

975 / 31 / 1506

Moisture total 1006 gm

Sample number: 5 Analyze for: ____

Method determination: ____

Comments: ____

PARTICULATE CLEANUP SHEET

Date: 10-8-71 Plant: Oregon Portland Cement

Run number: 6 Location of sample port: Kiln Baghouse

Operator: Howard Crist Barometric pressure: 29.85

Sample box number: 1 Ambient temperature: 80°

Impinger H_2O

Volume after sampling 1170 ml Container No. SA Ether-chloroform extraction

Impinger prefilled with 200 ml Extra No. SA2 of impinger water ____ mg

Volume collected 970 ml Impinger water residue ____ mg

Impingers and back half of filter, acetone wash: Container No. SB

Extra No. ____ Weight results ____ mg

Dry probe and cyclone catch: Container No. ____

Extra No. ____ Weight results ____ mg

Probe, cyclone, flask, and front half of filter, acetone wash: Container No. SC

Extra No. ____ Weight results ____ mg

Filter Papers and Dry Filter Particulate

Filter number	Container no.	Filter number	Container no.
11964	SD		

Filter particulate weight ____ mg

Total particulate weight ____ mg

Silica Gel

Weight after test:	443.8	____	____	____	970 / 433 / 1013.8
Weight before test:	400	____	____	____	
Moisture weight collected:	43.8	____	____	____	Moisture total 1013.8 gm
Container number:	1. ____	2. ____	3. ____	4. ____	

Sample number: 6 Analyze for: ____

Method determination: ____

Comments: Catch good shape!

PARTICULATE CLEANUP SHEET

Date: 10-6-71
Run number: 2
Operator: C.E. Raley
Sample box number: 1

Plant: Oregon Portland Cement
Location of sample port: Kiln Baghouse
Barometric pressure: 29.96
Ambient temperature: 70

Impinger H_2O

Volume after sampling 1100 ml
Impinger prefilled with 200 ml
Volume collected 900 ml

Container No. 2
Extra No. ____

Ether-chloroform extraction of impinger water ____ mg
Impinger water residue ____ mg

Impingers and back half of filter, acetone wash:

Container No. ____
Extra No. ____
Weight results ____ mg

Dry probe and cyclone catch:

Container No. 1
Extra No. ____
Weight results ____ mg

Probe, cyclone, flask, and front half of filter, acetone wash:

Container No. 2
Extra No. ____
Weight results ____ mg

Filter Papers and Dry Filter Particulate

Filter number	Container no.	Filter number	Container no.
01196	2		

Filter particulate weight ____ mg
Total particulate weight ____ mg

Silica Gel

Weight after test:	220	218.5	____	____	18.5 / 20 / 38.5
Weight before test:	200	200	____	____	
Moisture weight collected:	20	18.5	____	____	
Container number:	1. ____	2. ____	3. ____	4. ____	

Moisture total 938.5 gm

Sample number: 1
Analyze for: ____
Method determination: ____
Comments: Run stopped short due to kiln shut-down and torn bags

Set Run No 2 The green for test runs!

SAMPLING SUMMARY SHEETS

PLANT Oregon Portland Cement LOCATION Lake Oswego, Oregon

SAMPLED SOURCE Kiln Baghouse Stack

Train Data

Run No.	Date	Nozzle dia. in.	Net time min.	Bar. pres. "Hg.	Orifice diff. ΔH "H_2O	Volume sampled meter cond. cu. ft.	Meter temp. °F	Volume sampled standard cond. cu. ft.
~~1~~	~~10-5-71~~	~~.250~~	~~30~~	~~29.96~~	~~.689~~	~~34.777~~	~~102.1~~	~~32.365~~
2	10-6-71	.250	146.5	29.96	.814	68.700	81.2	67.450
4	10-7 (10-8)	.250	165	29.93	.776	76.497	92.8	73.449
5	10-8-71	.250	160	29.90	.977	84.032	106.8	78.702
6	10-8-71	.250	160	29.85	1.033	85.656	105.4	80.246

Moisture and Gas Data

Run No.	Total moisture ml.	Moisture std. cond. cu. ft.	% Moisture by volume	Mole fraction dry gas	Molecular wt. of dry stack gas	Molecular wt. of moist. stack gas
~~1~~	~~431.5~~	~~20.45~~	~~32.31~~	~~.616~~	~~31.53~~	~~26.33~~
2	933.5	44.48	39.74	.603	31.15	25.93
4	1046.0	49.58	40.30	.597	31.17	25.86
5	1006.0	47.63	31.13	.623	31.02	26.11
6	1013.3	48.05	37.45	.625	31.02	26.14

Stack Data

Run No.	Stack area in^2	Velocity head "H_2O	Static press. "Hg.	Stack press. "Hg. Abs.	Stack temp. °F
~~1~~	~~5542~~	~~.439~~	~~.12~~	~~30.08~~	~~376~~
2	5542	.539	.14	30.10	375
4	5542	.496	.13	30.06	353
5	5542	.620	.16	30.06	351
6	5542	.638	.16	30.01	353

Velocity and Calculation Data

Run No.	Average $\sqrt{\text{Velocity} \times \text{temperature}}$ °R		Stack velocity fpm stack cond.	Stack gas volume scfm	Percent isokinetic
~~1~~	~~18.79~~		~~2904~~	~~43,873~~	~~105.4~~
2	21.07		3281	48,616	106.6
4	19.97	120,135	3122	46,976 46,976	106.7
5	22.33	133,718	3425	54,699 ✓	101.2
6	22.71	135,988	3581	55,577 ✓	101.6

Note - Run 3 was stopped due to a plant shut down and restarted the following day.

APPENDIX D
STANDARD SAMPLING PROCEDURES

The particulate and carrier gas sampling procedures for the testing are identical to those outlined in the Federal Register, "Standards of Performance For New Stationary Sources", (December 23, 1971).

Continuous monitoring of the SO_2 concentrations was accomplished by using an electrochemical sensing analyzer manufactured by Dynasciences Corporation*.

*Mention of a specific company or product does not constitute endorsement by EPA.

APPENDIX E

LABORATORY REPORT

Table E-I presents the particulate analysis results which were reported by the EPA laboratory.

Table E-I

PARTICULATE MASS DETERMINATION

Subject: Oregon Portland Cement Company

To: Mr. Gene Riley, DAT, ETB
Mechanical & Metallurgical Section

The results of particulate mass determination for the sampling trip to Oregon Portland Cement Company appear below:

Sampling Trip No. 2 (October 1971)

Run No.	Fraction	Particulate, mg
4	Impinger Water residue	175 3
	Back half rinse	2.3
	Front half rinse	113.7
	Filter	38.9
		330.2
5	Impinger water residue	25.7
	Back half rinse	5.8
	Front half rinse	144.1
	Filter	48.8
		224.4
6*	Impinger water residue	16.8
	Back half rinse	3.2
	Front half rinse	118.8
	Filter	46.6
		185.4
	Water Blank	0.3 mg/500 ml
	Acetone blank	0.0 mg/500 ml

The above results reflect subtraction of the blanks.

* This sample leaked in transit to the laboratory; the original volume was estimated to be 1503 ml, the average volume of the other two runs. The actual volume was 800 ml. The particulate mass was adjusted to reflect the particulate weight of the assumed original volume.

Howard Crist
Howard Crist
Chief, Source Sample
Analysis Section, SSFAB, DAS

APPENDIX F

TEST LOG

Table F - I presents the actual time during which particulate sampling was conducted.

Table F - I

Sampling Log

Run	Date	Sampling Port	Began	Ended	Elapsed Time(min.)
1	10-7-71	1	13:46	15:06	80
		2	15:18	15:48	30
1 cont.	10-8-71	2	08:50	09:45	55
2	10-8-71	2	12:00	13:20	80
		1	13:30	14:50	80
3	10:8-71	1	15:45	17:05	80
		2	17:14	18:34	80

APPENDIX G

PROJECT PARTICIPANTS AND TITLES

Name	Title
Howard Crist	Analytical Chemist, ETB
James Herlihy	Chemical Engineer, SDID
Allan Riley	Technician, ETB
Clyde Riley	Technician, ETB
Gene Smith	Chemical Engineer, ETB
Philip York	Chemical Engineer, SDID