EMISSION TESTING REPORT

ETB TEST NUMBER 71-MM-05

Emissions From
Dry Process Cement Kiln
at

FINAL

FINAL

DRAGON CEMENT COMPANY
NORTHAMPTON, PENNSYLVANIA

FINAL

Project Officer
Clyde E. Riley

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

Source category: Portland Cement
Plant name : Dragon Cement Company
Test date : 4/29 - 4/30/71
Process : dry

Date: 01/15/93
Location: Northampton, PA
Ref. No.: 4
Basis for process rate : feed rate

Source	Type of control	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor		Volumetric flow rate, DSCFM	Concen. ppm
						kg/Mg	lb/ton		
Rotary kiln (coal-fired)	fabric filter	filt. PM	1	DATA NOT VALID					
		filt. PM	2	2.532	45.75	0.0277	0.0553		
		filt. PM	3	2.601	42.93	0.0303	0.0606		
					average	0.0290	0.0580	Rating:	C
		cond. inorg.	1	DATA NOT VALID					
		cond. inorg.	2	5.47	45.75	0.0598	0.120		
		cond. inorg.	3	4.901	42.93	0.0571	0.114		
					average	0.0584	0.117	Rating:	C
		SOx	1	151	44.03	1.71	3.43	51,187	296
		SOx	2	200	45.75	2.18	4.37	50,643	396
		SOx	3	97.6	42.93	1.14	2.27	50,013	196
					average	1.68	3.36	Rating:	B
		NOx	1	107	44.03	1.22	2.43	51,187	293
		NOx	2	54.1	45.75	0.592	1.18	50,643	150
					average	0.904	1.81	Rating:	B
		Hg	1	0.0012	42.93	1.35E-05	2.69E-05	50,013	0.0007
		Hg	2	0.00053	42.93	6.19E-06	1.24E-05	50,013	0.0003
		Hg	3	0.00056	42.93	6.56E-06	1.31E-05	50,013	0.0004
					average	8.74E-06	1.75E-05	Rating:	B
		CO2	1	26,376	44.89	294	588	51,415	75,000
		CO2	2	19,499	42.93	227	454	50,013	57,000
					average	260	521	Rating:	B

Notes:
1. CO2 data based on ORSAT.
2. Run No. 1 of PM sample was contaminated and results are not useable.
3. Impinger water for PM Runs 2 and 3 were mixed together.
4. PM data rated C; CO2, SOx, NOx, Hg data rated B.

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DRAGON CEMENT COMPANY
NORTHAMPTON, PENNSYLVANIA

Data Rating: B ⑬

TP- kiln multiclone + baghouses (dry)

Coal-fired kilns

NO_x-SO_x-Hg- Data Rating B

FINAL

Project Officer
Clyde E. Riley

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

72-MM-05

PREFACE

The work reported herein was conducted by The Roy F. Weston Company, pursuant to a Task Order issued by the Environmental Protection Agency (EPA), under the terms of EPA Contract No. CPA 70 - 132 Task Order 1. Mr. Tom Cadwallader served as the Project Engineer and directed the Weston field team consisting of: Messrs. Howard Schiff, Brent Cowan, Larry Johnson, and Charles Mattocks. Mr. Schiff and Mr. Cowan performed the pollutant analyses at the Weston laboratories. Roy F. Weston submitted to EPA a draft document from which EPA personnel prepared the final report (Test No. 71-MM-05).

Approved:

Environmental Protection Agency

Gene W. Smith

Gene W. Smith
Chief, Metallurgical & Mechanical Section

March 27, 1972

II. LIST OF TABLES

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III. LIST OF FIGURES

IV. SUMMARY

The Office of Air Programs of the Environmental Protection Agency contracted with Roy F. Weston, Inc. to conduct an emission testing program on the No. 1 and No. 2 kilns at the Dragon Cement Company located in Northampton, Pennsylvania.

The sampling results demonstrated that the outlet particulate concentrations from the kilns were low. Baghouse dust collectors controlled the emissions from each kiln. Particulate concentrations ranged from 0.00592 grains per standard cubic foot (gr/scf) to 0.00954 gr/scf (taking into account only the particulates caught in the probe, cyclone, and filter of the sampling train). Particulates emitted per ton of feed to the kilns ranged from 0.0553 to 0.0942 (probe, cyclone, and filter). A summary of the particulate data is presented in Table 1.

In addition to the particulate sampling, nitrogen oxides, sulfur dioxide, gaseous mercury, and CO, CO_2, and O_2 sampling were conducted at the same location. Nitrogen oxides and sulfur dioxide concentrations ranged from 94 to 419 ppm and from 295 to 650 ppm, respectively. The concentration of gaseous mercury was of the order of 10^{-4} parts per million by volume. Percent excess air ranged between 322% and 466%.

TABLE 1

SUMMARY OF PARTICULATE DATA FOR KILN STACK

Run Number	1	2	3
Date	4-29-71	4-29-71	4-30-71
Percent Excess Air	322	322	466
Percent Isokinetic	95.3	95.4	95.4
Stack Flow Rate - SCFM* dry	51,187	50,643	50,013
Stack Flow Rate - ACFM wet	69,470	69,169	69,269
Volume of Dry Gas Sampled - SCF*	89.75	88.92	87.79
Feed Rate - tons/hr	44.03	45.75	42.93
Particulates			
Probe, Cyclone, & Filter Catch			
mg	55.6	34.2	34.6
gr/SCF* dry	0.00954	0.00592	0.00607
gr/CF @ Stack Conditions	0.00702	0.00433	0.00438
lbs/hr	4.146	2.532	2.601
lbs/ton feed	0.0942	0.0553	0.0606
Total Catch			
mg	118.5	106.7	100.1
gr/SCF* dry	0.0203	0.0185	0.0176
gr/CF @ Stack Conditions	0.0150	0.0135	0.0127
lbs/hr	8.907	8.002	7.502
lbs/ton feed	0.202	0.175	0.175
% Impinger Catch	53.1	67.9	65.4

* 70°F, 29.92" Hg

V. 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.

In the cement industry eight plants exhibiting well controlled operation were selected for the emissions testing program. This report presents the emissions data for the Northampton, Pennsylvania plant of the Dragon Cement Company.

On April 29-30, 1971, Roy F. Weston, Inc. conducted source sampling at the duct from the baghouse collector on the No. 1 and No. 2 kilns of the Northampton plant. The kilns calcine the raw cement materials (a blend of ground clay and limestone), producing the element hydraulic calcium silicate known as "clinker".

Three particulate sampling runs were conducted at the connecting duct between the kiln baghouse collectors and the kiln stack. In addition, nitrogen oxides, sulfur dioxide, and gaseous mercury samples were collected and analyzed by wet chemical techniques. Continuous monitoring of NO_x and SO_2 concentrations was accomplished using electrochemical reaction sensing analyzers manufactured by Dynasciences Corp.* The kiln gas molecular weight was determined using the standard Orsat analytical technique.

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

VI. PROCESS DESCRIPTION

Clay and limestone are trucked to the plant from an open pit quarry adjacent to the plant. The limestone is crushed by an impactor-type crusher at the rate of 600 tons per hour. The crushed limestone and clay are ground in a ball mill and conveyed to storage silos where these materials are subsequently blended with shale and pyrite to form the kiln feed.

The blended feed is fed into one of four sloping (3/8 inch per foot) kilns. These coal-fired kilns are 323 feet long by 9 feet inside diameter with refractory lining encased in a steel cylinder. Fuel consumpton is about 54 pounds of coal per barrel of cement produced. The coal is a blend of 70 percent bituminous and 30 percent anthracite. The bitumuous coal contains 3.10 percent sulfur and an ash content of 7.7 percent and has a heating value of about 13,900 BTU per pound. The anthracite coal contains 0.4 percent sulfur and an ash content of 16.3 percent and has a heating value of about 12,800 BTU per pound. The blended coal (containing 2.29 percent sulfur) is ground in Raymond mills to a fineness of about 85 percent through 200 mesh. The dried and powdered coal is swept through and out ~~at~~ of the grinding mills by a heated air stream and blown directly into the kilns. During passage through the kiln, the raw materials are heated to a temperature of about 2800°F to produce the element hydraulic calcium silicate known in the trade as "clinker". This marble-sized clinker is then discharged from the lower end of the kiln at temperatures exceeding 2000°F and fed immediately into air-quenching cooler units which reduce the temperature of the material to about 150°F. From these coolers, the newly-formed clinker material is conveyed to a storage silo.

A small amount of gypsum (4.45% by weight) is added to the clinker material and this mixture is fed into the finish grinding mill. The mixture leaving the grinding mill 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) is pneumatically pumped to storage silos. Present plant production is approximately 2,250,000 barrels of cement per year.

4 kilns ~ 1200 T clinker/day/kiln

The control equipment of interest in this report consist of two Dracco baghouse collectors on the No. 1 and No. 2 kilns. The gases from each kiln (1,100°F and 2-4 volume percent moisture) first pass through an insulated duct and multiclone, then through an induced fan, and are then combined into a single duct [illegible] (at the bottom and between) the two baghouse collectors. Ambient air is added to the kiln gases in the ducts to lower the gas temperature to about 600°F before entering the baghouses.

7 BH [illegible]

The basic unit of the baghouse collector is a compartment which contains 56 fiberglass bags (11.5 inches in diameter x 25 feet long) or a total of 4,210 ft^2 of filtering area. There are seven (7) compartments in each baghouse and these compartments are about 6 feet wide, 24 feet long, and 30 feet tall with a single 60° hopper at the bottom. The bags are cleaned by reverse air flow and sonic horns and each compartment is cleaned sequentially. The particulate matter is collected on the inside of the glass-fiber filter bags and falls to the hopper below where the material is removed by a screw conveyor.

Each Dracco baghouse collector is designed to handle an air volume of 55,000 ACFM at 600°F for a performance of 99.5 percent efficiency. The effective collecting surface area of each baghouse is 29,500 ft^2 which gives an air to-cloth-ratio of 1.87 CFM/Ft^2. The pressure drop across one compartment is about three inches of water. The expected life of the bags is two (2) years and each bag costs $12.00. The annual operating cost of the four (4) baghouses in 1970 was about $20,700.00, of which $12,400 was for labor and maintenance and $8,300.00 was for new fiber-glass bags. The baghouses were installed in 1958 and the cost of installation was not available.

VII. DISCUSSION OF TESTING AND RESULTS

Source sampling data was collected at one point in the Dragon Cement Company Plant, Northampton, Pennsylvania. The point was located approximately 60 feet above ground level on the horizontal duct which collects gases from the two baghouses and immediately precedes the stack. Four sampling ports, as shown in Figure 1 of Appendix A, were used for collecting particulate samples and 2 ports for gaseous sampling (1 port by the Roy F. Weston team and 1 port by an OAP team). Detailed dimensions of the particulate and gaseous sampling areas may be found in Appendix B.

A detailed description of the particulate sampling procedures and equipment may be found in the Federal Register "Standards of Performance for New Stationary Sources", Vol. 36, No. 247 (23 December, 1971). A summary of the data collected and calculated for these runs is presented in Table 2. Field data for each run may be found in Appendix B. A sample calculation is presented in Appendix D, utilizing the data from Run No. 1.

Sixty equal areas in the duct were sampled for two minutes at each area for a total run time of 120 minutes. Three particulate runs were conducted.

TABLE 2
PARTICULATE EMISSIONS DATA FOR KILN STACK

Run No.		1	2	3
Test Date		4-29-71	4-29-71	4-30-71
D_n	Sampling nozzle diameter, in.	0.375	0.375	0.375
T_t	Net time of test, min.	120	120	120
P_b	Barometric pressure, in. Hg absolute	29.50	29.50	29.64
P_m	Average Orifice pressure drop, in. H_2O	2.54	2.40	2.43
V_m	Volume of dry gas sampled, ft^3 at meter conditions	92.06	91.24	89.99
T_m	Average gas meter temperature, °F	79	79	81
$V_{m_{std}}$	Volume of dry gas sampled at standard conditions*, SCF	89.75	88.92	87.79
V_w	Total H_2O collected in impingers and silica gel, ml	39.2	42.0	47.0
$V_{w_{gas}}$	Volume of water vapor collected at standard conditions*, SCF	1.86	1.99	2.23
% M	% Moisture in the stack gas by volume	2.03	2.19	2.47
M_d	Mole fraction of dry gas	0.980	0.978	0.975
% CO_2		7.5	7.5	5.7
% O_2		15.5	15.5	16.8
% CO		<1	<1	<1
% N_2		77.0	77.0	77.5
% EA	Excess Air Percent	322	322	466
MW_d	Molecular weight of stack gas, dry basis	29.82	29.82	29.58
MW	Molecular weight of stack gas, wet basis	29.58	29.56	29.29
C_p	Pitot tube coefficient	0.85	0.85	0.85
ΔP_s	Average velocity head of stack gas, in. H_2O	0.127	0.124	0.123
T_s	Average stack temperature, °F	236	239	250
N_p	Net sampling points	60	60	60
P_{st}	Static pressure of stack gas in. Hg	0.04	0.04	0.04
P_s	Stack gas pressure in. Hg absolute	29.54	29.54	29.68
V_s	Stack gas velocity at stack conditions fpm	1385	1373	1381
A_s	Stack area, $in.^2$	7224	7224	7224
Q_s	Dry stack gas volumetric flow rate at standard conditions*, SCFM	51,187	50,643	50,013
Q_a	Stack gas volumetric flow rate at stack conditions, ACFM	69,470	69,169	69,269
% I	Percent isokinetic	95.3	95.4	95.4

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* 70°F, 29.92 in. Hg

TABLE 2 (Concluded)

PARTICULATE EMISSIONS DATA FOR KILN STACK

Run No.		1	2	3
T_c	Unit Feed Rate-Tons/hr	44.03	45.75	42.93
m_f	Particulate - probe, cyclone and filter, mg	55.6	34.2	34.6
m_t	Particulate - total, mg	118.5	106.7	100.1
I_c	% impinger catch	53.1	67.9	65.4
C_{an}	Particulate - probe, cyclone, and filter, gr/SCF*	0.00954	0.00592	0.00607
C_{ao}	Particulate - total, gr/SCF*	0.0203	0.0185	0.0176
C_{at}	Particulate - probe, cyclone, and filter, gr/cf at stack conditions	0.00702	0.00433	0.00438
C_{au}	Particulate - total, gr/cf at stack conditions	0.0150	0.0135	0.0127
C_{aw}	Particulate - probe, cyclone, and filter, lb/hr.	4.146	2.532	2.601
C_{ax}	Particulate - total, lb/hr.	8.907	8.002	7.502
P_{tf}	Particulate - probe, cyclone, and filter, lb/ton feed	0.0942	0.0553	0.0606
P_{tt}	Particulate - total, lb/ton feed	0.202	0.175	0.175

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*70°F, 29.92 in. Hg, dry basis

At the completion of Run 1, several large (approximately 1/16" to 1/4" diameter) particles were found in the probe, cyclone and front half of the filter acetone wash. Closer inspection of the duct revealed that the zero velocity recorded at point D-1 (the farthest point from the bottom port) was the result of a large buildup of encrusted solids in this area, some of which were picked up by the probe. For this reason, the weight of material (98.1 mg) found in this wash has been discounted. In its place, the value (17.0 mg) obtained by averaging those found in this wash from Runs 2 (15.9 mg) and 3 (18.0 mg) has been used.

In addition to the build up of encrusted solids at point D-1, it was found that solids were also deposited to a uniform depth of 10 inches along the bottom of the duct. It was not possible to clean these solids from the sampling area. To account for this 'dead' area, the area of the stack was calculated to be 7,224 square inches, rather than 8,016 square inches which is based on the actual duct dimensions.

During the evaporation of the impinger waters, approximately 300 milliliters of impinger water from Run 3 was mistakenly poured into the evaporation beaker for Run 2. This resulted in impinger water residues weighing 82.0 mg and 22.4 mg for Runs 2 and 3, respectively. This mistake was accounted for by reporting the average value (52.2 mg) of the weights found for both Runs 2 and 3. As can be seen in the raw data sheets, this value compares favorably with that found (50.5 mg) for the impinger wash residue in Run 1.

Twelve nitrogen oxide samples were collected during the particulate testing. The first set of samples was collected during a preliminary particulate run.

The second and third sets of samples were collected during particulate runs 1 and 2. The sampling procedure for nitrogen oxides is described in the Federal Register (December 23, 1971), Method 7. A summary of the nitrogen oxide results is shown in Table 3.

Three sulfur dioxide samples were collected and analyzed according to Method 6 of the Federal Register(December 23, 1971). The results are presented in Table 4.

Continuous monitoring of oxides of nitrogen and sulfur dioxide was conducted at the baghouse inlet and outlet utilizing electrochemical reaction sensing analyzers. The readings, which were taken every 2- 5 minutes, are presented in Tables 5 and 6.

Three gaseous mercury samples were collected using a mini-impinger train by bubbling the baghouse effluent through an acidic solution of iodine monochloride, collecting mercury and mercury containing compounds. Flameless atomic absorption spectrophotometry was used for analysis of the resultant solutions. The mercury data is presented in Table 7.

Results of the Orsat analysis are presented in Table 8.

Table 3

Summary of Nitrogen Oxide Testing

Dragon Cement Co. - Northampton, Pennsylvania

Sampling Location - Kiln Duct

Sampling Date	Sampling Time	NO, Milligrams	Sample Volume, liters[a]	Concentration, ppmv[b]
28 April 1971	1425	0.665	1.9143	182
28 " "	1430	0.340	1.9099	93
28 " "	1435	0.570	1.9815	153
28 " "	1440	0.650	2.0647	159
29 " "	1108	0.690	1.8890	192
29 " "	1112	1.480	1.8497	420
29 " "	1115	0.835	1.7677	248
29 " "	1118	1.070	1.7958	313
29 " "	1603	0.430	1.7955	126
29 " "	1607	0.493	1.8827	138
29 " "	1610	0.570	1.8940	158
29 " "	1612	0.648	1.9185	177

[a] Corrected to 70°F, 29.92 in. Hg.

[b] Parts per million by volume calculated by the equation

$$\text{ppmv NO}_2 = \frac{5.25 \times 10^2 \text{ (mg NO}_2)}{(\text{Sample Volume})^a}$$

TABLE 4

SUMMARY OF SULFUR DIOXIDE TESTING

Dragon Cement Co. - Northampton, Pennsylvania

Sample Location - Kiln Duct

Sampling Date	Sampling Time 24-hour clock	mg SO_2	SO_2 ppmv[a]
29 April, 1971	935-1100	115.7	296
29 April, 1971	1435-1542	131.1	396
30 April, 1971	955-1130	89.4	196

a. Calculated to 70°F, 29.92 in. Hg by the following formula:

$$\text{ppmv } SO_2 = \frac{0.752 \times \text{mg } SO_2 \times (T_m + 460)}{P_b \times V_m}$$

where:

mg SO_2 = weight of SO_2 collected

T_m = Average gas meter temperature, °F

P_b = Barometric pressure, in. Hg Absolute

V_m = Volume of dry gas sampled at meter conditions, ft^3

TABLE 5

Nitrogen Oxide data comparing the PDS Method vs the Dynascience Instrument

Date	Time	Wet method	Dynascience	Comments
4-28-71	14:25	182	-----	All values are in ppm NO_x dry basis
4-28-71	14:30	94	-----	
4-28-71	14:35	153	-----	Sampling point located after baghouse
4-28-71	14:40	159	-----	PDS: Phenoldisolfonic Acid
4-29-71	11:08	191	-----	
4-29-71	11:12	419	-----	
4-29-71	11:15	247	-----	
4-29-71	11:18	312	-----	
4-29-71	14:35	---	170	
4-29-71	14:40	---	170	
4-29-71	14:45	---	160	
4-29-71	14:50	---	170	
4-29-71	14:55	---	170	
4-29-71	15:00	---	180	
4-29-71	15:05	---	180	
4-29-71	15:10	---	160	
4-29-71	15:15	---	180	
	zero unit			
4-29-71	15:30	---	160	
4-29-71	15:35	---	160	
4-29-71	15:40	---	160	
4-29-71	15:45	---	160	
4-29-71	15:50	---	160	

TABLE 5 (Continued)

Date	Time	wet method	Dynasciences	Comments
4-29-71	15:55	---	170	Sampling point located after baghouse
4-29-71	16:00	---	170	
4-29-71	16:03	126	-----	
4-29-71	16:05	---	160	
4-29-71	16:07	137	-----	
4-29-71	16:10	158	170	
4-29-71	16:12	177	-----	
4-29-71	16:15	---	165	
4-29-71	16:20	---	165	
4-29-71	16:25	---	175	
4-29-71	16:30 zero unit	---	170	
4-29-71	16:35	---	175	
4-29-71	16:45	---	180	
4-29-71	17:00	---	200	
4-30-71	09:35	---	200	
4-30-71	09:40	---	200	
4-30-71	09:45	---	220	
4-30-71	09:50	---	230	
4-30-71	09:55	---	230	
4-30-71	09:58	---	220	
4-30-71	10:00	----	230	
4-30-71	10:05	---	230	
4-30-71	10:10	---	230	All values are in ppm NO_x dry basis
4-30-71	10:15 zero unit	---	230	
4-30-71	10:35	---	150	
4-30-71	10:40	---	150	

TABLE 5 (Continued)

Date	Time	Wet Method	Dynasciences	Comment
4-30-71	10:45	---	150	Sampling point located after baghouse.
4-30-71	10:50 zero unit	---	150	
4-30-71	11:00	---	160	
4-30-71	11:05	---	170	
4-30-71	11:10	---	170	
4-30-71	11:15	---	170	
4-30-71	11:20	---	170	
4-30-71	11:25	---	170	
4-30-71	11:30	---	180	
4-30-71	11:35	---	170	
4-30-71	13:07	---	320	All values are in ppm NO_x dry basis
4-30-71	13:10	---	340	
4-30-71	13:15	---	335	Sampling point located before baghouse. Note decrease in NO_x upon passage of gases through baghouse.

TABLE 6

SULFUR DIOXIDE DATA COMPARING THE MODIFIED SHELL METHOD VS THE DYNASCIENCES INSTRUMENT

Date	Time	Dynasciences Instrument Readings	Wet method Average during SO_2 Sampling	Comments
4-29-71	09:35	------	295	All values are in ppm SO_2 dry basis.
4-29-71	11:00	------	295	
4-29-71	14:35	350	396	
4-29-71	14:40	390	396	
4-29-71	14:42	450	396	Sample port located after baghouse.
4-29-71	14:45	390	396	
4-29-71	14:47	530	396	
4-29-71	14:50	400	396	
4-29-71	14:55	450	396	
4-29-71	14:58	500	396	
4-29-71	15:00	380	396	
4-29-71	15:05	360	396	
4-29-71	15:10	380	396	
4-29-71	15:15	420	396	
	zeroed unit			
4-29-71	15:30	620	396	
4-29-71	15:35	650	396	
4-29-71	15:40	560	396	
4-29-71	15:45	490	396	
4-29-71	15:50	460		
4-29-71	15:55	420		All values are in ppm SO_2 dry basis.
4-29-71	16:00	360		
4-29-71	16:05	260		
4-29-71	16:10	340		
4-29-71	16:15	490		
4-29-71	16:20	500		

TABLE 6 (Continued)

Date	Time	Readings	Wet Method Sampling	Comments
4-29-71	16:25	480		Sampling port located after baghouse.
4-29-71	16:30	510		
4-29-71	16:35	390		
	zeroed unit			
4-29-71	16:45	380		
4-29-71	17:00	260		
4-30-71	09:35	350		
4-30-71	09:40	350		
4-30-71	09:45	350		
4-30-71	09:50	390		
4-30-71	09:55	380	196	
4-30-71	09:58	510	196	
4-30-71	10:00	420	196	
4-30-71	10:05	420	196	
4-30-71	10:10	330	196	
4-30-71	10:15	400	196	
	zeroed unit			
4-30-71	10:35	240	196	
4-30-71	10:40	420	196	All values are in ppm SO_2 dry basis
4-30-71	10:45	420	196	
4-30-71	10:50	400	196	
	zeroed unit		196	
4-30-71	11:00	420	196	
4-30-71	11:05			
4-30-71	11:10	340		Sampling port located after baghouse.
4-30-71	11:15	500		
4-30-71	11:20	260		
4-30-71	11:25	250		
4-30-71	11:30	240		
4-30-71	11:35	230		

TABLE 6 (Continued)

Modified Shell Method Sampling Time and Dates

Date	Time	Run
4-29-71	0935-1100	1
4-29-71	1435-1542	2
4-30-71	0955-1100	3

Sulfur Oxide data recorded from the Dynasciences Instrument

Date	Time	Dynasciences	Comments
4-30-71	13:07	1350	All values are in ppm SO_2 dry basis.
4-30-71	13:10	1800	
4-30-71	13:15	1200	Sample port located before baghouse. Note the decrease in SO_2 concentration upon passage of the gas through the baghouse

TABLE 7

Hg EMISSION DATA

Run No.	1	2	3
Date	4-30-71	4-30-71	4-30-71
mg Hg	0.000393	0.000179	0.000161
T_m - Average Gas Meter Temperature, °F	92	105	104
P_b - Barometric Pressure, "Hg abs.	29.64	29.64	29.64
V_m - Volume of dry gas sampled @ meter conditions, $ft.^3$	2.365	2.375	2.035
ppm Hg dry basis[a]	0.00074	0.00034	0.00036

[a] Calculated by using the formula

$$\text{ppm Hg} = \frac{0.2399 \times \text{mg Hg} \times (T_m + 460)}{V_m \times P_b}$$

Note: Values are within limits of detectability of the analysis method (2×10^{-5} ppm).

TABLE 8

RESULTS OF ORSAT ANALYSIS

	Percent by Volume - Dry Basis	
	29 April	30 April
Carbon Dioxide - CO_2	7.5	5.7
Oxygen - O_2	15.5	16.8
Carbon Monoxide - CO	<1	<1
Nitrogen[a] - N_2	77.0	77.5
Molecular Weight	29.82	29.58

[a] Determined by subtraction from 100 percent.

VIII. APPENDICES

APPENDIX A

SCHEMATICS OF TEST LOCATIONS

DRAGON CEMENT COMPANY
NORTHAMPTON, PENNSYLVANIA
SAMPLING LOCATIONS FOR KILN EMISSIONS

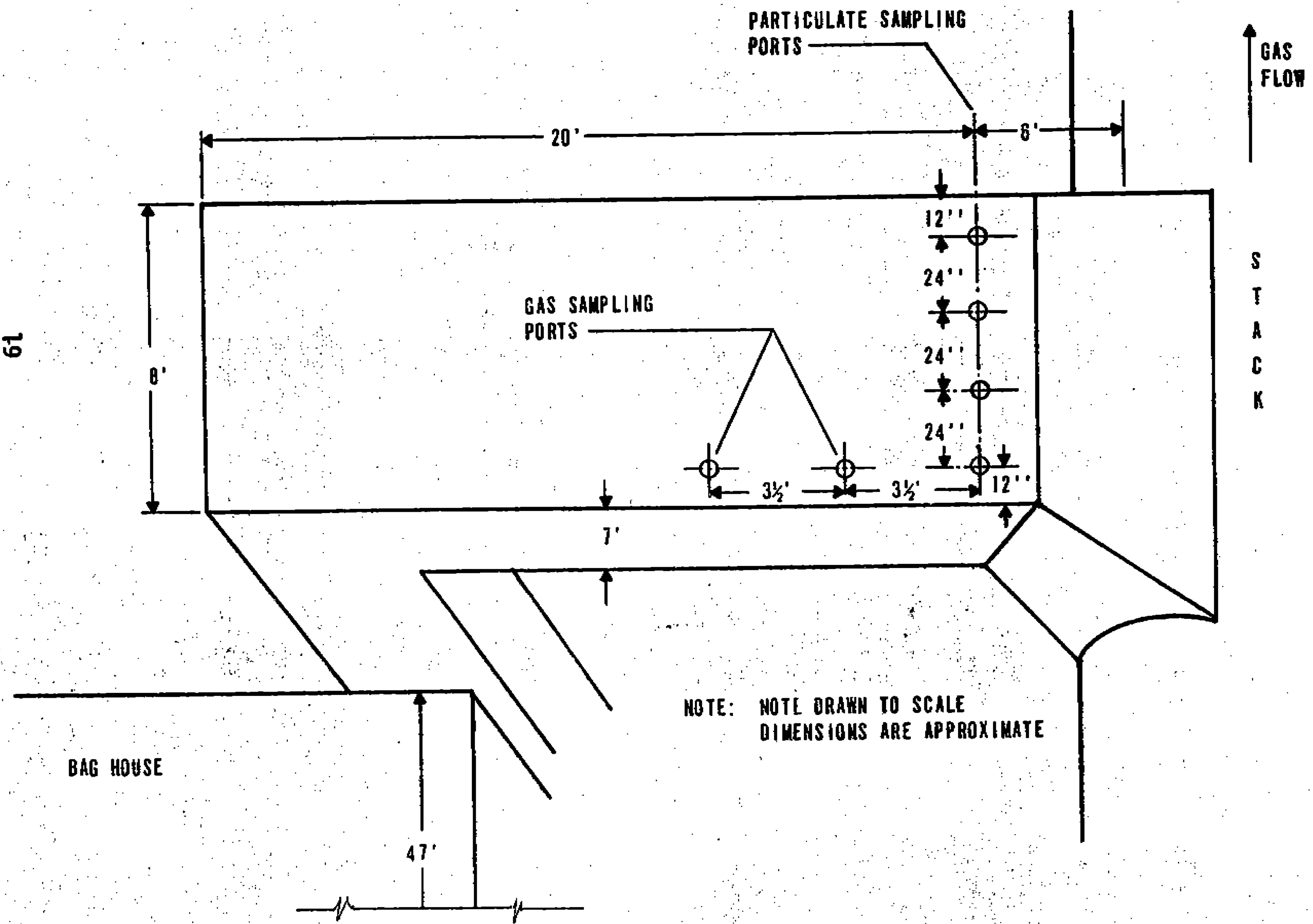

FIGURE A-1

VIII. APPENDICES

APPENDIX A

SCHEMATICS OF TEST LOCATIONS

DRAGON CEMENT COMPANY

NORTHAMPTON, PENNSYLVANIA

SAMPLING LOCATIONS FOR KILN EMISSIONS

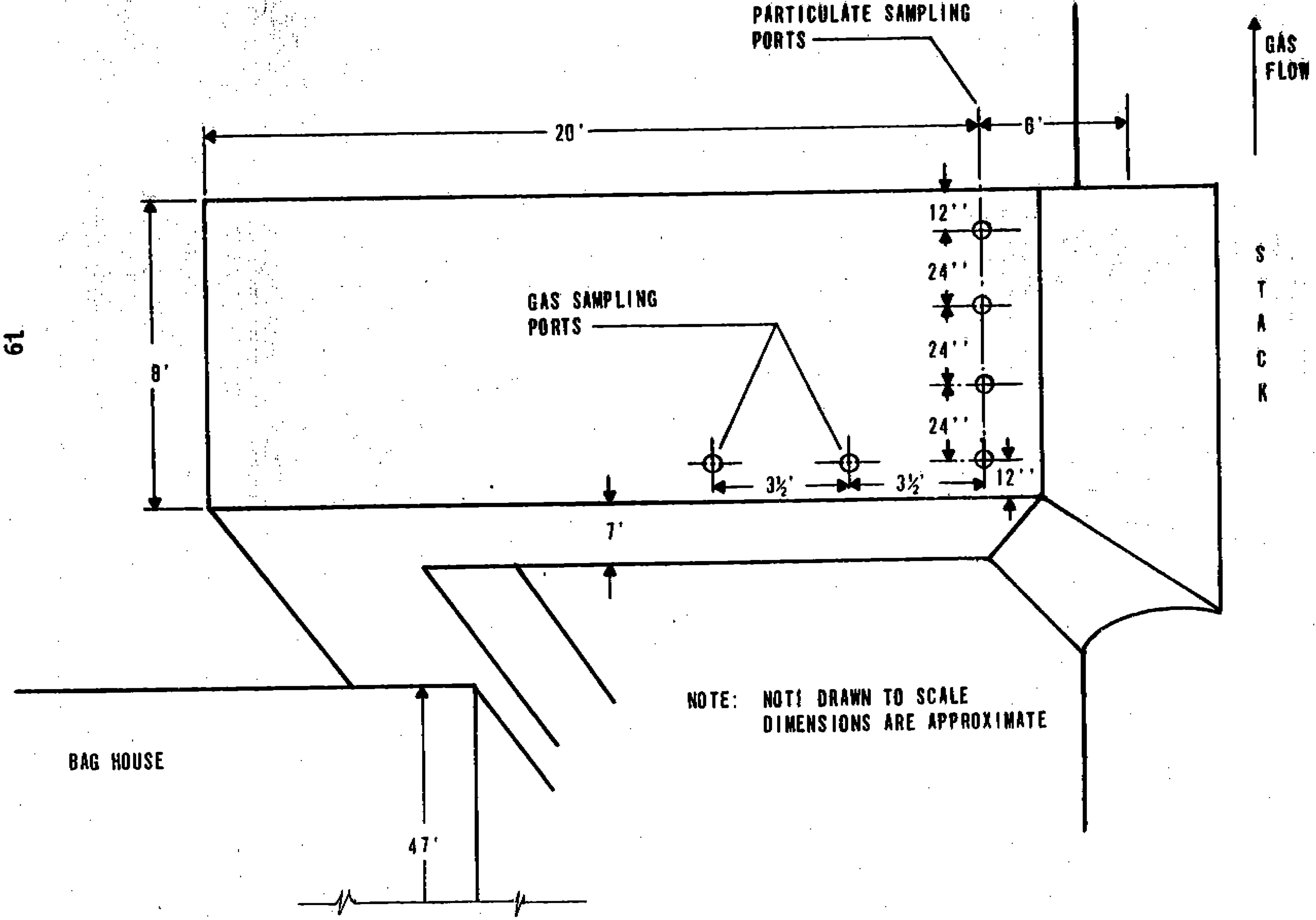

FIGURE A-1

APPENDIX C

LABORATORY PROCEDURES

The distribution of particulates collected within the sampling train is presented in Table C-1. An emission spectroscopy analysis was conducted on the residue samples to determine the concentrations of the elements in Table C-2.

A chemical analysis was performed on the particulate sample collected in the front half of run No. 2 to determine the ammonium and sulfate contents. The weight percent of each component was found to be <0.1 and 0.3, respectively.

For a description of analytical procedures used for the analysis of the SO_2 and NO_x samples, please refer to the Federal Register, December 23, 1971 (Vol. 36, No. 247), Methods 6 and 7.

Sampling and analytical procedures, pertaining to gaseous mercury sampling maybe found in Method 1, December 7, 1971, Federal Register (Vol. 36, No. 235).

TABLE C - 1

RESULTS OF SAMPLE RECOVERY PROCEDURE

		Run 1	Run 2	Run 3
Impinger H_2O + H_2O wash of impingers, connectors and back half of filter holder	RFW #	1566	1570	1574
	Beaker #	141	144	147
	Net wt., mg	50.5	82.0[a]	22.4[b]
Acetone wash of impingers, connectors and back half of filter holder	RFW #	1565	1569	1573
	Beaker #	140	143	146
	Net wt., mg	7.7	15.8	9.7
Probe, connector, front half of filter holder, acetone wash	RFW #	1564	1568	1572
	Beaker	139	142	145
	Net wt., mg	98.1[c]	15.9	18.0
Filter	RFW #	1567	1571	1575
	Filter #	W.S. F4	W.S. F5	W.S. F8
	Net wt., mg	38.6	18.3	16.6
Organic extraction of impinger H_2O & wash H_2O solution	RFW #	1566	1570	1574
	Beaker #	148	149	150
	Net wt., mg	4.7	4.5	3.6
Total Particulates[d]		199.6	136.5	70.3

Notes:

a,b. Impinger water from Run 3 partially mixed with that of Run 2. Average value is 52.2 mg.

c. Encrusted solids from duct probably included in this value. Use average of Runs 2 and 3 instead, 17.0 mg.

d. Actual values; total particulates as per notes a,b, and c are as follows: Run 1, 118.5; Run 2, 106.7; Run 3, 100.1.

TABLE C- 2

RESULTS OF EMISSION SPECTROSCOPY ANALYSIS

Dragon Cement, Northampton, Pennsylvania

Analysis of residue samples*

Concentration, micrograms per gram (8g/g)

Element	Run No. 1 (Total Catch)	Run No. 2 (Front half only)
Sb	<144	-
As	<361	-
Be	<1	-
Cd	1,500	-
Cr	1,400	400
Cu	900	3000
Fe	50,000	5000
Pb	800	200
Mn	350	100
Ni	1,300	600
Se	<361	-
V	<7	-
Zn	14,000	-
Sample weight, mg.	199.6	15.9
Volume of gas sampled, scf.	89.79	88.92

* Analysis conducted by EPA.

APPENDIX E

TEST LOG

Table E - 1 presents the actual time during which the particulate testing was conducted.

Table E - 1

Sampling Log

Run	Date	Sampling Port	Began	Ended	Elapsed Time (min)*
1	4-29-71	A	09:37	10:01	24
		B	10:17	10:47	30
		C	11:03	11:33	30
		D	11:43	12:11	28
2	4-29-71	D	14:38	15:04	26
		C	15:20	15:50	30
		B	15:55	16:25	30
		A	16:49	17:15	26
3	4-30-71	A	09:59	10:25	26
		B	10:32	11:02	30
		C	11:15	11:45	30
		D	11:54	12:18	24

* Traverse points exhibiting zero or negative flow were not sampled, and the probe was moved to the next point having a positive velocity head.