74-LIM-7 A-80-53
(REPORT NUMBER) 74/5-II-A-16

AIR POLLUTION EMISSION TEST

Marblehead Lime Company
(PLANT NAME)

Gary, Indiana
(PLANT ADDRESS)

U. S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
Office of Air Quality Planning and Standards
Emission Standards and Engineering Division
Emission Measurement Branch
Research Triangle Park, N. C. 27711

Walden

SOURCE SAMPLING

CONTRACT NO. 68-02-0238
TASK NO. 9

MARBLEHEAD LIME COMPANY
GARY, INDIANA
LIME KILN

Prepared for

Emissions Measurement Branch
Environmental Protection Agency

Prepared by

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201 Vassar Street
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(C-337-9)

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I. 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. A performance standard is a standard for emissions of air pollutants which reflects the best emission reduction systems that have been adequately demonstrated (taking into account economic considerations).

The development of realistic performance standards requires accurate data on pollutant emissions within the various source categories. In the lime production industry, the No. 5 baghouse at Marblehead Lime Company, located in Gary, Indiana, was designated by EPA as representative of a well-controlled operation, and was thereby selected for the emission testing program. This report presents the results of the testing which was performed at the Gary facilities of Marblehead Lime during the week of June 10, 1974.

The tests performed were particulate, sulfur dioxide, nitrogen oxides, carbon monoxide, and visible emissions taken after the No. 5 baghouse serving No. 5 lime kiln at the Marblehead Lime Company, Gary, Indiana. The tests were conducted by Walden Research Division of Abcor Inc., under the technical direction of EPA Project Officer, John W. Brown. The process monitoring engineer was James Eddinger. The test crew considted of Richard Furman, Program Manager for Walden, Lawrence Katzman, Gary Pulliam, David Jessich, and Denis Weder, Van Madden, Samuel Geer and Paul Wade from STW Testing, Inc., and Ralph Torborg from Honeywell Corporate Research. The tests included six four-hour runs designed to measure average emission rates.

II. SUMMARY AND DISCUSSION OF RESULTS

Tables 2-1 through 2-8 summarize the results of particulates, sulfur dioxide, nitrogen oxides, carbon monoxide, and visible emissions tests performed at the Marblehead Lime Company, Gary, Indiana. Tables 2-1, 2-3, and 2-5 give the test results in English units, while Tables 2-2, 2-4, and 2-6 give the results in Metric units.

The outlet particulate concentrations in Tables 2-1 and 2-2 are given for the front half (particulate matter collected on the filter and all sample-exposed surfaces prior to the filter) and the total particulate concentration including the condensible portion of the sample catch.

TABLE 2-1

PARTICULATE SUMMARY
ENGLISH UNITS

PRODUCTION RATE
$= (\frac{1}{2}) 37.76$
$= 18.88$

Run Number / Date	1	2	3				age
	June 11, 1974		June 12, 197				
Volume of Gas Sampled-DSCF	181.62	162.69	163.91	16			.08
Percent Moisture by Volume	6.5	4.8	6.3				6.5
Average Stack Temperature-°F	291	263	284				275
Stack Volumetric Flow Rate-DSCFM	23,797	22,407	23,162	21			108
Stack Volumetric Flow Rate-ACFM	37,049	33,031	35,532	32			182
Percent Isokinetic	98.5	93.7	91.4	1(			7.8
Percent Stack Opacity	0.031	0.005	0.055	0.			021
Feed Rate-ton/hr. (limestone only)	37.76	37.76	38.63	3			.20
Particulates - Probe & Filter Catch							
mg.	262.4	223.1	104.6	118.1	156.2	137.0	166.9
gr/DSCF	0.0223	0.0216	0.0098	0.0109	0.0125	0.0116	0.0148
gr/ACF	0.0143	0.0146	0.0064	0.0072	0.0082	0.0077	0.0097
lb/hr	4.55	4.15	1.96	1.98	2.67	2.30	2.92
lb/ton feed	0.1205	0.1099	0.0507	0.0513	0.0700	0.0602	0.0771
Particulates - Total Catch							
mg.	424.5	426.0	340.0	275.0	320.4	377.0	360.5
gr/DSCF	0.0361	0.0404	0.0320	0.0254	0.0257	0.0319	0.0319
gr/ACF	0.0232	0.0274	0.0209	0.0167	0.0168	0.0210	0.0210
lb/hr	7.36	7.76	6.36	4.62	5.47	6.33	6.32
lb/ton feed	0.1949	0.2055	0.1646	0.1196	0.1432	0.1657	0.1656
Percent Impinger Catch	38.2	47.6	69.2	57.1	51.2	63.7	54.5

multiply x 6
(see p. 5-1)

6 x .0771 = 0.47 lb/T

TABLE 2-2

PARTICULATE SUMMARY
METRIC UNITS

Run Number / Date	1	2	3	4	5	6	Average
	June 11, 1974		June 12, 1974		June 13, 1974		
Volume of Gas Sampled-Nm^3	5.14	4.61	4.64	4.73	5.46	5.16	4.96
Percent Moisture by Volume	6.5	4.8	6.3	7.5	7.4	6.5	6.5
Average Stack Temperature-°C	143.9	128.3	140.0	131.7	133.3	133.9	135.2
Stack Volumetric Flow Rate-Nm^3/min	674	635	656	602	705	656	655
Stack Volumetric Flow Rate-m^3/min	1,049	935	1,006	917	1,077	993	996
Percent Isokinetic	98.5	93.7	91.4	101.6	100.0	101.6	97.8
Percent Stack Opacity	0.031	0.005	0.055	0.000	0.031	0.003	0.021
Feed Rate-M ton/hr (limestone only)	34.26	34.26	35.04	35.04	34.66	34.66	34.65
Particulates - Probe & Filter Catch							
mg.	262.4	223.1	104.6	118.1	156.2	137.0	166.9
mg/Nm^3	51.1	48.4	22.5	25.0	28.6	26.6	33.7
mg/m^3	32.8	32.8	14.7	16.4	18.7	17.6	22.2
kg/hr	2.07	1.84	0.89	0.90	1.21	1.05	1.33
kg/M ton	0.0604	0.0537	0.0254	0.0257	0.0349	0.0303	0.0384
Particulates - Total Catch							
mg.	424.5	426.0	340.0	275.0	320.4	377.0	360.5
mg/Nm^3	82.6	92.4	73.3	58.1	58.7	73.1	73.0
mg/m^3	53.1	62.7	47.7	38.1	38.4	48.2	48.1
kg/hr	3.34	3.52	2.88	2.10	2.48	2.87	2.87
kg/M ton	0.0975	0.1027	0.0822	0.0599	0.0715	0.0828	0.0828
Percent Impinger Catch	38.2	47.6	69.2	57.1	51.2	63.7	54.5

TABLE 2-3

SULFUR DIOXIDE SUMMARY
ENGLISH UNITS

Run Number / Date	1	2	3	4	5	6	Average
	June 11, 1974		June 12, 1974		June 13, 1974		
Volume of Gas Sampled-DSCF	2.01	1.18	1.64	1.56	1.61	1.03	1.51
Percent Moisture by Volume	6.5	4.8	6.3	7.5	7.4	6.5	6.5
Average Stack Temperature-°F	291	263	284	269	272	273	275
Stack Volumetric Flow Rate-DSCFM	23,797	22,407	23,162	21,247	24,878	23,156	23,108
Stack Volumetric Flow Rate-ACFM	37,049	33,032	35,532	32,375	38,024	35,078	35,182
Laboratory Data							
Normality of Barium Perchlorate-g-eq/l	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103
Titrant Volume Minus Blank Volume-mls							
Replicate 1	7.35	4.15	7.56	6.27	6.00	3.75	
Replicate 2	7.35	4.10	7.59	6.45	6.05	3.75	
Total Solution Volume-mls	100	100	100	100	121	117	
Volume of Sample Aliquot-mls	20	20	20	20	20	20	
SO_2 Concentration - (Average of 2 Replicates							
lbs/DSCF x 10^{-5}	1.32	1.27	1.74	1.48	1.64	1.55	1.50
ppm (Volume) @ 25°C	80.9	77.4	106	90.7	100	94.8	91.6
lbs/hr	18.9	17.0	24.2	18.9	24.4	21.5	20.8

TABLE 2-4

SULFUR DIOXIDE SUMMARY
METRIC UNITS

Run Number / Date	1	2	3	4	5	6	Average
	June 11, 1974		June 12, 1974		June 13, 1974		
Volume of Gas Sampled-Nm^3	0.057	0.033	0.046	0.044	0.046	0.029	0.042
Percent Moisture by Volume	6.5	4.8	6.3	7.5	7.4	6.5	6.5
Average Stack Temperature-°C	143.9	128.3	140.0	131.7	133.3	133.9	135.2
Stack Volumetric Flow Rate-Nm^3/min	674	635	656	602	705	656	655
Stack Volumetric Flow Rate-m^3/min	1,049	935	1,006	917	1,077	993	996
Laboratory Data							
Normality of Barium Perchlorate-g-eq/l	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103	0.0103
Titrant Volume Minus Blank Volume-mls							
Replicate 1	7.35	4.15	7.56	6.27	6.00	3.75	
Replicate 2	7.35	4.10	7.59	6.45	6.05	3.75	
Total Solution Volume-mls	100	100	100	100	121	117	
Volume of Sample Aliquot-mls	20	20	20	20	20	20	
SO_2 Concentration - (Average of Replicates)							
gms/Nm^3	0.21	0.20	0.28	0.24	0.26	0.25	0.24
kg/hr	8.6	7.7	11.0	8.6	11.1	9.8	9.5
ppm	80.9	77.4	106	90.7	100	94.8	91.6

TABLE 2-5

NITROGEN OXIDES SUMMARY
ENGLISH UNITS

Run Number / Date	1	2	3	4	5	6	7	8	9	10	11	12	Average
		June 11, 1974				June 12, 1974			June 13, 1974				
Percent Moisture by Volume	6.5	6.5	6.5	6.5	6.3	6.3	6.3	6.3	7.4	7.4	7.4	7.4	6.7
Stack Volumetric Flow Rate-DSCFM	23,797	23,797	23,797	23,797	23,162	23,162	23,162	23,162	24,878	24,878	24,878	24,878	23,946
Stack Volumetric Flow Rate-ACFM	37,049	37,049	37,049	37,049	35,532	35,532	35,532	35,532	38,024	38,024	38,024	38,024	36,868
Analysis													
Flask Volume-mls	2,038	2,030	1,961	1,992	1,964	2,046	2,009	2,020	2,030	1,992	2,040	1,994	
Absorbant Volume-mls	26.0	24.5	24.0	25.5	25.0	25.0	25.0	24.0	26.0	26.0	25.0	26.0	
Initial Pressure-in. Hg.	1.89	1.89	1.79	1.89	2.04	1.81	1.80	1.78	1.62	1.59	1.62	1.68	
Final Pressure-in. Hg.	29.41	28.51	28.61	29.41	29.68	29.06	29.18	28.88	29.67	29.57	29.47	29.37	
Initial Temperature-°F	72.0	70.0	73.0	72.0	72.0	75.0	76.0	71.0	77.0	78.0	82.0	80.0	
Final Temperature-°F	76.0	74.0	73.0	74.0	80.0	81.0	81.0	82.0	85.0	85.0	86.0	83.0	
Total NO_x Collected-µg	145.6	132.0	138.8	146.7	143.1	143.1	118.1	107.4	279.1	221.9	268.4	225.5	
NO_x Concentration													
lbs/DSCF x 10^{-7} (as NO_2)	49.4	46.2	29.9	50.7	50.5	49.2	41.2	37.7	94.8	77.0	91.5	78.7	59.7
ppm	42.1	39.4	42.5	43.2	43.0	41.9	35.1	32.1	80.8	65.6	77.9	67.0	50.9
lbs/hr.	7.05	6.60	7.12	7.24	7.02	6.84	5.73	5.24	14.2	11.5	13.7	11.7	8.66

TABLE 2-6

NITROGEN OXIDES SUMMARY
METRIC UNITS

Run Number / Date	1	2	3	4	5	6	7	8	9	10	11	12	Average
		June 11, 1974				June 12, 1974				June 13, 1974			
Percent Moisture by Volume	6.5	6.5	6.5	6.5	6.3	6.3	6.3	6.3	7.4	7.4	7.4	7.4	6.7
Stack Volumetric Flow Rate-Nm^3/min	674	674	674	674	656	656	656	656	705	705	705	705	678
Stack Volumetric Flow Rate-m^3/min	1,049	1,049	1,049	1,049	1,006	1,006	1,006	1,006	1,077	1,077	1,077	1,077	1,044
Analysis													
Flask Volume-mls	2,038	2,030	1,961	1,992	1,964	2,046	2,009	2,020	2,030	1,992	2,040	1,994	
Absorbant Volume-mls	26.0	24.5	24.0	25.5	25.0	25.0	25.0	24.0	26.0	26.0	25.0	26.0	
Initial Pressure-mm Hg.	48.0	48.0	45.5	48.0	51.8	56.0	45.7	45.2	41.1	40.4	41.1	42.7	
Final Pressure-mm Hg.	747.0	724.2	726.7	747.0	753.9	738.2	741.2	733.6	753.6	751.1	748.6	746.0	
Initial Temperature-°C	22.2	21.1	22.8	22.2	22.2	23.9	24.4	21.7	25.0	25.6	27.8	26.7	
Final Temperature-°C	24.4	23.3	22.8	23.3	26.7	27.2	27.2	27.8	29.4	29.4	30.0	28.3	
Total NO_x collected-µg	145.6	132.0	138.8	146.7	143.1	143.1	118.1	107.4	279.1	221.9	268.4	225.5	
NO_x Concentration													
mg/Nm^3	79.1	74.0	79.9	81.2	80.9	78.8	65.0	60.4	151.9	123.3	146.6	126.1	95.7
ppm	42.1	39.4	42.5	43.2	43.0	41.9	35.1	32.1	80.8	65.6	77.9	67.0	50.9
kg/hr	3.20	2.99	3.23	3.28	3.18	3.10	2.60	2.38	6.44	5.22	6.21	5.31	3.93

TABLE 2-7

CARBON MONOXIDE SUMMARY
(INTEGRATED 2-HOUR BAG SAMPLES)

Date	Time	CO, ppm
June 11, 1974	1500 - 1700	15
June 12, 1974	1030 - 1230	580
June 13, 1974	930 - 1130	30

PM runs

1 23,797 2 22,407 AVG DSCFM 1: 23,102

3 23,162 4 21,247 2: 22,205

5 24878 6 23,156 3: 24017

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TABLE 2-8

SUMMARY OF OPACITY READINGS: NO. 5 LIME KILN

Stack No. / Date	1 June 11, 1974		2 June 11, 1974		3 June 12, 1974		4 June 12, 1974		5 June 13, 1974		6 June 13, 1974	
	Obs. 1	Obs. 2	Obs. 1	Obs. 2	Obs. 1	Obs. 2	Obs. 1	Obs. 2	Obs. 1	Obs. 2	Obs. 1	Obs. 2
tart Time	1238	1601	1556	1601	1053	1053	1342	1305	931		1146	1210
uration of Observation (min)	240	240	240	240	234	240	240	240	240		240	227
otal No. of Readings	960	960	960	960	936	960	960	960	960		960	908
o. Readings Unobservable	0	0	0	0	0	0	0	0	0		0	0
o. Readings 0% Opacity	952	960	958	960	928	954	960	960	956		959	908
5	6	0	2	0	7	4	0	0	2		1	0
10	2	0	0	0	0	2	0	0	2		0	0
15	0	0	0	0	2	0	0	0	0		0	0
20-100	0	0	0	0	0	0	0	0	0		0	0
ercent Readings Unobservable	0	0	0	0	0	0	0	0	0		0	0
ercent Readings 0% Opacity	99.2	100.2	99.8	100.0	99.1	99.4	100.0	100.0	99.6		99.9	100.0
5	0.6	0.0	0.2	0.0	0.7	0.4	0.0	0.0	0.2		0.1	0.0
10	0.2	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.2		0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
20-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
verage Opacity =	0.062	0.000	0.010	0.000	0.069	0.042	0.000	0.000	0.031		0.005	0.000

$$\frac{\text{Sum of Nos.}}{\text{o. Readings Observable}}$$

III. PROCESS DESCRIPTION AND OPERATION

Limestone consists primarily of calcium carbonate or combinations of calcium and magnesium carbonate with varying amounts of impurities. The most abundant of all sedimentary rocks, limestone is found in a variety of consistencies from marble to chalk. Lime is a calcined or burned form of limestone, commonly divided into two basic products — quicklime and hydrated lime. Calcination expels carbon dioxide from the raw limestone, leaving calcium oxide (quicklime). With the addition of water, calcium hydroxide (hydrated lime) is formed.

The basic processes in production are: (1) quarrying the limestone raw material; (2) preparing the limestone for kilns by crushing and sizing; (3) calcining the feed; and (4) optionally processing the quicklime further by additional crushing and sizing and the hydration. The majority of lime is produced in rotary kilns which can be fired by coal, oil, or gas. Rotary kilns have the advantages of high production per man-hour and a uniform product, but require higher capital investment and have higher unit fuel costs than most vertical kilns.

The Marblehead Lime plant has five rotary lime kilns operating on high calcium limestone. The product is a high calcium metallurgical lime which is used in the steel industry.

The No. 5 lime kiln, which was source tested by EPA, is 300 feet in length with an inside diameter of 10 feet 6 inches. The kiln has a design capacity of 500 tons per day. The limestone feed is brought into the plant sized to one and three-quarters by one-half inch. There is no stone pre-heater. The kiln is fired with pulverized coal.

The No. 5 lime kiln is provided with a baghouse manufactured by the Marblehead Lime Company. The exit gas from the lime kiln is cooled to about 500°F with a combination of water spray and tempering air. The cooled gases pass to a knock-out box where some chips and stones are removed and then to the induced draft fan. From the fan, the exhaust gas goes directly to the

TABLE 3-1

SUMMARY OF LIME KILN PROCESS
DATA DURING SAMPLING

Test Run	Date 1974	Limestone* Feed Rate tph	Fuel (coal)* Feed Rate tph	[redacted]	Baghouse Temp °F	Oxygen %
1, 2	June 11	37.76	5.77	1.7-2.0	570-592	[redacted]
3, 4	June 12	38.63	5.80	1.2-1.6	550-600	[redacted]
5, 6	June 13	38.21	5.58	1.4-1.5	560-600	[redacted]
			5.71			

*Feed rates were determined from the feed weight indicator during each test. A monitor of the process uniformity was obtained from feed rate meters, however, these meter readings were not calibrated to indicate the actual feed rates. These numbers are shown in Appendix F.

FEED	PRODUCTION
37.76	18.9
38.63	19.3
38.21	19.1

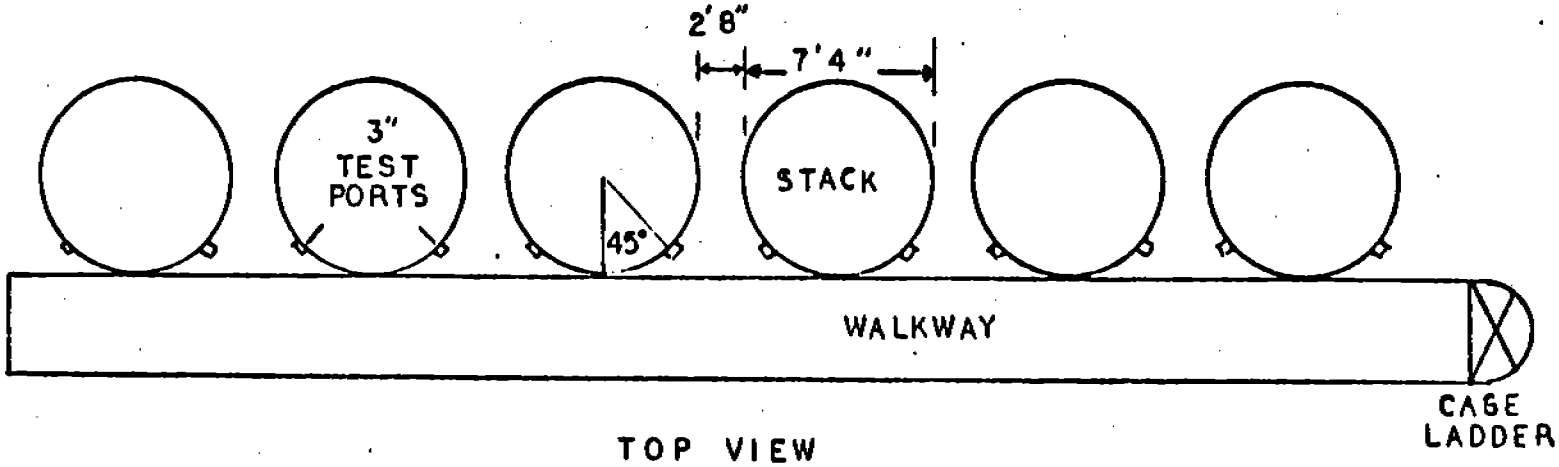
baghouse. This baghouse has twelve compartments, six stacks, and about 80,000 square feet of bag surface area. The bags are cleaned by reversing the air flow in a section. Each section is cleaned in sequence with a typical cleaning cycle taking about two hours. The dust collected is used by a portland cement manufacturer located nearby.

During testing, the baghouse stacks were sampled for particulates, SO_2, CO, and NO_x. Simultaneous visible emissions data were also recorded.

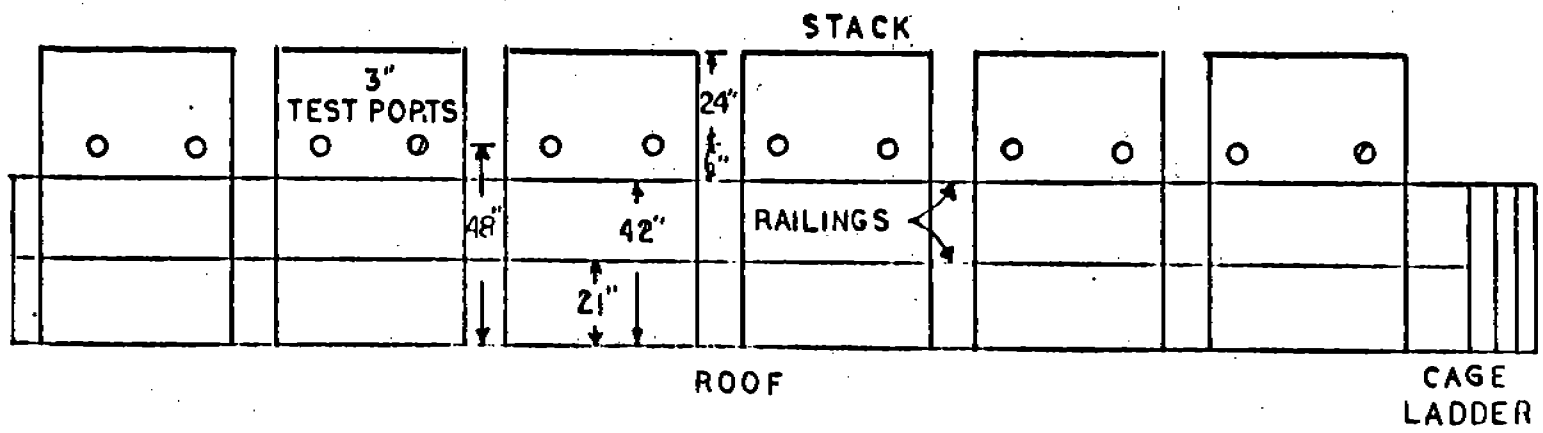
The operation of the kiln and the baghouse was monitored during the test and the process data recorded. Readings were taken about every half hour. These records are in Appendix F. As far as known from the process data and conversations with the operators, the kiln and baghouse operated normally during the tests. The main process information is summarized in Table 3-1.

IV. LOCATION OF SAMPLING POINTS

A schematic layout of the test location is shown in Figure 4-1. There are two three-inch sampling ports on each of the six stacks. They are located 90° apart, two feet from the outlet and six feet from the inlet. The stacks are 7'4" in diameter and therefore, require the maximum number of traverse points (48). Samples were taken at each of the 48 points for five minutes per point, or a total of 240 minutes (four hours) for each run.



TOP VIEW



SIDE VIEW

Figure 4-1. Test Location

V. SAMPLING AND ANALYTICAL PROCEDURES

All field sampling data is provided in Appendix F. All sample calculations and test results are provided in Appendices A through E.

A. PARTICULATE SAMPLING (EPA METHOD 5)

One four-hour particulate run was made on each of the six stacks and two particulate trains were used simultaneously. The particulate sampling was performed in accordance with EPA Method 5, Federal Register, December 23, 1971. The location of the sampling site, determination of stack gas velocity and volumetric flow rate, gas analysis for carbon dioxide and dry molecular weight, and determination of moisture in the stack gases were performed in accordance with Methods 1, 2, 3, and 4, respectively, of the aforementioned document.

The variations from Method 5 as described in the Federal Register were the addition of one hundred milliliters of water to the third impinger and the use of a stationary impinger box connected to the heated filter box through Teflon tubing. Normally, the third impinger is left empty, however, the addition of water did not alter the sampling methods or results as the water was eventually evaporated in a beaker for the determination of particulate matter in the residual water fraction. Approval was granted by the EPA Project Officer for use of the stationary impinger box, Teflon tubing, and stainless steel probe. The sampling train is shown in Figure 5-1.

Due to the low velocities (about 15 feet per second), inclined manometers with a range of 0 - 0.25 inches H_2O were used. Nomographs were not used for the adjustment of the sampling rate, rather the equations that serve as the basis for the nomograph were calculated. A direct relationship between the stack velocity heat (ΔP_s) and the pressure differential across the orifice meter (ΔH) was determined and used for setting the isokinetic sampling rate. The relationship is a follows:

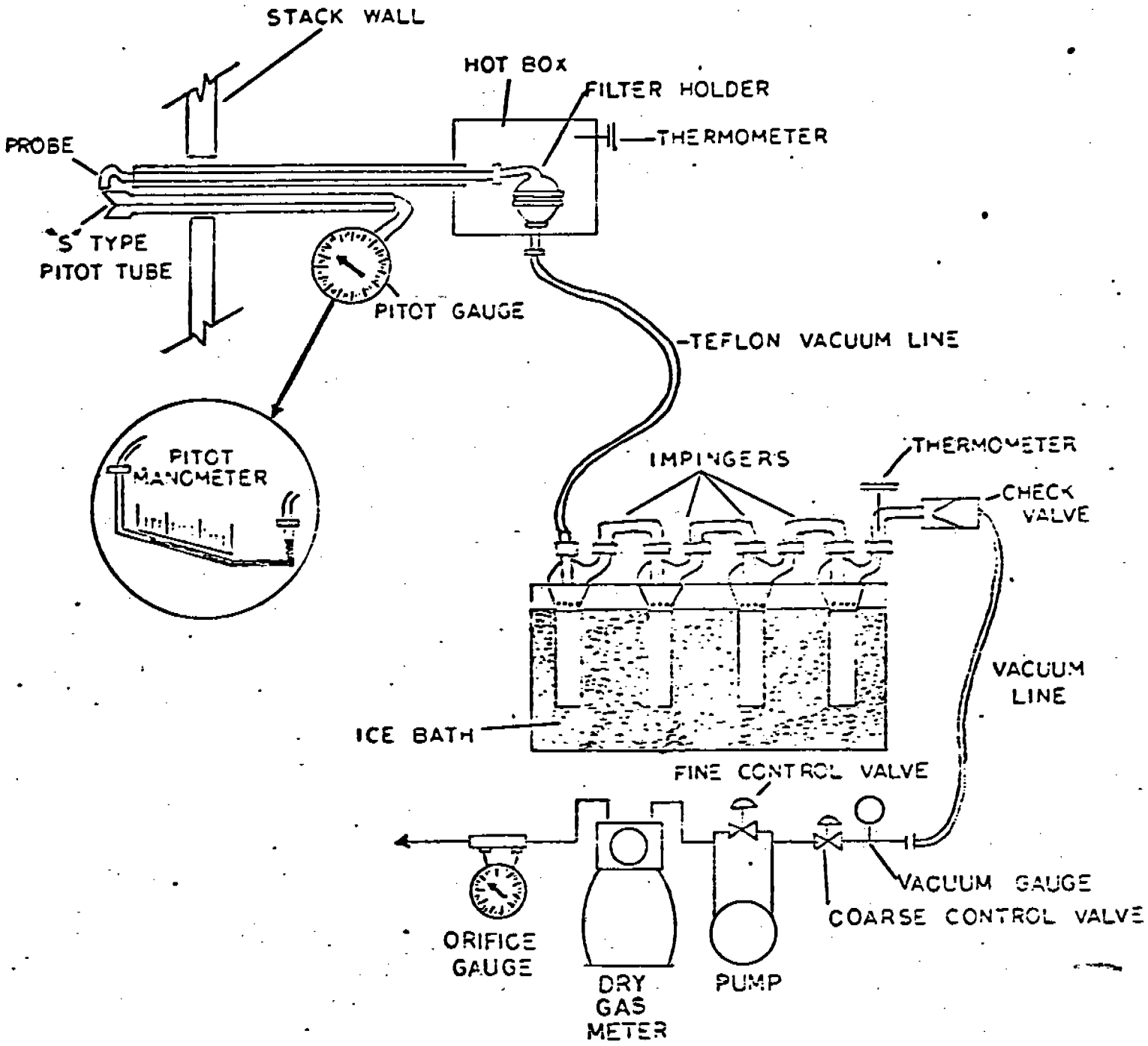


Figure 5-1. Particulate Sampling Train, Marblehead Lime, Gary, Indiana

$$\left[\frac{(2.9)\ (_{P.C.F.}^{STD})\ (60)\ (\pi)\ (D)^2\ (1-B)\ (Tm)}{4(144)\ (Ts)^{1/2}\ (O.C.F.)}\right]^2 \quad \Delta P = \Delta H$$

where:

STD P.C.F. = Pitot correction factor (dimensionless)
D = Diameter of nozzle, inches
B = Percent moisture in gas stream
Tm = Meter temperature, °R
Ts = Stack temperature, °R
O.C.F. = Orifice correction factor

Also, a meter rate formula was determined and used to maintain isokinetic flow by checking the flow rate at 15-second intervals. We have found this approach to be quite accurate as the two equations serve as a check for each other. The meter rate formula is as follows:

$$M_r = (P.C.F.) \times V_{avg.} \times 60 \times \frac{Tm}{Ts} \times \frac{Pb \pm Ps}{Pb - P_m} \times An \times (1-\%H_2O)$$

where:

M_r = Volumetric flow rate, $ft^3/min.$
P.C.F. = Pitot correction factor (dimensionless)
$V_{avg.}$ = Average velocity, ft/sec
T_m = Meter temperature, °R
T_s = Stack temperature, °R
P_b = Barometric pressure, in. Hg.
P_s = Stack static pressure, in. Hg.
P_m = Vacuum at meter, in. Hg.
A_n = Area of nozzle, ft^2
$\%H_2O$ = Percent moisture in gas stream

The stack gas molecular weight was determined by three 4-hour integrated gas analyses collected simultaneously with the particulate tests. An Orsat was used to determine CO_2 and Fyrites were used to determine CO_2 and O_2. The Orsat scale is only capable of reading up to 21%. Since the O_2 is read together with the CO_2, a reading above 21% (16.5% O_2 and 7.0% CO_2 = 23.5% total) was obtained and therefore, Fyrites were used.

Sample recovery and analysis were performed in accordance with the methods described in the Federal Register, August 17, 1971. At the request of the Project Officer, a front-half water wash was performed after the acetone wash. This procedure should be used when testing lime kilns due to the nature of the particulate emissions. All sample bottles were acid-washed Wheaton bottles in accordance with specifications requested by the EPA. The tared beakers and filters containing the particulate matter will be held by EPA for their use.

B. SULFUR DIOXIDE (METHOD 6)

Six sulfur dioxide tests were performed in accordance with EPA Method 6, Federal Register, December 23, 1971. The probe was located in various stacks so there would be no interference with the traversing particulate sampling train. The tests were not run for the complete 4-hour period due to carry-over of the sulfuric acid fraction in the isopropanol impinger. Each test was conducted until bubbles from the first isopropanol impinger began carrying over into the second impinger containing the sulfur dioxide fraction. Two replicate analyses were performed by the barium thorin titration method on each sample and recorded as the average of the two replicates.

C. NITROGEN OXIDES (METHOD 7)

The nitrogen oxide tests were performed in accordance with EPA Method 7, Federal Register, December 23, 1971, and a modified draft supplied by the EPA. Four NO_x flasks were taken for each of the three days during the particulate tests. The samples were analyzed colorimetrically using the phenoldisulfonic acid procedure at the Walden laboratories.

D. CARBON MONOXIDE (METHOD 10)

Three 2-hour integrated bag samples were collected during the particulate tests. The carbon monoxide was measured according to Method 10 in the Federal Register, March 8, 1974. Carbon monoxide tests were conducted by Honeywell Corporate Research using a Honeywell NDIR Analyzer. Although CO, CO_2 and CH_4 channels were available, only the CO channel was operated.

EPA Method 10 specifies that for both integrated (bag) and continuous sampling, the sample must pass through a volume of silica gel and another of ascarite immersed in an ice bath (to remove H_2O and CO_2). Tests with the Honeywell NDIR CO Analyzer have demonstrated rejection ratios greater than 10^4 for both H_2O and CO_2. Therefore, passing the sample through silica gel and ascarite is unnecessary. In fact, passing the sample through the ascarite caused considerable technical difficulty. After about an hour of sampling, the ascarite formed a hard ball around the inlet tube to the ascarite container, causing a severe flow restriction.

E. VISIBLE EMISSIONS (METHOD 9)

The relative opacity of each of the six stacks was determined in accordance with Method 9 of the Federal Register, December 23, 1971. The opacity determinations were conducted for two hours on each stack during the particulate tests. Two observers read each stack except Stack No. 5, which was read by one observer.

APPENDIX A

PARTICULATE TEST RESULTS AND SAMPLE CALCULATION

WALDEN SOURCE TEST REPORT

COMPANY= MARBLEHEAD LIME COMPANY

PLANT= LIME KILN NUMBER 5

LOCATION= GARY, INDIANA

PROCESS= LIME KILN

CONTROL EQUIPMENT= BAGHOUSE

TEST SCHEDULE

RUN NO.	DATE	POLLUTANTS SAMPLED				
1	11JUN 74	PART	SO2	NOX	CO	OPACITY
2	11JUN 74	PART	SO2			OPACITY
3	12JUN 74	PART	SO2	NOX	CO	OPACITY
4	12JUN 74	PART	SO2			OPACITY
5	13JUN 74	PART	SO2	NOX	CO	OPACITY
6	13JUN 74	PART	SO2			OPACITY

MARBLEHE

FIELD TEST DATA SUMMARY TEST NO. 1

PROBE LOCATION= STACK NO.1

COLLECTOR TYPE= EPA TRAIN

AMBIENT TEMPERATURE= 67.0 DEGREES FAHRENHEIT

BAROMETRIC PRESSURE= 29.10 INCHES MERCURY

PROBE LENGTH= 13.0 FEET

NOZZLE DIAMETER= 0.50 INCHES

PITOT TUBE CALIBRATION FACTOR= 0.83

STACK AREA= 42.24 SQ. FT.

GAS ANALYSIS

CO2= 6.8 %
CO = 0.0 %
O2 = 19.5 %
N2 = 73.7 %

MOLECULAR WEIGHT= 29.87 , DRY BASIS

EXCESS AIR= **** %

SPECIAL INFORMATION (ALL 6 PARTICULATE TEST RUNS)

The outlet of the baghouse consists of six stacks. Each stack is 7.3 feet in diameter. One particulate run was made on each of the stacks. The meter temperatures given to the computer were set at 70°F because the Joy control unit that was used corrects the meter volume for temperature. No values for pump vacuum were taken and therefore 0.0 is shown. 300 ml. of water was used in the impingers (100 ml. in each of the first three impingers).

MARBLEHE

TRAVERSE SUMMARY(TEST NO. 1)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H20)	ORIFICE DELTAP (IN.H20)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
START	1225	357.280							
N24	30	360.900	0.04	0.70	275.0	70.0	70.0	0.0	60.0
N23	35	364.600	0.04	0.70	275.0	70.0	70.0	0.0	60.0
N22	40	0.0	0.04	0.80	300.0	70.0	70.0	0.0	60.0
N21	45	372.100	0.06	1.00	300.0	70.0	70.0	0.0	60.0
N20	50	375.900	0.04	0.90	300.0	70.0	70.0	0.0	60.0
N19	55	379.700	0.04	0.90	300.0	70.0	70.0	0.0	60.0
N18	1300	0.0	0.05	1.00	300.0	70.0	70.0	0.0	60.0
N17	5	388.100	0.05	1.00	300.0	70.0	70.0	0.0	60.0
N16	10	392.800	0.05	0.90	300.0	70.0	70.0	0.0	60.0
N15	15	397.100	0.05	0.90	300.0	70.0	70.0	0.0	60.0
N14	20	0.0	0.05	1.00	300.0	70.0	70.0	0.0	60.0
N13	25	404.700	0.05	1.00	300.0	70.0	70.0	0.0	60.0
N12	30	408.600	0.05	1.00	290.0	70.0	70.0	0.0	60.0
N11	35	412.500	0.05	1.00	300.0	70.0	70.0	0.0	65.0
N10	40	416.500	0.05	1.00	300.0	70.0	70.0	0.0	60.0
N 9	45	420.200	0.04	0.90	290.0	70.0	70.0	0.0	65.0
N 8	50	423.800	0.05	1.00	290.0	70.0	70.0	0.0	65.0
N 7	55	427.600	0.05	1.00	290.0	70.0	70.0	0.0	65.0
N 6	1400	431.400	0.05	1.00	280.0	70.0	70.0	0.0	65.0
N 5	5	435.200	0.05	1.00	275.0	70.0	70.0	0.0	65.0
N 4	10	439.100	0.05	1.00	275.0	70.0	70.0	0.0	65.0
N 3	15	443.000	0.05	1.00	260.0	70.0	70.0	0.0	65.0
N 2	20	446.800	0.05	1.00	260.0	70.0	70.0	0.0	65.0
N 1	25	450.420	0.04	0.90	240.0	70.0	70.0	0.0	65.0
S24	1605	454.000	0.04	0.80	285.0	70.0	70.0	0.0	50.0
S23	10	457.500	0.04	0.80	285.0	70.0	70.0	0.0	50.0
S22	15	461.000	0.04	0.80	290.0	70.0	70.0	0.0	50.0
S21	20	465.000	0.05	0.90	290.0	70.0	70.0	0.0	50.0

MARBLEHE

TRAVERSE SUMMARY (CONTINUED)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H2O)	ORIFICE DELTAP (IN.H2O)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
S20	25	468.700	0.05	0.90	290.0	70.0	70.0	0.0	60.0
S19	30	472.600	0.05	0.90	290.0	70.0	70.0	0.0	60.0
S18	35	476.500	0.05	1.10	300.0	70.0	70.0	0.0	60.0
S17	40	480.500	0.05	1.10	300.0	70.0	70.0	0.0	70.0
S16	45	484.500	0.05	1.10	300.0	70.0	70.0	0.0	75.0
S15	50	488.500	0.05	1.10	300.0	70.0	70.0	0.0	75.0
S14	55	492.500	0.05	1.10	300.0	70.0	70.0	0.0	75.0
S13	1700	496.500	0.05	1.10	300.0	70.0	70.0	0.0	80.0
S12	5	500.800	0.06	1.20	295.0	70.0	70.0	0.0	80.0
S11	10	504.800	0.06	1.20	300.0	70.0	70.0	0.0	80.0
S10	15	509.200	0.06	1.20	300.0	70.0	70.0	0.0	80.0
S 9	20	513.200	0.05	1.10	300.0	70.0	70.0	0.0	80.0
S 8	25	517.100	0.05	1.10	300.0	70.0	70.0	0.0	80.0
S 7	30	521.000	0.05	1.10	295.0	70.0	70.0	0.0	70.0
S 6	35	525.000	0.05	1.10	300.0	70.0	70.0	0.0	65.0
S 5	40	529.000	0.05	1.15	300.0	70.0	70.0	0.0	60.0
S 4	45	533.000	0.05	1.10	300.0	70.0	70.0	0.0	60.0
S 3	50	537.000	0.05	1.10	300.0	70.0	70.0	0.0	60.0
S 2	55	540.500	0.04	1.00	270.0	70.0	70.0	0.0	60.0
S 1	1800	543.590	0.03	0.65	260.0	70.0	70.0	0.0	60.0
AVERAGE OF 48 POINTS			0.05	0.99	290.6	70.0	70.0	0.0	64.2

MARBLEHE

PARTICULATE TEST SUMMARY-RUN NO. 1

STACK DATA

AVERAGE VELOCITY HEAD= 0.22
ACTUAL VELOCITY= 14.6 FEET PER SECOND(FPS)
PERCENT ISOKINETIC FLOW= 98.5 %
MOISTURE CONTENT= 6.5 %
MOLECULAR WEIGHT,WET BASIS= 29.10
VOLUMETRIC FLOW= 1427802.0 SCFH,DRY
2222941.0 ACFH
37049.0 ACFM ✓

LABORATORY DATA (Front Half Only)

FILTER CATCH	=	78.5 MG.	78.5 MG.
FRONT HALF(ACETONE WASH)	=	113.3 MG.	113.3 MG.
FRONT HALF(WATER WASH)	=	70.6 MG.	~~70.6 MG.~~
BACK HALF(ACETONE WASH)	=	19.2 MG.	262.4 MG.
BACK HALF(ORGANIC EXTRACT)	=	4.2 MG.	
BACK HALF(WATER RESIDUE)	=	138.7 MG.	
TOTAL PARTICULATE COLLECTED	=	424.5 MG.	

TEST RESULTS-PARTICULATE EMISSIONS

GRAINS/SCF,DRY= 3.61E-02
POUNDS/SCF,DRY= 5.15E-06
POUNDS/HOUR= 7.36E 00
POUNDS/1000 POUNDS FLUE GAS= 7.33E-02

fh: 262.4 mg : 4.55 lb/hr : 57.67 mg/(lb/hr)

∴ ORGANIC = ~~57.67 mg/lb/hr * 4.2 mg = 242~~

~~57.67 mg~~ 4.2 mg * 1 lb/hr / 57.67 mg = 0.728 lb/hr

Inorganic : (19.2 + 138.7) mg * 1 lb/hr / 57.67 mg

= 2.74 lb/hr

MARBLEHE

FIELD TEST DATA SUMMARY TEST NO. 2

PROBE LOCATION= STACK NO.2

COLLECTOR TYPE= EPA TRAIN

AMBIENT TEMPERATURE= 67.0 DEGREES FAHRENHEIT

BAROMETRIC PRESSURE= 29.10 INCHES MERCURY

PROBE LENGTH= 13.0 FEET

NOZZLE DIAMETER= 0.50 INCHES

PITOT TUBE CALIBRATION FACTOR= 0.83

STACK AREA= 42.24 Sq. FT.

GAS ANALYSIS

CO2= 6.8 %
CO = 0.0 %
O2 = 19.5 %
N2 = 73.7 %

MOLECULAR WEIGHT= 29.87 , DRY BASIS

EXCESS AIR= **** %

SPECIAL INFORMATION (TEST #2 ONLY)

[redacted]

MARBLEHE

TRAVERSE SUMMARY (TEST NO. 2)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H2O)	ORIFICE DELTAP (IN.H2O)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
START	1226	435.510							
N 1	31	439.600	0.05	0.75	270.0	70.0	70.0	0.0	55.0
N 2	36	443.400	0.05	0.81	270.0	70.0	70.0	0.0	55.0
N 3	41	447.400	0.05	0.92	275.0	70.0	70.0	0.0	55.0
N 4	46	451.300	0.05	0.92	275.0	70.0	70.0	0.0	55.0
N 5	51	455.100	0.05	0.90	270.0	70.0	70.0	0.0	55.0
N 6	56	459.900	0.05	0.92	275.0	70.0	70.0	0.0	55.0
N 7	1301	462.000	0.05	0.95	270.0	70.0	70.0	0.0	55.0
N 8	6	466.000	0.05	0.98	255.0	70.0	70.0	0.0	50.0
N 9	36	470.100	0.05	1.00	275.0	70.0	70.0	0.0	55.0
N10	41	474.000	0.05	0.98	280.0	70.0	70.0	0.0	55.0
N11	46	477.900	0.05	0.98	280.0	70.0	70.0	0.0	55.0
N12	51	481.000	0.03	0.77	275.0	70.0	70.0	0.0	55.0
N13	56	484.700	0.03	0.73	260.0	70.0	70.0	0.0	55.0
N14	1401	487.800	0.03	0.60	260.0	70.0	70.0	0.0	55.0
N15	6	490.900	0.04	0.65	270.0	70.0	70.0	0.0	60.0
N16	11	494.200	0.04	0.69	265.0	70.0	70.0	0.0	60.0
N17	16	498.000	0.04	0.78	265.0	70.0	70.0	0.0	55.0
N18	21	501.500	0.04	0.75	260.0	70.0	70.0	0.0	55.0
N19	26	505.000	0.04	0.80	260.0	70.0	70.0	0.0	55.0
N20	31	508.100	0.03	0.55	255.0	70.0	70.0	0.0	55.0
N21	36	511.100	0.03	0.58	255.0	70.0	70.0	0.0	55.0
N22	41	514.300	0.04	0.65	250.0	70.0	70.0	0.0	55.0
N23	46	518.800	0.04	0.88	250.0	70.0	70.0	0.0	55.0
N24	51	521.520	0.04	0.85	250.0	70.0	70.0	0.0	55.0
S 1	1606	524.300	0.03	0.52	260.0	70.0	70.0	0.0	50.0
S 2	11	527.700	0.03	0.52	260.0	70.0	70.0	0.0	50.0
S 3	16	530.000	0.04	0.60	260.0	70.0	70.0	0.0	50.0
S 4	21	533.700	0.03	0.58	260.0	70.0	70.0	0.0	55.0

MARBLEHE

TRAVERSE SUMMARY (CONTINUED)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H2O)	ORIFICE DELTAP (IN.H2O)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
S 5	26	536.800	0.03	0.62	250.0	70.0	70.0	0.0	50.0
S 6	31	540.500	0.05	1.00	260.0	70.0	70.0	0.0	55.0
S 7	36	544.900	0.03	0.68	260.0	70.0	70.0	0.0	60.0
S 8	41	547.700	0.05	0.98	270.0	70.0	70.0	0.0	60.0
S 9	46	551.600	0.05	0.98	260.0	70.0	70.0	0.0	65.0
S10	51	555.200	0.04	0.90	270.0	70.0	70.0	0.0	65.0
S11	56	558.600	0.04	0.85	260.0	70.0	70.0	0.0	70.0
S12	1701	562.000	0.03	0.70	260.0	70.0	70.0	0.0	70.0
S13	6	565.300	0.04	0.78	260.0	70.0	70.0	0.0	65.0
S14	11	568.800	0.04	0.80	275.0	70.0	70.0	0.0	65.0
S15	16	572.200	0.04	0.80	260.0	70.0	70.0	0.0	70.0
S16	21	575.700	0.04	0.80	275.0	70.0	70.0	0.0	70.0
S17	26	579.600	0.05	1.02	275.0	70.0	70.0	0.0	70.0
S18	31	583.300	0.05	0.75	260.0	70.0	70.0	0.0	70.0
S19	36	586.700	0.04	0.73	250.0	70.0	70.0	0.0	60.0
S20	41	590.000	0.03	0.69	260.0	70.0	70.0	0.0	60.0
S21	46	593.200	0.03	0.68	270.0	70.0	70.0	0.0	60.0
S22	51	595.500	0.03	0.60	260.0	70.0	70.0	0.0	60.0
S23	56	599.200	0.03	0.63	260.0	70.0	70.0	0.0	60.0
S24	1801	602.490	0.04	0.75	240.0	70.0	70.0	0.0	60.0
AVERAGE OF 48 POINTS			0.04	0.78	263.4	70.0	70.0	0.0	58.2

MARBLEHE

PARTICULATE TEST SUMMARY-RUN NO. 2

STACK DATA

AVERAGE VELOCITY HEAD= 0.20
ACTUAL VELOCITY= 13.0 FEET PER SECOND(FPS)
PERCENT ISOKINETIC FLOW= 93.7 %
MOISTURE CONTENT= 4.8 %
MOLECULAR WEIGHT,WET BASIS= 29.30
VOLUMETRIC FLOW= 1344402.0 SCFH,DRY
1981892.0 ACFH
33031.5 ACFM

LABORATORY DATA

			(Front Half Only)
FILTER CATCH	=	92.5 MG.	92.5 MG.
FRONT HALF(ACETONE WASH)	=	83.4 MG.	83.4 MG.
FRONT HALF(WATER WASH)	=	47.2 MG.	47.2 MG.
BACK HALF(ACETONE WASH)	=	15.6 MG.	223.1 MG.
BACK HALF(ORGANIC EXTRACT)	=	3.5 MG.	
BACK HALF(WATER RESIDUE)	=	183.8 MG.	
TOTAL PARTICULATE COLLECTED	=	426.0 MG.	

Front ½ : 223.1 mg : 4.15 lb/hr = 53.76 mg/(lb/hr)

TES

	(Front Half Only)
	2.16E-02
	3.02E-06
	4.06E-00
.15E-02	4.27E-02

ORGANIC 3.5 mg × (lb/hr)/53.76 mg = 0.651 lb/hr

INORGANIC (15.6+183.8) mg × 1/53.76 mg/(lb/hr)

= 3.7.09

MARBLEHE

FIELD TEST DATA SUMMARY TEST NO. 3

PROBE LOCATION= STACK NO.3

COLLECTOR TYPE= EPA TRAIN

AMBIENT TEMPERATURE= 74.0 DEGREES FAHRENHEIT

BAROMETRIC PRESSURE= 29.21 INCHES MERCURY

PROBE LENGTH= 13.0 FEET

NOZZLE DIAMETER= 0.50 INCHES

PITOT TUBE CALIBRATION FACTOR= 0.83

STACK AREA= 42.24 SQ. FT.

GAS ANALYSIS

CO2= 7.0 %
CO = 0.0 %
O2 = 16.5 %
N2 = 76.5 %

MOLECULAR WEIGHT= 29.78 , DRY BASIS

EXCESS AIR= **** %

MARBLEHE

TRAVERSE SUMMARY(TEST NO. 3)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H20)	ORIFICE DELTAP (IN.H20)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
START	1030	602.590							
S24	35	606.300	0.04	0.85	270.0	70.0	70.0	0.0	60.0
S23	40	610.200	0.05	1.00	270.0	70.0	70.0	0.0	55.0
S22	45	613.800	0.04	0.85	270.0	70.0	70.0	0.0	55.0
S21	50	619.000	0.05	1.05	270.0	70.0	70.0	0.0	60.0
S20	55	622.300	0.05	1.10	270.0	70.0	70.0	0.0	60.0
S19	1100	626.400	0.05	1.10	285.0	70.0	70.0	0.0	60.0
S18	5	630.700	0.05	1.10	275.0	70.0	70.0	0.0	60.0
S17	10	634.800	0.05	1.10	270.0	70.0	70.0	0.0	60.0
S16	15	638.900	0.05	1.10	275.0	70.0	70.0	0.0	60.0
S15	20	643.000	0.05	1.10	285.0	70.0	70.0	0.0	60.0
S14	25	647.200	0.05	1.15	280.0	70.0	70.0	0.0	60.0
S13	30	651.400	0.05	1.10	280.0	70.0	70.0	0.0	60.0
S12	35	654.800	0.03	0.80	280.0	70.0	70.0	0.0	60.0
S11	40	658.400	0.04	0.90	280.0	70.0	70.0	0.0	65.0
S10	45	662.300	0.04	0.90	290.0	70.0	70.0	0.0	60.0
S 9	50	665.500	0.03	0.75	295.0	70.0	70.0	0.0	60.0
S 8	55	669.200	0.04	0.90	295.0	70.0	70.0	0.0	60.0
S 7	1200	672.300	0.03	0.75	295.0	70.0	70.0	0.0	60.0
S 6	5	675.400	0.03	0.75	275.0	70.0	70.0	0.0	60.0
S 5	10	678.600	0.03	0.70	275.0	70.0	70.0	0.0	60.0
S 4	15	681.800	0.03	0.65	255.0	70.0	70.0	0.0	60.0
S 3	20	685.500	0.04	0.80	235.0	70.0	70.0	0.0	60.0
S 2	25	689.200	0.04	0.80	180.0	70.0	70.0	0.0	55.0
S 1	30	691.850	0.02	0.50	185.0	70.0	70.0	0.0	55.0
N24	1300	695.500	0.04	0.90	320.0	70.0	70.0	0.0	60.0
N23	5	699.200	0.04	0.90	320.0	70.0	70.0	0.0	60.0
N22	10	703.300	0.05	1.10	310.0	70.0	70.0	0.0	55.0
N21	15	707.800	0.06	1.20	310.0	70.0	70.0	0.0	60.0

MARBLEHE

TRAVERSE SUMMARY (CONTINUED)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H20)	ORIFICE DELTAP (IN.H20)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
N20	20	712.300	0.06	1.30	310.0	70.0	70.0	0.0	60.0
N19	25	716.400	0.05	1.10	300.0	70.0	70.0	0.0	60.0
N18	30	720.500	0.05	1.10	300.0	70.0	70.0	0.0	60.0
N17	35	725.000	0.06	1.30	305.0	70.0	70.0	0.0	60.0
N16	40	729.400	0.06	1.30	305.0	70.0	70.0	0.0	60.0
N15	45	734.000	0.06	1.30	300.0	70.0	70.0	0.0	60.0
N14	50	738.300	0.06	1.30	300.0	70.0	70.0	0.0	60.0
N13	55	742.800	0.06	1.40	300.0	70.0	70.0	0.0	60.0
N12	1400	746.800	0.05	1.20	295.0	70.0	70.0	0.0	60.0
N11	5	750.500	0.04	1.00	295.0	70.0	70.0	0.0	60.0
N10	10	754.200	0.04	0.90	290.0	70.0	70.0	0.0	60.0
N 9	15	758.000	0.04	0.90	290.0	70.0	70.0	0.0	60.0
N 8	20	762.300	0.05	1.10	290.0	70.0	70.0	0.0	60.0
N 7	25	766.400	0.05	1.15	290.0	70.0	70.0	0.0	60.0
N 6	30	770.600	0.05	1.20	275.0	70.0	70.0	0.0	65.0
N 5	35	774.700	0.05	1.15	290.0	70.0	70.0	0.0	65.0
N 4	40	778.800	0.05	1.15	300.0	70.0	70.0	0.0	65.0
N 3	45	782.900	0.05	1.15	290.0	70.0	70.0	0.0	60.0
N 2	50	787.200	0.05	1.15	300.0	70.0	70.0	0.0	60.0
N 1	55	770.100	0.02	0.50	300.0	70.0	70.0	0.0	60.0
AVERAGE OF 48 POINTS			0.05	1.01	283.9	70.0	70.0	0.0	59.9

MARBLEHE

PARTICULATE TEST SUMMARY-RUN NO. 3

STACK DATA

AVERAGE VELOCITY HEAD= 0.21
ACTUAL VELOCITY= 14.0 FEET PER SECOND(FPS)
PERCENT ISOKINETIC FLOW= 91.4 %
MOISTURE CONTENT= 6.3 %
MOLECULAR WEIGHT,WET BASIS= 29.04
VOLUMETRIC FLOW= 1389731.0 SCFH,DRY
2131933.0 ACFH
35532.2 ACFM

LABORATORY DATA (Front Half Only)

FILTER CATCH	=	35.9 MG.	35.9 MG.
FRONT HALF(ACETONE WASH)	=	51.7 MG.	51.7 MG.
FRONT HALF(WATER WASH)	=	17.0 MG.	17.0 MG.
BACK HALF(ACETONE WASH)			104.6 MG.
BACK HALF(ORGANIC EXTRACT)			
BACK HALF(WATER RESIDUE)			
TOTAL PARTICULATE COLLECTE			

Front ½ : 104.6 mg : 1.96 lb/hr = 53.37 mg/lb/hr

TEST RESULTS-PARTICULATE EMIS (Front Half Only)

GRAINS/SCF,DRY= 3.20E-02	9.84E-03
POUNDS/SCF,DRY= 4.57E-06	1.41E-06
POUNDS/HOUR= 6.36E 00	1.96E-00
POUNDS/1000 POUNDS FLUE GA	2.00E-02

ORGANIC 3.4 mg × 1/53.37 mg/lb/hr = 0.0637 lb/hr

INORGANIC (19.7 + 212.3) mg × 1/53.37 mg/lb/hr

= 4.35 lb/hr

MARBLEHE

FIELD TEST DATA SUMMARY TEST NO. 4

PROBE LOCATION= STACK NO.4

COLLECTOR TYPE= EPA TRAIN

AMBIENT TEMPERATURE= 74.0 DEGREES FAHRENHEIT

BAROMETRIC PRESSURE= 29.21 INCHES MERCURY

PROBE LENGTH= 13.0 FEET

NOZZLE DIAMETER= 0.50 INCHES

PITOT TUBE CALIBRATION FACTOR= 0.83

STACK AREA= 42.24 SQ. FT.

GAS ANALYSIS

CO2= 7.0 %
CO = 0.0 %
O2 = 16.5 %
N2 = 76.5 %

MOLECULAR WEIGHT= 29.78 , DRY BASIS

EXCESS AIR= **** %

MARBLEHE

TRAVERSE SUMMARY(TEST NO. 4)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H2O)	ORIFICE DELTAP (IN.H2O)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
START	1025	546.690							
N 1	30	550.500	0.02	0.45	260.0	70.0	70.0	0.0	60.0
N 2	35	553.400	0.03	0.53	260.0	70.0	70.0	0.0	55.0
N 3	40	556.200	0.03	0.53	255.0	70.0	70.0	0.0	55.0
N 4	45	559.400	0.03	0.70	260.0	70.0	70.0	0.0	55.0
N 5	50	562.600	0.03	0.70	260.0	70.0	70.0	0.0	55.0
N 6	55	565.800	0.03	0.70	260.0	70.0	70.0	0.0	60.0
N 7	1105	693.300	0.04	0.83	265.0	70.0	70.0	0.0	60.0
N 8	5	572.800	0.04	0.85	270.0	70.0	70.0	0.0	60.0
N 9	10	576.900	0.04	0.93	260.0	70.0	70.0	0.0	60.0
N10	15	580.000	0.04	0.87	260.0	70.0	70.0	0.0	60.0
N11	20	583.900	0.05	1.18	265.0	70.0	70.0	0.0	60.0
N12	25	587.900	0.05	1.08	270.0	70.0	70.0	0.0	60.0
N13	30	591.200	0.03	0.72	265.0	70.0	70.0	0.0	60.0
N14	35	594.100	0.03	0.57	280.0	70.0	70.0	0.0	60.0
N15	40	597.300	0.03	0.72	280.0	70.0	70.0	0.0	60.0
N16	45	600.600	0.04	0.85	280.0	70.0	70.0	0.0	60.0
N17	50	604.000	0.03	0.87	280.0	70.0	70.0	0.0	60.0
N18	55	607.600	0.04	0.93	280.0	70.0	70.0	0.0	60.0
N19	1200	610.600	0.03	0.58	280.0	70.0	70.0	0.0	60.0
N20	5	613.500	0.02	0.58	280.0	70.0	70.0	0.0	60.0
N21	10	616.700	0.03	0.70	280.0	70.0	70.0	0.0	60.0
N22	15	619.800	0.03	0.70	280.0	70.0	70.0	0.0	60.0
N23	20	621.900	0.01	0.20	140.0	70.0	70.0	0.0	65.0
N24	25	623.680	0.01	0.20	130.0	70.0	70.0	0.0	65.0
N 1	1255	627.300	0.04	1.05	280.0	70.0	70.0	0.0	60.0
N 2	1300	631.200	0.04	1.05	280.0	70.0	70.0	0.0	55.0
N 3	30	635.400	0.06	1.23	275.0	70.0	70.0	0.0	60.0
N 4	45	639.700	0.06	1.23	280.0	70.0	70.0	0.0	60.0

MARBLEHE

TRAVERSE SUMMARY (CONTINUED)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H2O)	ORIFICE DELTAP (IN.H2O)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
N 5	50	643.700	0.05	1.17	280.0	70.0	70.0	0.0	60.0
N 6	55	648.000	0.06	1.23	280.0	70.0	70.0	0.0	60.0
N 7	1400	652.500	0.06	1.40	280.0	70.0	70.0	0.0	60.0
N 8	5	656.800	0.06	1.35	280.0	70.0	70.0	0.0	60.0
N 9	15	661.000	0.05	1.20	280.0	70.0	70.0	0.0	60.0
N10	30	664.800	0.04	1.00	280.0	70.0	70.0	0.0	60.0
N11	35	668.700	0.04	1.05	275.0	70.0	70.0	0.0	55.0
N12	40	672.800	0.05	1.17	280.0	70.0	70.0	0.0	55.0
N13	45	676.900	0.05	1.17	280.0	70.0	70.0	0.0	55.0
N14	50	680.800	0.04	1.02	280.0	70.0	70.0	0.0	60.0
N15	55	684.700	0.04	1.05	285.0	70.0	70.0	0.0	60.0
N16	1500	688.400	0.04	0.98	280.0	70.0	70.0	0.0	60.0
N17	5	692.300	0.04	1.07	280.0	70.0	70.0	0.0	60.0
N18	10	696.200	0.04	1.07	285.0	70.0	70.0	0.0	60.0
N19	15	700.100	0.04	1.07	285.0	70.0	70.0	0.0	60.0
N20	20	704.000	0.04	1.07	285.0	70.0	70.0	0.0	60.0
N21	25	707.500	0.04	0.83	280.0	70.0	70.0	0.0	60.0
N22	30	710.900	0.04	0.83	285.0	70.0	70.0	0.0	60.0
N23	35	714.600	0.04	1.00	270.0	70.0	70.0	0.0	60.0
N24	40	717.600	0.03	0.58	280.0	70.0	70.0	0.0	60.0
AVERAGE OF 48 POINTS			0.04	0.89	269.3	70.0	70.0	0.0	59.4

MARBLEHE

PARTICULATE TEST SUMMARY-RUN NO. 4

STACK DATA

AVERAGE VELOCITY HEAD= 0.19
ACTUAL VELOCITY= 12.8 FEET PER SECOND(FPS)
PERCENT ISOKINETIC FLOW= 101.6 %
MOISTURE CONTENT= 7.5 %
MOLECULAR WEIGHT,WET BASIS= 28.90
VOLUMETRIC FLOW= 1274832.0 SCFH,DRY
1942475.0 ACFH
32374.6 ACFM

LABORATORY DATA

			(Front Half Only)
FILTER CATCH	=	32.4 MG.	32.4 MG.
FRONT HALF(ACETONE WASH)	=	58.5 MG.	58.5 MG.
FRONT HALF(WATER WASH)	=	27.2 MG.	27.2 MG.
BACK HALF(ACETONE WASH)	=	31.7 MG.	118.1 MG.
BACK HALF(ORGANIC EXTRACT)	=	4.5 MG.	
BACK HALF(WATER RESIDUE)	=	120.7 MG.	
TOTAL PARTICULATE COLLECTED	=	275.0 MG.	

(Front 1/2 118.1 mg : 1.98 lb/hr = 59.65 mg/lb/hr

ORGANIC : 4.5 mg * 1/59.65 mg/lb/hr = 0.0754 lb/hr

INORGANIC (31.7+120.7) mg * 1/59.65 mg/lb/hr = 2.55 lb/hr

EMISSIONS

	(Front Half Only)
·02	1.09E-02
·06	1.56E-06
	1.98E-00
)E GAS= 5.19E-02	2.23E-02

MARBLEHE

FIELD TEST DATA SUMMARY TEST NO. 5

PROBE LOCATION= STACK NO.5

COLLECTOR TYPE= EPA TRAIN

AMBIENT TEMPERATURE= 73.0 DEGREES FAHRENHEIT

BAROMETRIC PRESSURE= 29.21 INCHES MERCURY

PROBE LENGTH= 13.0 FEET

NOZZLE DIAMETER= 0.50 INCHES

PITOT TUBE CALIBRATION FACTOR= 0.83

STACK AREA= 42.24 SQ. FT.

GAS ANALYSIS

CO2= 7.0 %
CO = 0.0 %
O2 = 16.5 %
N2 = 76.5 %

MOLECULAR WEIGHT= 29.78 , DRY BASIS

EXCESS AIR= **** %

MARBLEHE

TRAVERSE SUMMARY (TEST NO. 5)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H2O)	ORIFICE DELTAP (IN.H2O)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
START	930	717.610							
N 1	35	721.900	0.06	1.25	280.0	70.0	70.0	0.0	55.0
N 2	40	726.300	0.06	1.28	285.0	70.0	70.0	0.0	55.0
N 3	45	730.600	0.06	1.32	280.0	70.0	70.0	0.0	55.0
N 4	50	734.700	0.05	1.22	280.0	70.0	70.0	0.0	60.0
N 5	55	739.000	0.06	1.32	280.0	70.0	70.0	0.0	60.0
N 6	1000	743.600	0.07	1.52	280.0	70.0	70.0	0.0	60.0
N 7	5	748.300	0.07	1.55	280.0	70.0	70.0	0.0	60.0
N 8	10	752.900	0.07	1.55	285.0	70.0	70.0	0.0	60.0
N 9	15	757.300	0.06	1.32	280.0	70.0	70.0	0.0	60.0
N10	20	761.700	0.06	1.45	280.0	70.0	70.0	0.0	60.0
N11	25	766.200	0.06	1.47	280.0	70.0	70.0	0.0	60.0
N12	30	770.700	0.06	1.47	280.0	70.0	70.0	0.0	60.0
N13	35	774.470	0.04	0.88	280.0	70.0	70.0	0.0	60.0
N14	40	777.900	0.04	0.98	280.0	70.0	70.0	0.0	60.0
N15	45	781.600	0.04	0.90	280.0	70.0	70.0	0.0	60.0
N16	50	785.600	0.05	1.22	280.0	70.0	70.0	0.0	60.0
N17	55	789.600	0.04	1.02	280.0	70.0	70.0	0.0	65.0
N18	1100	793.300	0.04	1.10	280.0	70.0	70.0	0.0	65.0
N19	5	797.100	0.04	0.98	280.0	70.0	70.0	0.0	65.0
N20	10	800.800	0.04	1.00	280.0	70.0	70.0	0.0	65.0
N21	15	804.700	0.04	1.08	280.0	70.0	70.0	0.0	60.0
N22	20	808.900	0.05	1.30	280.0	70.0	70.0	0.0	60.0
N23	25	812.700	0.04	1.02	275.0	70.0	70.0	0.0	60.0
N24	30	816.100	0.03	0.70	270.0	70.0	70.0	0.0	65.0
S 1	1205	820.500	0.04	0.98	280.0	70.0	70.0	0.0	70.0
S 2	10	824.300	0.04	0.98	280.0	70.0	70.0	0.0	60.0
S 3	15	827.100	0.04	1.00	285.0	70.0	70.0	0.0	60.0
S 4	20	832.200	0.07	0.0	285.0	70.0	70.0	0.0	60.0

MARBLEHE

TRAVERSE SUMMARY (CONTINUED)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H2O)	ORIFICE DELTAP (IN.H2O)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
S 5	35	836.300	0.06	1.45	280.0	70.0	70.0	0.0	60.0
S 6	45	841.100	0.07	1.78	280.0	70.0	70.0	0.0	60.0
S 7	50	846.100	0.07	1.80	280.0	70.0	70.0	0.0	60.0
S 8	55	850.800	0.07	1.65	280.0	70.0	70.0	0.0	60.0
S 9	1300	855.600	0.07	1.67	275.0	70.0	70.0	0.0	60.0
S10	5	860.200	0.07	1.52	275.0	70.0	70.0	0.0	60.0
S11	10	864.700	0.07	1.52	275.0	70.0	70.0	0.0	60.0
S12	15	869.300	0.07	1.52	280.0	70.0	70.0	0.0	60.0
S13	20	874.200	0.07	1.52	280.0	70.0	70.0	0.0	60.0
S14	25	878.400	0.07	1.52	280.0	70.0	70.0	0.0	60.0
S15	30	881.900	0.04	0.82	280.0	70.0	70.0	0.0	60.0
S16	35	885.300	0.04	0.95	280.0	70.0	70.0	0.0	65.0
S17	40	889.000	0.04	0.98	280.0	70.0	70.0	0.0	65.0
S18	45	893.400	0.07	1.60	280.0	70.0	70.0	0.0	70.0
S19	50	898.300	0.07	1.75	280.0	70.0	70.0	0.0	70.0
S20	55	902.200	0.04	1.18	280.0	70.0	70.0	0.0	65.0
S21	1400	906.000	0.04	1.05	245.0	70.0	70.0	0.0	65.0
S22	5	908.800	0.03	1.10	230.0	70.0	70.0	0.0	65.0
S23	10	911.700	0.03	1.05	160.0	70.0	70.0	0.0	65.0
S24	15	914.470	0.02	0.50	110.0	70.0	70.0	0.0	65.0
AVERAGE OF 48 POINTS			0.05	1.22	272.0	70.0	70.0	0.0	61.6

MARBLEHE

PARTICULATE TEST SUMMARY-RUN NO. 5

STACK DATA

AVERAGE VELOCITY HEAD= 0.23
ACTUAL VELOCITY= 15.0 FEET PER SECOND(FPS)
PERCENT ISOKINETIC FLOW= 100.0 %
MOISTURE CONTENT= 7.4 %
MOLECULAR WEIGHT,WET BASIS= 28.90
VOLUMETRIC FLOW= 1492680.0 SCFH,DRY
2281456.0 ACFH
38024.3 ACFM

LABORATORY DATA

			(Front Half Only)
FILTER CATCH	=	69.4 MG.	69.4 MG.
FRONT HALF(ACETONE WASH)	=	65.5 MG.	65.5 MG.
FRONT HALF(WATER WASH)	=	21.3 MG.	21.3 MG.
BACK HALF(ACETONE WASH)	=	60.3 MG.	156.2 MG.
BACK HALF(ORGANIC EXTRACT)	=	6.0 MG.	
BACK HALF(WATER RESIDUE)	=	97.9 MG.	
TOTAL PARTICULATE COLLECTED	=	320.4 MG.	

front ½ 156.2 mg : 2.67 lb/hr = 58.5 mg/lb/hr

ORGANIC 6.0 mg * 1/58.5 mg/lb/hr
= 0.103 lb/hr

INORGANIC : (60.3 + 97.9) mg * 1/58.5
2.70

SIONS

S= 5.25E-02

(Front Half Only)
1.25 E-02
1.79E-06
2.67E-00
2.56E-02

MARBLEHE

FIELD TEST DATA SUMMARY TEST NO. 6

PROBE LOCATION= STACK NO.6

COLLECTOR TYPE= EPA TRAIN

AMBIENT TEMPERATURE= 73.0 DEGREES FAHRENHEIT

BAROMETRIC PRESSURE= 29.21 INCHES MERCURY

PROBE LENGTH= 13.0 FEET

NOZZLE DIAMETER= 0.50 INCHES

PITOT TUBE CALIBRATION FACTOR= 0.83

STACK AREA= 42.24 SQ. FT.

GAS ANALYSIS

CO2= 7.0 %
CO = 0.0 %
O2 = 16.5 %
N2 = 76.5 %

MOLECULAR WEIGHT= 29.78 , DRY BASIS

EXCESS AIR= **** %

MARBLEHE

TRAVERSE SUMMARY (TEST NO. 6)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H20)	ORIFICE DELTAP (IN.H20)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
START	925	790.120							
N24	30	794.200	0.05	1.05	270.0	70.0	70.0	0.0	70.0
N23	35	798.400	0.05	1.00	270.0	70.0	70.0	0.0	60.0
N22	40	802.600	0.06	1.20	270.0	70.0	70.0	0.0	65.0
N21	45	807.100	0.06	1.30	280.0	70.0	70.0	0.0	70.0
N20	50	811.600	0.06	1.30	280.0	70.0	70.0	0.0	70.0
N19	55	816.100	0.06	1.30	280.0	70.0	70.0	0.0	70.0
N18	1000	820.200	0.05	1.15	275.0	70.0	70.0	0.0	70.0
N17	5	824.300	0.05	1.15	270.0	70.0	70.0	0.0	65.0
N16	10	828.500	0.05	1.20	275.0	70.0	70.0	0.0	65.0
N15	15	832.800	0.05	1.20	280.0	70.0	70.0	0.0	60.0
N14	20	837.000	0.05	1.20	275.0	70.0	70.0	0.0	60.0
N13	25	840.800	0.05	1.00	275.0	70.0	70.0	0.0	65.0
N12	30	845.000	0.05	1.20	270.0	70.0	70.0	0.0	65.0
N11	35	849.300	0.05	1.20	270.0	70.0	70.0	0.0	65.0
N10	40	853.400	0.05	1.20	270.0	70.0	70.0	0.0	65.0
N 9	45	857.700	0.05	1.20	270.0	70.0	70.0	0.0	70.0
N 8	50	861.800	0.05	1.20	260.0	70.0	70.0	0.0	70.0
N 7	55	866.800	0.05	1.20	260.0	70.0	70.0	0.0	65.0
N 6	1100	869.700	0.04	1.00	265.0	70.0	70.0	0.0	65.0
N 5	5	872.800	0.03	0.80	260.0	70.0	70.0	0.0	60.0
N 4	10	876.600	0.03	0.80	260.0	70.0	70.0	0.0	60.0
N 3	15	879.800	0.03	0.60	260.0	70.0	70.0	0.0	60.0
N 2	20	882.500	0.02	0.60	260.0	70.0	70.0	0.0	65.0
N 1	25	885.100	0.02	0.50	255.0	70.0	70.0	0.0	65.0
S24	1205	889.300	0.05	1.20	280.0	70.0	70.0	0.0	65.0
S23	10	893.400	0.05	1.20	275.0	70.0	70.0	0.0	60.0
S22	15	897.500	0.05	1.15	280.0	70.0	70.0	0.0	65.0
S21	20	901.600	0.05	1.20	280.0	70.0	70.0	0.0	60.0

MARBLEHE

TRAVERSE SUMMARY(CONTINUED)

POINT NO.	CLOCK TIME (MIN)	METER VOLUME (ACF)	PITOT TUBE DELTAP (IN.H20)	ORIFICE DELTAP (IN.H20)	STACK TEMP. (DEG F)	METER TEMPERATURE INLET (DEG F)	METER TEMPERATURE OUTLET (DEG F)	PUMP VACUUM (IN.HG)	IMPINGER TEMP. (DEG F)
S20	25	905.800	0.05	1.20	280.0	70.0	70.0	0.0	60.0
S19	30	910.200	0.06	1.35	280.0	70.0	70.0	0.0	65.0
S18	35	914.700	0.06	1.35	280.0	70.0	70.0	0.0	65.0
S17	40	919.300	0.06	1.40	280.0	70.0	70.0	0.0	70.0
S16	45	923.400	0.05	1.20	280.0	70.0	70.0	0.0	70.0
S15	50	927.500	0.05	1.20	280.0	70.0	70.0	0.0	65.0
S14	55	931.700	0.05	1.20	280.0	70.0	70.0	0.0	65.0
S13	1300	935.900	0.05	1.20	275.0	70.0	70.0	0.0	60.0
S12	5	939.200	0.03	0.50	280.0	70.0	70.0	0.0	65.0
S11	10	942.100	0.03	0.50	275.0	70.0	70.0	0.0	65.0
S10	15	945.000	0.03	0.50	275.0	70.0	70.0	0.0	65.0
S 9	20	948.100	0.03	0.60	275.0	70.0	70.0	0.0	65.0
S 8	25	951.200	0.03	0.70	275.0	70.0	70.0	0.0	65.0
S 7	30	954.800	0.04	0.90	280.0	70.0	70.0	0.0	65.0
S 6	35	958.500	0.04	0.90	275.0	70.0	70.0	0.0	65.0
S 5	40	961.700	0.03	0.60	280.0	70.0	70.0	0.0	65.0
S 4	45	964.900	0.03	0.70	270.0	70.0	70.0	0.0	65.0
S 3	50	968.600	0.04	0.90	270.0	70.0	70.0	0.0	65.0
S 2	55	972.700	0.04	0.90	270.0	70.0	70.0	0.0	70.0
S 1	1400	976.430	0.04	0.90	270.0	70.0	70.0	0.0	70.0
AVERAGE OF 48 POINTS			0.04	1.02	273.0	70.0	70.0	0.0	65.1

MARBLEHE

PARTICULATE TEST SUMMARY-RUN NO. 6

STACK DATA

AVERAGE VELOCITY HEAD= 0.21
ACTUAL VELOCITY= 13.8 FEET PER SECOND(FPS)
PERCENT ISOKINETIC FLOW= 101.6 %
MOISTURE CONTENT= 6.5 %
MOLECULAR WEIGHT,WET BASIS= 29.02
VOLUMETRIC FLOW= 1389359.0 SCFH,DRY
2104649.0 ACFH
35077.5 ACFM

LABORATORY DATA (Front Half Only)

FILTER CATCH	=	47.0 MG.	47.0 MG.
FRONT HALF(ACETONE WASH)	=	63.8 MG.	63.8 MG.
FRONT HALF(WATER WASH)	=	26.2 MG.	26.2 MG.
BACK HALF(ACETONE WASH)	=	22.2 MG.	137.0 MG.
BACK HALF(ORGANIC EXTRACT)	=	5.2 MG.	
BACK HALF(WATER RESIDUE)	=	212.6 MG.	
TOTAL PARTICULATE COLLECTED	=	377.0 MG.	

FRONT ½ : 137.0 mg : 2.3 lb/hr = 59.57 mg/lb/hr

ORGANIC : 5.2 mg * 1/59.57 mg/lb/hr
= 0.873 lb/hr

INORGANIC : (22.2 + 212.6) mg 1/59.57
= 3.94

IONS : 6.50E-02

(Front Half Only)
1.16E-02
1.66E-06
2.30E-00
2.36E-02

Sample Calculations
Test No. 1

1. Volume of dry gas sampled at standard conditions, DSCF

$$V_{m_{STD}} = \frac{17.71 \times V_m (P_b + \frac{\Delta H}{13.6})}{(T_m + 460)} = \frac{(17.71)(186.31)(29.10 + \frac{.99}{13.6})}{530} = 181.62 \text{ scf}$$

2. Volume of Water Vapor at Standard Conditions, SCF

$$V_{W_{STD}} = (0.0474) V_{LC} = (0.0474)(265) = 12.56$$

3. Moisture Content in Stack Gas

$$B_{wo} = \frac{V_{W_{STD}}}{V_{m_{STD}} + V_{W_{STD}}} = \frac{12.56}{181.62 + 12.56} = 0.065 = 6.5\% \text{ Moisture}$$

4. Mole Fraction of Dry Gas

$$M_D = \frac{100 - 100(B_{wo})}{100} = \frac{100 - 100(.065)}{100} = 0.935$$

5. Molecular Weight of Dry Stack Gas, lb/lb-mole

$$M_{WD} = (0.44)(\%CO_2) + (0.32)(\%O_2) + (0.28)(\%N_2 + \%CO)$$

$$= .44(6.8) + .32(19.5) + .28(73.7) = 29.87 \text{ lb/lb-mole}$$

6. Molecular Weight of Wet Stack Gas, lb/lb-mole

$$M_w = M_{w_D} \times M_D + 18(1 - M_D) = 29.87 \times .935 + 18(1 - .935) = 29.10 \frac{lb}{lb\text{-}mole}$$

7. Stack Gas Velocity at Stack Conditions, fpm

$$V_s = 5128.8 \times C_p \times (\sqrt{\Delta P})_{avg.} \sqrt{\frac{T_{s\,avg.}}{P_s M_w}} =$$

$$5128.8 \times .83 \times .22 \sqrt{\frac{751}{(29.10)(29.10)}} = 881.9 \text{ fpm}$$

8. Stack Gas Volumetric Flow Rate at Stack Conditions, DSCFM

$$Q_s = (1 - B_{wo})(V_s)(A)\left(\frac{T_{STD}}{T_{s\,avg}}\right)\left(\frac{P_s}{P_{STD}}\right) =$$

$$(1 - .065)(881.9)(42.24)\left(\frac{530}{751}\right)\left(\frac{29.10}{29.92}\right) = 23{,}907 \text{ DSCFM}$$

9. Stack Volumetric Flow Rate at Stack Conditions, ACFM

$$Q_D = \frac{Q_s(T_s + 460)(29.92)}{530(P_s)(M_D)} = \frac{(23{,}907)(751)(29.92)}{530(29.10)(.935)} = 37{,}252 \text{ ACFM}$$

(530 ↑ T_{std})

10. Percent Isokinetic

$$\%I = \frac{1{,}032 \times (T_s + 460) V_{m_{STD}}}{V_s \times T_t \times P_s \times M_D \times D_N^2} = \frac{(1032)(751)(181.62)}{(881.9)(240)(29.10)(.935)(.5)^2} = 97.8\%$$

1. PARTICULATE - PROBE + FILTER, GR./DSCF

$$C_{an} = 0.0154 \times \frac{M_f}{V_{mSTD}} = 0.0154 \times \frac{262.4}{181.62} = 0.0222 \text{ GR./DSCF}$$

2. PARTICULATE - TOTAL, GR./DSCF

$$C_{ao} = 0.0154 \times \frac{M_t}{V_{mSTD}} = 0.0154 \times \frac{424.5}{181.62} = 0.0360 \text{ GR/DSCF}$$

3. PARTICULATES - PROBE + FILTER AT STACK CONDITIONS, GR./ACF

$$C_{at} = \frac{17.71 \times C_{an} \times P_s \times M_D}{(T_s + 460)} = \frac{17.71 \times .0223 \times 29.10 \times .935}{751} = 0.0143 \text{ GR./ACF}$$

4. PARTICULATES - TOTAL AT STACK CONDITIONS, GR/ACF

$$C_{au} = \frac{17.71 (C_{ao}) \times P_s \times M_D}{(T_s + 460)} = \frac{17.71 \times .0361 \times 29.1 \times .935}{751} = 0.0231 \text{ GR./ACF}$$

5. PARTICULATES - PROBE + FILTER, LB/HR.

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = .00857 \times .0222 \times 23,907 = 4.55 \text{ LB/HR}$$

6. PARTICULATES - PROBE + FILTER, LBS/HR.

$$C_{ax} = 0.00857 \times C_{ao} \times Q_s = 0.00857 \times .036 \times 23,907 = 7.38 \text{ LBS/H}$$

17. PARTICULATE - probe, cyclone, AND filter, lb/ton feed

$$P_{tf} = \frac{C_{aw}}{T_c} = \frac{4.55}{37.76} = 0.1205 \text{ lb/ton}$$

18. PARTICULATE - total, lb/ton feed

$$P_{tt} = \frac{C_{ax}}{T_c} = \frac{7.38}{37.76} = 0.1949 \text{ lb/ton}$$

APPENDIX B

SULFUR DIOXIDE TEST RESULTS AND SAMPLE CALCULATION

Walden

WALDEN SOURCE TEST REPORT

COMPANY= MARBLEHEAD LIME COMPANY

PLANT= LIME KILN NUMBER 5

LOCATION= GARY, INDIANA

PROCESS= LIME KILN

CONTROL EQUIPMENT= BAGHOUSE

TEST SCHEDULE

RUN NO.	DATE	POLLUTANTS SAMPLED				
1	11JUN 74	PART	SO2	NOX	CO	OPACITY
2	11JUN 74	PART	SO2			OPACITY
3	12JUN 74	PART	SO2	NOX	CO	OPACITY
4	12JUN 74	PART	SO2			OPACITY
5	13JUN 74	PART	SO2	NOX	CO	OPACITY
6	13JUN 74	PART	SO2			OPACITY

MARBLEHE

SO2 TEST SUMMARY-RUN NO. 1
BASED ON METHOD 5 TRAVERSE

STACK DATA

ACTUAL VELOCITY= 14.6 FEET PER SECOND(FPS)
MOISTURE CONTENT= 6.5 %
VOLUMETRIC FLOW= 1427802.0 SCFH,DRY
2222941.0 ACFH
37049.0 ACFM

LABORATORY DATA

REPLICATE NO.= 1
TITRANT VOLUME= 7.350 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 100.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.32E-05 POUNDS/SCF,DRY

REPLICATE NO.= 2
TITRANT VOLUME= 7.350 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 100.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.32E-05 POUNDS/SCF,DRY

SO2 RESULTS(AVERAGE OF 2 REPLICATES)

POUNDS/SCF,DRY= 1.32E-05
POUNDS/HOUR= 1.89E 01

PPM(VOLUME)= 8.09E 01 (@25 DEG C.)

MARBLEHE

SO2 TEST SUMMARY-RUN NO. 2
BASED ON METHOD 5 TRAVERSE

STACK DATA

ACTUAL VELOCITY= 13.0 FEET PER SECOND(FPS)
MOISTURE CONTENT= 4.8 %
VOLUMETRIC FLOW= 1344402.0 SCFH,DRY
1981892.0 ACFH
33031.5 ACFM

LABORATORY DATA

REPLICATE NO.= 1
TITRANT VOLUME= 4.150 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 100.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.27E-05 POUNDS/SCF.DRY

REPLICATE NO.= 2
TITRANT VOLUME= 4.100 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 100.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.26E-05 POUNDS/SCF.DRY

SO2 RESULTS(AVERAGE OF 2 REPLICATES)

POUNDS/SCF.DRY= 1.27E-05
POUNDS/HOUR= 1.70E 01

PPM(VOLUME)= 7.74E 01 (@25 DEG C.)

MARBLEHE

SO2 TEST SUMMARY-RUN NO. 3
BASED ON METHOD 5 TRAVERSE

STACK DATA

ACTUAL VELOCITY= 14.0 FEET PER SECOND(FPS)
MOISTURE CONTENT= 6.3 %
VOLUMETRIC FLOW= 1389731.0 SCFH,DRY
2131933.0 ACFH
35532.2 ACFM

LABORATORY DATA

REPLICATE NO.= 1
TITRANT VOLUME= 7.560 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 100.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.74E-05 POUNDS/SCF,DRY

REPLICATE NO.= 2
TITRANT VOLUME= 7.590 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 100.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.74E-05 POUNDS/SCF,DRY

SO2 RESULTS(AVERAGE OF 2 REPLICATES)

POUNDS/SCF,DRY= 1.74E-05
POUNDS/HOUR= 2.42E 01

PPM(VOLUME)= 1.06E 02 (@25 DEG C.)

MARBLEHE

SO2 TEST SUMMARY-RUN NO. 4
BASED ON METHOD 5 TRAVERSE

STACK DATA

ACTUAL VELOCITY= 12.8 FEET PER SECOND(FPS)
MOISTURE CONTENT= 7.5 %
VOLUMETRIC FLOW= 1274832.0 SCFH,DRY
1942475.0 ACFH
32374.6 ACFM

LABORATORY DATA

REPLICATE NO.= 1
TITRANT VOLUME= 6.270 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 100.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.46E-05 POUNDS/SCF,DRY

REPLICATE NO.= 2
TITRANT VOLUME= 6.450 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 100.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.50E-05 POUNDS/SCF,DRY

SO2 RESULTS(AVERAGE OF 2 REPLICATES)

POUNDS/SCF,DRY= 1.48E-05
POUNDS/HOUR= 1.89E 01

PPM(VOLUME)= 9.07E 01 (@25 DEG C.)

MARBLEHE

SO2 TEST SUMMARY-RUN NO. 5
BASED ON METHOD 5 TRAVERSE

STACK DATA

ACTUAL VELOCITY= 15.0 FEET PER SECOND(FPS)
MOISTURE CONTENT= 7.4 %
VOLUMETRIC FLOW= 1492680.0 SCFH,DRY
2281456.0 ACFH
38024.3 ACFM

LABORATORY DATA

REPLICATE NO.= 1
TITRANT VOLUME= 6.000 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 121.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.63E-05 POUNDS/SCF,DRY

REPLICATE NO.= 2
TITRANT VOLUME= 6.050 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 121.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.64E-05 POUNDS/SCF,DRY

SO2 RESULTS(AVERAGE OF 2 REPLICATES)

POUNDS/SCF,DRY= 1.64E-05
POUNDS/HOUR= 2.44E 01

PPM(VOLUME)= 1.00E 02 (@25 DEG C.)

MARBLEHE

SO2 TEST SUMMARY-RUN NO. 6
BASED ON METHOD 5 TRAVERSE

STACK DATA

ACTUAL VELOCITY= 13.8 FEET PER SECOND(FPS)
MOISTURE CONTENT= 6.5 %
VOLUMETRIC FLOW= 1389359.0 SCFH,DRY
2104649.0 ACFH
35077.5 ACFM

LABORATORY DATA

REPLICATE NO.= 1
TITRANT VOLUME= 3.750 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 117.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.55E-05 POUNDS/SCF,DRY

REPLICATE NO.= 2
TITRANT VOLUME= 3.750 ML
BLANK VOLUME= 0.0 ML
TITRANT NORMALITY=0.01030N
SOLUTION VOLUME= 117.0 ML
ALIQUOT VOLUME= 20.0 ML
SO2 CONCENTRATION= 1.55E-05 POUNDS/SCF,DRY

SO2 RESULTS(AVERAGE OF 2 REPLICATES)

POUNDS/SCF,DRY= 1.55E-05
POUNDS/HOUR= 2.15E 01

PPM(VOLUME)= 9.48E 01 (@25 DEG C.)

Sample Calculations
Test No. 1

1. Volume of Gas Sample through Dry Gas Meter, DSCF

$$V_{m_{STD}} = \frac{(17.71)(V_m)(P_{Bar})}{T_m} = \frac{(17.71)(2.08)(29.10)}{532} = 2.01 \text{ DSCF}$$

2. Sulfur Dioxide Concentration, LBS./DSCF

$$C_{SO_2} = \frac{(7.05 \times 10^{-5})(V_f - V_i)(N)\left(\frac{V_{soln}}{V_a}\right)}{V_{m_{STD}}} =$$

$$= \frac{(7.05 \times 10^{-5})(7.35)(.0103)\left(\frac{100}{20}\right)}{2.01} = 1.32 \times 10^{-5} \frac{LBS}{DSCF}$$

3. Sulfur Dioxide Concentration, PPM

$$C_{PPM} = C_{SO_2} \times \frac{359}{m_{\omega_{SO_2}}} \times \frac{T_{25}}{T_o} \times 10^6 = 1.32 \times 10^{-5} \times \frac{359}{64} \times \frac{298}{273} \times 10^6 =$$

$$= 80.8 \text{ PPM}$$

4. Sulfur Dioxide - Total, LBS/HR.

$$C = (C_{SO_2})(Q_s)(60) = (1.32 \times 10^{-5})(23,797)(60) = 18.8 \text{ LBS/HR.}$$

APPENDIX C

NITROGEN OXIDES TEST RESULTS AND SAMPLE CALCULATION

Walden

WALDEN SOURCE TEST REPORT

COMPANY= MARBLEHEAD LIME COMPANY

PLANT= LIME KILN NUMBER 5

LOCATION= GARY, INDIANA

PROCESS= LIME KILN

CONTROL EQUIPMENT= BAGHOUSE

TEST SCHEDULE

RUN NO.	DATE	POLLUTANTS SAMPLED				
1	11JUN 74	PART	SO2	NOX	CO	OPACITY
2	11JUN 74	PART	SO2			OPACITY
3	12JUN 74	PART	SO2	NOX	CO	OPACITY
4	12JUN 74	PART	SO2			OPACITY
5	13JUN 74	PART	SO2	NOX	CO	OPACITY
6	13JUN 74	PART	SO2			OPACITY

MARBLEHE

NOX TEST SUMMARY-RUN NO. 1
BASED ON METHOD 5 TRAVERSE

STACK DATA

ACTUAL VELOCITY= 14.6 FEET PER SECOND(FPS)
MOISTURE CONTENT= 6.5 %
VOLUMETRIC FLOW= 1427802.0 SCFH,DRY
2222941.0 ACFH
37049.0 ACFM

LABORATORY DATA

REPLICATE NO.= 1
FLASK VOLUME= 2038.0 ML
ABSORBANT VOLUME= 26.0 ML
INITIAL PRESSURE= 1.89 IN.HG
FINAL VOLUME= 29.41 IN.HG
INITIAL TEMPERATURE= 72.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 76.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 4.94E-06 POUNDS/SCF,DRY(AS NO2)

REPLICATE NO.= 2
FLASK VOLUME= 2030.0 ML
ABSORBANT VOLUME= 24.5 ML
INITIAL PRESSURE= 1.89 IN.HG
FINAL VOLUME= 28.51 IN.HG
INITIAL TEMPERATURE= 70.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 74.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 4.62E-06 POUNDS/SCF,DRY(AS NO2)

REPLICATE NO.= 3
FLASK VOLUME= 1961.0 ML
ABSORBANT VOLUME= 24.0 ML
INITIAL PRESSURE= 1.79 IN.HG
FINAL VOLUME= 28.61 IN.HG
INITIAL TEMPERATURE= 73.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 73.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 4.99E-06 POUNDS/SCF,DRY(AS NO2)

REPLICATE NO.= 4
FLASK VOLUME= 1992.0 ML
ABSORBANT VOLUME= 25.5 ML
INITIAL PRESSURE= 1.89 IN.HG
FINAL VOLUME= 29.41 IN.HG
INITIAL TEMPERATURE= 72.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 74.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 5.07E-06 POUNDS/SCF,DRY(AS NO2)

NOX RESULTS(AVERAGE OF 4 REPLICATES)

POUNDS/SCF,DRY= 4.90E-06
POUNDS/HOUR= 7.00E 00

PPM(VOLUME)= 4.18E 01 (@25 DEG C.)

MARBLEHE

NOX TEST SUMMARY-RUN NO. 3
BASED ON METHOD 5 TRAVERSE

STACK DATA

ACTUAL VELOCITY= 14.0 FEET PER SECOND(FPS)
MOISTURE CONTENT= 6.3 %
VOLUMETRIC FLOW= 1389731.0 SCFH,DRY
2131933.0 ACFH
35532.2 ACFM

LABORATORY DATA

REPLICATE NO.= 1
FLASK VOLUME= 1964.0 ML
ABSORBANT VOLUME= 25.0 ML
INITIAL PRESSURE= 2.04 IN.HG
FINAL VOLUME= 29.68 IN.HG
INITIAL TEMPERATURE= 72.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 80.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 5.05E-06 POUNDS/SCF,DRY(AS NO2)

REPLICATE NO.= 2
FLASK VOLUME= 2046.0 ML
ABSORBANT VOLUME= 25.0 ML
INITIAL PRESSURE= 1.81 IN.HG
FINAL VOLUME= 29.06 IN.HG
INITIAL TEMPERATURE= 75.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 81.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 4.92E-06 POUNDS/SCF,DRY(AS NO2)

REPLICATE NO.= 3
FLASK VOLUME= 2009.0 ML
ABSORBANT VOLUME= 25.0 ML
INITIAL PRESSURE= 1.80 IN.HG
FINAL VOLUME= 29.18 IN.HG
INITIAL TEMPERATURE= 76.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 81.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 4.12E-06 POUNDS/SCF,DRY(AS NO2)

REPLICATE NO.= 4
FLASK VOLUME= 2020.0 ML
ABSORBANT VOLUME= 24.0 ML
INITIAL PRESSURE= 1.78 IN.HG
FINAL VOLUME= 28.88 IN.HG
INITIAL TEMPERATURE= 71.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 82.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 3.77E-06 POUNDS/SCF,DRY(AS NO2)

NOX RESULTS(AVERAGE OF 4 REPLICATES)

POUNDS/SCF,DRY= 4.47E-06
POUNDS/HOUR= 6.21E 00

PPM(VOLUME)= 3.81E 01 (@25 DEG C.)

MARBLEHE

NOX TEST SUMMARY-RUN NO. 5
BASED ON METHOD 5 TRAVERSE

STACK DATA

ACTUAL VELOCITY= 15.0 FEET PER SECOND(FPS)
MOISTURE CONTENT= 7.4 %
VOLUMETRIC FLOW= 1492680.0 SCFH,DRY
2281456.0 ACFH
38024.3 ACFM

LABORATORY DATA

REPLICATE NO.= 1
FLASK VOLUME= 2030.0 ML
ABSORBANT VOLUME= 26.0 ML
INITIAL PRESSURE= 1.62 IN.HG
FINAL VOLUME= 29.67 IN.HG
INITIAL TEMPERATURE= 77.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 85.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 9.48E-06 POUNDS/SCF,DRY(AS NO2)

REPLICATE NO.= 2
FLASK VOLUME= 1992.0 ML
ABSORBANT VOLUME= 26.0 ML
INITIAL PRESSURE= 1.59 IN.HG
FINAL VOLUME= 29.57 IN.HG
INITIAL TEMPERATURE= 78.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 85.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 7.70E-06 POUNDS/SCF,DRY(AS NO2)

REPLICATE NO.= 3
FLASK VOLUME= 2040.0 ML
ABSORBANT VOLUME= 25.0 ML
INITIAL PRESSURE= 1.62 IN.HG
FINAL VOLUME= 29.47 IN.HG
INITIAL TEMPERATURE= 82.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 86.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 9.15E-06 POUNDS/SCF,DRY(AS NO2)

REPLICATE NO.= 4
FLASK VOLUME= 1994.0 ML
ABSORBANT VOLUME= 26.0 ML
INITIAL PRESSURE= 1.68 IN.HG
FINAL VOLUME= 29.37 IN.HG
INITIAL TEMPERATURE= 80.0 DEG. FAHRENHEIT
FINAL TEMPERATURE= 83.0 DEG. FAHRENHEIT
NOX CONCENTRATION= 7.87E-06 POUNDS/SCF,DRY(AS NO2)

NOX RESULTS(AVERAGE OF 4 REPLICATES)

POUNDS/SCF,DRY= 8.55E-06
POUNDS/HOUR= 1.28E 01

PPM(VOLUME)= 7.29E 01 (@25 DEG C.)

Sample Calculation
No. 1 Test

1. Volume of Gas Sample, mls, dry

$$V_{sc} = \frac{T_{STD}(V_f - V_a)}{P_{STD}}\left(\frac{P_f}{T_f} - \frac{P_i}{T_i}\right) = 17.71(2038-26)\left(\frac{29.41}{536} - \frac{1.89}{532}\right) =$$

$$= 1828.7 \text{ mls.}$$

2. Nitrogen Oxides Concentration, LBS/SCF, DRY (25°C)

$$C_{NOx} = 6.2\times10^{-5}\left(\frac{M}{V_{sc}}\right) = 6.2\times10^{-5}\left(\frac{145.6}{1828.7}\right) = 49.4\times10^{-7} \text{ LBS/SCF}$$

3. Nitrogen Oxides Concentration, PPM

$$C_{PPM} = C_{NOx} \times \frac{359}{46} \times \frac{T_{25}}{T_0} \times 10^6 = \left(49.4\times10^{-7}\ \frac{\text{lbs}}{\text{ft}^3}\right)\left(\frac{359}{46}\ \frac{\text{ft}^3}{\text{lb}}\right)\left(\frac{298}{273}\right)\times10^6 =$$

(0°C)

$$= 42.1 \text{ ppm}$$

4. Nitrogen Oxides - Total, LBS/HR.

$$C = (C_{NOx})(Q_s)(60) = (49.4\times10^{-7})(23{,}797)(60) = 7.05 \text{ LBS/HR}$$

APPENDIX D

CARBON MONOXIDE TEST RESULTS

Walden

WALDEN SOURCE TEST REPORT

COMPANY= MARBLEHEAD LIME COMPANY

PLANT= LIME KILN NUMBER 5

LOCATION= GARY, INDIANA

PROCESS= LIME KILN

CONTROL EQUIPMENT= BAGHOUSE

TEST SCHEDULE

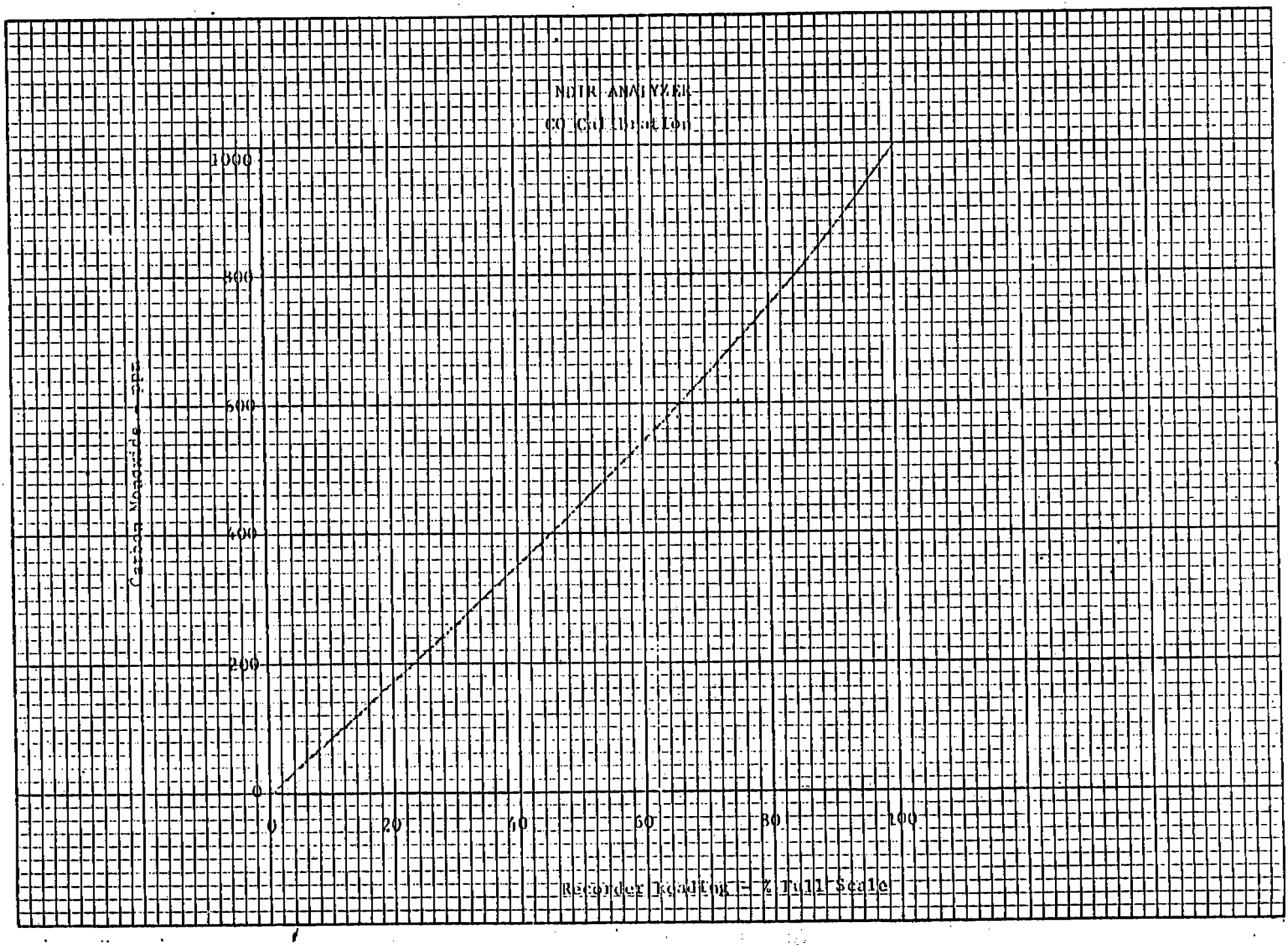
RUN NO.	DATE	POLLUTANTS SAMPLED				
1	11JUN 74	PART	SO2	NOX	CO	OPACITY
2	11JUN 74	PART	SO2			OPACITY
3	12JUN 74	PART	SO2	NOX	CO	OPACITY
4	12JUN 74	PART	SO2			OPACITY
5	13JUN 74	PART	SO2	NOX	CO	OPACITY
6	13JUN 74	PART	SO2			OPACITY

TABLE D-1

SUMMARY OF CO TEST RESULTS

Date	Time	CO, ppm
June 11, 1974	1500 - 1700	15
June 12, 1974	1030 - 1230	580
June 13, 1974	930 - 1130	30

The following graph is the calibration curve for the NDIR Analyzer.



APPENDIX E

OPACITY TEST RESULTS

Walden

The relative opacity of each of the six stacks was determined by EPA Method 9. The opacity determinations were conducted for two hours on each stack during the particulate tests. Two certified EPA-9 observers read each stack except Stack No. 5, which was read by one observer. The results are summarized in Table E-1.

TABLE E-1

SUMMARY OF OPACITY READINGS: NO. 5 LIME KILN

Stack No. / Date	1 June 11, 1974		2 June 11, 1974		3 June 12, 1974		4 June 12, 1974		5 June 13, 1974		6 June 13, 1974	
	Obs. 1	Obs. 2	Obs. 1	Obs. 2	Obs. 1	Obs. 2	Obs. 1	Obs. 2	Obs. 1	Obs. 2	Obs. 1	Obs. 2
Start Time	1238	1601	1556	1601	1053	1053	1342	1305	931		1146	1210
Duration of Observation (min)	240	240	240	240	234	240	240	240	240		240	227
Total No. of Readings	960	960	960	960	936	960	960	960	960		960	908
No. Readings Unobservable	0	0	0	0	0	0	0	0	0		0	0
No. Readings 0% Opacity	952	960	958	960	928	954	960	960	956		959	908
5	6	0	2	0	7	4	0	0	2		1	0
10	2	0	0	0	0	2	0	0	2		0	0
15	0	0	0	0	2	0	0	0	0		0	0
20-100	0	0	0	0	0	0	0	0	0		0	0
Percent Readings Unobservable	0	0	0	0	0	0	0	0	0		0	0
Percent Readings 0% Opacity	99.2	100.2	99.8	100.0	99.1	99.4	100.0	100.0	99.6		99.9	100.0
5	0.6	0.0	0.2	0.0	0.7	0.4	0.0	0.0	0.2		0.1	0.0
10	0.2	0.0	0.0	0.0	0.2	0.2	0.0	0.0	0.2		0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
20-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.0
Average Opacity =	0.062	0.000	0.010	0.000	0.069	0.042	0.000	0.000	0.031		0.005	0.000

$$\frac{\text{Sum of Nos.}}{\text{No. Readings Observable}}$$

APPENDIX F

FIELD DATA

Company Marblehead | Location Gary, Indiana

Facility Lime Kiln | Unit No. 5

Operators

Date June 11 1974

Data Set No. 1 | Page 1

	Units	1030	1100	1130	1200	1230	1300	1330	1400
Stone Feed Rate	TPH	55	55	55	55	55	55	55	55
Coal Feed Rate	TPH	5.7	5.6	5.8	5.7	5.7	5.7	5.7	5.7
Bag Collector Press. (Control Room)	in. H_2O	1.5	1.5	1.6	1.6	1.6	1.4	2.0	2.5
" " (Baghouse *)	in H_2O	1.7	1.8	1.8	1.7	2.0	1.7	1.8	1.8
Backend Temp	°F	Not Working	—	—	—	—	—	—	—
Calcining Zone Temp	°F	Not Working	—	—	—	—	—	—	—
Burning Zone Temp	°F	~~1150~~	~~1150~~	Being calibrated	—	—	1150	1525	1520
Kiln Draft	in. H_2O	3.4	3.5	3.4	3 4	3.2	3.2	3 2	1.6
Hood Draft	in. H_2O	-.48	-.46	-.48	-0.44	-0.41	-.44	-.44	-.49
Burner Pressure	in H_2O	4.6	4.6	4.6	4.7	4.7	4.7	4.7	4.7
Oxygen	%	2.2	2.3	2.3	2.1	1.8	1.75	1.8	2.2
Combustibles	%	0	0	0	0	0	0	0	0
ID Fan Temp	°F	590	585	590	585	580	580	575	580
Coal Feed Counter	revolutions	988493	988739	989014	989295	989563	989879	990150	990439
	24-Time	1039	1105	1134	1203	1231	1304	1332	1402
Stone Feed Counter	revolutions	3239650	3241281	3242983	3244794	3246553 ~~[illegible]3~~	3248692	3250335	3252278
	24-Time	1040	1106	1133	1202	1230	1304	1330	1401
I.D Fan Speed	rpm	620	620	620	620	620	620	620	620
Primary Air Damper Position	%	35	35	35	35	35	34.5	34	34
Speed of Kiln	RPH	64	64	64	64	64	64	64	64
Stone Feed weight *	1/100 tons	249142	250580	251994	253874	255630	257958	259670	261629
Time	24-hour	1045	1108	1131	1201	1229	1306	1333	1404
Coal Feed Weight *	1/100 tons	~~090413~~	090613	090834	091123	091391	091748	092016	0923 0[illegible]
Time		~~1107~~	1107	1130	1200	1228	1305	1333	1403
Baghouse Temp.	°F	—	—	—	580	580	580	580	580

* [illegible]

Company: Marblehead | Location: Gary, Indiana

Facility: Lime Kiln | Unit No. 6

Operators

Date: June 11, 1974

Data Set No. 1 | Page 2

	Units	1430	1530	1600	1630	1700	1725	1805
Stone Feed Rate	tons/hr	55	55	55	55	55	55	55
Coal Feed Rate	tons/hr	5.75	5.75	5.8	5.8	5.7	5.7	5.7
Bag Collector Press. (Control Room)	in. H_2O	2.4	2.3	2.2	2.2	2.1	2.2	0.9
" " " * (Bag House)	in. H_2O	1.8	2.0	1.9	1.8	1.8	1.7	1.8
Backend Temp.	°F	—	—	—	—	—	—	—
Calcining Temp	°F	—	—	—	—	—	—	—
Burning Zone Temp	°F	1525	1540	1570	1600	1620	1650	1650
Kiln Draft	-in. H_2O	1.4	2.6	2.6	2.6	2.7	2.9	2.8
Hood Draft.	in H_2O	-.5	-.4	-.4	-.39	-.42	-.43	-.37
Burner Pressure	in. H_2O	4.7	4.7	4.8	4.8	4.8	4.8	4.8
Oxygen	%	2.2	1.6	2.1	~~3.0~~ *	1.8	1.7	2.1
Combustibles	%	0	0	0	0	0	0	0
I.D Fan Temp.	°F	586	560	570	585	585	585	590
Coal Feed Counter	revolutions	990709	991258	991597	991801	992169	992408	992811
Time	24-hour	1430	1527	1602	1633	1701	1726	1808
Stone Feed Counter	revolutions	3254067	3257779	3259913	3261858	3263615	3265184	3267760
Time		1429	1528	1602	1633	1701	1726	1807
I.D. Fan Speed	rpm	620	620	620	620	620	620	620
Primary Air Fan Damper	%	34	34	34	34	34	34	34
Kiln Speed	RPH	64	64	64	64	63.5	63.5	64
Stone Feed Weight Intg.*	Xxx tons	263461	267298	269180	271126	272820	274452	277151
Time:	24-hour	1433	1534	1604	1635	1702	1728	1811
Coal Feed Weight Intg.*	Xxx tons	092585	093173	093465	093769	094056	094276	094678
Time	24-hour	1432	1533	1603	1634	1702	1727	1809
Baghouse Temp	°F	585	570	575	582	580	580	592

* Oxygen probe was removed for cleaning during this period. (~~max reading out~~) 3%.

Company: Marblehead | Location: Gary, Indiana

Facility: Lime Kiln | Unit No. 5

Operators

Date: June 12, 1974

Data Set No. 2 | Page 1

	Units	930	1015	1100	1130	1200	1230	1300	1330
Stone Feed Rate	tons/hr	58.5	57	55.5	55.5	55.5	55.5	55.5	55.5
Coal Feed Rate	tons/hr.	5.6	5.8	5.75	5.6	5.6	5.8	5.8	5.8
Bag Collector Pressure (Central Pt.)	in. H_2O	1.3	1.2	1.1	1.1	1.1	1.1	1.1	1.1
" " (Baghouse)	in. H_2O	1.6	1.5	1.2	1.3	1.5	1.5	1.5	1.4
Backend Temp.	°F	—	—	—	—	—	—	—	—
Calcining Temp.	°F	—	—	—	—	—	—	—	—
Burning Zone Temp.[2] (Rot. Kiln Pt.)	°F	1650	1570	1550	1550	1550	1570	1590	1600
Kiln Draft	- in. H_2O	2.9	3.0	2.8	2.8	3.1	3.2	3.2	3.0
Hood Draft	in. H_2O	-.5+	-.5+	-.5	-.5+	-.5+	-.5+	-.5+	-.5+
Burner Pressure	in H_2O	4.5	4.5	4.6	4.6	4.6	4.6	4.6	4.6
Oxygen	%	1.7	2.3	1.9	—*	1.0	1.7	1.7	1.4
Combustibles	%	0	0	0	0	0	0	0	0
I.D. Fan Temp	°F	560	580	580	580	585	592	600	600
Coal Feed Counter	revolutions	001832	002250	002670	002950	003259	003538	003838	004120
Time	24-hour	933	1017	1100	1129	1207	1231	1302	1331
Stone Feed Counter	revolutions	3327966	3330932	3333683	3335474	3337648	3339572	3341567	3343421
Time	24-hour	931	1016	1058	1127	1201	1231	1302	1331
I.D. Fan Speed	rpm	595	600	540	540	590	590	590	560
Primary Air Fan Damper Position	%	34	34.5	35	35	35	35	35	35
Kiln Speed	rph	68	67	66	66	66	66	66	66
Stone Feed Weight Intg.	1/100 tons	337380	340013	343085	344939	347049	348843	350833	352758
" " Time	24-hour	935	1015	1103	1132	1205	1233	1304	1334
Coal Feed Weight Intg.	1/100 tons	103698	104079	104547	104827	105136	105407	105706	105998
Time	24-hour	934	1014	1102	1131	1204	1232	1303	1333
Baghouse Temp.	°F	550	560	585	582	580	590	600	600

10:00 a.m. Stone Feed rate dropped to 55.5 tph. *O_2 meter off-line (prior one of stack).

Company Marblehead | Location Gary, Indiana

Facility Lime Kiln | Unit No. 5

Operators

Date June 12, 1974

Data Set No. 2 | Page 2

	Units	1400	1430	1530	1600
Stone Feed Rate	tons/hr.	55.5	55.5	55.5	56
Coal Feed Rate	tons/hr	5.7	5.8	5.7	5.75
Bag Collector Press (Cold Pole)	in. H_2O	1.1	1.1	1.1	1.1
" " " (Baghouse)	in. H_2O	1.5	1.4	1.4	1.4
Backend Temp.	°F	—	—	—	—
Calcining Temp.	°F	—	—	—	—
Burning Zone Temp.	°F	1590	1575	1625	1625
Kiln Draft	in H_2O	3.0	3.1	3.2	3.2
Hood Draft	in H_2O	-.5+	-.5+	-.5+	-.5+
Burner Pressure	in H_2O	4.7	4.7	4.7	4.7
Oxygen	%	1.4	—*	1.6	1.9
Combustibles	%	0	0	0	0
I.D. Fan Temp	°F	590	595	595	600
Coal Feed Counter	rev.	004429	004700	005328	005568
Time	24-hour	1403	1431	1536	1401
Stone Feed Counter	rev.	3345477	3347277	3351461	3353124
Time	24-hour	1403	1431	1536	1402
I.D. Fan Speed	rpm	600	580	580	580
Primary Air Fan Damper Position	% open	35	35	35	35
Kiln Speed	rph	66	66	66	66
Stone Feed Intg.	100 tons	354815	356613	360855	362398
Time	24-hour	1406	1434	1539	1404
Coal Feed Intg.	100 tons	106306	106577	107214	107445
Time	24-hour	1405	1433	1538	1403
Baghouse Temp.	°F	590	590	595	595

O. level ≈ 0.2% between 11:30–11:45a (7 AM ... 4 = 11:30a) *O_2 meter off-line

Company Marblehead | Location Gary, Indiana

Facility Lime Kiln | Unit No. 5

Operators

Date June 13, 1974

Data Set No. 3 | Page 1

	Units	0915	1000	1030	1100	1130	1230	1300	1330
Stone Feed Rate	tons/hr.	52.5	52.5	54	54.5	56.5	55.5	55.5	55.5
Coal Feed Rate	tons/hr	5.6	5.6	5.6	5.5	5.4	5.5	5.6	5.5
Bag Collector Press (Control Room)	in. H_2O	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
" " " (Baghouse)	in. H_2O	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.4
Backend Temp.	°F	—	—	—	—	—	—	—	
Calcining Zone Temp	°F	—	—	—	—	—	—	—	—
Burning Zone Temp	°F Blue-ink Pen	1600	1750	1850	1850	1875	1820	1775	1675
Kiln Draft	-in H_2O	3.2	3.1	3.2	3.2	3.1	3.2	3.2	3.2
Hood Draft	in H_2O	-.5+	-.5+	-.5+	-.5+	-.5+	-.5+	-.5+	-.5+
Burner Pressure	in H_2O	6.0	6.0	6.0	6.1	6.0	6.0	6.0	6.0
Oxygen	%	1.4	1.4	1.4	1.5	1.5	1.5	1.6	1.5
Combustibles	%	0	0	0	0	0	0	0	0
I.D. Fan Temp.	°F	600	590	590	585	570	580	580	585
Coal Feed Counter	rev.	015352	015736	016044	016300	016586	016778	017400	017700
Time	24-hour	0917	0958	1031	1059	1130	1234	1258	1331
Stone Feed Counter	rev.	3418448	3420920	3422981	3424729	3426714	3430875	3432439	3434558
Time	24-hour	0917	0958	1031	1059	1130	1234	1258	1331
I.D. Fan Speed	rpm	560	560	560	560	560	560	560	560
Primary Air Fan Damper Position	% open	40	40	40	40	40	40	40	40
Kiln Speed	rph	61.5	61.5	63	64	66	67	67	67
Stone Feed Intg.	x100 tons	427716	430248	432252	434072	436053	440151	444522	447335
Time	24-hour	0919	1001	1033	1102	1133	1236	1257	1334
Coal Feed Intg.	x100 tons	117220	117613	117911	118177	118462	119046	119240	119585
Time	24-hour	0918	1000	1032	1101	1132	1235	1256	1333
Baghouse Temp.	°F	600	590	590	580	560	580	580	580

~10 min. Coal rate increased to 54.5 tph ; 11:05 a.m. Coal back up to 55.5 tph

Company Marblehead | Location Gary, Indiana

Facility Lime Kiln | Unit No. 5

Operators | Date June 13, 1974

Data Set No. 3 | Page 2

	Units	1400
Stone Feed Rate	tons/hr.	55.5
Coal Feed Rate	tons/hr	5.5
Bag Collector Press. (Control Room)	in. H_2O	1.0
" " (Baghouse)	in H_2O	1.4
Backend Temp.	°F	—
Calcining Zone Temp.	°F	—
Burning Zone Temp.	°F	1625
Kiln Draft	-in H_2O	3.2
Hood Draft	-in H_2O	0.5*
Burner Pressure	in H_2O	6.0
Oxygen	%	1.7
Combustibles	%	0
I.D. Fan Temp.	°F	582
Coal Feed Counter	rev.	017949
Time	24-hour	1357
Stone Feed Counter	rev.	343682
Time	24-hour	1357
I.D. Fan Speed	rpm	560
Primary Air Fan Damper Position	% open	40
Kiln Speed	rph	67
Stone Feed Intg.	X00 tons	445560
Time	24-hour	1358
Coal Feed Intg	X00 tons	17825
Time	24-hour	1358
Baghouse Temp.	°F	585

1) Marblehead personnel feels that these are the most accurate of the feed rate meters.

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Marblehead Lime
DATE June 10, 74
SAMPLING LOCATION
INSIDE OF FAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE A)
INSIDE OF NEAR WALL TO
OUTSIDE OF NIPPLE. (DISTANCE B)
STACK I.D.. (DISTANCE A - DISTANCE B)
NEAREST UPSTREAM DISTURBANCE
NEAREST DOWNSTREAM DISTURBANCE
CALCULATOR

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1 8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	1.1	88"	.96		
2	3.2		2.8		
3	5.5		4.8		
4	7.9		6.95		
5	10.5		9.24		
6	13.2		11.6		
7	16.1		14.2		
8	19.7		17.3		
9	23.0		20.2		
10	27.2		23.9		
11	32.3		28.4		
12	39.8		35.0		
13	60.2		53.0		
14	67.7		59.6		
15	72.8		64.1		
16	77.0		67.8		
17	80.6		70.9		
18	83.9		73.8		
19	86.8		76.4		
20	89.5		78.8		
21	92.1		81.0		
22	94.5		83.2		
23	96.8		85.2		
24	98.9		87.0		

EPA (Dur) 232
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MARBLEHEAD Lime Co. 6/10/74

WET-BULB	DRY-BULB
114	156
116	164
116	167
118	175
118	179
119	185
120	187
118	188
117	188
118	188

PRELIMINARY VELOCITY TRAVERSE

PLANT Marblehead Lime
DATE 6/10/79
LOCATION Stack 2
STACK I.D.
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O
OPERATORS

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1	.08	255°
2	.12	
3	.12	
4	.13	
5	.13	
6	.13	
7	.13	
8	.13	
9	.13	
10	.13	
11	.13	
12	.13	
13	.14	
14	.14	
15	.14	
16	.15	
17	.14	
18	.15	
19	.14	
20	.14	
21	.14	
22	.14	
23	.12	
24	.	
AVERAGE		

SCHEMATIC OF TRAVERSE POINT LAYOUT

Corrected

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
.01		
.05		
.05		
.06		
.06		
.06		
.06		
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AVERAGE		

EPA (Dur) 233
4/72

STW INCORPORATED

Field Test Data

Plant Household Limes
Location Gary Ind.
Date June 11, 1974
Run No.

Amb. Temp. 67
Bar. Pressure 29.1
Stack Pressure 0
Nozzle Size ½"
Heater Box Setting 250
Probe Heater Setting

Stack #1

$Rm = 3.54/\sqrt{H}$

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s)	Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F
	1225				1359.78		255		60
N2	1230	275	.001 .16	.76	1360.8	66	255		60
2	1235	275	.05 .196	.76	1364.0	68	250		60
3	40	300	.041 .26	.50		70	250		60
4	45	300	.06 .245	1.0	1372.1	70	275		60
5	50	300	.04 .20	.6	1375.9	72	275		60
6	55	300	.04 .20	.6	1379.7	72	260		60
7	1300	300	.05 .224	1.0	1383.6	70	260		60
8	05	300	.05 .224	1.0	1387.5	70	260		60
9	10	300	.05 .224	.8	1391.4	75	260		60
10	15	300	.05 .224	.8	1395.3	75	260		60
11	20	300	.05 .224	1.0	1399.2	75	260		60
12	25	300	.05 .224	1.0	1403.1	75	260		60
13	30	300	.05 .224	1.0	1407.0	75	260		60
14	35	300	.05 .224	1.0	1410.9	75	260		60
15	40	300	.05 .224	1.0	1414.8	75	260		60
16	45	300	.05 .224	1.0	1418.7	75	260		60
17	50	300	.05 .224	1.0	1422.6	75	260		60
18	55	300	.05 .224	1.0	1426.5	75	260		60
19	1400	300	.05 .224	1.0	1430.4	75	260		60
20	05	300	.05 .224	1.0	1434.3	75	260		60
21	10	300	.05 .224	1.0	1438.2	75	260		60
22	15	300	.05 .224	1.0	1442.1	75	260		60
23	20	300	.05 .224	1.0	1446.0	75	260		60
24	25	300	.05 .224	1.0	1449.9	75	260		60
1				0.7					
					93.14				
Total		6770	5.227	22.6					
Average		282	.218	0.94	93.14				

STW INCORPORATED

Field Test Data

Plant Marblehead Lime Co.
Location Gary Ind.
Date June 11, 1974
Run No. 1
Stack NO. 1.

Amb. Temp.
Bar. Pressure
Stack Pressure
Nozzle Size 1/2"
Heater Box Setting 250
Probe Heater Setting 250

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s) ΔP	$\sqrt{P}$	Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F
Start	1600					1450.43				50
24	05	285	.048	200	0.8	1454.0	65	245		50
23	10	285	.04	.200	0.8	1457.5	65	255		50
22	15	290	.04	.20	0.8	1461.0	65	260		50
21	20	291	.05	.224	0.9	1465.0	65	260		60
20	25	291	.05	.224	0.9	1468.7	70	270		60
19	30	290	.09	.224	0.9	1472.6	70	275		60
18	35	300	.09	.224	0.1	1476.5	70	275		70
17	40	300	.05	.224	1.1	1480.5	80	265		75
16	45	300	.05	.224	1.1	1484.5	85	270		75
15	50	300	.05	.224	1.1	1488.5	85	255		75
14	55	300	.05	.224	1.1	1492.5	85	255		80
13	1700	300	.05	.224	1.1	1496.5	90	255		80
12	05	295	.06	.245	1.2	1500.8	95	245		80
11	10	300	.06	.245	1.2	1504.8	95	250		80
10	15	300	.06	.245	1.2	1509.2	95	250		80
9	20	300	.05	.224	1.1	1513.2	100	230		80
8	25	300	.05	.224	1.1	1517.1	100	230		70
7	30	295	.05	.224	1.1	1521.0	90	240		65
6	35	300	.05	.224	1.1	1525.0	100	245		60
5	40	300	.05	.224	1.15	1529.0	100	250		60
4	45	300	.05	.224	1.10	1533.0	100	260		60
3	50	300	.05	.224	1.1	1537.0	100	260		60
2	55	270	.04	200	1.0	1540.6	100	260		60
1	1800	200	.03	.173	.65	1543.59	100	260		
						93.16	= Sample Vol			
						97.1%	= Vol			
							101 90	150		
				VEP						
Total		6985	5.292	237						
Average		291	.221	0.99		186.3				

PARTICULATE TEST NO. 1

I. Total Water Collected

	Silica Gel	Impingers
Final		524
Initial		300
Net	41	224

Total = 265 ml

II. Conversion of Water Collected to gas at Meter Conditions
(for gas meter internally corrected to 70°F)

Pm = Pb + Po/13.6 = 29.09 + 0.96 /13.6
= 29.16 in Hg

Vv = 1.415 x ml/Pm = 1.415 x 265/29.16
= 12.86 cu.ft.

III. Percent Moisture of Flue Gas

199.16

Vv/Vv + Vm = 12.86/(186.3 + 12.86)
= 6.5 %

19.916 / 0.4 = 22.13 + 199.16 = 221.29

IV. Relative Density of Flue Gas
From Fyrite Analysis:

CO_2 = % Vol, dry
O_2 = % Vol, dry
N_2 = % Vol, dry

Determination of Average Molecular Weight of Flue Gas

H_2O	= 18 x		=	
CO_2	= 44 x	x	=	
O_2	= 32 x	x	=	
N_2	= 28 x	x	=	_____

Relative Flue Gas Density

Gd = /28.95 = _____

PARTICULATE TEST NO. ____

V. Average Flue Gas Velocity

Ps = 29.09 - .04 /13.6 = 29.09 in.Hg

$$Vs = 2.9 \times Fs \times \sqrt{\frac{29.92 \times Ts}{Ps \times Gd}} \times \sqrt{P}\ avg.$$

$$= 2.9 \times 0.83 \times \sqrt{\frac{29.92 \times 749}{29.09 \times 1}} \times .220 \times \sqrt{765.11}$$

= 14.7 ft/sec

VI. Actual Flue Gas Flowrate

V = Vs x Area x 60 = x Sq.ft. x 60

= _____ ACFM

VII. Wet Meter Volume Converted to Stack Conditions

MVm = Vv + Vm = + = 199.16 cu.ft.

$$MVs = MVm \times \frac{Pm}{Ps} \times \frac{Ts}{530} = 199.16 \times \frac{29.16}{29.09} \times \frac{749}{530}$$

= 282.13 cu. ft.

VIII. Dry Meter Volume Converted to Standard Conditions

MVstd = Vm x Pm/29.92 = 196.3 x 29.16 /29.92

= 181.57 DSCF

IX. Weight of Particulate Collected

Gross	_____	_____
Tare	_____	_____
Net		

D = TOTAL = _____ grams

PARTICULATE TEST NO. ____

X. Dust Concentration

Grains/ACF = 15.43 x D/MVs = 15.43 x /

= _____ grains/ACF

Grains/DSCF = 15.43 x D/MVstd = 15.43 x /

= _____ grains/DSCF

XI. Emission Rate

Pounds/Hr = D x V x 60/MVs x 454

= x x 60/ x 454

= lb/hr

Pounds/Million Btu = lb/hr / x 10^6 Btu/hr

= _____ lb/million Btu

XII. Percent Isokinetic Sampling

% = 305.6 x MVs/Vs x t x d^2

= 305.6 x 282.13/(14.7 x 140 x $(.5)^2$)

= 97.8 %

STW TESTING, INC.

Field Test Data

Plant MARBLE HEAD LIME CO.
Location 3 U F
Date 6-11-74
Run No.
STACK 2

Amb. Temp. 67
Bar. Pressure 29.1
Stack Pressure 0
Nozzle Size 1/2"
Heater Box Setting
Probe Heater Setting

$R_w = 3.54\sqrt{H}$

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s) PITOT ΔP $\sqrt{\Delta P}$	Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F METER OUT	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F IMPOUT
START	12:26				1435.51				
A 1	12:31	270	.05 .224	.75	1437.6	66	165		55
2	:36	270	.05 .224	.81	1440.4	65	165		55
3	:41	275	.05 .224	.92	1443.4	65	175		55
4	:46	275	.05 .224	.92	1445.3	65	170		55
5	:51	270	.05 .224	.90	1455.1	70	165		55
6	:56	275	.05 .224	.92	1450.9	70	165		55
7	13:01	270	.05 .224	.95	1462.0	73	160		55
8	:06	257	.05 .224	.98	1466.0	70	165		50
9	:36	275	.05 .224	1.0	1470.1	70	175		55
10	:41	280	.05 .224	.98	1478.0	70	180		55
11	:46	280	.04 .200	.95	1477.4	75	180		55
12	:51	275	.03 .173	.77	1481.2	75	180		55
13	:56	260	.03 .173	.77	1484.7	70	180		55
14	14:01	260	.03 .173	.60	1489.8	75	210		55
15	14:06	270	.04 .200	.66	1490.9	80	190		60
16	:11	265	.04 .200	.69	1494.2	80	190		60
17	:16	265	.04 .200	.78	1498.0	80	175		55
18	:21	260	.04 .200	.75	1501.5	80	190		55
19	:26	260	.04 .200	.80	1505.0	80	190		55
20	31	255	.03 .173	.54	1508.1	80	190		55
21	36	255	.03 .173	.58	1511.1	80	190		55
22	41	250	.04 .200	.65	1514.3	90	180		55
23	46	250	.04 .200	.88	1518.5	80	135		55
24	51	265	.04 .200	.95	1521.55	80	175		55
	56								
					96.8				
					26.0				
			$\sqrt{\Delta P}$						
Total	120		4.905	19.60					
Average			.204	36.57 0.76					

.03 .62

9

.70

.05 .74

.5

.77

.44 .71

STW TESTING, INC.

Field Test Data

Plant
Location
Date
Run No. Stack 2

$R_m = 3.54$ UH.

.05 = .79
.04 = .71
.03 = .62
.02 =

Amb. Temp.
Bar. Pressure
Stack Pressure
Nozzle Size 1/2"
Heater Box Setting
Probe Heater Setting

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s) Pitot	Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F Meter / Out	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F Imp Out
Start	16:01				1521.52				
1	:06	265	.03 .173	.52	1524.3	60	210		50
2	:11	260	.03 .173	.5	1528.1	60	250		50
3	:16	260	.04 .203	.60	1530.0	60	235		50
4	:21	260	.03 .173	.58	1533.7	65	220		55
5	:26	250	.03 .173	.6	1536.5	60	220		50
6	:31	260	.05 .224	1.0	1540.7	70	225		55
7	36	260	.03 .173	.68	1544.9	70	240		60
8	:41	270	.05 .224	.98	1547.1	80	240		60
9	46	260	.05 .224	.98	1551.6	80	250		65
10	51	270	.04 .200	.90	1555.2	80	255		65
11	56	260	.04 .200	.85	1558.6	85	260		70
12	17:01	260	.03 .173	.70	1562.0	85	260		70
13	:06	260	.04 .200	.75	1565.3	90	250		65
14	:11	275	.04 .200	.80	1568.4	90	250		65
15	16	260	.04 .200	.80	1572.2	90	250		70
16	21	275	.04 .200	.80	1575.7	95	260		70
17	26	275	.04 .200	1.0	1579.6	95	260		70
18	31	260	.04 .224	.75	1583.3	100	265		70
19	36	260	.04 .200	.73	1586.7	90	265		60
20	41	260	.03 .173	.69	1590.1	95	265		60
21	46	270	.03 .173	.60	1593.2	95	265		60
22	51	260	.03 .173	.60	1596.4	95	265		60
23	56	260	.03 .173	.63	1599.2	100	260		60
24	18:01	240	.04 .200	.75	1602.49	95	260		60
				Should Set	82.4				
					80.47				
						102 To	150		
			VDP						
Total			4.65	16.97	166.93				
Average		263	.194						

PARTICULATE TEST NO. ____

I. Total Water Collected

	Silica Gel	Impingers
Final		452
Initial	_____	300
Net	21	152

Total = 173 ml

II. Conversion of Water Collected to gas at Meter Conditions
(for gas meter internally corrected to 70°F)

Pm = Pb + Po/13.6 = 29.09 + 0.76 /13.6
= 29.15 in Hg

Vv = 1.415 x ml/Pm = 1.415 x 173/ 29.15
= 8.40 cu.ft.

III. Percent Moisture of Flue Gas

175.38

Vv/(Vv + Vm) = 8.40 /(8.40 + 166.98)
= 4.8 %

.10 = x /(x + 166.98)

.10x + 16.698 = x

16.698 = 0.9x

18.55 = x

+ 166.98

185.53

IV. Relative Density of Flue Gas
From Fyrite Analysis:

CO_2 = % Vol, dry
O_2 = % Vol, dry
N_2 = % Vol, dry

Determination of Average Molecular Weight of Flue Gas

H_2O	= 18 x		=	
CO_2	= 44 x	x	=	
O_2	= 32 x	x	=	
N_2	= 28 x	x	=	_____

Relative Flue Gas Density

Gd = /28.95 = _____

PARTICULATE TEST NO. ____

V. Average Flue Gas Velocity

Ps = 29.07 - .04 /13.6 = 29.09 in.Hg

$$Vs = 2.9 \times Fs \times \sqrt{\frac{29.92 \times Ts}{Ps \times Gd}} \times \sqrt{P}\ avg.$$

$$= 2.9 \times 0.83 \times \sqrt{\frac{29.92 \times 723}{29.09 \times 1.0}} \times 0.197 \qquad \sqrt{743.6} = 27.27$$

= 13.1 ft/sec

VI. Actual Flue Gas Flowrate

V = Vs x Area x 60 = x Sq.ft. x 60

= _____ ACFM

VII. Wet Meter Volume Converted to Stack Conditions

MVm = Vv + Vm = + = cu.ft.

$$MVs = MVm \times \frac{Pm}{Ps} \times \frac{Ts}{530} = 175.38 \times \frac{29.15}{29.09} \times \frac{723}{530}$$

= 240.40 cu. ft.

VIII. Dry Meter Volume Converted to Standard Conditions

MVstd = Vm x Pm/29.92 = x /29.92

= _____ DSCF

IX. Weight of Particulate Collected

Gross	_____	_____
Tare	_____	_____
Net		

D = TOTAL = _____ grams

PARTICULATE TEST NO. ____

X. Dust Concentration

Grains/ACF = 15.43 x D/MVs = 15.43 x /

= _____ grains/ACF

Grains/DSCF = 15.43 x D/MVstd = 15.43 x /

= _____ grains/DSCF

XI. Emission Rate

Pounds/Hr = D x V x 60/MVs x 454

= x x 60/ x 454

= lb/hr

Pounds/Million Btu = lb/hr / x 10^6 Btu/hr

= _____ lb/million Btu

XII. Percent Isokinetic Sampling

% = 305.6 x MVs/(Vs x t x d^2)

= 305.6 x 240/(13.1 x 240 x $(.5)^2$)

= 93.5 %

STW TESTING, INC.

Field Test Data

Plant Marblehead Lime Co
Location Gary Ind
Date 6/12/74
Run No.
Stack 3

Amb. Temp. 74 °F
Bar. Pressure 29.21
Stack Pressure
Nozzle Size 1/2" diameter
Heater Box Setting 300
Probe Heater Setting 250

$R_m = 3.68\sqrt{H}$

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s) P √P	Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F
Start	10.30	—	—	—	1602.59				
S 24	35	270	.04 .20	0.55	1606.3	70	320	—	60
23	40	270	.05 .224	1.0	1610.2	70	310	—	55
22	45	270	.04 .200	0.85	1613.8	75	300	—	55
21	50	270	.05 .224	1.05	1618.0	75	300	—	60
20	55	270	.05 .224	1.10	1622.3	80	275	—	60
19	1100	275	.05 .224	1.10	1626.4	80	260	—	60
18	05	275	.05 .224	1.10	1630.7	90	250	—	60
17	10	270	.05 .224	1.10	1634.5	85	250	—	60
16	15	275	.05 .224	1.10	1638.9	85	250	—	60
15	20	255	.05 .224	1.10	1643.0	90	260	—	60
14	25	280	.05 .224	1.15	1647.2	90	252	—	65
13	30	290	.05 .224	1.10	1651.4	90	250	—	65
12	35	290	.03 .173	0.90	1654.8	90	247	—	65
11	40	290	.04 .20	0.9	1658.4	95	250	—	65
10	45	290	.04 .20	0.9	1662.3	90	255	—	60
9	50	295	.03 .173	0.75	1665.5	95	250	—	60
8	55	295	.04 .200	0.9	1669.2	95	255	—	60
7	1200	275	.03 .173	0.75	1672.3	95	250	—	60
6	05	275	.03 .173	0.75	1675.4	95	250	—	60
5	10	275	.03 .173	0.70	1678.6	95	250	—	60
4	15	255	.03 .173	0.65	1681.9	95	240	—	60
3	20	235	.04 .200	0.5	1685.5	95	252	—	55
2	25	150	.04 .200	0.5	1689.2	95	250	—	55
1	30	150	.02 .141	0.5	1691.55	95	250	—	55
Total									
Average									

STW TESTING, INC.

Field Test Data

Plant Marblehead Lime Co.
Location Gary Ind.
Date 6/12/74
~~Run No~~
Stack #3

$Q_m = 3.68\sqrt{H}$

Amb. Temp. 78°F
Bar. Pressure 29.22
Stack Pressure
Nozzle Size ½" d.
Heater Box Setting 250
Probe Heater Setting 250

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s)		Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F
Start	1253					1691.84				
24	1300	320	.04	.20	0.9	1695.5	85	250		60
23	05	320	.04	.20	0.9	1699.2	85	240		60
22	10	310	.05	.224	1.1	1703.3	90	245		55
21	15	310	.06	.245	1.2	1707.8	90	245		60
20	20	310	.06	.245	1.3	1712.3	90	245		60
19	25	300	.05	.224	1.1	1716.4	90	245		60
18	30	300	.05	.224	1.1	1720.5	90	250		60
17	35	305	.06	.245	1.3	1725.0	95	250		60
16	40	305	.06	.245	1.3	1729.4	95	240		60
15	45	300	.06	.245	1.3	1734.0	90	250		60
14	50	300	.06	.245	1.3	1738.3	90	275		60
13	55	300	.06	.245	1.4	1742.8	95	275		60
12	1400	295	.05	.224	1.2	1746.8	95	250		60
11	05	245	.04	.20	1.0	1750.5	95	260		60
10	10	240	.04	.20	0.9	1754.2	95	240		60
9	15	240	.04	.20	0.9	1758.9	100	250		60
8	20	240	.05	.224	1.1	1763.3	95	275		60
7	25	250	.05	.224	1.15	1766.4	95	250		60
6	30	275	.05	.224	1.20	1770.6	95	250		60
5	35	290	.05	.224	1.15	1774.7	95	255		65
4	40	300	.05	.224	1.15	1778.8	100	245		65
3	45	290	.05	.245	1.15	1782.9	95	250		60
2	50	300	.05	.245	1.15	1787.2	95	260		60
1	55	300	.04	.141	0.5	1790.10	95	270		60
Total										
Average										

PARTICULATE TEST NO. ____

I. Total Water Collected

	Silica Gel	Impingers
Final		500
Initial		[illegible]
Net	32.0	

Total = ml

II. Conversion of Water Collected to gas at Meter Conditions
(for gas meter internally corrected to 70°F)

Pm = Pb + (Po/13.6) = + /13.6
= in Hg

Vv = 1.415 x ml/Pm = 1.415 x /
= ____cu.ft.

III. Percent Moisture of Flue Gas

Vv/(Vv + Vm) = / +
= ____%

IV. Relative Density of Flue Gas
From Fyrite Analysis:

CO_2 = % Vol, dry
O_2 = % Vol, dry
N_2 = % Vol, dry

Determination of Average Molecular Weight of Flue Gas

H_2O = 18 x =
CO_2 = 44 x x =
O_2 = 32 x x =
N_2 = 28 x x = ____

Relative Flue Gas Density

Gd = /28.95 = ____

STW TESTING, INC.

.01=.37

Field Test Data

.045 = .78 .03 = .64
.05 = .82 .025 = .50
.04 = .69
.04 = .74

Plant
Location
Date
Run No.
Stack # 4
South ~~Atlanta~~ Port

$R_m = 3.68\sqrt{H}$

Amb. Temp. 74°F
Bar. Pressure 29.21
Stack Pressure
Nozzle Size 0.5"
Heater Box Setting
Probe Heater Setting

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s)	Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F In Out	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F In Out
Start	10:35				1546.69				
1	10:30	260	.025	.45	1550.5	70	265		60
2	10:35	260	.025	.53	1553.4	70	270		55
3	10:40	255	.02	.53	1556.2	65	270		55
4	10:45	260	.035	.70	1559.4	75	250		55
5	10:50	260	.03	.70	1563.6	80	240		55
6	10:55	260	.03	.70	1565.8	85	220		60
7	11:00	260	.04	.83	1569.3	85	220		60
8	11:05	270	.04	.85	1572.8	90	240		60
9	11:10	260	.045	.93	1576.9	90	220		60
10	11:15	260	.04	.87	1580	90	220		60
11	11:20	265	.05	1.08	1583.9	90	230		60
12	11:25	270	.045	1.05	1587.9	95	270		60
13	11:30	265	.03	.72	1591.2	95	220		60
14	11:35	270	.025	.57	1594.1	95	220		60
15	11:40	270	.03	.72	1597.3	95	230		60
16	11:45	270	.04	.83	1600.6	95	240		60
17	11:50	270	.035	.97	1604.0	95	240		60
18	11:55	270	.04	.93	1607.6	100	240		60
19	12:00	280	.025	.58	1610.5	100	230		60
20	12:05	280	.025	.58	1613.5	100	230		60
21	12:10	280	.03	.70	1616.7	100	230		60
22	12:15	280	.03	.70	1619.9	100	235		60
23	12:20	140	.01	.20	1621.9	100	210		65
24	12:25	130	.01	.20	1623.64	100	210		65
Total									
Average									

STW TESTING, INC.

Field Test Data

Plant
Location
Date
Run No.
North

$R_N = 3.68\sqrt{N}$

.05 = .82 .01 = .37
.055 = .86 .025 = .50
.06 = .9 .03 = .64
.035 = .69
.04 = .74
.045 = .78

Amb. Temp. 71°F
Bar. Pressure 29.22
Stack Pressure
Nozzle Size ~~¾~~ ½"
Heater Box Setting
Probe Heater Setting

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s)	Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F Meter Out	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F In, Out
Start	12:52				16236.9				
1	1235	280	.045	1.05	16273	90	220		60
2	13:00	280	.045	1.05	16312	90	220		55
3	:30	275	.055	1.23	16364	85	185		60
4	:40	280	.055	1.23	16397	80	200		60
5	:50	280	.05	1.17	16437	80	210		60
6	13:55	280	.055	1.23	16480	85	210		60
7	14:00	280	.06	1.40	16525	85	220		60
8	:05	280	.06	1.35	16564	90	200		60
9	:15	280	.05	1.20	16616	90	225		60
10	:30	280	.045	1.0	16648	90	200		60
11	:35	275	.045	1.05	16697	90	210		55
12	:40	280	.05	1.17	16729	90	220		55
13	:45	280	.05	1.17	16769	90	255		55
14	:50	280	.045	1.02	16805	90	225		60
15	:55	285	.045	1.03	16847	90	225		60
16	:60	280	.04	.96	16884	95	235		60
17	14:05	280	.045	1.07	16923	95	210		60
18	:10	285	.045	1.07	16962	95	215		60
19	:15	285	.045	1.07	17001	100	240		60
20	:20	285	.045	1.07	17040	100	225		60
21	:25	290	.045	.83	17075	100	230		60
22	:30	285	.035	.93	17107	100	245		60
23	35	270	.04	1.0	17140	100	230		60
24	40	280	.045	.58	17176.0	100	240		60
Total									
Average									

PARTICULATE TEST NO. ____

I. Total Water Collected

	Silica Gel	Impingers
Final		559
Initial	____	~300
Net	27.0	259

Total = ml

II. Conversion of Water Collected to gas at Meter Conditions
(for gas meter internally corrected to 70°F)

Pm = Pb + (Po/13.6) = + /13.6
= in Hg

Vv = 1.415 x ml/Pm = 1.415 x /
= ____cu.ft.

III. Percent Moisture of Flue Gas

Vv/(Vv + Vm) = / +
= ____%

IV. Relative Density of Flue Gas
From Fyrite Analysis:

CO_2 = % Vol, dry
O_2 = % Vol, dry
N_2 = % Vol, dry

Determination of Average Molecular Weight of Flue Gas

H_2O = 18 x =
CO_2 = 44 x x =
O_2 = 32 x x =
N_2 = 28 x x = ____

Relative Flue Gas Density

Gd = /28.95 = ____

STW TESTING, INC.

Field Test Data

Plant Mobile Bay
Location
Date 6-13-74
Run No.
Stack 5
North Port

.04 = .73
.05 = .90
.045 = .77
.05 = .92
.055 = .97
.06 = .89
.065 = .93

Amb. Temp. 73°F
Bar. Pressure 29.21
Stack Pressure —11
Nozzle Size 0.5
Heater Box Setting
Probe Heater Setting

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s)	Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F Mtr In / Mtr Out	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F Imp In / Imp Out
Start	9:35				1718.61				
1	:35	280	.055	1.25	1721.9	70	235		55
2	:40	286	.06	1.20	1726.3	70	220		55
3	:45	280	.06	1.32	1730.6	75	225		55
4	:50	280	.05	1.22	1734.7	75	240		60
5	:55	280	.055	1.32	1739.0	80	240		60
6	10:00	280	.065	1.52	1743.6	85	250		60
7	:05	280	.064	1.55	1748.3	85	260		60
8	:10	280	.065	1.55	1752.9	90	240		60
9	:15	280	.055	1.32	1757.3	90	245		60
10	:20	280	.06	1.45	1761.7	95	250		60
11	:25	280	.06	1.47	1766.2	95	250		60
12	:30	280	.06	1.47	1770.7	100	245		60
* 13	:35	280	.045	.88	1774.4	95	240		60
14	:40	280	.040	.96	1777.9	100	240		60
15	:45	280	.046	.90	1781.6	100	245		60
16	:50	280	.05	1.22	1785.6	100	245		65
17	:55	280	.045	1.082	1789.6	100	245		65
18	11:00	280	.045	1.1	1793.3	100	250		65
19	:05	280	.045	.98	1797.1	100	250		65
20	:10	280	.045	1.0	1800.8	100	250		65
21	:15	280	.045	1.08	1804.7	100	250		60
22	:20	280	.04	1.36	1809.9	100	250		60
23	:25	277	.04	1.02	1812.7	100	250		60
24	:30	270	.035	.70	1816.4	100	260		65
Total									
Average									

* Run @ .72/min should be .77/min

STW TESTING, INC.

Field Test Data

Plant Marblehead
Location Gorf, Inc
Date 6-13-74
Run No. Stack 5
South Port
5 2

.045 = .77
.05 = .82
.055 = .87
.06 = .89
.065 = .93
.04 = .73
.025 = .50

.075 = 1
.07 = .96

Amb. Temp. 76
Bar. Pressure 29.17
Stack Pressure
Nozzle Size .5"
Heater Box Setting
Probe Heater Setting

$R_n = 364\sqrt{H}$

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s)	Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F
Start	12:00				1011.08				
1	:05	280	.045	.98	1820.5	95	270		70
2	:10	280	.045	.98	1824.3	95	275		60
3	:15	285	.045	1.0	1827.1	95	280		60
* 4	:20	285	.035	-	1832.2	95	280		60
5	:35	280	.06	1.45	1836.1	100	280		60
6	:45	280	.075	1.75	1841.1	95	280		60
7	55	280	.075	1.0	1844.1	95	270		60
8	55	280	.071	1.65	1850.2	95	270		60
9	13:00	275	.01	1.67	1855.6	100	290		60
10	:05	275	.065	1.52	1860.2	100	300		60
11	:10	275	.065	1.52	1864.7	100	290		60
12	15	280	.065	1.52	1869.3	100	270		60
13	20	280	.065	1.52	1873.2	100	280		60
14	25	280	.065	1.52	1877.4	100	290		60
15	30	280	.045	.92	1881.9	100	295		65
16	35	280	.040	.95	1885.3	100	290		65
17	40	280	.045	.90	1889.4	100	290		65
18	45	280	.065	1.60	1893.4	105	290		70
19	50	280	.070	1.75	1898.3	105	290		70
20	55	280	.045	1.10	1902.2	110	290		65
21	14:00	245	.045	1.05	1906	110	270		65
22	14:05	230	.025	1.1	1908.9	110	265		65
23	10	160	.025	1.05	1911.7	110	270		65
24	15	110	.02	.5	1914.47	110	270		65
Total									
Average									

* Fell off level

PARTICULATE TEST NO. ____

I. Total Water Collected

	Silica Gel	Impingers
Final	390.8	589
Initial	352.8	300
Net	38.0	289

Total = ml

II. Conversion of Water Collected to gas at Meter Conditions
(for gas meter internally corrected to 70°F)

Pm = Pb + (Po/13.6) = + /13.6
= in Hg

Vv = 1.415 x ml/Pm = 1.415 x /
= ____cu.ft.

III. Percent Moisture of Flue Gas

Vv/(Vv + Vm) = / +
= ____%

IV. Relative Density of Flue Gas
From Fyrite Analysis:

CO_2 = % Vol, dry
O_2 = % Vol, dry
N_2 = % Vol, dry

Determination of Average Molecular Weight of Flue Gas

H_2O = 18 x =
CO_2 = 44 x x =
O_2 = 32 x x =
N_2 = 28 x x = ____

Relative Flue Gas Density

Gd = /28.95 = ____

STW TESTING, INC.

Field Test Data

Plant Marblehead Lime Co.
Location Gary, Ind.
Date 6/13/74
~~Run No.~~
Stack #6

Amb. Temp. 73°F
Bar. Pressure 29.21
Stack Pressure 29.21
Nozzle Size 1/2" diam.
Heater Box Setting 250
Probe Heater Setting 250

North Port $Rn = 3.6\sqrt{H}$

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s)	Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F
Start	925				1790.12				
24	30	270	.224	1.05	1794.2	70	260	—	70
23	35	270	.224	1.00	1798.4	75	260	—	65
22	40	270	.249	1.20	1802.9	75	260	—	70
21	45	270	.249	1.30	1807.1	80	250	—	70
20	50	270	.249	1.30	1811.6	80	255	—	70
19	55	270	.249	1.30	1816.1	85	250	—	70
18	1000	275	.224	1.15	1820.2	90	275	—	65
17	05	270	.224	1.15	1824.0	90	270	—	65
16	10	275	.224	1.20	1828.4	90	245	—	60
15	15	250	.224	1.20	1832.8	95	255	—	60
14	20	270	.224	1.20	1837.0	90	255	—	65
13	25	275	.210	1.00	1840.8	95	255	—	65
12	30	270	.224	1.20	1845.0	95	250	—	65
11	35	270	.224	1.20	1849.2	100	245	—	65
10	40	270	.224	1.2	1853.4	100	245	—	70
9	45	270	.224	1.2	1857.7	100	250	—	70
8	50	260	.224	1.2	1862.8	100	250	—	65
7	55	260	.224	1.2	1866.0	100	250	—	65
6	1100	265	.2	1.0	1869.7	100	255	—	60
5	05	260	.173	0.8	1873.3	100	250	—	60
4	10	260	.173	0.8	1876.6	100	250	—	60
3	15	260	.173	0.8	1879.8	100	250	—	65
2	20	260	.141	0.6	1882.5	100	250	—	65
1	25	255	.141	0.5	1885.13	100	250	—	
Total									
Average									

229

STW TESTING, INC.

Field Test Data

Plant MARBLEHEAD LIME CO.
Location Quarry Ind.
Date 6/13/74
~~Run No.~~ Stack #6
South Port

$P_m = 3.64\sqrt{H}$

Amb. Temp. 73°F.
Bar. Pressure 29.21
Stack Pressure 29.21
Nozzle Size 0.5" d.
Heater Box Setting 250
Probe Heater Setting 250

Traverse Point Number	Sampling Time (Min)	Stack Temp. °F	Velocity Head (ΔP_s)		Pressure Differential Across Meter (ΔH) In. H_2O	Gas Sample Volume Ft^3	Gas Sample Temp. at Dry Gas Meter °F	Sample Box Temp. °F	Temp. of Gas Impinger Inlet °F	Temp. of Gas Impinger Outlet °F
START	1200					1885.13				
24	05	280	.05	.224	1.2	1889.3	90	300	—	65
23	10	270	.05	.224	1.2	1893.4	90	300	—	60
22	15	280	.05	.224	1.15	1897.5	95	300	—	65
21	20	280	.05	.224	1.20	1901.6	90	290	—	60
20	25	280	.05	.224	1.2	1905.8	100	290	—	60
19	30	290	.06	.245	1.35	1910.2	100	290	—	65
18	35	280	.06	.245	1.35	1914.7	100	275	—	65
17	40	290	.06	.245	1.46	1919.3	100	260	—	70
16	45	280	.05	.224	1.20	1923.4	100	260	—	70
15	50	280	.05	.224	1.20	1927.5	100	250	—	65
14	55	280	.05	.224	1.2	1931.7	100	250	—	65
13	1300	275	.05	.224	1.2	1935.9	100	250	—	70
12	05	270	.04	.158	0.5	1939.2	100	254	—	65
11	10	275	.03	.177	0.5	1942.1	100	259	—	65
10	15	275	.03	.173	0.5	1945.0	100	250	—	65
9	20	275	.03	.173	0.6	1948.1	100	250	—	65
8	25	275	.03	.173	0.7	1951.2	100	250	—	65
7	30	280	.04	.20	0.9	1954.8	100	250	—	65
6	35	275	.04	.20	0.9	1958.5	100	252	—	65
5	40	280	.03	.173	0.6	1961.7	100	270	—	65
4	45	270	.03	.173	0.7	1964.9	100	260	—	65
3	50	270	.04	.2	0.9	1968.6	100	270	—	65
2	55	270	.04	.2	0.9	1972.7	100	270	—	70
1	1400	280	.04	.2	0.9	1976.43	100	270	—	70
Total										
Average										

PARTICULATE TEST NO. ____

I. Total Water Collected

	Silica Gel	Impingers
Final	390.3	529
Initial	352.8	300
Net	37.5	229

Total = ____ml

II. Conversion of Water Collected to gas at Meter Conditions
(for gas meter internally corrected to 70°F)

Pm = Pb + (Po/13.6) = + /13.6
= in Hg

Vv = 1.415 x ml/Pm = 1.415 x /
= ____cu.ft.

III. Percent Moisture of Flue Gas

Vv/(Vv + Vm) = / +
= ____%

IV. Relative Density of Flue Gas
From Fyrite Analysis:

CO_2 = % Vol, dry
O_2 = % Vol, dry
N_2 = % Vol, dry

Determination of Average Molecular Weight of Flue Gas

H_2O = 18 x =
CO_2 = 44 x x =
O_2 = 32 x x =
N_2 = 28 x x = ____

Relative Flue Gas Density

Gd = /28.95 = ____

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Marblehead Lime

DATE 6/11/79

SAMPLING TIME (24-hr CLOCK) 10:30 - 1:30

SAMPLING LOCATION Stack No. 6 (North)

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) bag

ANALYTICAL METHOD Orsat / FYRITE

AMBIENT TEMPERATURE 65-70°F

OPERATOR L.K

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	6.8		6.8		6.7		6.8	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	could not be read on		Orsat, required fyrites				19.5	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	unknown							28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

- Fyrite

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT MARBLEHEAD Lime

DATE 6/12/74

SAMPLING TIME (24-hr CLOCK) _____

SAMPLING LOCATION _____

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) _____

ANALYTICAL METHOD FYRITES

AMBIENT TEMPERATURE _____

OPERATOR _____

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2		7.0		7.2		6.8	7.0	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)		16.5		16.0		17.0	16.5	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT MARBLEHEAD Lime Co

DATE 6/13/24

SAMPLING TIME (24-hr CLOCK) _____

SAMPLING LOCATION _____

SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) _____

ANALYTICAL METHOD FYRITES

AMBIENT TEMPERATURE _____

OPERATOR _____

COMMENTS:

RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2		7.0		7.0		7.0	7.0	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)		16.5		16.5		16.5	16.5	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)								28/100	
								TOTAL	

EPA (Dut) 230
4/72

Test Site MARBLEHEAD LYME

Date 11 JUNE 1974

Time 12:30

Sample No. ONE

Sampling Location STACK NO. 5

Sampling Train SO_2

Pump Temp. (°F) i 68°

f

Sampling Rate, ℓ/min 1.0

Sampling Time (min) 75

% CO_2 mℓ H_2O Stack Temp. (°F)

% O_2 Vol. Sampled (ℓ)

% CO % H_2O

Sample No.

Sampling Train

Time (min)	Sampling Rate (ℓ/min)	Temp. °F	ΔP"	Dry Test Meter (A^3)
0	1.0	68	2.5	127.52
5	1.0	70	2.5	127.70
10	1.0	70	2.5	127.90
15	1.0	70	2.5	128.10
20	0.9	70	2.5	128.30
25	1.1	71	2.5	128.52
30	0.7	73	2.5	128.71

Test Site MAGBLEHEAD LIME

Date 11 JUNE 1974

Time _____

Sample No. ONE Sampling Location STACK NO 5

Sampling Train SO_2

Pump Temp. (°F) i 72°

f _____

Sampling Rate, ℓ/min 1.0

Sampling Time (min) 25

% CO_2 _____ mℓ H_2O _____ Stack Temp. (°F) _____

% O_2 _____ Vol. Sampled (ℓ) _____

% CO _____ % H_2O _____

Sample No. _____

Sampling Train _____

Time (min)	Sampling Rate (ℓ/min)	Temp. °F	ΔP"	Dry Test Meter (A^3)	
35	1.0	72	2.5	128.92	
07 PM 5	1.0	72	2.5	129.01	← STOP
10 PM 10	1.0	72	2.5	129.01	(power loss)
45	1.0	73	2.5	129.21	
17 PM 50	1.0	73	2.5	129.30	← STOP *
18 PM	1.0	73	2.5	129.30	START
50	1.0	73	2.5	129.39	
21 PM 55	1.0	73	2.5	129.49	← STOP
28 PM 60	1.0	73	2.5	129.49	← START
30 PM	1.0	73	2.5	129.55	
32 PM	1.0	73	2.5	129.60	← END

* CO_2 NOT STOPPED HERE. IS 7.0

Test Site MAIN BLEED AD LINE

Date 11 JUNE 1974

Time 2:00

Sample No. TWC

Sampling Location SMOKE STACK #5

Sampling Train SO$_2$

Pump Temp. (°F) i _____

f _____

Sampling Rate, ℓ/min 1.5

Sampling Time (min) 30

NOTE: SMOKE FROM CEMENT FACTORY COMES THIS WAY. WINDS ABOUT 20 MPH.

% CO_2 _____ mℓ H_2O _____ Stack Temp. (°F) 270

% O_2 _____ Vol. Sampled (ℓ) _____

% CO _____ % H_2O _____

Sample No. _____

Sampling Train _____

NOTE: TEST STARTED AFTER 30 MIN BECAUSE FIRST IMPINGER BUBBLED TOO HIGH.

	Time (min)	Sampling Rate (ℓ/min)	Temp. °F	ΔP"	Dry Test Meter (A^3)
2:00 PM	0	1.0	73	2.5	129.69
2:05 PM	5	1.0	75	2.5	129.81
2:10 PM	10	1.0	78	2.5	130.01
2:15 PM	15	1.0	76	2.5	130.21
2:20 PM	20	1.0	77	2.5	130.42
2:25 PM	25	1.0	77	2.5	130.62
2:30 PM	30	1.0	74	2.5	130.83

Test Site MARBLEHEAD LIME

Date 12 JUNE 1974

Time 11:00 AM

Sample No. THREE

Sampling Location STACK NO. 2

Sampling Train SO_2

Pump Temp. (°F) i 71

f

Sampling Rate, ℓ/min 1.0

Sampling Time (min)

% CO_2 mℓ H_2O Stack Temp. (°F) 280

% O_2 Vol. Sampled (ℓ)

% CO % H_2O

Sample No.

Sampling Train

	Time (min)	Sampling Rate (ℓ/min)	Temp. °F	ΔP"	Dry Test Meter (A^3)
11:00 AM	0	1.0	71	2.5	130.91
11:05 AM	5	1.0	72	2.5	131.09
11:10 AM	10	1.0	73	2.5	131.30
11:15 AM	15	1.0	73	2.5	131.51
11:20 AM	20	1.0	74	2.5	131.72
11:25 AM	25	1.0	73	2.5	131.96
11:30	30	1.0	75	2.5	132.16

Test Site MARBLEHEAD LIME

Date 12 JUNE 1974

Time 11:30 AM

Sample No. THREE

Sampling Location STACK No. 2

Sampling Train SO_2

Pump Temp. (°F) i 75

f

Sampling Rate, ℓ/min 1.0

Sampling Time (min)

% CO_2 mℓ H_2O Stack Temp. (°F) 280

% O_2 Vol. Sampled (ℓ)

% CO % H_2O

Sample No.

Sampling Train

Time (min)	Sampling Rate (ℓ/min)	Temp. °F	ΔP"	Dry Test Meter (A^3)
30				
35	1.0	72	2.5	132.33
40	1.0	74	2,5	132.54
45				
50				
55				
60				

Test Site MARBLEHEAD LIME

Date 12 JUNE 1979

Time 1:50 PM

Sample No. FOUR

Sampling Location STACK NO. 2

Sampling Train SO_2

Pump Temp. (°F) i 72

f

Sampling Rate, ℓ/min 1.0

Sampling Time (min)

% CO_2 mℓ H_2O Stack Temp. (°F)

% O_2 Vol. Sampled (ℓ)

% CO % H_2O

Sample No.

Sampling Train

Time (min)	Sampling Rate (ℓ/min)	Temp. °F	ΔP"	Dry Test Meter (A^3)
1:50 PM 0	1.0	72	2.5	132.83
1:55 PM 5	1.0	73	2.5	133.09
2:00 PM 10	1.0	75	2.5	133.25
2:05 PM 15	1.0	77	2.5	133.45
2:10 PM 20	0.9	81	2.5	
2:15 PM 25	1.0	81	2.5	133.86
2:20 30	1.1	83	2.5	134.07

Test Site MARBLEHEAD LIME

Date 12 JUNE 1974

Time 2:25 PM

Sample No. FOUR

Sampling Location STACK NO. 2

Sampling Train SO_2

Pump Temp. (°F) i 81

f

Sampling Rate, ℓ/min 1.0

Sampling Time (min)

% CO_2 mℓ H_2O Stack Temp. (°F)

% O_2 Vol. Sampled (ℓ)

% CO % H_2O

Sample No.

Sampling Train

	Time (min)	Sampling Rate (ℓ/min)	Temp. °F	ΔP"	Dry Test Meter (A^3)
	0				
2:25 PM	35	1.0	81	2.5	134.26
2:30 PM	40	0.8	81	2.5	134.45
	45				
	50				
	55				
	60				

NOTE: SAMPLING STOPPED AFTER 40 MIN BECAUSE FIRST IMPINGER (ISOPROPAL) BUBBLING TOO HIGH.

Test Site MARBLEHEAD LIME

Date 13 JUNE 1974

Time 9:25 AM

Sample No. FIVE Sampling Location STACK NO. 2

Sampling Train SO_2

Pump Temp. (°F) i _____

f _____

Sampling Rate, ℓ/min 1.0

Sampling Time (min) 40

% CO_2 _____ mℓ H_2O _____ Stack Temp. (°F) 280

% O_2 _____ Vol. Sampled (ℓ) _____

% CO _____ % H_2O _____

Sample No. _____

Sampling Train _____

Time (min)	Sampling Rate (ℓ/min)	Temp. °F	ΔP"	Dry Test Meter (A^3)
9:25 AM 0	1.0	72	2.5	134.82
9:30 AM 5	1.0	73	2.5	135.03
9:35 AM 10	1.0	76	2.5	135.23
9:40 AM 15	1.0	78	2.5	135.44
9:45 AM 20	1.0	80	2.5	135.66
9:50 AM 25	1.0	83	2.5	135.875
9:55 AM 30	1.0	85	2.5	136.09

Test Site MARBLEHEAD LIME

Date 13 JUNE 1974

Time 10:00 AM

Sample No. FIVE

Sampling Location STACK NO. 2

Sampling Train SO_2

Pump Temp. (°F) i 85

f

Sampling Rate, ℓ/min 1.0

Sampling Time (min) 40

NOTE: AGAIN TEST CONCLUDED DUE TO EXCESSIVE BUBBLING OF ISOPROPYNOL IN IMPINGER #1

% CO_2 ____ mℓ H_2O ____ Stack Temp. (°F) 280

% O_2 ____ Vol. Sampled (ℓ) ____

% CO ____ % H_2O ____

Sample No. ____

Sampling Train ____

Time (min)	Sampling Rate (ℓ/min)	Temp. °F	ΔP"	Dry Test Meter (A^3)	
0					
10:00 AM 35	0.95	88	2.5	136.29	
10:05 AM 40	1.0	88	2.5	136.51	STOP.
45					
20					
25					
30					

40 ≠ min

Test Site MARBLEHEAD LIME

Date 13 JUNE 1974

Time 10:42 AM

Sample No. SIX

Sampling Location STACK NO. 2

Sampling Train SO_2

Pump Temp. (°F) i _____

f _____

Sampling Rate, ℓ/min 1.0

Sampling Time (min) _____

NOTE: SAMPLING STOPPED DUE TO EXCESSIVE BUBBLING IN FIRST IMPINGER.

% CO_2 _____ mℓ H_2O _____ Stack Temp. (°F) 275

% O_2 _____ Vol. Sampled (ℓ) _____

% CO _____ % H_2O _____

Sample No. _____

Sampling Train _____

Time (min)	Sampling Rate (ℓ/min)	Temp. °F	ΔP"	Dry Test Meter (A^3)	
10:42 AM 0	1.0	78	2.5	136.96	
10:47 AM 5	1.0	83	2.5	137.17	
10:52 AM 10	1.0	84	2.5	137.38	
10:57 AM 15	1.0	85	2.5	137.60	
11:02 AM 20	1.0	86	2.5	137.82	
11:07 AM 25	1.0	87	2.5	138.04	STOP.
30					

25 min

STW INCORPORATED

NO_x DATA SHEET

Customer: MARBLE HEAD LIME CO

Installation: BUFFINGTON

Location: STACK #5, SOUTH PORT

Job No.:

Rate: Probe was 34 inches in from inside of stack

Test No.: 1

Amb. Temp:

Test Date: 6-11-74

Test By: D. G. Wader

6/12/74

11:00-11:30 am

Sample Number	Date	Time	Flask Number	Volume of Flask, ml	Initial Conditions: Bar. Press. in. Hg	Initial Conditions: Flask Temp, °F	Initial Conditions: Flask Vac. in. Hg	Final Conditions: Bar. Press. in. Hg	Final Conditions: Flask Temp, °F	Final Conditions: Flask Vac. in. Hg
① A-N-1-1	6-11-74	13:21	7	2038	29.09	72	-27.2	29.21	76	+.2
② A-N-1-2	6-11-74	14:03	8	2030	29.09	70	-27.2	29.21	74	-.7
③ A-N-2-1	6-11-74	16:25	9	1961	29.09	73	-27.3	29.21	73	-.6
④ A-N-2-2	6-11-74	17:34	10	1992	29.09	72	-27.2	29.21	74	+.2
A-N- -B	Blank for -N- Series									

7 - 26.0mls.
8 - 24.5mls.
9 - 24.0mls.
10 - 25.5mls.

STW INCORPORATED

NO_x DATA SHEET

Customer: MARBLE HEAD LIME CO.

Installation: BUFFINGTON

Location: GARY, IND

Job No.: 73-109

Rate:

Test No.: 2

Amb. Temp:

Test Date: 6-12-74

Test By: D.J.W

~~Stack~~ Stack #6, south port (Probe Tip was 34 inches in from inside of stack)

Sample Bottle Number	Date	Time	Flask Number	Volume of Flask, ml	Initial Conditions: Bar. Press. in. Hg	Initial Conditions: Flask Temp, °F	Initial Conditions: Flask Vac. in. Hg	Final Conditions: Bar. Press. in. Hg	Final Conditions: Flask Temp, °F	Final Conditions: Flask Vac. in. Hg
5 -N-	6-12-74	12:23	1	1964	29.24	72	-27.2	29.18	80	+.5
6 -N-	6-12-74	13:05	2	2046	29.21	75	-27.4	29.16	81	-.1
7 -N-	6-12-74	13:40	4	2009	29.20	76	-27.4	29.18	81	0
8 -N-	6-12-74	14:14	5	2020	29.18	71	-27.4	29.18	82	-.3

-N- -B Blank for -N- Series

Sample Bottle →

Volumes: 5 – 25 ml; 6 – 25 ml; 7 – 25 ml; 8 – 24 ml

Stack: Tue 08:00 – 17:30 = 9:30
Others 10:00 – 17:30 = 7:30

14.4
12.9
27.2

STW INCORPORATED

NO_x DATA SHEET

Customer: MARBLE HEAD LIME CO

Installation: BUFFINGTON

Location: GARY, IND.

Job No.: 73-109

Rate:

Test No.: 3

Amb. Temp: 73

Test Date: 6-13-74

Test By: D. J. Weber

Stack #3, south port (Probe tip 34 inches in from inside of stack) (Reading taken at 10:30-11:00 6-14-74)

Sample Bottle Number	Date	Time	Flask Number	Volume of Flask, ml	Initial Conditions: Bar. Press. in. Hg	Initial Conditions: Flask Temp, °F	Initial Conditions: Flask Vac. in. Hg	Final Conditions: Bar. Press. in. Hg	Final Conditions: Flask Temp, °F	Final Conditions: Flask Vac. in. Hg
~~9 -N-~~	6-13-74	11:04	~~8~~	~~2030~~	29.22	77	-27.6	29.37	85	+0.3
10 -N-	"	10:36	10	1992	29.19	78	-27.6	29.37	85	+0.2
11 -N-	"	11:36	11	2040	29.22	82	-27.6	29.37	86	+0.1
12 -N-	"	12:36	12	1994	29.18	80	-27.5	29.37	83	0
~~-N-B~~	Blank for -N- Series									

Sample bottle #	Volume of absorbing solution, ml
9	26
10	26
11	25
12	26

Test #1

(1)

ENVIRONMENTAL PROTECTION AGENCY

COMPANY NAME Marblehead Lime

EQUIPMENT LOCATION (ADDRESS) Gary, Indiana

TIME OF OBSERVATION: FROM 12[25] A.M. P.M. TO 1[38] A.M. P.M. DATE 6/11/74

RECORD OF VISIBLE EMISSIONS

Stack No. 1

Start hour 12[25]

R. No.	%	Min. 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20
5	100	
4¾	95	
4½	90	
4¼	85	
4	80	
3¾	75	
3½	70	
3¼	65	
3	60	
2¾	55	
2½	50	
2¼	45	
2	40	
1¾	35	
1½	30	
1¼	25	
1	20	
¾	15	
½	10	
¼	5	
0	0	

Start hour 5 1[25]

R. No	%	Min. 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
5	100	
4¾	95	
4½	90	
4¼	85	
4	80	
3¾	75	
3½	70	
3¼	65	
3	60	
2¾	55	
2½	50	
2¼	45	
2	40	
1¾	35	
1½	30	
1¼	25	
1	20	
¾	15	
½	10	
¼	5	
0	0	

Start hour 5 1[25]

R. No.	%	Min. 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
5	100	
4¾	95	
4½	90	
4¼	85	
4	80	
3¾	75	
3½	70	
3¼	65	
3	60	
2¾	55	
2½	50	
2¼	45	
2	40	
1¾	35	
1½	30	
1¼	25	
1	20	
¾	15	
½	10	
¼	5	
0	0	

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants exhaust from lime Kiln baghouse

Type of Air Contaminants _____

Point of Discharge: Stack ☒ Other series of 6 stacks

Point of Observation:

Distance to Base of Point of Discharge, feet ~~200~~ 100 ft

Height of Point of Discharge Above Ground Level, feet ~~250~~ 80 ft

Background Description < K

Weather: Clear ☐ Overcast ☒ Partly Cloudy ☐ Other _____

Wind Direction _____ Wind Velocity, mi/hr 20

Plume Description:

Detached: Yes ☐ No ☐

Color: Black ☐ White ☐ Other not observable

Plume Dispersion Behavior: Looping ☐ Coning ☐ Fanning ☐

Lofting ☐ Fumigating ☐ See Comments ☒

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments no visible plume mostly

Signed [signature] Title [illegible]

Test #1

(2)

ENVIRONMENTAL PROTECTION AGENCY

COMPANY NAME Marbletead Lime

EQUIPMENT LOCATION (ADDRESS) exhaust of backuse of Lime Kiln

RECORD OF VISIBLE EMISSIONS

Stack No. 1

TIME OF OBSERVATION: FROM 138 A.M. P.M. TO 2 38 A.M. P.M. DATE 6/11/74

Start/hour 1 23

R. No.	%	Min.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	19	19	20
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
3	60																					
2¾	55																					
2½	50																					
2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour

R. No.	%	Min.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
3	60																					
2¾	55																					
2½	50																					
2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour

R. No.	%	Min.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
3	60																					
2¾	55																					
2½	50																					
2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants exhaust from Lime Kiln Scrubber

Type of Air Contaminants

Point of Discharge: Stack [X] Other series of six stacks

Point of Observation:

Distance to Base of Point of Discharge, feet ~~500~~ 800

Height of Point of Discharge Above Ground Level, feet ~~200~~ 800

Background Description SKs

Weather: Clear [ ] Overcast [X] Partly Cloudy [ ] Other

Wind Direction SE Wind Velocity, mi/hr 20

Plume Description:

Detached: Yes [ ] No [ ]

Color: Black [ ] White [ ] Other not visible

Plume Dispersion Behavior: Looping [ ] Coning [ ] Fanning [ ]
Lofting [ ] Fumigating [ ] See Comments [X]

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments no visible plume mostly

Signed Gari Pulliam Title Chemical Technician

T25 #1

(3)

ENVIRONMENTAL PROTECTION AGENCY

COMPANY NAME Marblehead Lime

EQUIPMENT LOCATION (ADDRESS) exhaust of Exhaust of Lime Kiln

TIME OF OBSERVATION: FROM 3:56 A.M. P.M. TO 4:56 A.M. P.M. DATE 6/11/74

RECORD OF VISIBLE EMISSIONS

Stack No. 2

Start/hour 3:56

R. No.	%	Min. 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20
8	100	
4⅞	95	
4½	90	
4⅛	85	
4	80	
3⅞	75	
3½	70	
3⅛	65	
3	60	
2⅞	55	
2½	50	
2⅛	45	
2	40	
1⅞	35	
1½	30	
1⅛	25	
1	20	
⅞	15	
½	10	
⅛	5	
0	0	

Start/hour

R. No.	%	Min. 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
8	100	
4⅞	95	
4½	90	
4⅛	85	
4	80	
3⅞	75	
3½	70	
3⅛	65	
3	60	
2⅞	55	
2½	50	
2⅛	45	
2	40	
1⅞	35	
1½	30	
1⅛	25	
1	20	
⅞	15	
½	10	
⅛	5	
0	0	

Start/hour

R. No.	%	Min. 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
8	100	
4⅞	95	
4½	90	
4⅛	85	
4	80	
3⅞	75	
3½	70	
3⅛	65	
3	60	
2⅞	55	
2½	50	
2⅛	45	
2	40	
1⅞	35	
1½	30	
1⅛	25	
1	20	
⅞	15	
½	10	
⅛	5	
0	0	

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

#5 Stk Puffing @ 15% Opacity

Source of Air Contaminants exhaust from Lime Kiln baghouse

Type of Air Contaminants

Point of Discharge: Stack ☐ Other series of six stacks

Point of Observation:

Distance to Base of Point of Discharge, feet 200 ft 100 m

Height of Point of Discharge Above Ground Level, feet 200 ft: 80 m

Background Description sky

Weather: Clear ☐ Overcast ☒ Partly Cloudy ☐ Other

Wind Direction SW Wind Velocity, mi/hr 20

Plume Description:

Detached: Yes ☐ No ☐

Color: Black ☐ White ☒ Other not observable mostly

Plume Dispersion Behavior: Looping ☐ Coning ☐ Fanning ☐

Lofting ☐ Fumigating ☐ See Comments ☒

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments Not visible Plume mostly

Signed _____ Title _____

Test #1

(4)

ENVIRONMENTAL PROTECTION AGENCY

RECORD OF VISIBLE EMISSIONS

COMPANY NAME Marblehead Lime

EQUIPMENT LOCATION (ADDRESS) exhaust of Marblehead Lime Kiln

TIME OF OBSERVATION: FROM 4:56 A.M. P.M. TO 5:53 A.M. P.M. DATE 6-11-74

Stack No. 2

Start/hour																						
R. No.	%	Min.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
3	60																					
2¾	55																					
2½	50																					
2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour																						
R. No.	%	Min.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
3	60																					
2¾	55																					
2½	50																					
2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour																						
R. No.	%	Min.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
3	60																					
2¾	55																					
2½	50																					
2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants [illegible]

Type of Air Contaminants _____

Point of Discharge: Stack ☐ Other Series of six stacks

Point of Observation:

Distance to Base of Point of Discharge, feet 400 ft.

Height of Point of Discharge Above Ground Level, feet 80 ft.

Background Description Sky

Weather: Clear ☐ Overcast ☐ Partly Cloudy ☐ Other _____

Wind Direction SW Wind Velocity, mi/hr 20

Plume Description:

Detached: Yes ☐ No ☐

Color: Black ☐ White ☒ Other [illegible]

Plume Dispersion Behavior: Looping ☐ Coning ☐ Fanning ☐

Lofting ☐ Fumigating ☐ See Comments ☐

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments No visible emission

Signed _____ Title _____

ENVIRONMENTAL PROTECTION AGENCY

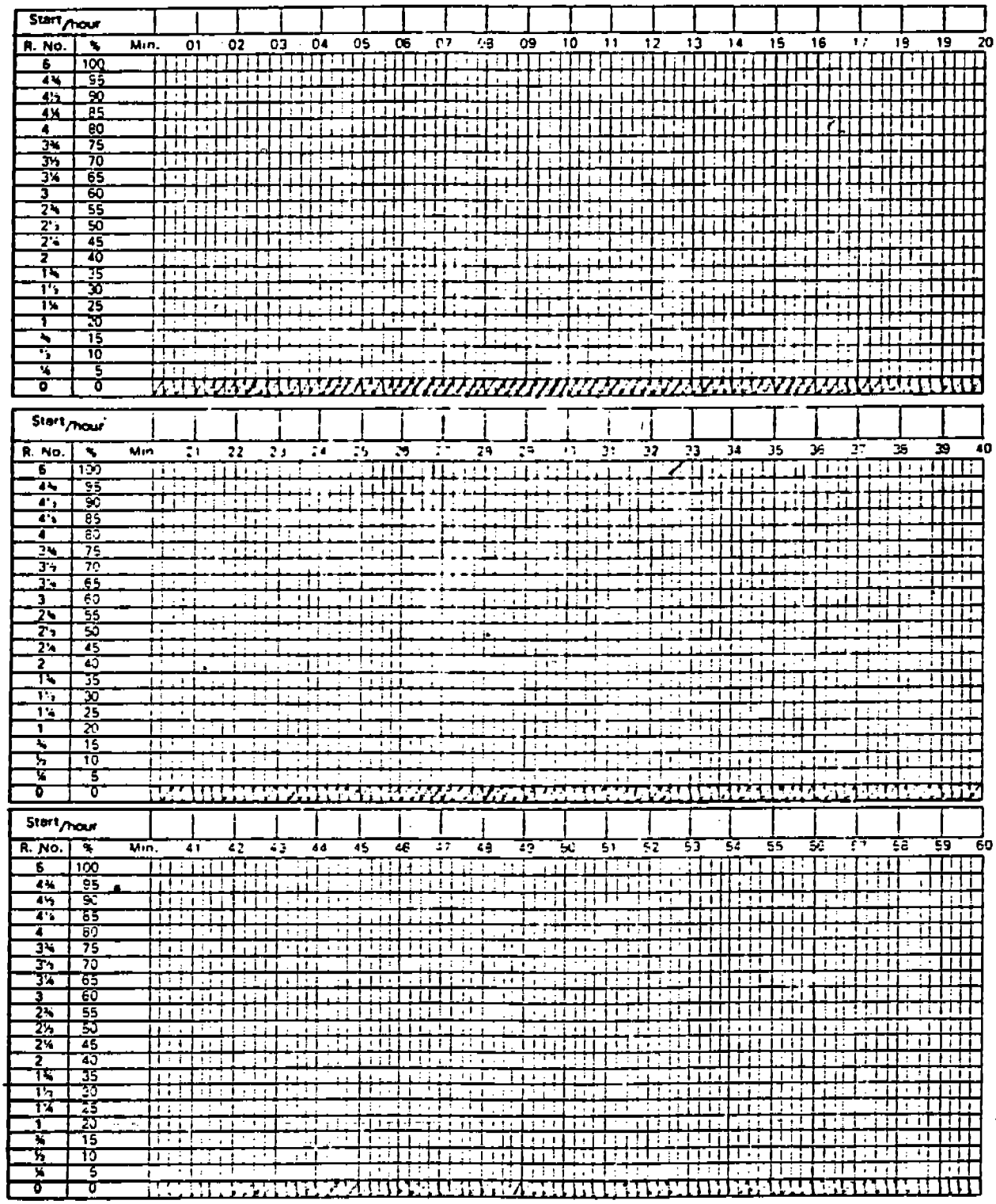
COMPANY NAME MARBLEHEAD LIME CO.

EQUIPMENT LOCATION (ADDRESS) GARY, IND.

TIME OF OBSERVATION: FROM 17:01 A.M. P.M. TO 18:01 A.M. P.M. DATE 6-11-74

RECORD OF VISIBLE EMISSIONS

STACKS 1+2



NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants LIME KILN

Type of Air Contaminants PARTICULATE, SO_2, NO_x, CO

Point of Discharge: Stack ☑ Other #1 & #2

Point of Observation:

Distance to Base of Point of Discharge, feet ~100

Height of Point of Discharge Above Ground Level, feet 80

Background Description SKY

Weather: Clear ☐ Overcast ☐ Partly Cloudy ☑ Other

Wind Direction _____ Wind Velocity, mi/hr 5-10

Plume Description:

Detached: Yes ☐ No ☐

Color: Black ☐ White ☐ Other NONE

Plume Dispersion Behavior: Looping ☐ Coning ☐ Fanning ☐

Lofting ☐ Fumigating ☐ See Comments ☐

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments

Signed John W. Brown Title

ENVIRONMENTAL PROTECTION AGENCY

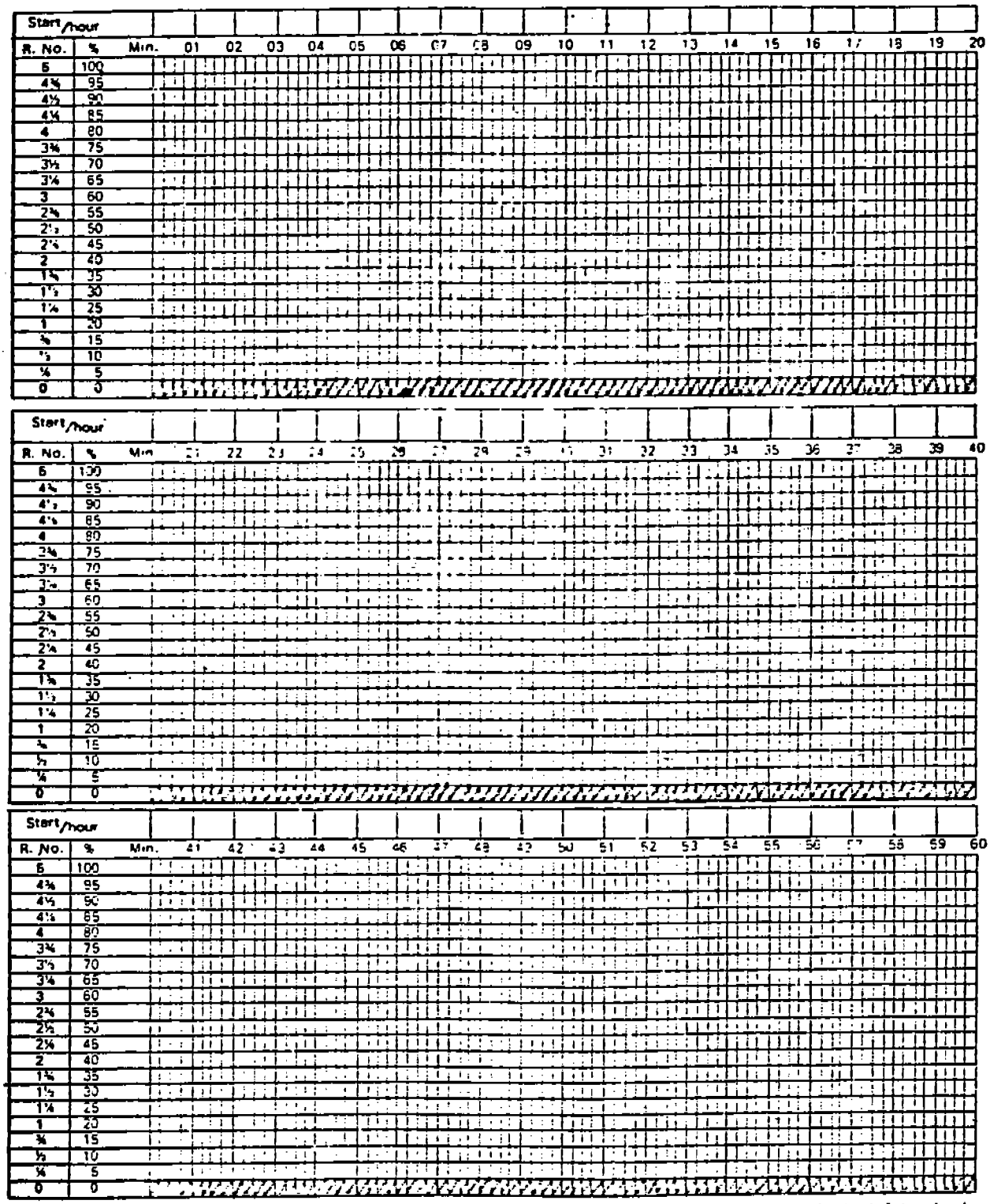
COMPANY NAME MARBLEHEAD LIME Co.

EQUIPMENT LOCATION (ADDRESS) GARY, INDIANA

TIME OF OBSERVATION: FROM 10:31 A.M. P.M. TO 17:01 A.M. P.M. DATE 6-11-74

RECORD OF VISIBLE EMISSIONS

STACKS 1+2



NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants LIME KILN

Type of Air Contaminants PARTICULATE, SO_2, NO_x, CO

Point of Discharge: Stack ☑ Other #1 & #2

Point of Observation:

Distance to Base of Point of Discharge, feet ~100

Height of Point of Discharge Above Ground Level, feet 80

Background Description SKY

Weather: Clear ☐ Overcast ☑ Partly Cloudy ☐ Other

Wind Direction SW Wind Velocity, mi/hr 5-15

Plume Description:

Detached: Yes ☐ No ☐

Color: Black ☐ White ☐ Other NONE

Plume Dispersion Behavior: Looping ☐ Coning ☐ Fanning ☐

Lofting ☐ Fumigating ☐ See Comments ☐

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments LIGHT INTERMITTENT SHOWERS

Signed J. W. Brown Title _____

(1)

Test #2

ENVIRONMENTAL PROTECTION AGENCY

COMPANY NAME Marblehead Lime

RECORD OF VISIBLE EMISSIONS

EQUIPMENT LOCATION (ADDRESS) exhaust of baghouse of Lime Kiln

TIME OF OBSERVATION: FROM 1053 A.M. P.M. TO 1153 A.M. P.M. DATE 6/12/74

Stack No. 3

Start/hour 10 53

R. No.	%	Min. 01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
5	100																				
4¾	95																				
4½	90																				
4¼	85																				
4	80																				
3¾	75																				
3½	70																				
3¼	65																				
3	60																				
2¾	55																				
2½	50																				
2¼	45																				
2	40																				
1¾	35																				
1½	30																				
1¼	25																				
1	20																				
¾	15																				
½	10																				
¼	5																				
0	0																				

Start/hour

R. No.	%	Min. 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
5	100																				
4¾	95																				
4½	90																				
4¼	85																				
4	80																				
3¾	75																				
3½	70																				
3¼	65																				
3	60																				
2¾	55																				
2½	50																				
2¼	45																				
2	40																				
1¾	35																				
1½	30																				
1¼	25																				
1	20																				
¾	15																				
½	10																				
¼	5																				
0	0																				

Start/hour

R. No.	%	Min. 41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
5	100																				
4¾	95																				
4½	90																				
4¼	85																				
4	80																				
3¾	75																				
3½	70																				
3¼	65																				
3	60																				
2¾	55																				
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1½	30																				
1¼	25																				
1	20																				
¾	15																				
½	10																				
¼	5																				
0	0																				

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants Lime Kiln

Type of Air Contaminants Particulate SO_2, NO_x CO

Point of Discharge: Stack ☑ Other 3 + 4

Point of Observation:

Distance to Base of Point of Discharge, feet 130' Observed From #4 Scrubber

Height of Point of Discharge Above Ground Level, feet 80'

Background Description Sky

Weather: Clear ☑ Overcast ☐ Partly Cloudy ☐ Other

Wind Direction _____ Wind Velocity, mi/hr _____

Plume Description:

Detached: Yes ☐ No ☐

Color: Black ☐ White ☒ Other Not Visible Mostly

Plume Dispersion Behavior: Looping ☐ Coning ☐ Fanning ☐

Lofting ☐ Fumigating ☐ See Comments ☐

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments _____

Signed Mary Pullen Title Chemical Technician

Test #2

ENVIRONMENTAL PROTECTION AGENCY

RECORD OF VISIBLE EMISSIONS

COMPANY NAME Marble Head Lime

EQUIPMENT LOCATION (ADDRESS) exhaust of bag house of lime Kiln

TIME OF OBSERVATION: FROM 11 53 A.M. P.M. TO 12 47 P.M. DATE 6/12/74

Stack No. 3

Start/hour 1	53	Min.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
R. No.	%																					
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
3	60																					
2¾	55																					
2½	50																					
2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour		Min.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
R. No.	%																					
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
3	60																					
2¾	55																					
2½	50																					
2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour		Min.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
R. No.	%																					
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
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2¾	55																					
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2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants exhaust Stack Baghouse Lime Kiln

Type of Air Contaminants Particulate Non SO2

Point of Discharge: Stack [X] Other N/A

Point of Observation:

Distance to Base of Point of Discharge, feet 100' Observed from #4 Scaffold

Height of Point of Discharge Above Ground Level, feet 80'

Background Description

Weather: Clear [X] Overcast [ ] Partly Cloudy [ ] Other

Wind Direction SW Wind Velocity, mi/hr 20

Plume Description:

Detached: Yes [ ] No [ ]

Color: Black [ ] White [X] Other Not Visible Mostly

Plume Dispersion Behavior: Looping [ ] Coning [ ] Fanning [ ]

Lofting [ ] Fumigating [ ] See Comments [ ]

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments

Signed Gary Pulliam Title Chem Tech.

ENVIRONMENTAL PROTECTION AGENCY

(3)

RECORD OF VISIBLE EMISSIONS

Test #2

COMPANY NAME Marblehead Lime

EQUIPMENT LOCATION (ADDRESS) exhaust of baghouse of lime Kiln

TIME OF OBSERVATION: FROM 1:42 A.M. P.M. TO 2:42 A.M. P.M. DATE 6/12/74

Stack No. 4

Start/hour 1 42

R. No.	%	Min. 01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
5	100																				
4¾	95																				
4½	90																				
4¼	85																				
4	80																				
3¾	75																				
3½	70																				
3¼	65																				
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2¾	55																				
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2¼	45																				
2	40																				
1¾	35																				
1½	30																				
1¼	25																				
1	20																				
¾	15																				
½	10																				
¼	5																				
0	0																				

Start/hour

R. No.	%	Min. 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
5	100																				
4¾	95																				
4½	90																				
4¼	85																				
4	80																				
3¾	75																				
3½	70																				
3¼	65																				
3	60																				
2¾	55																				
2½	50																				
2¼	45																				
2	40																				
1¾	35																				
1½	30																				
1¼	25																				
1	20																				
¾	15																				
½	10																				
¼	5																				
0	0																				

Start/hour

R. No.	%	Min. 41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
5	100																				
4¾	95																				
4½	90																				
4¼	85																				
4	80																				
3¾	75																				
3½	70																				
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1½	30																				
1¼	25																				
1	20																				
¾	15																				
½	10																				
¼	5																				
0	0																				

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants Lime Kiln Bark Coal STK.

Type of Air Contaminants Particulate. NO_x SO.

Point of Discharge: Stack ☒ Other _____

Point of Observation:

Distance to Base of Point of Discharge, feet 100'

Height of Point of Discharge Above Ground Level, feet 80'

Background Description Sky

Weather: Clear ☐ Overcast ☐ Partly Cloudy ☒ Other _____

Wind Direction SW Wind Velocity, mi/hr 20

Plume Description:

Detached: Yes ☐ No ☐

Color: Black ☐ White ☒ Other Not Visible Mostly

Plume Dispersion Behavior: Looping ☐ Coning ☐ Fanning ☐

Lofting ☐ Fumigating ☐ See Comments ☐

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments _____

Signed Gary Pulliam Title Chem. Tech.

Test #2

(4)

ENVIRONMENTAL PROTECTION AGENCY

RECORD OF VISIBLE EMISSIONS

COMPANY NAME Marblehead Lime

EQUIPMENT LOCATION (ADDRESS) exhaust of baghouse of Lime Kiln Stack No. 4

TIME OF OBSERVATION: FROM 2:42 A.M. P.M. TO 3:42 A.M. P.M. DATE 6/12/74

Start/hour 2:42

R. No.	%	Min. 01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
5	100																				
4¾	95																				
4½	90																				
4¼	85																				
4	80																				
3¾	75																				
3½	70																				
3¼	65																				
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2¼	45																				
2	40																				
1¾	35																				
1½	30																				
1¼	25																				
1	20																				
¾	15																				
½	10																				
¼	5																				
0	0																				

Start/hour

R. No.	%	Min. 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
5	100																				
4¾	95																				
4½	90																				
4¼	85																				
4	80																				
3¾	75																				
3½	70																				
3¼	65																				
3	60																				
2¾	55																				
2½	50																				
2¼	45																				
2	40																				
1¾	35																				
1½	30																				
1¼	25																				
1	20																				
¾	15																				
½	10																				
¼	5																				
0	0																				

Start/hour

R. No.	%	Min. 41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
5	100																				
4¾	95																				
4½	90																				
4¼	85																				
4	80																				
3¾	75																				
3½	70																				
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0	0																				

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants Lime Kiln Baghouse SYK

Type of Air Contaminants Particulate NO_x SO_2

Point of Discharge: Stack [X] Other _____

Point of Observation:

Distance to Base of Point of Discharge, feet 100'

Height of Point of Discharge Above Ground Level, feet 80'

Background Description _____

Weather: Clear [ ] Overcast [ ] Partly Cloudy [X] Other _____

Wind Direction _____ Wind Velocity, mi/hr _____

Plume Description:

Detached: Yes [ ] No [ ]

Color: Black [ ] White [X] Other Not Visible Mostly

Plume Dispersion Behavior: Looping [ ] Coning [ ] Fanning [ ]

Lofting [ ] Fumigating [ ] See Comments [ ]

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments _____

Signed Gary Pulliam Title Chem Tech.

ENVIRONMENTAL PROTECTION AGENCY

RECORD OF VISIBLE EMISSIONS

COMPANY NAME MARBLEHEAD Lime Co.

EQUIPMENT LOCATION (ADDRESS) BAGHOUSE STACKS No. 5 (STACK #3)

TIME OF OBSERVATION: FROM 10:53 (A.M.) P.M. TO ____ A.M. P.M. DATE 6/12/74

Start/hour		Min.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
R. No.	%																					
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
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2¾	55																					
2½	50																					
2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour		Min.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
R. No.	%																					
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
3	60																					
2¾	55																					
2½	50																					
2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour		Min.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
R. No.	%																					
5	100																					
4¾	95																					
4½	90																					
4¼	85																					
4	80																					
3¾	75																					
3½	70																					
3¼	65																					
3	60																					
2¾	55																					
2½	50																					
2¼	45																					
2	40																					
1¾	35																					
1½	30																					
1¼	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants _____

Type of Air Contaminants _____

Point of Discharge: Stack ☐ Other _____

Point of Observation:

Distance to Base of Point of Discharge, feet _____

Height of Point of Discharge Above Ground Level, feet _____

Background Description _____

Weather: Clear ☐ Overcast ☐ Partly Cloudy ☐ Other _____

Wind Direction _____ Wind Velocity, mi/hr _____

Plume Description:

Detached: Yes ☐ No ☐

Color: Black ☐ White ☐ Other _____

Plume Dispersion Behavior: Looping ☐ Coning ☐ Fanning ☐

Lofting ☐ Fumigating ☐ See Comments ☐

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments _____

_____

_____

_____

_____

Signed _____ Title _____

ENVIRONMENTAL PROTECTION AGENCY

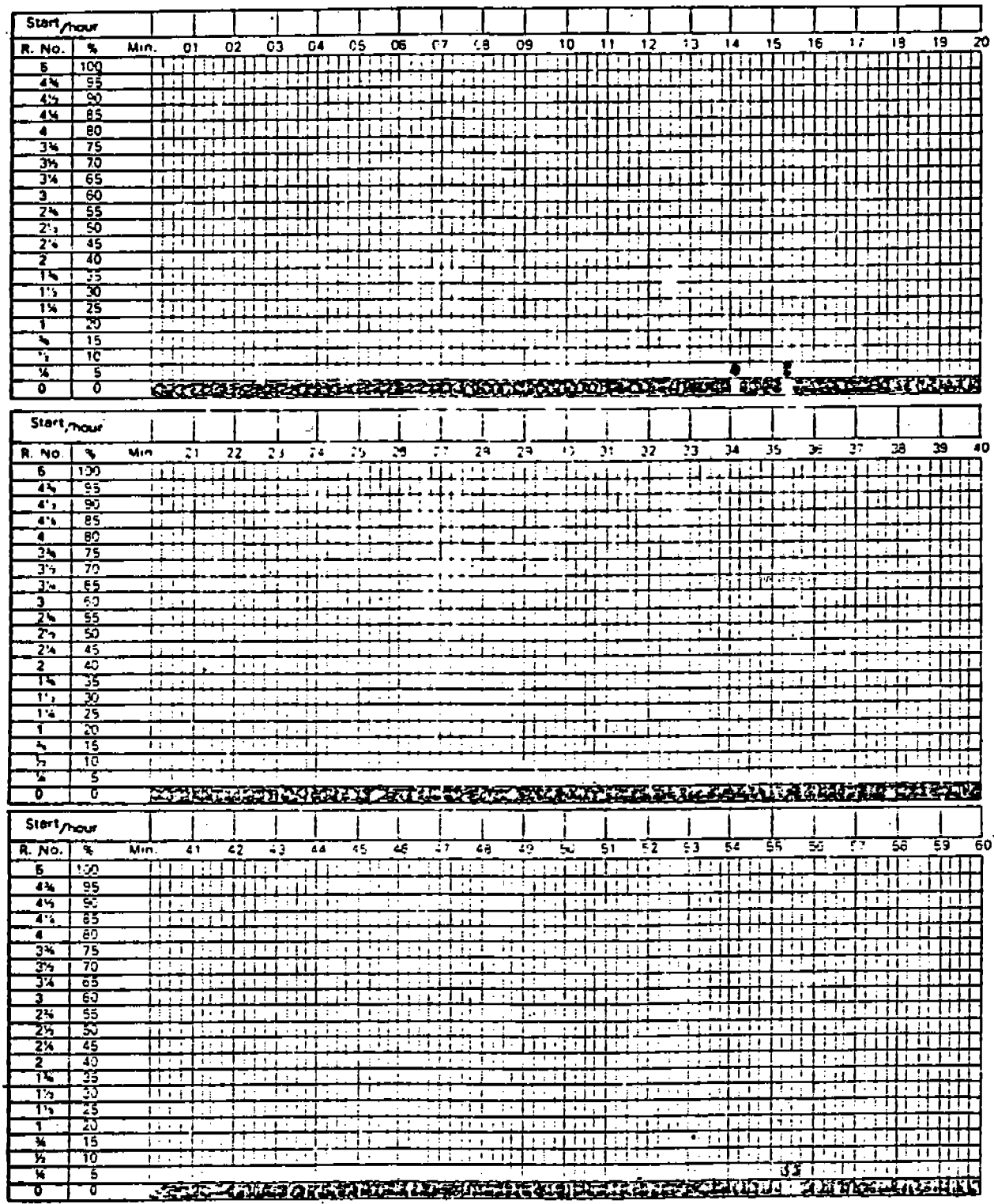
COMPANY NAME MARBLEHEAD LIME CO.

EQUIPMENT LOCATION (ADDRESS) GARY, INDIANA

TIME OF OBSERVATION: FROM 11:53 A.M. P.M. TO 12:53 A.M. P.M. DATE 6-17-74

RECORD OF VISIBLE EMISSIONS

STACK #3



NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants #5 LIME KILN BAGHOUSE

Type of Air Contaminants PARTICULATE, SO2, NOx, CO

Point of Discharge: Stack [✓] Other STACK # 3

Point of Observation:

Distance to Base of Point of Discharge, feet ~90, OBSERVED FROM #4 SCAFFOLD

Height of Point of Discharge Above Ground Level, feet 80

Background Description

Weather: Clear [ ] Overcast [ ] Partly Cloudy [✓] Other

Wind Direction SW Wind Velocity, mi/hr ~20 GUSTS TO 35

Plume Description:

Detached: Yes [ ] No [ ]

Color: Black [ ] White [ ] Other NONE VISIBLE

Plume Dispersion Behavior: Looping [ ] Coning [ ] Fanning [ ]
Lofting [ ] Fumigating [ ] See Comments [ ]

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments

Signed J. W. Burn Title

ENVIRONMENTAL PROTECTION AGENCY

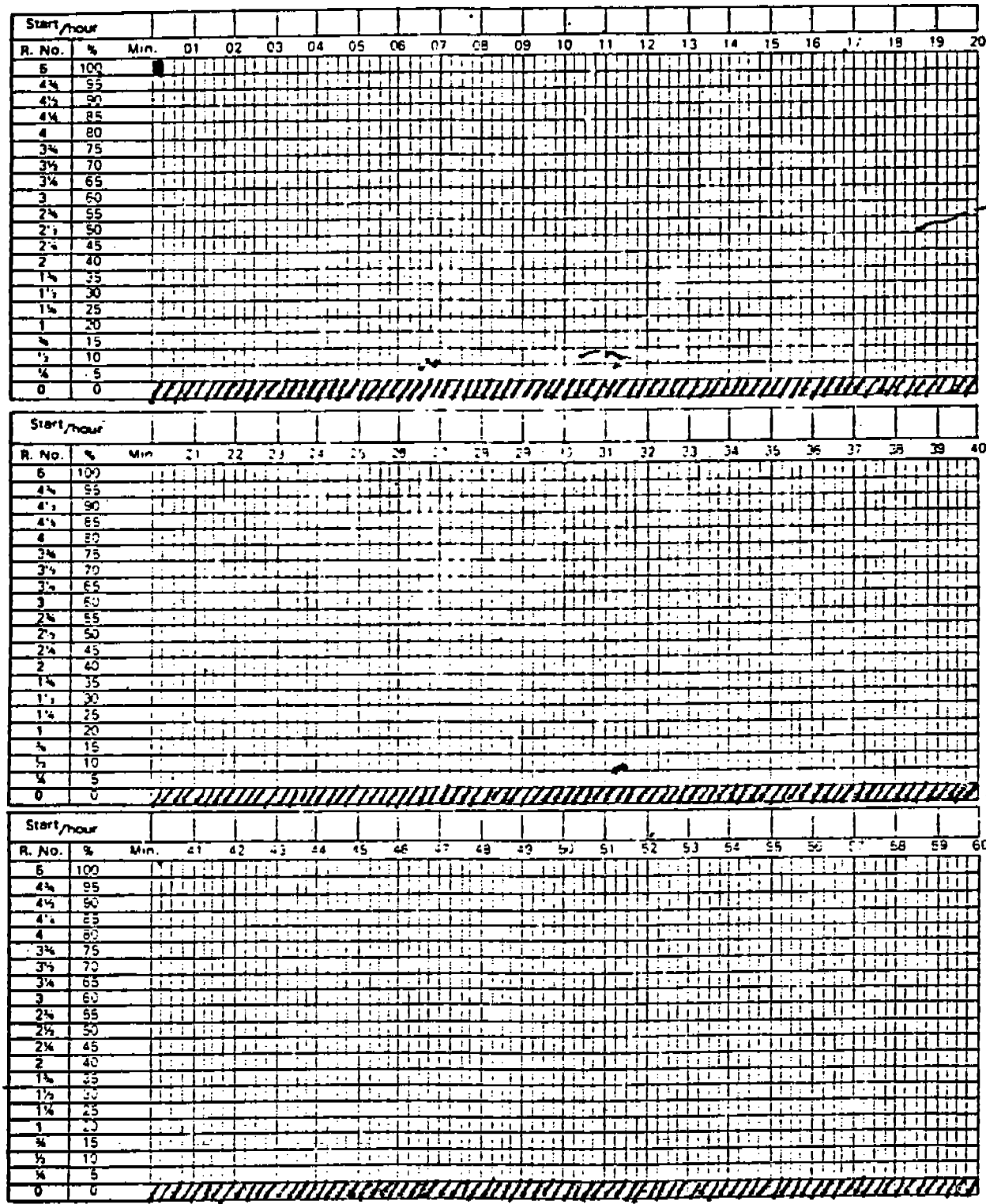
COMPANY NAME MARBLEHEAD LIME Co.

EQUIPMENT LOCATION (ADDRESS) GARY, INDIANA

TIME OF OBSERVATION: FROM 13:05 A.M. P.M. TO 17:05 A.M. P.M. DATE 6-12-74

RECORD OF VISIBLE EMISSIONS

STACK #4



NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants #5 LIME KILN BAGHOUSE

Type of Air Contaminants PARTICULATE, SO_2, NO_x, CO

Point of Discharge: Stack ☑ Other STACK # 4

Point of Observation:

Distance to Base of Point of Discharge, feet ~200

Height of Point of Discharge Above Ground Level, feet 80

Background Description SKY

Weather: Clear ☐ Overcast ☐ Partly Cloudy ☑ Other

Wind Direction SW Wind Velocity, mi/hr ~15

Plume Description:

Detached: Yes ☐ No ☐

Color: Black ☐ White ☐ Other NONE VISIBLE

Plume Dispersion Behavior: Looping ☐ Coning ☐ Fanning ☐

Lofting ☐ Fumigating ☐ See Comments ☐

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments

Signed J.W. Brown Title

ENVIRONMENTAL PROTECTION AGENCY

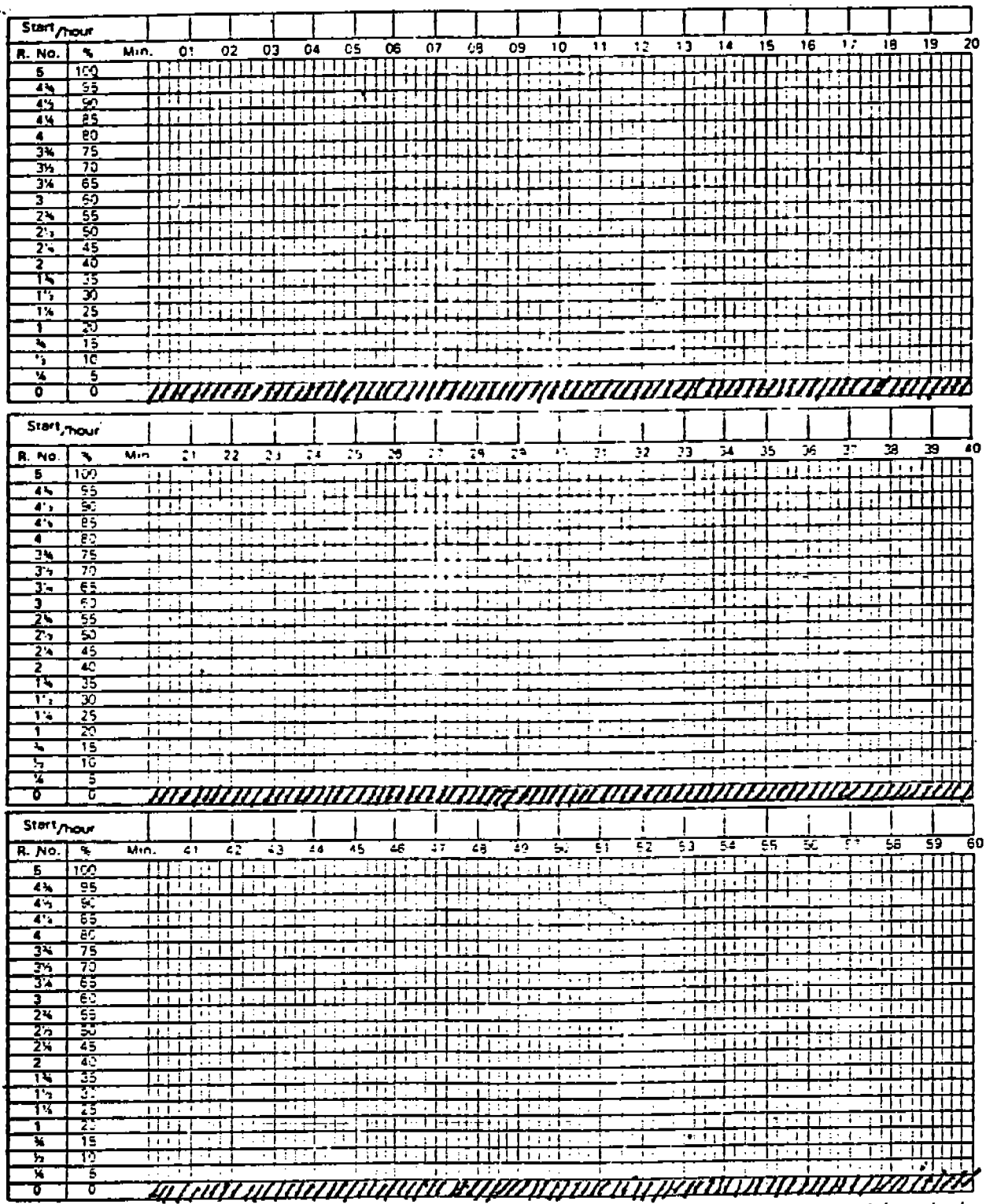
COMPANY NAME MARBLEHEAD LIME CO.

EQUIPMENT LOCATION (ADDRESS) GARY, INDIANA

TIME OF OBSERVATION: FROM 11:05 A.M./P.M. TO ____ A.M./P.M. DATE 6-12-74

RECORD OF VISIBLE EMISSIONS

STACK #4



NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Source of Air Contaminants #5 LIME KILN BAGHOUSE

Type of Air Contaminants PARTICULATE, SO_2, NO_x, CO

Point of Discharge: Stack ☑ Other STACK #4

Point of Observation:

Distance to Base of Point of Discharge, feet ~200

Height of Point of Discharge Above Ground Level, feet 80

Background Description SKY

Weather: Clear ☐ Overcast ☐ Partly Cloudy ☑ Other

Wind Direction _____ Wind Velocity, mi/hr ~10

Plume Description:

Detached: Yes ☐ No ☐

Color: Black ☐ White ☐ Other NONE VISIBLE

Plume Dispersion Behavior: Looping ☐ Coning ☐ Fanning ☐

Lofting ☐ Fumigating ☐ See Comments ☐

Estimated Distance (feet) Plume Visible (Maximum) _____ (Minimum) _____

Comments _____

Signed J.W. Brown Title _____

ENVIRONMENTAL PROTECTION AGENCY

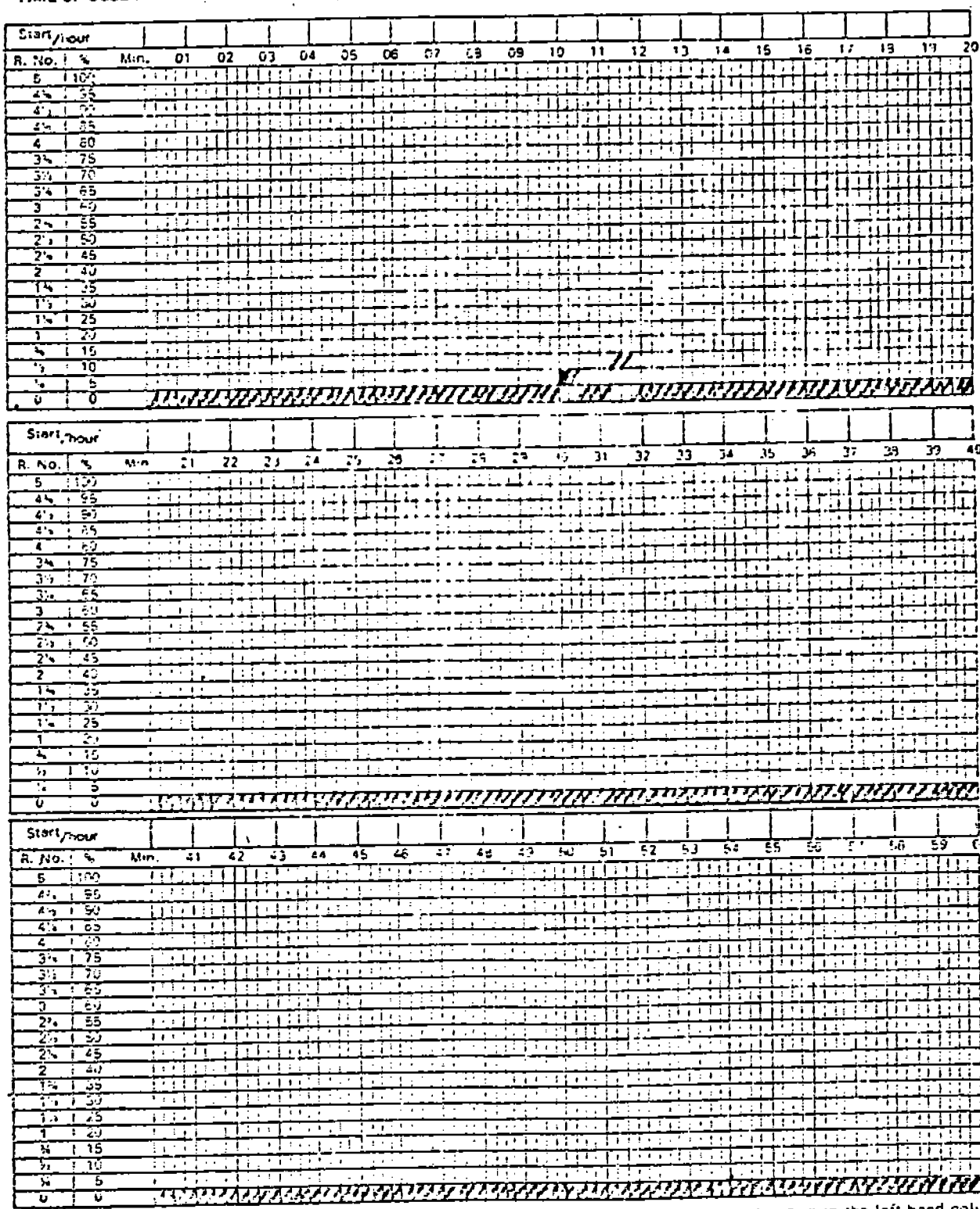
COMPANY NAME MARBLEHEAD LIME CO.

EQUIPMENT LOCATION (ADDRESS) GARY, INDIANA

TIME OF OBSERVATION: FROM 09:31 A.M. / P.M. TO 15:31 A.M. / P.M. DATE 6-13-74

RECORD OF VISIBLE EMISSIONS

STACK #5



NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Lime Kiln Baghouse

Particulate, SO_x, NO_x, CO

Stack # 5

Observed from # 4 scaffold - stack base 80', height 100'

Background - sky

Weather - Partly cloudy
Wind ~20 mph from S

No visible plume

By Mary Pellum-Walden

ENVIRONMENTAL PROTECTION AGENCY

COMPANY NAME MARBLEHEAD LIME CO.

EQUIPMENT LOCATION (ADDRESS) GLEN, ILLINOIS

TIME OF OBSERVATION: FROM 10:31 A.M. / P.M. TO 11:31 A.M. / P.M. DATE 6-13-74

RECORD OF VISIBLE EMISSIONS

STACK #5

Start/hour

R. No.	%	Min.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
5	100																					
4½	95																					
4½	90																					
4½	85																					
4	80																					
3½	75																					
3½	70																					
3½	65																					
3	60																					
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2½	45																					
2	40																					
1½	35																					
1½	30																					
1½	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
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Start/hour

R. No.	%	Min.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
5	100																					
4½	95																					
4½	90																					
4½	85																					
4	80																					
3½	75																					
3½	70																					
3½	65																					
3	60																					
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2½	50																					
2½	45																					
2	40																					
1½	35																					
1½	30																					
1½	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour

R. No.	%	Min.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
5	100																					
4½	95																					
4½	90																					
4½	85																					
4	80																					
3½	75																					
3½	70																					
3½	65																					
3	60																					
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1½	30																					
1½	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

ENVIRONMENTAL PROTECTION AGENCY

COMPANY NAME Marblehead Lime Co.

EQUIPMENT LOCATION (ADDRESS) Gary, Indiana

TIME OF OBSERVATION: FROM 11:46 A.M. P.M. TO 12:46 A.M. P.M. DATE 6-13-74

RECORD OF VISIBLE EMISSIONS

STACK #6

Start/hour																					
R. No.	%	Min.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
5	100																					
4½	95																					
4½	90																					
4½	85																					
4	80																					
3½	75																					
3½	70																					
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¾	15																					
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¼	5																					
0	0																					

Start/hour																					
R. No.	%	Min.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
5	100																					
4½	95																					
4½	90																					
4½	85																					
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¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour																					
R. No.	%	Min.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
5	100																					
4½	95																					
4½	90																					
4½	85																					
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0	0																					

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Lime Kiln Baghouse.
Particulate, SO_2, NO_x, CO
Stack #4
Observed from ground - ~200' from base. Stack - 80' high
Background - sky
Weather - overcast
Wind: 5-10 MPH from S-SW
No visible plume

By Doug Pullium - Weldon

ENVIRONMENTAL PROTECTION AGENCY

COMPANY NAME Marquette Lime Co.

EQUIPMENT LOCATION (ADDRESS) Gary, Indiana

TIME OF OBSERVATION: FROM 12:46 A.M. P.M. TO 13:46 A.M. P.M. DATE 6-13-74

RECORD OF VISIBLE EMISSIONS

STACK #6

R. No.	%	Min.	Start/hour 01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
5	100																					
4½	95																					
4½	90																					
4½	85																					
4	80																					
3½	75																					
3½	70																					
3½	65																					
3	60																					
2½	55																					
2½	50																					
2½	45																					
2	40																					
1½	35																					
1½	30																					
1½	25																					
1	20																					
¾	15																					
½	10																					
⅛	5																					
0	0																					

R. No.	%	Min.	Start/hour 21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
5	100																					
4½	95																					
4½	90																					
4½	85																					
4	80																					
3½	75																					
3½	70																					
3½	65																					
3	60																					
2½	55																					
2½	50																					
2½	45																					
2	40																					
1½	35																					
1½	30																					
1½	25																					
1	20																					
¾	15																					
½	10																					
⅛	5																					
0	0																					

R. No.	%	Min.	Start/hour 41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
5	100																					
4½	95																					
4½	90																					
4½	85																					
4	80																					
3½	75																					
3½	70																					
3½	65																					
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1½	35																					
1½	30																					
1½	25																					
1	20																					
¾	15																					
½	10																					
⅛	5																					
0	0																					

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Lime Kiln Baghouse
Particulate, SO_2, NO_x, CO
Stack #6
Observed from ground - ~200' from base. Stack - 50' high.
Background - sky
Weather - overcast
Wind: 5-10 MPH from S-SW
No visible plume

By Doug Pullium - Walker

ENVIRONMENTAL PROTECTION AGENCY

COMPANY NAME Marblehead

EQUIPMENT LOCATION (ADDRESS) Gary, Indiana

TIME OF OBSERVATION: FROM 12:10 A.M./P.M. TO 13:10 A.M./P.M. DATE 6-13-74

RECORD OF VISIBLE EMISSIONS

STACK #6

Start/hour 12|0

R. No.	%	Min. 01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20
5	100	
4½	90	
4½	90	
4½	85	
4	80	
3½	75	
3½	70	
3½	65	
3	60	
2½	55	
2½	50	
2½	45	
2	40	
1½	35	
1½	30	
1½	25	
1	20	
½	15	
½	10	
¼	5	
0	0	XXXXXXXX

Start/hour

R. No.	%	Min. 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
5	100	
4½	90	
4½	90	
4½	85	
4	80	
3½	75	
3½	70	
3½	65	
3	60	
2½	55	
2½	50	
2½	45	
2	40	
1½	35	
1½	30	
1½	25	
1	20	
½	15	
½	10	
¼	5	
0	0	

Start/hour

R. No.	%	Min. 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
5	100	
4½	90	
4½	90	
4½	85	
4	80	
3½	75	
3½	70	
3½	65	
3	60	
2½	55	
2½	50	
2½	45	
2	40	
1½	35	
1½	30	
1½	25	
1	20	
½	15	
½	10	
¼	5	
0	0	

NOTE: Each small square represents an individual reading of intensity corresponding to that shown in the left-hand column over a time span of ¼ minute. Insert an "S" in the top row of blank squares to indicate the exact minute of the start of observation. In the next square after the "S", insert the hour in which the measurement was made. Each page of this form can thus be used to record 1 hour of measurements.

Location : Lime Kiln #s-
Stack : #6
Background : Overcast Sky

Height of stack - 80'

Height of observation - ground

Distance from observer to stack ~ 200'

Wind Speed : 5--10 mph

" Direction : S-SW

No visible plume

John W. Brown

ENVIRONMENTAL PROTECTION AGENCY

COMPANY NAME Marblehead

EQUIPMENT LOCATION (ADDRESS) Gary, Indiana

TIME OF OBSERVATION: FROM 13:10 A.M. P.M. TO 13:56 A.M. P.M. DATE 6-13-74

RECORD OF VISIBLE EMISSIONS

STACK #6

Start/hour																					
R. No.	%	Min.	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
5	100																					
4½	90																					
4½	90																					
4½	85																					
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1½	30																					
1½	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour																					
R. No.	%	Min.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
5	100																					
4½	90																					
4½	90																					
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1½	25																					
1	20																					
¾	15																					
½	10																					
¼	5																					
0	0																					

Start/hour																					
R. No.	%	Min.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
5	100																					
4½	90																					
4½	90																					
4½	85																					
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Location: Lime Kiln #5 Baghouse
Stack: #6

Background: Overcast sky

Height of Stack: 80'
Point of observation: ground
Distance from stack: ~200'

Wind Speed: 5-10 mph
Direction: S-SW

No visible plume

John W. Brown

APPENDIX G

STANDARD SAMPLING PROCEDURES

A. PARTICULATE SAMPLING (EPA METHOD 5)

The selection of sampling sites and the number of traverse points for particulate sampling was performed in accordance with EPA Method 1, Federal Register, December 23, 1971. There are two 3" sampling ports on each of the six stacks. They are located 90° apart, 2' from the outlet and 6' from the inlet. The stacks are 7'4" in diameter and therefore required the maximum number of traverse points (48). Samples were taken at each of the 48 points for five minutes per point or a total of 240 minutes (four hours) for each run.

Preliminary pitot traverses were performed on June 10, 1974, in accordance with Method 2, Federal Register, December 23, 1971, to determine the stack gas velocity. Measurements of the velocity head using a Type S (Stauscheibe) pitot tube and inclined manometer and stack temperature using a thermocouple were recorded and are presented in Appendix F. The stack gas molecular weight was determined by three 4-hour integrated Orsat gas analyses simultaneously with the particulate tests as indicated in Method 3, Federal Register, December 23, 1971. The stack gas velocity and the volumetric flow rates were calculated for each test in Walden's computer program and presented in the summary results. The equations used to calculate the stack gas velocity and the volumetric flow rate were Equations 2-2 and 2-3, respectively, of the Federal Register, December 23, 1971.

Percent moisture in the gas stream was determined by a wet bulb - dry bulb technique. A 3/4-inch standard pipe fitted with a standard "tee" and a connection to a pump was inserted into the test port. A dry bulb thermometer with rubber stopper and a wet bulb thermometer were placed in the tee. The proper temperatures were obtained by regulating the rate of flow at 1.5 cubic feet per minute to obtain a flow of at least six hundred feet per minute in accordance with tables computed from U.S. Bureau of Standards data.

The particulate sampling train was a Joy Manufacturing Emission Parameter Analyzer with a 13-foot stainless steel probe. A six-foot glass-lined probe was not long enough to completely traverse the duct diameter,

therefore, the EPA Project Officer granted approval for the use of a stainless steel probe. The control unit contained the temperature and pressure instrumentation, vacuum source, temperature-compensated dry gas meter, and interval timer. It should be noted that the computer data sheets indicate the meter temperature to be 70°F due to temperature compensation within the control unit. The design specifications of this particulate sampling train comply with standards set forth in APTD-0581. EPA approval was also granted for the use of stationary impingers connected to the traversing probe and heater box through flexible Teflon tubing. The sampling train is shown in Figure G-1.

The variations from Method 5 as described in the Federal Register were the addition of one hundred milliliters of water to the third impinger and the use of a stationary impinger box connected to the heated filter box through Teflon tubing. Normally, the third impinger is left empty, however, the addition of water did not alter the sampling methods or results as the water was eventually evaporated in a beaker for the determination of particulate matter in the residual water fraction.

Due to the low velocities (about 15 feet per second), inclined manometers with a range of 0 - 0.25 inches H_2O were used. Nomographs were not used for the adjustment of the sampling rate, rather the equations that serve as the basis for the nomograph were calculated. A direct relationship between the stack velocity head (ΔP_S) and the pressure differential across the orifice meter (ΔH) was determined and used for setting the isokinetic sampling rate. The relationship is as follows:

$$\left[\frac{(2.9)\ (P^{STD}_{P.C.F.})\ (60)\ (\pi)\ (D)^2\ (1\text{-}B)\ (Tm)}{4(144)\ (T_S)^{1/2}\ (O.C.F.)}\right]^2 \Delta P = \Delta H$$

where:

STD P.C.F. = Pitot correction factor (dimensionless)
D = Diameter of nozzle, inches
B = Percent moisture in gas stream
Tm = Meter temperature, °R
T_S = Stack temperature, °R
O.C.F. = Orifice correction factor

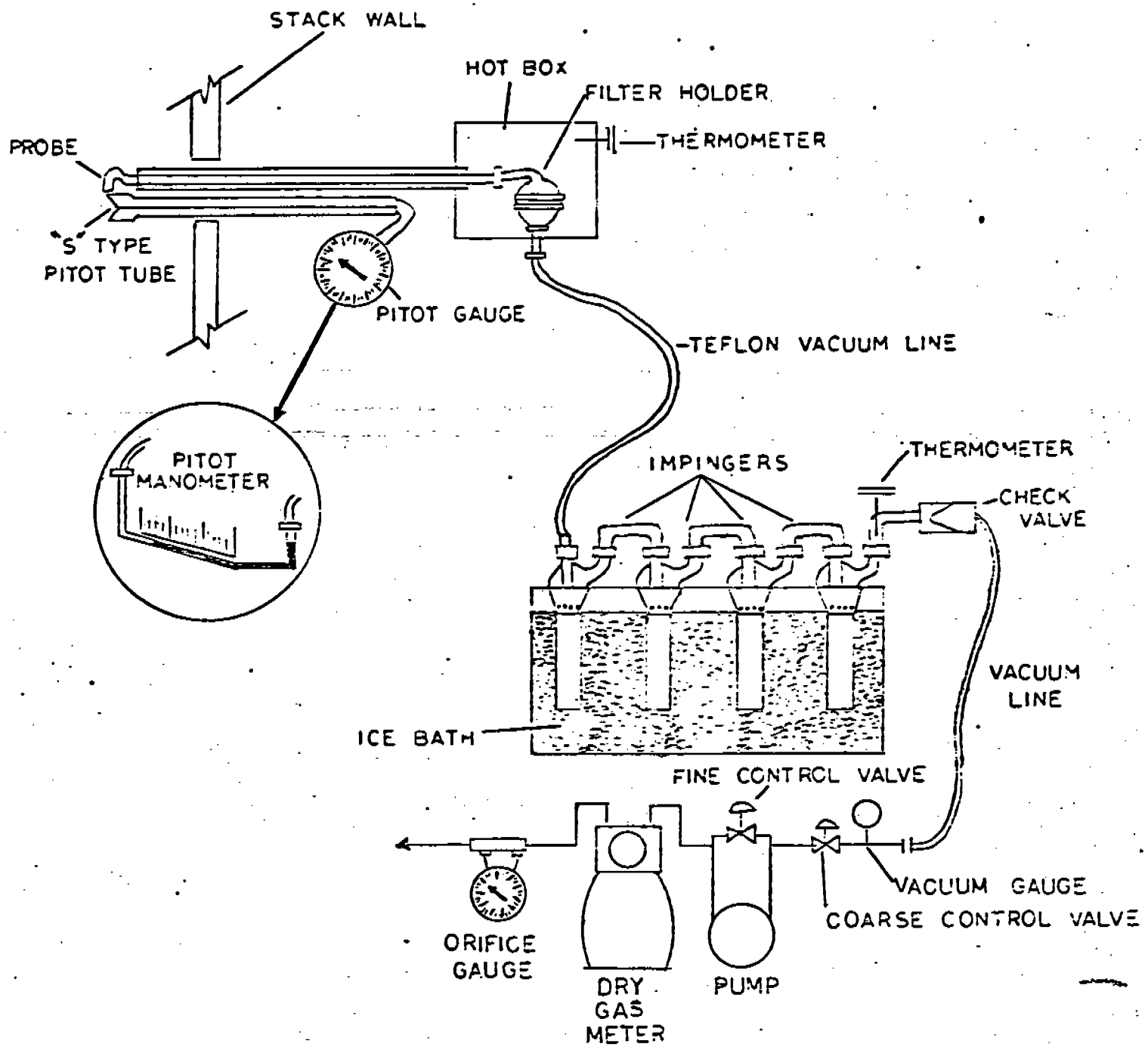

Figure G-1. Particulate Sampling Train, Marblehead Lime, Gary, Indiana

Walden

Also, a meter rate formula was determined and used to maintain isokinetic flow by checking the flow rate at 15-second intervals. We have found this approach to be quite accurate as the two equations serve as a check for each other. The meter rate formula is as follows:

$$M_r = (P.C.F.) \times V_{avg.} \times 60 \times \frac{T_m}{T_s} \times \frac{P_b \pm P_s}{P_b - P_m} \times An \times (1-\%H_2O).$$

where:

M_r = Volumetric flow rate, $ft^3/min.$
P.C.F. = Pitot correction factor (dimensionless)
$V_{avg.}$ = Average velocity, ft/sec
T_m = Meter temperature, °R
T_s = Stack temperature, °R
P_b = Barometric pressure, in. Hg.
P_s = Stack static pressure, in. Hg.
P_m = Vacuum at meter, in. Hg.
A_n = Area of nozzle, ft^2
$\%H_2O$ = Percent moisture in gas stream

The stack gas molecular weight was determined by three 4-hour integrated gas analyses collected simultaneously with the particulate tests. An Orsat was used to determine CO_2 and Fyrites were used to determine CO_2 and O_2. The Orsat scale is only capable of reading up to 21%. Since the O_2 is read together with the CO_2, a reading above 21% (16.5% O_2 and 7.0% CO_2 = 23.5% total) was obtained and therefore, Fyrites were used.

Three and one-half-inch diameter glass fiber filters were desiccated for 48 hours and weighed to the nearest 0.5 milligram on a Satorius Model 2742 analytical balance prior to the test period. Also, approximately two hundred grams of silica gel were weighed to the nearest gram and placed in storage bottles for use in the field. The sampling train was prepared by placing a preweighed glass fiber filter into a pyrex glass filter holder with a heating system capable of maintaining a minimum temperature of 225°F. One hundred milliliters of distillate water was placed in each of the first three impingers and preweighed silica gel was placed in

the fourth impinger. The impingers were connected in series with glass ball joint fittings. The first, third and fourth impingers were of the Greenburg-Smith design, modified by replacing the tip with a one-half-inch ID glass tube extending to one-half inch from the bottom of the flask. The second impinger was of the Greenburg-Smith design with the standard tip. The addition of one hundred milliliters of water to the third impinger was an error in the field preparation.

Sample recovery and analysis were performed in accordance with the methods described in the Federal Register, August 17, 1971. At the request of the Project Officer, a front-half water wash was performed after the acetone wash. This procedure should be used when testing lime kilns due to the nature of the particulate emissions. All sample bottles were acid-washed Wheaton bottles in accordance with specifications requested by the EPA. The tared beakers and filters containing the particulate matter will be held by EPA for their use.

Following completion of each repetition, the sample recovery procedure was conducted in the laboratory within the plant facility. Portions of the distilled water and acetone used were set aside as blanks for analysis. The filter was removed from its holder and placed in a container along with any filter residue clinging to the filter holder. All loose particulate matter from all sample-exposed surfaces prior to the filter was washed with acetone and placed in a second labeled container. The volume of water from the first three impingers was measured and placed in a third container along with water rinsings of all sample-exposed surfaces between the filter and fourth impinger. This included the flexible Teflon tubing. The silica gel was weighed and placed in a fourth container. Finally, all sample-exposed surfaces between the filter and fourth impinger were rinsed with acetone and placed in a fifth container.

All samples were returned to the Walden laboratories and analyzed. The filter and loose particulate matter was dried, dessicated, and weighed over a 72-hour period. The front-half acetone washings were evaporated to dryness under a hood in a tared beaker at ambient temperature and pressure. The beaker was then dried, dessicated and weighed. Three 25 milliliter

portions of chloroform were individually added to a separatory funnel containing the water washings from the impinger catch. The extraction was completed with three 25 milliliter portions of ethyl ether and both the ether and chloroform extracts combined in a tared beaker. The extracts were evaporated at 70°F under a hood and then dried, dessicated, and weighed. The back half acetone washings were treated in a similar manner as the front-half acetone washings.

B. SULFUR DIOXIDE SAMPLING (EPA METHOD 6)

Six sulfur dioxide tests were run at the outlet in accordance with Test Method 6 as described in the Federal Register, December 23, 1971. The sampling period was to be four hours, however, carry-over from the first impinger containing isopropanol occurred prior to the end of the test. To avoid carrying over the sulfuric acid fraction into the sulfur dioxide fraction, the tests were terminated at this point. The sampling system consisted of a Walden-built control module containing the temperature and pressure instrumentation, vacuum source, dry gas meter, rotameter, and drying tube, three midget impingers, one midget bubbler, a three-foot heated glass-lined probe, and a pitot tube. The sampling point was chosen as the average velocity point and proportional gas sampling was easily maintained as only minor variations were noted in the stack gas velocity during these runs. Leak checks were run prior to each repetition by plugging the probe inlet and pulling 10 inches Hg. vacuum. A leakage rate less than one percent of the sampling rate was found for each run.

The sampling reagents were prepared prior to the tests and added to the sampling trains at the test site. Eighty percent isopropanol was made up by mixing 160 milliliters of isopropanol to forty milliliters of deionized, distilled water. Three percent hydrogen peroxide was made up by diluting two hundred milliliters of thirty percent hydrogen peroxide to two liters with deionized distilled water. The hydrogen peroxide was prepared fresh daily.

Fifteen milliliters of eighty percent isopropanol was poured into a midget bubbler and fifteen milliliters of three percent hydrogen peroxide was poured into each of the first two midget impingers. The final midget impinger was left empty. The sampling system was set up as shown in Figure G-2. Quartz wool was packed into the probe end and crushed ice placed around the impingers.

Sample collection was performed by adjusting the sample flow rate proportional to the stack gas velocity. Since the sample is taken at a single point, variations in velocity were minimal and the sample flow rate was maintained at the original setting of one liter per minute. Readings were taken every five minutes during the tests. Upon completion of each sample run, the train was purged for 15 minutes with charcoal filtered ambient air. The contents in the midget bubbler were discarded and the contents in the midget impingers were stored in glass Wheaton bottles along with the distilled water washings.

The sulfur dioxide samples were returned to the Walden labs for analysis. The concentration of SO_2 in the samples was determined by the Barium-Thorin titration method described in the Federal Register. The procedure calls for the samples to be diluted to fifty milliliters with deionized water. Since some sample volumes exceeded fifty milliliters, all samples were diluted to 100 milliliters and twenty milliliter aliquots were obtained and diluted with eighty milliliters of certified reagent grade 2-propanol. Four drops of thorin indicator were added and titrated with a standardized barium perchlorate solution (0.0103N) to a pink end point. Two titrations were performed per sample and an average value determined.

The reagents used in the SO_2 analysis are as follows:

(1) Barium perchlorate solution (0.0100N). Dissolve 1.9500 g barium perchlorate [β_a $(ClO4)_2 \cdot 3\ H_2O$] in 200 milliliter deionized water and dilute to one liter with reagent grade 2-propanol.

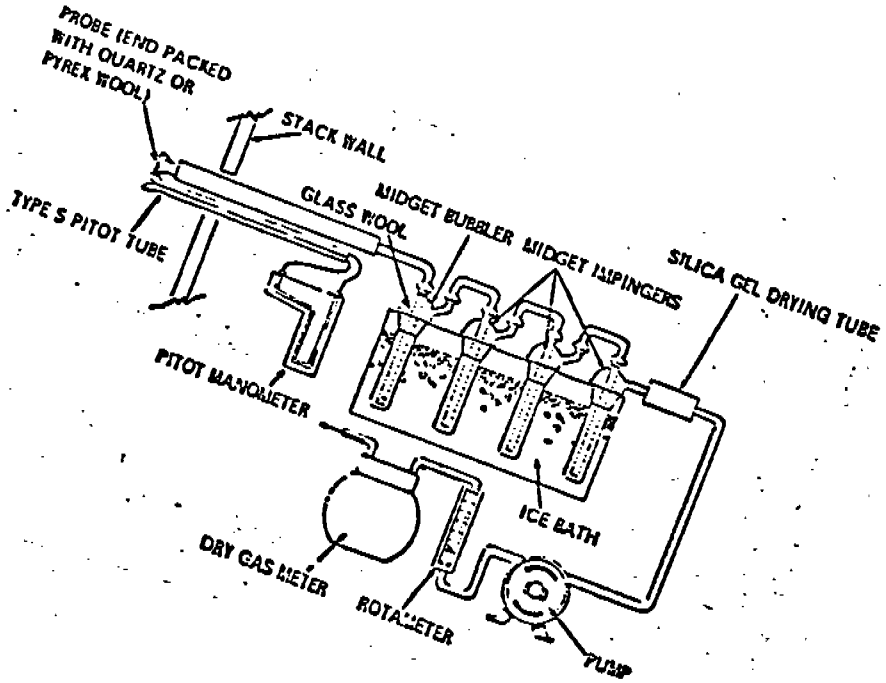

Figure G-2. SO_2 Sampling Train

(2) Thorin indicator 1-(p-arsonophenyazo)2-napthol-3,6-disulfonic acid. Dissolve 0.20 g disoldium salt in one hundred milliliter distilled water.

C. NITROGEN OXIDES SAMPLING (EPA METHOD 7)

Twelve nitrogen oxides samples were collected at the outlet in accordance with the Federal Register, December 23, 1971, Method 7, and a modified draft procedure provided by the EPA. Four samples were obtained on June 10, 11, and 12 during the four hour particulate tests.

The sample collection flasks were two liter, Pyrex round bottom flasks with short neck and 24/40 standard taper opening encased in a protective foam covering. The absorbing solution was made up by adding 2.8 milliliters of concentrated sulfuric acid to one liter of distilled water with a graduated pipette. Twenty-five milliliters of absorbing solution was added to each flask prior to sampling and then the flask valve stopper inserted with the valve in the "purge" position. The sampling system was assembled as shown in Figure G-3 and the heated probe was located at the average velocity point for that port being sampled. All ground glass joints were greased with a high vacuum, high temperature chlorofluorocarbon based stopcock grease. The flask valve and pump valve were then turned to their "evacuate" positions and evacuated with the pump on. Upon evacuating the flask to three inches Hg absolute pressure, the pump valve was turned to the vent position and turned off. A leak check was made for the next minute by checking for fluctuations in the mercury level in the manometer. The flask volume, temperature, and barometric pressure were recorded and the flask valve and pump valve turned to their "purge" positions. The probe and tubing were purged with a squeeze bulb. The pump was then turned to its "vent" position and the flask valve to its "evacuate" position and the difference in mercury levels in the manometer recorded. The flask valve was immediately turned to its "sample" position and the gas was allowed to enter the flask until pressures in the flask and sample lines were equal. Finally, the flask valve was turned to its "purge" position and the flask shaken for five minutes.

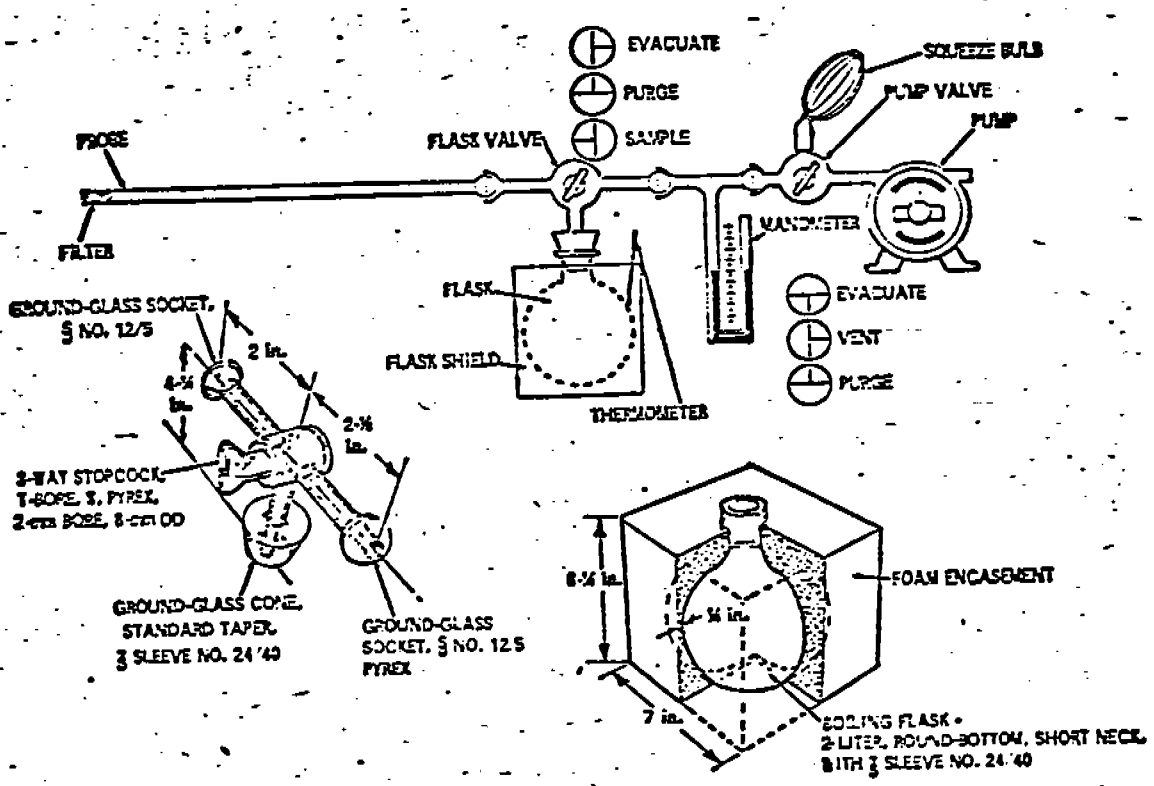

Figure G-3. Nitrogen Oxides Sampling System

The following day (approximately 24 hours) the contents of the flasks were shaken for two minutes. The flask was then connected to a mercury filled U-tube manometer, opening the valve from the flask and recording the flask temperature, pressure and the barometric pressure. The flask contents were transferred to glass Wheaton bottles for shipment to the laboratory. The flasks were rinsed with two five milliliter portions of deionized distilled water and the rinse water added to the storage bottles.

The concentration of NO_x samples were measured colorimetrically on a Beckman Spectronic 20, using the phenoldisulfonic acid (PDS) procedure. The procedure calls for a blank and a set of standards to be processed with the samples. The results of the colorimetric analysis are then used to calculate the sample concentrations.

After shipping, sodium hydroxide was added to the contents of the samples and the blank until the pH was 9-12. Each sample was quantitatively transferred to a two hundred and fifty milliliter evaporating dish, evaporated to dryness on a steam bath, and cooled. Next, two milliliters of phenoldisulfonic acid were added such that it made contact with all of the residue. One milliliter of deionized water was added and the samples were heated on the steam bath for three minutes, with stirring and cooling. Twenty milliliters of distilled water were added to the samples and concentrated ammonium hydroxide was added dropwise until a pH of 10 was reached, as determined by pH paper. Each sample was then transferred quantitatively to a one hundred milliliter volumetric flask and diluted to the mark with deionized water. A set of standards and the blank was prepared by pipeting 0.0, 1.0, 2.0, 3.0 and 4.0 milliliters of the potassium nitrate working solution into a two hundred and fifty milliliter evaporating dish. To each sample, ten milliliters of deionized water was added and then sodium hydroxide (1N) was added dropwise until a pH of 9-12 was reached. They were then diluted volumetrically to 100 milliliters and analyzed spectrophotometrically at 410 nm using the blank as the zero reference.

The reagents used in the analysis are as follows:

(1) Phenoldisulfonic acid. Dissolve 25 g of pure white phenol in 150 milliliters concentrated sulfuric acid on a steam bath. Cool, add 75 milliliters fuming sulfuric acid and heat at 100°C for two hours. Store in dark stoppered bottle.

(2) Potassium nitrate standard solution. Stock soln. Dissolve exactly 2.1980 g dry potassium nitrate (KNO_3) in deionized water and dilute to one liter. Working solution. Dilute 10 milliliters of stock solution to 100 milliliters with deionized water. One milliliter of working solution is equivalent to 100 µg NO_2.

(3) Absorbing reagent. Add 2.8 milliliters concentrated H_2SO_4 to one liter deionized water. Mix well and add 6 milliliters of 3% hydrogen peroxide.

(4) Sodium hydroxide (1N). Dissolve 40 g NaOH in deionized water and dilute to one liter.

D. CARBON MONOXIDE SAMPLING (METHOD 10)

CO was measured according to EPA Method 10 by Honeywell Corporate Research using a Honeywell NDIR CO Analyzer. The bag samples represented approximately 2-hour accumulations and were run on three consecutive days.

The instrumentation for the measurements at Marblehead Lime Company was housed in a mobile van. The bag samples were collected through a probe and condenser sampling from a port near the top of the stack (about 80' high). A three-channel Honeywell NDIR Analyzer was used in this study. Although CO, CO_2 and CH_4 channels were available, only the CO channel was monitored.

After analysis of the bag sample on the Honeywell NDIR Analyzer, the CO concentration in the stack was determined from Equation 10-1 of the Federal Register, Volume 39, No. 47, March 8, 1974, page 9320.

EPA Method 10 specifies that for both integrated (bag) and continuous sampling, the sample must pass through a volume of silica gel and another of ascarite immersed in an ice bath (to remove H_2O and CO_2). Tests with the Honeywell NDIR CO Analyzer have demonstrated rejection ratios greater than 10^4 for both H_2O and CO_2. Therefore, passing the sample through silica gel

and ascarite is unnecessary. In fact, passing the sample through the ascarite caused considerable technical difficulty. After about an hour of sampling, the ascarite formed a hard ball around the inlet tube to the ascarite container, causing a severe flow restriction.

E. OPACITY READINGS (METHOD 9)

The relative opacity of each of the six stacks was determined in accordance with Method 9 of the Federal Register, December 23, 1971. The opacity determinations were conducted for two hours on each stack during the particulate tests. Two observers read each stack except Stack No. 5, which was read by one observer.

APPENDIX H

LABORATORY REPORT

SAMPLE IDENTIFICATION LOG 6-11-74
Marblehead Lime Co. Gary, Indiana

EPA Number	Sample Location	Run ☆	Contents	Comments
74-000-701	Stack #1	1-1	Filter	
" 702		"	Front half acetone wash	
" 703		"	" " acetone wash	
" 704		"	~~Silica gel from train~~	VOID Moisture by difference, Moisture lost.
" 705		"	Back half acetone wash	
" 706		"	" " acetone wash	
" 707		"	Distilled water blank	
" 708		"	Acetone blank	
" 709	Stack #2	1-2	Filter	
" 710		"	Front half acetone wash	
" 711		"	" " acetone wash	
" 712		"	~~Silica gel from train~~	VOID Moisture by difference, Moisture lost.
" 713		"	Back half acetone wash	
" 714		"	" " acetone wash	
" 715	Stack #5	1	Method 7 NO_x	
" 716		2	"	
" 717		3	"	
" 718		4	"	
" 719	Stack #6	1	Method 6 SO_2	
" 720		2	"	
" 721		1	Acetone	Limestone
" 722		1	Acetone	Pulverized Coal
" 723		1	Acetone	Lime
" 724		1	Dust	Baghouse collections
" 725	Stack #1	1-1	Silica gel	
" 726	Stack #2	1-2	Silica gel	
" 727	Stack #1	1-1	Stack - chloroform extract	
" 728	Stack #2	1-2	"	
" 729	Stack #3	2-3	"	
" 730	Stack #4	2-4	"	
" 731	Stack #5	3-5	"	
" 732	Stack #6	3-6	"	

☆ First number - run, Second number - stack

SAMPLE IDENTIFICATION LOG 6-12-74

Marblehead Lime Co. Bonne Indiana

EPA Number	Sample Location	Run #	Contents	Comments
5-74-000-735		2	Fuel	Limestone
" 734		2	Fuel	Pulverized Coal
" 735		2	Product	Lime
" 736		2	Dust	Baghouse collection
" 737	Stack # 3	2-3	Filter	
" 738		"	Front Half Water Wash	
" 739		"	" " Acetone Wash	
" 740		"	Back Half Water Wash	
" 741		"	" " Acetone Wash	
" 742		"	Acetone Blank	
" 743			H_2O_2 Absorption Solution Blank	
" 744	Stack # 4	2-4	Filter	
" 745		"	Front Half Water Wash	
" 746		"	" " Acetone Wash	
" 747		"	Back Half Water Wash	
" 748		"	" " Acetone Wash	
" 749	Stack # 6	#5	Method 7 NO_x	
" 750		6	"	
" 751		7	"	
" 752		8	"	
" 753	Stack # 2	3	Method 6 SO_2	
" 754		4	"	
" 755	Stack # 3	2-3	Silica Gel	
" 756	Stack #4	2-4	Silica Gel	

* First number - run, Second number - Stack

SAMPLE IDENTIFICATION LOG 6-13-74
Marblehead Lime Co. Bay, Indiana

EPA Number	Sample Location	Run *	Contents	Comments
5-74-ccc-757		3	Fuel	Limestone
" 758		3	Fuel	Pulverized Coal
" 759		3	Product	Lime
" 760		3	Dust	Baghouse Collection
" 761	Stack #5	3-5	Filter	
" 762		"	Front Half Water Wash	
" 763		"	" " Acetone Wash	
" 764		"	Back Half Water Wash	
" 765		"	" " Acetone Wash	
" 766	Stack #6	3-6	Filter	
" 767		"	Front Half Water Wash	
" 768		"	" " Acetone Wash	
" 769		"	Back Half Water Wash	
" 770		"	" " Acetone Wash	
" 771	Stack #3	9	Method 7 NO_x	
" 772		10	"	
" 773		11	"	
" 774		12	"	
" 775	Stack #2	5	Method 6 SO_2	
" 776		6	"	
" 777	Stack #5	3-5	Silica Gel	
" 778	Stack #6	3-6	Silica Gel	

* First number - run, Second number - stack

MARBLEHEAD Lime CO. C-337-9

FILTER #	TARE mg	FINAL mg	STACK	SAMPLE #	DATE
1	484.1	562.6	1	S-74-000-701	6/11
2	484.6	577.1	2	" 709	6/11
3	484.5	520.4	3	" 737	6/12
4	482.9	515.3	4	" 744	6/12
5	482.1	551.5	5	" 761	6/13
6	483.0	530.0	6	" 766	6/13

250 ML. BEAKERS

EPA NO.	CONTRACT NO.	TYPE	BEAKER NO. 1	
				FINAL 67.3275
S-74-000 703	C-337-7	F.H. Acetone Wash Run 1-1	.1135 −.0002 (.1133)	TARE WT 67.2153
				GAIN .1135
S-74-001-702	"	F.H. H_2O Wash Run 1-1	2	68.1505 68.0799 (.0706)
705(A)	"	B.H. H_2O Wash Run 1-1 (Organic Extract)	3	99.2231 99.2189 (.0042)
S-74-000-706	"	B.H. Acetone Wash Run 1-1	.0194 .0002 (.0192) 4	67.1897 67.1703 .0194
705(B)	"	B.H H_2O Reman Run 1-1	5	98.1176 97.9789 (.1387)
S-74-000-711		F.H. Acetone Wash 1-2	.0836 −.0002 (.0834) 6	67.4935 67.4099 .0836
S-74-000-710		F.H H_2O Wash 1-2	7	68.2024 68.1552 (.0472)
713(A)		B.H. H_2O Wash (Organic Extract)	8	101.1636 101.1601 (.0035)
Core 708 + .0002 / 742 + .0028				
0	0			

67.3291

EPA No	Contract No	TYPE	Beaker No?	
S-74-220-714	337-9	Bk. Acetone Wash Run 1-2.	Final .0158 Tare .0002 Gain .0156	68.0737 68.0781 .0158
713(B)	337-9	Bk. H_2O Remain Run 1-2	10	101.8675 101.6837 .1838
S-74-000 739	337-9	FH Acetone Wash Run 2-3	11 .0545 .0028 .0517	66.6502 66.5957 .0545
738	337-9	FH H_2O wash Run 2-3	12	66.3802 66.3632 .0170
742(A)	337-9	BH H_2O Wash Organic Extract Run 2-3	13	102.9933 102.9899 .0034
741	337-9	BH Acetone wash Run 2-3	14 .0225 .0028 .0197	66.2552 66.2327 .0225
744(B)	337-9	H_2O Remain B.H. Run 2-3	15	98.3500 98.1377 .2123
746	337-9	FH Acetone wash Run 2-4	.0613 .0028 .0585	16 67.8319 67.7706 .0613

745	337-9	Ext. H_2O Was L Run 2-4		Rack No. 17 67.2142 67.1972 .0272
747	(A) 337-9 *	Bt H_2O Wash Organic extract Run 2-4		18 105.5290 105.5245 .0045
748	337-9	Bt. Acetone wash Run 2-4	.0345 .0028 .0317	19 67.1212 67.0867 .0345
747	(B) 337-9	Bt. H_2O Remain Run 2-4	dark	20 100.9240 100.7032 .1207
763	337-9	Ft Acetone wash Run 3-5	.0683 .0028 .0655	21 63.6037 63.5354 .0683
762	337-9	Ft H_2O wash Run 3-5		22 68.3845 68.3632 .0213
764	(A) 337-9 *	Bt H_2O wash (Organic extract) Run 3-5		23 99.4570 99.4510 .0060
765	337-9	Bt. Acetone wash Run 3-5	.0631 .0028 .0603	24 66.7349 66.6718 .0631

764 (A)	337-9	BH H_2O Remain 3-5 Run		Parker Lb 25 102.8544 102.7545 .0999
768	337-9	F.H. Acetone Wash Run 3-6	.0666 .0028 .0638	26 68.0016 67.9350 .0666
767	337-9	F.H. H_2O Wash Run 3-6		27 69.1592 69.1330 .0262
769 (A)	337-9 *	BH H_2O Wash Overall Extr. Run 3-6		28 153.0330 153.0278 .0052
770	337-9	BH Acetone Wash Run 3-6	Wash .0250 .0028 .0222	29 66.6521 66.6271 .0250
769 (B)	337-9	BH H_2O Remain Run 3-6		30 101.5031 101.2905 .2126
John Deere Waterloo, Iowa		Plant C-337-7		
5-74-001 001	337-7	F.H. Acetone Wash Run 1		31 Final 105.0210 Tare 100.8292 Gain .0198

(Run - Filter (STACK))

	755	232 g	2-3
	777	238 g	3-5
	726	221 g	1-2
SILICA GEL	725	241 g	1-1
	778	237.5	3-6
	756	227.0 g	2-4

1	2	3	4	5	6
224.0	152.0	200.0	259.0	289.0	229.0
41.0	21.0	32.0	27.0	38.0	37.5
265.0	173.0	232.0	286.0	327.0	266.5

TABLE 2

NO_x METHOD 7 RESULTS*
MARBLEHEAD LIME CO.
GARY, IND.

Date	Sample		µgms NO_2
6/11/74	1	S-74-000 715	145.6
	2	716	132.0
	3	717	138.8
	4	718	146.7
6/12/74	5	749	143.1
	6	750	143.1
	7	751	118.1
	8	752	107.4
6/13/74	9	771	279.1
	10	772	221.9
	11	773	268.4
	12	774	225.5

*Method description followed was a draft procedure from L. Katzman

Walden

TABLE 4

SO_2 METHOD 6 RESULTS
MARBLEHEAD LIME CO.
GARY, IND.

Date	Sample		g - eg SO_2*
6/11/74	1	S-74-000-719	0.379
	2	720	0.212
6/12/74	3	753	0.390
	4	754	0.327
6/13/74	5	775	0.375
	6	776	0.226

* Average of duplicate determinations on the same sample

Walden

Field Identification of NO_x Samples

Description jars with Marking tape labels:

Marked NO_x and numbered 1 → 15

Dated 1, 2 and 3 6/18/74

4 → 15 6/19/74

Description of Jars with the EPA labels

Common to all labels "Marblehead Lime Co. Geog Dept. Method 7 NO_x

Sample No.				
1	26 mls	Bottle 7	6/11/74	S-74-000-715
2	24.5 mls	Bottle 8	6/11/74	S-74-000-716
3	24 mls	Bottle 9	6/11/74	S-74-000-717
4	25.5 mls	Bottle 10	6/11/74	S-74-000-718
5	25 mls		6/12/74	S-74-000-749
6	25 mls		6/12/74	S-74-000-750
7	25 mls		6/12/74	S-74-000-751
8	24 mls		6/12/74	S-74-000 752
9	26 mls		6/13/74	S-74-000 771
10	26 mls		6/13/74	S-74-000 772
11	25 mls		6/13/74	S-74-000 773
12	26 mls		6/13/74	S-74-000 774

SO_x Identification

Common to all labels "Marblehead Lime Geog Dept." Method 6 SO_2

1	6/11/74	S-74-000-719
2	6/11/74	720
3	6/12/74	753
4	6/12/74	754
5	6/13/74	775
6	6/18/74	776

Marking tape labels "SO_2 Impinger Wash John Deere Waterloo Dora"

1	18 June 1974	Test No. 1
2	19 "	Test No. 2
3	19 "	Test No. 3
4	20 "	Test No. 4

7/3/74

SO_2 Sampling

Note: Samples are greater than 50 mls, so diluted to 100 mls and 25 mls taken for analysis.
20 mls; 40 mls IPA 4 drops Thorin

Sample	20 mls	mls $Ba(ClO_4)_2$	mls Titrated	SO_2 gm-eq
6/11/74 Gray Ind Sample #1 (7?5)	A	0.00 – 7.35	7.35	0.379
	B	7.35 – 14.70	7.35	
[illegible] Blank	1 drop			
11/74 Gray Ind	A	14.70 18.85	4.15	0.212
Sample #2 (750)	B	18.85 – 22.95	4.10	
12/74 Gray Ind.	A	22.95 – 30.51	7.56	0.390
Sample #3 (753)	B	30.51 38.10	7.59	
13/74 Gray Ind	A	38.15 44.42	6.27	0.327
[illegible] (754)	B	17.67 24.12	6.45	
7/13/74 Gray Ind [illegible]	A	0.65 6.65	6.00	0.375
Sample #5 (775) 121 ml	B	6.65 12.70	6.05	
Blank	2 drops			
13/74 Gray Ind Sample	A	12.70 16.45	3.75	0.226
Sample #6 (776) Vol = 117 ml	B	16.45 20.20	3.75	
SO_2 Impinger wash No 1	A	20.20 21.30	1.10	0.0528
Blue Lane 12 Ju 74	B	21.30 22.25	0.95	
SO_2 Impinger wash No 2 Vol	A	22.25 23.25	1.00	0.0623
Blue Lane 19 Ju 74 118	B	23.25 24.30	1.05	
IMP wash No 3 Vol	A	24.30 25.13	0.83	0.0521
Blue Lane 19 Ju 74 119	B	25.13 26.00	0.87	
IMP wash No 4 Vol	A	26.00 [illegible]	0.70	0.0443
Blue Lane 20 Ju 74 123	B	26.70 27.40	0.70	
SO_2 Blank Distilled Water Blue Lane	A	change on		
	B	addition of Indicator		

7/8/74

N of $Ba(ClO_4)_2$ = 0.0103

Eq 6.2 from Method 6

$$C_{SO_2} = \left(7.05 \times 10^{-5}\ \frac{lb\text{-}l}{g\text{-}ml}\right)\frac{(V_t - V_{tB})N\left(\frac{V_{soln}}{V_a}\right)}{V_{m\,std}}$$

7/1/74

NO_2 Samples

Samples: These samples were not made basic in the field. Samples of 6/18 and 6/19.

Procedure: Revised draft from Larry Katzman

(See Opposite Page)

1 ml = 25 μgm

		μgm NO_2				
Calibration Curve			U_0 T	R_0 T	Corrected Readings	
0	0		98.5	0.005	0.0	
1 ml	25		89.5	0.05	A_1 0.045	
2	50		85.6	0.065	A_2 0.060	
3	75		77.0	0.11	A_3 0.105	
4	100		70.0	0.14	A_4 0.135	
6/18/74	#1		91.0	0.040	0.035	25.7
	#2		96.0	0.015	0.010	7.33
	#3		95.5	0.020	0.015	10.99
6/19/74	#5		96.5	0.015	0.010	7.33
	#6		96.0	0.017	0.012	8.79
	#7		95.0	0.005	0.000	—
	#10		95.5	0.020	0.015	10.99
	#11		97.5	0.016	0.005	3.66
	#15		95.5	0.015	0.010	7.33

$$K_c = \left[\frac{(25 A_1 + 50 A_2 + 75 A_3 + 100 A_4)}{A_1^2 + A_2^2 + A_3^2 + A_4^2} \right]$$

1.125 3.00 7.875 13.5

0.002 0.0036 0.0110 0.0162 — 0.0348

$K_c = 732.76$

ml in 10 ml flask
25
24
24.5
26
26
24
25.5
25
25

7/1/74

					μgm NO_2	
0		97.5	0.01	0.0		
1 ml		69.0	0.16	A_1 0.15	100	
2		39.0	0.31	A_2 0.30	200	
3		35.5	0.45	A_3 0.44	300	
4		25.0	0.60	A_4 0.59	400	
6/19/74	#4	92.0	0.035	0.025	16.9	
	#8	94.0	0.025	0.015	10.2	
	#9	91.0	0.040	0.030	20.3	
	#12	98.0	0.010	0.000	—	
	#13	97.0	0.012	0.002	1.35	
	#14	94.5	0.021	0.011	7.45	
7/1/74	1	59.0	0.226	0.215	145.6	
	2	62.0	0.205	0.195	~~145.6~~ 132.0	
	3	61.0	0.215	0.205	138.8	
blank		92.5	0.010	—		

$$K_c = 100 \left[\frac{(A_1 + 2A_2 + 3A_3 + 4A_4)}{A_1^2 + A_2^2 + A_3^2 + A_4^2} \right]$$

4.43

0.15 0.60 1.32 2.36

0.0225 0.09 0.1936 0.3481

0.6542

$K_c = 679.16$

this block

used

7/3/74

4.2 2.13

0.155 0.59 1.335

$$\frac{A_1 + 2A_2 + 3A_3 + 4A_4}{A_1^2 + A_2^2 + A_3^2 + A_4^2}$$

0.01203 0.027 0.1780 0.2770 0.5952

1 ml = 100 µg @ 410 nm

Tube No.	%T	A_{4cm}		Corrected Absorbance	µg/ml LO_2
0	98.5	0.005			
1	69.0	0.160	A_1	0.155	100
2	50.0	0.300	A_2	0.295	200
3	35.5	0.450	A_3	0.445	300
4	27.5	0.550	A_4	0.545	400

Subtracting the reagent Blank of 0.010 for 6/11 Samples

4	64.0	0.215	0.205	146.7
5	63.0	0.210	0.200	143.1
6	63.5	0.210	0.200	143.1
7	67.0	0.175	0.165	118.1
8	69.0	0.166	0.150	107.4
9	40.0	0.403	0.390	279.1
10	48.0	0.320	0.310	221.9
11	41.0	0.385	0.375	268.4
12	47.0	0.325	0.315	225.5

$K_c = 100$

$K_c = 715.93$

APPENDIX I

TEST LOG

SAMPLING TASK LOG

Plant Marblehead Lime Co.
Date 6-11 → 13-74

Plant Location Davy, Indiana
Recorded by

6/11/74 Comments	Run	Sampling location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
Three stops due to power loss	1-1	Stack # 1, NORTH	Particulate	12:25	14:25	120	S-74-000-701→703, 705→709, 715, 727
							"
							"
	"	, SOUTH	"	16:03	18:00	120	"
Three stops due to power loss	1-2	Stack # 2, NORTH	"	12:15	13:05	40	S-74-000-705+711, 713, 714, 726, 728
	"	" "	"	13:20	13:40	20	"
	"	" "	"	13:50	14:00	10	"
	"	" "	"	14:10	15:00	50	"
	"	" , SOUTH	"	16:00	18:00	120	"
	1	Stack # 5, SOUTH	NOx	13:21	13:22	< 1	S-74-000-715
	2	"	"	14:03	14:04	"	" 716
	3	"	"	16:25	16:26	"	" 717
	4	"	"	17:34	17:35	"	" 718
Three stops due to power loss	1	Stack # 5	SO2	12:30	13:07	37	S-74-000-719
	"	"	"	13:10	13:17	7	"
	"	"	"	13:18	13:21	3	"
	"	"	"	13:28	13:32	4	"
Test stopped due to excessive impinger bubbling	2	"	"	14:00	14:30	30	S-74-000-720
	1		CO	15:00	17:00	120	
Material, composite sample for one day		Limestone feed					S-74-000-721
"		Classifier catch					" 722
"		Lime product					" 723
"		Baghouse dust					" 724

SAMPLING TASK LOG

Plant Marblehead Lime Co. Plant Location Gary, Indiana
Date 6-11→13-74 Recorded by

Comments	Run	Sampling location (Port)	Pollutant	Clock Time Began	Clock Time Ended	Elapsed Time (min)	Sample Nos.
6/12/74							
	2-3	Stack #3, SOUTH	Particulate	10:30	12:30	120	S-74-000-731→742, 721, 755
	"	" , NORTH	"	12:55	14:55	120	" "
Two stops - vacuum hose blew, wiring overheated.	2-4	Stack #4, SOUTH	"	10:30	12:30	120	S-74-000-744→747, 730, 752
	"	" , NORTH	"	12:55	13:25	30	
	"	" "	"	13:35	13:45	10	
	"	" "	"	14:10	15:30	10	
	5	Stack #6, SOUTH	NO_x	12:25	12:27	<1	S-74-000-749
	6	" "	"	13:05	13:06	"	" 750
	7	" "	"	13:42	13:41	"	" 751
	8	" "	"	14:14	14:15	"	" 752
	3	Stack #2	SO_2	11:00	11:40	40	S-74-000-753
	4	"	"	13:50	14:30	40	" 754
	2		CO	10:30	12:30	120	
Material composite sample for one day	2	Limestone feed					S-74-000-733
"	"	Pulverized coal					" 734
"	"	Lime product					" 735
"	"	Baghouse dust					" 736
6/13/74							
	3-5	Stack #5, NORTH	Particulate	09:30	11:30	120	S-74-000-761→765, 731, 777
	"	" , SOUTH	"	11:00	14:00	120	"
	3-6	Stack #6, NORTH	"	09:30	11:30	120	S-74-000-766→770 732, 778
	"	" , SOUTH	"	12:00	14:00	120	"
NO_x Absorption Solution Blanks			NO_x				S-74-000-743