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Reference 42
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ENTROPY ENVIRONMENTALISTS, INC.

SPECIALISTS IN AIR POLLUTION MEASUREMENT & MANAGEMENT

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STATIONARY SOURCE SAMPLING REPORT

0066

LONE STAR INDUSTRIES, INC.

NEW ORLEANS, LOUISIANA

PARTICULATE AND SULFUR DIOXIDE EMISSIONS COMPLIANCE TESTING

KILN #1 & #2 PRECIPITATORS OUTLET STACKS

MAY 20, 21, & 25, 1982

P.O. Box 12291, Research Triangle Park, North Carolina 27709
Phone 919-781-3550

REPORT CERTIFICATION

The sampling and analysis performed for this report was carried out under my direction and supervision.

Date July 8,1982 Signature Michael L. Kirkman

Michael L. Kirkman

I have received all testing details and results in this test report and hereby certify that the test report is authentic and accurate.

Date July 8, 1982 Signature Walter S. Smith

Walter S. Smith, P.E.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

INTRODUCTION

Stationary source sampling was performed for Lone Star Industries, Incorporated at their New Orleans, Louisiana plant. Testing was done on the precipitators outlet stacks to Kilns #1 and #2 to determine the pollutant emissions using a sampling train and methodology which might explain why a detached plume is being formed at the stacks outlets. An in-stack filter preceding the EPA Method 5 train was used to give two filtration temperatures of the particulates.

Additional analyses of the sampling train impingers' water were done to determine the ammonium, chlorides, potassium, sodium, sulfate, and sulfur dioxide catches. Three runs were done on each kiln with Kiln #1 being tested on May 20 and 21, 1982 and Kiln #2 on May 25, 1982. Roy Click of Lone Star was present to coordinate the testing between the plant and Entropy.

Immediately following is the "Summary of Results" section which presents the test results; for detailed results of each run, refer to Appendix A. A description of the source and an air flow schematic appear in the "Process Description and Operation" section. Process data is included in Appendix C. The final section, "Sampling and Analytical Procedures", briefly describes the sampling strategy used. For a detailed description of the equipment and procedures, refer to Appendix E. Pertinent calibration data is presented in Appendix F.

SUMMARY OF RESULTS

A presentation of the average emissions from the two kilns tested on May 20, 21, and 25, 1982 is given by Table 1. Note that the emissions are divided into three groups: 1) particulate that was caught by the in-stack Method 17 filter (at stack temperatures) on the end of the Method 5 probe, 2) particulate that was caught by the Method 5 filter (at about 250 degrees F), and 3) pollutants that were collected by the Method 5 impingers' water. Tables 2, 3, and 4 summarize the individual runs at Kiln #1; the individual run summaries for Kiln #2 are in Tables 5, 6, and 7.

To study the formation of particulate as the exhaust gases cool, an in-stack filter (at stack temperatures) was followed by another filter maintained at a temperature of 250 degrees F. Approximately 95 percent of the total particulate catch was caught on the in-stack filter and would be, therefore, in the attached plume. This filterable particulate is not the probable cause of the detached plume because there is no visible attached plume.

A possible explanation of the detached plume is suggested by the amounts of ammonia, chloride, and sulfate ions collected in the impingers' water. When the flue gases enter the atmosphere and begin to cool, these gaseous pollutants could liquify/solidify into very hygroscopic aerosols. The exhaust gases contain enough moisture for each hygroscopic aerosol

TABLE 1

AVERAGE POLLUTANT EMISSIONS RATES AND CONCENTRATIONS

	Kiln #1	Kiln #2	Avg
Filterable Particulate			
In-stack Method 17			
lb/hr	17.41	10.35	14.3
gr/dscf	0.0266	0.0185	0.0234
Method 5			3.3×10^{-6}
lb/hr	0.54	0.32	
gr/dscf	0.0012	0.0005	
Gaseous Emissions			
Ammonium as Nitrogen			
lb/hr	3.30	10.6	
ppm	19.7	74.4	
Chlorides as Chlorine			
lb/hr	27.9	51.4	
ppm	65.6	142	
Potassium			
lb/hr	0.0614	0.047	
ppm	0.131	0.118	
Sodium			
lb/hr	0.402	0.165	
ppm	1.45	0.13	
Sulfate as SO			
lb/hr	17.3	12.2	
ppm	17.9	14.9	
Sulfur Dioxide*			
lb/hr	251	282	
ppm	327	432	

* The emission rates and concentrations are an average of two samples taken per run.

TABLE 2

KILN #1 POLLUTANT EMISSION RATES AND CONCENTRATIONS

Run	1	2	3	Avg
Filterable Particulate				
In-stack Method 17 lb/hr	31.93	11.48	8.83	17.41
gr/dscf	0.0491	0.0174	0.0132	0.0266
Method 5 lb/hr	1.27	0.11	0.23	0.54
gr/dscf	0.0019	0.0002	0.0003	0.0012
Gaseous Emissions				
Ammonium as Nitrogen lb/hr	2.41	4.77	2.72	3.30
ppm	14.6	28.5	15.9	19.7
Chlorides as Chlorine lb/hr	44.0	13.6	26.0	27.9
ppm	105	32.0	59.9	65.6
Potassium lb/hr	0.0552	0.0544	0.0745	0.0614
ppm	0.120	0.116	0.156	0.131
Sodium lb/hr	0.330	0.362	0.513	0.402
ppm	1.21	1.32	1.82	1.45
Sulfate as SO lb/hr	14.4	17.2	20.2	17.3
ppm	15.2	18.0	20.6	17.9
Sulfur Dioxide* lb/hr	241	320	193	251
ppm	318	418	246	327

* The emission rates and concentrations are an average of two samples taken per run.

TABLE 3

PARTICULATE TESTS SUMMARY OF RESULTS

Kiln #1 Precipitators Outlet Stack

	1	2	3
RUN DATE	05/20/82	05/20/82	05/21/82
TEST TRAIN PARAMETERS:			
VOLUME OF DRY GAS SAMPLED, SCF*	48.353	45.726	44.399
PERCENT ISOKINETIC	108.1	103.1	97.7
STACK PARAMETERS:			
TEMPERATURE, DEG. F	336	330	329
AIR FLOW RATES SCFM*, DRY	75,881	76,743	78,645
ACFM, WET	170,028	169,761	167,196
PERCENT EXCESS AIR	61.4	70.8	61.4
METHODS 5 & 17 RESULTS:			
CATCH, MILLIGRAMS	159.9	52.2	38.7
GRAINS PER DSCF*	0.0510	0.0176	0.0135
LBS PER HOUR	33.19	11.59	9.07

* 68 Deg. F. - 29.92 in. Hg.

TABLE 4

SULFUR DIOXIDE TESTS SUMMARY OF RESULTS

Kiln #1 Precipitators Outlet Stack

	1	2	3
RUN DATE	5/20/82	5/20/82	5/20/82
VOLUME OF DRY GAS SAMPLED, SCF*	0.746	0.752	0.763
SULFUR DIOXIDE (SO2) RESULTS:			
CATCH, MILLIGRAMS	17.3	18.6	20.5
CONCEN., PPM BY VOL., DRY	308	328	357
EMISSION RATE, LBS/HOUR	232.8	248.3	272.7

	4	5	6
RUN DATE	5/20/82	5/21/82	5/21/82
VOLUME OF DRY GAS SAMPLED, SCF*	0.762	0.758	0.735
SULFUR DIOXIDE (SO2) RESULTS:			
CATCH, MILLIGRAMS	27.5	15.4	12.3
CONCEN., PPM BY VOL., DRY	479	270	222
EMISSION RATE, LBS/HOUR	366.4	211.4	174.1

*68 Deg. F - 29.92 in. Hg

lb/hr 49.1

TABLE 5

KILN #2 POLLUTANT EMISSION RATES AND CONCENTRATIONS

Run	1	2	3	Avg
Filterable Particulate				
In-stack Method 17 lb/hr	3.73	15.21	12.11	10.35
gr/dscf	0.0066	0.0278	0.0211	0.0185
Method 5 lb/hr	0.07	0.40	0.48	0.32
gr/dscf	0.0001	0.0007	0.0008	0.0005
Gaseous Emissions				
Ammonium as Nitrogen lb/hr	8.42	12.5	10.9	10.6
ppm	58.9	89.7	74.5	74.4
Chlorides as Chlorine lb/hr	41.7	50.3	62.1	51.4
ppm	115	143	167	142
Potassium lb/hr	0.119	0.00679	0.0151	0.047
ppm	0.300	0.017	0.037	0.118
Sodium lb/hr	0.447	0.0206	0.0272	0.165
ppm	0.19	0.09	0.11	0.13
Sulfate as SO lb/hr	15.9	9.08	11.5	12.2
ppm	19.5	11.4	13.8	14.9
Sulfur Dioxide* lb/hr	321	223	303	282
ppm	491	350	454	432

* The emission rates and concentrations are an average of two samples taken per run.

TABLE 6

PARTICULATE TESTS SUMMARY OF RESULTS

Kiln #2 Precipitators Outlet Stack

	19	20	21
RUN DATE	05/25/82	05/25/82	05/25/82
TEST TRAIN PARAMETERS:			
VOLUME OF DRY GAS SAMPLED, SCF*	60.545	59.847	60.540
PERCENT ISOKINETIC	107.7	109.2	105.4
STACK PARAMETERS:			
TEMPERATURE, DEG. F	340	370	345
AIR FLOW RATES SCFM*, DRY	65,580	63,973	66,999
ACFM, WET	149,437	159,982	153,709
PERCENT EXCESS AIR	51.4	53.9	44.4
METHODS 5 & 17 RESULTS:			
CATCH, MILLIGRAMS	26.5	110.4	86.0
GRAINS PER DSCF*	0.0068	0.0285	0.0219
LBS PER HOUR	3.80	15.41	12.59

* 68 Deg. F. - 29.92 in. Hg.

TABLE 7

SULFUR DIOXIDE TESTS SUMMARY OF RESULTS

Kiln #2 Precipitators Outlet Stack

	1	2	3
RUN DATE	5/25/82	5/25/82	5/25/82
VOLUME OF DRY GAS SAMPLED, SCF*	0.762	0.748	0.728
SULFUR DIOXIDE (SO2) RESULTS:			
CATCH, MILLIGRAMS	33.4	22.5	19.3
CONCEN., PPM BY VOL., DRY	582	399	352
EMISSION RATE, LBS/HOUR	380.2	260.9	224.3

	4	5	6
RUN DATE	5/25/82	5/25/82	5/25/82
VOLUME OF DRY GAS SAMPLED, SCF*	0.751	0.724	0.743
SULFUR DIOXIDE (SO2) RESULTS:			
CATCH, MILLIGRAMS	19.7	25.9	24.2
CONCEN., PPM BY VOL., DRY	348	475	432
EMISSION RATE, LBS/HOUR	222.0	317.0	288.7

*68 Deg. F - 29.92 in. Hg

cl/hr. 541

lb/hr cl.

molecule to attach as many as 20 water molecules. The aerosol molecules with attached waters would have sufficient mass to result in a detached plume with 100 percent opacity; the detached plume would eventually dissipate with further mixing and cooling in the atmosphere. The results of this study show that this phenomenon does not occur at 250 degree F.

Due to testing at other locations, the three runs performed on Kiln #2 are numbered 19, 20, and 21 and are the only combined Method 5 and 17 runs done at the precipitators outlets.

PROCESS DESCRIPITION AND OPERATION

The New Orleans, Louisiana plant of Lone Star Industries uses two coal-fired rotary kilns in a wet process system in the production of Portland Cement. This report covers the testing of the precipitators outlet stack of both kilns.

The basic raw materials used are argonite and clay. These materials are fed to a ball mill in proportion of 80 percent argonite, 18 percent clay, and 2 percent iron ore and are ground so that 70 percent passes 200 mesh screen. Water is added to this mixture in the ball mill forming a slurry containing 36 to 40 percent water.

The slurry, when properly blended and conforming to the desired chemical composition, is fed or pumped to the rotary kiln. The kiln temperatures range from 600 degrees F at the feed end to 2800 degrees F in the clinkering zone. Within the kiln, the slurry or raw feed goes through four main processes which are as follows:

1. Drying
2. Calcination or decarbonation of argonite or limestone.
3. Clinkering - liquid formation to form cement compounds.
4. The cooling of clinker.

The liquid, upon cooling, forms hard masses 1/8 inch to 1-1/2 inches in diameter in size. These masses are called clinkers. Clinkers, when cooled, are conveyed to a storage area and are eventually transferred to a ball mill where they are

ground to a fine powder. This is the final product. A general material flow diagram is included in Appendix C.

During the past several years, considerable production and process data have been compiled and summarized which enables a prediction and verification of production capacities of the various process units.

Presently, kiln production is obtained by weighing clinker as it departs the clinker cooler area to storage. Daily clinker production may be further substantiated by flow meter rate, slurry tank measurements, or an inventory of raw mix slurries.

During the emission sampling of Kiln #1, the production process weight was 77.2 tons per hour. Coal was being fed to the kiln at an average rate of 8.8 tons per hour, which brings the total feed to Kiln #1 to 86.0 tons per hour. Production process weight for Kiln #2 during emission testing was 84.8 tons per hour. Coal is not considered part of the process weight under EPA Regulations.

Emissions from the process are fine particulates and combustion gases. Coal is used as a source of fuel which contains some sulfur; consequently, the combustion gases are a mixture of water vapor, oxygen, carbon dioxide, and sulfur dioxide. The particulates are composed of calcined or semi-calcined argonite and clay.

From the kiln, the air enters a dust collector and splits into two electrostatic precipitators where the majority of the particulate is removed. The air is then exhausted through a fan

out the stack to the atmosphere, as shown in Figure 1.

Plant operations were normal during outlet emission testing of Kiln #1. These tests were conducted between 5:00 P.M. - 11:30 P.M., on May 20, 1982, and from 9:00 A.M. to 11:30 A.M. on May 21, 1982. Operational problems were encountered with Kiln #1 during the morning of May 20, but by 5:00 P.M. kiln production was back to normal, and the test team proceeded with testing.

Plant operations were normal during outlet emission testing of Kiln #2 on May 25, 1982. Testing was delayed, however, from 12:00 P.M. to 2:30 P.M. on May 25, because of a thunderstorm.

Tabulated below is a summation of production data accumulated during outlet testing of Kilns #1 and #2. This information was provided by Lone Star, Incorporated.

PRODUCTION DATA DURING TESTING

OUTLET KILNS 1 AND 2

	Raw Feed tons/hr	Coal Feed tons/hr	Total Feed tons/hr	Allowable Emissions pounds/hr
5/20-21/82 Kiln #1	77.2	8.75	85.95	49.8*
5/25/82 8 A.M.-10 P.M. Kiln #2	~~84.8~~ 74.9	9.90	84.80	25.4**

* Kiln #1 - is under State Regulations, existing facilities

** Kiln #2 - Installed after December 1971, therefore, must abide by EPA Regulations of 0.3 pound of particulate per ton of raw feed.

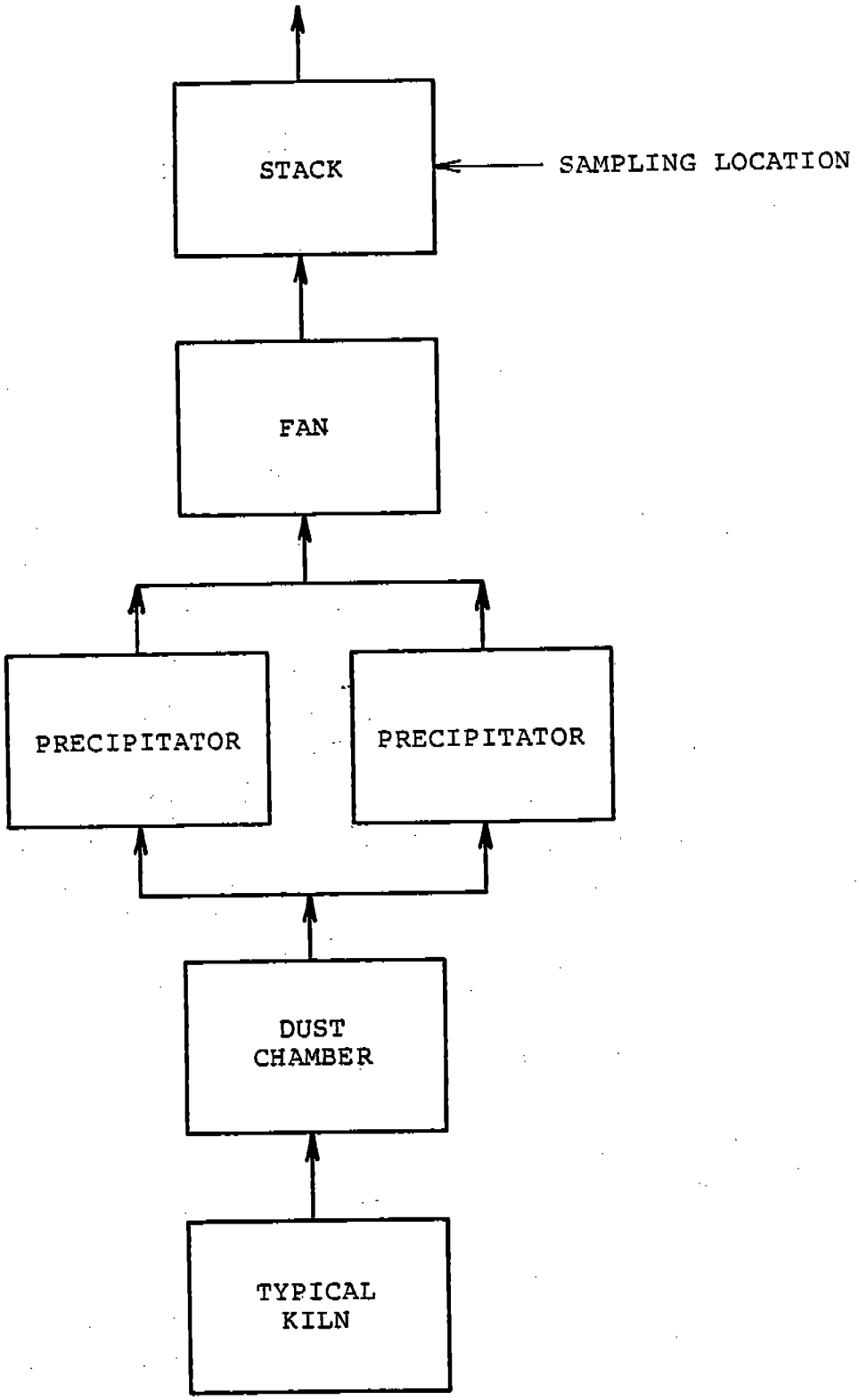


FIGURE 1. KILN AIR FLOW SCHEMATIC SHOWING SAMPLING LOCATION

SAMPLING AND ANALYTICAL PROCEDURES

All sampling and analytical procedures used were those generally recommended by the United States Environmental Protection Agency and the Louisiana Health and Human Resources Administration. Complete details of the equipment and procedures used are described in Appendix E, which is extracted from the Federal Register, August 18, 1977.

The number and location of the sampling points were determined following the procedures outlined in Method 1. The stack dimensions for Kilns #1 and #2 are shown in Figures 2 and 3, respectively. Both stack cross sections were divided into forty-four equal areas. Each stack had two traverse axes with Kiln #1 having 22 points per axis, as shown in Figure 4. Kiln #2 had 11 points per half-axis, as shown in Figure 5. The centroid of each equal area was sampled for two minutes for a net run time of eighty-eight minutes.

Velocity measurements were made according to Method 2. Method 3 was followed in determining the flue gas composition and molecular weight. Particulate emission determinations were made using a sample train that combined Methods 5 and 17. Additional analyses were done on the impingers water catch to determine the ammonium, chlorides, potassium, sodium, and sulfate emissions. Sulfur dioxide emissions were determined using Method 6.

All sampling equipment used was manufactured by Nutech Corporation or Entropy Environmentalists, Inc.

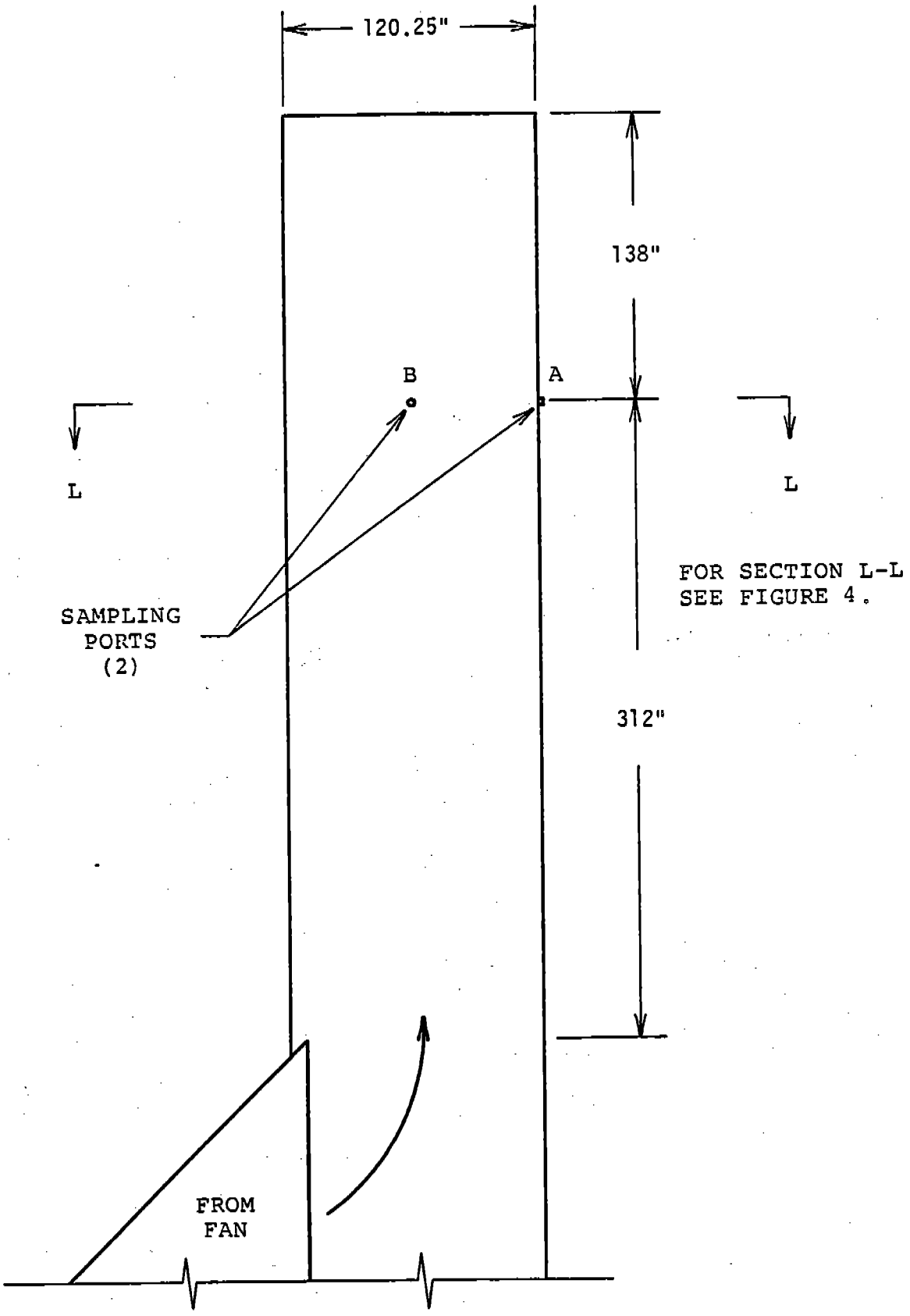


FIGURE 2. KILN #1 STACK DIMENSIONS AND SAMPLING PORT LOCATIONS.

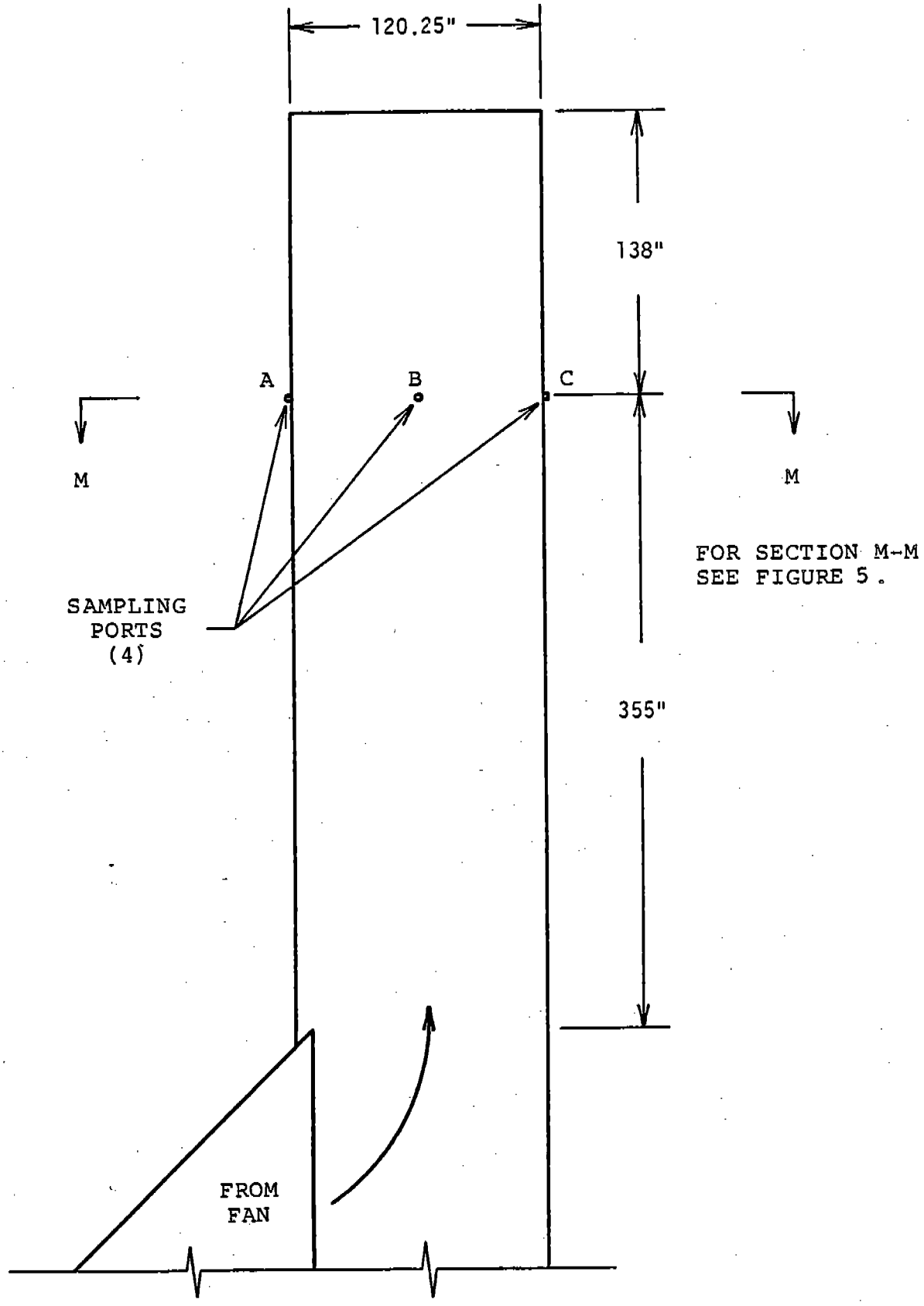
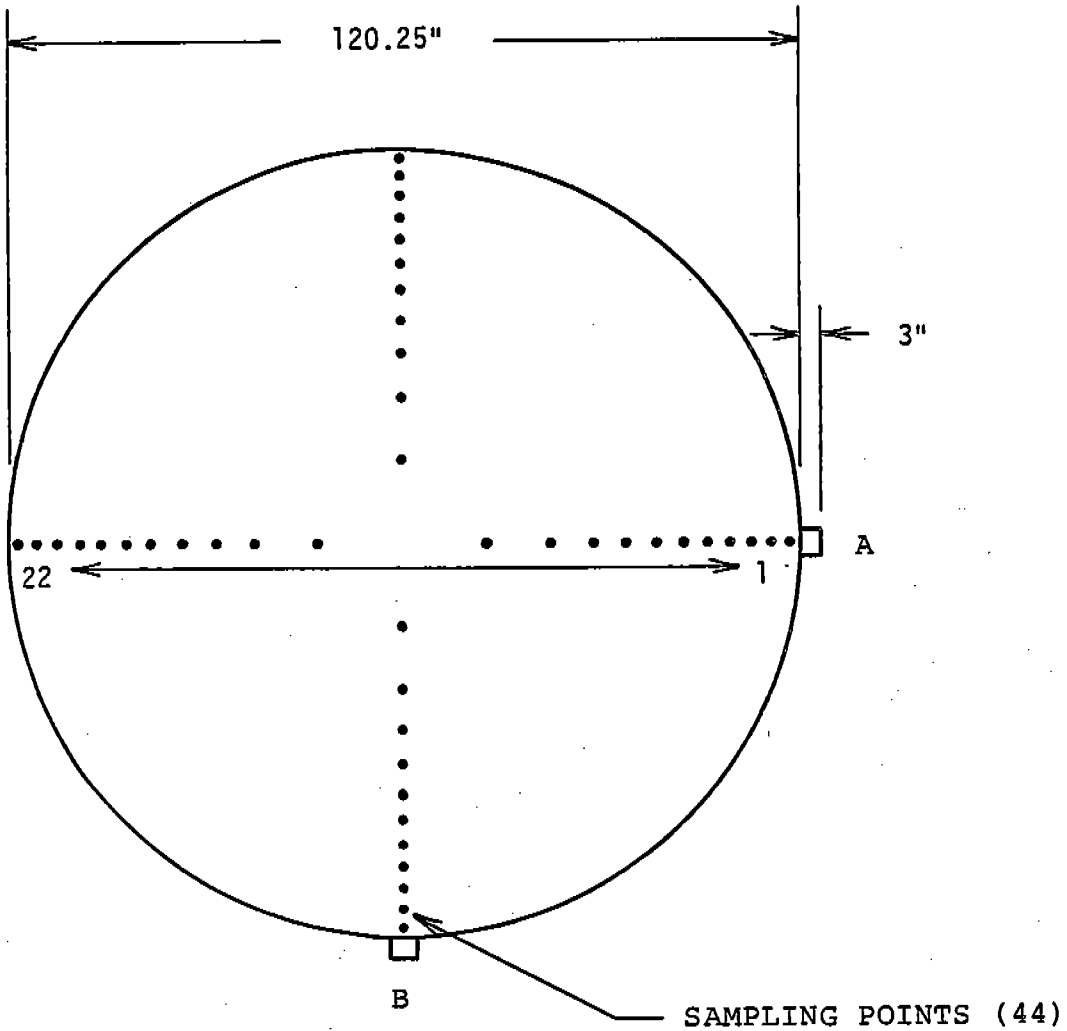
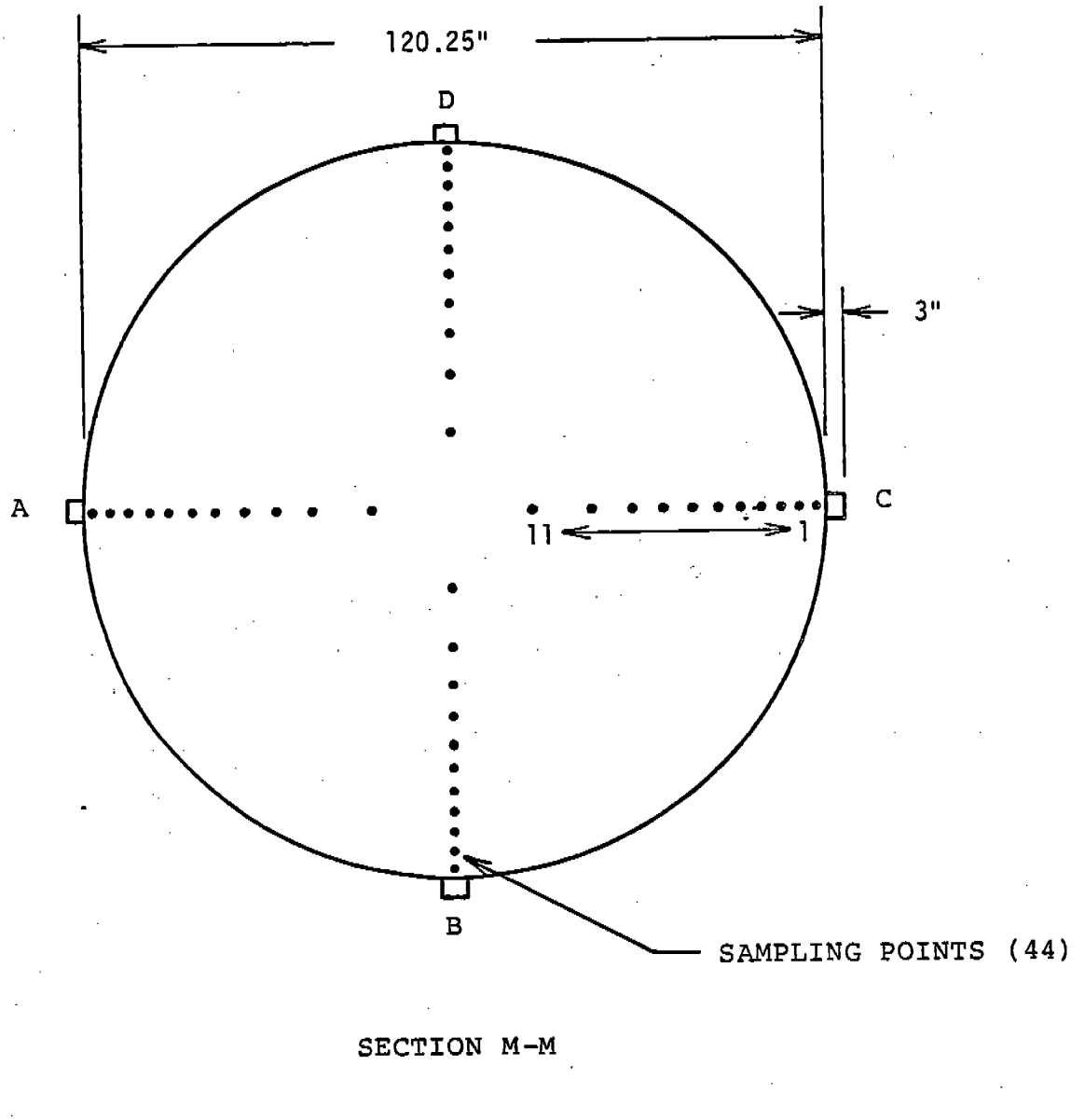


FIGURE 3. KILN #2 STACK DIMENSIONS AND SAMPLING PORT LOCATIONS.



SECTION L-L

FIGURE 4. KILN #1 STACK CROSS SECTION SHOWING SAMPLING POINT LOCATIONS.



SECTION M-M

FIGURE 5. KILN #2 STACK CROSS SECTION SHOWING SAMPLING POINT LOCATIONS.