EMISSION TESTING REPORT

ETB TEST NUMBER 71-MM-06

Emissions From
Wet Process Clinker Cooler
And Finish Mill Systems

FINAL

at

FINAL

IDEAL CEMENT COMPANY
HOUSTON, TEXAS

FINAL

FINAL

Project Officer
Clyde E. Riley

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

Source category: Portland Cement
Plant name : Ideal Cement Company
Test date : 5/18 - 5/20/71
Process : wet

Date: 01/15/93
Location: Houston, T
Ref. No.: 5
Basis for process rate : slurry feed

Source	Type contro	Pollutant	Run No.	Emission rate, lb/hr	Process rate, ton/hr	Emission factor kg/Mg	Emission factor lb/ton	
clinker cooler	fabric filter	filt. PM	1	1.561	61.8	0.0126	0.0253	
		filt. PM	2	2.812	62.7	0.0224	0.0448	
		filt. PM	3	1.941	63.7	0.0152	0.0305	
					average	0.0168	0.0335	Rating: B
		con. inorg. P	1	1.977	61.8	0.0160	0.0320	
		con. inorg. P	2	2.511	62.7	0.0200	0.0400	
		con. inorg. P	3	1.328	63.7	0.0104	0.0208	
					average	0.0155	0.0310	Rating: B
finish mill grinding	fabric filter	filt. PM	1	0.527	34.6	0.0076	0.0152	
		filt. PM	2	0.683	33.9	0.0101	0.0201	
		filt. PM	3	0.446	37.2	0.0060	0.0120	
					average	0.0079	0.0158	Rating: B
		con. inorg. P	1	0.264	34.6	0.0038	0.0076	
		con. inorg. P	2	0.288	33.9	0.0042	0.0085	
		con. inorg. P	3	0.315	37.2	0.0042	0.0085	
					average	0.0041	0.0082	Rating: B

EMISSION TESTING REPORT

ETB TEST NUMBER 71-MM-06

Emissions From Wet Process Clinker Cooler And Finish Mill Systems at

FINAL

FINAL

IDEAL CEMENT COMPANY

HOUSTON, TEXAS

FINAL

FINAL

Project Officer
Clyde E. Riley

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

71-MM-06

PREFACE

The work reported herein was conducted by The Environmental Protection Agency (EPA), Office of Air Programs, Emission Testing Branch (ETB), Metallurgical and Mechanical Section. Mr. Clyde Riley served as the Project Officer and directed the ETB field team consisting of Mr. Frederick Maerker and Mr. Gene Smith. Mr. Philip York served as Project Engineer and Mr. Howard Crist performed the pollutant analyses at the EPA laboratories.

Approved:

Environmental Protection Agency

Gene W. Smith
Chief, Metallurgical & Mechanical Section

March 29, 1972

I. TABLE OF CONTENTS

II. LIST OF TABLES

III. LIST OF FIGURES

IV. INTRODUCTION

Source sampling was conducted at the Houston, Texas wet process plant of the Ideal Cement Company to determine particulate emissions from the baghouse stacks of the clinker cooler and the finish mill grinding system. Three particulate runs were performed at each stack (for a total of 6 runs) between 18 May and 20 May, 1971. Sampling locations are shown in Figure 1.

EPA Methods 1 and 2, Federal Register, December 23, 1971, were used to determine the number of required sampling points per stack and the stack gas velocity and volumetric flow rate. Particulate emissions were determined using EPA Method 5 of the Federal Register.

V. SUMMARY OF RESULTS

A summary of the particulate emissions data for the No. 2 clinker cooler and finish mill grinding system is presented in Tables 1 and 2. Clinker cooler emissions (based on the probe, cyclone and filter catches) ranged from 0.0253 to 0.0448 lbs/ton of feed. Emissions from the finish mill grinder baghouse were between 0.0120 and 0.0201 lb/ton of feed.

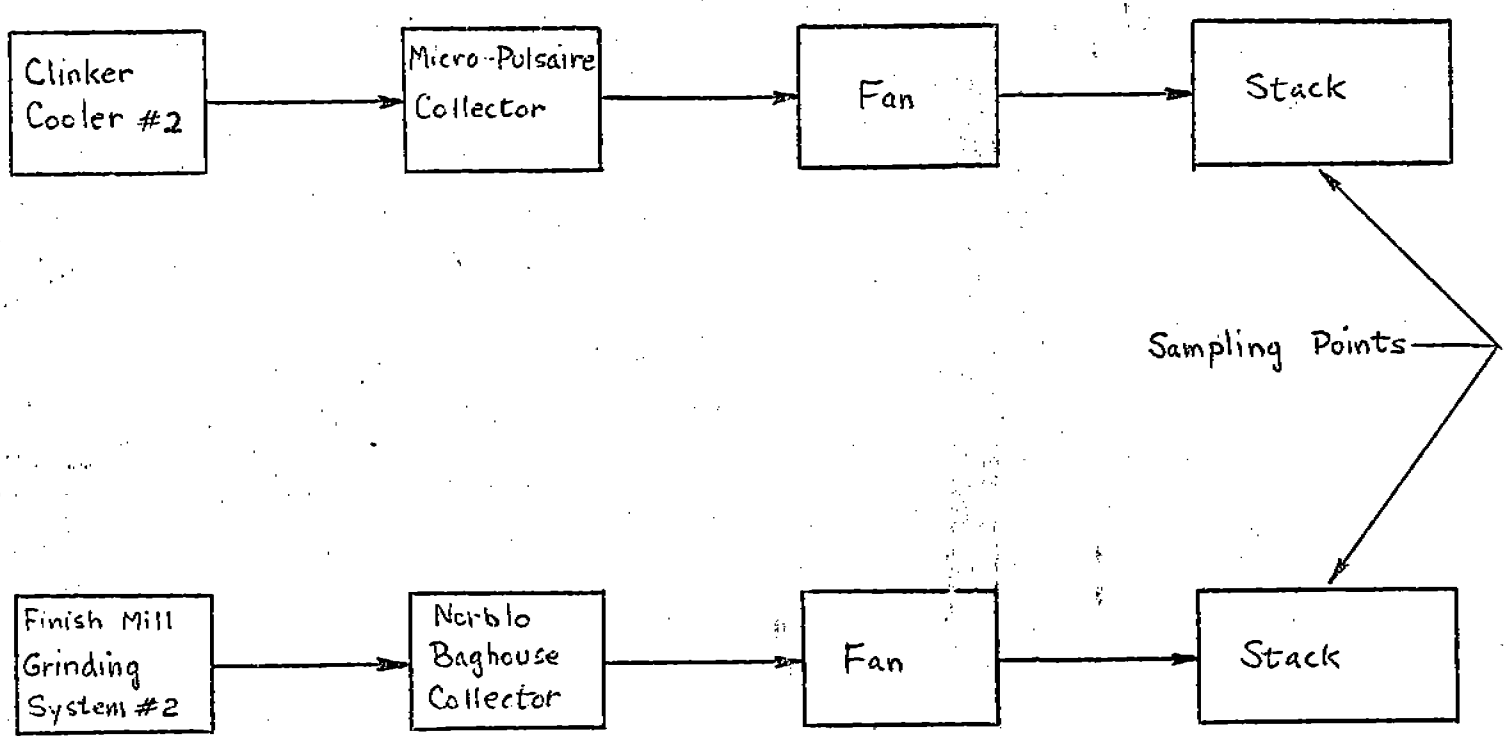

Figure 1 Sampling Locations

TABLE I

SUMMARY OF RESULTS FOR CLINKER COOLER

Run Number	1	2	3
Date	5-18-71	5-18-71	5-18-71
Percent Excess Air	NA	NA	NA
Percent Isokinetic	102.1	98.5	98.8
Stack Flow Rate - SCFM* dry	104,057	100,432	102,165
Stack Flow Rate - ACFM wet	127,032	126,664	128,672
Volume of Dry Gas Sampled - SCF	101.07	94.15	96.05
Feed Rate - tons/hr	61.8	62.7	63.7
Particulates			
Probe, Cyclone, & Filter Catch			
mg	11.8	20.5	14.2
gr/SCF* dry	0.00180	0.00335	0.00228
gr/CF @ Stack Conditions	0.00147	0.00266	0.00180
lbs/hr.	1.561	2.812	1.941
lbs/ton feed	0.0253	0.0448	0.0305
Total Catch			
mg	26.3	38.1	23.3
gr/SCF* dry	0.00401	0.00623	0.00373
gr/CF @ Stack Conditions	0.00328	0.00494	0.00296
lbs/hr	3.538	5.323	3.269
lbs/ton feed	0.0572	0.0849	0.0513
% Impinger Catch	55.1	46.2	39.1

* 70°F, 29.92" Hg

NA - Not Applicable

TABLE 2

SUMMARY OF RESULTS FOR FINISH MILL GRINDING SYSTEM

Run Number	1	2	3
Date	5-19-72	5-19-71	5-20-71
Percent Excess Air	NA	NA	NA
Percent Isokinetic	109.0	102.9	98.9
Stack Flow Rate - SCFM* dry	26,360	26,252	26,244
Stack Flow Rate - ACFM wet	35,185	35,679	35,780
Volume of Dry Gas Sampled - SCF	140.35	131.99	126.82
Feed Rate - tons/hr	34.6	33.9	37.2
Particulates			
Probe, Cyclone, & Filter Catch			
mg	22.0	26.9	17.1
gr/SCF* dry	0.00241	0.00314	0.00208
gr/CF @ Stack Conditions	0.00181	0.00231	0.00152
lbs/hr.	0.527	0.683	0.446
lbs/ton feed	0.0152	0.0201	0.0120
Total Catch			
mg	32.9	37.8	27.9
gr/SCF* dry	0.00361	0.00441	0.00339
gr/CF @ Stack Conditions	0.00270	0.00324	0.00248
lbs/hr	0.791	0.971	0.761
lbs/ton feed	0.0229	0.0287	0.0205
% Impinger Catch	33.1	28.8	38.7

* 70°F, 29.92" Hg

NA - Not Applicable

VI. PROCESS DESCRIPTION

Clay, crushed oyster shell, and silica sand are brought to the plant by barge from deposits along the Gulf of Mexico. These materials are ground and blended in two rotating ball mills to form a slurry.

The blended slurry is fed into the upper ends of two sloping, slowly revolving kilns. These kilns are gas-fired with a capacity of 5,250 bbls. per day each and are 450 ft. long and 12 ft. in diameter with refractory lining encased in a steel cylinder. Fuel consumption is 1,300,000 BTU per barrel of cement produced. During passage through the kiln, the raw materials are heated to a temperature of approximately 2800°F to produce the element hydraulic calcium silicates, known in the trade as "clinker". This marble-sized clinker material is then discharged from the lower end of the kilns at temperatures exceeding 2000°F and fed immediately into two air-quenching cooler units which reduce the temperature of the material to about 150°F. From these coolers, the newly-formed clinker material is conveyed to storage silos.

A small amount of gypsum (4.45% by weight) is added to the clinker material and this mixture is fed into two finish grinding mills with a capacity of 47 tons per hour each. The mixture leaving the grinding mills is fed to two air-separators or classifiers where the coarse material is returned to the mills and the finished cement (90% through 325 mesh screen) is pneumatically pumped to storage silos. Present plant production is approximately 4,000,000 barrels of cement per year.

The control equipment of interest in this report consists of a Mikro-Pulsaire baghouse collector on the No. 2 clinker cooler and a Norblo baghouse collector on the No. 2 finish mill grinding system.

The Mikro-Pulsaire collector consists primarily of a series of cylindrical filter elements enclosed in a dust-tight housing. The felted filter media is "Nomex" which is heat-resistant for temperatures up to 425°F and is supported on a stainless-steel wire frame. Dust-laden air is admitted to the housing and clean air withdrawn from inside the filter cylinder. As clinker dust particles accumulate on the filter elements, periodic cleaning is accomplished by introduction of a momentary jet of high-pressure air through a venturi mounted above each filter cylinder. A continuous flow of air through the collector is maintained, since only a fraction of the total filter area is cleaned at one time. The dust particles fall by gravity during the cleaning cycle to the hoppers below where the material is removed by a horizontal screw conveyor and then conveyed to the clinker storage silos.

The Mikro-Pulsaire unit is designed to handle an air volume of 145,000 ACFM at 250°F for a performance of 99.9+ percent efficiency. The effective collecting surface area is 18,720 ft^2 which gives an air-to-cloth ratio of 7.7:1. The pressure drop across the filter varies from 4 to 6 inches of water. The collector contains 2,016 bags with a minimum life expectancy of three (3) years, and each bag costs $12.00. The expected life of the baghouses is 40+ years, and the installed cost in September, 1970 was about $600,000.00 for both collectors.

The basic unit of the Norblo baghouse collectors on the finish mill grinding systems is a compartment which contains 108 cloth filter bags (6" diameter x 8' 3" long) or a total of 1,296 ft^2 of free filtering area. These bags are arranged in two groups of 54 bags. Each group has its own individual bag holder and shaker controlled by an electric timer with reversing air flow. Each compartment is 10' tall x 8' 6" x 5' above a 6' 6" tall 60° hopper. The particulate

matter is collected on the inside of the cloth filter bags (spun "Dacron") and falls by gravity during the cleaning cycle to the hopper, where the material (cement) is removed by a horizontal screw conveyer.

The Norblo baghouse collector is designed to handle an air volume of 33,000 ACFM at 180°F for a performance of 99.9+ percent efficiency. The effective collecting surface area of each baghouse which contains 12 compartments is 15,552 ft^2, giving an air-to-cloth ratio of 2.12:1. The pressure drop across the filter is approximately 3 inches of water. The collectors each contain 1,296 bags with an average life of five (5) years and each bag costs $3.65. The baghouses were installed in 1958 and the expected life is 40+ years. Neither the total installed cost nor the annual operating cost of this unit were available.

VII. LOCATION OF SAMPLING POINTS

The locations of the sampling ports are shown schematically in Figures 2 and 3. At each stack, sampling was conducted along each of two perpendicular stack diameters. The number of sampling points was dependent upon the distance of the sampling ports from disturbances in the gas flow, as described in Method 1 of the Federal Register, Vol. 36, No. 247, December 23, 1971. The number of points sampled was 22 points per diameter (for a total of 44 points) at the clinker cooler stack, and 12 points per diameter (each point sampled twice, for a total of 48 points) at the finish mill stack. The sampling time at each point throughout the testing was three minutes.

VIII. PROCESS OPERATION

Operating conditions of this continuous process were normal throughout the testing.

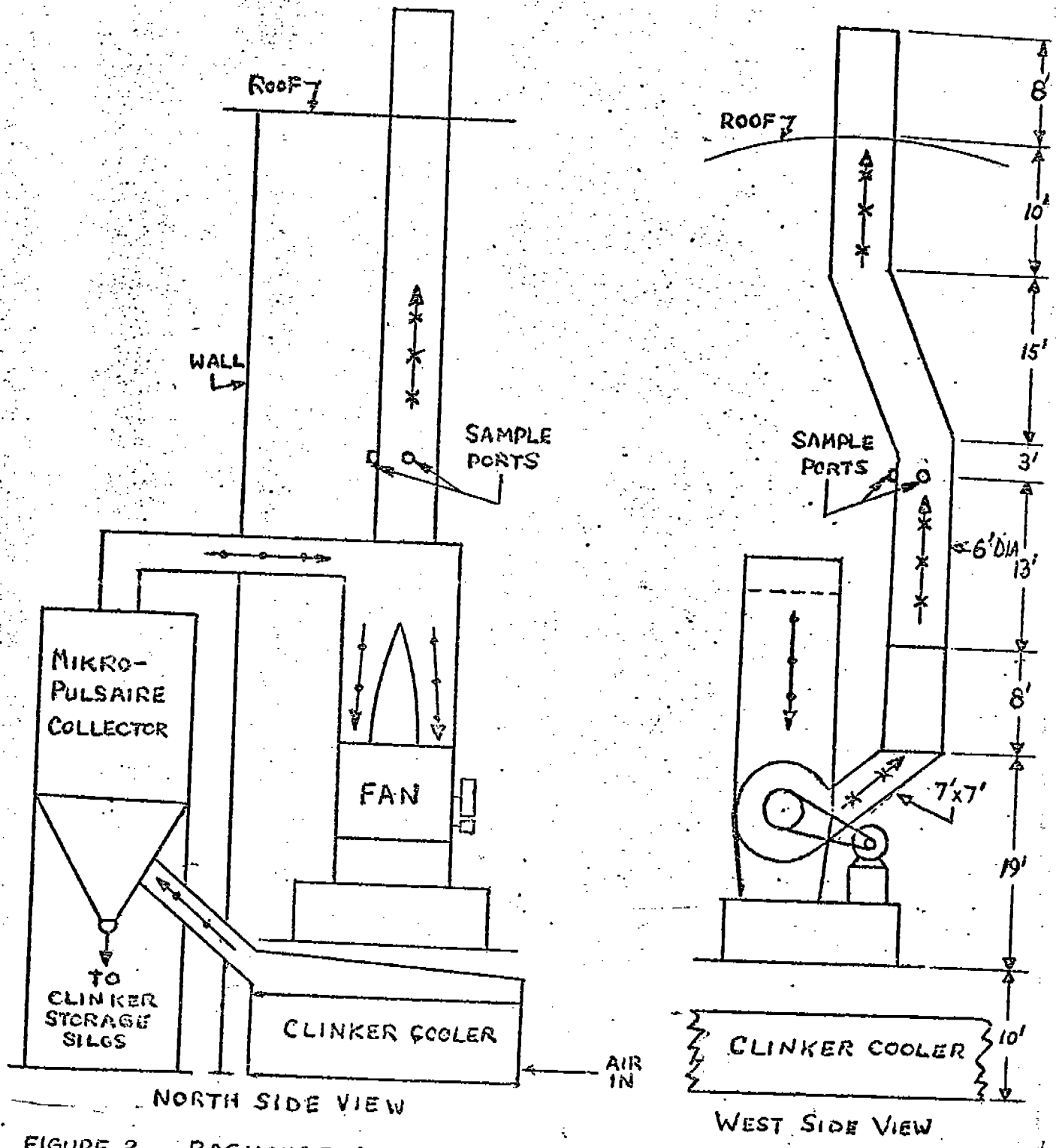

FIGURE 2 BAGHOUSE COLLECTOR ON CLINKER COOLER

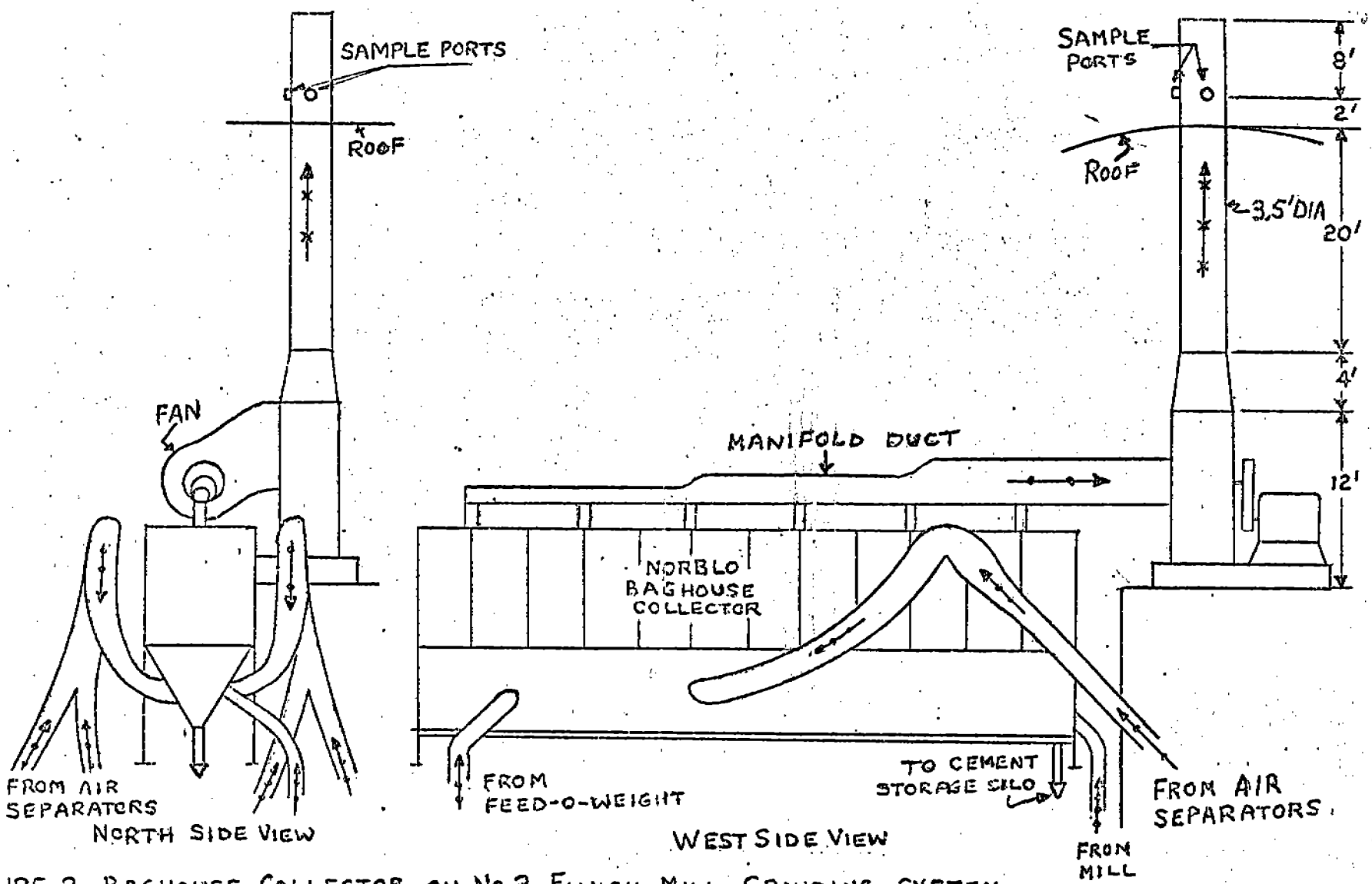

FIGURE 3 BAGHOUSE COLLECTOR ON No.2 FINISH MILL GRINDING SYSTEM

IX. SAMPLING AND ANALYTICAL PROCEDURES

Complete details of the equipment and procedures used for particulate sampling are described in Method 5, Federal Register, December 23, 1971.

The procedures for analyzing the particulates conform to Method 5 with the added exception of the impinger catch being analyzed for particulate residue including organic matter.

Quantitative analyses results of material collected on the glass fiber filter and in the residue samples are reported in Appendix C.

APPENDIX C

LABORATORY RESULTS

Tables C - 1 and C - 2 present a summary of the particulate cleanup and analysis data. Table C - 3 presents the results of a metals analysis conducted on the samples from runs no. 3 of the clinker cooler and finish mill stacks.

TABLE C - 1

PARTICULATE RESULTS, CLINKER COOLER (1)

		run 1	run 2	run 3
impinger water	sample no.	(1 A)	(2 A)	(3 A)
	wt., mg	14.5	17.6	9.1
probe, cyclone	sample no.	(1 B)	(2 B)	(3 B)
	wt., mg	11.8	19.4	13.4
filter	sample no.	(1 C)	(2 C)	(3 C)
	wt., mg	0.0	1.1	0.8
Total particulates, mg		26.3	38.1	23.3

Note: water blank: 1.4 mg/500 ml
acetone blank: 1.1 mg/500 ml

TABLE C - 2

PARTICULATE RESULTS, FINISH MILL GRINDING SYSTEM (1)

		run 1	run 2	run 3
impinger water	sample no.	(4 A)	(5 A*)	(6A)
	wt., mg	10.9	10.9	10.8
probe, cyclone	sample no.	(4 B)	(5 B)	(6B)
	wt., mg	19.2	20.2	14.1
filter	sample no.	(4 C)	(5 C)	(6C)
	wt., mg	2.8	6.7	3.0
Total Particulates, mg		32.9	37.8	27.9

* Several particles of silica gel found in impinger water; removed before analysis

Note: water blank: 1.4 mg/500 ml
acetone blank: 1.1 mg/500 ml

(1) Blank values have been subtracted from sample results.

TABLE C - 3

RESULTS OF METALS ANALYSIS[a]

Sample: run number 3, clinker cooler

Types of Analyses - Spark Source Mass Spectrograph (SSMS)
Optical Emission Spectrography (OES)

Analysis Sample No. wt., mg	SSMS 3A+3B 22.5	OES 3A+3B 22.5	SSMS 3C 0.8	OES 3C 0.8	Analysis Sample No. wt., mg	SSMS 3A+3B 22.5	OES 3A+3B 22.5	SSMS 3C 0.8	OES 3C 0.8
Element					Element				
Hg	0.01	<0.03	<0.05	<0.6	B	10.	20.	(c)	(c)
Be	<0.005	<0.02	<0.005	<2.	F	<0.03	(b)	(c)	(b)
Cd	2.	<2.	<0.4	<60.	Li	0.2	<3.	3.	<15.
As	0.3	<2.	<0.4	<3.	Ag	4.	2.	<0.1	< 2.
V	0.3	1.	<10.	<30.	Sn	30.	40.	7.	10.
Mn	5.	10.	<5.	< 6.	Fe	200.	400.	<500.	<600.
Ni	100.	200.	<7.	<6.	Sr	3.	8.	30.	<60.
Sb	0.1	<1.	0.03	<15.	Na	High	10,000.	(c)	(c)
Cr	40.	80.	<10.	<30.	K	High	10,000	(c)	(c)
Zn	20.	<10.	<4.	<30.	Ca	High	50,000.	(c)	(c)
Cu	15.	10.	<0.5	<3.	Si	High	1,500.	(c)	(c)
Pb	20.	12.	<1.	<15.	Mg	High	60.	(c)	(c)
Se	2.	(b)	<0.3	(b)					

(a) All results given in total micrograms per sample.

(b) Not detectable by OES.

(c) Useful determination is precluded by high contribution from blank.

* Glass filters - values given are impurity levels above glass background.

Comments - (1) Estimates of precision are ±25% and ±100% for SSMS.

(2) Where discrepancies in results occur between OES and SSMS, take the average as being most correct. If greater accuracy is demanded, the concentrations can be determined by AA, other classical chemical techniques and/or better standardization of the OES and SSMS.

(3) High in the SSMS column is given where concentrations are found generally greater than 500 ppm. The latitude of the photographic emulsion prevents obtaining detections to 0.1 ppm and up to 500 ppm. This would not be a problem with electrical detection.

TABLE C - 4

RESULTS OF METALS ANALYSIS(a)

Sample: run number 3, finish mill air separator

Types of Analyses - Spark Source Mass Spectrograph (SSMS)
Optical Emission Spectrography (OES)

Analysis Sample No. wt.,mg	SSMS 6A+6B 24.9	OES 6A+6B 24.9	SSMS 6C 3.0	OES 6C 3.0	Analysis Sample No. wt.,mg	SSMS 6A+6B 24.9	OES 6A+6B 24.93.0	SSMS 6C 3.0	OES 6C 3.0
Element					Element				
Hg	0.02	<0.02	0.04	<0.6	B	40.	40.	(c)	(c)
Be	<0.02	<0.02	<0.005	<2.	F	<0.1	(b)	(c)	(b)
Cd	2.	<2.	<0.4	<60.	Li	0.1	<3.	3.	<15.
As	1.	<2.	≤0.4	<30.	Ag	2.	2.	<0.4	<2.
V	1.	2.	≤5.	<30.	Sn	60.	40.	20.	<20
Mn	4.	6.	≤5.	<6.	Fe	200.	400.	<500.	<600.
Ni	300.	400.	<15.	<6.	Sr	10.	15.	50.	< 60.
Sb	0.3	<1.	0.03	<15.	Na	High	10,000.	(c)	(c)
Cr	20.	40.	10.	<30.	K	High	10,000.	(c)	(c)
Zn	10.	<10.	<4.	<30.	Ca	High	50,000.	(c)	(c)
Cu	10.	10.	<0.5	<3.	Si	High	1,500.	(c)	(c)
Pb	4.	6.	2.	<15.	Mg	High	100.	(c)	(c)
Se	1.	(b)	<0.3	(b)					

(a) All results given in total micrograms per sample.

(b) Not detectable by OES.

(c) Useful determination is precluded by high contribution from blank.

* Glass filters - values given are impurity levels above glass background.

Comments - (1) Estimates of precision are ±25% and ±100% for SSMS.

(2) Where discrepancies in results occur between OES and SSMS, take the average as being most correct. If greater accuracy is demanded, the concentrations can be determined by AA, other classical chemical techniques and/or better standardization of the OES and SSMS.

(3) High in the SSMS column is given where concentrations are found generally greater than 500 ppm. The latitude of the photographic emulsion prevents obtaining detections to 0.1 ppm and up to 500 ppm. This would not be a problem with electrical detection.