EPA PROJECT REPORT NO. 74-LIM-1

Note: This is a reference cited in *AP 42, Compilation of Air Pollutant Emission Factors, Volume I Stationary Point and Area Sources.* AP42 is located on the EPA web site at www.epa.gov/ttn/chief/ap42/

The file name refers to the reference number, the AP42 chapter and section. The file name "ref02_c01s02.pdf" would mean the reference is from AP42 chapter 1 section 2. The reference may be from a previous version of the section and no longer cited. The primary source should always be checked.

AIR POLLUTION EMISSION TEST

BETHLEHEM MINES CORPORATION

Annville, Pennsylvania

~~B-27~~

B-28

T.P., SO_2, NO_x, Metals

(14) @ blower outlet

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Waste Management
Office of Air Quality Planning and Standards
Emission Measurement Branch
Research Triangle Park, North Carolina

SN 96032.020

EMB Test Number 74-LIM-1

Bethlehem Mines Corporation

Annville, Pennsylvania

by

T. E. Eggleston

August 1974

TRW Transportation and Environmental Operations
800 Follin Lane S. E.
Vienna, Virginia 22180

Contract Number 68-02-0235

PREFACE

The work reported herein was conducted by TRW Environmental Services pursuant to the terms of Task Order No. 17, Contract No. 68-02-0235 with the Environmental Protection Agency. Mr. T. E. Eggleston served as Project Chief and Crew Leader. Mr. Carl D. Bell, Office of Air Programs, Emission Measurement Branch served as Project Officer. Mr. Leslie Evans, Office of Air Programs, Industrial Studies Branch served as Project Engineer.

I. TABLE OF CONTENTS

		Page
II.	Introduction	2
III.	Summary and Discussion of Results	3
IV.	Process Description and Operation	7
V.	Location of Sampling Points	11
VI.	Sampling and Analytical Procedures	14
VII.	Appendix	15

A. Complete Particulate Results with Example Calculations

B. Complete Gaseous Results with Example Calculations

C. Process Data

D. Field Data

E. Sampling Procedure

F. Laboratory Report

G. Test Log

H. Project Participants

II. INTRODUCTION

Under the Clean Air Act of 1970, as ammended, the Environmental Protection Agency is charged with the establishment of performance standards for new or modified stationary sources which may contribute significantly to air pollution. A performance standard is based on the best emission reduction systems which have been shown to be technically and economically feasible.

In order to set realistic performance standards, accurate data on pollutant emissions must be gathered from the stationary source category under consideration.

Bethlehem Mines Corporation's (BMC) lime kiln located at Annville, Pennsylvania was designated as a well-controlled stationary source of its type and was therefore selected by OAQPS for an emission testing program. Testing was conducted on two of the four stacks serving the control device while BMC personnel tested the other two stacks.

Samples were collected to determine filterable and total particulates, sulfur dioxide, nitrogen oxides, trace metals, carbon monoxide, and visible emissions.

III. SUMMARY AND DISCUSSION OF RESULTS

General

During the test series, the process operation was maintained at normal operating levels. No major upset or change was encountered. The baghouse was also operating normally. Total baghouse emissions are calculated by extrapolating the data to cover all four stacks. Emissions and flow rates from the C and D ducts were assumed to be identical to the A and B ducts which were tested. The BMC test results of stacks C and D have not been provided.

Results

Results are shown in Tables 1-4.

The results of the trace metal analysis are included in Appendix F. This analysis was a spark source mass spectrographic analysis.

The test program was carried out with only a few significant problem areas. During the first day, problems were encountered with the electrical circuits and it became necessary to stagger some of the tests to avoid overloading the circuits provided.

The other significant problem was the sampling location and this is covered in Section V.

The visible emissions results indicate an operation with no significant visible emissions. The values greater than zero were generally associated with bag inspection (compartment doors being opened and closed).

TABLE 1

SUMMARY OF PARTICULATE RESULTS

DATE		1-22-74	1-23-74	1-24-74	AVERAGE
RUN		LM-1	LM-2	LM-3	
"A" DUCT:	TOTAL TRAIN				
	gr/scf*	0.024	0.024	0.025	0.024
	lb/hr	2.77	2.25	3.39	2.80
	FRONT HALF**				
	gr/scf*	0.020	0.021	0.021	0.021
	lb/hr	2.32	1.98	2.78	2.36
	% of total	83.8	88.0	82.0	84.3
"B" DUCT:	TOTAL TRAIN				
	gr/scf*	0.035	0.041	0.051	0.042
	lb/hr	5.13	7.83	7.01	6.66
	FRONT HALF**				
	gr/scf*	0.032	0.036	0.048	0.039
	lb/hr	4.62	6.92	6.62	6.05
	% of total	90.1	88.4	94.4	90.8
SYSTEM:	TOTAL TRAIN				
	gr/scf*	0.0305	0.0354	0.0380	0.0346
	lb/hr	15.80	20.16	20.80	18.92
	FRONT HALF**				
	gr/scf*	0.0268	0.0310	0.0340	0.0306
	lb/hr	13.88	17.80	18.80	16.83
	% of total	87.8	88.3	90.4	89.0
TOTAL:	lb/ton of feed	0.263	0.336	0.347	0.315

* 70°F, 29.92" Hg, dry

** Probe & Filter

TABLE 2

SUMMARY OF GASEOUS RESULTS

Date	Run No.*	SO_2 Lb./SCF Dry
1-22-74	ALS-1	2.42×10^{-6}
1-23-74	BLS-1	1.30×10^{-6}
1-23-74	ALS-2	4.98×10^{-6}
1-23-74	BLS-2	3.24×10^{-6}
1-24-74	ALS-3	1.96×10^{-6}
1-24-74	BLS-3	3.85×10^{-6}
	Average	2.96×10^{-6}

Date	Run No.*	NOx Lb./SCF Dry
1-22-74	ALN-1	2.52×10^{-5}
1-22-74	BLN-1	3.23×10^{-5}
1-23-74	ALN-2	2.32×10^{-5}
1-23-74	BLN-2	3.38×10^{-5}
1-24-74	ALN-3	2.10×10^{-5}
1-24-74	BLN-3	3.13×10^{-5}
	Average	2.77×10^{-5}

*First letter designates A or B Duct.

TABLE 3

VISIBLE EMISSIONS RESULTS

Date	Time	% Opacity		
		Minimum	Maximum	Average
1-22-74	1341 - 1440	0	5	0
1-23-74	1042 - 1141	0	0	0
1-24-74	0916 - 1015	0	10	0

TABLE 4

CARBON MONOXIDE

Date	Concentration, ppm
1-22-74	20
1-23-74	10
1-24-74	10
Average	13

IV. PROCESS DESCRIPTION AND OPERATION

Limestone consists primarily of calcium carbonate or combinations of calcium and magnesium carbonate with varying amounts of impurities. 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 limestone, and (4) optionally processing the quicklime further by additional crushing and sizing and then 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 Millard quarry of Bethlehem Mines Corporation has five rotary kilns. Four of the kilns were constructed in 1933-35 and have a combined capacity of 600 tons per day. The fifth kiln, a large one of 650 tons a day capacity, was installed in 1969. The four older kilns are ducted together and emissions are controlled by one baghouse. The new kiln (Kiln 5) and its separate baghouse was tested.

Kiln 5 is 405 feet long and 13 feet in diameter. There is a 60 foot recoup section at the feed inlet and a 22 foot trefoil section near the product discharge end designed to increase the heat exchange between the combustion gas and the solids traveling down the kiln. There are no preheat facilities. The feed from the limestone crusher is five-eights to one and a half inches when BOF lime is produced. A three-eighths feed is used to produce lime for general chemical use. The limestone feed is a high calcium, fairly hard stone, which has been washed.

The fuel used is a low sulfur coal (0.5 to 1.5%) which is ground in a Raymond roller mill and blown into the kiln. Bethlehem believes that most of the sulfur in the coal passes through the kiln and out the stack. Coal consumption for No. 5 kiln is estimated to be 0.2 to 0.22 tons per ton of lime produced. The sulfur content of the product lime is estimated at 0.001%.

The hot lime is cooled with incoming combustion air in a Kennedy cooler, fines air removed by screening and the product stored in hoppers. All shipments are in bulk.

The exit gas from kiln No. 5 is cooled from 900-950°F to 525°F by spraying water directly into the gas stream upstream of the baghouse. The baghouse fan which is located between the kiln and the baghouse is equipped with a 600HP motor. Any large chips are removed by a drop-out chamber located upstream of the fans. The baghouse which was built by American Air Filter Corporation, has 14 compartments and is so sized that it can operate with two compartments down for maintenance without reducing kiln production. The bags are woven fiberglass, about 8 inches in diameter and 30 feet long and are cleaned by reverse air.

Disposal of the collected dust does not appear to be a problem at Bethlehem Mines' Annville plant. The waste dust collected in the baghouses is stored in silos and sold to cement manufacturers. Baghouse dust from the No. 5 kiln is estimated to be 100 to 150 tons per 24 hour period. Any not sold is stored in open piles which are wet with water to reduce dust. Bethlehem has plans to granulate this dust with water to form a coarse, dry, non-dusting commercial product. Also, if necessary they can use all of this material in Bethlehem Steel's metallurgical operations. In addition the City of Philadelphia has expressed interest in using the byproduct dust to stabilize sewage sludge.

There are four exit stacks about six feet long from the baghouse, with each stack serving three or four compartments. Two stacks were tested by the EPA contractor and two by Bethlehem. The plant operated normally during all testing except for some nozzle atomizing difficulties in the cooling tower spray chamber which caused a requirement that tempering air be added at the cooling tower exit. This tempering air was required during the tests from 3:30 p.m. until the end of the test on January 22 and during the complete test on January 24. No tempering air was required on January 23. Process data was gathered during the test and is summarized on the following Table.

TABLE 5

Summary of Operating Variables

Date	1/22	1/23	1/24
Test No.	1	2	3
Stone feed rate (tons/hr)	60	60	60
Coal feed rate (tons/hr)	5.1-5.5	5.25	5.5
Water (gallons/min)	28-29	28	31
Pressure drop (inches of W.C.)	4.3-4.4	4.3-4.4	4.1-4.3
Kiln speed (RPH)	78	78	78
Feed end temp. (°F)	915-925	910-920	920-930
Product temp. (°F)	175-185	160-180	160-165
Baghouse inlet temp. (°F)	505-520	485-490	520-530

PRODUCTION RATE: 1/2 FEED RATE

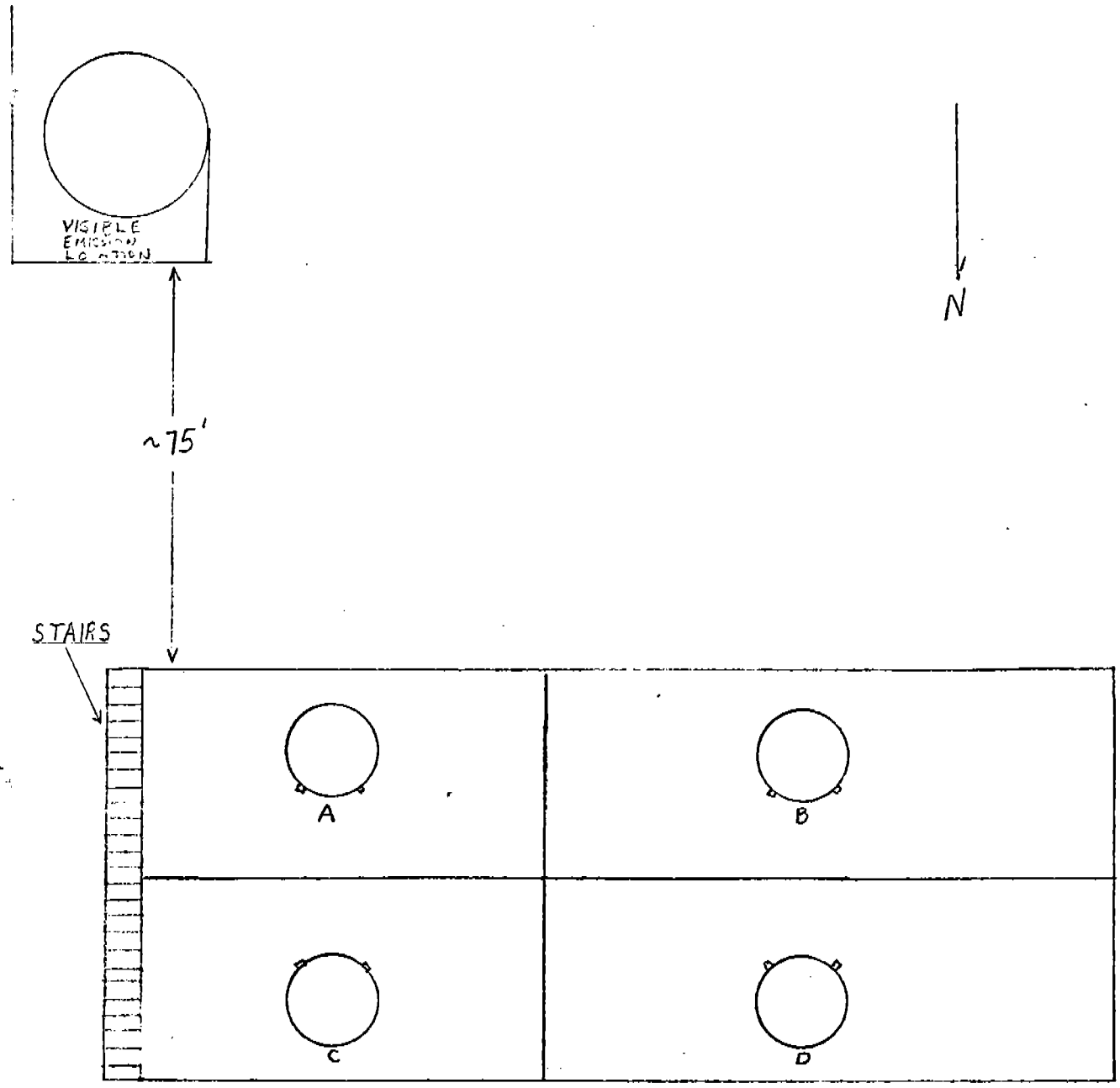
∴ P.R. = 30 $\frac{ton}{hr}$

V. LOCATION OF SAMPLING POINTS

Sampling was conducted in two circular ducts at the outlet of the baghouse (see figures 1 and 2).

The "A" duct services 3 compartments, while the "B" duct services 4 compartments. The "C" and "D" ducts are essentially identical to the "A" and "B" ducts.

The sample ports were located less than one diameter in either direction from the nearest obstructions. The locations do not meet the minimum requirements of Method 1, Federal Register, December 23, 1971, but no other feasible alternative was available. Due to the inadequate location, a total of 48 points were sampled in each duct.



BAGHOUSE

FIGURE 1

STACK LOCATIONS

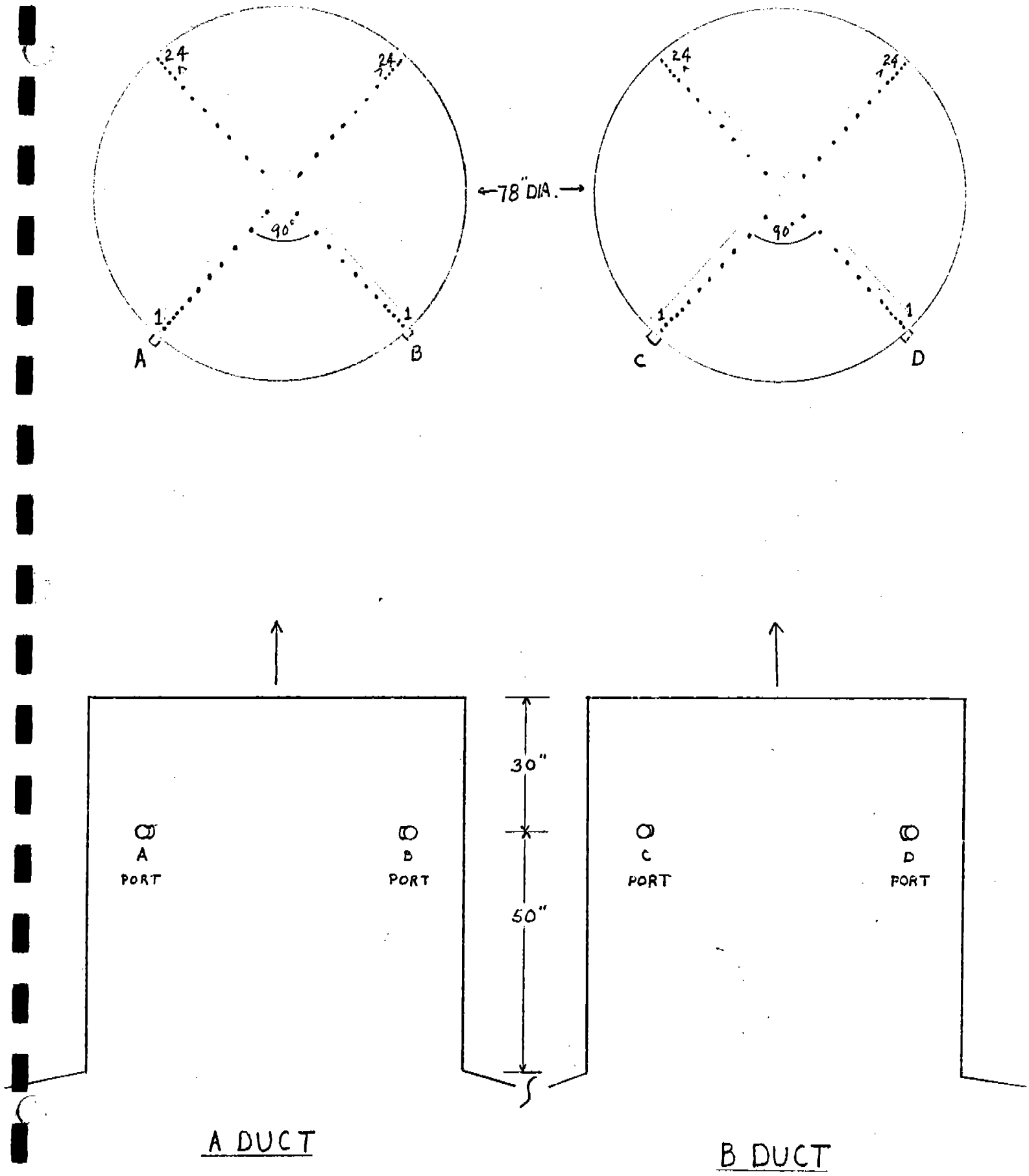


FIGURE 2

LOCATION OF SAMPLING PORTS

VI. SAMPLING AND ANALYTICAL PROCEDURES

Test methods were in accordance with standard methods as published in the Federal Register, Volume 36, Number 159, Part II, December 23, 1971, and other established methods. The following is a breakdown of the methods used in evaluating the various test parameters.

Particulates

Methods 1, 2, 5, Federal Register, December 23, 1971. In addition to this, the impinger solutions were analyzed for mass (Federal Register, August 17, 1971).

Sulfur Dioxide

Method 6, Federal Register, December 23, 1971.

Molecular Weight (ORSAT Analysis)

Method 3, Federal Register, December 23, 1971.

Nitrogen Oxides

Method 7, Federal Register, December 23, 1971.

Carbon Monoxide

Method 10, Federal Register, June 11, 1973.

Visible Emissions

Method 9, Federal Register, December 23, 1971.

Trace Metals

The filter and residue were ashed in a low temperature asher, then refluxed with nitric and hydrochloric acid. The material was then analyzed by spark source mass spectrophotometry.

VII. APPENDIX

APPENDIX A

COMPLETE PARTICULATE RESULTS WITH EXAMPLE CALCULATIONS

SOURCE TESTING CALCULATION FORMS

Test No. 74-LIM-1 No. Runs 3

Name of Firm Bethlehem Mines

Location of Plant Annville, Pennsylvania

Type of Plant Lime Kiln

Control Equipment Baghouse

Sampling Point Locations 2 Exhaust Stacks

Pollutants Sampled Particulates

Time of Particulate Test:

Run No. ALM/BLM-1	Date 1-22-74	Begin 1301	End 1721
Run No. ALM/BLM-2	Date 1-23-74	Begin 1025	End 1330
Run No. ALM/BLM-3	Date 1-24-74	Begin 0906	End 1202
Run No.	Date	Begin	End

PARTICULATE EMISSION DATA

Run No.	ALM-1	ALM-2	ALM-3	BLM-1	BLM-2	BLM-
P_b barometric pressure, "Hg Absolute	30.02	29.94	30.22	30.02	29.94	30.2
P_m orifice pressure drop, "H_2O	1.34	0.87	1.68	1.48	1.11	0.6
V_m volume of dry gas sampled @ meter conditions, ft.^{3}	109.155	68.196	91.285	128.915	78.40	56.3
T_m Average Gas Meter Temperature, °F	76	69	67	86	75	61
$V_{m_{std.}}$ Volume of Dry Gas Sampled @ Standard Conditions, ft.^{3}	108.564	68.463	93.031	125.912	77.87	57.9
V_w Total H_2O collected, ml., Impingers & Silica Gel.	383.0	266.4	336.4	519.6	360.6	244.2
$V_{w_{gas}}$ Volume of Water Vapor Collected ft.^{3} @ Standard Conditions*	18.154	12.63	15.94	24.630	17.09	11.5

* 70°F, 29.92" Hg.

PARTICULATE EMISSION DATA (CONT'D)

Run No.	ALM-1	ALM-2	ALM-3	BLM-1	BLM-2	BLM-3
%M -% Moisture in the stack gas by volume	14.33	15.57	14.63	16.36	17.99	16.66
M_d - Mole fraction of dry gas	0.857	0.844	0.854	0.836	0.820	0.834
% CO_2	16.63	19.40	19.03	17.83	18.73	18.80
% O_2	6.83	8.20	8.13	6.83	8.03	8.17
% N_2	76.54	72.40	72.84	75.34	73.24	73.03
M W_d - Molecular weight of dry stack gas	30.934	31.432	31.37	31.126	31.318	31.334
M W - Molecular weight of stack gas	29.081	29.340	29.41	28.979	28.921	29.113
Δ Ps - Velocity Head of stack gas, In.H_2O	0.0291	0.0210	0.042	0.0506	0.0910	0.0467
T_s - Stack Temperature, °F	362	352	372	372	358	378
$\sqrt{\Delta P_s X(T_s + 460)}$	-	-	-	-	-	-
P_s - Stack Pressure,"Hg.Absolute	30.02	29.94	30.22	30.02	29.94	30.22
V_s - Stack Velocity @ stack conditions, fpm	720	606	862.5	956.9	1274.4	917.4
A_s - Stack Area, in.^{2}	4778.4	4778.4	4778.4	4778.4	4778.4	4778.4
Q_s - Stack Gas Volume @ Standard Conditions, *SCFM	13,241	11,081	15,718	16,973	22,481	16,206
Tt - Net Time of Test, min.	192	144	144	192	144	144
D_n - Sampling Nozzle Diameter, in.	0.500	0.500	0.500	0.500	0.375	0.375
%I - Percent isokinetic	103.6	104.1	99.72	93.7	103.7	107.0
m_f - Particulate - probe, cyclone and filter, mg.	144.0	92.8	124.8	259.8	181.7	179.3
m_t - Particulate - total, mg	171.9	105.2	152.2	288.5	205.6	189.8
C_{an} - Particulate - probe, cyclone, and filter, gr/SCF	0.0204	0.0209	0.0210	0.0318	0.0359	0.0477
C_{ao} - Particulate - total, gr/SCF	0.0244	0.0237	0.0250	0.0353	0.0407	0.0505
C_{at} - Particulate - probe, cyclone, and filter, gr/cf @ stack conditions	0.0113	0.0115	0.0110	0.0170	0.0191	0.025

PARTICULATE EMISSION DATA (cont'd)

Run No.	ALM-1	ALM-2	ALM-3	BLM-1	BLM-2	BLM-3
C_{au} - Particulate, total, gr/cf @ stack cond.	0.0135	0.0130	0.0140	0.0188	0.0216	0.02[illegible]
C_{aw} - Particulate, probe, cyclone, and filter, lb/hr.	2.318	1.982	2.783	4.622	6.923	6.6[illegible]
C_{ax} - Particulate - total, lb/hr.	2.767	2.247	3.394	5.133	7.834	7.0[illegible]
% EA- % Excess air @ sampling point	50.5	74.2	72.3	51.7	70.1	72.[illegible]

* 70°F, 29.92" Hg.

SAMPLE PARTICULATE CALCULATIONS

1. Volume of dry gas sampled at standard conditions - 70°F, 29.92" Hg, ft^3.

$$V_{m_{std}} = \frac{17.7 \times V_m \left(P_B + \frac{P_m}{13.6}\right)}{(T_m + 460)} = Ft.^3 =$$

$$V_{m_{std}} = \frac{17.7 \times 22.20 \left(29.80 + \frac{1.31}{13.6}\right)}{(104.7 + 460)} = \underline{20.8\ Ft^3}$$

2. Volume of water vapor at 70°F and 29.92" Hg, $Ft.^3$

$$V_{w_{gas}} = 0.0474 \times V_w = ft.^3$$

$$V_{w_{gas}} = 0.0474 \times 39.6 = \underline{1.88\ Ft^3}$$

3. % moisture in stack gas

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

$$\%M = \frac{100 \times 1.88}{20.8 + 1.88} = \underline{8.28\%}$$

4. Mole fraction of dry gas

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

$$M_d = \frac{100 - 8.28\%}{100} = \underline{0.917}$$

5. Average molecular weight of dry stack gas

$$M\,W_d = (\%CO_2 \times \frac{44}{100}) + (\%O_2 \times \frac{32}{100}) + (\%N_2 \times \frac{28}{100})$$

$$M\,W_d = (2 \times \frac{44}{100}) + (3 \times \frac{32}{100}) + (95 \times \frac{28}{100}) = \underline{28.44}$$

6. Molecular weight of stack gas

$$M\,W = M\,W_d \times M_d + 18\,(1 - M_d)$$

$$M\,W = 28.44 \times 0.917 + 18\,(1-0.917) = 27.58$$

7. Stack velocity @ stack conditions, fpm

$$V_s = 4350 \times \sqrt{\Delta P_s \times (T_s + 460)} \left[\frac{1}{P_s \times M\,W}\right]^{1/2} = \text{fpm}$$

$$V_s = 4350 \times \frac{\text{AVERAGE}}{\sqrt{\text{INDIVIDUAL VALUES}}} \cdot \frac{1}{30.20 \times 27.58}^{1/2} = \underline{8896\ \text{FPM}}$$

8. Stack gas volume @ standard conditions, SCFM

$$Q_s = \frac{0.123 \times V_s \times A_s \times M_d \times P_s}{(T_s + 460)} = \text{SCFM}$$

$$Q_s = \frac{0.123 \times 8896 \times 154 \times 0.917 \times 30.20}{(153 + 460)} = \underline{7613 \text{ SCFM}}$$

9. Percent isokinetic

$$\%I = \frac{1032 \times (T + 460) \times V_m}{V_s \times T_t \times P_s \times M_d \times (D_n)^2} = \%$$

$$\%I = \frac{1032 \times (153 + 460) \times 20.80}{8896 \times 35 \times 30.20 \times 0.917 \times (0.1250)^2} = 98\%$$

10. Particulate - probe, cyclone, and filter, gr/SCF

$$C_{an} = 0.0154 \times \frac{M_f}{V_{m_{std}}} = \text{gr/scf}$$

$$C_{an} = 0.0154 \times \frac{108.2}{20.8} = \underline{0.0801 \text{ gr/SCF}}$$

11. Particulate total, gr/SCF

$$C_{ao} = 0.0154 \times \frac{M_t}{V_{m_{std}}} = \text{gr/SCF}$$

$$C_{ao} = 0.0154 \times \frac{118.5}{20.8} = \underline{0.0877 \text{ gr/SCF}}$$

12. Particulate - probe, cyclone and filter, gr/CF at stack conditions

$$C_{at} = \frac{17.7 \times C_{an} \times P_s \times M_d}{(T_s + 460)} = \text{gr/CF}$$

$$C_{at} = \frac{17.7 \times 0.0801 \times 30.20 \times 0.917}{(153 + 460)} = \underline{0.0641 \text{ gr/CF}}$$

13. Particulate - total, gr/CF @ stack conditions

$$C_{au} = \frac{17.7 \times C_{ao} \times P_s \times M_d}{(T_x + 460)} = \text{gr/CF}$$

$$C_{au} = \frac{17.7 \times 0.0877 \times 30.20 \times 0.917}{(153 + 460)} = \underline{0.0702 \text{ gr/CF}}$$

14. Particulate - probe, cyclone filter filter, lb/hr.

$$C_{aw} = 0.00857 \times C_{an} \times Q_s = \text{lb/hr.}$$

$$C_{aw} = 0.00857 \times 0.0801 \times 7613 = \underline{5.2 \text{ lb/hr.}}$$

15. Particulate - total, lb/hr.

$$C_{ax} = 0.00857 \times C_{ao} \times Q_s = \text{lb/hr.}$$

$$C_{ax} = 0.00857 \times 0.0877 \times 7613 = \underline{5.7 \text{ lb/hr.}}$$

16. % excess air at sampling point

$$\% \text{ EA} = \frac{100 \times \% O_2}{(0.266 \times \% N_2) - \% O_2} = \%$$

$$\% \text{ EA} = \frac{100 \times 13.0}{(0.266 \text{ s } 75.0) - 13.0} = \frac{1300}{(19.95) - 13.0} = \underline{187\%}$$

APPENDIX B

COMPLETE GASEOUS RESULTS WITH EXAMPLE CALCULATIONS

NOx

SAMPLE #	Lbs/SCF ($x10^{-5}$)	AVG. FOR TEST
ALN-1a	2.69	
-1b	1.69	2.52
-1c	2.97	
-1d	2.73	
ALN-2a	2.53	
-2b	2.17	2.32
-2c	2.28	
-2d	2.28	
ALN-3a	2.38	
-3b	1.71	2.10
-3c	2.59	
-3d	1.73	
BLN-1a	3.14	
-1b	3.50	3.23
-1c	3.28	
-1d	3.01	
BLN-2a	3.46	
-2b	3.50	3.38
-2c	----	
-2d	3.19	
BLN-3a	3.37	
-3b	3.40	3.13
-3c	3.17	
-3d	2.56	

SO_2

SAMPLE #	Lb/SCF($x10^{-6}$)	AVG. FOR TEST
ALS-1a	1.45	2.42
-1b	3.39	
ALS-2a	6.99	4.98
-2b	2.96	
ALS-3a	1.95	1.96
-3b	1.97	
BLS-1a	1.25	1.30
-1b	1.35	
BLS-2a	3.66	3.24
-2b	2.81	
BLS-3a	3.44	3.85
-3b	4.26	

EXAMPLE

NO_x CALCULATION

$$C = \left(6.2 \times 10^{-5} \frac{\text{lb./s.c.f.}}{\mu\text{g./ml.}}\right) \left(\frac{M}{Vsc}\right) = \left(6.2 \times 10^{-5} \frac{\text{lb./s.c.f.}}{\mu\text{g./ml.}}\right) \left(\frac{272}{1709}\right) =$$

$$(6.2 \times 10^{-5})\ (0.159) = 9.87 \times 10^{-6} \text{ lbs./s.c.f.}$$

Where: C = Concentration of NO_x as NO_2 (dry basis), lb/s.c.f.

M = Mass of NO_2 in gas sample, μg

Vsc = Sample volume at standard conditions (dry basis), ml.

EXAMPLE

SO_2 CALCULATION

$$C_SO_2 = \left(7.05 \times 10^{-5} \frac{\text{lb.-l.}}{\text{g.-ml.}}\right) \frac{(Vt-Vtb)(N)\left(\frac{Vsoln}{Va}\right)}{Vmsto} =$$

$$\left(7.05 \times 10^{-5} \frac{\text{lb.-l}}{\text{g.-Ml.}}\right) \frac{(2.0-0)\ (0.01)\left(\frac{65}{5}\right)}{1.20} = 1.53 \times 10^{-5} \text{ lb./cu. ft.}$$

Where: C_SO_2 - Concentration of SO_2 at std. conditions, dry, lb./cu. ft.

7.05×10^{-5} = Conversion factor

Vt = Volume of titrant used, ml.

Vtb = Volume of titrant used, blank, ml.

N = Normality of titrant, g.-eq./l.

Vsoln = Total soln of SO_2, ml.

Va = Volume of aliquot titrated, ml.

Vmstd = Sample gas volume at standard conditions, cu. ft.

APPENDIX C

PROCESS DATA

Bethlehem Mines Corporation
Process Data - January 22, 1974

Time	1:05	2:30	4:05	5:25
Stone Feed Rate (tons/hr)	60	60	60	60
Coal Feed Rate (tons/hr)	5.5	5.5	5.5	5.1
Water (gallons/min)	28	29	29	28
Pressure Drop* (inches of W.C.)	4.4	4.3	4.3	4.3
Kiln Speed (RPH)	78	78	78	78
Feed End Temperature (°F)	920	925	920	915
Mid Kiln Temperature (°F)	1700	1680	1690	1680
Product Temperature (°F)	175	180	185	175
Cooler Temperature (°F)	1000	1000	1000	1000
Baghouse Inlet Temperature (°F)	520	515	505	515

*This is minimum pressure drop with all bags on line. All doors etc. on baghouse closed.

Bethlehem Mines Corporation
Process Data - January 23, 1974

Time	10:20	12:00	1:15
Stone Feed Rate (tons/hr)	60	60	60
Coal Feed Rate (tons/hr)	5.25	5.25	5.25
Water (gallons/min)	28	28	28
Pressure Drop (inches of W.C.)	4.4	4.4	4.3
Kiln Speed (RPH)	78	78	78
Feed End Temperature (°F)	920	910	915
Mid Kiln Temperature (°F)	1680	1680	1680
Product Temperature (°F)	170	180	160
Cooler Temperature (°F)	1000	1000	1000
Baghouse Inlet Temperature (°F)	485	490	490

Bethlehem Mines Corporation
Process Data - January 24, 1974

Time	9:00	10:05	10:55	12:1[illegible]
Stone Feed Rate (tons/hr)	60	60	60	6[illegible]
Coal Feed Rate (tons/hr)	5.5	5.5	5.5	5.[illegible]
Water (gallons/min)	31	31	31	3[illegible]
Pressure Drop (inches of W.C.)	4.1	4.3	-	4.[illegible]
Kiln Speed (RPH)	78	78	78	7[illegible]
Feed End Temperature (°F)	920	920	930	920
Mid Kiln Temperature (°F)	1710	1740	1730	1740
Product Temperature (°F)	160	160	160	165
Cooler Temperature (°F)	1000	1000	1000	1000
Baghouse Inlet Temperature (°F)	520	530	525	530

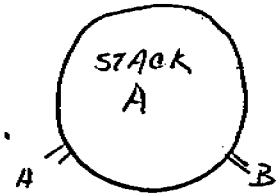
APPENDIX D

FIELD DATA

FIELD DATA

PLANT Beech Lime Corp.
DATE 1/22/74
SAMPLING LOCATION Exhaust A
SAMPLE TYPE PARTICULATE
RUN NUMBER A401-1
OPERATOR Seitz
AMBIENT TEMPERATURE 62
BAROMETRIC PRESSURE 30.02
STATIC PRESSURE, (P_s) 30.02
FILTER NUMBER (s) 350

PROBE LENGTH AND TYPE RAC 10'
NOZZLE I.D. .561
ASSUMED MOISTURE, % 8
SAMPLE BOX NUMBER 4
METER BOX NUMBER 4
METER $\Delta H_@$ 1.95
C FACTOR 1.05
PROBE HEATER SETTING 60
HEATER BOX SETTING 250
REFERENCE Δp .044



SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 4 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0000 1301	822.345									
A-3	(4)	823.680	.01	.44	.44	355	62	62	3	250	65
A-3	(8)	825.080	.01	.44	.44	355	62	62	3		
A-3	(12)	826.400	.01	.44	.44	355	64	62	3		
A-4	(16)	827.770	.01	.44	.44	345	68	63	3		
A-5	(20)	829.180	.01	.44	.44	360	69	63	3		
A-6	(24)	830.600	.01	.44	.44	355	70	65	3		
A-7	(28)	832.310	.01	.44	.44	365	73	67	3		
A-8	(32)	833.620	.015	.65	.65	365	73	68	4		
A-9	(36)	835.630	.020	.86	.86	360	75	68	5		
A-10	(40)	837.670	.020	.86	.86	370	77	68	5		
A-11	(44)	840.080	.035	1.5	1.5	365	79	68	8		
A-12	(48)	842.510	.035	1.5	1.5	365	82	69	8		
A-13	(52)	845.250	.050	2.1	2.1	370	85	70	11		
A-14	(56)	848.510	.065	2.7	2.7	370	88	72	17		
A-15	(60)	851.400	.050	2.1	2.1	370	89	73	12		
A-16	(64)	854.290	.050	2.1	2.1	370	90	73	12		
A-17	(68)	856.980	.040	1.7	1.7	370	91	74	10		
A-18	(72)	859.830	.050	2.1	2.1	370	94	74	12		
A-19	(76)	862.210	.030	1.3	1.3	370	94	75	7.5		
A-20	(80)	864.690	.035	1.5	1.5	370	93	76	8		
A-21	(84)	867.300	.040	1.7	1.7	365	94	77	9		
A-22	(88)	869.880	.040	1.7	1.7	365	94	78	9		
A-23	(92)	873.160	.065	2.7	2.7	370	95	78	16		
A-24	(96) 1431	876.535	.065	2.7	2.7	370	97	79	16		

COMMENTS: OFF

EPA (Dun) 235

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0000	1507	876.535									
B-2	0004	1511	878.550	.02	.87	.87	340	68	69	6	250	65
B-2	0008	1515	880.860	.03	1.3	1.3	340	71	70	9		
B-3	0012	1519	883.730	.055	2.3	2.3	355	76	70	13		
B-4	0016	1523	886.420	.040	1.7	1.7	360	82	70	10		
B-5	0020	1527	889.095	.040	1.7	1.7	365	84	70	10		
B-6	0024	1531	891.80	.040	1.7	1.7	365	85	70	10		
B-7	0028	1535	894.590	.050	2.1	2.1	370	85	71	12		
B-8	0032	1539	897.30	.04	1.7	1.7	370	87	71	10		
B-9	0036	1543	899.830	.035	1.5	1.5	370	87	71	9		
B-10	0040	1547	902.640	.050	2.1	2.1	370	86	71	16		
B-11	0044	1551	905.840	.060	2.5	2.5	370	86	71	16		
B-12	0048	1555	908.300	.030	1.3	1.3	360	87	71	8		
B-13	0052	1559	911.01	.045	1.9	1.9	365	86	71	12		
B-14	0056	1603	913.68	.040	1.7	1.7	350	87	71	10		
B-15	0060	1607	916.08	.03	1.3	1.3	355	87	71	7		
B-16	0064	1611	918.15	.02	.87	.87	360	84	71	6		
B-17	0068	1615	920.45	.03	1.3	1.3	365	82	71	6		
B-18	0072	1619	922.49	.02	.87	.87	365	80	69	6		
B-19	0076	1623	923.92	.01	.41	.41	350	78	68	3		
B-20	0080	1627	925.27	.01	.41	.41	350	75	68	3		
B-21	0084	1631	926.68	.01	.41	.41	350	73	68	3		
B-22	0088	1635	928.05	.01	.41	.41	350	72	68	3		
B-23	0092	1639	930.03	.02	.87	.87	350	71	68	6		
B-24	0096	1643	931.50	.01	.41	.41	350	71	68	3		
OFF												
	1/2		[illegible]			1.34	[illegible]	71	70			
								76				
			mean	13.210								
			[illegible]									

EPA (Dur) 236
4 72

FI[redacted] DATA

PLANT BETHLEHEM MINE CORP
DATE 1/22/74
SAMPLING LOCATION
SAMPLE TYPE PARTICULATE
RUN NUMBER BLM-1
OPERATOR SWITZ
AMBIENT TEMPERATURE 62°F
BAROMETRIC PRESSURE 30.02
STATIC PRESSURE, (P_s) 30.02
FILTER NUMBER (s) 356

PROBE LENGTH AND TYPE 10' RAC
NOZZLE I.D. .50
ASSUMED MOISTURE, % 15
SAMPLE BOX NUMBER 3
METER BOX NUMBER 1
METER $\Delta H_@$ 1.84
C FACTOR .86
PROBE HEATER SETTING 70
HEATER BOX SETTING 250
REFERENCE Δp .053

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 4 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F AT OR BELOW
	0000	1303	400.155									
D-2	0005	1308	402.50	.03	1.2	1.2	310	62	62	7	250	70
D-2	0010	1313	404.87	.03	1.2	1.2	365	65	62	7		
D-3	0015	1318	407.30	.04	1.55	1.55	365	66	63	9		
D-4	0020	1323	409.90	.04	1.55	1.55	365	76	64	9		
D-5	0025	1328	412.50	.04	1.55	1.55	375	82	66	9		
D-6	0030	1333	415.40	.045	1.75	1.75	370	87	68	11		
D-7	0035	1338	418.29	.045	1.75	1.75	370	95	70	11		
D-8	0040	1343	421.05	.040	1.55	1.75	360	98	72	10		
D-9	0045	1348	423.76	.040	1.55	1.55	365	98	73	10		
D-10	0050	1353	426.34	.035	1.35	1.35	365	98	74	9		
D-11	0055	1358	428.65	.090	3.40	3.40	370	100	75	19		
D-12	0060	1403	432.84	.130	4.90	2.10	370	100	78	21		
D-13		1408	436.07	.105	4.0	2.0	370	108	78	21		
D-14		1413	438.99	.105	4.0	1.8	380	108	79	20.5		
D-15	[illegible]		441.99	.100	3.75	1.8	385	110	80	20.5		
D-16	[illegible]		445.04	.105	4.0	1.8	385	108	80	20.5		
D-17	[illegible]		448.12	.105	4.0	1.8	385	108	81	20.5		
D-18			451.18	.105	4.0	1.8	385	108	82	21		
D-19			454.25	.105	4.0	1.8	385	108	82	21		
D-20			457.33	.105	4.0	2.0	385	110	83	21		
D-21			460.41	.105	4.0	2.0	385	110	84	21		
D-22			463.65	.100	3.75	2.0	385	109	84	21		
D-23			466.57	.100	3.75	2.0	345	105	84	21		
D-24	96	1439	469.70	.100	3.75	2.05	385	103	82	21		

COMMENTS:

EPA (Dull) 235

205

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0000	1503	469.70									
C-1	0004	1507	471.73	.09	3.5	1.4	350	70	69	22	250	
C-2	0008	1511	474.88	.12	4.6	1.45	350	82	70	22		
C-3	0012	1515	477.33	.07	0.8	0.8	350	78	70	22		
C-4	0016	1519	480.00	.09	[illegible]	1.55	360	86	72	22		
C-5	0020	1523	482.80	.03	1.2	[illegible]	375	90	73	21		
C-6	0024	1527	485.97	.035	1.35	1.35	375	100	74	21		
C-7	0028	1531	489.12	.035	1.35	1.35	375	104	76	16		
C-8	0032	1535	492.02	.03	1.2	1.2	375	106	76	12		
C-9	0036	1539	495.00	.08	3.1	2.3	375	108	78	20		
C-10	0040	1543	498.76	.07	2.7	2.3	375	109	79	20		
C-11	0044	1547	501.93	.09	3.4	2.3	375	109	80	20		
C-12	0048	1551	505.30	.05	1.9	1.9	375	110	80	19		
C-13	0052	1555	508.64	.045	1.75	1.75	380	112	82	18		
C-14	0056	1559	511.96	.035	1.4	1.4	380	114	82	15		
C-15	0100	1603	514.04	.01	.41	.41	375	110	82	4		
C-16	0104	1607	515.56	.01	.41	.41	380	104	82	4		
C-17	0108	1611	517.13	.01	.41	.41	375	91	80	4		
C-18	0112	1615	518.60	.01	.41	.41	375	91	80	4		
C-19	0116	1619	520.14	.01	.41	.41	355	88	80	4		
C-20	0120	1623	521.61	.01	.41	.41	375	86	78	4		
C-21	0124	1627	[illegible]	.01	.41	.41	370	84	75	4		
C-22	0128	1631	524.98	.015	.61	.61	375	83	76	5		
C-23	0132	1635	526.42	.015	.61	.61	375	82	75	5		
C-24	0136	1639	524.07	.035	1.35	1.35	375	82	74	8		
END												
	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]			
			max	9.1 %								

EPA (Dur) 236
4 72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Bethlehem Mines Corp.
DATE 1/22/74
SAMPLING TIME (24-hr CLOCK) 1305-1402
SAMPLING LOCATION STACK B
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG.
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 70
OPERATOR SEITZ

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	17.6	17.6	17.7	17.7	18.2		17.83	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	24.7 ~~24.4~~	~~9.8~~ 7.1	24.6	6.9	24.7	6.5	6.83	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	0	0	0					28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							75.34	28/100	
								TOTAL	

EPA (Dur) 230
4/72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Bethlehem Mines Corp.
DATE 1/23/74
SAMPLING TIME (24-hr CLOCK) 1405-1500 (1-22-74)
SAMPLING LOCATION STACK A.
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG.
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 65°F
OPERATOR SEITZ

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	16.5	16.5	16.8	16.8	16.6	16.6	16.63	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	23.4	6.9	23.4	6.6	23.6	7.0	6.83	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	23.4		23.4		23.6			28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							76.54	28/100	
								TOTAL	

EPA (Dur) 230
4/72

212

FIELD DATA

PLANT Petroleum Mains Corp
DATE 1/23/74
SAMPLING LOCATION STACK A
SAMPLE TYPE PARTICULATE
RUN NUMBER ALM-2
OPERATOR HARTMAN
AMBIENT TEMPERATURE 50°
BAROMETRIC PRESSURE 27.74
STATIC PRESSURE, (P_s) 27.74
FILTER NUMBER (s)

PROBE LENGTH AND TYPE 10' RAC
NOZZLE I.D. .50
ASSUMED MOISTURE, % 12
SAMPLE BOX NUMBER 4
METER BOX NUMBER 2
METER $\Delta H_@$ 1.95
C FACTOR .94
PROBE HEATER SETTING 60
HEATER BOX SETTING 250°F
REFERENCE Δp .049

B -- OUT TO IN

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	00 / 10:25	931.757									
B-2	03 / 10:28	933.310	.025	.95	.95	350°	45	45	7.0"	250°	60°
B-2	06 / 10:31	934.900	.025	.95	.95	350°	48	45	5.5"	250°	60°
B-3	09 / 10:34	936.650	.040	1.50	1.50	350°	52	45	7.5"	250°	60°
B-4	12 / 10:37	938.460	.030	1.20	1.20	320°	56	46	7.0"	250°	60°
B-5	15 / 10:40	940.165	.030	1.20	1.20	345°	60	47	7.0"	250	60°
B-6	18 / 10:43	941.950	.040	1.50	1.50	350°	63	48	8.0"	250	60°
B-7	21 / 10:46	943.990	.050	1.90	1.90	350°	64	49	10.0"	250	60°
B-8	24 / 10:49	945.920	.040	1.50	1.50	350°	68	50	8.0"	250	60°
B-9	27 / 10:52	947.810	.040	1.50	1.50	355°	70	51	8.0"	250	60°
B-10	30 / 10:55	949.710	.040	1.50	1.50	355°	73	53	8.5"	250	60°
B-11	33 / 10:58	951.580	.040	1.50	1.50	360°	76	55	8.5"	250	60°
B-12	36 / 11:01	953.890	.060	2.25	2.25	360°	80	57	11.0"	250	60°
B-13	39 / 11:04	956.010	.040	1.50	1.50	360°	82	59	8.5"	250°	60°
B-14	42 / 11:07	957.770	.040	1.50	1.50	360°	83	60	8.5"	250°	60°
B-15	45 / 11:10	959.480	.030	1.20	1.20	360°	82	61	7.0"	250°	60°
B-16	48 / 11:13	961.300	.030	1.20	1.20	360°	81	62	7.0"	250°	60°
B-17	51 / 11:16	962.630	.020	0.76	0.76	360°	80	64	5.0"	250°	60°
B-18	54 / 11:19	963.710	.010	0.40	0.40	360°	78	64	3.5"	250°	60°
B-19	57 / 11:22	964.700	.010	0.40	0.40	360°	75	65	3.5"	250°	60°
B-20	60 / 11:25	965.840	.010	0.40	0.40	350°	74	66	3.5"	250°	60°
B-21	63 / 11:28	966.890	.010	0.40	0.40	350°	73	66	3.5	250°	60°
B-22	66 / 11:31	967.820	.010	0.40	0.40	350°	72	66	3.0	250°	60°
B-23	69 / 11:34	968.860	.010	0.40	0.40	350°	71	66	3.0	250°	60°
COMMENTS:	72 / 11:37	969.850	.010	0.40	0.40	350°	70	66	3.0	250°	60°

EPA (Dun) 235

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	000 / 11:48	969.850									
A-3	003 / 11:51	970.900	.010	0.40	0.40	350°	66	65	3.0	250°	55°
A-3	006 / 11:54	971.960	.010	0.40	0.40	350°	66	66	3.0	250°	55°
A-3	009 / 11:57	972.835	.010	0.40	0.40	350°	68	66	3.0	250°	55°
A-4	012 / 12:00	973.840	.010	0.40	0.40	350	70	66	3.0	250°	55°
A-5	015 / 12:03	974.845	.010	0.40	0.40	340	72	67	3.0	250	55°
A-6	018 / 12:06	975.840	.010	0.40	0.40	350	74	68	3.0	250°	55°
A-7	021 / 12:09	977.020	.015	0.58	0.58	350	75	69	4.0	250°	55°
A-8	024 / 12:12	978.235	.015	0.58	0.58	350	78	69	4.0	250	55°
A-9	027 / 12:15	979.450	.015	0.58	0.58	350	79	70	4.0	250	55°
A-10	030 / 12:18	980.660	.015	0.58	0.58	350	81	71	4.0	250	55°
A-11	033 / 12:21	981.870	.015	0.58	0.58	350	80	70	4.0	250	55°
A-12	036 / 12:24	983.090	.015	0.58	0.58	350	80	70	4.0	250	55°
A-13	039 / 12:27	984.480	.02	0.77	0.77	350	78	71	5.0	250	55°
A-14	042 / 12:30	985.880	.02	0.77	0.77	350	78	71	5.0	250	55°
A-15	045 / 12:33	987.30	.02	0.77	0.77	355	79	71	5.0	250	55°
A-16	048 / 12:36	988.70	.02	0.77	0.77	355	79	71	5.0	250	55°
A-17	051 / 12:39	990.12	.02	0.77	0.77	355	82	72	5.0	250	55°
A-18	054 / 12:42	991.52	.02	0.77	0.77	355	83	72	5.0	250	55°
A-19	057 / 12:45	992.925	.02	0.77	0.77	355	85	72	5.0	250	55°
A-20	1:00 / 12:48	994.310	.02	0.77	0.77	352	86	73	5.0	250	55°
A-21	1:03 / 12:51	995.725	.02	0.77	0.77	352	87	74	5.0	250	55°
A-22	1:06 / 12:54	997.135	.02	0.77	0.77	350	87	74	5.0	250	55°
A-23	1:09 / 12:57	998.540	.02	0.77	0.77	350	87	74	5.0	250	55
A-24	1:12 / 13:00	999.955	.02	0.77	0.77	350	84	73	5.0	250	55
	OFF										
			163								

EPA (Dur) 236
4 72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Bethlehem Mass Corp.
DATE 1/23/74
SAMPLING TIME (24-hr CLOCK) 1030 - 1130
SAMPLING LOCATION Stack A
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG.
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 20
OPERATOR ~~Sam~~ HARTMAN

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	19.2	19.2	19.4	19.4	19.4	19.4	19.4	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	27.4	8.2	27.6	8.2	27.6	8.2	8.2	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)	0							28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							72.4	28/100	
								TOTAL	

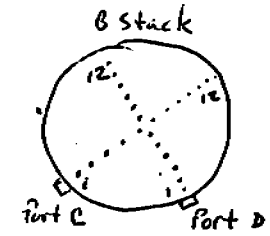
EPA (Dur) 230
4/72

FIELD DATA

213

PLANT Bethlehem Mines Corp.
DATE 1/23/74
SAMPLING LOCATION STACK B
SAMPLE TYPE Particulates
RUN NUMBER BLM-2
OPERATOR BARNARD
AMBIENT TEMPERATURE 50°
BAROMETRIC PRESSURE 24.94
STATIC PRESSURE, (P_s) 27.94
FILTER NUMBER (s)

PROBE LENGTH AND TYPE 13' Incoloy
NOZZLE I.D. .375
ASSUMED MOISTURE, % 12
SAMPLE BOX NUMBER 3
METER BOX NUMBER 1
METER $\Delta H_@$ 1.8.4
C FACTOR .848
PROBE HEATER SETTING 70
HEATER BOX SETTING 250°
REFERENCE Δp .151



SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0000	1026	529.48									
C-2	0003	1029	531.07	.095	.93	.93	350	46	46	18	250	50
C-2	0006	1032	532.70	.095	1.15	1.15	350	54	47	16		50
C-3	0009	1035	534.40	.095	1.15	1.15	350	60	48	16		50
C-4	0012	1038	536.14	.095	1.15	1.15	350	68	50	12		50
C-5	0015	1041	537.93	.115	1.40	1.40	355	73	50	12		50
C-6	0018	1044	539.71	.11	1.30	1.30	360	77	52	11		50
C-7	0021	1047	541.52	.13	1.60	1.60	360	78	54	12		50
C-8	0024	1050	544.20	.10	1.20	1.20	360	80	56	10		52
C-9	0027	1053	544.97	.12	1.45	1.45	360	82	57	10		55
C-10	0030	1056	546.74	.115	1.40	1.40	358	84	58	10		58
C-11	0033	1059	548.55	.12	1.45	1.45	358	86	60	10		60
C-12	0036	1102	550.35	.115	1.40	1.40	357	88	61	10		60
C-13	0039	1105	552.10	.10	1.20	1.20	357	90	62	9		55
C-14	0042	1108	553.84	.105	1.30	1.30	357	92	64	9		55
C-15	0045	1111	555.52	.085	1.05	1.05	355	92	66	8		55
C-16	0048	1114	557.15	.085	1.05	1.05	355	92	67	8		55
C-17	0051	1117	558.78	.085	1.05	1.05	355	92	68	8		55
C-18	0054	1120	560.41	.085	1.05	1.05	355	90	68	8		55
C-19	0057	1123	562.03	.085	1.05	1.05	355	90	70	8		52
C-20	0060	1126	563.64	.085	1.05	1.05	355	90	70	8		50
C-21	0103	1129	565.26	.085	1.05	1.05	355	92	71	8		50
C-22	0106	1132	566.88	.085	1.05	1.05	350	92	72	8		50
C-23	0109	1135	568.51	.09	1.10	1.10	350	92	72	8		52
C-24	0112	1138	570.15	.085	1.05	1.05	350	92	72	8		52

COMMENTS:

EPA (Dun) 235

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0000	1148	570.15									
D-2	0003	1151	571.85	.085	1.05	1.05	350	78	70	7	250	55
D-2	0006	1154	573.56	.08	1.0	1.0	350	82	72	7	250	55
D-3	0009	1157	575.07	.085	1.05	1.05	350	84	72	8	250	55
D-4	0012	1200	576.70	.08	1.0	1.0	350	88	72	7	250	52
D-5	0015	1203	578.31	.08	1.0	1.0	355	90	72	7	250	52
D-6	0018	1206	579.93	.085	1.05	1.05	355	92	73	8	250	53
D-7	0021	1209	581.56	.085	1.05	1.05	355	93	74	8	250	52
D-8	0024	1212	583.20	.085	1.05	1.05	355	92	74	8	250	52
D-9	0027	1215	584.83	.085	1.05	1.05	355	91	74	8	250	52
D-10	0030	1218	586.46	.08	1.0	1.0	355	88	73	7	250	52
D-11	0033	1221	588.24	.08	1.0	1.0	355	86	72	7	250	52
D-12	0036	1224	589.71	.08	1.0	1.0	355	84	70	8	250	52
D-13	0039	1227	591.42	.01	.12	.12	365	84	70	8	250	54
D-14	0042	1230	592.10	.01	.12	.13	365	78	68	8	250	52
D-15	0045	1233	592.52	.12	1.5	.12	365	78	68	8	250	54
D-16	0048	1236	593.85	.12	1.5	1.5	365	78	68	8	250	52
D-17	0051	1239	595.75	.12	1.5	1.5	365	78	68	8	250	54
D-18	0054	1242	597.13	.12	1.5	1.5	365	78	70	9	250	54
D-19	0057	1245	598.90	.12	1.5	1.5	365	90	72	9	250	55
D-20	0100	1248	600.64	.10	1.2	1.2	370	92	72	10	250	55
D-21	0103	1251	602.45	.11	1.3	1.3	370	94	72	10	250	55
D-22	0106	1254	604.37	.11	1.3	1.3	370	95	73	10	250	55
D-23	0109	1257	606.16	.10	1.2	1.2	370	96	74	10	250	55
D-24	0112	1300	607.88	.08	1.0	1.0	370	96	74	8	250	55
	112		78.40	0.073		.11	358	81.3	65.2			
								75				
			max									
			error	3.8%								

EPA (Dun) 236
4 72

WIND INTERFERED WITH FLOW

DRY MOLECULAR WEIGHT DETERMINATION

PLANT Bethlehem Mines Corp.
DATE 1/23/74
SAMPLING TIME (24-hr CLOCK) 1135-1235
SAMPLING LOCATION STACK B
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG.
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 70°
OPERATOR ~~SEITZ~~ HARTMAN

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	18.8		18.6		18.8	18.73	18.73	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	26.8	8.0	26.7	8.1	26.9	8.1	8.03	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							73.24	28/100	
								TOTAL	

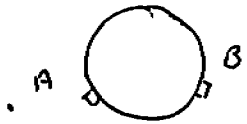
EPA (Dur) 230
4/72

#220

FIELD DATA

PLANT Bethlehem Lime
DATE 1/24/94
SAMPLING LOCATION Stack
SAMPLE TYPE Particulate
RUN NUMBER PLM-3
OPERATOR Hardman
AMBIENT TEMPERATURE 48°F
BAROMETRIC PRESSURE 30.22
STATIC PRESSURE, (P_s) 30.22
FILTER NUMBER (s)

PROBE LENGTH AND TYPE 10' SS
NOZZLE I.D. .500
ASSUMED MOISTURE, % 12%
SAMPLE BOX NUMBER 4
METER BOX NUMBER 2
METER $\Delta H_@$ 1.95
C FACTOR .94
PROBE HEATER SETTING 70%
HEATER BOX SETTING 350
REFERENCE Δp .049



OUT TO IN

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\,in}$), °F	DRY GAS METER TEMPERATURE OUTLET ($T_{m\,out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	00	0906	000.321									
A-2	03	0909	001.350	.01	0.41	0.41	350	48	48	3.5	250	55°
A-2	06	9:12	002.720	.02	0.76	0.76	350	49	48	4.5	250	55°
A-3	09	9:15	004.070	.02	0.76	0.76	350	51	48	4.5	250	55°
A-4	12	9:18	005.420	.02	0.76	0.76	350	54	48	4.5	250	55°
A-5	15	9:21	006.800	.02	0.76	0.76	350	58	48	4.5	250	55°
A-6	18	9:24	007.810	.01	0.41	0.41	350	59	49	4.0	250	55°
A-7	21	9:27	008.770	.01	0.41	0.41	365	60	49	4.0	250	55°
A-8	24	9:30	010.080	.02	0.76	0.76	370	62	50	4.5	250	55°
A-9	27	9:33	011.400	.02	0.76	0.76	370	63	51	4.5	250	55°
A-10	30	9:36	013.220	.04	1.50	1.50	360	65	52	7.5	250	55°
A-11	33	9:39	015.040	.04	1.50	1.50	380	68	53	7.5	250	55°
A-12	36	9:42	017.175	.06	2.25	2.25	380	70	54	10.0	250	55°
A-13	39	9:45	019.320	.08	3.05	3.05	385	74	54	18.0	250	55°
A-14	42	9:48	022.220	.07	2.65	2.65	380	77	56	16.0	250	55°
A-15	45	9:51	024.730	.07	2.65	2.65	380	79	57	15.0	250	55°
A-16	48	9:54	027.200	.07	2.65	2.65	380	80	58	15.0	250	55°
A-17	51	9:57	029.700	.07	2.65	2.65	380	80	59	15.0	250	55°
A-18	54	10:00	031.580	.04	1.50	1.50	375	79	59	8.5	250	55°
A-19	57	10:03	034.010	.07	2.65	2.65	375	80	60	15.0	250	55°
A-20	60	10:06	035.500	.02	0.76	0.76	375	81	61	5.0	250	55°
A-21	63	10:09	037.810	.07	2.65	2.65	375	82	62	15.0	250	55°
A-22	66	10:12	040.300	.07	2.65	2.65	375	84	62	15.0	250	55°
A-23	69	10:15	042.720	.07	2.65	2.65	375	85	62	15.0	250	55°
COMMENTS: 24	72	10:18	045.111	.07	2.65	2.65	375	85	63	15.0	250	55°

2.674

EPA (Dun) 235

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	00 / 10:30	045.111									
B-2	03 / 10:33	047.000	.04	1.50	1.50	360	66	62	8.0	250	55°
B-2	06 / 10:36	048.870	.04	1.50	1.50	360	68	62	8.0	250	55°
B-3	09 / 10:39	050.720	.04	1.50	1.50	360	72	62	8.0	250	55°
B-4	12 / 10:42	052.690	.04	1.50	1.50	360	75	62	8.0	250	55°
B-5	15 / 10:45	054.450	.04	1.50	1.50	360	76	63	8.0	250	55°
B-6	18 / 10:48	056.280	.04	1.50	1.50	360	78	63	8.0	250	55°
B-7	21 / 10:51	058.130	.04	1.50	1.50	375	79	64	8.0	250	55°
B-8	24 / 10:54	060.150	.05	1.90	1.90	375	79	64	9.0	250	55°
B-9	27 / 10:57	062.180	.05	1.90	1.90	375	80	65	9.0	250	55°
B-10	30 / 11:00	064.080	.04	1.50	1.50	375	82	65	8.0	250	55°
B-11	33 / 11:03	066.470	.07	2.65	2.65	380	83	65	14.5	250	55°
B-12	36 / 11:06	068.870	.07	2.65	2.65	380	84	65	14.5	250	55°
B-13	39 / 11:09	071.300	.07	2.65	2.65	380	85	65	14.5	250	55°
B-14	42 / 11:12	073.600	.06	2.25	2.25	380	86	66	12.0	250	55°
B-15	45 / 11:15	075.740	.06	2.25	2.25	380	86	66	12.0	250	55°
B-16	48 / 11:18	077.210	.04	1.50	1.50	~~380~~ 385	86	66	8.0	250	55°
B-17	51 / 11:21	079.520	.04	1.50	1.50	385	86	66	8.0	250	55°
B-18	54 / 11:24	081.430	.04	1.50	1.50	385	82	66	8.0	250	55°
B-19	57 / 11:27	083.310	.04	1.50	1.50	385	80	66	8.0	250	55°
B-20	60 / 11:30	085.110	.04	1.50	1.50	385	79	65	8.0	250	55°
B-21	63 / 11:33	086.250	.01	.40	.40	385	75	65	3.0	250	55°
B-22	66 / 11:36	088.000	.04	1.50	1.50	380	73	65	8.0	250	55°
B-23	69 / 11:39	089.790	.04	1.50	1.50	380	73	65	8.0	250	55°
B-24	72 / 11:42	091.606	.04	1.50	1.50	350	73	65	8.0	250	55°
	144 min	71.285	0.045		1.68	372	[illegible]	[illegible]			
							67				
		Max	8.4%								

6.1182

EPA (Dur) 236
4 72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT BETHLEHEM MINES
DATE 1/24/74
SAMPLING TIME (24-hr CLOCK) 0915-1015
SAMPLING LOCATION A STACK
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) Int BAG
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 50
OPERATOR Eggleston

COMMENTS:

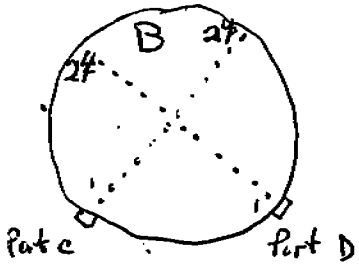
RUN / GAS	1		2		3		AVERAGE NET VOLUME	MULTIPLIER	MOLECULAR WEIGHT OF STACK GAS (DRY BASIS) M_d, lb/lb-mole
	ACTUAL READING	NET	ACTUAL READING	NET	ACTUAL READING	NET			
CO_2	19.1		19.0		19.0		19.03	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	27.1	8.0	27.2	8.2	27.2	8.2	8.13	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							72.84	28/100	
								TOTAL	

EPA (Dur) 230
4/72

FIELD DATA

PLANT BETHLEHEM MINES CORP
DATE 1/24/14
SAMPLING LOCATION STACK B
SAMPLE TYPE PARTICULATE
RUN NUMBER BLM-3
OPERATOR GARNHED
AMBIENT TEMPERATURE 46
BAROMETRIC PRESSURE 30.22
STATIC PRESSURE, (P_s) 30.22
FILTER NUMBER (s)

PROBE LENGTH AND TYPE 10' SS
NOZZLE I.D. .375
ASSUMED MOISTURE, % 12%
SAMPLE BOX NUMBER 3
METER BOX NUMBER 1
METER $\Delta H_@$ 1.54
C FACTOR .55
PROBE HEATER SETTING 70%
HEATER BOX SETTING 350
REFERENCE Δp .151



SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 3 MINUTES

TRAVERSE POINT NUMBER	SAMPLING TIME, min	CLOCK TIME (24 hr CLOCK)	GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in. H_2O DESIRED	ACTUAL	STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F	PUMP VACUUM, in. Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
	0000	0908	605.34									
D-2	0003	0911	609.00	.01	.13	.13	350	46	46	2	250	45
D-2	0006	0914	609.62	.01	.13	.13	350	46	45	2	250	45
D-3	0009	0917	610.20	.01	.13	.13	350	48	45	2	250	45
D-4	0012	0920	610.78	.01	.13	.13	350	50	46	1	250	50
D-5	0015	0923	611.06	.01	.13	.13	365	50	46	1	250	50
D-6	0018	0926	611.63	.01	.13	.13	365	52	46	1	250	52
D-7	0021	0929	612.23	.01	.13	.13	375	54	48	1	250	55
D-8	0024	0932	612.78	.01	.13	.13	375	52	48	1	250	55
D9	0027	0935	613.34	.01	.13	.13	375	57	50	1	250	55
D-10	0030	0938	613.91	.01	.13	.13	375	58	50	1	250	55
D-11	0033	0941	614.48	.01	.13	.13	350	58	50	1	250	55
D-12	0036	0944	615.03	.01	.13	.13	355	58	51	1	250	55
D-13	0039	0947	615.53	.01	.13	.13	355	58	51	1	252	55
D-14	0042	0950	617.44	.10	1.20	1.20	390	63	51	9	250	55
D-15	0045	0953	619.04	.095	1.15	1.15	390	68	52	9	250	55
D-16	0048	0956	620.64	.10	1.20	1.20	395	71	53	9	250	55
D-17	0051	0959	622.23	.10	1.20	1.20	395	73	54	9	250	55
D-18	0054	1002		.095	1.15	1.15	395	76	54	9	250	55
D-19	0057	1005	625.43	.095	1.15	1.15	390	76	54	9	250	55
D-20	0100	1008	626.92	.07	.87	.87	390	79	56	7	250	55
D-21	0103	1011	628.32	.06	.74	.74	390	78	57	6	250	55
D-22	0106	1014	629.69	.06	.74	.74	390	77	57	6	250	55
D-23	0109	1017	631.05	.06	.74	.74	390	76	58	6	250	55
D-24	0112	1020	632.41	.06	.74	.74	355	76	58	6	250	55

COMMENTS:

EPA (Dur) 235

#221

TRAVERSE POINT NUMBER	SAMPLING TIME, min / CLOCK TIME (24-hr CLOCK)		GAS METER READING (V_m), ft^3	VELOCITY HEAD (Δp_s), in. H_2O	ORIFICE PRESSURE DIFFERENTIAL (ΔH), in H_2O		STACK TEMPERATURE (T_s), °F	DRY GAS METER TEMPERATURE		PUMP VACUUM, in Hg	SAMPLE BOX TEMPERATURE, °F	IMPINGER TEMPERATURE, °F
					DESIRED	ACTUAL		INLET ($T_{m\ in}$), °F	OUTLET ($T_{m\ out}$), °F			
	0000	1032	632.41									
C-3	0003	1035	633.94	.08	1.0	1.0	370	60	55	8	250	55
C-3	0006	1038	635.50	.085	1.05	1.05	370	65	57	8	250	55
C-3	0009	1041	637.09	.095	1.15	1.15	370	69	58	9	250	55
C-4	0012	1044	638.69	.10	1.2	1.2	370	72	58	9	250	55
C-5	0015	1047	640.30	.095	1.15	1.15	370	74	58	9	250	55
C-6	0018	1050	641.98	.11	1.35	1.35	365	76	59	11	250	55
C-7	0021	1053	643.71	.11	1.35	1.35	365	78	59	11	250	55
C-8	0024	1056	645.38	.095	1.15	1.15	370	80	60	10	250	55
C-9	0027	1059	647.01	.09	1.1	1.1	375	80	60	10	250	55
C-10	0030	1102	648.62	.09	1.1	1.1	380	80	60	10	250	55
C-11	0033	1105	650.26	.10	1.2	1.2	385	80	60	10	250	55
C-12	0036	1108	651.93	.105	1.3	1.3	385	78	60	10	250	55
C-13	0039	1111	653.48	.07	.87	.87	385	78	60	8	250	55
C-14	0042	1114	654.80	.05	.62	.62	385	77	60	5	250	50
C-15	0045	1117	656.06	.05	.62	.62	380	76	60	5	250	50
C-16	0048	1120	656.93	.02	.25	.25	380	72	59	2	250	50
C-17	0051	1123	658.03	.04	.50	.50	380	68	58	4	250	50
C-18	0054	1126	658.85	.02	.25	.25	380	67	58	2	250	50
C-19	0057	1129	659.65	.02	.25	.25	380	65	57	2	250	50
C-20	0100	1132	660.44	.02	.25	.25	380	64	56	2	250	50
C-21	0103	1135	661.41	.03	.38	.38	380	64	56	3	250	50
C-22	0106	1138	662.39	.03	.38	.38	380	62	55	3	250	50
C-23	0109	1141	663.51	.04	.50	.50	385	61	54	4	250	50
C-24	0112	1144	664.650	.04	.50	.50	385	60	53	4	250	50
	[illegible]		56.31	0.054		0.67	378					
			may use	11.5%								

EPA (Dur) 236
4 72

DRY MOLECULAR WEIGHT DETERMINATION

PLANT BETHLEHEM MINES
DATE 1/24/74
SAMPLING TIME (24-hr CLOCK) 1020-1125
SAMPLING LOCATION B STACK
SAMPLE TYPE (BAG, INTEGRATED, CONTINUOUS) BAG - INT.
ANALYTICAL METHOD ORSAT
AMBIENT TEMPERATURE 50
OPERATOR Eggleston

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	18.8		18.8		18.8		18.80	44/100	
O_2 (NET IS ACTUAL O_2 READING MINUS ACTUAL CO_2 READING)	27.0	8.2	27.1	8.1	27.0	8.2	8.17	32/100	
CO (NET IS ACTUAL CO READING MINUS ACTUAL O_2 READING)								28/100	
N_2 (NET IS 100 MINUS ACTUAL CO READING)							73.03	28/100	
								TOTAL	

EPA (Dur) 230
4/72

GAS SAMPLING FIELD DATA

Material Sampled for SO_2

Date 1/22/74

Plant BETHLEHEM Location PORT A

Bar. Pressure 30.02 "Hg Comments:

Ambient Temp. 50 °F

Run No. ALS-1 A & B

Power Stat Setting

Filter Used: Yes ✓ No

Operator

	CLOCK TIME	METER (Ft.^{3})	FLOW METER SETTING (CFH)	METER TEMPERATURE IN
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
Purge		[illegible]		
	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]
Purge		[illegible]		

Comments:

Impinger Bucket No. [illegible]

Meter Box No. [illegible]

GAS SAMPLING FIELD DATA

Material Sampled for SO_2

Date

Plant Location Port B

Bar. Pressure 29.94 "Hg Comments:

Ambient Temp. °F

Run No. ALS-2 A&B

Power Stat Setting

Filter Used: Yes No

Operator

	CLOCK TIME	METER (Ft.^{3})	FLOW METER SETTING (CFH)	METER TEMPERATURE IN
ALS-2 a	1225	29.490	1 LPM	84
	1245	29.990	1 LPM	83
Purge				
	1305	30.370	1 LPM	84
ALS-2 b	1325	30.940	1 LPM	82
Purge				

Comments:

Impinger Bucket No. N. A

Meter Box No.

GAS SAMPLING FIELD DATA

Material Sampled for SO_2

Date 1-24-74

Plant Bethlehem Mines Location Port. A

Bar. Pressure 30.22 "Hg Comments:

Ambient Temp. 52 °F

Run No. ALS 3 A & B

Power Stat Setting 60%

Filter Used: Yes ✓ No ____

Operator Ms Reynolds

	CLOCK TIME	METER (Ft.^{3})	FLOW METER SETTING (CFH)	METER TEMPERATURE IN °F
	1102	36.680	1 LPM	65
ALS-3a	1122	37.255	1 LPM	66
Purge				
	1142 ~~1122~~	37.570	1 LPM	66
ALS-3b	1202	38.100	1 LPM	66
Purge				

Comments:

Impinger Bucket No. N. A.

Meter Box No. G-3

GAS SAMPLING FIELD DATA

Material Sampled for SO_2

Date

Plant Location

Bar. Pressure "Hg Comments:

Ambient Temp. °F

Run No. BLS-2 A&B

Power Stat Setting

Filter Used: Yes No

Operator

	CLOCK TIME	METER (Ft.^{3})	FLOW METER SETTING (CFH)	METER TEMPERATURE IN
BLS-2a				
BLS-2b				

Comments:

Impinger Bucket No.

Meter Box No.

TRW

NO_x FIELD SAMPLING DATA

DATE 1/22/79

SAMPLE NO.	SAMPLE TIME	FLASK #/VOLUME	TEMPERATURE °F		FLASK PRESSURE "Hg		BAROMETRIC PRESSURE "Hg		RECOVERY DATE/TIME
			INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	
BLN-1A	1610	23 2116	64	66	28.5	-1.4	30.02	29.94	1/23 0830
BLN-1B	1455	24 2169	62	66	28.6	-2.3	30.02	29.94	↓
BLN-1C	1715	25 2102	62	66	28.7	-0.1	30.02	29.94	↓
BLN-1D	1745	26 2110	60	66	28.5	-0.1	30.02	29.94	↓

NOTES: Vsc

1A 1901.0

1B 1839.0

1C 1993.7

1D 1986.8

TRW

NO_x FIELD SAMPLING DATA

BETHLEHEM MINE

DATE 1-23-74

SAMPLE NO.	SAMPLE TIME	FLASK #/VOLUME	TEMPERATURE °F		FLASK PRESSURE "Hg		BAROMETRIC PRESSURE "Hg		RECOVERY DATE/TIME
			INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	
BLN-2A	1220	#22 2116	58	70	27.4	-0.2	29.94	30.22	1/24 0900
B	1234	#24 2109	58	70	27.9	-2.5	29.94	30.22	↓ ↓
C	1300	#25 2102	58	70	28.0	-2.3	29.94	30.22	↓ ↓
D	1330	#26 2110	58	70	28.0	-0.9	29.94	30.22	↓ ↓

NOTES:

	V_{sc}
2A	1916.0
2B	1785.0
2C	1800.0
2D	1904.5

TRW

NO_x FIELD SAMPLING DATA

Bethlehem Mines

DATE 1-24-74

SAMPLE NO.	SAMPLE TIME	FLASK #/VOLUME	TEMPERATURE °F		FLASK PRESSURE "Hg		BAROMETRIC PRESSURE "Hg		RECOVERY DATE/TIME
			INITIAL	FINAL	INITIAL	FINAL	INITIAL	FINAL	
BLN-3A	1055	#23 2116	50	73°	25.1	-1.6	30.22	30.14	1/25/74
B	1127	#24 2169	45	73°	25.7	-1.2	30.22	30.14	1600
C	1145	#25 2162	45	73°	25.6	-2.0	30.22	30.14	↓
D	1200	#26 2160	45	73°	24.5	+1.2	30.22	30.14	↓

NOTES:

	V_{sc}
3A	1829.0
3B	1893.5
3C	1824.7
3D	2046.2

SUMMARY
RECORD OF VISIBLE EMISSIONS

Type of Plant Lime Kiln

Date 1-22-74

Company Name Bethlehem Mines Co

Hours of Observation

Plant Address Annville, Pa.

Observer Doug Bell

Type of Discharge (STACK) OTHER

Discharge Location Baghouse Outlet

Height of Point of Discharge 100'

Observer's Location:

Distance to Discharge Point 75'

Height of Observation Point 70'

Direction from Discharge Point south

Background Description Hill - brown

Weather: Clear (Overcast) (Partly Cloudy) Other Color

Wind Direction ~~[illegible]~~ variable Wind Velocity 5-10 mi/hr

Plume Description:

Detached: Yes (No)

Color: Black White Other none

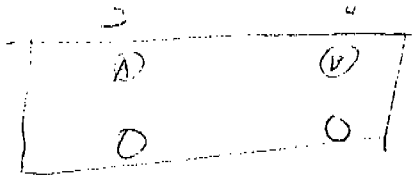
Plume Dispersion Behavior: Looping Coning Fanning

Lofting Fumigating Other —

Estimated Distance Plume Visible —

Summary of Observations:

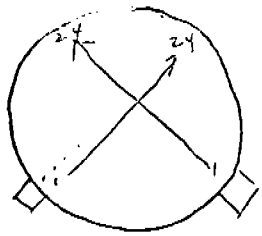
Opacity	Aggregate Time @ Opacity	Opacity	Aggregate Time @ Opacity
0	60 min. sec.	55	
5		60	
10		65	
15		70	
20		75	
25		80	
30		85	
35		90	
40		95	
45		100	
50			



A & B IDENTICAL

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT Bethlehem Mines Corp.
DATE 1/22/74
SAMPLING LOCATION Stack A + B
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) 80"
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) 2"
STACK I.D., (DISTANCE A - DISTANCE B) 78"
NEAREST UPSTREAM DISTURBANCE ~1 DIA
NEAREST DOWNSTREAM DISTURBANCE ~1 DIA
CALCULATOR Seitz



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	78	.858		1
2	3.2		2.49		2.5
3	5.5		4.29		4.25
4	7.9		6.16		6 1/8
5	10.5		8.19		8 1/4
6	13.2		10.29		10 1/4
7	16.1		12.56		12 1/2
8	19.4		15.13		15 1/8
9	23.0		17.94		18
10	27.2		21.22		21 1/4
11	32.3		25.19		25 1/4
12	39.8		31.05		31
13	60.2		~~47.56~~ 46.68		~~60~~ 46.5
14	67.7		52.81		52 3/4
15	72.8		56.78		56 3/4
16	77.0		60.06		60
17	80.6		62.88		62 7/8
18	83.9		65.44		65 1/2
19	86.8		67.70		67 3/4
20	89.5		69.81		69 3/4
21	92.1		71.84		71 3/4
22	94.5		73.71		73 3/4
23	96.8		75.50		75 1/2
24	98.9		77.14		77

E (Dur) 232
4/72

PRELIMINARY VELOCITY TRAVERSE

PLANT LIMESTONE

DATE [illegible]

LOCATION [illegible]

STACK I.D. 78"

BAROMETRIC PRESSURE, in. Hg 30.01

STACK GAUGE PRESSURE, in. H_2O [illegible] +.0

OPERATORS [illegible]MAN / SEITZ

SCHEMATIC OF TRAVERSE POINT LAYOUT

A STACK

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1	.02	370
2	.02	
3	.03	
4	.04	
5	.05	
6	.05	
7	.05	
8	.05	
AVERAGE		

B STACK

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
1	0.10	370
2	0.11	
3	0.11	
4	0.08	
5	0.04	
6	0.03	
AVERAGE		

EPA (Dur) 233
4/72

NOMOGRAPH DATA

PLANT BETHLEHEM

DATE 1/22/74

SAMPLING LOCATION PORT A

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.95
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	80
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	8
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.02
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	30.02
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	370
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.04
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.05
C FACTOR		1.05
CALCULATED NOZZLE DIAMETER, in.		5
ACTUAL NOZZLE DIAMETER, in.		.5
REFERENCE Δp, in. H_2O		.044

EPA (Dur) 234
4/72

NOMOGRAPH DATA

PLANT BETHLEHEM

DATE 1/22/74

SAMPLING LOCATION PORT B

.053

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.84
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F), °F	$T_{m_{avg.}}$	80
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	8
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.02
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	30.02
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	370
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.09
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.10 ~~.05~~
C FACTOR		~~.86~~ .95
CALCULATED NOZZLE DIAMETER, in.		.50
ACTUAL NOZZLE DIAMETER, in.		.50
REFERENCE Δp, in. H_2O		.053

EPA (Dur) 234
4/72

APPENDIX E

SAMPLING PROCEDURE

360 Sierra Madre Villa, Pasadena, California 91107 • Phone (213) 795-0611

Electronic Materials Corporation
An affiliate of Material Sciences Corporation

PROCEDURE FOR THE ANALYSIS OF POWDERS

The powders received from TRW were wrapped in gold foil envelops and mounted in the mass spectrometer. Before analysis, the gold envelop was sparked against a high purity gold counterelectrode to expose the powder sample to the counterelectrode. A series of graduated exposures were then made.

The following pages contain a brief description of the general procedure in the spark source mass spectrometric analysis of solids.

ANALYTICAL TECHNIQUES FOR THE DETERMINATION OF TRACE IMPURITIES IN SOLIDS BY SPARK SOURCE MASS SPECTROMETRY

The techniques described are examples of general procedures. Depending on the desired analysis, many materials require new or special methods of handling.

1. INTRODUCTION

The analytical techniques described herein cover the preparation of samples for analysis and include sample cutting and etching, and the special handling of small or fragile samples or powders. Also described are the methods used for sparking non-conductive as well as conductive materials and the techniques for the qualitative and quantitative evaluation of mass spectra obtained by both electronic and photographic techniques.

The mass spectrometers used are two CEC 21-110X instruments which have been modified with large ion pumps on both the source and collector sections. All exposures are obtained using automatic equipment to ensure reproducible exposure times. Automatic sample feeds are used to obtain better reproducibility during ionization.

2. SAMPLE HANDLING AND SPARKING TECHNIQUES

Sample Preparation - Routine handling of samples is conducted at a laminar flow bench. When necessary, solid samples are formed into bar electrodes by cutting or breaking. They are then chemically cleaned in appropriate etchants. Powders are hydrostatically pressed into electrodes. Depending on analysis requirements, they may be mixed with a high purity conductive powder to ensure a more uniform spark.

Unusual samples require special handling. Samples of such size or structure that they cannot be held directly in the sample holder are first wrapped

in high purity gold foil. Special holders are required for thin platelets. Hygroscopic samples are handled in dry nitrogen filled boxes and bags when requested. Unique handling techniques have also been developed to accommodate the unusual specimen.

Sample Holders - In the study of the properties of many materials, the comparative analytical results between samples are often as important as the actual impurity concentrations of each sample. In order to make a direct comparison between one sample and another, a multiple sample holder ring capable of holding up to twelve samples is used. These sample holders permit a number of samples to be analyzed with the same pumpdown of the mass spectrometer, essential for electrical detection and useful for the analysis of up to six samples (depending on sensitivity) on a single photographic plate.

Contaminants - The reduction and control of contaminants is of prime importance in any analytical method. In mass spectrometry, interpretation of the photographic plate is hampered by lines due to ionized atoms of residual gases, previously analyzed materials ("memory"), and source parts. These lines often interfere with the determination of actual impurity concentrations. In addition, the photographic plate often shows heavy backgrounds from gas scattering if the pressure in the collector is excessive.

The following procedures are used to reduce contaminants in the source and collector sections of the instrument and for the removal of surface impurities from the sample just prior to sparking.

Before a given material is analyzed, a complete set of clean source parts, used only for the analysis of that matrix, is installed. These source parts include the first and second apertures and a set of sample holders and covers. These parts are made of high purity materials, usually tantalum and gold, rarely nickel, vanadium, or titanium. The most commonly used materials are gold sample holder covers and tantalum slits. The procedure of having

a complete set of source parts for each matrix can reduce the "memory" from previously analyzed materials to less than 20 parts per billion.

After placing the samples in the instrument, the source section is pumped to high vacuum ($< 2 \times 10^{-8}$ torr) using a triode ion pump. The collector section can be isolated and is pumped down with another ion pump. In some cases, liquid nitrogen cryogenic pumps are also used to further reduce pressures in the source and collector sections.

The systematic reduction of contaminants in the instrument and on the sample surface results in an increase in the sensitivity of the analyses. Pressures of 1×10^{-8} torr (after cryogenic pumping) obtained in both the collector and source sections of the instrument permit lengthy photographic exposures to be made with a minimum of background from ions scattered by residual gases in the instrument.

Sparking Techniques - When possible, electrodes fashioned from the sample material are sparked against each other. Samples of high resistivity are ionized by sparking them against ultrahigh purity gold electrodes. Samples which require analyses of specific locations (such as thin films, surface studies, junctions, etc.) are sparked using sharply pointed ultrahigh purity counterelectrodes which are directed to the area of analysis. Sparking is visually monitored with a stereo microscope. When the sample and spark is consistent, the spark can be maintained at a constant voltage utilizing automatic equipment. Before a set of exposures is made the sample is given a pre-spark, that is, the surface of the sample is sparked to further reduce the possibility of surface contamination.

3. PHOTOGRAPHIC DETECTION

Qualitative Analysis - The following techniques are used for the interpretation of the lines which appear on the photographic plate.

To facilitate the identification of the lines, a mass scale is used which is

dimensionally proportional to the square root of the mass of the ions. This scale permits the rapid identification of mass lines to a fraction (1 part in 3,000) of a mass number. Three of these mass scales are in use. Each scale covers a group of mass numbers (0.98 to 39, 2.6 to 105, and 6.2 to 250) which corresponds to selected magnetic field strengths of the mass spectrometer.

Although the mass scale provides the mass number at which a line occurs, the differentiation from lines which can occur at the same mass number is necessary. Tables are prepared for this purpose. For the specific material which is being analyzed, a table is developed which provides all the possible combinations of the major constituents of the sample. These tables, along with the mass scale, make possible the rapid identification of all mass lines on the photographic plate.

Quantitative Analysis - With the completion of the identification of the lines on the photographic plate, the following techniques are used for the conversion of the line densities into impurity concentrations.

A microdensitometer is used to scan the line to be analyzed. The density of the line is dependent on the numbers of ions which have struck the photographic plate at that particular mass number. The density and width of a line, however, are not uniform. Corrections must be made for the variation in density and the width of the lines. These corrections are made by performing a numerical integration of the line by relating the density of each small unit area of the line to the number of ions required for this exposure, and then summing the number of ions representative of all the areas. A density to number of ions curve is developed for the particular type of photographic plate which is being used. Corrections for the background on which the lines appear are also necessary because part of the line density is due to background. For a particular photographic emulsion, variations in the background density are generally due to ion or gas scattering in the instrument. The background corrections are made by subtracting the background density from that of the line density.

In order to perform the numerical integration rapidly, a computer system is used which performs this integration and applies the corrections.

The advantages of the computer are the rapid and accurate conversion of line densities into impurity concentrations. Factors such as corrections for background density, plate sensitivity and response, isotopic abundance, selective ionization factors, and variation in line density with mass are quickly and conveniently adapted to the program of the computer.

Other advantages of the computer are: (1) Rapid determination of abundances of several isotopes of the same impurity which offers a cross-check of the H&D curve of each plate. (2) Repeated scanning of a line in several regions and averaging to reduce effects of local variations in the emulsion. (3) Impurity concentrations of previously run plates can be readily rechecked by resetting the computer for that particular plate sensitivity and cross-checking any lines which had been previously analyzed. These computations are also independent of the operator performing the analysis.

4. ELECTRONIC DETECTION

In cases where analysis is required for only one or two impurities in a number of similar samples, electronic detection is preferred to photographic plate detection.

The ion beam of the element desired is selectively focused on the entrance slit of a secondary emission multiplier system by use of the appropriate magnet field. The amplified ion current is measured with a beam monitor similar to the one checking the total ion beam (before magnetic focusing). A cut-off switch has been coupled with the total beam monitor in such a way that the RF spark is turned off when the integrated charge reaches a pre-set value. The impurity ion beam charge is then noted on a digital voltmeter.

Quantitative results are obtained by comparison to a standard sample of the same matrix. Where no suitable standard is available, a photographic plate

analysis may be made of one of a series of samples to provide a standard value for comparison.

APPENDIX F

LABORATORY REPORT

+ 204

ANALYTICAL DATA

PLANT Bethlehem Mines Corp.

DATE 1/21/74

SAMPLING LOCATION Exhaust Stack A

SAMPLE TYPE Particulate

RUN NUMBER ALM-1

SAMPLE BOX NUMBER 4

CLEAN-UP MAN Taylor + Scott

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER _____ 989 mg

FILTER NUMBER 350 _____

350 .6758g

CONTAINER _____ 45.1 mg

FRONT HALF SUBTOTAL 144.0 mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ 13.1 mg

ETHER-CHLOROFORM EXTRACTION 8.4 mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ 9.4 mg

BACK HALF SUBTOTAL 27.9 mg

TOTAL WEIGHT 1719 mg

2+3 - 140
1 - 505
T - 645

MOISTURE

IMPINGERS

FINAL VOLUME 645 ml

INITIAL VOLUME 300 ml

NET VOLUME 345 ml

SILICA GEL

FINAL WEIGHT	[illegible] g	_____ g	424.8 g
INITIAL WEIGHT	172.1 g	188.7 g	389.8 g
NET WEIGHT	[illegible] g	_____ g	35.0 g

TOTAL MOISTURE 383.0 g

EPA (Dur) 231
4/72

ANALYTICAL DATA

PLANT Bethlehem Mines Corp.

DATE 1/21/74

SAMPLING LOCATION Exhaust Stack B

SAMPLE TYPE Particulate

RUN NUMBER BLM-1

SAMPLE BOX NUMBER 3

CLEAN-UP MAN Taylor - Seitz

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER 174.5 mg

FILTER NUMBER — CONTAINER 85.3 mg

	85
356	.6998

FRONT HALF SUBTOTAL 259.8 mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER 19.2 mg; ETHER-CHLOROFORM EXTRACTION 3.9 mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER 6.5 mg

BACK HALF SUBTOTAL 28.7 mg

TOTAL WEIGHT 288.5 mg

MOISTURE

2+3 - 190
585
775

IMPINGERS

FINAL VOLUME	775 ml
INITIAL VOLUME	300 ml
NET VOLUME	475 ml

SILICA GEL

FINAL WEIGHT			434.5 g
INITIAL WEIGHT	144.3 g	195.6 g	339.9 g
NET WEIGHT			94.6 g

TOTAL MOISTURE 519.6 g

EPA (Dur) 231
4/72

ANALYTICAL DATA

PLANT Bethlehem Mines Corp

DATE 1/23/74

SAMPLING LOCATION Exhaust Stack A

SAMPLE TYPE Particulate

RUN NUMBER ALM-2

SAMPLE BOX NUMBER

CLEAN-UP MAN Hartman

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER ____ 6.42 mg

FILTER NUMBER 358 0.6838 — CONTAINER ____ 2.86 mg

FRONT HALF SUBTOTAL 9.28 mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ____ 6.5 mg

ETHER-CHLOROFORM EXTRACTION 1.9 mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER ____ 4.0 mg

BACK HALF SUBTOTAL 12.4 mg

TOTAL WEIGHT 105.2 mg

MOISTURE

2+23 127 ml.
1 = 412
539

IMPINGERS

FINAL VOLUME 539 ml

INITIAL VOLUME 300 ml

NET VOLUME 239 ml

SILICA GEL

FINAL WEIGHT	g	g	413.0 g
INITIAL WEIGHT	187.2 g	198.4 g	355.6 g
NET WEIGHT	g	g	27.4 g

TOTAL MOISTURE 266.4 g

EPA (Dur) 231
4/72

ANALYTICAL DATA

PLANT BETHLEHEM MINES CORP.

DATE 1/23/74

SAMPLING LOCATION EXHAUST STACK #3

SAMPLE TYPE PARTICULATE

RUN NUMBER BLM-2

SAMPLE BOX NUMBER

CLEAN-UP MAN HARTMAN

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER — CONTAINER _____ 108.1 mg

FILTER NUMBER 359 0.6732 — CONTAINER _____ 73.6 mg

FRONT HALF SUBTOTAL 181.7 mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ 87 mg

ETHER-CHLOROFORM EXTRACTION 42 mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER — CONTAINER _____ 109 mg

BACK HALF SUBTOTAL 238 mg

TOTAL WEIGHT 205. mg

MOISTURE

IMPINGERS

FINAL VOLUME 629 ml

INITIAL VOLUME 300 ml

NET VOLUME 329 ml

2 + 3 = 148

1 = 481

629

SILICA GEL

FINAL WEIGHT	g	g	409.0 g
INITIAL WEIGHT	175.1 g	199.3 g	374.4 g
NET WEIGHT	g	g	34.6 g

TOTAL MOISTURE 362.6 g

EPA (Dur) 231
4/72

ANALYTICAL DATA

PLANT BETHLEHEM MINES CORP

DATE 1/24/74

SAMPLING LOCATION EXHAUST STACK A

SAMPLE TYPE PARTICULATE

RUN NUMBER AUM - 3

SAMPLE BOX NUMBER

CLEAN-UP MAN HARTMAN

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER

CONTAINER 86.0 mg

CONTAINER 37.9 mg

FILTER NUMBER

119	0.6975 g

FRONT HALF SUBTOTAL 124.8 mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER

CONTAINER 7.8 mg

ETHER-CHLOROFORM EXTRACTION 2.0 mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER

CONTAINER 3.9 mg

BACK HALF SUBTOTAL 13.7 mg

TOTAL WEIGHT 152.2 mg

MOISTURE

IMPINGERS

FINAL VOLUME	604 ml
INITIAL VOLUME	300 ml
NET VOLUME	304 ml

SILICA GEL

FINAL WEIGHT	g	g	415.1 g
INITIAL WEIGHT	195.2 g	157.5 g	352.7 g
NET WEIGHT	g	g	32.4 g

TOTAL MOISTURE 336.4 g

EPA (Dur) 231
4/72

ANALYTICAL DATA

PLANT BETHLEHEM MINES CORP

DATE 1/24/79

SAMPLING LOCATION EXHAUST STACK B

SAMPLE TYPE PARTICULATE

RUN NUMBER B-M-3

SAMPLE BOX NUMBER

CLEAN-UP MAN HARTMAN

COMMENTS:

FRONT HALF

LABORATORY RESULTS

ACETONE WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER

CONTAINER 139.5 mg

FILTER NUMBER 118 0.6899 g

CONTAINER 39.8 mg

FRONT HALF SUBTOTAL 179.3 mg

BACK HALF

IMPINGER CONTENTS AND WATER WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER

CONTAINER 5.7 mg

ETHER-CHLOROFORM EXTRACTION 14 mg

ACETONE WASH OF IMPINGERS, CONNECTORS, AND BACK HALF OF FILTER HOLDER

CONTAINER 3.8 mg

BACK HALF SUBTOTAL 19.5 mg

TOTAL WEIGHT 198.8 mg

MOISTURE

IMPINGERS

FINAL VOLUME 520 ml

INITIAL VOLUME 300 ml

NET VOLUME 220 ml

SILICA GEL

FINAL WEIGHT	g	g	411.3 g
INITIAL WEIGHT	196.5 g	190.6 g	387.1 g
NET WEIGHT	g	g	24.2 g

TOTAL MOISTURE 244.2 g

EPA (Dur) 231

TRW

PROJECT Bethlehem Mines

A	B	C	D	E	F	G	H	J	K	
Sample #	Container #	Sample Volume	Aliquot	Gross -Tare / Net	Gross -Tare / Net		C/D x Net = Total Wt Gn	C/N x S = Blank	H-J = Final Wt	Final Wt
ALM-1	A-AA-1	2.00		[illegible]	[illegible]	[illegible]	0.1072	[illegible]		[illegible]
ALM-2	A-AA-2	2.50		[illegible] 29.7004	[illegible]		[illegible]	[illegible]		[illegible]
ALM-3	A-AA-3	1.00		[illegible] 29.7420	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
BLM-1	A-AA-4	3.20		[illegible] 27.6716	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
BLM-2	A-AA-5	3.00		[illegible] 27.1170	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
BLM-3	A-AA-6	2.25		[illegible] 31.1743	[illegible]	[illegible]	[illegible]	0.0077		[illegible]

L	M	N	P	Q	R	S
Blank	Container #	Volume	Gross -Tare / Net	Gross -Tare / Net		Blank Wt
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Date 1-2-[illegible]

Analyst [illegible]

Wt Units [illegible]

NOTE: [illegible]

TRANSPORTATION AND ENVIRONMENTAL OPERATIONS OF TRW INC.

PROJECT Bethlehem Mines Corp.

A	B	C	D	E	F	G	H	J	K	
Sample #	Container #	Sample Volume	Aliquot	Gross -Tare / Net	Gross -Tare / Net		$\frac{C}{D}$ x Net = Total Wt Gn	$\frac{C}{N}$ x S = Blank	H-J = Final Wt	Final Wt
[illegible]-1	1			[illegible]	[illegible]					0.0457
[illegible]-2	2			[illegible]	[illegible]					0.0256
[illegible]-3	3			[illegible]	[illegible]					0.0379
[illegible]-4	4			[illegible]	[illegible]					0.0552
[illegible]-2	5			[illegible]	[illegible]					0.0726
[illegible]-3	6			[illegible]	[illegible]					0.0395

L	M	N	P	O	R	S
Blank	Container #	Volume	Gross -Tare / Net	Gross -Tare / Net		Blank Wt

Date 1-29-79

Analyst [illegible]

Wt Units grams

NOTE: Filter wts.

TRAY

PROJECT Bethlehem Mines

A	B	C	D	E	F	G	H	J	K	
Sample #	Container #	Sample Volume	Aliquot	Gross -Tare / Net	Gross -Tare / Net		C/D x Net = Total Wt Gn	C/N x S = Blank	H-J = Final Wt	Final Wt
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]		[illegible]
[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]		[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]

L	M	N	P	Q	R	S
Blank	Container #	Volume	Gross -Tare / Net	Gross -Tare / Net		Blank Wt
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Date [illegible]

Analyst [illegible]

Wt Units [illegible]

NOTE: [illegible]

TRANSPORTATION AND ENVIRONMENTAL OPERATIONS OF TRW INC.

CUSTOMER: [illegible] Analysis: [illegible] Analyst: [illegible] MJO: _____

Collection Date (Exposure Period) Analysis Completed:

SAMPLE NO.	SAMPLE WEIGHT (VOLUME)	TIT. ALIQ.	READING	FACTOR						
[illegible] 1	100 [illegible]	[illegible]	0.63							
[illegible] 2	100 [illegible]	[illegible]	0.45							
[illegible] 3	100 [illegible]	[illegible]	0.73							
[illegible] 4	[illegible]	[illegible]	0.69	1						
[illegible] 5	100 [illegible]	[illegible]	0.61							
[illegible] 6	[illegible]	[illegible]	0.63							
[illegible] 7	[illegible]	[illegible]	0.58							
[illegible] 8	[illegible]	[illegible]	0.59	1						
[illegible] 9	[illegible]	[illegible]	[illegible]							
[illegible] 10	[illegible]	[illegible]	0.46							
[illegible] 11	[illegible]	[illegible]	[illegible]							
[illegible]	[illegible]	[illegible]	0.47							

represent the calculated concentration of the element in the residue of the sample. The values in Table II reported for the control are the actual concentrations found for these elements in the blank. A sample calculation for lithium concentration in sample ALM-1 is:

$$\frac{170 \times 0.2533-(76 \times 0.1507)}{0.2533-(0.1507)} = 309$$

Attention should be called to the fact that the results in Table II show only the elements at lower concentrations, other elements present at concentrations greater than 1% are also reported in Table III.

It is important to point out that the data reported in Table II and III are on a very rough scale. Since the weight variation in filter pad could offset the assumption made to formulate Table II. It is, therefore, suggested that the data reported in Tables II and IV are only on a semi-quantitative scale.

It should be mentioned that the filter pads used for the collection contain all of the elements of interest except for V, and in the case of Zn, Sr and Sb the blank values were actually higher than the sample.

Approved: [signature]
C. A. Flegal, Section Head
Analytical Chemistry

CL/ls
Attachments

TABLE I

Weight Parameters in Samples

Sample I.D.	Weight Prior To Digestion (g) (1)	Weight of Extracted Residue (g)
ALM-1	0.7088	0.2533
BLM-2	0.7419	0.2700
Control	0.6887	0.1507

(1) Includes the weight of filter pad

TABLE II

Concentration of Impurity Elements in the Samples ALM-1 and BLM-2*
(ppm or mg per g of Extracted Weight)

Element	ALM-1	BLM-2
Li	310	270
B	4,700	9,900
C	>10,000	>10,000
N	82	N.D.
F	240	450
P	210	1,800
V	3	<1*
Cr	8,900	4,700
Mn	18,000	410
Fe	>10,000	>10,000
Co	12,000	420
Ni	>10,000	>10,000
Cu	2,000	1,200
Zn	>10,000	<10*
Sr	17,000	<0.5*
Sb	540	33
Cs	46	21
Pb	1,600	220

* Concentration lower than the background of corresponding elements in filter pad (control blank)

N.D. - Not detected

TABLE III

Matrix Elements in Samples

Element	ALM-1	BLM-2
C	0-	Minor
O	Major	Major
Na	Minor	Major
Mg	Minor	0-
Al	Minor	Minor
Si	Minor	Minor
Cl	Minor	Minor
K	0-	Minor
Ca	Major	Major
Fe	Minor	0-
Ni	Minor	Minor
Zn	Minor	0-
Ba	Minor	Minor

Major: Concentration greater than 10% by weight

Minor: Concentration between 1-10% by weight

360 Sierra Madre Villa, Pasadena, California 91107 • Phone (213) 795-0811

Electronic Materials Company
An affiliate of Materials Research Corporation

IMPURITY CONCENTRATIONS IN TRW POWDERS
(IN PARTS PER MILLION ATOMIC)

Element[a]	Detection Limit[b]	ALM-1	BLM-2	DLM-0
Matrix Elements				
C		--	Minor	--
O		Major	Major	Major
Na		Minor	Major	Major
Mg		Minor	--	Minor
Al		Monor	Minor	Minor
Si		Minor	Minor	Minor
Cl		Minor	Minor	Minor
K		--	Minor	Minor
Ca		Major	Major	Major
Fe		Minor	--	--
Ni		Minor	Minor	--
Zn		Minor	--	--
Ba		Minor	Minor	Minor

Major: Concentration greater than 10% by weight.
Minor: Concentration between 1-10% by weight.

Impurity Elements (Less than 1% by weight)				
Li	0.01	170	160	76
B	0.1	6200	8400	7200
C	1	6700	(c)	1600
N	10	33	N.D.	N.D.
F	0.1	130	230	55
Mg	0.3	(c)	6400	(c)
P	0.1	89	800	8.8
K	0.1	7100	(c)	(c)
V	1	1	N.D.	N.D.
Cr	1	3600	2100	72
Mn	0.3	7300	270	160
Fe	1	(c)	8400	5500
Co	1	5100	270	150
Ni	10	(c)	(c)	4700
Cu	0.7	890	600	110

Element[a]	Detection Limit[b]	ALM-1	BLM-2	DLM-0
Zn	10	(c)	1100	3600
Sr	0.5	8900	1500	3100
Sb	1	270	64	89
Cs	0.3	19	9.7	0.81
Pb	5	690	120	42

(a) No analysis was made for hydrogen. Analyses for tantalum and gold are not given since tantalum slits are used in the mass spectrometer and the samples were wrapped in gold foil and sparked against high purity gold counterelectrodes. Background lines of matrix elements interfere with the analyses for sulfur. Other impurities not listed were not detected and have concentrations less than 1ppm atomic.

(b) Determined for 1×10^{-7} coulomb exposure.

(c) Matrix element

N.D. Not detected

E. M. Heil
June 6, 1974

APPENDIX G

TEST LOG

TEST LOG

Date	Time	Activity
1-21-74	0800 - 1130	Travel
	1300 - 1500	Set-Up Preparation Area (Heavy Rain)
	1500 - 1700	Set-Up Sampling Equipment, Site Preparation
1-22-74	0800 - 1000	Final Preparation and Set-Up
	1000 - 1300	Waiting for Additional Electrical Circuits to be Prepared/Lunch
	1301 - 1721	Tests ALM-1, BLM-1, ALS-1, BLS-1, ALN-1, BLN-1, Visible Emissions, Bag Sample
	1643 - 1830	Sample Recovery, Clean-Up
1-23-74	0800 - 1025	Move Equipment to Stack, Set-Up
	1025 - 1330	Tests ALM-2, BLM-2, ALS-2, BLS-2, ALN-2, BLN-2, Visible Emissions, Bag Samples
	1300 - 1730	Sample Recovery, Clean-Up
1-24-74	0800 - 0905	Move Equipment to Stack, Set-Up
	0906 - 1202	Tests ALM-3, BLM-3, ALS-3, BLS-3, ALN-3, BLN-3, Visible Emissions, Bag Sample
	1144 - 1445	Sample Recovery, Clean-Up
	1445 - 1630	Pack
	1630 -	Travel