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.

Background Report Reference

AP-42 Section Number: 11.17

Background Chapter: 4

Reference Number: 49

Title: Emission Test Report, Warner Company, Bellefonte, Penn., Test No. 1771

Department of Health

Commonwealth of Pennsylvania

November 1971

(10)

see NEDS data

scrubber

WARNER COMPANY
BELLEFONTE, PA.

PROCESS DESCRIPTION

Stack Test No. 1771 was performed in the stack effluent of the Warner Company's kiln No. 2. This kiln is a rotary type manufactured by the Vulcan Iron Works and installed in 1925. It is 9 feet in diameter, 175 feet long and has a rated thruput of 440 tons per day of stone and 70 tons per day of bituminous coal.

Limestone mined at adjacent company mines is fed into the feed end of the kiln. Kiln rotation causes the stone to travel toward the firing or lower end of the kiln. Heat is supplied to the kiln from the combustion of bituminous coal pulverized in Raymond ball mills. The heat is utilized to convert the limestone to lime by driving off the carbon dioxide. The lime is then fed into Unax heat exchangers where it is cooled prior to further handling.

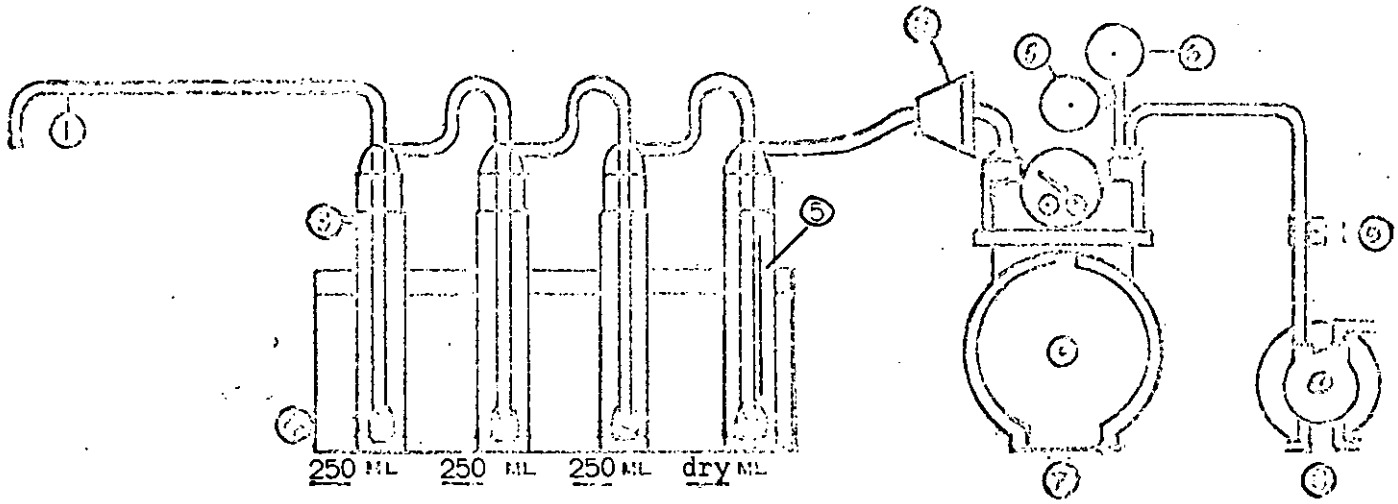
The effluent from the kiln is discharged through a Chemico venturi type scrubber and exhausted to the atmosphere through an 87 foot metal stack having a 6'6" diameter.

$$\frac{98 \frac{lb}{hr}}{9.5 \frac{ton\ product}{hr}} = 10.3 \frac{lb}{ton\ product}$$

TEST NO. 1771

SAMPLING APPARATUS

DATE 11/11/71



1. SAMPLE PROBE
2. DRY FILTER 4" Dia. Glass Fiber Filter
   (DUST CONCENTRATION SAMPLER)
3. IMPINGER
4. ICE BATH CONTAINER
5. TEMPERATURE INDICATORS
6. VACUUM GAGE
7. SPRAGUE DRY GAS METER
8. VACUUM PUMP
9. VALVES TO CONTROL GAS FLOW RATE
10. IMPINGER SOLUTION

Distilled Water

HAP - 5686

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

TEST NO. 1771

GAS VOLUME DATA

NAME OF FIRM: Warner Company, Bellefonte, Pa.

DATE: 11/11/71

SAMPLE STATION: Sampling ports located in stack of #2 kiln approximately 35 feet above grade.

TIME	POINT	V. H.	T °F.	VEL FT/SEC	TIME	POINT	V. H.	T °F.	VEL FT/SEC
10.25 A.M.	A - 1	0.17	155	29.6		A - 1	0.17	155	29.6
	2	.19		31.3		2	.23		34.4
	3	.22		33.7		3	.22		33.7
	4	.23		34.4		4	.23		34.4
	5	.26		36.6		5	.25		35.9
	6	.25		35.9		6	.25		35.9
	MP	.25		35.9		MP	.26		36.6
	7	.22		33.7		7	.24		35.1
	8	.23		34.4		8	.25		35.9
	9	.23		34.4		9	.24		35.1
	10	.22		33.7		10	.27		37.3
	11	.23		34.4		11	.23		34.4
	12	.22		33.7		12	.20		32.2
	12	.19		31.3					
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	10	.22		33.7					
	9	.23		34.4					
	8	.26		36.6					
	7	.25		35.9					
	MP	.23		34.4					
	6	.24		35.1					
	5	.24		35.1					
	4	.24		35.1					
	3	.23		34.4					
	2	.21		32.9					
	1	.17		29.6					

$P_{Barometric}$ = 29.39 In. Hg.

P_{Static} = Negligible

HAP - 5686

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

TEST NO. 1771

GAS VOLUME DATA

NAME OF FIRM: Warner Company, Bellefonte, Pa.

DATE: 11/11/71

SAMPLE STATION: Sampling ports located in stack of #2 kiln approximately 35 feet above grade.

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10:35 A.M.	B - 1	0.17	155	29.6		B - 1	0.13	155	25.9
	2	.15		27.8		2	.13		25.9
	3	.18		30.5		3	.19		31.3
	4	.18		30.5		4	.18		30.5
	5	.20		32.2		5	.20		32.2
	6	.22		33.7		6	.22		33.7
	MP	.22		33.7		MP	.21		32.9
	7	.21		32.9		7	.25		35.9
	8	.18		30.5		8	.20		32.2
	9	.20		32.2		9	.17		29.6
	10	.17		29.6		10	.17		29.6
	11	.15		27.8		11	.15		27.8
	12	.12		24.9		12	.12		24.9
	12	.13		25.9					
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	5	.25		35.9					
	4	.21		32.9					
	3	.20		32.2					
	2	.17		29.6					
	1	.13		25.9					

TRAVERSE VELOCITY 32.3 FT./SEC.

REFERENCE POINT VELOCITY ------ FT./SEC.

FLUE FACTOR (TRAVERSE/REF. PT.) ------

PITOT CORRECTION FACTOR 0.855

GAS DENSITY CORRECTION FACTOR ------

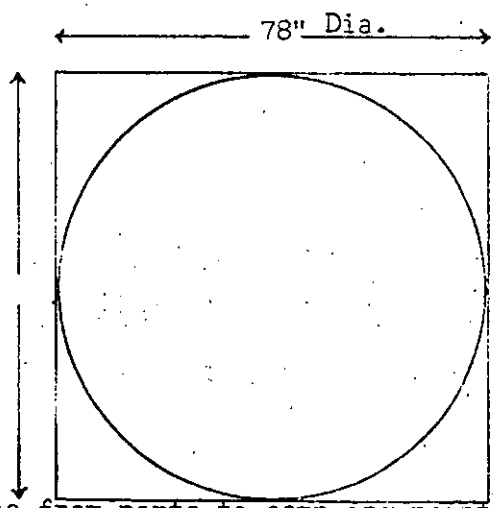
CORRECTED TRAVERSE VELOCITY

32.3 x 0.855 x ___ x ___ = 27.6 FT./SEC.

AREA OF FLUE 33.2 SQ. FT. AV. FLUE TEMP. 155 °F.

VOL. = 27.6 FT./SEC. x 33.2 SQ. FT. x 60 = 55,000 CFM

VOL. = 55,000 CFM x 520/615 = 46,500 SCFM



Distance from ports to sampling points

1. 1 5/8"	5. 19½"	7. 50 3/8"	10. 68 7/8"
2. 5 1/8"	6. 27 5/8"	8. 58½"	11. 72 7/8"
3. 9 1/8"	MP. 39"	9. 64¼"	12. 76 3/8"
4. 13 3/4"	7. 50 3/8"		

HAP-5037 REV. 5/68

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

TEST NO.

CALCULATION SHEET

NAME OF FIRM	DATE
Warner Company, Bellefonte, Pa.	11/11/71

SAMPLE STATION

Sampling ports located in stack of #2 kiln approximately 35 feet above grade.

COLLECTION TRAIN FOR	SAMPLE POINT	SAMPLE NOZZLE DIA.
Particulate	A-2, 4, MP, 8, 11 B-2, 4, 7, 9, 11	3/8" to 1/4"

TOTAL WGT. COLLECTED (GMS)	CONDENSATE CC.
0.8772	278

CONDENSATE: .00267 × 278 × 518/25.5 = 15.1 CF

TOTAL METER VOL. = 15.1 + 49.4 = 64.5 CF

METER CORR. 64.5 × 520/518 × 25.5/29.9 = 55.2 SCF

CONCENTRATION $\frac{0.8772 \text{ GM} \times 15.43}{55.2 \text{ SCF}}$ = 0.245 GR/SCF

CALCULATED LOSS: $\frac{0.245 \text{ GR/SCF}}{7000} \times 46{,}500 \text{ SCFM} \times 60$ = 98 LBS/HR

SAMPLING POINT	TIME	GAS METER CU. FT.	GAS METER VAC IN. HG	GAS METER T°F.	IMP. T1°F.	SAMPLING POINT	TIME	GAS METER CU. FT.	GAS METER VAC IN. HG	GAS METER T°F.	IMP. T°F.
A-2	12:09P.M.	77.3	6.5	62	47	B-4	1:32	109.7	3.5	57	38
	+5	81.7	7.5	60	43		+5	111.9	3.5	57	38
	+10	86.8	8.0	60	41		+10	114.1	3.5	57	39
	Test Down - Change Nozzle to ¼"					B-7	1:43	114.1	3.8	57	38
A-4	12:31	86.8	3.3	58	40		+5	116.4	4.0	57	41
	+5	89.1	3.0	59	45		+10	118.9	4.0	57	41
	+10	91.2	3.0	59	45	B-9	1:55	118.9	3.3	57	41
A-MP	12:42	91.2	3.8	59	43		+5	120.9	3.3	57	43
	+5	93.7	3.7	59	45		+10	122.9	3.3	58	44
	+10	96.2	3.8	59	45	B-11	2:06	122.9	3.0	58	43
A-8	12:53	96.2	3.8	59	42		+5	124.8	3.2	58	43
	+5	98.6	3.8	59	45		+10	126.7	3.2	58	44
	+10	101.1	3.8	59	46						
A-11	1:04	101.1	3.8	59	43		Total	49.4			
	+5	103.6	3.8	59	44		Average		3.9	58	42
	+10	106.1	3.8	59	45						
B-2	1:21	106.1	2.8	56	38						
	+5	107.8	3.0	57	38						
	+10	109.7	3.0	57	38						

HAP-5033

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

MOISTURE CALCULATIONS

DATE 11/11/71

1. PERCENT WATER VAPOR IN GASES	TEST NUMBERS				
	1771				
A. Gas pressure at meter (Inches HG-ABS)	25.5				
B. Vapor pressure of water at impinger temp. (In. HG.)	0.2678				
C. Vol. of metered gas (Cu. Ft.)	49.4				
D. Vol. of water vapor metered (BC/A, Cu. Ft.)	0.5				
E. Vol. of water vapor condensed (Cu. Ft.)	15.1				
F. Total vol. of water vapor in gas sample (D + E, Cu. Ft.)	15.6				
G. Total vol. of gas sample (C + E, Cu. Ft.)	64.5				
H. % water vapor in sampled gas (100 F/G)	24.2				
I. % water vapor (Average Value)	14.1				
2. ORSAT ANALYSIS – DRY BASIS					
A. CO_2 (%)					
B. CO (%)					
C. O_2 (%)					
D. N_2 (%)					

LABORATORY RESULTS:

Sampling Train Components	Particulate Weight - Gms
Probe and Tubing Washings	0.0690
* Impinger #1	0.2086
Impinger #2	0.1290
* Impinger #3	0.4349
4" Dia. Glass Fiber Filter #437	0.0357
Total	0.8772

Condensate volume = 278 ml

* Impinger #1 transferred to Impinger #3 position during test.

WARNER COMPANY
BELLEFONTE, PA.

PARTICLE SIZE DATA
DISTRIBUTION BY NUMBER - SIZE

size % / not weight

Range - Microns	Percent
0 - 0.49	40.1
0.50 - 0.70	25.2
0.71 - 0.98	12.9
0.99 - 1.40	7.9
1.41 - 1.96	4.8
1.97 - 2.80	4.3
2.81 - 3.92	2.0
3.93 - 5.60	1.4
5.61 - 7.85	0.6
>7.85	0.6

78.2 % LESS THAN 1 micron

WEIGHT - SIZE DISTRIBUTION DATA

Median = 1.24

% $\leq$ 10μ = 98.5

WARNER COMPANY
BELLEFONTE, PA.

PARTICLE SIZE DATA
CALCULATION SHEET

$X_{ng} = 0.54$ $\qquad \sigma_{ng} = \frac{X_{84\%}}{X_{50\%}} = \frac{1.41}{0.54} = 2.61$

$$\ln X_{vg} = \ln X_{ng} + 3.0 \ln^2 \sigma_{ng}$$

$$= \ln 0.54 + 3.0 \ln^2 2.61$$

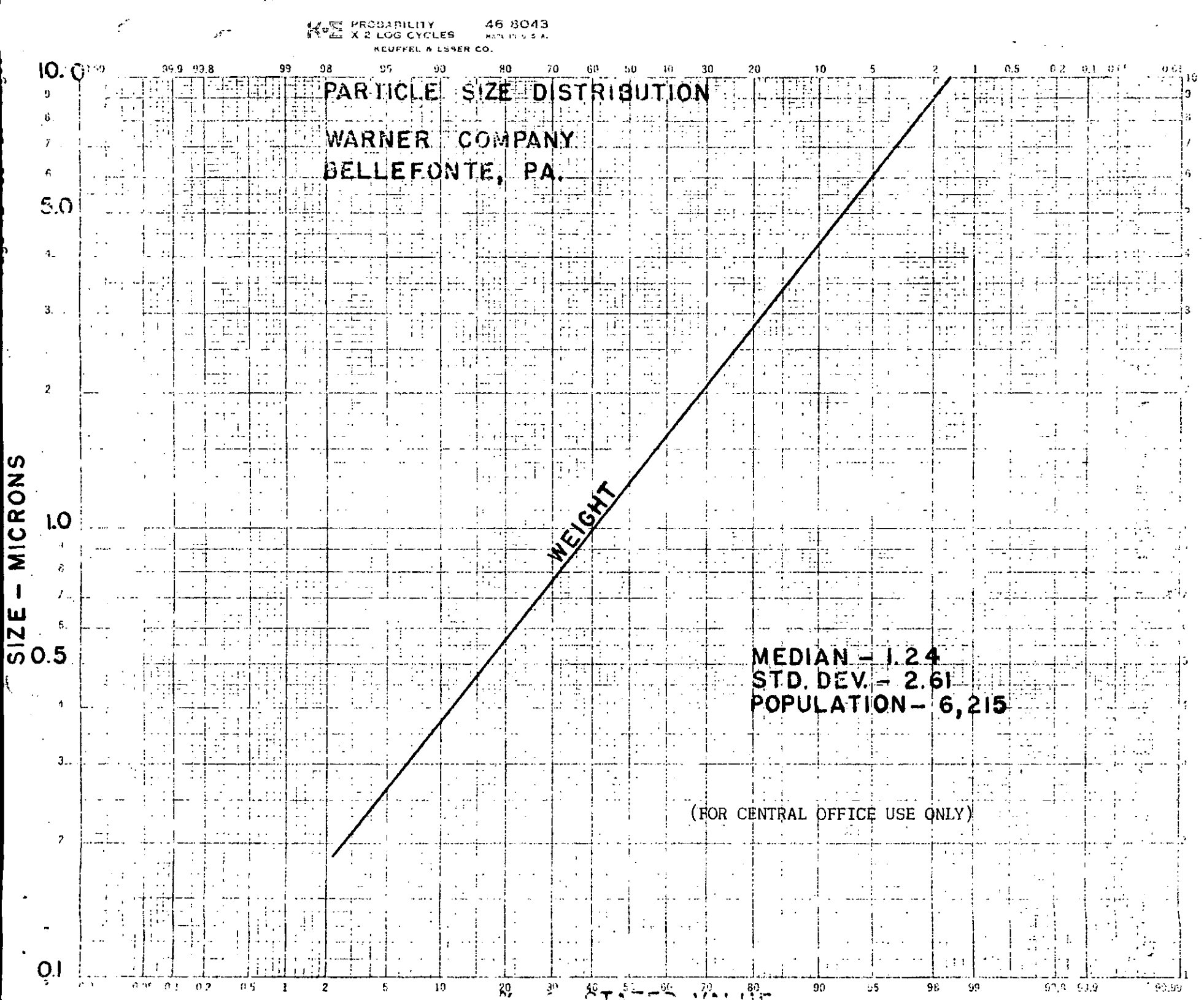
$$= -0.62 + 3.0 (0.96)^2$$

$$= -0.62 + 2.76$$

$$= 2.14$$

$$X_{vg} = 1.24$$

(Central Office Use Only)


PROBABILITY
X 2 LOG CYCLES
46 8043
KEUFFEL & ESSER CO.
PARTICLE SIZE DISTRIBUTION
WARNER COMPANY
BELLEFONTE, PA.
WEIGHT
MEDIAN - 1.24
STD. DEV. - 2.61
POPULATION - 6,215
(FOR CENTRAL OFFICE USE ONLY)
SIZE - MICRONS
10.0
5.0
1.0
0.5
0.1

HAP-5036

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

PROCESS DATA

DATE 11/11/71

NUMBER 1771

NAME OF FIRM
Warner Company, Bellefonte, Pa.

DESCRIPTION OF EQUIPMENT TESTED AND OPERATION COVERED IN TEST

Effluent from rotary lime kiln #2

SAMPLING STATION LOCATION

Sampling ports located in stack of #2 kiln approximately 35 feet above grade.

LENGTH OF PROCESS CYCLE continuous TIME CYCLE BEGINS _____ ENDS _____

TIME OF TEST: BEGINS 12:09 P.M. ENDS 2:16 P.M. CYCLE COVERAGE complete

RAW MATERIAL CHARGED DURING THIS TIME:

MATERIAL	Limestone	WT(LBS.)	63,245
MATERIAL	0.158 tons/min x 60	WT(LBS.)	31.6 feed
MATERIAL	15.8 / 100 min 9480 tons/hr	WT(LBS.)	15.8 produced
MATERIAL		WT(LBS.)	for 100 minutes
MATERIAL	operating over capacity	WT(LBS.)	
SOLID FUEL CHARGED	Bituminous Coal	WT(LBS.)	13,280
TOTAL POUNDS		WT(LBS.)	76,525

COLLECTION EQUIPMENT TYPE

Chemico venturi type scrubber

PLANT OFFICIAL AND TITLE

H. H. Reeves, Manager of Operations

ADDITIONAL COMMENTS

Total sampling was 100 minutes.

HAP-5038

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

TEST NO. 1771

SUMMARY

DATE 11/11/71

NAME OF FIRM

Warner Company, Bellefonte, Pa.

Description of Equipment Tested and Operation Covered in Test

Effluent from rotary lime kiln #2

Sampling Station Location	A-2, 4, MP, 8, 11, B-2, 4, 7, 9, 11
Average Gas Velocity (Ft./Sec.)	27.6
Area of Flue at Sampling Station	33.2
Flue Gas Volume (SCFM)	46,500
Sample Nozzle Diameter (In.)	3/8" to 1/4"
Sampling Rate at Meter (CFM)	0.49
Total Sampling Time (Minutes)	100
Meter Vacuum-Average (In. HG)	3.9
Meter Temperature – Average (°F)	58
Volume of Gas Sampled, Meter Conditions (CF)	49.4
Water Vapor Condensate (CC)	278
Water Vapor Volume Meter Conditions (CF)	15.1
Moisture in Gases (%)	24.2
Total Sampled Volume, Meter Conditions (CF)	64.5
Corrected Sample Volume (SCF)	55.2
Type Material Collected	Particulate
Weight Collected (GMS)	0.8772
Concentration Grains/SCF	.245
Calculated Loss (Lbs./Hr.)	Suspended Particulate = 96.5
	Particle Fall = 1.5
	Total Particulate = 98

REGULATORY STANDARD

Type of Material	Suspended Particulate	Particle Fall
Allowable Loss (Lb./Hr.)	26.6	18.9

COLLECTOR EFFICIENCY

Total Material to Collector (Lbs./Hr.)

Total Loss to Atmosphere (Lbs./Hr.)

Total Material Collected

COMMENTS

Approved By

Test Conducted By

DeHaven, St. Louis, Mills, Leaman

Test Computed and Checked By

L. Blaine DeHaven, P.E.

WARNER COMPANY
BELLEFONTE, PA.

DISCUSSION

Stack Test No. 1771 was conducted using standard procedures for the isokinetic collection of a particulate sample. A 10 point sampling traverse was used with a 10 minute sampling period per point.

A particle size analysis was performed according to the procedure described in the Bureau of Air Quality and Noise Control's Laboratory Procedure IV-1 entitled "Standard Method for Particle Size Determination." The results indicated that 98.5% of the collected particulate to be $\leq$ 10μ in diameter by weight.

The test data indicates a total emission rate of 98 pounds per hour of which 96.5 pounds per hour is suspended particulate and 1.5 pounds per hour is particle fall. The calculated allowable emission rates as determined by the Bureau of Air Quality and Noise Control's Regulation IV are 26.6 pounds per hour of suspended particulate and 18.9 pounds per hour of particle fall.

98 x .985 = 96.5

see NEDS data

scrubber

WARNER COMPANY
BELLEFONTE, PA.

PROCESS DESCRIPTION

Stack Test No. 1771 was performed in the stack effluent of the Warner Company's kiln No. 2. This kiln is a rotary type manufactured by the Vulcan Iron Works and installed in 1925. It is 9 feet in diameter, 175 feet long and has a rated thruput of 440 tons per day of stone and 70 tons per day of bituminous coal.

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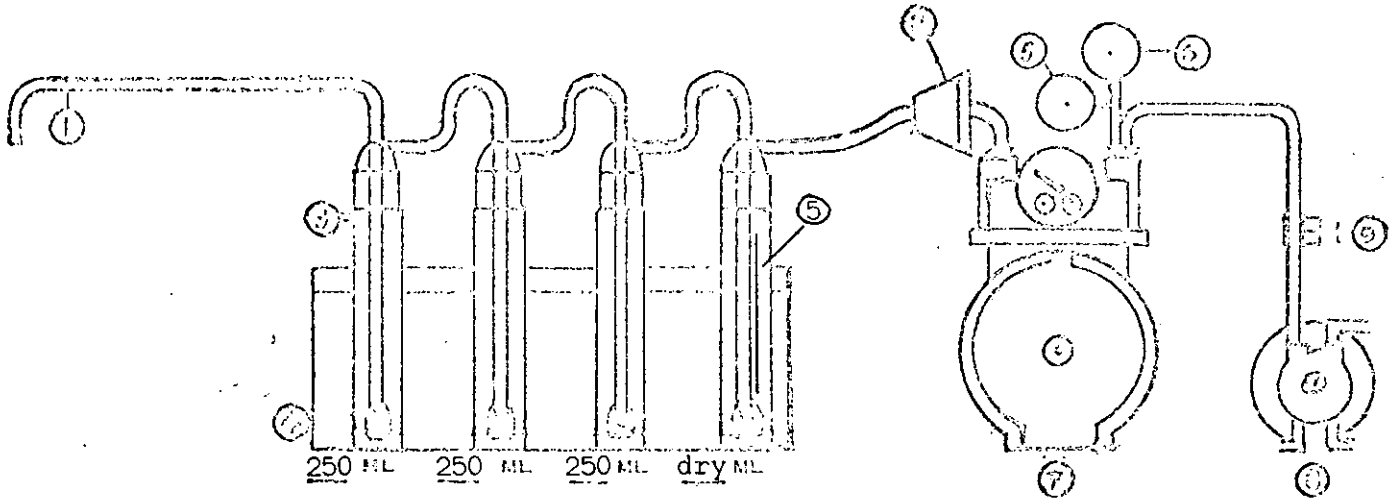
The effluent from the kiln is discharged through a Chemico venturi type scrubber and exhausted to the atmosphere through an 87 foot metal stack having a 6'6" diameter.

$$\frac{98 \frac{lb}{hr}}{9.5 \frac{ton\ product}{hr}} \approx 10.3 \frac{lb}{ton\ product}$$

TEST NO. 1771

SAMPLING APPARATUS

DATE 11/11/71



1. SAMPLE PROBE
2. DRY FILTER 4" Dia. Glass Fiber Filter
   (DUST CONCENTRATION SAMPLER)
3. IMPINGER
4. ICE BATH CONTAINER
5. TEMPERATURE INDICATORS
6. VACUUM GAGE
7. SPRAGUE DRY GAS METER
8. VACUUM PUMP
9. VALVES TO CONTROL GAS FLOW RATE
10. IMPINGER SOLUTION

Distilled Water

HAP - 5680

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

TEST NO. 1771

GAS VOLUME DATA

NAME OF FIRM: Warner Company, Bellefonte, Pa.

DATE: 11/11/71

SAMPLE STATION: Sampling ports located in stack of #2 kiln approximately 35 feet above grade.

TIME	POINT	V. H.	T °F.	VEL FT/SEC	TIME	POINT	V. H.	T °F.	VEL FT/SEC
10.25 A.M.	A - 1	0.17	155	29.6		A - 1	0.17	155	29.6
	2	.19		31.3		2	.23		34.4
	3	.22		33.7		3	.22		33.7
	4	.23		34.4		4	.23		34.4
	5	.26		36.6		5	.25		35.9
	6	.25		35.9		6	.25		35.9
	MP	.25		35.9		MP	.26		36.6
	7	.22		33.7		7	.24		35.1
	8	.23		34.4		8	.25		35.9
	9	.23		34.4		9	.24		35.1
	10	.22		33.7		10	.27		37.3
	11	.23		34.4		11	.23		34.4
	12	.22		33.7		12	.20		32.2
	12	.19		31.3					
	11	.23		34.4					
	10	.22		33.7					
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	7	.25		35.9					
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	6	.24		35.1					
	5	.24		35.1					
	4	.24		35.1					
	3	.23		34.4					
	2	.21		32.9					
	1	.17		29.6					

$P_{Barometric}$ = 29.39 In. Hg.

P_{Static} = Negligible

HAP - 5666

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

TEST NO. 1771

GAS VOLUME DATA

NAME OF FIRM: Warner Company, Bellefonte, Pa.

DATE: 11/11/71

SAMPLE STATION: Sampling ports located in stack of #2 kiln approximately 35 feet above grade.

TIME	POINT	V. H.	T °F.	VEL FT/SEC	TIME	POINT	V. H.	T °F.	VEL FT/SEC
10:35 A.M.	B - 1	0.17	155	29.6		B - 1	0.13	155	25.9
	2	.15		27.8		2	.13		25.9
	3	.18		30.5		3	.19		31.3
	4	.18		30.5		4	.18		30.5
	5	.20		32.2		5	.20		32.2
	6	.22		33.7		6	.22		33.7
	MP	.22		33.7		MP	.21		32.9
	7	.21		32.9		7	.25		35.9
	8	.18		30.5		8	.20		32.2
	9	.20		32.2		9	.17		29.6
	10	.17		29.6		10	.17		29.6
	11	.15		27.8		11	.15		27.8
	12	.12		24.9		12	.12		24.9
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	10	.15		27.8					
	9	.18		30.5					
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	MP	.21		32.9					
	6	.21		32.9					
	5	.25		35.9					
	4	.21		32.9					
	3	.20		32.2					
	2	.17		29.6					
	1	.13		25.9					

TRAVERSE VELOCITY 32.3 FT./SEC.

REFERENCE POINT VELOCITY ------ FT./SEC.

FLUE FACTOR (TRAVERSE/REF. PT.) ------

PITOT CORRECTION FACTOR 0.855

GAS DENSITY CORRECTION FACTOR ------

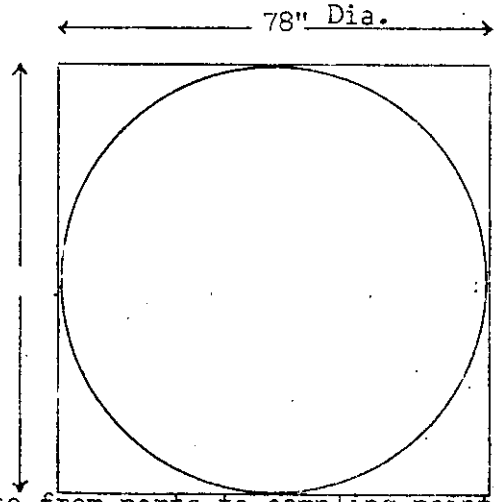
CORRECTED TRAVERSE VELOCITY -

32.3 x 0.855 x —— x —— = 27.6 FT./SEC.

AREA OF FLUE 33.2 SQ. FT. AV. FLUE TEMP. 155 °F.

VOL. = 27.6 FT./SEC. x 33.2 SQ. FT. x 60 = 55,000 CFM

VOL. = 55,000 CFM x 520/615 = 46,500 SCFM



Distance from ports to sampling points

1. 1 5/8"	5. 19½"	7. 50 3/8"	10. 68 7/8"
2. 5 1/8"	6. 27 5/8"	8. 58½"	11. 72 7/8"
3. 9 1/8"	MP. 39"	9. 64¼"	12. 76 3/8"
4. 13 3/4"	7. 50 3/8"		

HAP-5037 REV. 5/68

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

TEST NO.

CALCULATION SHEET

NAME OF FIRM	DATE
Warner Company, Bellefonte, Pa.	11/11/71

SAMPLE STATION

Sampling ports located in stack of #2 kiln approximately 35 feet above grade.

COLLECTION TRAIN FOR	SAMPLE POINT	SAMPLE NOZZLE DIA.
Particulate	A-2, 4, MP, 8, 11 B-2, 4, 7, 9, 11	3/8" to 1/4"

TOTAL WGT. COLLECTED (GMS)	CONDENSATE CC.
0.8772	278

CONDENSATE: .00267 × 278 × 518/25.5 = 15.1 CF

TOTAL METER VOL. = 15.1 + 49.4 = 64.5 CF

METER CORR. 64.5 × 520/518 × 25.5/29.9 = 55.2 SCF

CONCENTRATION $\frac{0.8772 \text{ GM} \times 15.43}{55.2 \text{ SCF}}$ = 0.245 GR/SCF

CALCULATED LOSS: $\frac{0.245 \text{ GR/SCF}}{7000} \times 46{,}500 \text{ SCFM} \times 60$ = 98 LBS/HR

SAMPLING POINT	TIME	GAS METER CU. FT.	GAS METER VAC IN. HG	GAS METER T °F.	IMP. T °F.	SAMPLING POINT	TIME	GAS METER CU. FT.	GAS METER VAC IN. HG	GAS METER T °F.	IMP. T °F.
A-2	12:09P.M.	77.3	6.5	62	47	B-4	1:32	109.7	3.5	57	38
	+5	81.7	7.5	60	43		+5	111.9	3.5	57	38
	+10	86.8	8.0	60	41		+10	114.1	3.5	57	39
	Test Down - Change Nozzle to ¼"					B-7	1:43	114.1	3.8	57	38
A-4	12:31	86.8	3.3	58	40		+5	116.4	4.0	57	41
	+5	89.1	3.0	59	45		+10	118.9	4.0	57	41
	+10	91.2	3.0	59	45	B-9	1:55	118.9	3.3	57	41
A-MP	12:42	91.2	3.8	59	43		+5	120.9	3.3	57	43
	+5	93.7	3.7	59	45		+10	122.9	3.3	58	44
	+10	96.2	3.8	59	45	B-11	2:06	122.9	3.0	58	43
A-8	12:53	96.2	3.8	59	42		+5	124.8	3.2	58	43
	+5	98.6	3.8	59	45		+10	126.7	3.2	58	44
	+10	101.1	3.8	59	46						
A-11	1:04	101.1	3.8	59	43		Total	49.4			
	+5	103.6	3.8	59	44		Average		3.9	58	42
	+10	106.1	3.8	59	45						
B-2	1:21	106.1	2.8	56	38						
	+5	107.8	3.0	57	38						
	+10	109.7	3.0	57	38						

HAP-5033

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

MOISTURE CALCULATIONS

DATE 11/11/71

1. PERCENT WATER VAPOR IN GASES	TEST NUMBERS				
	1771				
A. Gas pressure at meter (Inches HG-ABS)	25.5				
B. Vapor pressure of water at impinger temp. (In. HG.)	0.2678				
C. Vol. of metered gas (Cu. Ft.)	49.4				
D. Vol. of water vapor metered (BC/A, Cu. Ft.)	0.5				
E. Vol. of water vapor condensed (Cu. Ft.)	15.1				
F. Total vol. of water vapor in gas sample (D + E, Cu. Ft.)	15.6				
G. Total vol. of gas sample (C + E, Cu. Ft.)	64.5				
H. % water vapor in sampled gas (100 F/G)	24.2				
I. % water vapor (Average Value)	14.1				
2. ORSAT ANALYSIS - DRY BASIS					
A. CO_2 (%)					
B. CO (%)					
C. O_2 (%)					
D. N_2 (%)					

LABORATORY RESULTS:

Sampling Train Components	Particulate Weight - Gms
Probe and Tubing Washings	0.0690
* Impinger #1	0.2086
Impinger #2	0.1290
* Impinger #3	0.4349
4" Dia. Glass Fiber Filter #437	0.0357
Total	0.8772

Condensate volume = 278 ml

* Impinger #1 transferred to Impinger #3 position during test.

WARNER COMPANY
BELLEFONTE, PA.

PARTICLE SIZE DATA
DISTRIBUTION BY NUMBER - SIZE

size % not weight

78.2 % LESS THAN 1 micron

Range - Microns	Percent
0 - 0.49	40.1
0.50 - 0.70	25.2
0.71 - 0.98	12.9
0.99 - 1.40	7.9
1.41 - 1.96	4.8
1.97 - 2.80	4.3
2.81 - 3.92	2.0
3.93 - 5.60	1.4
5.61 - 7.85	0.6
>7.85	0.6

WEIGHT - SIZE DISTRIBUTION DATA

Median = 1.24

% $\leq$ 10μ = 98.5

WARNER COMPANY
BELLEFONTE, PA.

PARTICLE SIZE DATA
CALCULATION SHEET

$X_{ng} = 0.54$ $\qquad \sigma_{ng} = \frac{X_{84\%}}{X_{50\%}} = \frac{1.41}{0.54} = 2.61$

$$\ln X_{vg} = \ln X_{ng} + 3.0 \ln^2 \sigma_{ng}$$

$$= \ln 0.54 + 3.0 \ln^2 2.61$$

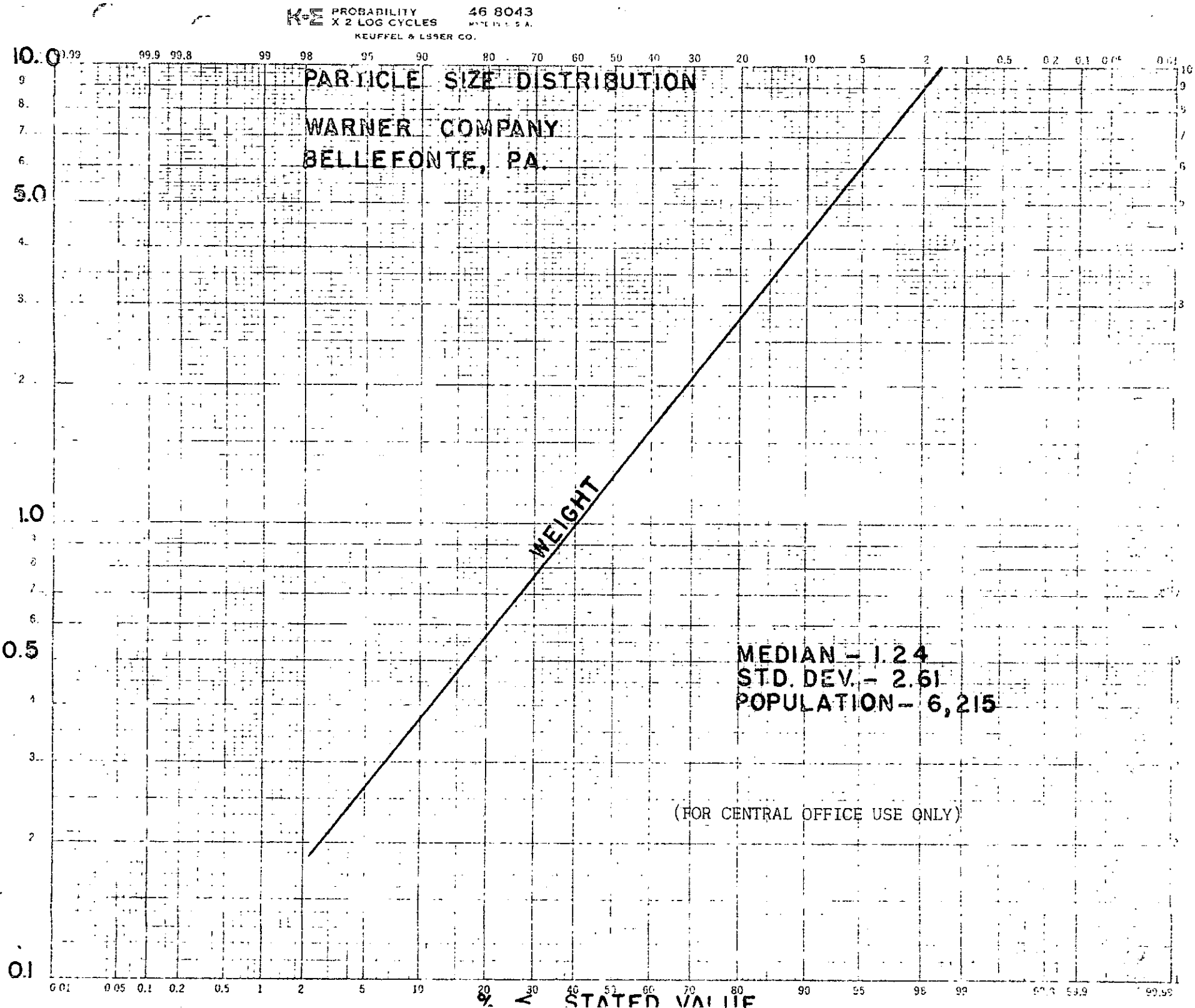
$$= -0.62 + 3.0 (0.96)^2$$

$$= -0.62 + 2.76$$

$$= 2.14$$

$$X_{vg} = 1.24$$

(Central Office Use Only)


K+E PROBABILITY X 2 LOG CYCLES
46 8043
KEUFFEL & ESSER CO.
PARTICLE SIZE DISTRIBUTION
WARNER COMPANY
BELLEFONTE, PA.
WEIGHT
MEDIAN - 1.24
STD. DEV. - 2.61
POPULATION - 6,215
(FOR CENTRAL OFFICE USE ONLY)
SIZE - MICRONS
% < STATED VALUE

HAP-5036

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

PROCESS DATA

DATE 11/11/71

NUMBER 1771

NAME OF FIRM
Warner Company, Bellefonte, Pa.

DESCRIPTION OF EQUIPMENT TESTED AND OPERATION COVERED IN TEST

Effluent from rotary lime kiln #2

SAMPLING STATION LOCATION

Sampling ports located in stack of #2 kiln approximately 35 feet above grade.

LENGTH OF PROCESS CYCLE continuous TIME CYCLE BEGINS _____ ENDS _____

TIME OF TEST: BEGINS 12:09 P.M. ENDS 2:16 P.M. CYCLE COVERAGE complete

RAW MATERIAL CHARGED DURING THIS TIME:

MATERIAL	Limestone	WT(LBS.)	63,245
MATERIAL	0.158 tons/min x 60	WT(LBS.)	31.6 feed
MATERIAL	15.8 / 100 min 9.480 tons/hr	WT(LBS.)	15.8 produced
MATERIAL		WT(LBS.)	for 100 minutes
MATERIAL	operating over capacity	WT(LBS.)	
SOLID FUEL CHARGED	Bituminous Coal	WT(LBS.)	13,280
TOTAL POUNDS		WT(LBS.)	76,525

COLLECTION EQUIPMENT TYPE

Chemico venturi type scrubber

PLANT OFFICIAL AND TITLE

H. H. Reeves, Manager of Operations

ADDITIONAL COMMENTS

Total sampling was 100 minutes.

HAP-5038

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF HEALTH
AIR POLLUTION CONTROL

TEST NO. 1771

SUMMARY

DATE 11/11/71

NAME OF FIRM

Warner Company, Bellefonte, Pa.

Description of Equipment Tested and Operation Covered in Test

Effluent from rotary lime kiln #2

Sampling Station Location	A-2, 4, MP, 8, 11, B-2, 4, 7, 9, 11
Average Gas Velocity (Ft./Sec.)	27.6
Area of Flue at Sampling Station	33.2
Flue Gas Volume (SCFM)	46,500
Sample Nozzle Diameter (In.)	3/8" to 1/4"
Sampling Rate at Meter (CFM)	0.49
Total Sampling Time (Minutes)	100
Meter Vacuum-Average (In. HG)	3.9
Meter Temperature – Average (°F)	58
Volume of Gas Sampled, Meter Conditions (CF)	49.4
Water Vapor Condensate (CC)	278
Water Vapor Volume Meter Conditions (CF)	15.1
Moisture in Gases (%)	24.2
Total Sampled Volume, Meter Conditions (CF)	64.5
Corrected Sample Volume (SCF)	55.2
Type Material Collected	Particulate
Weight Collected (GMS)	0.8772
Concentration Grains/SCF	.245
Calculated Loss (Lbs./Hr.)	Suspended Particulate = 96.5
	Particle Fall = 1.5
	Total Particulate = 98

REGULATORY STANDARD

Type of Material	Suspended Particulate	Particle Fall
Allowable Loss (Lb./Hr.)	26.6	18.9

COLLECTOR EFFICIENCY

Total Material to Collector (Lbs./Hr.)

Total Loss to Atmosphere (Lbs./Hr.)

Total Material Collected

COMMENTS

Approved By

Test Conducted By

DeHaven, St. Louis, Mills, Leaman

Test Computed and Checked By

L. Blaine DeHaven, P.E.

WARNER COMPANY
BELLEFONTE, PA.

DISCUSSION

Stack Test No. 1771 was conducted using standard procedures for the isokinetic collection of a particulate sample. A 10 point sampling traverse was used with a 10 minute sampling period per point.

A particle size analysis was performed according to the procedure described in the Bureau of Air Quality and Noise Control's Laboratory Procedure IV-1 entitled "Standard Method for Particle Size Determination." The results indicated that 98.5% of the collected particulate to be $\leq$ 10μ in diameter by weight.

The test data indicates a total emission rate of 98 pounds per hour of which 96.5 pounds per hour is suspended particulate and 1.5 pounds per hour is particle fall. The calculated allowable emission rates as determined by the Bureau of Air Quality and Noise Control's Regulation IV are 26.6 pounds per hour of suspended particulate and 18.9 pounds per hour of particle fall.

98 x .985 = 96.5