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.

APR 2

AP-42 Section 11.6
Reference 50
Report Sect. 4
Reference 55

806-355-4431

# SOUTHWESTERN PORTLAND CEMENT COMPANY

SOUTHWEST DIVISION

P. O. BOX 3520
AMARILLO, TEXAS 79106

Copy – E. D. Thorne Jr.
D. K. MacEwen
w/Report

April 14, 1983

Mr. Bill Stewart P.E.
Executive Director
Texas Air Control Board
6330 Highway 290 East
Austin, TX 78773

RE: Compliance Test Submittal for Construction Permit Number C-8411

Dear Mr. Stewart:

Enclosed are three copies of the compliance test report for the fuel conversion authorized under Construction Permit Number C-8411. The test results indicate that, except for $NO_x$, the various emissions as specified in Permit Number C-8411 were substantially below the permitted levels.

In the initial application for the fuel conversion, we requested a considerably higher $NO_x$ emission level than was subsequently designated in the construction permit. In accepting the permit, we emphasized that we felt the $NO_x$ permit value was unobtainable. Our projection for $NO_x$ emission on this conversion was based on the premise of 3#/HR $NO_x$ per ton of dry kiln feed. The results of the compliance test tends to substantiate our initial position.

This facility utilizes the best available control technology available for the reduction of particulates and $NO_x$ emissions. We, therefore, request that the construction permit be amended to reflect actual $NO_x$ test emission levels as identified in the compliance report.

Please advise if additional information is required.

Sincerely,

John E. Mummert
Geologist and Environmental Specialist

JEM/slk
Enclosures
CC: TACB Acting Supervisor, Odessa, Texas
Mr. Ford Sweetman, Chief Sanitarian, Odessa/Ector County Health Department, Odessa, Texas

**MULLINS ENVIRONMENTAL TESTING CO., INC.**
P.O. Box 598
Addison, Tx 75001
(214) 931-7127

METCO

# SOURCE EMISSIONS SURVEY
# OF
# SOUTHWESTERN PORTLAND CEMENT COMPANY
# KILN NUMBER 2 STACK
# ODESSA, TEXAS

FEBRUARY 1983

FILE NUMBER 83-09

METCO

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SOURCE EMISSIONS SURVEY
SOUTHWESTERN PORTLAND CEMENT COMPANY
KILN NUMBER 2 STACK
ODESSA, TEXAS
FILE NUMBER 83-09

## INTRODUCTION

Mullins Environmental Testing Co., Inc., Dallas, Texas, conducted a source emissions survey of Southwestern Portland Cement Company at its plant in Odessa, Texas, on February 21 and 22, 1983. The purpose of these tests was to determine the concentrations of particulate matter, sulfur dioxide, and oxides of nitrogen being emitted to the atmosphere via the Kiln Number 2 Exhaust Stack.

The sampling followed the procedures set forth in the Appendix to the Code of Federal Regulations, Title 40, Chapter I, Part 60, and in the "Compliance Sampling Manual, Texas Air Control Board, October 1975."

The sampling was observed by Mr. Neil J. Carman of the Texas Air Control Board, Odessa, Texas.

## SUMMARY OF RESULTS

The principal conclusions are as follows:

1. The emissions of particulate matter from the stack were equal to 10.73 pounds per hour, based on averaging the three tests using only the "front-half" collections from the EPA-type sampling train. The emissions limit for particulate matter as stated in TACB Permit C-8411 is equal to 22.0 pounds per hour. The actual emissions were 48.8 percent of the permitted emissions.

2. The emissions of sulfur dioxide were equal to 0.2 pounds per hour (0.2 parts per million), based on averaging the three tests. The emissions limit for sulfur dioxide as stated in TACB Permit C-8411 is equal to 86.6 pounds per hour. The actual emissions of sulfur dioxide were 0.2 percent of the permitted emissions.

3. The emissions of oxides of nitrogen were equal to 238.1 pounds per hour (384 parts per million), based on averaging the twelve flasks. The emissions limit for oxides of nitrogen as stated in TACB Permit C-8411 is equal to 119.2 pounds per hour. The actual emissions were 199.7 percent of the permitted emissions.

4. The visible emissions of the stack were equal to 3.7 percent opacity, based on the average of the readings taken during each of the three tests.

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SUMMARY OF RESULTS

Kiln Number 2 Exhaust Stack

| Run Number | 1 | 2 | 3 |
|---|---|---|---|
| Stack Flow Rate - ACFM | 147,547 | 153,014 | 152,506 |
| Stack Flow Rate - DSCFM* | 85,336 | 87,766 | 86,913 |
| % Water Vapor - % Vol. | 4.4 | 4.5 | 4.5 |
| % $CO_2$ - % Vol. | 13.9 | 13.9 | 13.9 |
| % $O_2$ - % Vol. | 12.1 | 12.4 | 12.5 |
| % Excess Air @ Sampling Point | 161 | 174 | 179 |
| Particulates Probe, Cyclone & Filter Catch grains/dscf* | 0.0149 | 0.0153 | 0.0132 |
| grains/cf @ Stack Conditions | 0.0086 | 0.0087 | 0.0075 |
| lbs/hr | 10.9 | 11.5 | 9.8 |
| Total Catch grains/dscf* | 0.0160 | 0.0169 | 0.0156 |
| grains/cf @ Stack Conditions | 0.0092 | 0.0096 | 0.0089 |
| lbs/hr | 11.7 | 12.7 | 11.6 |
| Allowable Emission Rate TACB Permit C-8411 - lbs/hr | 22.0 | 22.0 | 22.0 |
| Kiln Feed Rate - tons/hr | 72.4 | 73.8 | 71.3 |
| Visible Emissions - percent opacity | 5.0 | 1.9 | 4.2 |
| Clinker rate conv. 1.72 factor | 42.1 | 42.9 | 41.5 |

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Kiln Number 2 Exhaust Stack

| Run Number | 1 | 2 | 3 |
|---|---|---|---|
| Stack Flow Rate - DSCFM* | 85,336 | 87,766 | 86,913 |
| % Water Vapor - % Vol. | 4.4 | 4.5 | 4.5 |
| % $CO_2$ - % Vol. | 13.9 | 13.9 | 13.9 |
| % $O_2$ - % Vol. | 12.1 | 12.4 | 12.5 |
| % Excess Air @ Sampling Point | 161 | 174 | 179 |
| Sulfur Dioxide Concentration - ppm | 0.2 | 0.2 | 0.2 |
| Sulfur Dioxide Emissions - lbs/hr | 0.2 | 0.2 | 0.2 |
| Allowable Emission Rate PSD Permit TX-351, TACB Permit C-8411 - lbs/hr | 86.6 | 86.6 | 86.6 |
| Sulfur Trioxide Concentration - ppm | 0.4 | 0.1 | 0.2 |
| Sulfur Trioxide Emissions - lbs/hr | 0.5 | 0.2 | 0.2 |

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

SUMMARY OF RESULTS

Kiln Number 2 Exhaust Stack

Oxides of Nitrogen
(parts per million)

| Run Number | 1 | 2 | 3 | Average |
|---|---|---|---|---|
| Flask Number 1 | 391 | 381 | 261 | |
| Flask Number 2 | 471 | 394 | 338 | |
| Flask Number 3 | 419 | 402 | 368 | |
| Flask Number 4 | 392 | 378 | 408 | |
| Average | 418 | 389 | 344 | 384 |

| Run Number | 1 | 2 | 3 | Average |
|---|---|---|---|---|
| Oxides of Nitrogen - lbs/dscf* | $4.99 \times 10^{-5}$ | $4.65 \times 10^{-5}$ | $4.10 \times 10^{-5}$ | $4.58 \times 10^{-5}$ |
| Oxides of Nitrogen - lbs/hr | 255.5 | 244.9 | 213.8 | 238.1 |
| Allowable Emission Rate TACB Permit C-8411 - lbs/hr | 119.2 | 119.2 | 119.2 | 119.2 |

* 29.92 "Hg, 68°F (760 mm Hg, 20°C)

$\frac{238.1}{72\ T/hr\ KF} = 3.31\ \#NO_x/TKF$

$\frac{238.1}{40\ T/hr\ cl} = 5.95\ \#NO_x/T\ cl$

$\frac{238.1}{45} = 5.29\ \#NO_x/T\ cl$

## DISCUSSION OF RESULTS

The three tests for particulates and sulfur dioxide taken on the Kiln Number 2 Exhaust Stack appeared to be valid representations of the actual emissions during the tests. The indicative parameters calculated from the field data were in close agreement. The moisture percentages for the three tests were within 2.0 percent of the mean value. The measured flow rates ($Q_s$) for the three tests were within 1.5 percent of the mean value. The rates of sampling for the three tests were well within the specified limits, the greatest deviation being 5.7 percent.

The calculated emissions (pounds per hour) of particulate for the three tests showed a range of -8.7 percent to +7.1 percent variation from the mean value.

Sulfur dioxide was determined simultaneously with the particulate run. The indicative parameters all indicate that the results were valid. The sulfur dioxide concentrations were extremely low and near the lower detectable limit of the sampling procedure.

The three tests for oxides of nitrogen involved twelve flasks. The samples appeared to be valid representations of the actual emissions during the tests. The calculated emissions (parts per million) of oxides of nitrogen for the three tests showed a range of -10.4 percent to +9.0 percent variation from the mean value.

## DESCRIPTION OF SAMPLING LOCATION

The sampling location on the Kiln Number 2 Exhaust Stack is approximately 73 feet above the ground. The sampling ports are located 35 feet (3.52 stack diameters) downstream from the inlet to the stack and 7 feet 2 1/2 inches (0.72 stack diameters) upstream from the outlet of the stack.

## SAMPLING AND ANALYTICAL PROCEDURES

The sampling followed the procedures outlined in the Appendix to the Code of Federal Regulations, Title 40, Chapter I, Part 60, and in the "Compliance Sampling Manual, Texas Air Control Board, October 1975."

A preliminary velocity traverse was made at each of the two ports on the stack in order to determine the uniformity and magnitude of the flow prior to testing. Several traverse points were checked for cyclonic flow but none was found to be present. Twenty-two traverse points were sampled from each of the two ports for a total of forty-four traverse points. Samples of two-minute duration were taken isokinetically at each of the forty-four traverse points using an EPA-type, heated, glass-lined probe.

On all tests, the sampling train was leak-checked at the nozzle at 15 inches of mercury vacuum before each test, and leak-checked at the nozzle after each test at the highest vacuum reading recorded during the tests. This was done to predetermine the possibility of a diluted sample.

Also before and after each test, the pitot tube lines were checked for leaks under both a vacuum and pressure. The lines were also checked for clearance and the manometer zeroed before each test.

Particulate emissions were calculated from gravimetric analysis using both the "front-half" and "back-half" collections from the EPA-type sampling train. The "back-half" of the sampling train contained an 80 percent isopropyl alcohol solution to absorb sulfur trioxide, a six percent hydrogen peroxide solution to absorb sulfur dioxide, and silica gel to absorb moisture. The isopropyl alcohol was checked for hydrogen peroxide contamination and none was found to be present.

At the conclusion of each test, the sampling train was purged for 15 minutes with ambient air at the same sampling rate as used during the test.

The oxides of nitrogen samples were taken according to the procedures outlined in EPA Method 7.

## DESCRIPTION OF TESTS

Personnel from Mullins Environmental Testing Co., Inc. arrived at the plant at 4:15 p.m. on Monday, February 21, 1983. The equipment was moved onto the exhaust stack of Kiln Number 2 and the preliminary data was collected. The equipment was secured for the night at 7:30 p.m.

On Tuesday, February 22, work began at 8:00 a.m. The equipment was prepared for testing and the first test for particulates, sulfur dioxide and oxides of nitrogen began at 8:45 a.m. The test continued without difficulty until its completion at 10:15 a.m. The second test began at 11:15 a.m. and continued until its completion at 12:45 p.m. The third and final test began at 1:30 p.m. and continued without difficulty until its completion at 3:00 p.m.

The equipment was moved off the stack and loaded into the sampling van. The samples were recovered and taken to Mullins Environmental Testing Co.'s laboratory in Dallas, Texas, for analysis and evaluation.

Operations at the Southwestern Portland Cement Company, Kiln Number 2 Stack near Odessa, Texas, were completed at 4:00 p.m. on Tuesday, February 22, 1983.

Billy J. Mullins, Jr.

Billy J. Mullins, Jr., P.E.
President

# APPENDICES

A. Location of Sampling Points

B. Source Emissions Calculations

C. Calibration Data

D. Field Testing Data

E. Analytical Data

F. Coal Analysis Data

G. Kiln Operational Data

H. Plume Observation Data

I. Chain of Custody

J. Resumes of Test Personnel

# APPENDIX A

## Location of Sampling Points
## Kiln Number 2 Stack

The sampling ports are located 35 feet (3.52 stack diameters) downstream from the inlet to the stack and 7 feet 2 1/2 inches (0.72 stack diameters) upstream from the outlet of the stack. The locations of the sampling points were calculated as follows:

Port and Wall Thickness = 3 3/4 inches
Inside Stack Diameter = 119 3/8 inches

| Point Number | Percent of Diameter From Wall | Distance From Wall |
|---|---|---|
| 1 | 1.1 | 1 5/16" |
| 2 | 3.5 | 4 3/16" |
| 3 | 6.0 | 7 3/16" |
| 4 | 8.7 | 10 3/8 " |
| 5 | 11.6 | 13 7/8 " |
| 6 | 14.6 | 17 7/16" |
| 7 | 18.0 | 21 1/2 " |
| 8 | 21.8 | 26 " |
| 9 | 26.2 | 31 1/4 " |
| 10 | 31.5 | 37 5/8 " |
| 11 | 39.3 | 46 15/16" |
| 12 | 60.7 | 72 7/16" |
| 13 | 68.5 | 81 3/4 " |
| 14 | 73.8 | 88 1/8 " |
| 15 | 78.2 | 93 3/8 " |
| 16 | 82.0 | 97 7/8 " |
| 17 | 85.4 | 101 15/16" |
| 18 | 88.4 | 105 1/2 " |
| 19 | 91.3 | 109 " |
| 20 | 94.0 | 112 3/16" |
| 21 | 96.5 | 115 3/16" |
| 22 | 98.9 | 118 1/16" |

# APPENDIX B

## Nomenclature and Equations for Calculation of Source Emissions

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## Nomenclature for Particulate Calculations

| Symbol | English Units | Metric Units | Description |
|---|---|---|---|
| $A_s$ | $in.^2$ | $m^2$ | Stack Area |
| $C_{an}$ | gr/dscf | g/dscm | Particulate - probe, cyclone and filter |
| $C_{ao}$ | gr/dscf | g/dscm | Particulate - total |
| $C_{at}$ | gr/CF @ stack conditions | $g/m^3$ | Particulate - probe, cyclone and filter |
| $C_{au}$ | gr/CF @ stack conditions | $g/m^3$ | Particulate - total |
| $C_{aw}$ | lbs/hr | kg/hr | Particulate - probe, cyclone and filter |
| $C_{ax}$ | lbs/hr | kg/hr | Particulate - total |
| $C_p$ | | | Pitot Tube Calibration Factor |
| $D_n$ | in. | m | Sampling Nozzle Diameter |
| %EA | | | Percent Excess Air at sampling point |
| g | 32.2 $ft/sec^2$ | | Acceleration of gravity |
| %I | | | Percent isokinetic |
| %M | | | Percent moisture in the stack gas by volume |
| $M_d$ | | | Mole fraction of dry gas |
| $m_f$ | mg | mg | Particulate - probe, cyclone and filter |
| $M_{H_2O}$ | 18 lb/lb-mole | | Molecular Weight of Water |

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

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| Symbol | English Units | Metric Units | Description |
|---|---|---|---|
| $m_t$ | mg | mg | Particulate - total |
| MW | lb/lb-mole | g/g-mole | Molecular Weight of stack gas |
| $MW_{air}$ | 28.95 lb/ lb-mole | | Molecular Weight of air |
| $MW_d$ | lb/lb-mole | g/g-mole | Molecular Weight of dry stack gas |
| $P_b$ | "Hg Absolute | mm Hg | Barometric Pressure |
| $P_m$ | "$H_2O$ | mm $H_2O$ | Orifice Pressure drop |
| $P_s$ | "Hg Absolute | mm Hg | Stack Pressure |
| $\Delta P_s$ | "$H_2O$ | mm $H_2O$ | Velocity Head of stack gas |
| $P_{std}$ | 29.92 "Hg | 760 mm Hg | Standard Barometric Pressure |
| $Q_a$ | ACFM | $m^3$/hr | Stack Gas Volume at Actual Stack Conditions |
| $Q_s$ | DSCFM | dscm/hr | Stack Gas Volume at 29.92 "Hg, 528°R, dry |
| R | 21.83 "Hg-$ft^3$/lb-mole-°R | | Universal Gas Constant |
| $T_m$ | °F | °C | Average Gas Meter Temperature |
| $T_t$ | min | min | Net time of test |
| $T_s$ | °F | °C | Stack Temperature |
| $T_{std}$ | 528°R | 293°K | Standard Temperature |
| $V_m$ | $ft^3$ | $m^3$ | Volume of dry gas sampled @ meter conditions |
| $V_{m_{std}}$ | dscf | dscm | Volume of dry gas sampled @ standard conditions |
| $V_s$ | fpm | m/sec | Stack velocity @ stack conditions |

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

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| Symbol | English Units | Metric Units | Description |
|---|---|---|---|
| $V_w$ | ml | ml | Total Water Collected in Impingers and Silica Gel |
| $V_{w_{gas}}$ | scf | scm | Volume of Water Vapor Collected @ standard conditions |
| $\rho_{air}$ | 0.0748 lbs/ft$^3$ | | Density of Air |
| $\rho_{H_2O}$ | 1 g/ml | | Density of Water |
| $\rho_{man}$ | 51.63 lbs/ft$^3$ | | Density of Manometer Oil |

Standard Conditions: 68°F, 29.92 "Hg (20°C, 760 mm Hg)

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

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Example Particulate Calculations

1. Volume of dry gas sampled at standard conditions.*

$$V_{m_{std}} = V_m \left( \frac{T_{std}}{T_m + 460} \right) \left[ \frac{P_b + \frac{P_m}{13.6}}{P_{std}} \right]$$

$$V_{m_{std}} = 17.65\ V_m \left[ \frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right] = \text{dscf}$$

$$V_{m_{std}} = \text{dscf} \times 0.028317 = \text{dscm}$$

2. Volume of water vapor collected at standard conditions.*

$$V_{w_{gas}} = \frac{(V_w - \text{gms } SO_2 - \text{gms } H_2S)\ \rho_{H_2O}\ R\ T_{std}}{P_{std}\ M_{H_2O}\ 453.6}$$

$$V_{w_{gas}} = 0.0472\ (V_w - \text{gms } SO_2 - \text{gms } H_2S) = \text{scf}$$

$$V_{w_{gas}} = \text{scf} \times 0.028317 = \text{scm}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

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3. Percent moisture in stack gas.

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

4. Mole fraction of dry gas.

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

5. Average molecular weight of dry stack gas.

$$MW_d = \left[\%CO_2 \times \frac{44}{100}\right] + \left[\%O_2 \times \frac{32}{100}\right] + \left[\%N_2 \times \frac{28}{100}\right] + \left[\%CO \times \frac{28}{100}\right] = \text{lb/lb-mole}$$

$$= \text{g/g-mole}$$

6. Molecular weight of stack gas.

$$MW = MW_d \times M_d + 18\ (1-M_d) = \frac{\text{lb}}{\text{lb-mole}} = \text{g/g-mole}$$

7. Percent excess air at sampling point.

$$\%EA = \frac{100\ (\%O_2 - 0.5\%\ CO)}{0.265\ (\%N_2) - (\%O_2) + 0.5\ (\%CO)}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

8. Stack Pressure.

$$P_s = P_b + \frac{\text{stack pressure } ''H_2O}{13.6} = ''\text{Hg Absolute}$$

$$P_s = ''\text{Hg Abs.} \times 25.4 = \text{mm Hg}$$

9. Stack velocity at stack conditions.

$$V_s = C_p\ 60 \left[\frac{2g \times \rho_{man} \times P_{std} \times MW_{air} \times (T_s + 460) \times \Delta P_s}{12 \times \rho_{air} \times P_s \times MW \times T_{std}}\right]^{\frac{1}{2}}$$

$$V_s = 5123.8\ C_p \left[\frac{(T_s + 460) \times \Delta P_s}{P_s \times MW}\right]^{\frac{1}{2}} = \text{fpm}$$

$$V_s = \text{fpm} \times 0.00508 = \text{m/sec}$$

10. Dry stack gas volume at standard conditions.

$$Q_s = \frac{1}{144} V_s \times A_s \times M_d \times \frac{T_{std}}{T_s + 460} \times \frac{P_s}{P_{std}}$$

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

$$Q_s = \text{DSCFM} \times 1.6990 = \text{dscm/hr}$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

11. Actual stack gas volume at stack conditions.

$$Q_a = \frac{V_s \times A_s}{144} = \text{ACFM}$$

$$Q_a = \text{ACFM} \times 1.6990 = m^3/hr$$

12. Percent isokinetic.

$$\%I = \frac{V_{m_{std}} \times (T_s + 460) \times P_{std} \times 100 \times 144}{M_d \times T_{std} \times P_s \times T_t \times V_s \times \frac{\pi D_n^2}{4}}$$

$$\%I = \frac{1039\ V_{m_{std}} \times (T_s + 460)}{M_d \times P_s \times T_t \times V_s \times D_n^2}$$

13. Particulate - probe, cyclone and filter.

$$C_{an} = \frac{m_f}{V_{m_{std}}} \times \frac{1\ gr}{64.8\ mg}$$

$$C_{an} = 0.0154 \frac{m_f}{V_{m_{std}}} = gr/dscf$$

$$C_{an} = gr/dscf \times 2.290 = g/dscm$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

14. Particulate total.

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

$$C_{ao} = \text{gr/dscf} \times 2.290 = \text{g/dscm}$$

15. Particulate - probe, cyclone and filter at stack conditions.

$$C_{at} = C_{an} \times \frac{P_s}{P_{std}} \times \frac{(T_{std})}{(T_s + 460)} \times M_d$$

$$C_{at} = \frac{17.65 \times C_{an} \times P_s \times M_d}{T_s + 460} = \text{gr/CF}$$

$$C_{at} = \text{gr/CF} \times 2.290 = \text{g/m}^3$$

16. Particulate - total, at stack conditions.

$$C_{au} = \frac{17.65 \times C_{ao} \times P_s \times M_d}{T_s + 460} = \text{gr/CF}$$

$$C_{au} - \text{gr/CF} \times 2.290 = \text{g/m}^3$$

* 528°R, 29.92 "Hg (20°C, 760 mm Hg)

METCO

SOURCE EMISSIONS SURVEY
SOUTHWESTERN PORTLAND CEMENT COMPANY
ODESSA, TEXAS
FILE NUMBER 83-09

## SOURCE EMISSIONS CALCULATIONS

Kiln Number 2 Stack

| Symbol | Description | Units | | | |
|---|---|---|---|---|---|
| Run No. | | | 1 | 2 | 3 |
| Date | | | 2/22/83 | 2/22/83 | 2/22/83 |
| Begin | | | 0845 | 1115 | 1330 |
| End | | | 1015 | 1245 | 1500 |
| $P_b$ | barometric pressure | "Hg Abs.<br>(mm Hg) | 27.19<br>(691) | 27.23<br>(692) | 27.23<br>(692) |
| $P_m$ | orifice pressure drop | "$H_2O$<br>(mm $H_2O$) | 1.582<br>(40.2) | 1.778<br>(45.2) | 1.862<br>(47.3) |
| $V_m$ | volume dry gas sampled @ meter conditions | $ft.^3$<br>($m^3$) | 57.621<br>(1.632) | 62.380<br>(1.766) | 64.417<br>(1.824) |
| $T_m$ | avg. gas meter temp. | °F<br>(°C) | 55<br>(13) | 68<br>(20) | 73<br>(23) |
| $V_{m_{std}}$ | volume dry gas sampled @ standard conditions* | dscf<br>(dscm) | 53.924<br>(1.527) | 57.054<br>(1.616) | 58.377<br>(1.653) |
| $V_w$ | total $H_2O$ collected, impingers & silica gel | ml | 51.9 | 56.7 | 58.0 |
| $V_{w_{gas}}$ | volume water vapor collected @ standard conditions* | scf<br>(scm) | 2.450<br>(0.069) | 2.676<br>(0.076) | 2.738<br>(0.078) |
| %M | moisture in stack gas by volume | % | 4.35 | 4.48 | 4.48 |

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

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Source Emissions Calculations
Southwestern Portland Cement Company
Kiln Number 2 Stack
File Number 83-09

| Symbol | Description | Units | | | |
|---|---|---|---|---|---|
| $M_d$ | mol fraction of dry gas | ---- | 0.9565 | 0.9552 | 0.9552 |
| $CO_2$ | | % | 13.9 | 13.9 | 13.9 |
| $O_2$ | | % | 12.1 | 12.4 | 12.5 |
| $N_2$ | | % | 74.0 | 73.7 | 73.6 |
| %EA | excess air @ sampling point | % | 161.1 | 173.9 | 178.5 |
| $MW_d$ | molecular weight of dry stack gas | lb/lb-mole (g/g-mole) | 30.71 (30.71) | 30.72 (30.72) | 30.72 (30.72) |
| MW | molecular weight of stack gas | lb/lb-mole (g/g-mole) | 30.16 (30.16) | 30.15 (30.15) | 30.15 (30.15) |
| $\Delta Ps$ | velocity head of stack gas | "$H_2O$ (mm $H_2O$) | 0.212 (5.4) | 0.226 (5.7) | 0.222 (5.6) |
| $T_s$ | stack temperature | °F (°C) | 336 (169) | 343 (173) | 348 (176) |
| $P_s$ | stack pressure | "Hg Abs. (mm Hg) | 27.18 (690) | 27.22 (691) | 27.22 (691) |
| $V_s$ | stack velocity @ stack conditions | fpm (m/sec) | 1,898 (9.64) | 1,969 (10.00) | 1,962 (9.97) |
| $A_s$ | stack area | $in.^2$ ($m^2$) | 11,192 (7.22) | 11,192 (7.22) | 11,192 (7.22) |
| $Q_s$ | dry stack gas volume @ standard conditions* | DSCFM (dscm/hr) | 85,336 (144,986) | 87,766 (149,114) | 86,913 (147,665) |
| $Q_a$ | actual stack gas volume @ stack conditions | ACFM ($m^3$/hr) | 147,547 (250,682) | 153,014 (259,971) | 152,506 (259,108) |

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

METCO

Source Emissions Calculations

Southwestern Portland Cement Company
Kiln Number 2 Stack
File Number 83-09

| Symbol | Description | Units | | | |
|---|---|---|---|---|---|
| $T_t$ | net time of test | min. | 88 | 88 | 88 |
| $D_n$ | sampling nozzle diam. | in. (m) | 0.330 (0.008) | 0.330 (0.008) | 0.330 (0.008) |
| %I | percent isokinetic | % | 94.3 | 97.0 | 100.2 |
| $m_f$ | particulate - probe, cyclone and filter | mg | 52.2 | 56.6 | 50.0 |
| $m_t$ | particulate - total | mg | 56.0 | 62.5 | 59.2 |
| $C_{an}$ | particulate - probe, cyclone and filter | gr/dscf* (g/dscm) | 0.0149 (0.0341) | 0.0153 (0.0350) | 0.0132 (0.0302) |
| $C_{ao}$ | particulate - total | gr/dscf* (g/dscm) | 0.0160 (0.0366) | 0.0169 (0.0386) | 0.0156 (0.0358) |
| $C_{at}$ | particulate - probe, cyclone and filter @ stack conditions | gr/cf ($g/m^3$) | 0.0086 (0.0197) | 0.0087 (0.0200) | 0.0075 (0.0172) |
| $C_{au}$ | particulate total @ stack conditions | gr/cf ($g/m^3$) | 0.0092 (0.0211) | 0.0096 (0.0221) | 0.0089 (0.0203) |
| $C_{aw}$ | particulate - probe, cyclone and filter | lbs/hr (kg/hr) | 10.9 (4.9) | 11.5 (5.2) | 9.8 (4.5) |
| $C_{ax}$ | particulate - total | lbs/hr (kg/hr) | 11.7 (5.3) | 12.7 (5.8) | 11.6 (5.3) |

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

# $SO_2$ EMISSION DATA

Client Southwestern Portland Cement Company

Job Number 83-09

Unit Tested Kiln Number 2 Stack

| Run Number | 1 | 2 | 3 | | | |
|---|---|---|---|---|---|---|
| Date | 2/22/83 | 2/22/83 | 2/22/83 | | | |
| Time | 0845-1015 | 1115-1245 | 1330-1500 | | | |
| N - normality of $BaCl_2$ | 0.0101 | 0.0101 | 0.0101 | | | |
| $ML_I$ - ml in impinger #1 | ------ | ------ | ------ | | | |
| $ML_I$ - ml in impinger #2 | 322 | 315 | 331 | | | |
| $ML_I$ - ml in impinger #3 | 295 | 281 | 288 | | | |
| $ML_A$ - ml in aliquot #1 | ------ | ------ | ------ | | | |
| $ML_A$ - ml in aliquot #2 | 10 | 10 | 10 | | | |
| $ML_A$ - ml in aliquot #3 | 10 | 10 | 10 | | | |
| $ML_B$ - ml of $BaCl_2$ to titrate #1 | ------ | ------ | ------ | | | |
| $ML_B$ - ml of $BaCl_2$ to titrate #2 | 0.10 | 0.10 | 0.10 | | | |
| $ML_B$ - ml of $BaCl_2$ to titrate #3 | 0.10 | 0.10 | 0.10 | | | |
| $ML_{BB}$ - ml of $BaCl_2$ to titrate blank | 0.05 | 0.05 | 0.05 | | | |
| $T_m$ - average gas meter temp., °F | 55 | 68 | 73 | | | |
| $V_m$ - volume of dry gas sampled @ meter conditions, $ft.^3$ | 57.621 | 62.380 | 64.417 | | | |
| $P_b$ - barometric pressure, "Hg Abs. | 27.19 | 27.23 | 27.23 | | | |
| $Q_s$ - Stack gas volume dry @ standard conditions, *SCFM | 85,336 | 87,766 | 86,913 | | | |
| $C_I$ - $SO_2$ in impinger #1, mgs | ------ | ------ | ------ | | | |
| $C_I$ - $SO_2$ in impinger #2, mgs | 0.5 | 0.5 | 0.5 | | | |
| $C_I$ - $SO_2$ in impinger #3, mgs | 0.5 | 0.5 | 0.5 | | | |
| $C_T$ - total $SO_2$ in impingers, mgs | 1.0 | 1.0 | 1.0 | | | |
| ppm $SO_2$ | 0.2 | 0.2 | 0.2 | | | |
| $C_{SO_2}$ - emission rate of $SO_2$, lbs/day | 5.0 | 4.7 | 4.7 | | | |
| $C_s$ - emission rate of S, lbs/day | 2.5 | 2.4 | 2.4 | | | |

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$C_I = \frac{ML_I \times (ML_B - ML_{BB}) \times N \times 32}{ML_A}$$

$$C_T = C_I\ \#1 + C_I\ \#2 + C_I\ \#3$$

$$\text{ppm } SO_2 = \frac{0.7513 \times C_T \times (T_m + 460)}{V_m\ P_b}$$

$$C_{SO_2} = \text{ppm } SO_2 \times Q_s \times 239.2 \times 10^{-6}$$

$$C_s = \frac{C_{SO_2}}{2}$$

METCO

SULFUR TRIOXIDE EMISSION DATA

Job Number 83-09

Job Name Southwestern Portland Cement Company

Location Odessa, Texas

Unit Tested Kiln Number 2 Stack

| Run Number | 1 | 2 | 3 | |
|---|---|---|---|---|
| Date | 2/22/83 | 2/22/83 | 2/22/83 | |
| Time | 0845-1015 | 1115-1245 | 1330-1500 | |
| $\underline{N}$ - normality of $BaCl_2$ | 0.0101 | 0.0101 | 0.0101 | |
| $ML_I$ - ml in impinger | 153 | 185 | 176 | |
| $ML_A$ - ml in aliquot | 10 | 10 | 10 | |
| $ML_B$ - ml of $BaCl_2$ to titrate | 0.40 | 0.15 | 0.20 | |
| $ML_{BB}$- ml of $BaCl_2$ to titrate blank | 0.05 | 0.05 | 0.05 | |
| $T_m$ - average gas meter temp., °F | 55 | 68 | 73 | |
| $V_m$ - volume of dry gas sampled @ meter conditions, $ft.^3$ | 57.621 | 62.380 | 64.417 | |
| $P_b$ - barometric pressure, "Hg Abs. | 27.19 | 27.23 | 27.23 | |
| $Q_s$ - stack gas volume dry @ standard conditions, *SCFM | 85,336 | 87,766 | 86,913 | |
| $C_I$ - $SO_3$ in impinger, mgs | 2.2 | 0.7 | 1.1 | |
| ppm $SO_3$ | 0.4 | 0.1 | 0.2 | |
| $C_{SO_3}$ - emission rate of $SO_3$, lbs/day | 10.9 | 3.7 | 5.1 | |
| $C_S$ - emission rate of S, lbs/day | 4.4 | 1.5 | 2.0 | |

*68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$\text{ppm } SO_3 = \frac{0.6021 \times C_I \times (T_m + 460)}{V_m P_b}$$

$$C_I = \frac{ML_I \times (ML_B - ML_{BB}) \times \underline{N} \times 40}{ML_A}$$

$$C_{SO_3} = \text{ppm } SO_3 \times Q_s \times 299.1 \times 10^{-6}$$

$$C_S = \frac{C_{SO_3}}{2.5}$$

METCO

# $NO_x$ EMISSION DATA

Job Number 83-09

Client Southwestern Portland Cement Company

Unit Tested Kiln Number 2 Stack

Date 2/22/83

Run Number 1

| Flask Number | 1 | 2 | 3 | 4 | Average |
|---|---|---|---|---|---|
| Time | 0945 | 1000 | 1015 | 1030 | |
| Initial Barometric Pressure, "Hg Abs. | 27.12 | 27.12 | 27.12 | 27.12 | |
| Initial Manometer Reading, "Hg Abs. | -24.90 | -25.10 | -25.10 | -25.10 | |
| $P_I$ - Initial Pressure of Flask, "Hg Abs. | 2.22 | 2.02 | 2.02 | 2.02 | |
| $T_I$ - Initial Temperature of Flask, °F | 58 | 58 | 59 | 57 | |
| $V_F$ - Volume of Flask, ml | 2037 | 2038 | 2050 | 2079 | |
| Final Barometric Pressure, "Hg Abs. | 29.33 | 29.33 | 29.33 | 29.33 | |
| Final Manometer Reading, "Hg Abs. | +0.10 | +1.10 | -2.00 | +0.05 | |
| $P_F$ - Final Pressure of Flask, "Hg Abs. | 29.43 | 30.43 | 27.33 | 29.38 | |
| $T_F$ - Final Temperature of Flask, °F | 71 | 71 | 71 | 71 | |
| $\mu g NO_2$ - micrograms of $NO_2$ | 1357.8 | 1708.2 | 1362.2 | 1397.3 | |
| $V_s$ - Volume of sample at conditions*, ml | 1816 | 1897 | 1700 | 1864 | |
| ppm $NO_2$ - Concentration of $NO_2$, ppm | 391.0 | 470.9 | 419.1 | 392.1 | 418.3 |
| $C_{NO_2}$ - Emission Rate of $NO_2$, lbs/dscf* | $4.67 \times 10^{-5}$ | $5.62 \times 10^{-5}$ | $5.00 \times 10^{-5}$ | $4.68 \times 10^{-5}$ | $4.99 \times 10^{-5}$ |

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$V_s = \frac{528\ (V_F - 25)}{29.92} \left[ \frac{P_F}{T_F + 460} - \frac{P_I}{T_I + 460} \right] = \text{ml}$$

$$\text{ppm } NO_2 = \frac{523 \times \mu g\ NO_2}{V_s} = \text{ppm}$$

$$C_{NO_2} = \frac{\mu g\ NO_2}{V_s} \times \frac{1\ \text{lb/ft}^3}{1.6 \times 10^4\ \mu g/\text{ml}} = 6.243 \times 10^{-5}\ \frac{\mu g\ NO_2}{V_s} = \text{lbs/dscf}$$

METCO

# $NO_x$ EMISSION DATA

Job Number 83-09

Client Southwestern Portland Cement Company

Date 2/22/83

Unit Tested Kiln Number 2 Stack

Run Number 2

| Flask Number | 5 | 6 | 7 | 8 | Average |
|---|---|---|---|---|---|
| Time | 1105 | 1120 | 1135 | 1150 | |
| Initial Barometric Pressure, "Hg Abs. | 27.12 | 27.12 | 27.12 | 27.12 | |
| Initial Manometer Reading, "Hg Abs. | -25.10 | -25.10 | -25.10 | -25.20 | |
| $P_I$ - Initial Pressure of Flask, "Hg Abs. | 2.02 | 2.02 | 2.02 | 1.92 | |
| $T_I$ - Initial Temperature of Flask, °F | 61 | 60 | 59 | 58 | |
| $V_F$ - Volume of Flask, ml | 2025 | 2087 | 2019 | 2030 | |
| Final Barometric Pressure, "Hg Abs. | 29.33 | 29.33 | 29.33 | 29.33 | |
| Final Manometer Reading, "Hg Abs. | -1.90 | -2.10 | -1.90 | -2.00 | |
| $P_F$ - Final Pressure of Flask, "Hg Abs. | 27.43 | 27.23 | 27.43 | 27.33 | |
| $T_F$ - Final Temperature of Flask, °F | 71 | 71 | 71 | 71 | |
| $\mu g NO_2$ - micrograms of $NO_2$ | 1230.8 | 1300.9 | 1292.1 | 1222.1 | |
| $V_s$ - Volume of sample at conditions*, ml | 1686 | 1725 | 1681 | 1690 | |
| ppm $NO_2$ - Concentration of $NO_2$, ppm | 381.8 | 394.4 | 402.0 | 378.2 | 389.1 |
| $C_{NO_2}$ - Emission Rate of $NO_2$, lbs/dscf* | $4.56 \times 10^{-5}$ | $4.71 \times 10^{-5}$ | $4.80 \times 10^{-5}$ | $4.51 \times 10^{-5}$ | $4.65 \times 10^{-5}$ |

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$V_s = \frac{528\ (V_F - 25)}{29.92} \left[ \frac{P_F}{T_F + 460} - \frac{P_I}{T_I + 460} \right] = \text{ml}$$

$$\text{ppm } NO_2 = \frac{523 \times \mu g\ NO_2}{V_s} = \text{ppm}$$

$$C_{NO_2} = \frac{\mu g\ NO_2}{V_s} \times \frac{1\ \text{lb/ft}^3}{1.6 \times 10^4\ \mu g/\text{ml}} = 6.243 \times 10^{-5}\ \frac{\mu g\ NO_2}{V_s} = \text{lbs/dscf}$$

METCO

# $NO_x$ EMISSION DATA

Job Number 83-09

Client Southwestern Portland Cement Company

Date 2/22/83

Unit Tested Kiln Number 2 Stack

Run Number 3

| Flask Number | 9 | 10 | 11 | 12 | Average |
|---|---|---|---|---|---|
| Time | 1327 | 1342 | 1357 | 1412 | |
| Initial Barometric Pressure, "Hg Abs. | 27.17 | 27.17 | 27.17 | 27.17 | |
| Initial Manometer Reading, "Hg Abs. | -25.00 | -24.90 | -24.90 | -24.80 | |
| $P_I$ - Initial Pressure of Flask, "Hg Abs. | 2.17 | 2.27 | 2.27 | 2.37 | |
| $T_I$ - Initial Temperature of Flask, °F | 62 | 63 | 63 | 64 | |
| $V_F$ - Volume of Flask, ml | 2038 | 2027 | 2044 | 2055 | |
| Final Barometric Pressure, "Hg Abs. | 29.33 | 29.33 | 29.33 | 29.33 | |
| Final Manometer Reading, "Hg Abs. | -2.80 | -2.35 | -2.10 | -2.25 | |
| $P_F$ - Final Pressure of Flask, "Hg Abs. | 26.53 | 26.98 | 27.23 | 27.08 | |
| $T_F$ - Final Temperature of Flask, °F | 72 | 72 | 72 | 72 | |
| $\mu g NO_2$ - micrograms of $NO_2$ | 810.3 | 1060.0 | 1173.9 | 1296.5 | |
| $V_s$ - Volume of sample at conditions*, ml | 1624 | 1638 | 1669 | 1661 | |
| ppm $NO_2$ - Concentration of $NO_2$, ppm | 261.0 | 338.4 | 367.9 | 408.2 | 343.9 |
| $C_{NO_2}$ - Emission Rate of $NO_2$, lbs/dscf* | $3.11 \times 10^{-5}$ | $4.04 \times 10^{-5}$ | $4.39 \times 10^{-5}$ | $4.87 \times 10^{-5}$ | $4.10 \times 10^{-5}$ |

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$V_s = \frac{528\ (V_F - 25)}{29.92} \left[ \frac{P_F}{T_F + 460} - \frac{P_I}{T_I + 460} \right] = \text{ml}$$

$$\text{ppm } NO_2 = \frac{523 \times \mu g\ NO_2}{V_s} = \text{ppm}$$

$$C_{NO_2} = \frac{\mu g\ NO_2}{V_s} \times \frac{1\ \text{lb/ft}^3}{1.6 \times 10^4\ \mu g/\text{ml}} = 6.243 \times 10^{-5}\ \frac{\mu g\ NO_2}{V_s} = \text{lbs/dscf}$$

# APPENDIX C

## Calibration Data

| Equipment | Calibration Factor | Calibration Date |
|---|---|---|
| Pitot Tube #10 | 0.830 | 1/18/83 |
| Probe Tip #II-6 | 0.330 | 1/31/83 |
| Dry Gas Meter #2 | 0.985 | 1/ 4/83 |
| Stack Unit Orifice #2 | | 1/10/83 |
| Digital Temperature Indicator #2 | | 1/10/83 |
| $NO_x$ Flasks (1-27) | | 1/27/83 |

# PITOT TUBE CALIBRATION

Date: Jan 18, 1983

Pitot No. 10

Time: 1400

$P_b$: 29.44 "Hg  $P_s$: — "$H_2O$

$T_s$: 73 °F  $C_{pstd}$: 0.99

| Motor Setting | fps mark | CALIBRATOR STANDARD START | CALIBRATOR STANDARD END | √ STANDARD AVERAGE | HIGH | √ HIGH | CAL. FACTOR | LOW | √ LOW | CAL. FACTOR |
|---|---|---|---|---|---|---|---|---|---|---|
| 39 | 20 | 0.120 | 0.120 | 0.346 | 0.175 | 0.418 | 0.820 | 0.175 | 0.418 | 0.820 |
| 48 | 30 | 0.240 | 0.240 | 0.490 | 0.345 | 0.587 | 0.826 | 0.340 | 0.583 | 0.832 |
| 55 | 40 | 0.420 | 0.420 | 0.648 | 0.590 | 0.768 | 0.835 | 0.585 | 0.765 | 0.839 |
| 63 | 50 | 0.655 | 0.655 | 0.809 | 0.915 | 0.957 | 0.838 | 0.915 | 0.957 | 0.838 |
| 70 | 60 | 0.890 | 0.890 | 0.943 | 1.30 | 1.140 | 0.819 | 1.25 | 1.12 | 0.835 |
| 76 | 70 | 1.10 | 1.10 | 1.05 | 1.55 | 1.24 | 0.834 | 1.50 | 1.22 | 0.848 |
| 84 | 80 | 1.30 | 1.30 | 1.140 | 1.85 | 1.36 | 0.830 | 1.80 | 1.34 | 0.841 |
| 100 | 90 | 1.60 | 1.70 | 1.285 | 2.30 | 1.52 | 0.838 | 2.25 | 1.500 | 0.848 |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| Average | | | | | | | 0.830 | | | 0.838 |

Summary of Results:

Normal high side calibration factor 0.830
variation -1.3, +0.96

Normal low side calibration factor 0.838
variation -2.1, +1.2

Kevin S. Dooley

Signature of Calibrator

METCO

NOZZLE CALIBRATION

Nozzle Set No. II

Date: 1/31/83 Calibrator: Larry M Williams

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Reading 1 | 0.184 | 0.128 | 0.253 | 0.245 | 0.311 |
| Reading 2 | 0.182 | 0.130 | 0.253 | 0.246 | 0.312 |
| Reading 3 | 0.184 | 0.132 | 0.250 | 0.247 | 0.312 |
| Reading 4 | 0.183 | 0.130 | 0.252 | 0.246 | 0.310 |
| Reading 5 | 0.182 | 0.131 | 0.251 | 0.246 | 0.310 |
| Reading 6 | 0.184 | 0.131 | 0.252 | 0.248 | 0.310 |
| Reading 7 | 0.183 | 0.130 | 0.253 | 0.246 | 0.312 |
| Reading 8 | 0.184 | 0.131 | 0.252 | 0.247 | 0.311 |
| Reading 9 | 0.183 | 0.130 | 0.253 | 0.246 | 0.312 |
| Reading 10 | 0.183 | 0.131 | 0.252 | 0.245 | 0.312 |
| Average | 0.183 | 0.130 | 0.252 | 0.246 | 0.311 |

| | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|
| Reading 1 | 0.320 | 0.353 | 0.415 | 0.501 | 0.500 |
| Reading 2 | 0.329 | 0.351 | 0.413 | 0.503 | 0.499 |
| Reading 3 | 0.330 | 0.352 | 0.414 | 0.501 | 0.502 |
| Reading 4 | 0.331 | 0.352 | 0.413 | 0.503 | 0.499 |
| Reading 5 | 0.331 | 0.350 | 0.412 | 0.504 | 0.500 |
| Reading 6 | 0.330 | 0.353 | 0.414 | 0.504 | 0.499 |
| Reading 7 | 0.330 | 0.353 | 0.415 | 0.503 | 0.498 |
| Reading 8 | 0.329 | 0.350 | 0.415 | 0.501 | 0.499 |
| Reading 9 | 0.330 | 0.352 | 0.415 | 0.503 | 0.501 |
| Reading 10 | 0.329 | 0.353 | 0.414 | 0.501 | 0.502 |
| Average | 0.330 | 0.352 | 0.414 | 0.502 | 0.500 |

METCO

DRY GAS METER CALIBRATION

Meter Number: 2 Calibrator: Don C Alexander

Date: 1/4/83

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 2 $P_b$: 29.60 "Hg

Control Module Vacuum 5.2 "Hg

| | WET TEST METER | | | | DRY GAS METER | | | |
|---|---|---|---|---|---|---|---|---|
| | Time | Meter Reading | Temp. | $P_m$ | Meter Reading | Temp. In | Temp. Out | $P_m$ |
| End | 1715 | 6.000 cf | 69 °F | -0.65 "$H_2O$ | 262.460 cf | 81 °F | 80 °F | 0.50 "$H_2O$ |
| Start | 1700 | 0.000 cf | 69 °F | -0.65 "$H_2O$ | 256.502 cf | 81 °F | 80 °F | 0.50 "$H_2O$ |
| | | 6.000 cf | °F | "$H_2O$ | 5.958 cf | °F | °F | "$H_2O$ |

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 6.000 \left( \frac{29.60 \; -0.65 + 13.6}{69 + 460} \right) \times \underset{(C_f)}{0.972} = 5.754 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 5.958 \left( \frac{29.60 \; 0.50 + 13.6}{80 + 460} \right) \; 5.771 = \text{ dscf}$$

$$C_{DG} = \frac{5.750}{5.771} = \boxed{0.996}$$

Average $C_{DG}$ = 0.985

METCO

DRY GAS METER CALIBRATION

Meter Number: 2

Calibrator: Don C Alexander

Date: 1/4/83

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 1

$P_b$: 29.60 "Hg

Control Module Vacuum 4.8 "Hg

| | WET TEST METER | | | | DRY GAS METER | | | |
|---|---|---|---|---|---|---|---|---|
| | Time | Meter Reading | Temp. | $P_m$ | Meter Reading | Temp. In | Temp. Out | $P_m$ |
| End | 1658 | 5.252 cf | 69 °F | -1.15 "$H_2O$ | 256.252 cf | 87 °F | 86 °F | 1.00 "$H_2O$ |
| Start | 1644 | 0.000 cf | 69 °F | -1.15 "$H_2O$ | 251.000 cf | 82 °F | 80 °F | 1.00 "$H_2O$ |
| | | cf | °F | "$H_2O$ | 5.252 cf | °F | °F | "$H_2O$ |

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 5.252 \left( \frac{29.60 - 1.15 + 13.6}{69 + 460} \right) \times \underset{(C_f)}{0.972} = \quad \text{dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 5.252 \left( \frac{29.60 + 1.00 + 13.6}{81 + 460} \right) 5.084 = \quad \text{dscf}$$

$$C_{DG} = \frac{5.027}{5.084} = \boxed{0.989}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 3 Calibrator: Don C Alexander

Date: 1/4/83

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 3

$P_b$: 29.60 "Hg

Control Module Vacuum 5.2 "Hg

| | WET TEST METER | | | | DRY GAS METER | | | |
|---|---|---|---|---|---|---|---|---|
| | Time | Meter Reading | Temp. | $P_m$ | Meter Reading | Temp. In | Temp. Out | $P_m$ |
| End | 1735 | 10.000 cf | 69 °F | -1.65 "$H_2O$ | 272.901 cf | 86 °F | 79 °F | 1.50 "$H_2O$ |
| Start | 1716 | 0.000 cf | 69 °F | -1.65 "$H_2O$ | 262.701 cf | 81 °F | 79 °F | 1.50 "$H_2O$ |
| | | 10.000 cf | °F | "$H_2O$ | cf | °F | °F | "$H_2O$ |

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.250 \left(\frac{29.60 - 1.65 + 13.6}{69 + 460}\right) \times \underset{(C_f)}{0.972} = \overset{9.799}{\cancel{9.560}} \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 10.201 \left(\frac{29.60 - 1.50 + 13.6}{81 + 460}\right) \quad 9.884 \text{ dscf}$$

$$C_{DG} = \frac{\overset{799}{\cancel{9.560}}}{9.888} = \boxed{\overset{0.991}{\cancel{0.967}}}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 2 Calibrator: Don C Alexander

Date: 1/4/83

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 4 $P_b$: 29.60 "Hg

Control Module Vacuum 5.2 "Hg

| | WET TEST METER | | | | DRY GAS METER | | | |
|---|---|---|---|---|---|---|---|---|
| | Time | Meter Reading | Temp. | $P_m$ | Meter Reading | Temp. In | Temp. Out | $P_m$ |
| End | 1748 | 10.001 cf | 69 °F | -1.85 "$H_2O$ | 282.917 cf | 87 °F | 80 °F | 2.00 "$H_2O$ |
| Start | 1736 | 0.000 cf | 69 °F | -1.85 "$H_2O$ | 272.901 cf | 84 °F | 79 °F | 2.00 "$H_2O$ |
| | | cf | °F | "$H_2O$ | cf | °F | °F | "$H_2O$ |

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 10.001 \left( \frac{29.60 - 1.85 / 13.6}{69 + 460} \right) \times \underset{(C_f)}{0.972} = 9.556 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 10.016 \left( \frac{29.60 + 2.00 / 13.6}{82 + 460} \right) \quad 9.702 = \quad \text{dscf}$$

$$C_{DG} = \frac{9.556}{9.702} = \boxed{0.985}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 2

Calibrator: Don C Oldfield

Date: ~~12/2~~ 1/4/83

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 5

$P_b$: 29.60 "Hg

Control Module Vacuum 4.7 "Hg

| | WET TEST METER | | | | DRY GAS METER | | | |
|---|---|---|---|---|---|---|---|---|
| | Time | Meter Reading | Temp. | $P_m$ | Meter Reading | Temp. In | Temp. Out | $P_m$ |
| End | 1805 | 11.503 cf | 69 °F | -2.70 "$H_2O$ | 294.741 cf | 91 °F | 81 °F | 3.00 "$H_2O$ |
| Start | 1750 | 0.000 cf | 69 °F | -2.70 "$H_2O$ | 283.100 cf | 86 °F | 81 °F | 3.00 "$H_2O$ |
| | | cf | °F | "$H_2O$ | 11.641 cf | °F | °F | "$H_2O$ |

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 11.503 \left(\frac{29.60 + \frac{-2.70}{13.6}}{69 + 460}\right) \times \underset{(C_f)}{0.972} = 10.968 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 11.641 \left(\frac{29.60 + \frac{3.00}{13.6}}{85 + 460}\right) = 11.242 \text{ dscf}$$

$$C_{DG} = \frac{10.968}{11.242} = \boxed{0.976}$$

METCO

DRY GAS METER CALIBRATION

Meter Number: 2

Date: 1/4/83

Calibrator: Don C Alexander

$$\text{Calibration Factor } (C_{DG}) = \frac{\text{Wet Test Meter } V_{m_{std}}}{\text{Dry Gas Meter } V_{m_{std}}}$$

Run No.: 6

$P_b$: 29.60 "Hg

Control Module Vacuum 4.8 "Hg

| | WET TEST METER | | | | DRY GAS METER | | | |
|---|---|---|---|---|---|---|---|---|
| | Time | Meter Reading | Temp. | $P_m$ | Meter Reading | Temp. In | Temp. Out | $P_m$ |
| End | 1834 | 26.753 cf | 69 °F | -3.40 "$H_2O$ | 322.112 cf | 96 °F | 83 °F | 4.00 "$H_2O$ |
| Start | 1810 | 0.000 cf | 69 °F | -3.40 "$H_2O$ | 295.002 cf | 88 °F | 81 °F | 4.00 "$H_2O$ |
| | | 26.753 cf | °F | "$H_2O$ | 27.110 cf | °F | °F | "$H_2O$ |

$$\text{Wet Test Meter } V_{m_{std}} = 17.65 \times 26.753 \left( \frac{29.60 + \frac{-3.40}{13.6}}{69 + 460} \right) \times \underset{(C_f)}{0.972} = 25.465 \text{ dscf}$$

$$\text{Dry Gas Meter } V_{m_{std}} = 17.65 \times 27.110 \left( \frac{29.60 + \frac{4.00}{13.6}}{87 + 460} \right) = 26.150 \text{ dscf}$$

$$C_{DG} = \frac{25.465}{26.150} = \boxed{0.973}$$

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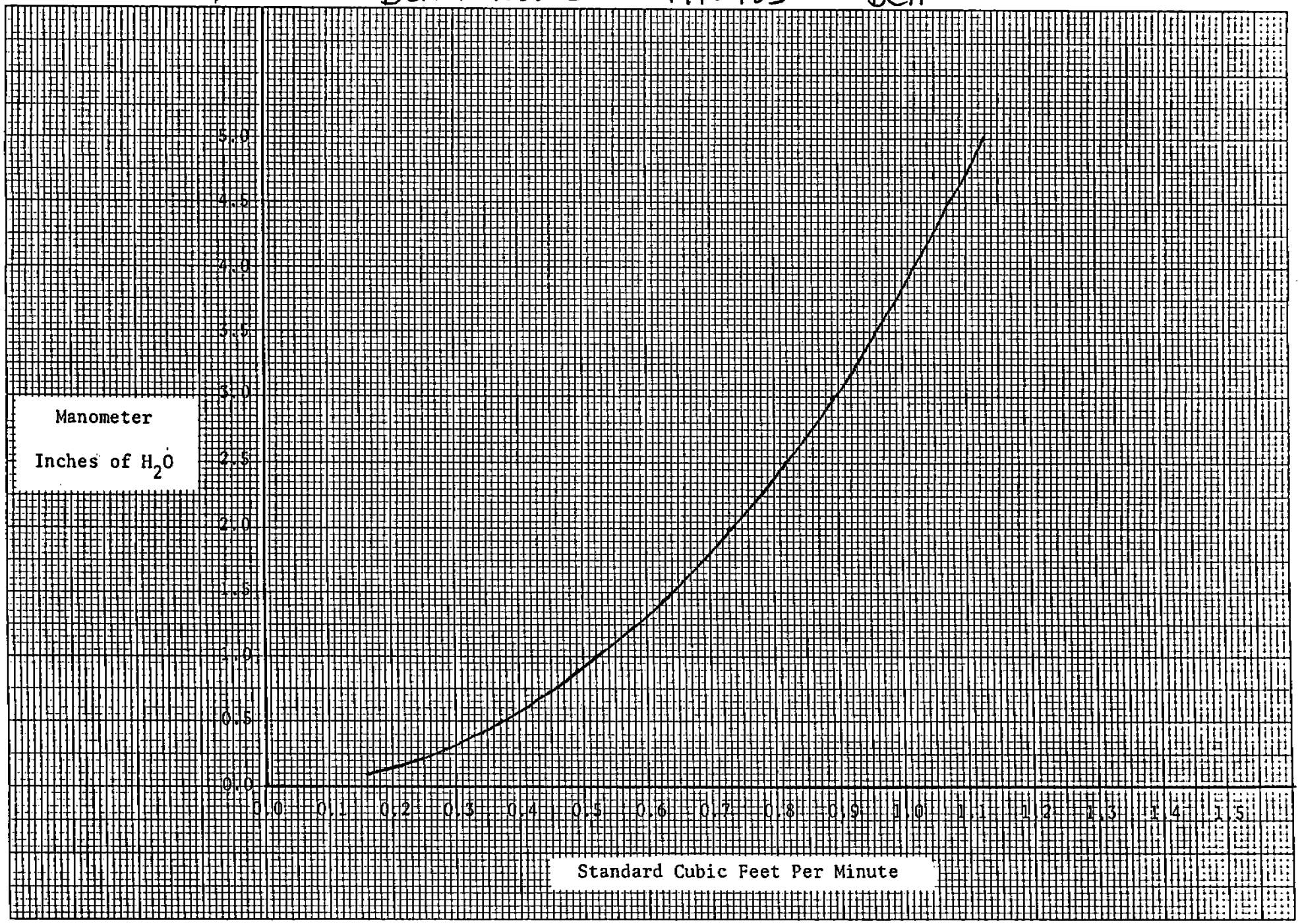
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1320

DGM No. 2 1/10/83 DCA



METCO

DIGITAL TEMPERATURE INDICATOR NO. 2

CALIBRATION DATA

Date: 1/10/83

| Media | Time | Mercury Thermometer (°F) | DTI (°F) |
|---|---|---|---|
| Ice Bath | 1432 | 32 | 32 |
| Ambient Air | 1430 | 72 | 72 |
| Boiling Water | 1440 | 210 | 211 |
| Oven | 1445 | 184 | 180 |
| Oven | 1455 | 311 | 308 |
| Oven | 1500 | 385 | 383 |
| Oven | 1507 | 439 | 437 |

Meter Adjusted? Yes _____ No ✓

Douglas R Leathoff
Signature of Calibrator

METCO

$NO_x$ Flask Calibration

1/27/83

| Flask Number | Flask Volume ml | Stopcock Volume ml | Total Volume ml |
|---|---|---|---|
| 1 | 2014 | 23 | 2037 |
| 2 | 2014 | 24 | 2038 |
| 3 | 2028 | 22 | 2050 |
| 4 | 2061 | 18 | 2079 |
| 5 | 2004 | 21 | 2025 |
| 6 | 2064 | 23 | 2087 |
| 7 | 1998 | 21 | 2019 |
| 8 | 2009 | 21 | 2030 |
| 9 | 2019 | 19 | 2038 |
| 10 | 2006 | 21 | 2027 |
| 11 | 2020 | 24 | 2044 |
| 12 | 2033 | 22 | 2055 |
| 13 | 2011 | 24 | 2035 |
| 14 | 2044 | 24 | 2068 |
| 15 | 2041 | 24 | 2065 |
| 16 | 2033 | 21 | 2054 |
| 17 | 2018 | 21 | 2039 |
| 18 | 2033 | 21 | 2054 |
| 19 | 2020 | 21 | 2041 |
| 20 | 2007 | 22 | 2029 |
| 21 | 2012 | 23 | 2035 |
| 22 | 1982 | 22 | 2004 |
| 23 | 2009 | 22 | 2031 |
| 24 | 1997 | 24 | 2021 |
| 25 | 2036 | 22 | 2058 |
| 26 | 2030 | 23 | 2053 |
| 27 | 2000 | 22 | 2022 |

# APPENDIX D

## Field Testing Data

MU NS RON TAL TIN CO., INC.

Job No. 83-09

Job Name SW PORTLAND CEMENT

Run No. 1

Location KILN NO. 2 STACK

Date 22 FEBRUARY 1983

Operator Alexander, Overton, Mullins Jr

Sample Box No. 7 Meter Box No. 2

Part. $SO_2$ FIELD DATA

Read and record at the start of each test point.

Purge to: 250.600

Purge time: 1018-1033

Ambient Temp. °F 45

Assumed Moisture % 5.7

Probe Length ~~8~~ 10

C Factor — to reference

Initial Leak @ 15.0 "Hg = 0.002 cfm

Final Leak @ 16.1 "Hg = 0.000 cfm

| Point | Clock Time | Dry Gas Meter, CF | Pitot in. $H_2O$ ($\Delta P_s$) | Orifice ΔH in. $H_2O$ ($P_m$) Desired | Orifice ΔH in. $H_2O$ ($P_m$) Actual | Pump Vacuum In. Hg Gauge | Stack Temp. °F ($T_s$) | Probe Temp. °F | Oven Temp. °F | Effluent Temp. °F | Dry Gas Temp. °F ($T_m$) Inlet | Dry Gas Temp. °F ($T_m$) Outlet | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A22 | 0845 | 183.302 | 0.23 | 1.70 | 1.70 | 10.0 | 320 | 273 | 268 | 49 | 46 | 45 | |
| 21 | 0847 | 184.68 | 0.29 | 2.20 | 2.20 | 11.0 | 339 | 262 | 263 | 42 | 47 | 45 | |
| 20 | 0849 | 186.22 | 0.34 | 2.50 | 2.50 | 12.5 | 342 | 264 | 262 | 42 | 47 | 45 | |
| 19 | 0851 | 187.88 | 0.36 | 2.70 | 2.70 | 14.0 | 342 | 252 | 260 | 42 | 49 | 45 | |
| 18 | 0853 | 189.62 | 0.36 | 2.70 | 2.70 | 14.3 | 344 | 245 | 260 | 42 | 49 | 45 | |
| 17 | 0855 | 191.36 | 0.36 | 2.70 | 2.70 | 15.0 | 344 | 242 | 261 | 43 | 50 | 46 | |
| 16 | 0857 | 193.10 | 0.37 | 2.75 | 2.75 | 15.0 | 342 | 254 | 264 | 44 | 51 | 46 | |
| 15 | 0859 | 194.85 | 0.33 | 2.45 | 2.45 | 13.5 | 339 | 269 | 263 | 46 | 52 | 46 | |
| 14 | 0901 | 196.53 | 0.30 | 2.25 | 2.25 | 12.5 | 343 | 259 | 262 | 47 | 52 | 46 | |
| 13 | 0903 | 198.17 | 0.30 | 2.25 | 2.25 | 12.3 | 344 | 254 | 262 | 48 | 53 | 47 | |
| 12 | 0905 | 199.76 | 0.25 | 1.85 | 1.85 | 10.5 | 338 | 249 | 264 | 50 | 54 | 47 | |
| 11 | 0907 | 201.26 | 0.18 | 1.35 | 1.35 | 7.5 | 333 | 245 | 266 | 51 | 55 | 47 | ORSAT |
| 10 | 0909 | 202.60 | 0.13 | 0.97 | 0.97 | 6.0 | 328 | 242 | 266 | 52 | 55 | 47 | |
| 9 | 0911 | 203.70 | 0.11 | 0.82 | 0.82 | 5.0 | 332 | 239 | 267 | 53 | 56 | 48 | |
| 8 | 0913 | 204.70 | 0.11 | 0.82 | 0.82 | 5.0 | 331 | 238 | 268 | 54 | 56 | 48 | |
| 7 | 0915 | 205.68 | 0.11 | 0.82 | 0.82 | 5.0 | 331 | 240 | 269 | 54 | 57 | 49 | |
| 6 | 0917 | 206.64 | 0.13 | 0.97 | 0.97 | 5.5 | 334 | 243 | 267 | 55 | 58 | 49 | |
| 5 | 0919 | 207.66 | 0.15 | 1.10 | 1.10 | 6.3 | 330 | 246 | 267 | 54 | 58 | 49 | |

Pitot Tube Calibration Factor $C_p$ 0.830

Volume Collected $V_m$ 57.621 $ft^3$

Water Collected $V_w$ 51.9 ml

Time of Test $T_t$ 88 min.

Stack Pressure $P_s$ −0.11 "$H_2O$

Baro. Press. $P_b$ 27.19 "Hg

Probe Tip Dia. $D_n$ 0.330 in.

% $CO_2$ 13.9 % CO 0.0

% $O_2$ 12.1 % $N_2$ 74.0

Area Stack $A_s$ 11192 $in^2$

Pitot Tube No. 10 Barometer No. —

Probe Tip No. II-6

$V_m$ = Dry Gas Meter Calibration Factor 0.985 X 58.498

[Dry Gas Meter Reading ____ $ft^3$ - ($T_t$ ____ min X Leak Rate ____ cfm)]

$M_F$ = ____ $M_T$ = ____

Impinger Box No. 7

| | | |
|---|---|---|
| Impinger 1 | Final Weight | 577.5 |
| | Initial Weight | 649.1 |
| | Increase | -71.46 |
| Impinger 2 | Final Weight | 749.0 |
| | Initial Weight | 681.0 |
| | Increase | 68.0 |
| Impinger 3 | Final Weight | 709.6 |
| | Initial Weight | 680.8 |
| | Increase | 28.8 |
| Impinger 4 | Final Weight | 487.0 |
| | Initial Weight | 483.8 |
| | Increase | 3.2 |
| Impinger 5 | Final Weight | 802.6 |
| | Initial Weight | 779.1 |
| | Increase | 23.5 |
| Impinger 6 | Final Weight | |
| | Initial Weight | |
| | Increase | |

Filter # _____ Final Weight _____ Initial Weight _____ Increase _____

Water Weight Gain

| | |
|---|---|
| Impinger 1 | -71.6 |
| Impinger 2 | 68.0 |
| Impinger 3 | 28.8 |
| Impinger 4 | 3.2 |
| Impinger 5 | 23.5 |
| Impinger 6 | |
| Total | 51.9 = $V_w$ |

$V_w$ =
g $SO_2$ = -
$V_w$ =

$P_b$ = 27.19
$V_m$ = 57.621
$V_w$ = 51.9
$P_m$ = 1.582
Avg $\Delta P$ = 0.212
Avg $\sqrt{\Delta P}$ = 0.453
$C_p$ = 0.830
$P_s$ = -0.11 $H_2O$ 27.18 Hg
$T_m$ = 55 °F 515 °R
$T_s$ = 336 °F 796 °R

%$CO_2$ = 13.8, 14.0 | 13.
%$O_2$ = 12.0, 12.2 | 12.1
%CO = 0.0, 0.0 | 0.0
%$N_2$ = 74.2, 73.8 | 74.

$A_s$ = 11192
$D_n$ = 0.330
$T_t$ = 88

Moisture Content: %M = 04.35 $M_d$ = 0.9565 $MW_d$ = 30.708 MW = 30.16

$$V_{m_{std}} = 17.65\ V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 57.621 \left(\frac{27.19 + \frac{1.582}{13.6}}{55 + 460}\right) = 53.924\ sft^3$$

0.613 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 51.9 = 2.450\ sft^3$$

$$\%\ Moisture = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{2.450}{53.924 + 2.450} \times 100 = 4.35\ \%$$

$$V_s = 5123.8 \times 0.830 \sqrt{\frac{796}{27.18 \times 30.16}} \times 0.453 = 1898\ fpm$$

ACFM: 147547

$$\%I = \frac{1039 \times 796 \times 53.924}{0.9565 \times 27.18 \times 1898 \times 88 \times (0.330)^2} = 94.3\ \%$$

SCFM: 85336

%EA: 166.1

Run No. 1

Location KILN NO. 2 STACK

Date 22 February 1983

PARTICULATE FIELD DATA

| Point | Clock Time | Dry Gas Meter, CF | $\Delta P_s$ Pitot in. $H_2O$ | $P_m$ Orifice $\Delta H$ in. $H_2O$ Desired | Actual | Pump Vacuum In. Hg Gauge | $T_s$ Stack Temp. °F | Probe Temp. °F | Oven Temp. °F | Effluent Temp. °F | $T_m$ Dry Gas Temp. °F Inlet | Outlet | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 0921 | 208.80 | 0.16 | 1.20 | 1.20 | 6.5 | 330 | 246 | 268 | 54 | 59 | 49 | |
| 3 | 0923 | 209.95 | 0.18 | 1.35 | 1.35 | 7.0 | 334 | 248 | 267 | 55 | 60 | 49 | |
| 2 | 0925 | 211.21 | 0.17 | 1.25 | 1.25 | 7.0 | 327 | 248 | 266 | 54 | 61 | 50 | |
| 1 | 0927 | 212.41 | 0.13 | 0.97 | 0.97 | 6.0 | 323 | 246 | 269 | 55 | 61 | 50 | |
| END | 0929 | 213.507 | — | — | — | — | — | — | — | — | — | — | |
| B 22 | 0931 | 213.507 | 0.28 | 2.10 | 2.10 | 11.0 | 340 | 256 | 239 | 60 | 61 | 50 | |
| 21 | 0933 | 214.91 | 0.30 | 2.20 | 2.20 | 11.6 | 339 | 262 | 240 | 57 | 62 | 50 | |
| 20 | 0935 | 216.51 | 0.32 | 2.40 | 2.40 | 13.0 | 338 | 261 | 233 | 57 | 63 | 51 | |
| 19 | 0937 | 218.15 | 0.27 | 2.00 | 2.00 | 11.3 | 342 | 269 | 229 | 55 | 64 | 52 | |
| 18 | 0939 | 219.69 | 0.23 | 1.70 | 1.70 | 9.5 | 340 | 268 | 231 | 55 | 65 | 52 | |
| 17 | 0941 | 221.20 | 0.22 | 1.60 | 1.60 | 9.0 | 336 | 272 | 235 | 53 | 65 | 52 | |
| 16 | 0943 | 222.51 | 0.16 | 1.20 | 1.20 | 7.0 | 340 | 274 | 247 | 52 | 64 | 52 | |
| 15 | 0945 | 223.78 | 0.13 | 0.97 | 0.97 | 6.1 | 336 | 259 | 251 | 52 | 65 | 52 | |
| 14 | 0947 | 224.85 | 0.12 | 0.90 | 0.90 | 5.5 | 337 | 252 | 246 | 52 | 65 | 53 | |
| 13 | 0949 | 225.90 | 0.10 | 0.75 | 0.75 | 4.9 | 335 | 243 | 236 | 53 | 65 | 54 | |
| 12 | 0951 | 226.83 | 0.15 | 1.10 | 1.10 | 6.0 | 334 | 238 | 241 | 52 | 65 | 54 | orsat |
| 11 | 0953 | 227.93 | 0.15 | 1.10 | 1.10 | 6.0 | 336 | 235 | 252 | 52 | 66 | 54 | |
| 10 | 0955 | 229.05 | 0.15 | 1.10 | 1.10 | 6.0 | 332 | 241 | 250 | 52 | 66 | 54 | |
| 9 | 0957 | 230.25 | 0.16 | 1.20 | 1.20 | 6.5 | 337 | 246 | 245 | 52 | 67 | 55 | |
| 8 | 0959 | 231.37 | 0.18 | 1.35 | 1.35 | 7.2 | 335 | 248 | 235 | 51 | 67 | 55 | |
| 7 | 1001 | 232.65 | 0.18 | 1.35 | 1.35 | 7.2 | 333 | 247 | 235 | 51 | 68 | 55 | |
| 6 | 1003 | 233.86 | 0.21 | 1.55 | 1.55 | 8.1 | 334 | 249 | 250 | 51 | 69 | 55 | |
| 5 | 1005 | 235.20 | 0.21 | 1.55 | 1.55 | 8.1 | 334 | 251 | 257 | 51 | 69 | 56 | |
| 4 | 1007 | 236.52 | 0.20 | 1.50 | 1.50 | 8.0 | 339 | 253 | 263 | 51 | 69 | 55 | |
| 3 | 1009 | 237.85 | 0.21 | 1.55 | 1.55 | 8.5 | 337 | 256 | 257 | 52 | 70 | 56 | |
| 2 | 1011 | 239.20 | 0.21 | 1.55 | 1.55 | 8.5 | 335 | 256 | 250 | 53 | 70 | 56 | |
| 1 | 1013 | 240.55 | 0.16 | 1.20 | 1.20 | 6.8 | 327 | 261 | 238 | 53 | 70 | 56 | |
| END | 1015 | 241.800 | — | — | — | — | — | — | — | — | — | — | |
| ALL | | | | | | | | | | | | | |

MU NS I RON AL TING CO., INC.

Job No. 83-09

Job Name SW PORTLAND CEMENT

Run No. 2

Location Kiln #2 Stack

Date 22 February 1983

Operator Alexander, Overton, Mullins Jr

Sample Box No. 8 Meter Box No. 2

Part., $SO_2$ FIELD DATA

Read and record at the start of each test point.

Purge to: 324.450

Purge time: 1247-1302

Ambient Temp. °F 58

Assumed Moisture % 4

Probe Length 10

C Factor — 78 to reference

Initial Leak @ 16.5 "Hg = 0.002 cfm

Final Leak @ 17.0 "Hg = 0.000 cfm

| Point | Clock Time | Dry Gas Meter, CF | Pitot in. $H_2O$ ($\Delta P_s$) | Orifice ΔH in. $H_2O$ ($P_m$) Desired | Orifice ΔH in. $H_2O$ ($P_m$) Actual | Pump Vacuum In. Hg Gauge | Stack Temp. °F ($T_s$) | Probe Temp. °F | Oven Temp. °F | Effluent Temp. °F | Dry Gas Temp. °F ($T_m$) Inlet | Dry Gas Temp. °F ($T_m$) Outlet | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B 22 | 1115 | 250.987 | 0.28 | 2.20 | 2.20 | 11.5 | 342 | 261 | 230 | 56 | 62 | 60 | |
| 21 | 1117 | 252.61 | 0.31 | 2.45 | 2.45 | 11.5 | 351 | 272 | 230 | 50 | 62 | 60 | |
| 20 | 1119 | 254.30 | 0.31 | 2.45 | 2.45 | 11.5 | 346 | 261 | 229 | 50 | 64 | 60 | |
| 19 | 1121 | 255.96 | 0.29 | 2.30 | 2.30 | 11.2 | 341 | 267 | 227 | 49 | 65 | 60 | |
| 18 | 1123 | 257.64 | 0.24 | 1.90 | 1.90 | 9.0 | 343 | 259 | 232 | 47 | 66 | 60 | |
| 17 | 1125 | 259.19 | 0.22 | 1.75 | 1.75 | 8.2 | 342 | 259 | 234 | 48 | 67 | 61 | |
| 16 | 1127 | 260.65 | 0.19 | 1.50 | 1.50 | 7.5 | 343 | 255 | 226 | 49 | 66 | 60 | |
| 15 | 1129 | 261.98 | 0.17 | 1.35 | 1.35 | 7.0 | 344 | 250 | 228 | 50 | 68 | 61 | |
| 14 | 1131 | 263.29 | 0.15 | 1.20 | 1.20 | 6.5 | 344 | 244 | 230 | 50 | 69 | 61 | |
| 13 | 1133 | 264.51 | 0.12 | 0.95 | 0.95 | 5.5 | 341 | 245 | 228 | 50 | 68 | 61 | |
| 12 | 1135 | 265.57 | 0.14 | 1.10 | 1.10 | 5.5 | 341 | 237 | 237 | 52 | 70 | 62 | orsf |
| 11 | 1137 | 266.73 | 0.14 | 1.10 | 1.10 | 5.5 | 342 | 250 | 243 | 52 | 70 | 62 | |
| 10 | 1139 | 267.83 | 0.17 | 1.35 | 1.35 | 6.5 | 342 | 251 | 238 | 52 | 70 | 62 | |
| 9 | 1141 | 269.05 | 0.17 | 1.35 | 1.35 | 6.5 | 341 | 253 | 244 | 52 | 71 | 62 | |
| 8 | 1143 | 270.34 | 0.18 | 1.40 | 1.40 | 7.0 | 339 | 251 | 244 | 52 | 72 | 62 | |
| 7 | 1145 | 271.67 | 0.22 | 1.75 | 1.75 | 8.2 | 340 | 250 | 252 | 51 | 73 | 62 | |
| 6 | 1147 | 273.05 | 0.24 | 1.90 | 1.90 | 9.1 | 341 | 249 | 261 | 51 | 73 | 62 | |
| 5 | 1149 | 274.50 | 0.24 | 1.90 | 1.90 | 9.1 | 340 | 250 | 265 | 50 | 74 | 62 | |

Pitot Tube Calibration Factor $C_p$ 0.830

Volume Collected $V_m$ 62.380 $ft^3$

Water Collected $V_w$ 56.7 ml

Time of Test $T_t$ 88 min.

Stack Pressure $P_s$ -0.14 "$H_2O$

Baro. Press. $P_b$ 27.23 "Hg

Probe Tip Dia. $D_n$ 0.330 in.

% $CO_2$ 13.9 % CO 0.0

% $O_2$ 12.4 % $N_2$ 73.7

Area Stack $A_s$ 1192 $in^2$

Pitot Tube No. 10 Barometer No. —

Probe Tip No. II-6

$V_m$ = Dry Gas Meter Calibration Factor 0.985 X 63.330

[Dry Gas Meter Reading ____ $ft^3$ - ($T_t$ ____ min X Leak Rate ____ cfm)]

$M_F$ = ____ $M_T$ = ____

Impinger Box No. 8

| | | |
|---|---|---|
| Impinger 1 | Final Weight | 603.6 |
| | Initial Weight | 648.1 |
| | Increase | -44.5 |
| Impinger 2 | Final Weight | 761.2 |
| | Initial Weight | 698.6 |
| | Increase | 62.6 |
| Impinger 3 | Final Weight | 707.2 |
| | Initial Weight | 689.3 |
| | Increase | 17.9 |
| Impinger 4 | Final Weight | 486.6 |
| | Initial Weight | 485.0 |
| | Increase | 1.6 |
| Impinger 5 | Final Weight | 855.9 |
| | Initial Weight | 836.8 |
| | Increase | 19.1 |
| Impinger 6 | Final Weight | |
| | Initial Weight | |
| | Increase | |

Filter # _____ Final Weight _____ Initial Weight _____ Increase _____

Water Weight Gain

$V_w$ =

g $SO_2$ = -

$V_w$ =

| | |
|---|---|
| Impinger 1 | -44.5 |
| Impinger 2 | 62.6 |
| Impinger 3 | 17.9 |
| Impinger 4 | 1.6 |
| Impinger 5 | 19.1 |
| Impinger 6 | |
| Total | 56.7 = $V_w$ |

| | | | | |
|---|---|---|---|---|
| $P_b$ = | 27.23 | %$CO_2$ = | 14.2, 13.6 | 1 |
| $V_m$ = | 62.380 | %$O_2$ = | 12.2, 12.6 | 12 |
| $V_w$ = | 56.7 | %CO = | 0.0, 0.0 | 0. |
| $P_m$ = | 1.778 | %$N_2$ = | 73.6, 73.8 | 73. |
| Avg $\Delta P$ = | 0.226 | $A_s$ = | 11192 | |
| Avg $\sqrt{\Delta P}$ = | 0.468 | $D_n$ = | 0.330 | |
| $C_p$ = | 0.830 | $T_t$ = | 88 | |
| $P_s$ = | -0.14 "$H_2O$ | | 27.22 "Hg | |
| $T_m$ = | 68 °F | | 528 °R | |
| $T_s$ = | 343 °F | | 803 °R | |

Moisture Content: %M = 4.48 $M_d$ = 0.9552 $MW_d$ = 30.720 MW = 30.15

$$V_{m_{std}} = 17.65\, V_m \left(\frac{P_b + \frac{P_m}{13.6}}{T_m + 460}\right) = 17.65 \times 62.380 \left(\frac{27.23 + \frac{1.778}{13.6}}{68 + 460}\right) = 57.054 \text{ sft}^3$$

0.648 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 56.7 = 2.676 \text{ sft}^3$$

$$\%\ \text{Moisture} = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{2.676}{57.054 + 2.676} \times 100 = 4.48\ \%$$

$$V_s = 5123.8 \times 0.830 \sqrt{\frac{803}{27.22 \times 30.15}} \times 0.468 = 1969 \text{ fpm}$$

ACFM: 153014

$$\%I = \frac{1039 \times 803 \times 57.054}{0.9552 \times 27.22 \times 1969 \times 88 \times (0.330)^2} = 97.0\ \%$$

SCFM: 87,766

%EA: 173.9

Run No. 2

PARTICULATE FIELD DATA

Location Kiln No. 2 Stack

Date 22 February 1983

| Point | Clock Time | Dry Gas Meter, CF | $\Delta P_s$ Pitot in. $H_2O$ | $P_m$ Orifice $\Delta H$ in. $H_2O$ Desired | Actual | Pump Vacuum In. Hg Gauge | $T_s$ Stack Temp. °F | Probe Temp. °F | Oven Temp. °F | Effluent Temp. °F | $T_m$ Dry Gas Temp. °F Inlet | Outlet | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 1151 | 275.97 | 0.25 | 2.00 | 2.00 | 9.7 | 347 | 253 | 270 | 51 | 75 | 63 | |
| 3 | 1153 | 277.50 | 0.23 | 1.80 | 1.80 | 9.2 | 341 | 254 | 272 | 51 | 74 | 62 | |
| 2 | 1155 | 278.97 | 0.23 | 1.80 | 1.80 | 9.2 | 337 | 256 | 272 | 52 | 75 | 63 | |
| 1 | 1157 | 280.52 | 0.17 | 1.35 | 1.35 | 8.0 | 330 | 257 | 271 | 53 | 75 | 63 | |
| END | 1159 | 281.839 | — | — | — | — | — | — | — | — | — | — | |
| A 22 | 1201 | 281.839 | 0.29 | 2.30 | 2.30 | 11.0 | 346 | 271 | 270 | 58 | 73 | 63 | |
| 21 | 1203 | 283.42 | 0.35 | 2.75 | 2.75 | 13.0 | 347 | 273 | 271 | 53 | 74 | 63 | |
| 20 | 1205 | 285.30 | 0.37 | 2.90 | 2.90 | 15.0 | 349 | 265 | 270 | 52 | 74 | 63 | |
| 19 | 1207 | 287.00 | 0.38 | 3.00 | 2.90 | 15.0 | 352 | 261 | 272 | 51 | 75 | 63 | |
| 18 | 1209 | 288.96 | 0.36 | 2.80 | 2.80 | 14.7 | 352 | 261 | 270 | 51 | 75 | 63 | |
| 17 | 1211 | 290.71 | 0.36 | 2.80 | 2.80 | 14.7 | 356 | 260 | 265 | 52 | 75 | 64 | |
| 16 | 1213 | 292.65 | 0.33 | 2.60 | 2.60 | 14.0 | 349 | 256 | 260 | 53 | 75 | 64 | |
| 15 | 1215 | 294.40 | 0.33 | 2.60 | 2.60 | 14.0 | 348 | 254 | 264 | 53 | 75 | 64 | |
| 14 | 1217 | 296.10 | 0.31 | 2.40 | 2.40 | 12.5 | 345 | 248 | 252 | 50 | 76 | 65 | |
| 13 | 1219 | 297.70 | 0.28 | 2.20 | 2.20 | 11.8 | 345 | 245 | 246 | 51 | 76 | 65 | |
| 12 | 1221 | 299.10 | 0.23 | 1.80 | 1.80 | 9.5 | 345 | 237 | 247 | 51 | 76 | 65 | |
| 11 | 1223 | 301.05 | 0.17 | 1.35 | 1.35 | 7.0 | 340 | 256 | 249 | 51 | 75 | 65 | |
| 10 | 1225 | 302.80 | 0.12 | 0.95 | 0.95 | 5.5 | 340 | 265 | 250 | 51 | 74 | 65 | |
| 9 | 1227 | 303.50 | 0.11 | 0.87 | 0.87 | 5.0 | 339 | 258 | 252 | 53 | 74 | 65 | |
| 8 | 1229 | 304.54 | 0.12 | 0.95 | 0.95 | 5.0 | 341 | 256 | 253 | 52 | 74 | 65 | |
| 7 | 1231 | 305.60 | 0.13 | 1.05 | 1.05 | 5.5 | 342 | 250 | 254 | 52 | 74 | 65 | |
| 6 | 1233 | 306.72 | 0.15 | 1.20 | 1.20 | 5.9 | 340 | 248 | 254 | 52 | 74 | 66 | |
| 5 | 1235 | 307.90 | 0.16 | 1.25 | 1.25 | 6.3 | 341 | 247 | 255 | 51 | 74 | 66 | |
| 4 | 1237 | 309.15 | 0.18 | 1.40 | 1.40 | 7.1 | 338 | 246 | 256 | 50 | 75 | 66 | |
| 3 | 1239 | 310.43 | 0.20 | 1.60 | 1.60 | 7.6 | 340 | 248 | 258 | 50 | 76 | 65 | |
| 2 | 1241 | 311.77 | 0.19 | 1.50 | 1.50 | 7.6 | 337 | 250 | 259 | 50 | 75 | 66 | |
| 1 | 1243 | 313.17 | 0.15 | 1.20 | 1.20 | 6.5 | 330 | 252 | 260 | 50 | 76 | 65 | |
| END | 1245 | 314.317 | — | — | — | — | — | — | — | — | — | — | |
| ALL | | | | | | | | | | | | | |

Job No. 83-09

Job Name SW Portland Cement

Run No. 3

Location Kiln No. 2 Stack

Date 22 February 1983

Operator Alexander Overton Mullins Jr

Sample Box No. 9 Meter Box No. 2

Part, $SO_2$ FIELD DATA

Read and record at the start of each test point.

Purge to: 400.850

Purge time: 1581-1516

MULLINS ENVIRONMENTAL TESTING CO., INC.

Ambient Temp. °F 60

Assumed Moisture % 4

Probe Length 10

C Factor — 84 to reference

Initial Leak @ 16.0 "Hg = 0.004 cfm

Final Leak @ 14.0 "Hg = 0.010 cfm

| Point | Clock Time | Dry Gas Meter, CF | Pitot in. $H_2O$ ($\Delta P_s$) | Orifice ΔH in. $H_2O$ ($P_m$) Desired | Orifice ΔH in. $H_2O$ ($P_m$) Actual | Pump Vacuum In. Hg Gauge | Stack Temp. °F ($T_s$) | Probe Temp. °F | Oven Temp. °F | Effluent Temp. °F | Dry Gas Temp. °F ($T_m$) Inlet | Dry Gas Temp. °F ($T_m$) Outlet | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 22 | 1330 | 324.846 | 0.31 | 2.45 | 2.45 | 9.5 | 348 | 270 | 274 | 55 | 67 | 66 | |
| 21 | 1332 | 326.52 | 0.32 | 2.50 | 2.50 | 9.5 | 355 | 266 | 266 | 49 | 68 | 66 | |
| 20 | 1334 | 328.35 | 0.35 | 2.75 | 2.75 | 10.0 | 355 | 269 | 254 | 47 | 69 | 66 | |
| 19 | 1336 | 330.12 | 0.35 | 2.75 | 2.75 | 10.0 | 353 | 272 | 249 | 46 | 70 | 67 | |
| 18 | 1338 | 331.85 | 0.35 | 2.75 | 2.75 | 10.0 | 355 | 273 | 250 | 45 | 70 | 66 | |
| 17 | 1340 | 333.70 | 0.35 | 2.95 | 2.95 | 11.0 | 358 | 265 | 248 | 46 | 72 | 67 | |
| 16 | 1342 | 335.61 | 0.35 | 2.95 | 2.95 | 11.0 | 354 | 263 | 248 | 46 | 73 | 67 | |
| 15 | 1344 | 337.51 | 0.33 | 2.80 | 2.80 | 11.0 | 356 | 262 | 248 | 47 | 73 | 66 | |
| 14 | 1346 | 339.24 | 0.30 | 2.55 | 2.55 | 10.1 | 353 | 257 | 249 | 48 | 74 | 67 | |
| 13 | 1348 | 340.94 | 0.27 | 2.30 | 2.30 | 9.2 | 353 | 255 | 247 | 49 | 75 | 67 | |
| 12 | 1350 | 342.68 | 0.24 | 2.05 | 2.05 | 8.3 | 351 | 250 | 249 | 48 | 75 | 66 | count |
| 11 | 1352 | 344.22 | 0.16 | 1.35 | 1.35 | 6.0 | 347 | 246 | 251 | 48 | 75 | 66 | |
| 10 | 1354 | 345.59 | 0.12 | 1.00 | 1.00 | 4.8 | 346 | 243 | 252 | 50 | 76 | 67 | |
| 9 | 1356 | 346.72 | 0.11 | 0.94 | 0.94 | 4.5 | 345 | 244 | 255 | 50 | 74 | 66 | |
| 8 | 1358 | 347.81 | 0.11 | 0.94 | 0.94 | 4.5 | 349 | 248 | 258 | 51 | 75 | 67 | |
| 7 | 1400 | 348.86 | 0.13 | 1.10 | 1.10 | 5.0 | 343 | 242 | 257 | 50 | 75 | 67 | |
| 6 | 1402 | 350.01 | 0.16 | 1.35 | 1.35 | 5.6 | 343 | 237 | 255 | 50 | 75 | 68 | |
| 5 | 1404 | 351.32 | 0.17 | 1.45 | 1.45 | 6.0 | 347 | 250 | 255 | 50 | 76 | 68 | |

Pitot Tube Calibration Factor $C_p$ 0.830

Volume Collected $V_m$ 64.417 $ft^3$

Water Collected $V_w$ 58.0 ml

Time of Test $T_t$ 88 min.

Stack Pressure $P_s$ -0.15 "$H_2O$

Baro. Press. $P_b$ 27.23 "Hg

Probe Tip Dia. $D_n$ 0.330 in.

% $CO_2$ 13.9 % CO 0.0

% $O_2$ 12.5 % $N_2$ 73.6

Area Stack $A_s$ 1192 $in^2$

Pitot Tube No. 10 Barometer No. —

Probe Tip No. II-6

$V_m$ = Dry Gas Meter Calibration Factor 0.985 X 65.398

[Dry Gas Meter Reading ____ $ft^3$ - ($T_t$ ____ min X Leak Rate ____ cfm)]

$M_F$ = ____ $M_T$ = ____

Impinger Box No. 9

| | | |
|---|---|---|
| Impinger 1 | Final Weight | 588.5 |
| | Initial Weight | 639.0 |
| | Increase | - 50.5 |
| Impinger 2 | Final Weight | 740.8 |
| | Initial Weight | 677.3 |
| | Increase | 63.5 |
| Impinger 3 | Final Weight | 704.8 |
| | Initial Weight | 681.0 |
| | Increase | 23.8 |
| Impinger 4 | Final Weight | 471.5 |
| | Initial Weight | 470.4 |
| | Increase | 1.1 |
| Impinger 5 | Final Weight | 799.2 |
| | Initial Weight | 779.1 |
| | Increase | 20.1 |
| Impinger 6 | Final Weight | |
| | Initial Weight | |
| | Increase | |

Filter # _____ Final Weight _____ Initial Weight _____ Increase _____

Water Weight Gain

$V_w$ =

g $SO_2$ = - _____

$V_w$ =

| | |
|---|---|
| Impinger 1 | -50.5 |
| Impinger 2 | 63.5 |
| Impinger 3 | 23.8 |
| Impinger 4 | 1.1 |
| Impinger 5 | 20.1 |
| Impinger 6 | |
| Total | 58.0 = $V_w$ |

| | | | | AVG |
|---|---|---|---|---|
| $P_b$ = 27.23 | $\%CO_2$ = | 13.2, 14.6 | | 13.9 |
| $V_m$ = 64.417 | $\%O_2$ = | 13.0, 12.0 | | 12.5 |
| $V_w$ = 58.0 | %CO = | 0.0, 0.0 | | 0.0 |
| $P_m$ = 1.862 | $\%N_2$ = | 73.8, 73.4 | | 73.6 |
| Avg $\Delta P$ = 0.222 | $A_s$ = | 11192 | | |
| Avg $\sqrt{\Delta P}$ = 0.465 | $D_n$ = | 0.330 | | |
| $C_p$ = 0.830 | $T_t$ = | 88 | | |
| $P_s$ = -0.15 $H_2O$ | 27.22 | "Hg | | |
| $T_m$ = 73 °F | 533 | °R | | |
| $T_s$ = 348 °F | 808 | °R | | |

Moisture Content: %M = 4.48 $M_d$ = 0.9552 $MW_d$ = 30.724 MW = 30.15

$$V_{m_{std}} = 17.65\ V_m \left( \frac{P_b + \frac{P_m}{13.6}}{T_m + 460} \right) = 17.65 \times 64.417 \left( \frac{27.23 + \frac{1.862}{13.6}}{73 + 460} \right) = 58.377\ sft^3$$

0.663 scfm

$$V_{w_{gas}} = 0.0472 \times V_w = 0.0472 \times 58.0 = 2.738\ sft^3$$

$$\%\ Moisture = \frac{V_{w_{gas}}}{V_{m_{std}} + V_{w_{gas}}} \times 100 = \frac{2.738}{58.377 + 2.738} \times 100 = 4.48\ \%$$

$$V_s = 5123.8 \times 0.830 \sqrt{\frac{808}{27.22 \times 30.15}} \times 0.465 = 1962\ fpm$$

$$\%I = \frac{1039 \times 808 \times 58.377}{0.9552 \times 27.22 \times 1962 \times 88 \times (0.330)^2} = 100.2\ \%$$

ACFM: 152506

SCFM: 86913

%EA: 178.5

Run No. 3

Location Kiln No. 2 Stack

Date 22 February 1983

PARTICULATE FIELD DATA

| Point | Clock Time | Dry Gas Meter, CF | $\Delta P_s$ Pitot in. $H_2O$ | $P_m$ Orifice $\Delta H$ in. $H_2O$ Desired | Actual | Pump Vacuum In. Hg Gauge | $T_s$ Stack Temp. °F | Probe Temp. °F | Oven Temp. °F | Effluent Temp. °F | $T_m$ Dry Gas Temp. °F Inlet | Outlet | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | 1406 | 352.57 | 0.18 | 1.50 | 1.50 | 6.2 | 342 | 262 | 254 | 50 | 77 | 68 | |
| 3 | 1408 | 353.94 | 0.20 | 1.70 | 1.70 | 7.0 | 342 | 268 | 255 | 49 | 78 | 68 | |
| 2 | 1410 | 355.36 | 0.20 | 1.70 | 1.70 | 7.0 | 340 | 269 | 256 | 48 | 77 | 67 | |
| 1 | 1412 | 356.71 | 0.15 | 1.30 | 1.30 | 6.0 | 344 | 272 | 256 | 49 | 78 | 68 | |
| END | 1414 | 358.108 | — | — | — | — | — | — | — | — | — | — | |
| B22 | 1416 | 358.108 | 0.25 | 2.10 | 2.10 | 8.0 | 343 | 272 | 243 | 60 | 77 | 67 | |
| 21 | 1418 | 359.65 | 0.32 | 2.70 | 2.70 | 10.0 | 351 | 271 | 235 | 51 | 78 | 68 | |
| 20 | 1420 | 361.40 | 0.30 | 2.55 | 2.55 | 9.7 | 344 | 265 | 243 | 49 | 78 | 68 | |
| 19 | 1422 | 363.20 | 0.27 | 2.30 | 2.30 | 9.2 | 350 | 257 | 252 | 50 | 80 | 69 | |
| 18 | 1424 | 364.82 | 0.26 | 2.20 | 2.20 | 8.8 | 352 | 264 | 252 | 51 | 80 | 69 | |
| 17 | 1426 | 366.53 | 0.23 | 1.95 | 1.95 | 8.3 | 358 | 257 | 252 | 52 | 80 | 68 | |
| 16 | 1428 | 368.01 | 0.19 | 1.60 | 1.60 | 6.8 | 350 | 254 | 255 | 52 | 80 | 68 | |
| 15 | 1430 | 369.43 | 0.15 | 1.30 | 1.30 | 5.7 | 351 | 249 | 248 | 54 | 80 | 69 | |
| 14 | 1432 | 370.74 | 0.15 | 1.30 | 1.30 | 5.7 | 349 | 242 | 255 | 55 | 80 | 70 | |
| 13 | 1434 | 371.97 | 0.13 | 1.10 | 1.10 | 5.0 | 344 | 245 | 256 | 56 | 80 | 70 | |
| 12 | 1436 | 373.15 | 0.13 | 1.10 | 1.10 | 5.0 | 346 | 245 | 247 | 56 | 81 | 70 | |
| 11 | 1438 | 374.33 | 0.15 | 1.30 | 1.30 | 5.5 | 347 | 243 | 243 | 56 | 81 | 70 | |
| 10 | 1440 | 375.57 | 0.17 | 1.45 | 1.45 | 6.0 | 346 | 241 | 244 | 54 | 80 | 69 | orsat |
| 9 | 1442 | 376.90 | 0.19 | 1.60 | 1.60 | 6.5 | 347 | 241 | 256 | 54 | 81 | 70 | |
| 8 | 1444 | 378.26 | 0.19 | 1.60 | 1.60 | 6.5 | 347 | 243 | 260 | 53 | 81 | 69 | |
| 7 | 1446 | 379.70 | 0.19 | 1.60 | 1.60 | 6.5 | 350 | 244 | 253 | 55 | 82 | 70 | |
| 6 | 1448 | 381.08 | 0.24 | 2.05 | 2.05 | 8.3 | 348 | 248 | 252 | 55 | 82 | 70 | |
| 5 | 1450 | 382.58 | 0.22 | 1.85 | 1.85 | 7.4 | 345 | 248 | 255 | 54 | 82 | 70 | |
| 4 | 1452 | 384.14 | 0.24 | 2.05 | 2.05 | 8.2 | 344 | 245 | 249 | 55 | 83 | 71 | |
| 3 | 1454 | 385.64 | 0.21 | 1.80 | 1.80 | 7.5 | 346 | 248 | 257 | 55 | 83 | 71 | |
| 2 | 1456 | 387.17 | 0.218 | 1.80 | 1.80 | 7.5 | 345 | 245 | 260 | 55 | 83 | 71 | |
| 1 | 1458 | 388.63 | 0.18 | 1.50 | 1.50 | 6.4 | 339 | 243 | 253 | 56 | 83 | 71 | |
| END | 1500 | 390.244 | — | — | — | — | — | — | — | — | — | — | |
| ALL | | | | | | | | | | | | | |

# APPENDIX E

## Analytical Data

Mullins Environmental Testing Co., Inc.

Particulate Analysis Summary

Job Number 83-09

Job Name SW Portland Cement

Location Odessa, TX

Date Analysis Completed 2-25-83

Unit Tested Kiln No. 2 Stack

| Run No. | 1 | 2 | 3 | | |
|---|---|---|---|---|---|
| Particulate on Filter (mg) | 24.8 | 23.0 | 24.0 | | |
| Particulate in Front Wash (mg)* | 27.4 | 33.6 | 26.0 | | |
| MF (mg) | 52.2 | 56.6 | 50.0 | | |
| Particulate in Impinger #1 (mg)** | 3.8 | 5.9 | 9.2 | | |
| MT (mg) | 56.0 | 62.5 | 59.2 | | |

Tamyla A. Jones

Analyst

* Less Acetone Residue

** Less Ammonium Sulfate

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

Stack Filters

Job Number 83-09 Location Odessa, Tx

Job Name SWJ Portland Cement Unit Tested Kiln No. 2 Stack

| | | | | | |
|---|---|---|---|---|---|
| Desiccator Time In | 0800 2/23/83 | 0815 2/24/83 | | | |
| Desiccator Time Out | 0800 2/24/83 | 0300 2/24/83 | | | |

| Run No. 1 | Filter No. T-4 | | | | |
|---|---|---|---|---|---|
| Filter & Particulate + Tare Weight (g) | 2.4367 | 2.4360 | | | |
| Tare Weight (g) | 1.7410 | 1.7400 | | | |
| Filter & Particulate (g) | 0.6957 | 0.6960 | ✓ | | |

Filter & Particulate Average (g) 0.6959

Initial Filter Weight (g) 0.6711 ✓

Total Particulate (mg) 24.8

| Run No. 2 | Filter No. T-12 & T-13 | | | | |
|---|---|---|---|---|---|
| Filter & Particulate + Tare Weight (g) | 3.0859 | 3.0855 | | | |
| Tare Weight (g) | 1.7409 | 1.7400 | | | |
| Filter & Particulate (g) | 1.3450 | 1.3455 | ✓ | | |

Filter & Particulate Average (g) 1.3453

0.6565 + 0.6658 = Initial Filter Weight (g) 1.3223 ✓

Total Particulate (mg) 23.0 ✓

| Run No. 3 | Filter No. R-3 | | | | |
|---|---|---|---|---|---|
| Filter & Particulate + Tare Weight (g) | 2.4282 | 2.4280 | | | |
| Tare Weight (g) | 1.7402 | 1.7399 | | | |
| Filter & Particulate (g) | 0.6880 | 0.6881 | ✓ | | |

Filter & Particulate Average (g) 0.6881

Initial Filter Weight (g) 0.6641 ✓

Total Particulate (mg) 24.0

Tamyra A. Jones

Analyst

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

Front Wash

Job Number 83-09 Location Odessa, TX

Job Name SW Portland Cement Unit Tested Kiln No. 2 Stack

| | | | | | |
|---|---|---|---|---|---|
| Desiccator Time In | 1500 2/23/83 | 1525 2/24/83 | 0810 2/25/83 | | |
| Desiccator Time Out | 1515 2/24/83 | 0800 2/25/83 | 1400 2/25/83 | | |

| Run No. 1 | Volume (ml) 363 | | | | |
|---|---|---|---|---|---|
| Final Weight (g) | 141.5575 | 141.5564 | 141.5568 | | |
| Initial Weight (g) | 141.5263 | 141.5263 | 141.5263 | | |
| Particulate Weight (g) | 0.0312 | 0.0301 | 0.0305 | ✓ | |

Particulate Average (mg) 30.3
Less Acetone Blank (mg) 2.9
Total Particulate (mg) 27.4

| Run No. 2 | Volume (ml) 390 | | | | |
|---|---|---|---|---|---|
| Final Weight (g) | 142.7834 | 142.7823 | 142.7828 | | |
| Initial Weight (g) | 142.7459 | 142.7459 | 142.7459 | | |
| Particulate Weight (g) | 0.0375 | 0.0364 | 0.0369 | ✓ | |

Particulate Average (mg) 36.7
Less Acetone Blank (mg) 3.1
Total Particulate (mg) 33.6

| Run No. 3 | Volume (ml) 363 | | | | |
|---|---|---|---|---|---|
| Final Weight (g) | 143.3102 | 143.3092 | 143.3095 | | |
| Initial Weight (g) | 143.2805 | 143.2805 | 143.2805 | | |
| Particulate Weight (g) | 0.0297 | 0.0287 | 0.0290 | ✓ | |

Particulate Average (mg) 28.9
Less Acetone Blank (mg) 2.9
Total Particulate (mg) 26.0

| Acetone Blank | Volume (ml) 424 | | | | |
|---|---|---|---|---|---|
| Final Weight (g) | 144.2847 | 144.2836 | 144.2840 | | |
| Initial Weight (g) | 144.2783 | 144.2783 | 144.2783 | | |
| Difference (g) | 0.0064 | 0.0053 | 0.0057 | ✓ | |

Average (mg) 5.5
* mg/l 13.0

* Note: If greater than 7.9 mg/l, use 7.9 mg/l.

Tamina A. Yates
Analyst

Mullins Environmental Testing Co., Inc.

Particulate Analysis EPA Method 5

Back Half Analysis

Job Number 83-09 Location Odessa, TX

Job Name SW Portland Cement Unit Tested Kiln No. 2 Stack

| | | | | | |
|---|---|---|---|---|---|
| Desiccator Time In | 1500 2/23/83 | 1535 2/24/83 | 0820 2/25/83 | | |
| Desiccator Time Out | 1525 2/24/83 | 0810 2/25/83 | 1410 2/25/83 | | |

| Run No. 1 | Volume (ml) 153 | | | | |
|---|---|---|---|---|---|
| Final Weight (g) | 144.6880 | 144.6872 | 144.6874 | | |
| Initial Weight (g) | 144.6799 | 144.6799 | 144.6799 | | |
| Particulate Weight (g) | 0.0081 | 0.0073 | 0.0075 | ✓ | |

Particulate Average (mg) 7.4
Less Ammonium Sulfate (mg) 3.6
Total Particulate (mg) 3.8

| Run No. 2 | Volume (ml) 185 | | | | |
|---|---|---|---|---|---|
| Final Weight (g) | 145.7391 | 145.7380 | 145.7381 | | |
| Initial Weight (g) | 145.7310 | 145.7310 | 145.7310 | | |
| Particulate Weight (g) | 0.0081 | 0.0070 | 0.0071 | ✓ | |

Particulate Average (mg) 7.1
Less Ammonium Sulfate (mg) 1.2
Total Particulate (mg) 5.9

| Run No. 3 | Volume (ml) 176 | | | | |
|---|---|---|---|---|---|
| Final Weight (g) | 146.2997 | 146.2987 | 146.2989 | | |
| Initial Weight (g) | 146.2878 | 146.2878 | 146.2878 | | |
| Particulate Weight (g) | 0.0119 | 0.0109 | 0.0111 | ✓ | |

Particulate Average (mg) 11.0
Less Ammonium Sulfate (mg) 1.8
Total Particulate (mg) 9.2

Tamyra A. Jones
Analyst

$NO_x$ Analysis

Job Number 83-09

Client SW Portland Cement

Unit Kiln No. 2 Stack

Date 2-25-83

| Sample Number | Run Number | Flask Number | Volume (ml) | Aliquot (ml) | Absorbance | $\mu g NO_2^-$ |
|---|---|---|---|---|---|---|
| 1 | 1 | 1 | 100 | 15 | 0.310 | 1357.8 |
| 2 | 1 | 2 | | | 0.390 | 1708.2 |
| 3 | 1 | 3 | | | 0.311 | 1362.2 |
| 4 | 1 | 4 | | | 0.319 | 1397.3 |
| 5 | 2 | 5 | | | 0.281 | 1230.8 |
| 6 | 2 | 6 | | | 0.297 | 1300.9 |
| 7 | 2 | 7 | | | 0.295 | 1292.1 |
| 8 | 2 | 8 | | | 0.279 | 1222.1 |
| 9 | 3 | 9 | | | 0.185 | 810.3 |
| 10 | 3 | 10 | | | 0.242 | 1060.0 |
| 11 | 3 | 11 | | | 0.268 | 1173.9 |
| 12 | 3 | 12 | | | 0.296 | 1296.5 |

Standards

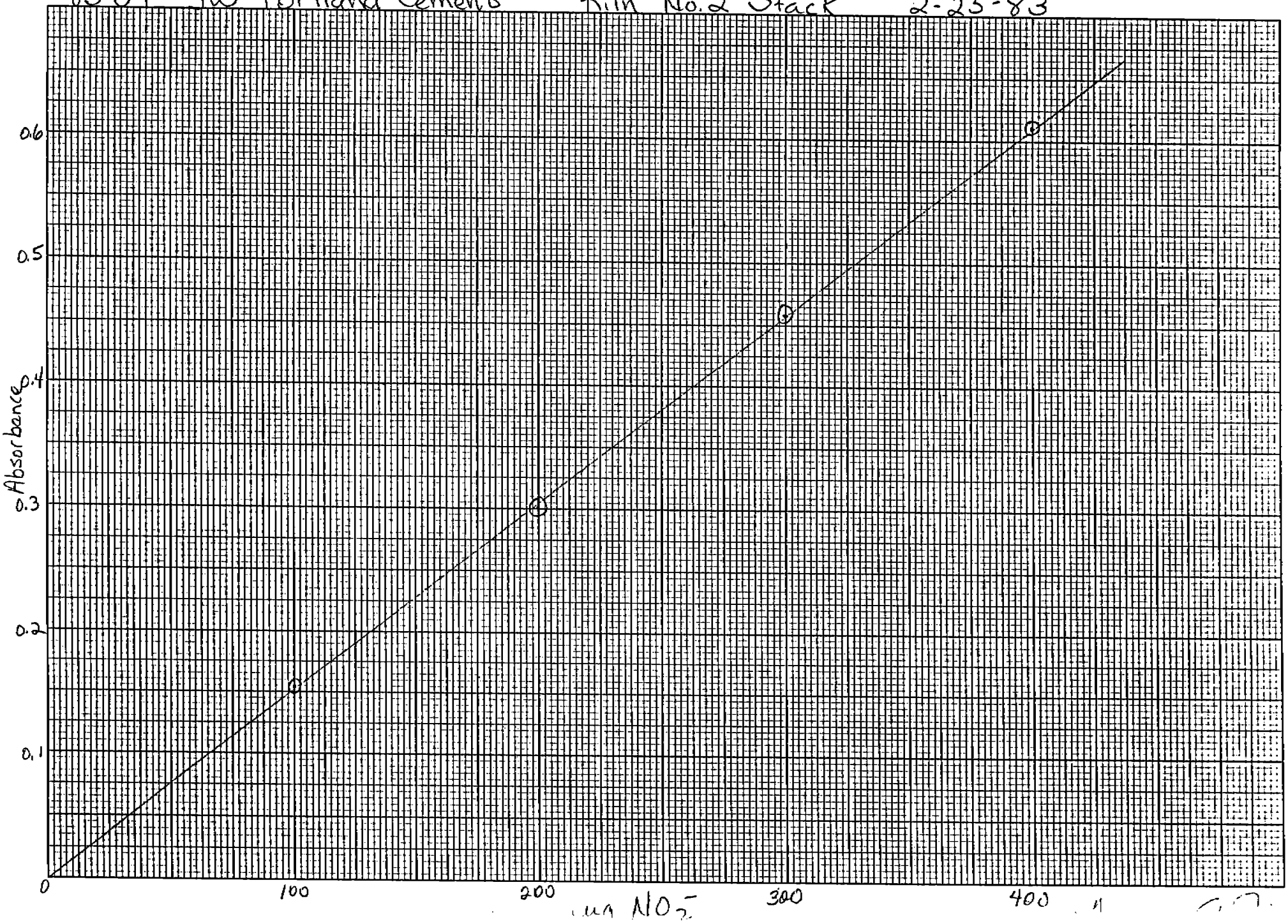
| | Abs. | | Abs. |
|---|---|---|---|
| 100 | 0.153 | 300 | 0.457 |
| 200 | 0.301 | 400 | 0.610 |

$K_c = 657.01718$

K+E 20 X 20 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1242

83-09 SW Portland Cement Kiln No. 2 Stack 2-25-83



# $SO_2$ EMISSION DATA

Client SW Portland Cement

Unit Tested Kiln No 2 Stack

Job Number 83-0

| Run Number | 1 | 2 | 3 | | | |
|---|---|---|---|---|---|---|
| Date | 2/22/83 | 2/22/83 | 2/22/83 | | | |
| Time | 0845-1015 | 1115-1245 | 1330-1500 | | | |
| N - normality of $BaCl_2$ | 0.0101 | 0.0101 | 0.0101 | | | |
| $ML_I$ - ml in impinger #1 | — | — | — | | | |
| $ML_I$ - ml in impinger #2 | 322 | 315 | 331 | | | |
| $ML_I$ - ml in impinger #3 | 295 | 281 | 288 | | | |
| $ML_A$ - ml in aliquot #1 | — | — | — | | | |
| $ML_A$ - ml in aliquot #2 | 10 | 10 | 10 | | | |
| $ML_A$ - ml in aliquot #3 | 10 | 10 | 10 | | | |
| $ML_B$ - ml of $BaCl_2$ to titrate #1 | — | — | — | | | |
| $ML_B$ - ml of $BaCl_2$ to titrate #2 | 0.10 | 0.10 | 0.10 | | | |
| $ML_B$ - ml of $BaCl_2$ to titrate #3 | 0.10 | 0.10 | 0.10 | | | |
| $ML_{BB}$ - ml of $BaCl_2$ to titrate blank | 0.05 | 0.05 | 0.05 | | | |
| $T_m$ - average gas meter temp., °F | 55 | 68 | 73 | | | |
| $V_m$ - volume of dry gas sampled @ meter conditions, $ft.^3$ | 57.621 | 62.380 | 64.417 | | | |
| $P_b$ - barometric pressure, "Hg Abs. | 27.19 | 27.23 | 27.23 | | | |
| $Q_s$ - Stack gas volume dry @ standard conditions, *SCFM | 85,336 | 87,766 | 86,913 | | | |
| $C_I$ - $SO_2$ in impinger #1, mgs | — | — | — | | | |
| $C_I$ - $SO_2$ in impinger #2, mgs | 0.5 | 0.5 | 0.5 | | | |
| $C_I$ - $SO_2$ in impinger #3, mgs | 0.5 | 0.5 | 0.5 | | | |
| $C_T$ - total $SO_2$ in impingers, mgs | 1.0 | 1.0 | 1.0 | | | |
| ppm $SO_2$ | 0.2 | 0.2 | 0.2 | | | |
| $C_{SO_2}$ - emission rate of $SO_2$, lbs/day | 5.0 | 4.7 | 4.7 | | | |
| $C_s$ - emission rate of S, lbs/day | 2.5 | 2.4 | 2.4 | | | |

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$C_I = \frac{ML_I \times (ML_B - ML_{BB}) \times \underline{N} \times 32}{ML_A}$$

$$C_T = C_I\ \#1 + C_I\ \#2 + C_I\ \#3$$

$$\text{ppm } SO_2 = \frac{0.7513 \times C_T \times (T_m + 460)}{V_m\ P_b}$$

$$C_{SO_2} = \text{ppm } SO_2 \times Q_s \times 239.2 \times 10^{-6}$$

$$C_s = \frac{C_{SO2}}{2}$$

METCO

SULFUR TRIOXIDE EMISSION DATA

Job Number 83-09 Location Odessa, TX

Job Name SW Portland Cement Unit Tested Kiln No. 2 Stack

| Run Number | 1 | 2 | 3 | |
|---|---|---|---|---|
| Date | 2/22/83 | 2/22/83 | 2/22/83 | |
| Time | 0845–1015 | 1115–1245 | 1330–1500 | |
| $\underline{N}$ - normality of $BaCl_2$ | 0.0101 | 0.0101 | 0.0101 | |
| $ML_I$ - ml in impinger | 153 | 185 | 176 | |
| $ML_A$ - ml in aliquot | 10 | 10 | 10 | |
| $ML_B$ - ml of $BaCl_2$ to titrate | 0.40 | 0.15 | 0.20 | |
| $ML_{BB}$- ml of $BaCl_2$ to titrate blank | 0.05 | 0.05 | 0.05 | |
| $T_m$ - average gas meter temp., °F | 55 | 68 | 73 | |
| $V_m$ - volume of dry gas sampled @ meter conditions, $ft.^3$ | 57.621 | 62.380 | 64.417 | |
| $P_b$ - barometric pressure, "Hg Abs. | 27.19 | 27.23 | 27.23 | |
| $Q_s$ - stack gas volume dry @ standard conditions, *SCFM | 85,336 | 87,766 | 86,913 | |
| $C_I$ - $SO_3$ in impinger, mgs | 2.2 | 0.7 | 1.1 | |
| ppm $SO_3$ | 0.4 | 0.1 | 0.2 | |
| $C_{SO_3}$ - emission rate of $SO_3$, lbs/day | 10.9 | 3.7 | 5.1 | |
| $C_S$ - emission rate of S, lbs/day | 4.4 | 1.5 | 2.0 | |

*68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$\text{ppm } SO_3 = \frac{0.6021 \times C_I \times (T_m + 460)}{V_m P_b}$$

$$C_I = \frac{ML_I \times (ML_B - ML_{BB}) \times \underline{N} \times 40}{ML_A}$$

$$C_{SO_3} = \text{ppm } SO_3 \times Q_s \times 299.1 \times 10^{-6}$$

$$C_S = \frac{C_{SO_3}}{2.5}$$

METCO

# $NO_x$ EMISSION DATA

Job Number 83-09

Client Southwestern Portland Cement Co.

Date 22 Feb 1983

Unit Tested Kiln No. 2 Stack

Run Number 1

| Flask Number | 1 | 2 | 3 | 4 | AVG |
|---|---|---|---|---|---|
| Time | 0945 | 1000 | 1015 | 1030 | |
| Initial Barometric Pressure, "Hg Abs. | 27.12 | 27.12 | 27.12 | 27.12 | |
| Initial Manometer Reading, "Hg Abs. | -24.9 | -25.1 | -25.1 | -25.1 | |
| $P_I$ - Initial Pressure of Flask, "Hg Abs. | 2.22 | 2.02 | 2.02 | 2.02 | |
| $T_I$ - Initial Temperature of Flask, °F | 58 | 58 | 59 | 57 | |
| $V_F$ - Volume of Flask, ml | 2037 | 2038 | 2050 | 2079 | |
| Final Barometric Pressure, "Hg Abs. | 29.33 | 29.33 | 29.33 | 29.33 | |
| Final Manometer Reading, "Hg Abs. | +0.10 | +1.10 | -2.00 | +0.05 | |
| $P_F$ - Final Pressure of Flask, "Hg Abs. | 29.43 | 30.43 | 27.33 | 29.38 | |
| $T_F$ - Final Temperature of Flask, °F | 71 | 71 | 71 | 71 | |
| $\mu g NO_2$ - micrograms of $NO_2$ | 1357.8 | 1708.2 | 1362.2 | 1397.3 | |
| $V_s$ - Volume of sample at conditions*, ml | 1816 | 1897 | 1700 | 1864 | / |
| ppm $NO_2$ - Concentration of $NO_2$, ppm | 391.0 | 470.9 | 419.1 | 392.1 | 418.3 |
| $C_{NO_2}$ - Emission Rate of $NO_2$, lbs/dscf* | $4.67 \times 10^{-5}$ | $5.62 \times 10^{-5}$ | $5.00 \times 10^{-5}$ | $4.68 \times 10^{-5}$ | $4.99 \times 10^{-5}$ |

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$V_s = \frac{528\ (V_F - 25)}{29.92} \left[ \frac{P_F}{T_F + 460} - \frac{P_I}{T_I + 460} \right] = \text{ml}$$

$$\text{ppm } NO_2 = \frac{523 \times \mu g\ NO_2}{V_s} = \text{ppm}$$

$$C_{NO_2} = \frac{\mu g\ NO_2}{V_s} \times \frac{1\ \text{lb/ft}^3}{1.6 \times 10^4\ \mu g/\text{ml}} = 6.243 \times 10^{-5}\ \frac{\mu g\ NO_2}{V_s} = \text{lbs/dscf}$$

METCO

## $NO_x$ EMISSION DATA

Job Number 83-09

Client Southwestern Portland Cement Co.

Date 22 Feb 1983

Unit Tested Kiln No. 2 Stack

Run Number 2

| Flask Number | 5 | 6 | 7 | 8 | AVG |
|---|---|---|---|---|---|
| Time | 1105 | 1120 | 1135 | 1150 | |
| Initial Barometric Pressure, "Hg Abs. | 27.12 | 27.12 | 27.12 | 27.12 | |
| Initial Manometer Reading, "Hg Abs. | -25.1 | -25.1 | -25.1 | -25.2 | |
| $P_I$ - Initial Pressure of Flask, "Hg Abs. | 2.02 | 2.02 | 2.02 | 1.92 | |
| $T_I$ - Initial Temperature of Flask, °F | 61 | 60 | 59 | 58 | |
| $V_F$ - Volume of Flask, ml | 2025 | 2087 | 2019 | 2030 | |
| Final Barometric Pressure, "Hg Abs. | 29.33 | 29.33 | 29.33 | 29.33 | |
| Final Manometer Reading, "Hg Abs. | -1.90 | -2.10 | -1.90 | -2.00 | |
| $P_F$ - Final Pressure of Flask, "Hg Abs. | 27.43 | 27.23 | 27.43 | 27.33 | |
| $T_F$ - Final Temperature of Flask, °F | 71 | 71 | 71 | 71 | |
| $\mu g NO_2$ - micrograms of $NO_2$ | 1230.8 | 1300.9 | 1292.1 | 1222.1 | |
| $V_s$ - Volume of sample at conditions*, ml | 1686 | 1725 | 1681 | 1690 | |
| ppm $NO_2$ - Concentration of $NO_2$, ppm | 381.8 | 394.4 | 402.0 | 378.2 | 389.1 |
| $C_{NO_2}$ - Emission Rate of $NO_2$, lbs/dscf* | $4.56 \times 10^{-5}$ | $4.71 \times 10^{-5}$ | $4.80 \times 10^{-5}$ | $4.51 \times 10^{-5}$ | $4.65 \times 10^{-5}$ |

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$V_s = \frac{528\ (V_F - 25)}{29.92} \left[ \frac{P_F}{T_F + 460} - \frac{P_I}{T_I + 460} \right] = \text{ml}$$

$$\text{ppm } NO_2 = \frac{523 \times \mu g\ NO_2}{V_s} = \text{ppm}$$

$$C_{NO_2} = \frac{\mu g\ NO_2}{V_s} \times \frac{1\ \text{lb/ft}^3}{1.6 \times 10^4\ \mu g/\text{ml}} = 6.243 \times 10^{-5}\ \frac{\mu g\ NO_2}{V_s} = \text{lbs/dscf}$$

METCO

## $NO_x$ EMISSION DATA

Job Number 83-09

Client Southwestern Portland Cement Co.

Date 22 Feb 1983

Unit Tested Kiln No. 2 Stack

Run Number 3

| Flask Number | 9 | 10 | 11 | 12 | AVG |
|---|---|---|---|---|---|
| Time | 1327 | 1342 | 1357 | 1412 | |
| Initial Barometric Pressure, "Hg Abs. | 27.17 | 27.17 | 27.17 | 27.17 | |
| Initial Manometer Reading, "Hg Abs. | -25.0 | -24.9 | -24.9 | -24.8 | |
| $P_I$ - Initial Pressure of Flask, "Hg Abs. | 2.17 | 2.27 | 2.27 | 2.37 | |
| $T_I$ - Initial Temperature of Flask, °F | 62 | 63 | 63 | 64 | |
| $V_F$ - Volume of Flask, ml | 2038 | 2027 | 2044 | 2055 | |
| Final Barometric Pressure, "Hg Abs. | 29.33 | 29.33 | 29.33 | 29.33 | |
| Final Manometer Reading, "Hg Abs. | -2.80 | -2.35 | -2.10 | -2.25 | |
| $P_F$ - Final Pressure of Flask, "Hg Abs. | 26.53 | 26.98 | 27.23 | 27.08 | |
| $T_F$ - Final Temperature of Flask, °F | 72 | 72 | 72 | 72 | |
| $\mu g NO_2$ - micrograms of $NO_2$ | 810.3 | 1060.0 | 1173.9 | 1296.5 | |
| $V_s$ - Volume of sample at conditions*, ml | 1624 | 1638 | 1669 | 1661 | |
| ppm $NO_2$ - Concentration of $NO_2$, ppm | 261.0 | 338.4 | 367.9 | 408.2 | 343.9 |
| $C_{NO_2}$ - Emission Rate of $NO_2$, lbs/dscf* | $2.11 \times 10^{-5}$ | $4.04 \times 10^{-5}$ | $4.39 \times 10^{-5}$ | $4.87 \times 10^{-5}$ | $4.10 \times 10^{-5}$ |

* 68°F, 29.92 "Hg (20°C, 760 mm Hg)

$$V_s = \frac{528\ (V_F - 25)}{29.92} \left[ \frac{P_F}{T_F + 460} - \frac{P_I}{T_I + 460} \right] = \text{ml}$$

$$\text{ppm } NO_2 = \frac{523 \times \mu g\ NO_2}{V_s} = \text{ppm}$$

$$C_{NO_2} = \frac{\mu g\ NO_2}{V_s} \times \frac{1\ \text{lb/ft}^3}{1.6 \times 10^4\ \mu g/\text{ml}} = 6.243 \times 10^{-5}\ \frac{\mu g\ NO_2}{V_s} = \text{lbs/dscf}$$

# APPENDIX F

## Coal Analysis Data

# APPENDIX F

## Coal Analysis Data

| | As Rec'd. Basis | As Analyzed | Dry Basis |
|---|---|---|---|
| Moisture - % | 4.20+0.62 = 4.82 | 0.62 | 0 |
| Sulfur - % | 0.47 | 0.48 | 0.48 |
| Btu/lb | 11,648 | 12,162 | 12,238 |
| Volatiles - % | 36.91 | 38.54 | 38.78 |
| Fixed C - % | 41.57 | 43.41 | 43.68 |
| Ash - % | 16.70 | 17.43 | 17.54 |

# APPENDIX G

## Kiln Operational Data

METCO

Run 1 39.03
Run 2 37.4
Run 3 39.9

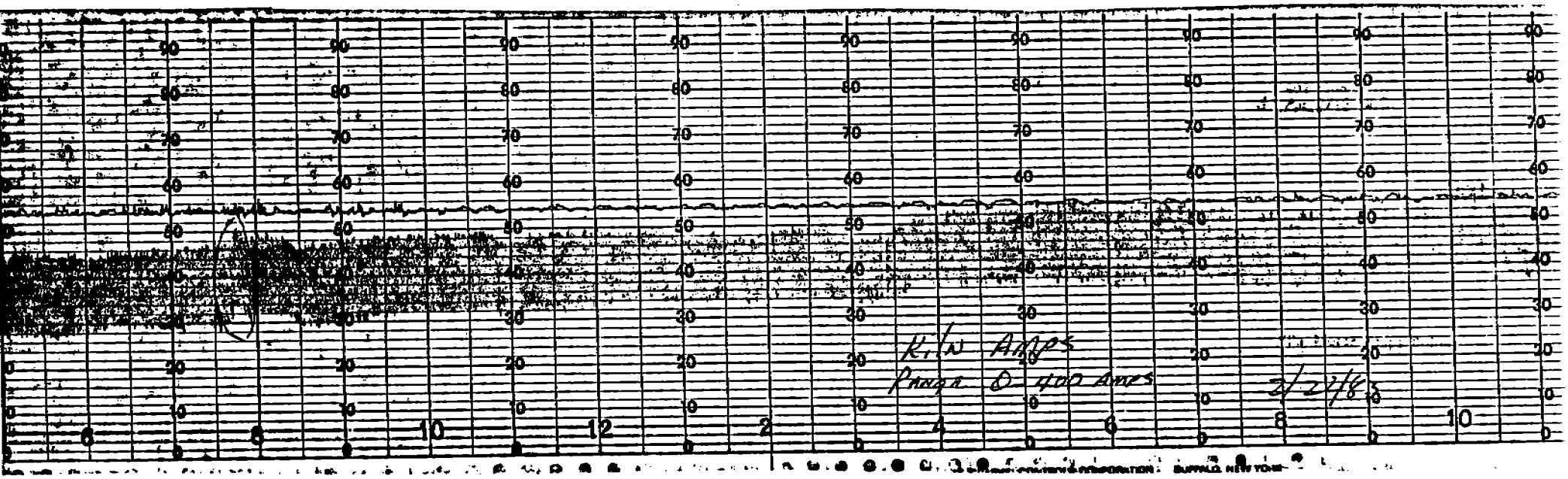
APPENDIX G

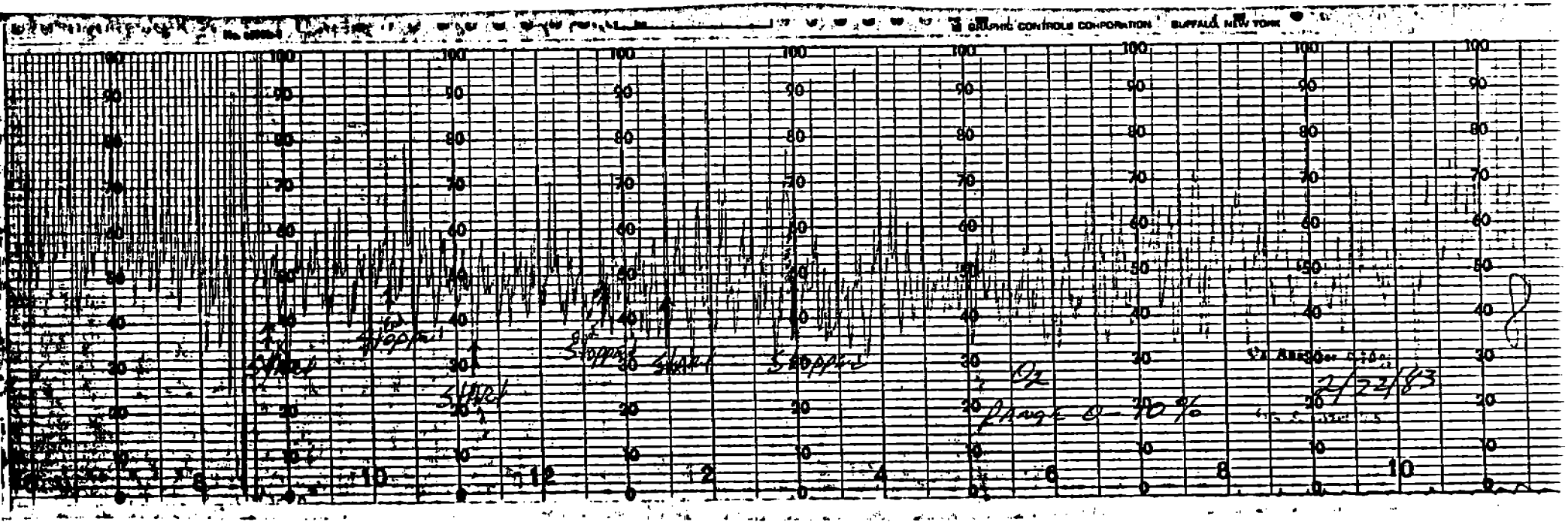
Kiln Operational Data

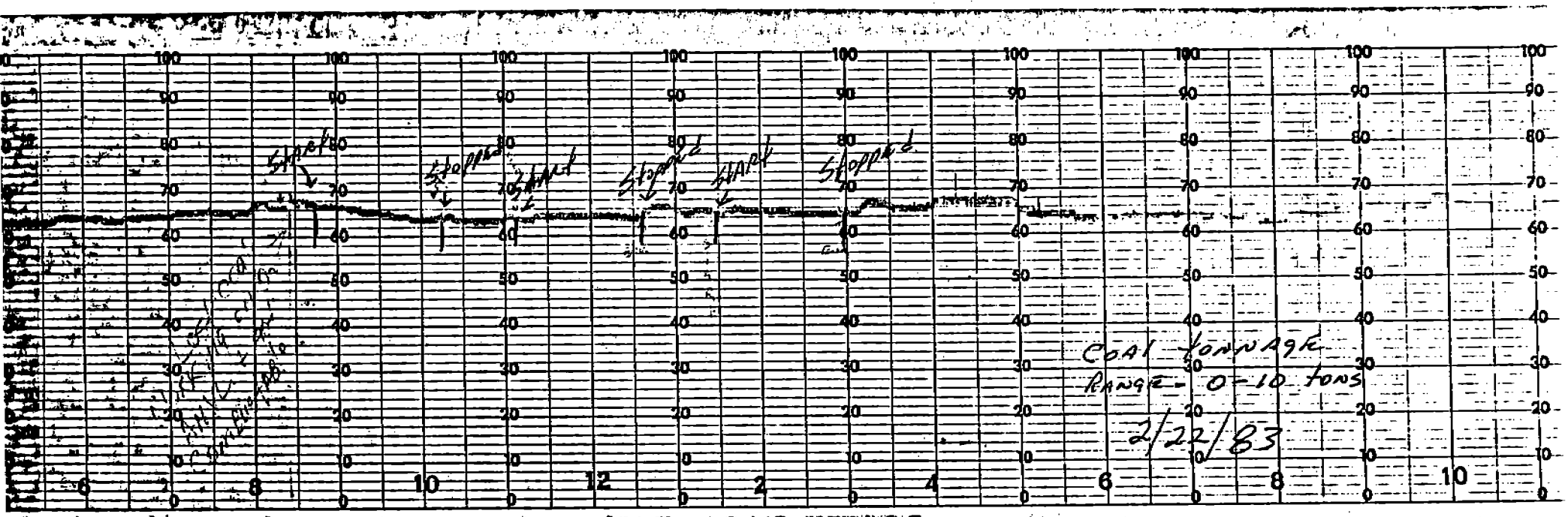
2/22/83

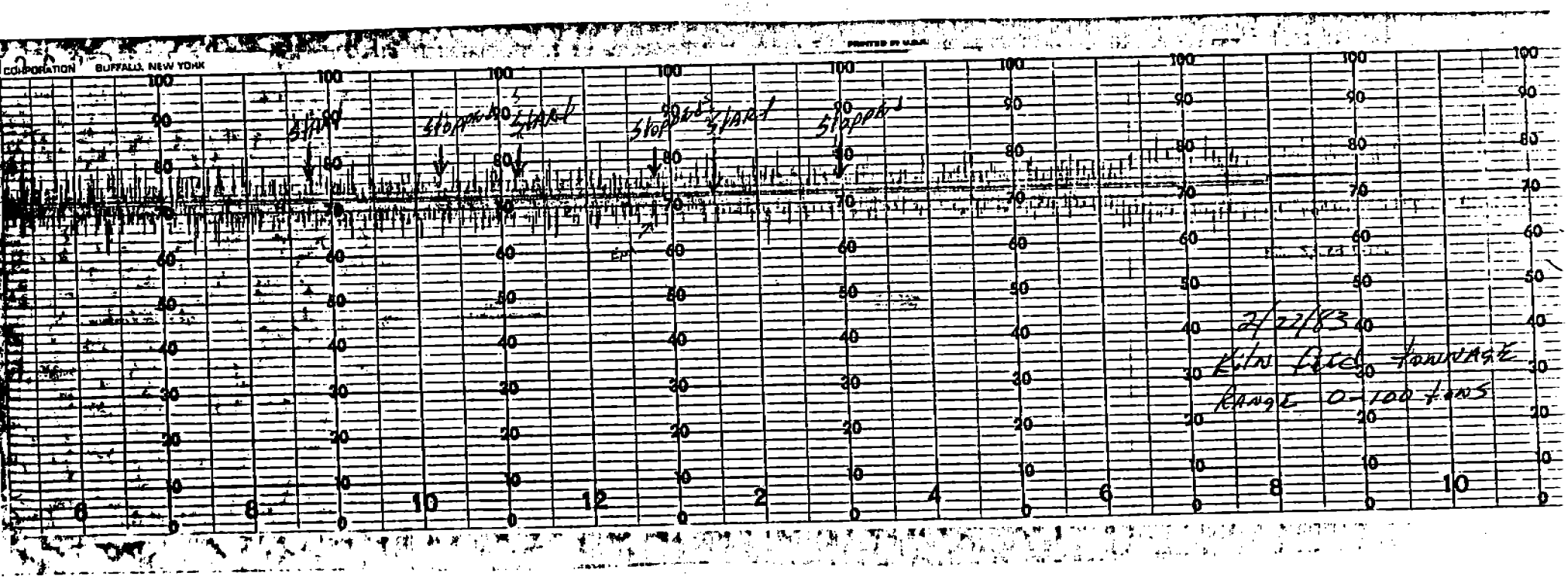
BAGHOUSE

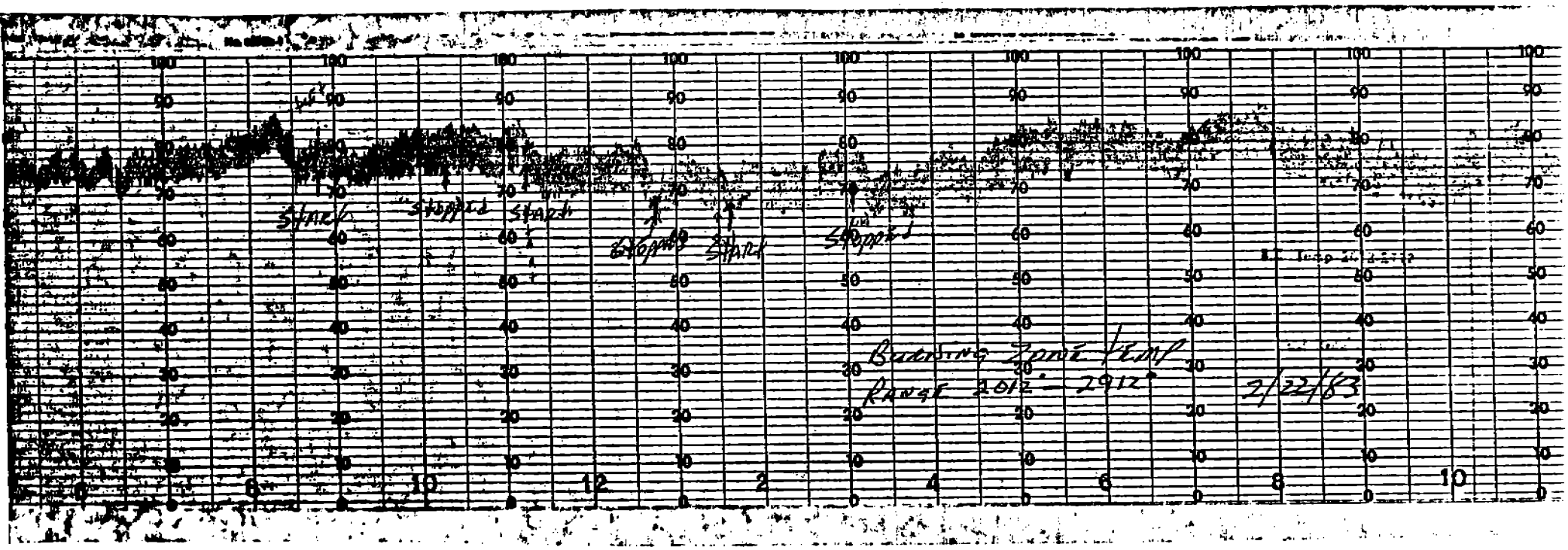
| | Time | Coal Rate tph | Coal Rate Totalizer | Feed Rate tph | Feed Rate Totalizer | Clinker Feed | Clinker Totalizer | GBH-7 B/H drop |
|---|---|---|---|---|---|---|---|---|
| | 0830 | 6.6 | 6.6 | 72 = 45 T/hr | 72.5 | | 29782.0 | bypassed (6) |
| | 0900 | 6.63 | 6.65 | 72 | 73.0 | | 29972.0 (190) | 36.8 |
| | 0930 | 6.5 | 6.5 | 72 | 72.7 | | 30150.0 (17.8) | 39.3 |
| | 1000 | 6.5 | 6.34 | 72 | 72.7 | | 30365.0 (21.5) | |
| End | 1015 | 6.35 | 6.35 | 72 | 70.9 | | 30465.0 (10.0) | 46.1 |
| | 1100 | 6.35 | 6.37 | 72 | 76.5 | | 30826.0 (36.1) | |
| | 1130 | 6.4 | 6.38 | 72 | 71.9 | | 30953.0 | 35.2 |
| | 1200 | 6.4 | 6.4 | 72 | 74.4 | | 31178.0 | 39.2 |
| | 1230 | 6.4 | 6.35 | 72 | 74.5 | | 31387.0 | |
| | 1300 | 6.57 | 6.55 | 72 | 71.6 | | 31571.0 | 1¼" drop |
| | 1330 | 6.45 | 6.47 | 72 | 70.3 | | 31783.0 | 46.2 |
| | 1400 | 6.5 | 6.52 | 72 | 73.1 | | 32034.0 | |
| | 1430 | 6.43 | 6.45 | 72 | 70.4 | | 32167.0 | 34.8 |
| | 1500 | 6.44 | 6.47 | 72 | 71.5 | | 32382.0 | |
| Avg - | ~~6.5 hr~~ 7.0 hr | | 6.45 | | 1016 / 72.57 | | 32501.5 − 32241.5 = 260.0 T; 260.0 T / 6.5 hr = 40 T/hr avg | |


Kilo Amps
Range 0-400 Amps
2/2/83
6
8
10
12
2
4
6
8
10


GRAPHIC CONTROLS CORPORATION BUFFALO, NEW YORK
Stopped
Stopped
Stopped
Stopped
Stopped
Stopped
O2
Range 0-20%
2/22/83
8
2
4
6
8
10
12
2
4
6
8
10


Stopped
Stopped
Stopped
Stopped
Stopped
Stopped
COAL TONNAGE
RANGE - 0-10 TONS
2/22/83
6
8
10
12
2
4
6
8
10


CORPORATION BUFFALO, NEW YORK
PRINTED IN U.S.A.
Stopped
Start
Stopped
Start
Stopped
Start
Stopped
2/22/83
Kiln feed tonnage
Range 0-100 tons
6
8
10
12
2
4
6
8
10


Started
Stopped
Started
Stopped
Started
Stopped
Bubbling Zone Temp
Range 201° - 291°
2/22/63
6
10
12
2
4
6
8
10

# APPENDIX H

## Plume Observation Data

MULLINS ENVIRONMENTAL TESTING CO., INC.
PLUME OBSERVATION REPORT FORM

REGION _____
COUNTY _____

DATE 22 Feb 1983

NAME OF SOURCE: Southwestern Portland Cement Co.

DDRESS: Odessa, TX

STACK IDENTIFICATION: Kiln No. 2 Stack

BSERVER'S APPROX. DISTANCE AND DIRECTION FROM STACK: 280'

OLOR OF EMISSION: Clear

TYPE OF BACKGROUND: Blue Sky

WIND: APPROX. SPEED 15mph APPROX. DIRECTION NE

TART TIME 0852:00 END TIME 0858:00

IOLATION OF RULE 103.1: [ ] YES [✓] NO

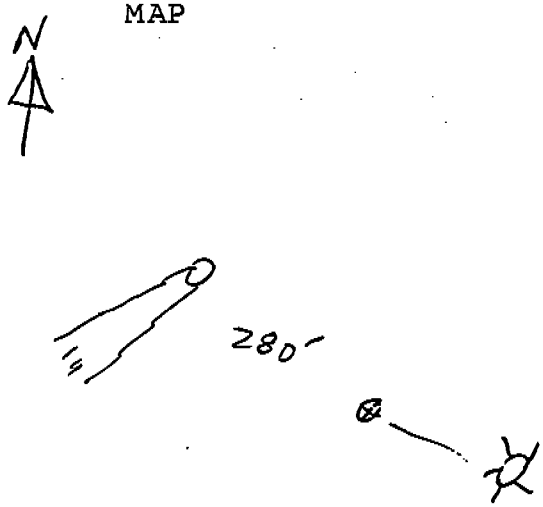
BSERVER: Billy J. Mullins, JR

TOTAL ÷ 24 = AVERAGE OPACITY = 5.0

OPACITY READINGS
(15 second intervals)

| | |
|---|---|
| 1. | 5 |
| 2. | 5 |
| 3. | 5 |
| 4. | 5 |
| 5. | 5 |
| 6. | 5 |
| 7. | 5 |
| 8. | 5 |
| 9. | 5 |
| 10. | 5 |
| 11. | 5 |
| 12. | 5 |
| 13. | 5 |
| 14. | 5 |
| 15. | 5 |
| 16. | 5 |
| 17. | 5 |
| 18. | 5 |
| 19. | 5 |
| 20. | 5 |
| 21. | 5 |
| 22. | 5 |
| 23. | 5 |
| 24. | 5 |
| TOTAL | 120 |

MAP




REMARKS

The opacity was clear in color and barely visible. The opacity appeared to be heat waves more than true visible emissions

SIGNED: Billy J. Mullins Jr.

AFFILIATION: METCO

MULLINS ENVIRONMENTAL TESTING CO., INC.
PLUME OBSERVATION REPORT FORM

REGION _____
COUNTY _____

DATE 22 Feb 1983

NAME OF SOURCE: Southwestern Portland Cement Co.

DDRESS: Odessa, TX

STACK IDENTIFICATION: Kiln No. 2 Stack

BSERVER'S APPROX. DISTANCE AND DIRECTION FROM STACK: 300'

OLOR OF EMISSION: Clear

'YPE OF BACKGROUND: Overcast Sky

WIND: APPROX. SPEED 5-10mph APPROX. DIRECTION NE

TART TIME 1213:00 END TIME 1219:00

IOLATION OF RULE 103.1: [ ] YES [✓] NO

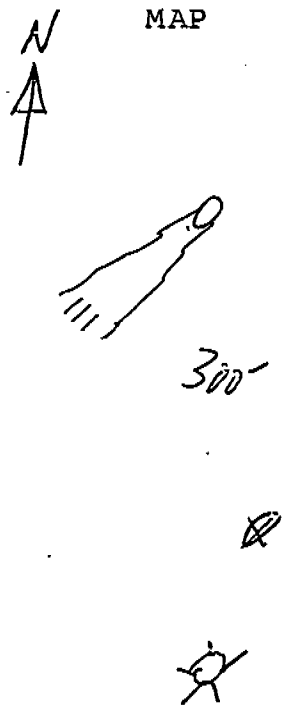
BSERVER: Billy J. Mullins, JR

TOTAL ÷ 24 = AVERAGE OPACITY = 1.9

OPACITY READINGS
(15 second intervals)

| | |
|---|---|
| 1. | 0 |
| 2. | 0 |
| 3. | 0 |
| 4. | 0 |
| 5. | 0 |
| 6. | 0 |
| 7. | 5 |
| 8. | 5 |
| 9. | 5 |
| 10. | 5 |
| 11. | 5 |
| 12. | 0 |
| 13. | 0 |
| 14. | 0 |
| 15. | 5 |
| 16. | 0 |
| 17. | 0 |
| 18. | 0 |
| 19. | 0 |
| 20. | 0 |
| 21. | 0 |
| 22. | 5 |
| 23. | 5 |
| 24. | 5 |
| TOTAL | 45 |

MAP




REMARKS

The opacity is clear and barely visible with overcast skies. The emissions appear to be heat waves.

SIGNED: Billy J. Mullins, Jr.

AFFILIATION: METCO

MULLINS ENVIRONMENTAL TESTING CO., INC.
PLUME OBSERVATION REPORT FORM

REGION _____
COUNTY _____

DATE 22 Feb 1983

NAME OF SOURCE: Southwestern Portland Cement Co.

DDRESS: Odessa, TX

STACK IDENTIFICATION: Kiln No. 2 Stack

BSERVER'S APPROX. DISTANCE AND DIRECTION FROM STACK: 300'

OLOR OF EMISSION: Clear

TYPE OF BACKGROUND: Partly Cloudy Sky

WIND: APPROX. SPEED 5mph APPROX. DIRECTION E

TART TIME 1440:00 END TIME 1446:00

IOLATION OF RULE 103.1: [ ] YES [✓] NO

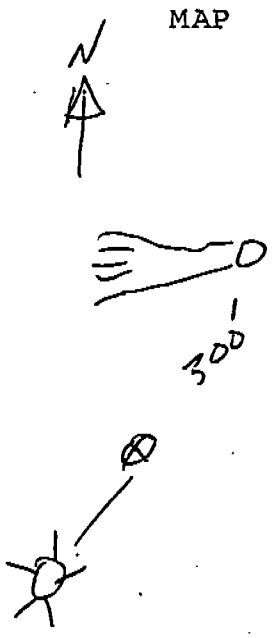
BSERVER: Billy J. Mullins, JR

TOTAL ÷ 24 = AVERAGE OPACITY = 4.2

OPACITY READINGS
(15 second intervals)

| | |
|---|---|
| 1. | 5 |
| 2. | 5 |
| 3. | 5 |
| 4. | 5 |
| 5. | 5 |
| 6. | 5 |
| 7. | 5 |
| 8. | 5 |
| 9. | 5 |
| 10. | 5 |
| 11. | 5 |
| 12. | 5 |
| 13. | 5 |
| 14. | 5 |
| 15. | 5 |
| 16. | 5 |
| 17. | 5 |
| 18. | 5 |
| 19. | 0 |
| 20. | 0 |
| 21. | 0 |
| 22. | 5 |
| 23. | 0 |
| 24. | 5 |
| TOTAL | 100 |

MAP




REMARKS
Plume barely visible and appears to be heat waves.

SIGNED: Billy J. Mullins, Jr.

AFFILIATION: METCO

APPENDIX I

Chain of Custody

MULLINS ENVIRONMENTAL TESTING CO., INC.

Chain of Custody

Job Number 83-09

Job Name SW Portland Cement

Location Odessa, Texas

Unit Tested Kiln No. 2 Stack

Date(s) Sampled 2/22/83

Number of Tests 111

Date Results Required Noon 2/25/83

SOURCE SAMPLES

| | Number of Containers | Particulate | $SO_2$ | $SO_3$ | $H_2S$ | Cl | $H_2SO_4$ | Metals | Other |
|---|---|---|---|---|---|---|---|---|---|
| Filter Container | 111 | ✓ | | | | | | | |
| Front Wash | 111 | ✓ | | | | | | | |
| Back Wash | | | | | | | | | |
| Impinger No. 1 | 111 | ✓ | | ✓ | | | | | |
| Impinger No. 2 | 111 | | ✓ | | | | | | |
| Impinger No. 3 | 111 | | ✓ | | | | | | |
| Impinger No. 4 | | | | | | | | | |
| Acetone Blank | 1 | ✓ | | | | | | | |
| $NO_x$ | 12 | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

Special Instructions

Sample No. 1 Recovered by: Don C Alexander Date: 2/22/82 Time: 1145 Location: VAN

Sample No. 2 Recovered by: Don C Alexander Date: 2/22/82 Time: 1400 Location: VAN

Sample No. 3 Recovered by: Don C Alexander Date: 2/22/82 Time: 1545 Location: VAN

Samples Received by: Billy J. Mullins, Jr for Transport Date: 2/22/83 Time: 1600

Samples Received at Lab by: Tamyra A. Jones Date: 2/23/83 Time: 0800

Samples Analyzed by: Tamyra A. Jones Date: 2/25/83 Time: 1420

# APPENDIX J

## Resumes of Test Personnel

**MULLINS ENVIRONMENTAL TESTING CO., INC.**
P.O. Box 598
Addison, Tx 75001
(214) 931-7127

METCO

BILLY J. MULLINS, JR., President

| | |
|---|---|
| Education | Post Graduate Study in Environmental Engineering at Southern Methodist University, Dallas, Texas, 1970.<br><br>M.S. 1969, New York University, New York, New York, in Civil Engineering (Air Resources).<br><br>B.S. 1968, Texas Tech University, Lubbock, Texas, in Civil Engineering (Water Resources).<br><br>Studies in Engineering at U.S. Naval Academy, Annapolis, Maryland, 1963-1964. |
| Professional Training Courses | Attended Short Course on Air Pollution Engineering at the University of Texas at Austin, February 1970.<br><br>Attended four-week management course presented by the American Management Association, 1976. |
| Certification | Registered Professional Engineer<br>Certified Visible Emissions Evaluator<br>Certified Fallout Shelter Analyst<br>Licensed Private Pilot (Multi-Engine - Land, Instrument)<br>Diplomat in the American Academy of Environmental Engineers |
| Professional Memberships | Air Pollution Control Association - Past Chairman, Southwest Section; Chairman - Consultants Committee<br>Source Evaluation Society - President<br>Texas Society of Professional Engineers<br>National Society of Professional Engineers<br>American Management Association |

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**Technical Experience**

Directed and performed stack sampling on over 1000 sources of which over 100 were sampled simultaneously using more than one sampling train at several points in the flue gas stream. 1972-present.

Directed and performed over 100 short-term ambient air studies using mobile sampling vans and various ambient air sampling equipment. 1972-present.

Designed, directed and operated over 20 permanent ambient air networks of various size and duration for a variety of parameters. 1972-present.

Designed surface and underground drainage systems for residential subdivisions, public works projects, and shopping centers. 1969-1972.

Designed several residential subdivisions including lot layout, street design, drainage design, and utility design. 1969-1972.

**Research Projects**

Supervised and conducted a study made by the Hawaiian Sugar Planters' Association to characterize the emissions for several bagasse-fired boilers. April-May 1976.

Supervised and conducted a study made by the Rio Grande Valley Sugar Growers, Inc. to determine the area affected by the burning of sugarcane fields prior to harvesting. November 1974-April 1975.

Supervised and conducted a study by a lightweight aggregate manufacturer to develop a material balance around the process through sampling and analysis of several parameters. November 1973.

Conducted a study in New York City to attempt to develop a correlation in the ambient air between carbon dioxide and sulfur dioxide to provide a tool for predicting air pollution episodes. January-May 1969.

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**Publications**

Co-authored "Sulfur Compound Emissions of the Petroleum Production Industry," December 1974.

Co-authored "Field Procedure for Stabilizing Hydrogen Sulfide Samples to be Analyzed Using Modified Methylene Blue Technique," presented at the Conference on Ambient Air Quality Measurements, Austin, Texas, March 1975.

Co-authored "Atmospheric Emissions Survey of the Sour Gas Industry," October 1975.

Co-authored "Technique for Insuring the Validity of Samples for High Concentrations of Sulfur Dioxide Using the EPA Method 5 Sampling Train," presented at the Third National Conference on Energy and the Environment, College Corner, Ohio, September 1975.

**Teaching Experience**

Served as a lecturer in the Environmental Protection Agency's training course number 450, "Source Sampling for Particulate Pollutants" for two years from January 1974 to October 1975.

Conducted a two-day training course entitled "Technical Assistance in Source Sampling" at Iowa State University, Ames, Iowa, for the Environmental Protection Agency, October 1974.

Conducted EPA's training course number 450, "Source Sampling for Particulate Pollutants" for the EPA at Research Triangle Park, North Carolina, September 1975.

Conducted a two-day short course entitled "Performing and Observing Source Sampling" at Dallas, Texas, July 1976, May 1977, October 1977; at Lake Charles, Louisiana, May 1977; and at Casper, Wyoming, May 1977.

Served as a lecturer in the Environmental Protection Agency's two-day seminar entitled "Asphalt Industry Environmental Solutions," presented in Dallas, Texas, on March 21 and 22, 1979.

Conducted a two-day short course entitled "Performing and Observing Source Sampling" in Lincoln, Nebraska, in March 1980 for the State of Nebraska, Air Quality Control Division.

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METCO

DON C. ALEXANDER, Field Testing Supervisor

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| Education | B.S. 1978, Angelo State University, San Angelo, Texas, in Biology with a minor in Chemistry. |
| Professional Training Courses | Two-day short course, "Performing and Observing Source Sampling," Dallas, Texas, March 1982. |
| Certification | Certified Visible Emissions Evaluator |
| Technicial Experience | Participated in the sampling of over 350 sources, including several which were sampled simultaneously using more than one sampling train and has supervised the sampling of over 150 sources. 1979-present.<br><br>Thoroughly trained in calibration techniques for all field testing equipment and all EPA testing procedures. Trained in the operation of MSA LIRA Model 202S Infrared Analyzer. |

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METCO

KEVIN OVERTON, Environmental Field Technician

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| Education | B.S. 1979, Texas Wesleyan College, Fort Worth, Texas, in Biology with a minor in Chemistry. |
| Professional Training Courses | Graduate courses in "Advanced Population Biology" and "Biometery" Texas Tech University, Lubbock, Texas, September 1980 to May 1981. |
| Technical Experience | Participated in the sampling of over 50 sources, including several which were sampled simultaneously using more than one sampling train. Thoroughly trained in all EPA testing procedures. 1982-present. |
| Research Projects | Research Technician in the Department of Molecular Genetics, University of Texas Health Science Center at Dallas. |
| Teaching Experience | Taught Freshman Zoology Laboratory at Texas Tech University, Lubbock, Texas. |