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|---------------|--------------|
| AP-42 Section | <u>11.23</u> |
| Reference | <u>15</u> |
| Report Sect. | <u>4</u> |
| Reference | <u>15</u> |

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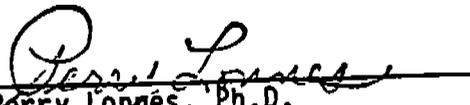
RESULTS OF THE OCTOBER 12-15, 1987
AIR EMISSION COMPLIANCE TESTS
AT THE EVELETH TACONITE PLANT IN
EVELETH, MINNESOTA

Submitted to:

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Report Number 7-2431
December 18, 1987

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ABBREVIATIONS

| | |
|------------------------|---|
| ACFM | actual cubic feet per minute |
| cc (ml) | cubic centimeter (milliliter) |
| DSCFM | standard cubic foot of dry gas per minute |
| DSML | dry standard milliliter |
| DEG-F (°F) | degrees Fahrenheit |
| DIA. | diameter |
| FT/SEC | feet per second |
| g | gram |
| GPM | gallons per minute |
| GR/ACF | grains per actual cubic foot |
| GR/DSCF | grains per dry standard cubic foot |
| g/dscm | grams per dry standard cubic meter |
| HP | horsepower |
| HRS | hours |
| IN. | inches |
| IN. HG. | inches of mercury |
| IN. WC. | inches of water |
| LB | pound |
| LB/DSCF | pounds per dry standard cubic foot |
| LB/HR | pounds per hour |
| LB/10 ⁶ BTU | pounds per million British Thermal Units heat input |
| LB/MMBTU | pounds per million British Thermal Units heat input |
| LTPD | long tons per day |
| Mw | megawatt |
| mg/DSCM | milligrams per dry standard cubic meter |
| microns (um) | micrometer |
| MIN. | minutes |
| ng | nanograms |
| ohm-cm | ohm-centimeter |
| PM | particulate matter |
| PPH | pounds per hour |
| PPM | parts per million |
| ppmC | parts per million carbon |
| ppm,d | parts per million, dry |
| ppm,w | parts per million, wet |
| ppt | parts per trillion |
| PSI | pounds per square inch |
| SQ. FT. | square feet |
| ug | micrograms |
| v/v | percent by volume |
| w/w | percent by weight |

Standard conditions are defined as 68 °F (20 °C) and 29.92 IN. of mercury pressure.

INTRODUCTION

During the Period of October 12-15, 1987, Interpoll Laboratories personnel conducted a series of air emission compliance tests at the Eveleth Taconite Company in Eveleth, Minnesota. The sources tested included the Expansion Plant Line 2 Induration Furnace Side B Scrubber, Kiln Cooler Exhaust and Scrubber, Ore Unloading Pocket and the Original Plant Fourth Stage Crusher. On-site testing was performed by E. Trowbridge and G. Lehman. Coordination between plant operation and testing activities was provided by Bob Anderson. The tests conducted on October 13 were witnessed by Bob Beresford of the Minnesota Pollution Control Agency.

The Line 2 Pellet Induration Furnace is an Allis-Chalmers rotary kiln (Serial No. B-41301) which is 130 feet in length with a 21'-6" diameter. It may be fired with No. 2 or 6 oil, natural gas or coal. During the test, the furnace was cofired with petroleum coke and coal.

The maximum annual average production rate of the Line 2 Induration Furnace is 495 LTONS/HR. The five year average is 481 LTONS/HR. During the air emission test, the production rate averaged 492 LTONS/HR.

= 551 T/HR

In the pellet induration process, gases from the rotary kiln and pellet cooling step are used to preheat and dry the green pellets on the traveling grate prior to entering into the rotary kiln. In the second stage of preheating, the exit gas from the kiln (1900 °F) is drawn through the bed of green pellets which results in a temperature reduction of the gas to approximately 775 °F. This gas is then mixed with recouped hot air from the pellet cooler giving a combined gas stream with a temperature of approximately 660 °F. This gas is drawn through the green pellet bed in the first stage of preheating. The temperature of the gas is reduced to 225 °F in this step and then passes through the grate box before entering into the wet scrubber

system (see Appendix B for scrubber system diagram). A wet feed rate of 585.7 LTONS/HR results in a finished pellet production rate of 492 LTONS/HR.

The wet scrubber consists of two identical scrubber systems operated in parallel. They are known as Side A and Side B. Each side has four venturi scrubbers followed by two drum demisters. The scrubbed and demisted gas then enters the I.D. fan and is exhausted to the stack. Side A and B have individual stacks. Only Side B was tested in this evaluation.

All of the tests were performed in accordance with EPA Methods 1-6 and 9, CFR Title 40, Part 60, Appendix A (revised July 1, 1987). A preliminary determination of the gas linear velocity profile was made at each site which had not been previously tested to allow selection of the appropriate nozzle diameter required for isokinetic sample withdrawal. Interpoll Labs sampling trains which meet or exceed specifications in the above-cited reference were used to collect the samples. An all-glass impinger assembly was used in the back half of the Method 5 sampling train to collect condensable particulates which were analyzed as per the test protocol promulgated by the MPCA. Sulfur dioxide testing was performed using the EPA Method 6 large impinger sampling train without the isopropanol impinger.

In the case of the Induration Furnace, an integrated flue gas sample was extracted simultaneously with each sulfur dioxide sample using a specially designed gas sampling system. Integrated flue gas samples were collected in 44-liter Tedlar bags. After sampling was complete, the bags were sealed and returned to the laboratory for Orsat analysis. Prior to sampling, the Tedlar bags are leak checked at 15 IN.HG. vacuum with an in-line rotameter. Bags with any detectable inleakage are discarded.

Testing on the Line 2 Induration Furnace Side B Scrubber System Stack was performed using four test ports. The ports are oriented at 90 degrees and are located more than seven stack diameters downstream of a transition breeching and more than two stack diameters upstream of the stack outlet. A three-point traverse was used to collect representative SO₂ samples from the stack. Each traverse point was sampled 20 minutes to give a total sampling time of 60 minutes per run. A 12-point traverse was used for the volumetric flow rate determination.

At the Induration Furnace Side B Scrubber System inlet test sites, only one port on each of the four venturi scrubber inlet ducts was used to collect SO₂ samples. Each of the four ports were sampled 15 minutes (using a five minutes per point three-point traverse) to give a 60-minute sample to correspond to the 60-minute stack sample.

Particulate testing on the Fourth Stage Crusher Wet Scrubber Stack was performed from two test ports located approximately 34 stack diameters downstream of the nearest flow disturbance and nine diameters upstream of the stack exit. A 12-point traverse was used with each traverse point being sampled five minutes for a total of 60 minutes per run.

Testing on the Kiln Cooler Area Wet Scrubber Stack was performed from two test ports oriented at 90 degrees. A 16-point traverse was used to collect particulate samples. Each traverse point was sampled four minutes for a total of 64 minutes per run.

Testing on the Kiln Cooler Exhaust was conducted from four ports oriented at 90 degrees and located more than four diameters downstream of the nearest flow disturbance and 0.6 diameters upstream of the stack exhaust. A 24-point traverse was used to collect particulate samples. Each point was sampled 2.5 minutes for a total of 60 minutes per run.

Testing on the North Unloader Pocket Baghouse Stack was conducted from two test ports located one diameter downstream and one diameter upstream of the nearest flow disturbance. A 24-point traverse was used to collect representative samples. Each traverse point was samples 2.5 minutes. Each run was approximately 35 minutes in length corresponding to the amount of time it took to unload the coal cars in each train.

The important results of the tests are summarized in Section 2. Detailed results are presented in Section 3. Field data and all other supporting information are presented in the appendices.

SUMMARY AND DISCUSSION

The results of the SO₂ tests on the Line 2 Induration furnace Side B Wet Scrubber System are given in Table 1. The results of the particulate emission tests performed on the other sources are presented in Tables 2-5.

No difficulties were encountered in the field or in the laboratory evaluation of the samples. On the basis of this fact and a complete review of the entire data and results, it is our opinion that the concentrations and emission rates reported herein are accurate and closely reflect the actual values which existed at the time the tests were performed.

Table 1. Summary of the Results of the October 14, 1987 Sulfur Dioxide Emission Compliance Test on the Line 2 Induration Furnace Side B Wet Scrubber System at the Eveleth Taconite Plant in Eveleth, Minnesota.

| Run | Concentration (ppm,w) | | Mass Rate (LB/HR) | |
|---------|-----------------------|------------|-------------------|------------|
| | Inlet | Stack | Inlet | Stack |
| 1 | 175* | 136 | 524* | 417 |
| 2 | 195 | 137 | 603 | 421 |
| 3 | <u>198</u> | <u>142</u> | <u>607</u> | <u>430</u> |
| Average | 197 | 138 | 603 | 423 |

*May have been a sampling or analytical difficulty on the first run and thus this run was not used in the average.

TABLE 2. Summary of the Results of the October 12, 1987 Particulate Emission Compliance Test on the F2 Crusher Scrubber Stack at the Eveleth Taconite Plant Located in Eveleth, Minnesota.

| ITEM | Run 1 | Run 2 | Run 3 |
|-----------------------------|-----------|-----------|-----------|
| Date of test | 10-12-87 | 10-12-87 | 10-12-87 |
| Time runs were done (HRS) | 1338/1445 | 1500/1602 | 1615/1717 |
| Process rate (KLB/HR) | | | |
| Volumetric flow | | | |
| actual (ACFM) | 19284 | 19217 | 19229 |
| standard (DSCFM) | 18644 | 18531 | 18569 |
| Gas temperature (DEG-F) | 56 | 56 | 56 |
| Moisture content (%V/V) | 1.31 | 1.58 | 1.43 |
| Gas composition (%V/V,dry) | | | |
| carbon dioxide | 0.03 | 0.03 | 0.03 |
| oxygen | 20.90 | 20.90 | 20.90 |
| carbon monoxide | 0.00 | 0.00 | 0.00 |
| nitrogen | 79.07 | 79.07 | 79.07 |
| Isokinetic variation (%) | 99.4 | 100.0 | 100.7 |
| Particulate concentration | | | |
| actual (GR/ACF) | .0426 | .0699 | .0652 |
| standard (GR/DSCF) | .0441 | .0725 | .0675 |
| Part. emission rate (LB/HR) | 7.05 | 11.51 | 10.75 |

* Dry + organic wet catch

TABLE 3. Summary of the Results of the October 13, 1987 Particulate Emission Compliance Test on the SS41 Kiln Cooler Scrubber Stack at the Eveleth Taconite Plant in Eveleth, Minnesota.

| ITEM | Run 1 | Run 2 | Run 3 |
|---|-----------|-----------|-----------|
| Date of test | 10-13-87 | 10-13-87 | 10-13-87 |
| Time runs were done (HRS) | 1112/1217 | 1238/1344 | 1408/1512 |
| Process rate (KLB/HR) | | | |
| Volumetric flow actual (ACFM) | 48618 | 48907 | 48633 |
| standard (DSCFM) | 45855 | 46006 | 45748 |
| Gas temperature (DEG-F) | 63 | 64 | 64 |
| Moisture content (%V/V) | 2.03 | 2.11 | 2.11 |
| Gas composition (%V/V,dry) | | | |
| carbon dioxide | 0.03 | 0.03 | 0.03 |
| oxygen | 20.90 | 20.90 | 20.90 |
| carbon monoxide | 0.00 | 0.00 | 0.00 |
| nitrogen | 79.07 | 79.07 | 79.07 |
| Isokinetic variation (%) | 100.4 | 99.6 | 99.6 |
| Particulate concentration actual (GR/ACF) | .0223 | .0185 | .00827 |
| standard (GR/DSCF) | .0236 | .0197 | .00879 |
| Part. emission rate (LB/HR) | 9.30 | 7.76 | 3.45 |

* Dry + organic wet catch

TABLE 4. Summary of the Results of the October 13, 1987 Particulate Emission Compliance Test on the Kiln Cooler Exhaust Stack at the Eveleth Taconite Plant Located in Eveleth, Minnesota.

| ITEM | Run 1 | Run 2 | Run 3 |
|-----------------------------|-----------|-----------|-----------|
| Date of test | 10-13-87 | 10-13-87 | 10-13-87 |
| Time runs were done (HRS) | 1558/1709 | 1732/1838 | 1855/2008 |
| Process rate (KLB/HR) | | | |
| Volumetric flow | | | |
| actual (ACFM) | 230534 | 234706 | 233279 |
| standard (DSCFM) | 121120 | 123091 | 122069 |
| Gas temperature (DEG-F) | 483 | 485 | 486 |
| Moisture content (%V/V) | 1.61 | 1.58 | 1.75 |
| Gas composition (%V/V, dry) | | | |
| carbon dioxide | 0.03 | 0.03 | 0.03 |
| oxygen | 20.90 | 20.90 | 20.90 |
| carbon monoxide | 0.00 | 0.00 | 0.00 |
| nitrogen | 79.07 | 79.07 | 79.07 |
| Isokinetic variation (%) | 99.9 | 100.0 | 100.1 |
| Particulate concentration | | | |
| actual (GR/ACF) | 0.201 | 0.158 | 0.133 |
| standard (GR/DSCF) | 0.382 | 0.301 | 0.255 |
| Part. emission rate (LB/HR) | 396.92 | 317.86 | 266.54 |

* Dry + organic wet catch

TABLE 5. Summary of the Results of the October 15, 1987 Particulate Emission Compliance Test on the North Unloader Pocket Baghouse Outlet at the Eveleth Taconite Plant in Eveleth, Minnesota.

| ITEM | Run 1 | Run 2 | Run 3 |
|-----------------------------|-----------|-----------|-----------|
| Date of test | 10-15-87 | 10-15-87 | 10-15-87 |
| Time runs were done (HRS) | 1315/1353 | 1724/1759 | 1936/2006 |
| Process rate (KLB/HR) | | | |
| Volumetric flow | | | |
| actual (ACFM) | 38515 | 42817 | 39124 |
| standard (DSCFM) | 37911 | 42445 | 38967 |
| Gas temperature (DEG-F) | 45 | 42 | 40 |
| Moisture content (%V/V) | 1.05 | 0.94 | 0.87 |
| Gas composition (%V/V, dry) | | | |
| carbon dioxide | 0.03 | 0.03 | 0.03 |
| oxygen | 20.90 | 20.90 | 20.90 |
| carbon monoxide | 0.00 | 0.00 | 0.00 |
| nitrogen | 79.07 | 79.07 | 79.07 |
| Isokinetic variation (%) | 99.6 | 99.6 | 99.5 |
| Particulate concentration | | | |
| actual (GR/ACF) | .00565 | .00854 | .00622 |
| standard (GR/DSCF) | .00574 | .00862 | .00625 |
| Part. emission rate (LB/HR) | 1.86 | 3.14 | 2.09 |

* Dry + organic wet catch

RESULTS

The results of all field and laboratory evaluations are presented in this section. Gas composition results (Orsat and moisture) are presented first followed by the computer printout of the particulate, sulfur dioxide and opacity observations. Preliminary measurements including test port locations are given in the appendices.

The results have been calculated on a Sperry PC Computer using programs written in Extended BASIC specifically for source testing calculations. EPA-published equations have been used as the basis of the calculation techniques in these programs.

The particulate emission rate has been calculated using the product of the concentration times flow method (as recommended by the EPA) rather than the ratio of areas method. The dry particulate emission factor has been calculated by the Oxygen F-Factor Method using the latest EPA-published dry F-Factor for the stated fuel.

3.1 Results of Orsat and Moisture Analyses

Test No. 1
 F2 Crusher Scrubber Stack

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

| Date of run | Run 1 10-12-87 | Run 2 10-12-87 | Run 3 10-12-87 |
|-----------------------------|-------------------|-------------------|-------------------|
| Dry basis (orsat) | | | |
| carbon dioxide..... | 0.03 | 0.03 | 0.03 |
| oxygen..... | 20.90 | 20.90 | 20.90 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 79.07 | 79.07 | 79.07 |
| Wet basis (orsat) | | | |
| carbon dioxide..... | 0.03 | 0.03 | 0.03 |
| oxygen..... | 20.63 | 20.57 | 20.60 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 78.03 | 77.82 | 77.94 |
| water vapor..... | 1.31 | 1.58* | 1.43 |
| Dry molecular weight..... | 28.84 | 28.84 | 28.84 |
| Wet molecular weight..... | 28.70 | 28.67 | 28.69 |
| Specific gravity..... | 0.991 | 0.990 | 0.991 |
| Water mass flow.....(LB/HR) | 696 | 898 | 755 |

* Free or condensed water in the gas stream.

FO 13 0.000 0.000 0.000

Test No. 2
 SS41 Kiln Cooler Scrubber Stack

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

| Date of run | Run 1 10-13-87 | Run 2 10-13-87 | Run 3 10-13-87 |
|------------------------------|-------------------|-------------------|-------------------|
| Dry basis (orsat) | | | |
| carbon dioxide..... | 0.03 | 0.03 | 0.03 |
| oxygen..... | 20.90 | 20.90 | 20.90 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 79.07 | 79.07 | 79.07 |
| Wet basis (orsat) | | | |
| carbon dioxide..... | 0.03 | 0.03 | 0.03 |
| oxygen..... | 20.48 | 20.46 | 20.46 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 77.46 | 77.41 | 77.41 |
| water vapor..... | 2.03* | 2.11* | 2.11* |
| Dry molecular weight..... | 28.84 | 28.84 | 28.84 |
| Wet molecular weight..... | 28.62 | 28.61 | 28.61 |
| Specific gravity..... | 0.989 | 0.988 | 0.988 |
| Water mass flow..... (LB/HR) | 2986 | 3007 | 3207 |

* Free or condensed water in the gas stream.

FO 14 0.000 0.000 0.000

Test No. 3
 Kiln Cooler Exhaust Stack

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

| Date of run | Run 1 10-13-87 | Run 2 10-13-87 | Run 3 10-13-87 |
|-----------------------------|-------------------|-------------------|-------------------|
| Dry basis (orsat) | | | |
| carbon dioxide..... | 0.03 | 0.03 | 0.03 |
| oxygen..... | 20.90 | 20.90 | 20.90 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 79.07 | 79.07 | 79.07 |
| Wet basis (orsat) | | | |
| carbon dioxide..... | 0.03 | 0.03 | 0.03 |
| oxygen..... | 20.56 | 20.57 | 20.53 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 77.80 | 77.82 | 77.69 |
| water vapor..... | 1.61 | 1.58 | 1.75 |
| Dry molecular weight..... | 28.84 | 28.84 | 28.84 |
| Wet molecular weight..... | 28.67 | 28.67 | 28.65 |
| Specific gravity..... | 0.990 | 0.990 | 0.990 |
| Water mass flow.....(LB/HR) | 5550 | 5542 | 6091 |

Test No. 4
 Indurating Line 2 Stack B

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

| Date of run | Run 1 10-14-87 | Run 2 10-14-87 | Run 3 10-14-87 |
|------------------------------|-------------------|-------------------|-------------------|
| Dry basis (orsat) | | | |
| carbon dioxide..... | 1.65 | 1.60 | 1.75 |
| oxygen..... | 18.60 | 18.80 | 18.60 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 79.75 | 79.60 | 79.65 |
| Wet basis (orsat) | | | |
| carbon dioxide..... | 1.47 | 1.42 | 1.58 |
| oxygen..... | 16.58 | 16.63 | 16.78 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 71.08 | 70.43 | 71.85 |
| water vapor..... | 10.87 | 11.52 | 9.80 |
| Dry molecular weight..... | 29.01 | 29.01 | 29.02 |
| Wet molecular weight..... | 27.81 | 27.74 | 27.94 |
| Specific gravity..... | 0.961 | 0.958 | 0.965 |
| Water mass flow..... (LB/HR) | 93654 | 99925 | 83387 |

Test No. 5
 Side B Scrubber Inlet

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

| Date of run | Run 1 10-14-87 | Run 2 10-14-87 | Run 3 10-14-87 |
|------------------------------|-------------------|-------------------|-------------------|
| Dry basis (orsat) | | | |
| carbon dioxide..... | 1.65 | 1.65 | 1.60 |
| oxygen..... | 18.60 | 18.70 | 18.75 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 79.75 | 79.65 | 79.65 |
| Wet basis (orsat) | | | |
| carbon dioxide..... | 1.51 | 1.46 | 1.43 |
| oxygen..... | 16.97 | 16.52 | 16.71 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 72.77 | 70.34 | 70.98 |
| water vapor..... | 8.75 | 11.68 | 10.88 |
| Dry molecular weight..... | 29.01 | 29.01 | 29.01 |
| Wet molecular weight..... | 28.04 | 27.73 | 27.81 |
| Specific gravity..... | 0.969 | 0.958 | 0.961 |
| Water mass flow..... (LB/HR) | 73692 | 101682 | 93843 |

Test No. 6
 North Unloader Pocket Baghouse Outlet

Results of Orsat & Moisture Analyses-----Methods 3 & 4(%v/v)

| Date of run | Run 1 10-15-87 | Run 2 10-15-87 | Run 3 10-15-87 |
|-------------|-------------------|-------------------|-------------------|
|-------------|-------------------|-------------------|-------------------|

Dry basis (orsat)

| | | | |
|----------------------|-------|-------|-------|
| carbon dioxide..... | 0.03 | 0.03 | 0.03 |
| oxygen..... | 20.90 | 20.90 | 20.90 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 79.07 | 79.07 | 79.07 |

Wet basis (orsat)

| | | | |
|------------------------------|-------|-------|-------|
| carbon dioxide..... | 0.03 | 0.03 | 0.03 |
| oxygen..... | 20.68 | 20.70 | 20.72 |
| carbon monoxide..... | 0.00 | 0.00 | 0.00 |
| nitrogen..... | 78.24 | 78.33 | 78.38 |
| water vapor..... | 1.05* | 0.94* | 0.87* |
| Dry molecular weight..... | 28.84 | 28.84 | 28.84 |
| Wet molecular weight..... | 28.73 | 28.74 | 28.75 |
| Specific gravity..... | 0.992 | 0.993 | 0.993 |
| Water mass flow..... (LB/HR) | 1472 | 1928 | 1843 |

* Free or condensed water in the gas stream.

3.2 Results of Particulate Loading Determinations

Test No. 1
 F2 Crusher Scrubber Stack

Results of Particulate Loading Determinations-----Method 5

| | Run 1 10-12-87 | Run 2 10-12-87 | Run 3 10-12-87 |
|---|-------------------|-------------------|-------------------|
| Date of run | | | |
| Time run start/end.....(HRS) | 1338/1445 | 1500/1602 | 1615/1717 |
| Static pressure.....(IN.WC) | -0.45 | -0.45 | -0.45 |
| Cross sectional area (SQ.FT) | 5.85 | 5.85 | 5.85 |
| Pitot tube coefficient..... | .840 | .840 | .840 |
| Water in sample gas | | | |
| condenser.....(ML) | 0.0 | 0.0 | 0.0 |
| impingers.....(GRAMS) | 2.0 | 3.0 | 2.0 |
| desiccant.....(GRAMS) | 8.0 | 10.0 | 9.0 |
| total.....(GRAMS) | 10.0 | 13.0 | 11.0 |
| Total particulate material..collected(grams) | 0.1013 | 0.1666 | 0.1566 |
| Gas meter coefficient..... | 0.9993 | 0.9993 | 0.9993 |
| Barometric pressure..(IN.HG) | 28.68 | 28.68 | 28.68 |
| Avg. orif.pres.drop..(IN.WC) | 1.19 | 1.20 | 1.19 |
| Avg. gas meter temp..(DEF-F) | 72.3 | 77.0 | 72.3 |
| Volume through gas meter.... | | | |
| at meter conditions...(CF) | 37.21 | 37.56 | 37.55 |
| standard conditions.(DSCF) | 35.45 | 35.47 | 35.77 |
| Total sampling time....(MIN) | 60.00 | 60.00 | 60.00 |
| Nozzle diameter.....(IN) | .185 | .185 | .185 |
| Avg.stack gas temp ..(DEG-F) | 56 | 56 | 56 |
| Volumetric flow rate..... | | | |
| actual.....(ACFM) | 19284 | 19217 | 19229 |
| dry standard.....(DSCFM) | 18644 | 18531 | 18569 |
| Isokinetic variation.....(%) | 99.4 | 100.0 | 100.7 |
| Particulate concentration... | | | |
| actual.....(GR/ACF) | 0.04262 | 0.06986 | 0.06521 |
| dry standard.....(GR/DSCF) | 0.04409 | 0.07247 | 0.06755 |
| Particle mass rate...(LB/HR) | 7.05 | 11.51 | 10.75 |

Test No. 2
 SS41 Kiln Cooler Scrubber Stack

Results of Particulate Loading Determinations-----Method 5

| | Run 1 | Run 2 | Run 3 |
|------------------------------|-----------|-----------|-----------|
| Date of run | 10-13-87 | 10-13-87 | 10-13-87 |
| Time run start/end.....(HRS) | 1112/1217 | 1238/1344 | 1409/1512 |
| Static pressure.....(IN.WC) | -0.37 | -0.37 | -0.37 |
| Cross sectional area (SQ.FT) | 18.03 | 18.03 | 18.03 |
| Pitot tube coefficient..... | .840 | .840 | .840 |
| Water in sample gas | | | |
| condenser.....(ML) | 0.0 | 0.0 | 0.0 |
| impingers.....(GRAMS) | 0.0 | 2.0 | 2.0 |
| desiccant.....(GRAMS) | 15.0 | 13.0 | 14.0 |
| total.....(GRAMS) | 15.0 | 15.0 | 16.0 |
| Total particulate material.. | | | |
|collected(grams) | 0.0467 | 0.0387 | 0.0172 |
| Gas meter coefficient..... | 0.9962 | 0.9962 | 0.9962 |
| Barometric pressure..(IN.HG) | 28.56 | 28.56 | 28.56 |
| Avg. orif.pres.drop..(IN.WC) | 0.83 | 0.85 | 0.85 |
| Avg. gas meter temp..(DEF-F) | 76.3 | 94.5 | 97.4 |
| Volume through gas meter.... | | | |
| at meter conditions...(CF) | 32.49 | 33.46 | 33.45 |
| standard conditions.(DSCF) | 30.47 | 30.35 | 30.18 |
| Total sampling time....(MIN) | 64.00 | 64.00 | 64.00 |
| Nozzle diameter.....(IN) | .185 | .185 | .185 |
| Avg.stack gas temp ..(DEG-F) | 63 | 64 | 64 |
| Volumetric flow rate..... | | | |
| actual.....(ACFM) | 48618 | 48907 | 48633 |
| dry standard.....(DSCFM) | 45855 | 46006 | 45748 |
| Isokinetic variation.....(%) | 100.4 | 99.6 | 99.6 |
| Particulate concentration... | | | |
| actual.....(GR/ACF) | 0.02230 | 0.01850 | 0.00827 |
| dry standard.....(GR/DSCF) | 0.02365 | 0.01967 | 0.00879 |
| Particle mass rate...(LB/HR) | 9.30 | 7.76 | 3.45 |

Test No. 3
 Kiln Cooler Exhaust Stack

Results of Particulate Loading Determinations-----Method 5

| | Run 1 | Run 2 | Run 3 |
|------------------------------|-----------|-----------|-----------|
| Date of run | 10-13-87 | 10-13-87 | 10-13-87 |
| Time run start/end.....(HRS) | 1559/1709 | 1732/1838 | 1855/2008 |
| Static pressure.....(IN.WC) | -0.34 | -0.34 | -0.34 |
| Cross sectional area (SQ.FT) | 190.73 | 190.73 | 190.73 |
| Pitot tube coefficient..... | .840 | .840 | .840 |
| Water in sample gas | | | |
| condenser.....(ML) | 0.0 | 0.0 | 0.0 |
| impingers.....(GRAMS) | 0.0 | 0.0 | 0.0 |
| desiccant.....(GRAMS) | 10.0 | 10.0 | 11.0 |
| total.....(GRAMS) | 10.0 | 10.0 | 11.0 |
| Total particulate material.. | | | |
|collected(grams) | 0.7152 | 0.5735 | 0.4814 |
| Gas meter coefficient..... | 0.9962 | 0.9962 | 0.9962 |
| Barometric pressure..(IN.HG) | 28.56 | 28.56 | 28.56 |
| Avg. orif.pres.drop..(IN.WC) | 0.90 | 0.93 | 0.91 |
| Avg. gas meter temp..(DEF-F) | 97.0 | 96.1 | 94.5 |
| Volume through gas meter.... | | | |
| at meter conditions...(CF) | 31.96 | 32.47 | 32.14 |
| standard conditions.(DSCF) | 28.86 | 29.37 | 29.16 |
| Total sampling time....(MIN) | 60.00 | 60.00 | 60.00 |
| Nozzle diameter.....(IN) | .373 | .373 | .373 |
| Avg.stack gas temp..(DEG-F) | 483 | 485 | 486 |
| Volumetric flow rate..... | | | |
| actual.....(ACFM) | 230534 | 234706 | 233279 |
| dry standard.....(DSCFM) | 121120 | 123091 | 122069 |
| Isokinetic variation.....(%) | 99.9 | 100.0 | 100.1 |
| Particulate concentration... | | | |
| actual.....(GR/ACF) | 0.20079 | 0.15794 | 0.13325 |
| dry standard.....(GR/DSCF) | 0.38233 | 0.30127 | 0.25475 |
| Particle mass rate...(LB/HR) | 396.92 | 317.86 | 266.54 |

Test No. 6
 North Unloader Pocket Baghouse Outlet

Results of Particulate Loading Determinations-----Method 5

| | Run 1 | Run 2 | Run 3 |
|------------------------------|-----------|-----------|-----------|
| Date of run | 10-15-87 | 10-15-87 | 10-15-87 |
| Time run start/end.....(HRS) | 1315/1353 | 1724/1759 | 1936/2006 |
| Static pressure.....(IN.WC) | -5.20 | -5.20 | -5.20 |
| Cross sectional area (SQ.FT) | 15.61 | 15.61 | 15.61 |
| Pitot tube coefficient..... | .840 | .840 | .840 |
| Water in sample gas | | | |
| condenser.....(ML) | 0.0 | 0.0 | 0.0 |
| impingers.....(GRAMS) | 0.0 | 0.0 | 0.0 |
| desiccant.....(GRAMS) | 9.0 | 11.0 | 9.0 |
| total.....(GRAMS) | 9.0 | 11.0 | 9.0 |
| Total particulate material.. | | | |
|collected(grams) | 0.0114 | 0.0179 | 0.0102 |
| Gas meter coefficient..... | 0.9938 | 0.9938 | 0.9938 |
| Barometric pressure..(IN.HG) | 28.85 | 28.85 | 28.85 |
| Avg. orif.pres.drop..(IN.WC) | 2.26 | 2.79 | 2.38 |
| Avg. gas meter temp..(DEF-F) | 52.2 | 56.1 | 60.5 |
| Volume through gas meter.... | | | |
| at meter conditions...(CF) | 30.87 | 32.46 | 25.75 |
| standard conditions.(DSCF) | 30.66 | 32.04 | 25.17 |
| Total sampling time....(MIN) | 37.50 | 35.00 | 30.00 |
| Nozzle diameter.....(IN) | .249 | .249 | .249 |
| Avg.stack gas temp ..(DEG-F) | 45 | 42 | 40 |
| Volumetric flow rate..... | | | |
| actual.....(ACFM) | 38515 | 42817 | 39124 |
| dry standard.....(DSCFM) | 37911 | 42445 | 38967 |
| Isokinetic variation.....(%) | 99.6 | 99.6 | 99.5 |
| Particulate concentration... | | | |
| actual.....(GR/ACF) | 0.00565 | 0.00854 | 0.00622 |
| dry standard.....(GR/DSCF) | 0.00574 | 0.00862 | 0.00625 |
| Particle mass rate...(LB/HR) | 1.86 | 3.14 | 2.09 |

3.3 Results of Sulfur Dioxide Determinations

Test No. 5
 Side B Scrubber Inlet

Results of Sulfur Dioxide Determinations-----Method 6

| | Run 1 | Run 2 | Run 3 |
|---|-----------|-----------|-----------|
| Date of run | 10-14-87 | 10-14-87 | 10-14-87 |
| Time run start/end.....(HRS) | 1610/1720 | 1730/1835 | 1845/1935 |
| Barometric pressure..(IN.HG) | 28.85 | 28.85 | 28.85 |
| Meter temperature....(DEG-F) | 66.83 | 72.25 | 73.89 |
| Meter correction coefficient | 0.9962 | 0.9962 | 0.9962 |
| Volume through gas meter.... at meter conditions... (CF) | 45.770 | 45.800 | 34.400 |
| standard conditions..(SCF) | 44.259 | 43.837 | 32.824 |
| Total sampling time....(MIN) | 60.0 | 60.0 | 45.0 |
| Moisture content.....(%V/V) | 8.75 | 11.68 | 10.88 |
| Oxygen content....(%V/V DRY) | 18.60 | 18.70 | 18.75 |
| Milliequivalents of SO4 in.. gas sample..... | 19.9597 | 22.7681 | 17.1680 |
| <u>Sulfur dioxide concentration</u> | | | |
| (GR/DSCF)..... | 0.2229 | 0.2567 | 0.2585 |
| (MG/DSCM)..... | 510 | 587 | 592 |
| (PPM-DRY)..... | 192 | 221 | 222 |
| (PPM-WET)..... | 175 | 195 | 198 |
| SO2 Emission rate....(LB/HR) | 523.51 | 602.92 | 607.15 |
| Sulfur dioxide emission.....factor (LB/MMBTU)* | 3.06 | 3.61 | 3.58 |

* Calculated using heat input

Note: The SO₂ emission rate was calculated using the stack flow rate due to large scale turbulence at the inlet.

Test No. 4
 Indurating Line 2 Stack B

Results of Sulfur Dioxide Determinations ----- Method 6

| | Run 1 | Run 2 | Run 3 |
|--|------------------|------------------|------------------|
| Date of run | 10-14-87 | 10-14-87 | 10-14-87 |
| Time run start/end..... (HRS) | 956/1056 | 1106/1206 | 1214/1314 |
| Barometric pressure.. (IN.HG) | 28.70 | 28.70 | 28.70 |
| Meter temperature.... (DEG-F) | 50.05 | 56.75 | 59.60 |
| Meter correction coefficient | 0.9962 | 0.9962 | 0.9962 |
| Volume through gas meter.... at meter conditions... (CF) standard conditions.. (SCF) | 45.510 45.220 | 45.800 44.918 | 45.840 44.711 |
| Total sampling time.... (MIN) | 60.0 | 60.0 | 60.0 |
| Moisture content..... (%V/V) | 10.87 | 11.52 | 9.80 |
| Oxygen content.... (%V/V DRY) | 18.60 | 18.80 | 18.60 |
| Milliequivalents of SO4 in.. gas sample..... | 16.2486 | 16.2987 | 16.5829 |
| <u>Sulfur dioxide concentration</u> | | | |
| (GR/DSCF)..... | 0.1776 | 0.1793 | 0.1833 |
| (MG/DSCM)..... | 406 | 410 | 420 |
| (PPM-DRY)..... | 153 | 154 | 158 |
| (PPM-WET)..... | 136 | 137 | 142 |
| SO2 Emission rate.... (LB/HR) | 416.63 | 420.72 | 430.04 |
| Sulfur dioxide emission.....factor (LB/MMBTU)* | 2.31 | 2.37 | 2.39 |

* Calculated using heat input

3.4 Results of Opacity Observations

Test No. 1
 F-2 Crusher Scrubber Stack

Results of Opacity Observations ----- EPA Method 9

| PERCENT OPACITY | OPTICAL DENSITY | RELATIVE FREQUENCY (%) |
|--------------------|--------------------|---------------------------|
| 0 | 0.0000 | 0.00 |
| 5 | 0.0223 | 0.00 |
| 10 | 0.0458 | 0.00 |
| 15 | 0.0706 | 0.00 |
| 20 | 0.0969 | 0.00 |
| 25 | 0.1249 | 11.67 |
| 30 | 0.1549 | 60.42 |
| 35 | 0.1871 | 27.92 |
| 40 | 0.2219 | 0.00 |
| 45 | 0.2596 | 0.00 |
| 50 | 0.3010 | 0.00 |
| 55 | 0.3468 | 0.00 |
| 60 | 0.3979 | 0.00 |
| 65 | 0.4559 | 0.00 |
| 70 | 0.5229 | 0.00 |
| 75 | 0.6021 | 0.00 |
| 80 | 0.6690 | 0.00 |
| 85 | 0.8239 | 0.00 |
| 90 | 1.0000 | 0.00 |
| 95 | 1.3010 | 0.00 |
| 99 | 2.0000 | 0.00 |
| Avg Opac30.81 | Avg OD 0.1604 | Time average |

Observer: E. Trowbridge
 Cert. Date: 04-23-87
 Date of Observation: 10-12-87
 Time of Observation: 1500-1600

Interpoll Labs Report No. 7-2431
Eveleth Taconite
Eveleth, Minnesota

Test No. 2
Kiln Cooler Scrubber Stack

Results of Opacity Observations - EPA Method 9*

| Percent Opacity | Optical Density | Relative Frequency (%) |
|--------------------|--------------------|---------------------------|
| 0 | .0000 | |
| 5 | .0223 | |
| 10 | .0458 | |
| 15 | .0706 | |
| 20 | .0969 | |
| 25 | .1249 | |
| 30 | .1549 | |
| 35 | .1871 | |
| 40 | .2219 | |
| 45 | .2596 | |
| 50 | .3010 | |
| 55 | .3468 | |
| 60 | .3979 | |
| 65 | .4559 | |
| 70 | .5229 | |
| 75 | .6021 | |
| 80 | .6990 | |
| 85 | .8239 | |
| 90 | 1.0000 | |
| 95 | 1.3010 | |
| 99 | 2.0000 | |

Time Average

Observer: E. Trowbridge
Cert Date: 4-23-87
Date of Observation: 10-13-87
Time of Observation:

*Unable to perform due to 100% cloud cover.

Test No. 3
Kiln Cooler Exhaust

Results of Opacity Observations - EPA Method 9*

| Percent Opacity | Optical Density | Relative Frequency (%) |
|--------------------|--------------------|---------------------------|
| 0 | .0000 | |
| 5 | .0223 | |
| 10 | .0458 | |
| 15 | .0706 | |
| 20 | .0969 | |
| 25 | .1249 | |
| 30 | .1549 | |
| 35 | .1871 | |
| 40 | .2219 | |
| 45 | .2596 | |
| 50 | .3010 | |
| 55 | .3468 | |
| 60 | .3979 | |
| 65 | .4559 | |
| 70 | .5229 | |
| 75 | .6021 | |
| 80 | .6990 | |
| 85 | .8239 | |
| 90 | 1.0000 | |
| 95 | 1.3010 | |
| 99 | 2.0000 | |

Time Average

Observer: E. Trowbridge
Cert Date: 4-23-87
Date of Observation: 10-13-87
Time of Observation:

*Unable to perform due to 100% cloud cover.

Test No. 6
North Unloader Pocket Baghouse Outlet

Results of Opacity Observations - EPA Method 9*

| Percent Opacity | Optical Density | Relative Frequency (%) |
|--------------------|--------------------|---------------------------|
| 0 | .0000 | |
| 5 | .0223 | |
| 10 | .0458 | |
| 15 | .0706 | |
| 20 | .0969 | |
| 25 | .1249 | |
| 30 | .1549 | |
| 35 | .1871 | |
| 40 | .2219 | |
| 45 | .2596 | |
| 50 | .3010 | |
| 55 | .3468 | |
| 60 | .3979 | |
| 65 | .4559 | |
| 70 | .5229 | |
| 75 | .6021 | |
| 80 | .6990 | |
| 85 | .8239 | |
| 90 | 1.0000 | |
| 95 | 1.3010 | |
| 99 | 2.0000 | |

Time Average

Observer: E. Trowbridge
Cert Date: 4-23-87
Date of Observation: 10-15-87
Time of Observation:

*Unable to perform due to 100% cloud cover.

APPENDIX A

RESULTS OF PRELIMINARY FLOW RATE DETERMINATION

Test No. 1
 F2 Crusher Scrubber Stack

Results of Volumetric Flow Rate Determination-----Method 2

| | |
|------------------------------------|----------|
| Date of Determination..... | 10-12-87 |
| Time of Determination..... (HRS) | 1300 |
| Barometric pressure..... (IN.HG) | 28.68 |
| Pitot tube coefficient..... | .84 |
| Number of sampling ports..... | 2 |
| Total number of points..... | 12 |
| Shape of duct..... | Round |
| Stack diameter..... (IN) | 32.75 |
| Duct area..... (SQ.FT) | 5.85 |
| Direction of flow..... | UP |
| Static pressure..... (IN.WC) | -.45 |
| Avg. gas temp..... (DEG-F) | 56 |
| Moisture content..... (% V/V) | 1.31 |
| Avg. linear velocity..... (FT/SEC) | 54.3 |
| Gas density..... (LB/ACF) | .07302 |
| Molecular weight..... (LB/LBMOLE) | 28.84 |
| Mass flow of gas..... (LB/HR) | 83547 |
| Volumetric flow rate..... | |
| actual..... (ACFM) | 19071 |
| dry standard..... (DSCFM) | 18439 |

Test No. 2
SS41 Kiln Cooler Scrubber Stack

Results of Volumetric Flow Rate Determination-----Method 2

| | |
|-----------------------------------|----------|
| Date of Determination..... | 10-13-87 |
| Time of Determination.....(HRS) | 1030 |
| Barometric pressure.....(IN.HG) | 28.56 |
| Pitot tube coefficient..... | .84 |
| Number of sampling ports..... | 2 |
| Total number of points..... | 16 |
| Shape of duct..... | Round |
| Stack diameter.....(IN) | 57.5 |
| Duct area.....(SQ.FT) | 18.03 |
| Direction of flow..... | UP |
| Static pressure.....(IN.WC) | -.37 |
| Avg. gas temp.....(DEG-F) | 63 |
| Moisture content.....(% V/V) | 2.03 |
| Avg. linear velocity.....(FT/SEC) | 44.5 |
| Gas density.....(LB/ACF) | .07156 |
| Molecular weight.....(LB/LBMOLE) | 28.84 |
| Mass flow of gas.....(LB/HR) | 206588 |
| Volumetric flow rate..... | |
| actual.....(ACFM) | 48118 |
| dry standard.....(DSCFM) | 45384 |

Test No. 3
 Kiln Cooler Exhaust Stack

Results of Volumetric Flow Rate Determination-----Method 2

| | |
|------------------------------------|----------|
| Date of Determination..... | 10-13-87 |
| Time of Determination..... (HRS) | 1530 |
| Barometric pressure..... (IN.HG) | 28.56 |
| Pitot tube coefficient..... | .84 |
| Number of sampling ports..... | 4 |
| Total number of points..... | 24 |
| Shape of duct..... | Round |
| Stack diameter..... (IN) | 187 |
| Duct area..... (SQ.FT) | 190.73 |
| Direction of flow..... | UP |
| Static pressure..... (IN.WC) | -.34 |
| Avg. gas temp..... (DEG-F) | 480 |
| Moisture content..... (% V/V) | 1.61 |
| Avg. linear velocity..... (FT/SEC) | 20.3 |
| Gas density..... (LB/ACF) | .03988 |
| Molecular weight..... (LB/LBMOLE) | 28.84 |
| Mass flow of gas..... (LB/HR) | 554977 |
| Volumetric flow rate..... | |
| actual..... (ACFM) | 231938 |
| dry standard..... (DSCFM) | 122253 |

Test No. 4
 2B Waste Gas Scrubber Stack

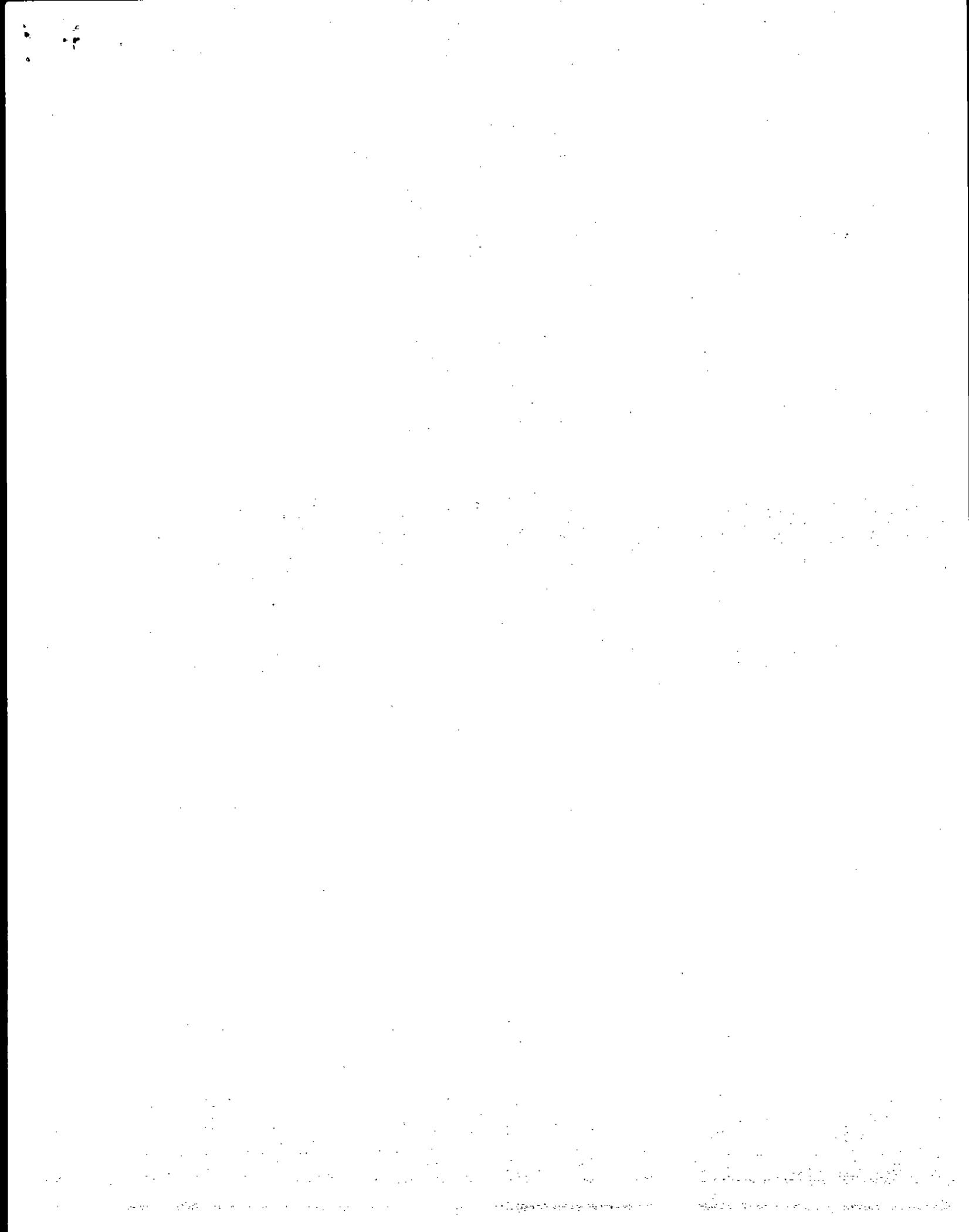
Results of Volumetric Flow Rate Determination-----Method 2

| | |
|------------------------------------|----------|
| Date of Determination..... | 10-14-87 |
| Time of Determination..... (HRS) | 905 |
| Barometric pressure..... (IN.HG) | 28.7 |
| Pitot tube coefficient..... | .84 |
| Number of sampling ports..... | 4 |
| Total number of points..... | 16 |
| Shape of duct..... | Round |
| Stack diameter..... (IN) | 144 |
| Duct area..... (SQ.FT) | 113.10 |
| Direction of flow..... | UP |
| Static pressure..... (IN.WC) | .38 |
| Avg. gas temp..... (DEG-F) | 115 |
| Moisture content..... (% V/V) | 10.87 |
| Avg. linear velocity..... (FT/SEC) | 51.3 |
| Gas density..... (LB/ACF) | .06368 |
| Molecular weight..... (LB/LBMOLE) | 29.01 |
| Mass flow of gas..... (LB/HR) | 1330600 |
| Volumetric flow rate..... | |
| actual..... (ACFM) | 348266 |
| dry standard..... (DSCFM) | 273680 |

Test No. 5
 2B Waste Gas Inlet

Results of Volumetric Flow Rate Determination-----Method 2

| | |
|------------------------------------|-------------|
| Date of Determination..... | 10-14-87 |
| Time of Determination..... (HRS) | 1600 |
| Barometric pressure..... (IN.HG) | 28.85 |
| Pitot tube coefficient..... | .84 |
| Number of sampling ports..... | 4 |
| Total number of points..... | 12 |
| Shape of duct..... | Rectangular |
| Duct width..... (IN) | 28 |
| Duct length..... (IN) | 132 |
| Duct area..... (SQ.FT) | 25.67 |
| Direction of flow..... | DOWN |
| Static pressure..... (IN.WC) | -22 |
| Avg. gas temp..... (DEG-F) | 113 |
| Moisture content..... (% V/V) | 8.75 |
| Avg. linear velocity..... (FT/SEC) | 75.9 |
| Gas density..... (LB/ACF) | .06113 |
| Molecular weight..... (LB/LBMOLE) | 29.01 |
| Mass flow of gas..... (LB/HR) | 429004 |
| Volumetric flow rate..... | |
| actual..... (ACFM) | 116956 |
| dry standard..... (DSCFM) | 89586 |



Test No. 6
 North Unloader Pocket Baghouse Outlet

Results of Volumetric Flow Rate Determination-----Method 2

| | |
|-----------------------------------|----------|
| Date of Determination..... | 10-15-87 |
| Time of Determination.....(HRS) | 830 |
| Barometric pressure.....(IN.HG) | 28.85 |
| Pitot tube coefficient..... | .84 |
| Number of sampling ports..... | 2 |
| Total number of points..... | 24 |
| Shape of duct..... | Round |
| Stack diameter.....(IN) | 53.5 |
| Duct area.....(SQ.FT) | 15.61 |
| Direction of flow..... | Down |
| Static pressure.....(IN.WC) | -5.2 |
| Avg. gas temp.....(DEG-F) | 45 |
| Moisture content.....(% V/V) | 1.05 |
| Avg. linear velocity.....(FT/SEC) | 42.6 |
| Gas density.....(LB/ACF) | .07421 |
| Molecular weight.....(LB/LBMOLE) | 28.84 |
| Mass flow of gas.....(LB/HR) | 177577 |
| Volumetric flow rate..... | |
| actual.....(ACFM) | 39881 |
| dry standard.....(DSCFM) | 39256 |

Source category:

Taconite ore processing

Date: 10/24/96

Plant name :

Eveleth Taconite Company

Location: Eveleth, MN

Test date :

October 12-15, 1987

Ref. No.: 15

Process :

Induration furnace

Basis for process rate :

| Source | Type of control | Pollutant | Run No. | Emission rate, lb/hr | Process rate, ton/hr | Emission factor | | |
|---|---------------------|-----------|---------|----------------------|----------------------|-----------------|--------|--------|
| | | | | | | kg/Mg | lb/ton | Rating |
| Line 2 Pellet induration furnace, rotary kiln (petroleum coke and coal fired) | Wet scrubber system | SO2 | 1 | | 535 | | | |
| | | SO2 | 2 | 841.44 | 535 | 0.79 | 1.6 | |
| | | SO2 | 3 | 860.08 | 535 | 0.80 | 1.6 | |
| | | AVERAGE | | | | | 0.80 | 1.6 |
| | | | | | | | | Rating |
| Line 2 Pellet induration furnace, rotary kiln (petroleum coke and coal fired) | None | SO2 | 1 | | 535 | | | |
| | | SO2 | 2 | 1205.84 | 535 | 1.1 | 2.3 | |
| | | SO2 | 3 | 1214.30 | 535 | 1.1 | 2.3 | |
| | | AVERAGE | | | | | 1.1 | 2.3 |

Notes

According to Minnesota Pollution Control Agency, production rates averaged 477.4 long tons/hr. Only one of two stacks tested, so emission rates doubled.

