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I. INTRODUCTION

Network Environmental, Inc. was retained by the Michigan Sugar Company to perform compliance emission sampling at their facility located in Bay City, Michigan. The purpose of the testing was to document compliance with the carbon monoxide (CO) emission limits for Boiler #7 (EUBOILER#7) and the oxides of nitrogen (NO_x) emission limits for Boiler #8 (EUBOILER8) established in Michigan Department of Environment, Great Lakes and Energy (EGLE) - Air Quality Division Renewable Operating Permit Number: MI-ROP-B1493-2021. MI-ROP-B1493-2021 has established the following emission limits for these boilers:

Source	Pollutant	Limit	Time Period / Operating Scenario
Boiler #7	CO	0.22 Lbs/MMBTU	8 Hour Average
		39.6 Lbs/Hr	Hourly
		86.7 Tons/Year	12 Month Rolling Time Period
Boiler #8	NO_x	0.09 Lbs/MMBTU	30 Day Rolling Average As Determined Each Day The Boiler Operates
		21.9 Lbs/Hr	Hourly
		76.1 Tons/Year	12 Month Rolling Time Period As Determined At The End Of Each Calendar Month

The following reference methods were employed to conduct the emission sampling:

- Carbon Monoxide (CO) – U.S. EPA Method 10
- Oxides of Nitrogen (NO_x) – U.S. EPA Method 7E
- Exhaust Gas Parameters (Air Flow Rate, Temperature, Moisture & Density) – U.S. EPA Methods 1 through 4

The sampling was performed over the period of October 31 - November 1, 2023 by Stephan K. Byrd, Richard D. Eerdmans and David D. Engelhardt of Network Environmental, Inc. Assisting with the testing were Ms. Meaghan Martuch and the operating staff of the facility. Mr. Daniel J. Droste of the Michigan Department of Environment, Great Lakes and Energy (EGLE) - Air Quality Division was present to observe the sampling and source operation.

II. PRESENTATION OF RESULTS

II.1 TABLE 1
CARBON MONOXIDE (CO) EMISSION RESULTS
BOILER #7 (EUBOILER#7)
MICHIGAN SUGAR COMPANY
BAY CITY, MICHIGAN
OCTOBER 31, 2023

Sample	Time	Air Flow Rate DSCFM (1)	CO Concentration PPM (2)	CO Mass Emission Rates	
				Lbs/Hr (3)	Lbs/MMBTU (4)
1	13:08-14:08	27,870	55.5	6.73	0.042
2	14:22-15:22	27,699	55.6	6.70	0.043
3	15:35-16:35	27,736	55.1	6.65	0.043
Average		**27,768**	**55.4**	**6.69**	**0.043**

(1) DSCFM = Dry Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 In. Hg).
(2) PPM = Parts Per Million (v/v) On A Dry Basis
(3) Lbs/Hr = Pounds of CO Per Hour
(4) Lbs/MMBTU = Pounds Of CO Per Million BTU Of Heat Input (Calculated Using Equation 2.1 From U. S. EPA Method 19 With An F-Factor of 8710 DSCF/MMBTU).

II.2 TABLE 2
OXIDES OF NITROGEN (NO_x) EMISSION RESULTS
BOILER #8 (EUBOILER8)
MICHIGAN SUGAR COMPANY
BAY CITY, MICHIGAN
NOVEMBER 1, 2023

Sample	Time	Air Flow Rate DSCFM (1)	NO_x Concentration PPM (2)	NO_x Mass Emission Rates	
				Lbs/Hr (3)	Lbs/MMBTU (4)
1	09:18-10:18	42,220	38.5	11.61	0.049
2	10:52-11:52	41,843	38.6	11.54	0.049
3	12:04-13:04	41,488	38.6	11.44	0.049
Average		**41,850**	**38.6**	**11.53**	**0.049**

(1) DSCFM = Dry Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 In. Hg).
(2) PPM = Parts Per Million (v/v) On A Dry Basis
(3) Lbs/Hr = Pounds of NO_x Per Hour
(4) Lbs/MMBTU = Pounds Of NO_x Per Million BTU Of Heat Input (Calculated Using Equation 2.1 From U. S. EPA Method 19 With An F-Factor of 8710 DSCF/MMBTU).

III. DISCUSSION OF RESULTS

III.1 Boiler #7 CO Emissions – The CO emissions are summarized in Table 1 (Section II.1) as follows:

- Sample
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (Standard Temperature and Pressure = 68 °F and 29.92 Inches Hg)
- CO Concentration (PPM) – Parts Per Million (v/v) On A Dry Basis
- CO Emission Rates –
    - Lbs/Hr – Pounds of CO Per Hour
    - Lbs/MMBTU – Pounds of CO Per Million BTU of Heat Input (Calculated Using Equation 2.1 From U.S. EPA Method 19 With An F-Factor of 8710 DSCF/MMBTU)

III.2 Boiler #8 NO_x Emissions – The NO_x emissions are summarized in Table 2 (Section II.2) as follows:

- Sample
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (Standard Temperature and Pressure = 68 °F and 29.92 Inches Hg)
- NO_x Concentration (PPM) – Parts Per Million (v/v) On A Dry Basis
- NO_x Emission Rates –
    - Lbs/Hr – Pounds of NO_x Per Hour
    - Lbs/MMBTU – Pounds of NO_x Per Million BTU of Heat Input (Calculated Using Equation 2.1 From U.S. EPA Method 19 With An F-Factor of 8710 DSCF/MMBTU)

IV. SOURCE DESCRIPTION

Boiler #7 is a gas-fired boiler with a rated capacity of 150,000 pounds per hour of steam (180 MMBTU per hour heat input). The boiler was manufactured by Nebraska Boiler and is equipped with economizers. Boiler #7 is used to provide process steam and heat to the facility. Operating parameters during the sampling for the boiler can be found in Appendix B.

Boiler #8 is a Cleaver-Brooks natural gas-fired high pressure boiler with a rated capacity of 243 MMBTU/Hr and a steam output of 200,000 pounds per hour. The boiler is equipped with a low NO_x burner and flue gas recirculation. Boiler 8 is used to provide process steam and heat to the facility. Operating parameters during the sampling for the boiler can be found in Appendix B.

V. SAMPLING AND ANALYTICAL PROTOCOL

The sampling methods used for the reference method determinations were as follows:

V.1 Carbon Monoxide – The CO sampling was conducted in accordance with U.S. EPA Reference Method 10. A Thermo Environmental Model 48C gas analyzer was used to monitor the Boiler #7 exhaust. A heated teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the CO concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 486.0 PPM was used to establish the initial instrument calibration. A calibration gas of 251.0 PPM was used to determine the calibration error of the analyzer. The sampling system (from the back of the stack probe to the analyzer) was injected using the 251.0 PPM gas to determine the system bias. After each sample, a system zero and system injection of 251.0 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified. Three (3) samples were collected from the Boiler #7 exhaust. Each sample was sixty (60) minutes in duration.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. A diagram of the sampling train is shown in Figure 1.

V.2 Oxides of Nitrogen – The NO_x sampling was conducted in accordance with U.S. EPA Reference Method 7E. A Thermo Environmental Model 42H gas analyzer was used to monitor the Boiler #8 exhaust. A heated probe was used to extract the sample gases from the exhaust stack. A heated Teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzer. The analyzer produces instantaneous readouts of the NO_x concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 55.6 PPM was used to establish the initial instrument calibration. A calibration gas of 25.1 PPM was used to determine the calibration error of the analyzer. A direct injection of 50.9 PPM nitrogen dioxide (NO_2) was performed to show the conversion efficiency of the monitor. The conversion efficiency data can be found in Appendix C. The sampling system (from the back of the stack probe to the analyzer) was injected using the 25.1 PPM gas to determine the system bias. After each sample, a system zero and system injection of 25.1 PPM were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzer was calibrated to the output of the data acquisition system (DAS) used to collect the data from the boiler. Three (3) samples, each sixty (60) minutes in duration were collected from the Boiler #8 exhaust. All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis. A diagram of the NO_x sampling train is shown in Figure 1.

V.3 Oxygen & Carbon Dioxide – The O_2 & CO_2 sampling was conducted in accordance with U.S. EPA Reference Method 3A. Servomex Model 1400M portable stack gas analyzers were used to monitor the boiler exhaust. A heated probe was used to extract the sample gases from the stack. A heated Teflon sample line was used to transport the exhaust gases to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner stack gases were passed to the analyzers. The analyzers produce instantaneous readouts of the O_2 & CO_2 concentrations (%).

The analyzers were calibrated by direct injection prior to the testing. Span gases of 21.0% O_2 and 21.05% CO_2 were used to establish the initial instrument calibrations. Calibration gases of 11.8% O_2/5.94% CO_2 and 6.05% O_2/11.7% CO_2 were used to determine the calibration error of the analyzers. The sampling system (from the back of the stack probe to the analyzer) was injected using the 6.05% O_2/11.7% CO_2 gas to determine the system bias. After each sample, a system zero and system injection of 6.05% O_2/11.7% CO_2 were performed to establish system drift and system bias during the test period. All calibration gases were EPA Protocol 1 Certified.

The analyzers were calibrated to the output of the data acquisition system (DAS) used to collect the data from the boilers. Three (3) samples, each sixty (60) minutes in duration were collected from each boiler exhaust. All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis. A diagram of the O_2 and CO_2 sampling train is shown in Figure 1

V.4 Exhaust Gas Parameters – The exhaust gas parameters (air flow rate, temperature, moisture and density) were determined in conjunction with the other sampling by employing U.S. EPA Methods 1 through 4.

Air flow rates were determined by conducting three (3) velocity traverses (one for each sample) from each boiler exhaust. Moisture was determined by conducting one (1) moisture sample from each boiler exhaust. Gas density was calculated using the moisture, O_2 and CO_2 readings from the analyzers.

All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis. A diagram of the air flow sampling train is shown in Figure 2. A diagram of the moisture sampling train is shown in Figure 3.

V.5 Sampling Locations – The sampling location for the Boiler #7 exhaust was on the 72 inch I.D. exhaust. The sampling location for the Boiler #8 exhaust was on the 60 inch I.D. exhaust. Both sampling locations were at distances greater than the 8 duct diameter downstream and 2 duct diameters upstream from the nearest disturbances requirement of U.S. EPA Method 1. Three (3) point stratification tests (as described in U.S. EPA Method 7E) have been performed for each exhaust stack on numerous occasions. The stratification tests have always showed no stratification (< 5%), so a single sampling point was used for the gas sampling.

This report was prepared by:

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This report was reviewed by:

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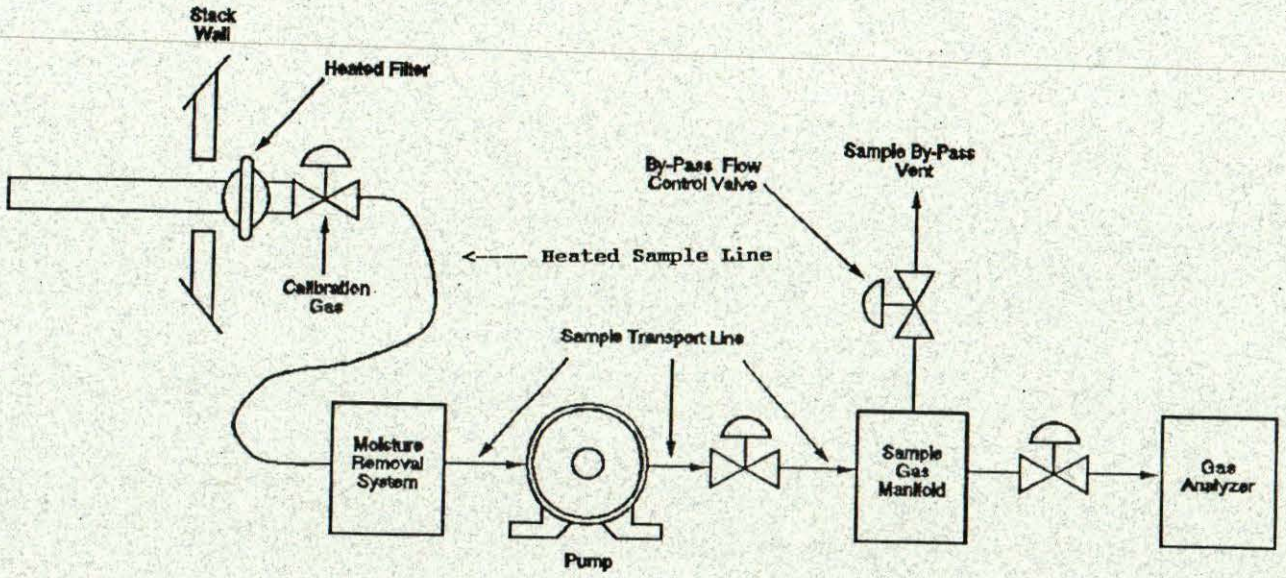

Figure 1

NO_x, CO, O_2 & CO_2 Sampling Train

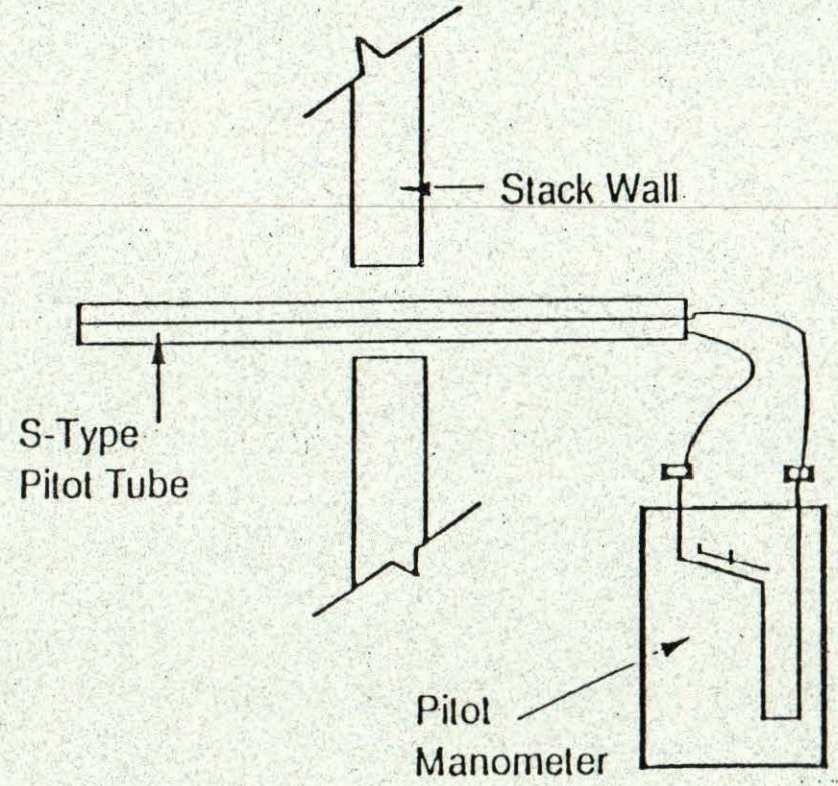

Figure 2

Air Flow
Sampling Train

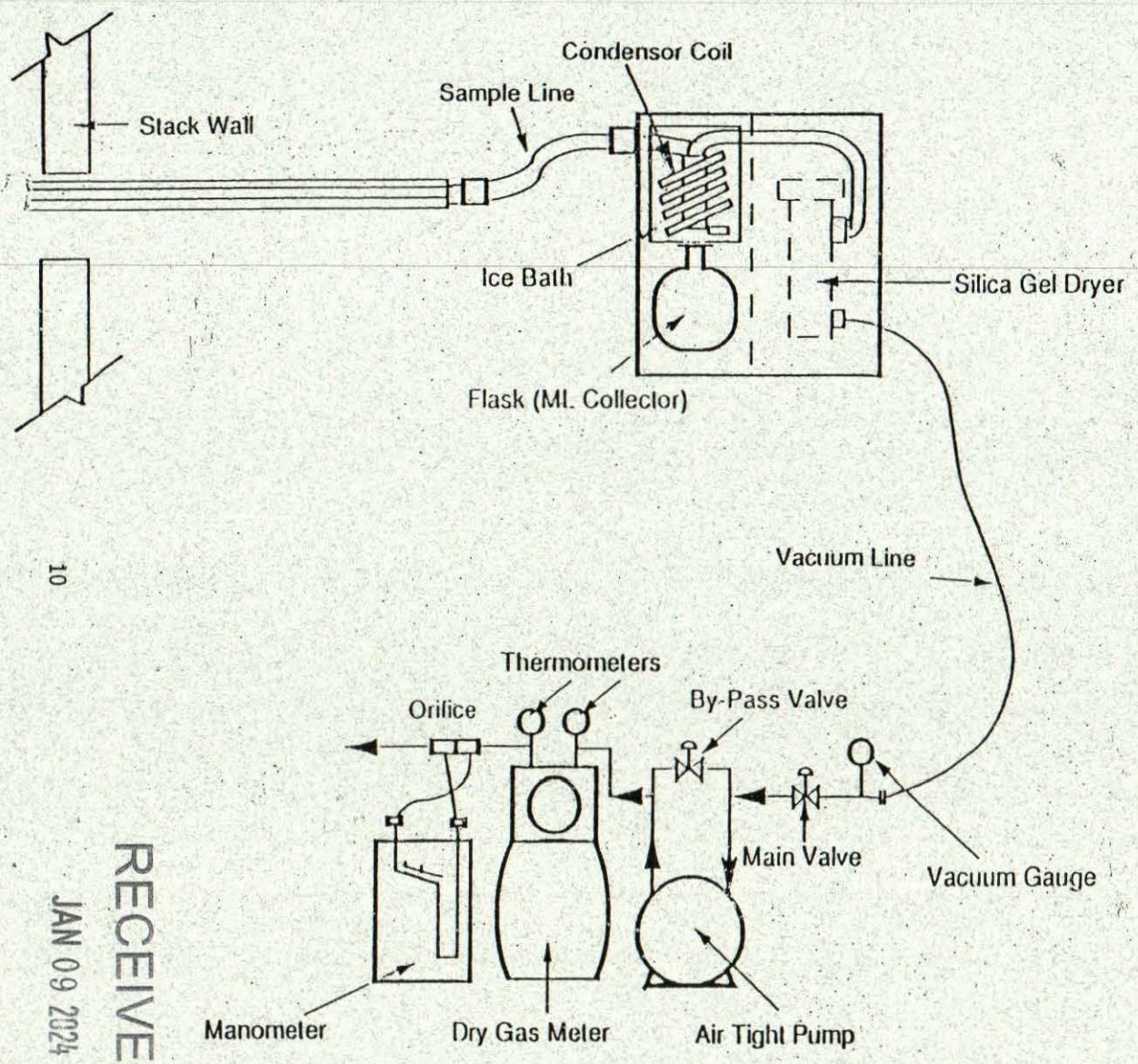

Figure 3

Moisture Sampling Train