Report of...

Compliance Emission Sampling

Performed for the...

Michigan Sugar Company

Sebewaing, Michigan

On...

Pulp Dryers 1, 2 & 3
(FG-PULPDRYERS & EU-DRYER#3)

November 29-30, 2022

Project #: 022.52

By...

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I. INTRODUCTION

Network Environmental, Inc. was retained by the Michigan Sugar Company of Bay City, Michigan to conduct an emission study at their Sebewaing, Michigan facility. The purpose of the study was to conduct compliance emission testing on Pulp Dryers 1 and 2 (FG-PULPDRYERS) and Pulp Dryer 3 (EU-DRYER#3) in order to determine compliance with the State of Michigan Department of Environment, Great Lakes and Energy (EGLE) Renewable Operating Permit (ROP) No. MI-ROP-B2873-2019.

Dryers 1 & 2 exhaust to the same stack, while Dryer 3 has its own exhaust stack. The particulate emissions were determined from both exhaust stacks. In addition to the particulate testing, the carbon monoxide (CO) and total hydrocarbon (VOC) emissions from the Pulp Dryer 3 exhaust were also determined. The exhaust gas parameters (air flow rate, temperature, moisture and gas density) were determined in conjunction with the other sampling.

MI-ROP-B2873-2019 has established the following emission limits for these sources:

Source	Pollutant	Emission Limit
Pulp Dryers 1 & 2	Particulate	0.10 Lbs/1000 Lbs of exhaust gas
Pulp Dryer 3	Particulate	0.10 Lbs/1000 Lbs of exhaust gas
	VOC	78.5 Lbs/Hr & 245 Tons/Year
	CO	160 Lbs/Hr & 442 Tons/Year

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

- Particulate – U.S. EPA Reference Method 17
- CO – U.S. EPA Reference Method 10
- Total Hydrocarbons (VOC) – U.S. EPA Method 25A
- Exhaust Gas Parameters (flow rate, temperature, moisture & density) – U.S. EPA Methods 1-4

The sampling in the study was conducted over the period of November 29-30, 2022 by Richard D. Eerdmans and David D. Engelhardt of Network Environmental, Inc.. Assisting with the study were Ms. Meaghan Martuch of the Michigan Sugar Company and the operating staff of the facility. Ms. Lindsey Wells and Mr. Ben Witkopp of the EGLE – Air Quality Division were present to observe the sampling and source operation.

II. PRESENTATION OF RESULTS

II.1 TABLE 1
PARTICULATE EMISSION RESULTS SUMMARY
PULP DRYER EXHAUSTS
MICHIGAN SUGAR COMPANY
SEBEWAING, MICHIGAN
NOVEMBER 29-30, 2022

Source	Sample	Date	Time	Air Flow Rate		Concentration	Mass Rate
				SCFM (1)	DSCFM (2)	Lbs/1000 Lbs, Actual (3)	Lbs/Hr (4)
Pulp Dryers 1 & 2	1	11/29/22	13:35-14:38	47,533	38,801	0.038	7.59
	2	11/29/22	15:15-16:18	46,934	37,869	0.028	5.39
	3	11/29/22	16:40-17:44	47,103	37,862	0.023	4.51
	Average			**47,190**	**38,177**	**0.030**	**5.83**
Pulp Dryer 3	1	11/30/22	10:35-11:42	56,311	38,785	0.077	17.39
	2	11/30/22	12:25-13:31	55,744	38,262	0.066	14.78
	3	11/30/22	14:17-15:23	56,865	38,993	0.074	16.85
	Average			**56,307**	**38,680**	**0.072**	**16.34**

(1) SCFM = Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 in. Hg)
(2) DSCFM = Dry Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 °F & 29.92 in. Hg)
(3) Lbs/1000 Lbs, Actual = Pounds Of Particulate Per Thousand Pounds Of Exhaust Gas On An Actual (Wet) Basis
(4) Lbs/Hr = Pounds of Particulate Per Hour

II.2 TABLE 2
TOTAL HYDROCARBON (VOC) EMISSION RESULTS
PULP DRYER 3 EXHAUST
MICHIGAN SUGAR COMPANY
SEBEWAING, MI
NOVEMBER 30, 2022

Sample	Time	Air Flow Rate SCFM (1)	VOC Concentration PPM (2)	VOC Mass Emission Rates	
				Lbs/Hr (3)	Tons/Year (4)
1	10:35-11:35	56,311	56.1	21.59	67.36
2	12:25-13:25	55,744	54.4	20.72	64.65
3	14:17-15:17	56,865	55.3	21.49	67.05
Average		**56,307**	**55.3**	**21.27**	**66.35**

(1) SCFM = Standard Cubic Feet Per Minute (Standard Temperature & Pressure = 68 ºF & 29.92 In. Hg)
(2) PPM = Parts Per Million (v/v) On A Wet (Actual) Basis
(3) Lbs/Hr = Pounds Per Hour
(4) Tons/Year were calculated using 6,240 hours of operation per year.

II.3 TABLE 3
CARBON MONOXIDE (CO) EMISSION RESULTS
PULP DRYER 3 EXHAUST
MICHIGAN SUGAR COMPANY
SEBEWAING, MI
NOVEMBER 30, 2022

Sample	Time	Air Flow Rate DSCFM (1)	CO Concentration PPM (2)	CO Mass Emission Rates	
				Lbs/Hr (3)	Tons/Year (4)
1	10:35-11:35	38,785	466.1	78.60	245.23
2	12:25-13:25	38,262	465.1	77.38	241.43
3	14:17-15:17	38,993	474.3	80.42	250.91
Average		**38,680**	**468.5**	**78.80**	**245.86**

(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 Per Hour
(4) Tons/Year were calculated using 6,240 hours of operation per year.

III. DISCUSSION OF RESULTS

The results of the emission sampling are summarized in Tables 1 through 3 (Sections II.1 through II.3). The results are presented as follows:

III.1 Particulate Emission Results (Table 1)

Table 1 summarizes the particulate emission results as follows:

- Source
- Sample
- Date
- Time
- Air Flow Rate
  - SCFM – Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
  - DSCFM – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- Particulate Concentration (Lbs/1000 Lbs) – Pounds Of Particulate Per Thousand Pounds Of Exhaust Gas On An Actual (Wet) Basis
- Particulate Mass Emission Rate (Lbs/Hr) – Pounds of Particulate Per Hour

A more detailed breakdown for each sample can be found in Appendix A.

III.2 Pulp Dryer 3 Total Hydrocarbon (VOC) Emission Results (Table 2)

Table 2 summarizes the VOC emission results as follows:

- Sample
- Time
- Air Flow Rate (SCFM) – Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)
- VOC Concentration (PPM) – Parts Per Million (v/v) On An Actual (Wet) Basis
- VOC Mass Emission Rate (Lbs/Hr) – Pounds of VOC Per Hour
- VOC Mass Emission Rate (Tons/Year) – Tons of VOC Per Year (Calculated using a maximum of 6,240 hours of operation per year)

III.3 Pulp Dryer 3 Carbon Monoxide (CO) Emission Results (Table 3)

Table 3 summarizes the CO emission results as follows:

- Sample
- Time
- Air Flow Rate (DSCFM) – Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)

- CO Concentration (PPM) – Parts Per Million (v/v) On A Dry Basis
- CO Mass Emission Rate (Lbs/Hr) – Pounds of CO Per Hour
- CO Mass Emission Rate (Tons/Year) – Tons of CO Per Year (Calculated using a maximum of 6,240 hours of operation per year)

IV. SOURCE DESCRIPTION

At Michigan Sugar, sugar beets are sliced and the sugar solution is extracted in large water extractors called pulp diffusers. The beet solids (pulp) are separated from the liquid extract and pressed to further extract as much sugar containing liquid as possible. The resulting pressed pulp is either sold as wet pulp or is dried in rotary dryers for sale as dry pellets. The primary use of the byproduct is as animal feed. The dryer is fired with either natural gas or #6 fuel oil and the dryer exhaust is controlled using a series of multiclones and flue gas re-circulation. A process flow diagram and schematic for the Pulp Dryers can be found in Appendix B. Appendix B also contains process operating data during the sampling.

V. SAMPLING AND ANALYTICAL PROTOCOL

The sampling locations for the sources were as follows:

- Pulp Dryers 1 & 2 (FG-PULPDRYERS) – A 72 inch I.D. exhaust stack with two (2) sample ports in a location approximately 8 duct diameters downstream and 4 duct diameters upstream from the nearest disturbances. Twelve (12) sampling points were used for the isokinetic sampling (6 points per port).

- Pulp Dryer 3 (EU-Dryer#3) – A 96 inch I.D. exhaust stack with two (2) sample ports in a location approximately five and a half (5.5) duct diameters downstream and three and a half (3.5) duct diameters upstream from the nearest disturbances. Twenty (20) sampling points were used for the isokinetic sampling (10 points per port).

The traverse point dimensions were as follows:

	Pulp Dryers 1 & 2	Pulp Dryer 3
Sample Point	Dimension (Inches)	Dimension (Inches)
1	3.17	2.50

2	10.51	7.87
3	21.31	14.02
4	50.69	21.70
5	61.48	32.83
6	68.83	63.17
7		74.30
8		81.98
9		88.13
10		93.50

Prior to the sampling, a cyclonic/turbulent flow check was conducted. The sampling locations met the requirements of U.S. EPA Method 1. Also, prior to the sampling on Dryer 3, a gas stratification test was conducted in accordance with U.S. EPA Method 7E. The stratification test showed no stratification, so one (1) point sampling was used for the gas sampling. The stratification test results can be found in Appendix C.

V.1 Particulate – The particulate emission sampling was conducted in accordance with U.S. EPA Method 17. Method 17 is an in-stack filtration method. Three (3) samples were collected from the exhausts. Each sample was sixty (60) minutes in duration and had a minimum sample volume of thirty (30) dry standard cubic feet. The samples were collected isokinetically and analyzed for particulate by gravimetric analysis. All the quality assurance and quality control procedures listed in the method were incorporated in the sampling and analysis. Figure 1 is a diagram of the particulate sampling train.

V.2 Total Hydrocarbons (VOC) – The VOC sampling was conducted in accordance with U.S. EPA Reference Method 25A. A J.U.M. Model 3-500 flame ionization detector (FID) analyzer was used to monitor the source sampled. Sample gas was extracted through a heated probe. A heated teflon sample line was used to transport the exhaust gases to the analyzer. The analyzer produces instantaneous readouts of the VOC concentrations (PPM).

The analyzer was calibrated by system injection (from the back of the stack probe to the analyzer) prior to the testing. A span gas of 491.0 PPM was used to establish the initial instrument calibration. Calibration gases of 152.0 PPM and 250.0 PPM were used to determine the calibration error of the analyzer. After

each sample, a system zero and system injection of 152.0 PPM were performed to establish system drift and system bias during the test period. All calibration gases used were EPA Protocol Propane Calibration Gases.

Three (3) samples were collected from the 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 exhaust. The analyzer averages were corrected for calibration error and drift using formula EQ.7E-5 from 40 CFR Part 60, Appendix A, Method 7E. Figure 2 is a diagram of the VOC sampling train.

V.3 Carbon Monoxide (CO) – The Carbon Monoxide (CO) emission sampling was conducted in accordance with U.S. EPA Reference Method 10. The sample gas was extracted from the exhaust through a heated teflon sample line which led to a VIA MAK 2 sample gas conditioner and then to a Thermo Environmental Model 48C portable stack gas monitor. This analyzer is capable of giving instantaneous readouts of the CO concentrations (PPM). Three (3) samples were collected from the exhaust. Each sample was sixty (60) minutes in duration.

The analyzer was calibrated with EPA protocol CO calibration gases. A span gas of 998.0 PPM was used to establish the initial instrument calibration. Calibration gases of 251.0 PPM and 498.0 PPM were 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 498.0 PPM gas to determine the system bias. After each sample, a system zero and system injection of 498.0 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 exhaust. 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 3.

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, temperatures and moistures were determined using the isokinetic sampling trains. Bag samples were collected from the exhaust of the isokinetic sampling trains and analyzed for $\%O_2$ & $\%CO_2$ by

ORSAT. All the quality assurance and quality control procedures listed in the methods were incorporated in the sampling and analysis.

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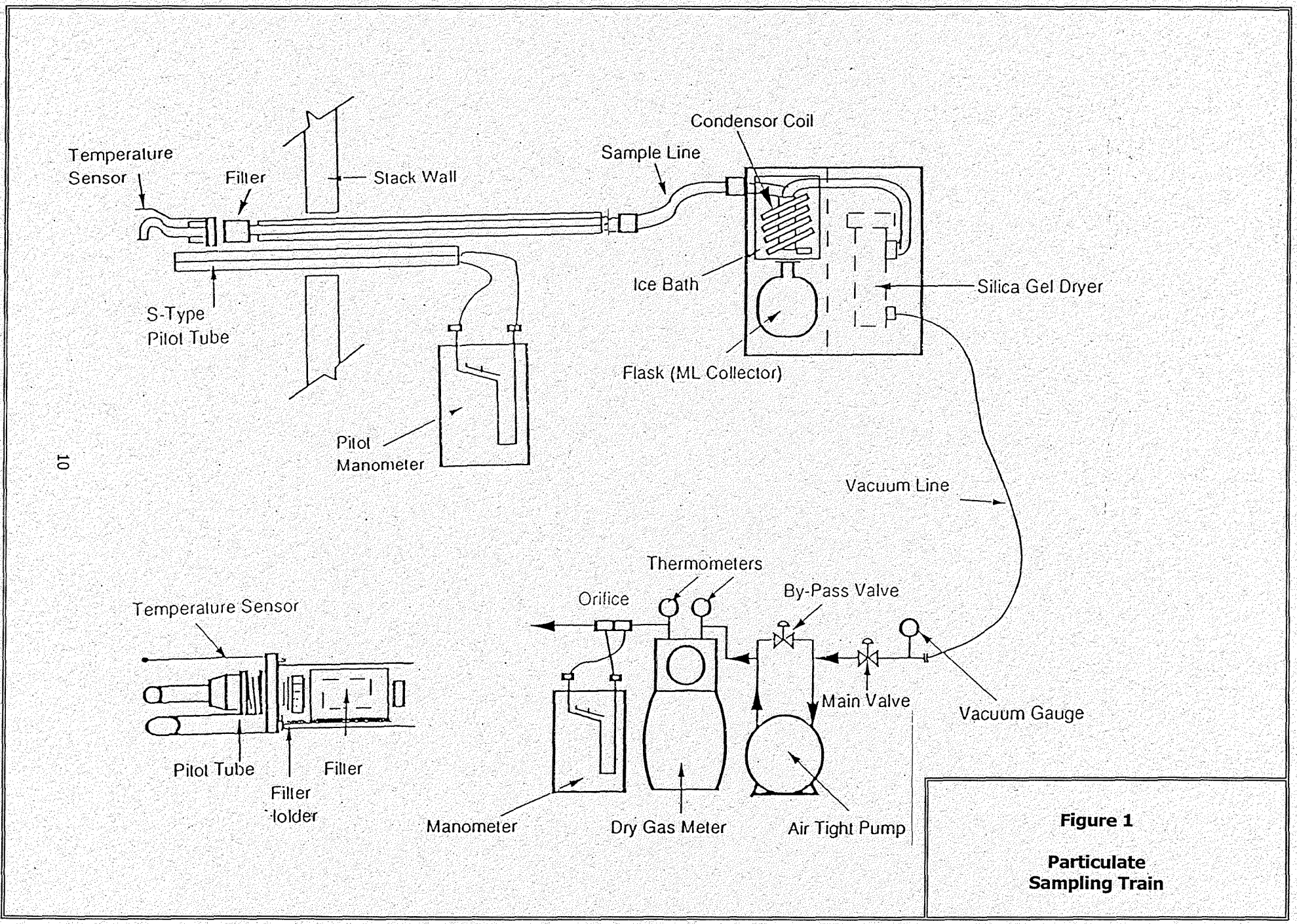

Figure 1

Particulate Sampling Train

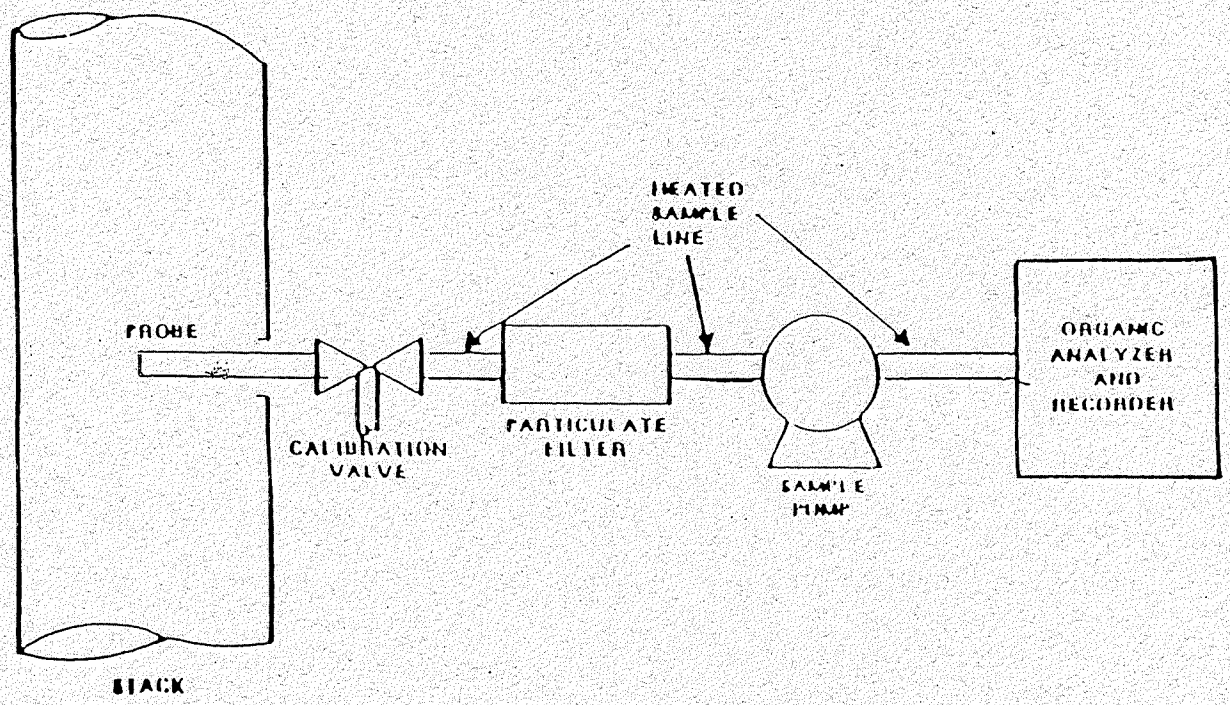

Figure 2

Total Hydrocarbon (VOC) Sampling Train

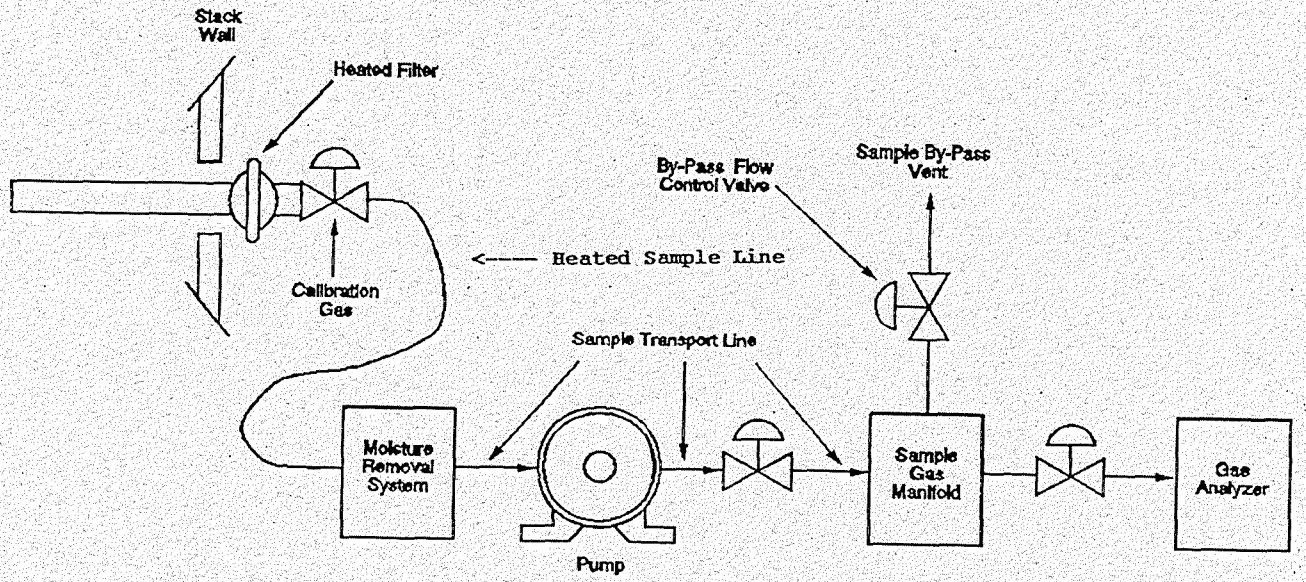

Figure 3

Carbon Monoxide (CO) Sampling Train