

Report of...

# Compliance Emission Testing

performed for...

**Cargill Salt**  
Hersey, Michigan

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**MAR 28 2018**

**AIR QUALITY DIVISION**

On the...

## Salt Refining Dryer, Cooling & Compaction

March 13-14, 2018

Project #: 062.20

By...

**Network Environmental, Inc.**  
Grand Rapids, MI

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**I. INTRODUCTION**

**AIR QUALITY DIVISION**

Network Environmental, Inc. was retained by Cargill Salt to conduct compliance emission testing at their facility located in Hersey, Michigan. The purpose of the testing was to document compliance with Michigan Department of Environmental Quality (MDEQ) – Air Quality Division Renewable Operating Permit No. MI-ROP-N2954-2014d.

The following is a list of the sources sampled and their corresponding emission limits from Permit No. MI-ROP-N2954-2014d:

Source	Compound(s) Sampled	Emission Limit
Salt Refining Drying/Cooling Exhaust (EUNACLREFINERY)	Particulate & Oxides of Nitrogen (NO <sub>x</sub> )	<b>Particulate:</b> 0.04 Lbs/1000 Lbs of exhaust gas, Dry & 8.5 Lbs/Hr <b>NO<sub>x</sub> (Applies Only To Salt Dryer):</b> 0.100 Lbs/MMBTU & 2.8 Lbs/Hr
Salt Refining Compaction Exhaust (EUNACLREFINERY)	Particulate	<b>Particulate:</b> 0.03 Lbs/1000 Lbs of exhaust gas, Dry & 5.8 Lbs/Hr

It should be noted that the NO<sub>x</sub> emission limit only applies to the Salt Dryer. The NO<sub>x</sub> sampling was conducted in the exhaust duct from only the Dryer. The particulate sampling for the Drying/Cooling was conducted in the combined Drying/Cooling exhaust stack (particulate emission limit is a combined Drying/Cooling limit).

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

- Particulate – U.S. EPA Method 17
- Total Oxides of Nitrogen (NO<sub>x</sub>) – U.S. EPA Method 7E
- Exhaust Gas Parameters (flow rate, temperature, moisture & density) – U.S. EPA Methods 1-4

The sampling in the study was performed over the period of March 13-14, 2018 by Stephan K. Byrd, R. Scott Cargill, Richard D. Eerdmans and David D. Engelhardt of Network Environmental, Inc.. Assisting in the study were Ms. Kelley Templin, Ms. Kip Cosan of Cargill Salt - Hersey and the operating staff of the facility. Mr. Kurt Childs of the MDEQ – Air Quality Division was present to observe the sampling and source operation.

**II. PRESENTATION OF RESULTS**

**II.1 TABLE 1  
PARTICULATE EMISSION RESULTS  
SALT REFINING  
CARGILL SALT  
HERSEY, MICHIGAN**

Source	Sample	Date	Time	Air Flow Rate DSCFM <sup>(1)</sup>	Particulate Emissions	
					Concentration Lbs/1000 Lbs, Dry <sup>(2)</sup>	Mass Rate Lbs/Hr <sup>(3)</sup>
Salt Refining Dryer/Cooler	1	3/13/18	10:15-11:18	43,637	0.0093	1.82
	2	3/13/18	11:35-12:38	42,842	0.0110	2.11
	3	3/13/18	13:05-14:08	42,687	0.0119	2.27
	<b>Average</b>				<b>43,055</b>	<b>0.0107</b>
Salt Refining Compaction	1	3/13/18	10:15-11:17	47,883	0.015	3.29
	2	3/13/18	11:35-12:37	48,636	0.022	4.82
	3	3/13/18	13:05-14:08	44,456	0.022	4.29
	<b>Average</b>				<b>46,992</b>	<b>0.020</b>

(1) DSCFM = Dry Standard Cubic Feet Per Minute (STP = 68 °F & 29.92 in. Hg)

(2) Lbs/1000 Lbs, Dry = Pounds Of Particulate Per Thousand Pounds of Exhaust Gas On A Dry Basis

(3) Lbs/Hr = Pounds Of Particulate Per Hour

**II.2 TABLE 2  
TOTAL OXIDES OF NITROGEN (NO<sub>x</sub>) EMISSION RESULTS  
SALT REFINING DRYER  
CARGILL SALT  
HERSEY, MICHIGAN**

Source	Sample	Date	Time	Air Flow Rate (DSCFM) <sup>(1)</sup>	NO <sub>x</sub> Emissions		
					Concentration	Mass Emission Rates	
					PPM <sup>(2)</sup>	Lbs/Hr <sup>(3)</sup>	Lbs/MMBTU <sup>(4)</sup>
Salt Refining Dryer	1	3/14/18	10:15-11:15	16,792	7.9	0.95	0.067
	2	3/14/18	11:27-12:27	16,649	8.0	0.95	0.068
	3	3/14/18	12:45-13:45	16,191	8.1	0.94	0.069
	<b>Average</b>			<b>16,544</b>	<b>8.0</b>	<b>0.95</b>	<b>0.068</b>

- (1) DSCFM = Dry Standard Cubic Feet Per Minute where STP = 68 °F & 29.92 in. Hg  
(2) PPM = Parts Per Million (V/V) On A Dry Basis  
(3) Lbs/Hr = Pounds Per Hour  
(4) Lbs/MMBTU = Pounds Per Million BTU of Heat Input (calculated on a dry basis using U.S. EPA Method 19 with an F-Factor of 8710 for Natural Gas)

### **III. DISCUSSION OF RESULTS**

The results of the emission sampling are presented in Tables 1-2 (Sections II.1-II.2) as follows:

#### **III.1 Table 1 – Salt Refining Particulate Emission Results**

- Source
- Sample Number
- Sample Date
- Sample Time
- Air Flow Rate in terms of Dry Standard Cubic Feet Per Minute (DSCFM). Standard Temperature and Pressure (STP) = 68 °F and 29.92 inches Hg.
- Particulate Concentration in terms of Pounds Of Particulate Per Thousand Pounds Of Exhaust Gas On A Dry Basis (Lbs/1000 Lbs, Dry)
- Particulate Mass Emission Rates in terms of Pounds Per Hour (Lbs/Hr)

A more detailed summary of each individual sample can be found in Appendix A.

#### **III.2 Table 2 – Salt Refining Dryer NO<sub>x</sub> Emission Results**

- Source
- Sample Number
- Sample Date
- Sample Time
- Air Flow Rate in terms of Dry Standard Cubic Feet Per Minute (DSCFM). Standard Temperature and Pressure (STP) = 68 °F and 29.92 inches Hg.
- NO<sub>x</sub> Concentrations in terms of Parts Per Million (V/V) On A Dry Basis (PPM)
- NO<sub>x</sub> Mass Emission Rates in terms of Pounds Per Hour (Lbs/Hr) and Pounds Per Million BTU of Heat Input (Lbs/MMBTU). Lbs/MMBTU were calculated on a dry basis using U.S. EPA Method 19 with an F-Factor of 8710 for natural gas.

### **IV. SAMPLING AND ANALYTICAL PROTOCOL**

**IV.1 Particulate** – The total particulate emission sampling was conducted in accordance with U.S. EPA Reference Method 17. Method 17 is an in stack filtration method. Three (3) samples were collected from each of the sources sampled. 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 from the exhausts

on filters. The filters and nozzle rinses were analyzed for total particulate by gravimetric analysis. All the quality assurance and quality control procedures listed in the method were incorporated in the sampling and analysis. The particulate sampling train is shown in Figure 1.

**IV.2 Oxides of Nitrogen** – The NO<sub>x</sub> sampling was conducted in accordance with U.S. EPA Reference Method 7E. A Thermo Environmental Model 42H gas analyzer was used to monitor the Salt Refining Dryer. 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<sub>x</sub> concentrations (PPM).

The analyzer was calibrated by direct injection prior to the testing. A span gas of 54.0 PPM was used to establish the initial instrument calibration. Calibration gases of 24.2 PPM and 10.96 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 10.96 PPM gas to determine the system bias. After each sample, a system zero and system injection of 10.96 PPM were performed to establish system drift and system bias during the test period. Prior to the sampling, a direct injection of 49.6 PPM NO<sub>2</sub> was performed to demonstrate the conversion efficiency of the analyzer (94.15% conversion). 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 source. Three (3), sixty (60) minute, samples were collected from the Salt Refining Dryer exhaust. All reference method data was corrected using Equation 7E-5 from U.S. EPA Method 7E. A schematic diagram of the sampling train is shown in Figure 2.

**IV.3 Oxygen & Carbon Dioxide (Salt Refining Dryer)** – The O<sub>2</sub> and CO<sub>2</sub> sampling was conducted in accordance with U.S. EPA Reference Method 3A. A heated teflon sample line was used to transport the exhaust gases from the stack to a gas conditioner to remove moisture and reduce the temperature. From the gas conditioner the stack gases were passed to Servomex Series 1400 analyzers. These analyzers produce instantaneous readouts of the O<sub>2</sub> and CO<sub>2</sub> concentrations (%).

The analyzers were calibrated by direct injection prior to the testing. Span gases of 21.0% O<sub>2</sub> and 20.1% CO<sub>2</sub> were used to establish the initial instrument calibrations. Calibration gases of 5.94% O<sub>2</sub> / 12.1% CO<sub>2</sub> and 12.0% O<sub>2</sub> / 6.03% CO<sub>2</sub> 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 12.0% O<sub>2</sub> / 6.03% CO<sub>2</sub> gas to determine the system bias. After each sample, a system zero and system injection of 12.0% O<sub>2</sub> /

6.03% CO<sub>2</sub> 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. Three (3), sixty (60) minute, samples were collected from the sources sampled. All reference method data was corrected using Equation 7E-5 from U.S. EPA Method 7E. A schematic diagram of the sampling train is shown in Figure 2.

**IV.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.

For the Compaction Exhaust and the Drying/Cooling Exhaust, air flow rate, temperature and moisture were determined using the Method 17 particulate sampling train. For the Dryer Exhaust (during NO<sub>x</sub> sampling) three (3) velocity traverses and one (1) moisture sample were conducted to determine the air flow rate, temperature and moisture.

The ambient default factor (20.9 %O<sub>2</sub> & 0.0 %CO<sub>2</sub>) was used for the gas density on the Compaction Scrubber. Gas density for the Drying/Cooling Exhaust was determined by collecting bags from the Method 17 sampling train and Orsat analysis. Gas density on the Dryer Exhaust was determined in conjunction with the Method 7E sampling train by monitoring for O<sub>2</sub> & CO<sub>2</sub> using EPA Method 3A (as described above).

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

**IV.5 Sampling Locations** – The sampling locations were as follows:

- Salt Refining Drying/Cooling Exhaust – A 66 inch I.D. exhaust stack with two (2) sampling ports at a location two (2) duct diameters downstream and greater than six (6) duct diameters upstream from the nearest disturbances. Twenty four (24) sampling points (12 per port) were used for the isokinetic sampling.
- Salt Refining Compaction Exhaust – A 60 inch I.D. exhaust stack, with two (2) sampling ports at a location two (2) duct diameters downstream and greater than 2 duct diameters upstream from the nearest disturbances. Twenty-four (24) sampling points (12 per port) were used for the isokinetic sampling.
- Salt Drying Exhaust – A 41 Inch I.D. exhaust duct with two (2) sampling ports at a location two (2) duct diameters downstream and one (1) duct diameter upstream from the nearest

disturbances. Sixteen (16) traverse points (8 per port) were used for the air flow determination. Also, prior to the NO<sub>x</sub> testing, a stratification test (in accordance with Method 7E) was conducted to determine the number of sampling points required for the NO<sub>x</sub> testing. The results of the stratification test can be found in Appendix C and indicated no stratification. A single sampling point was used for the NO<sub>x</sub> testing.

The particulate isokinetic sampling point dimensions were as follows:

<u>Sample Point</u>	<u>Compaction Exhaust Dimension (Inches)</u>	<u>Dryer/Cooler Exhaust Dimension (Inches)</u>
1	1.26	1.39
2	4.02	4.42
3	7.08	7.79
4	10.62	11.68
5	15.00	16.50
6	21.36	23.50
7	38.64	42.50
8	45.00	49.50
9	49.38	54.32
10	52.92	58.21
11	55.98	61.58
12	58.74	64.61

The Dryer air flow traverse point dimensions were as follows:

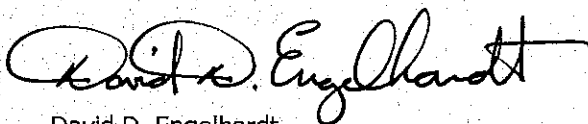
<u>Sample Point</u>	<u>Dryer Exhaust Dimension (Inches)</u>
1	1.31
2	4.30
3	7.96
4	13.24
5	27.76
6	33.04
7	36.70
8	39.69

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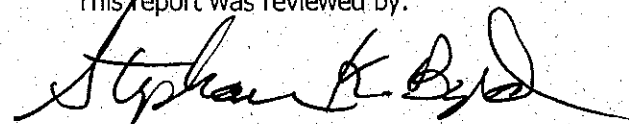
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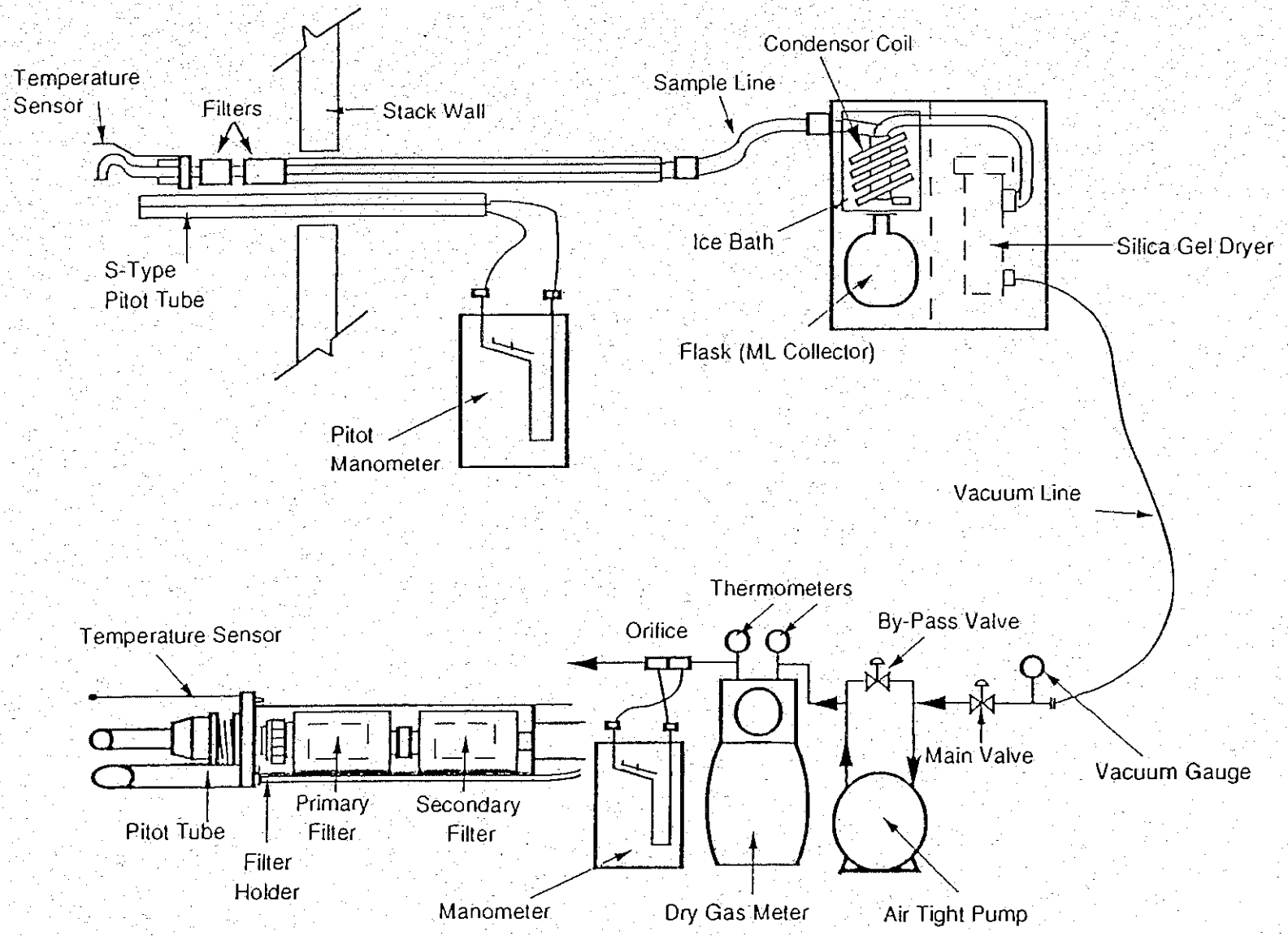
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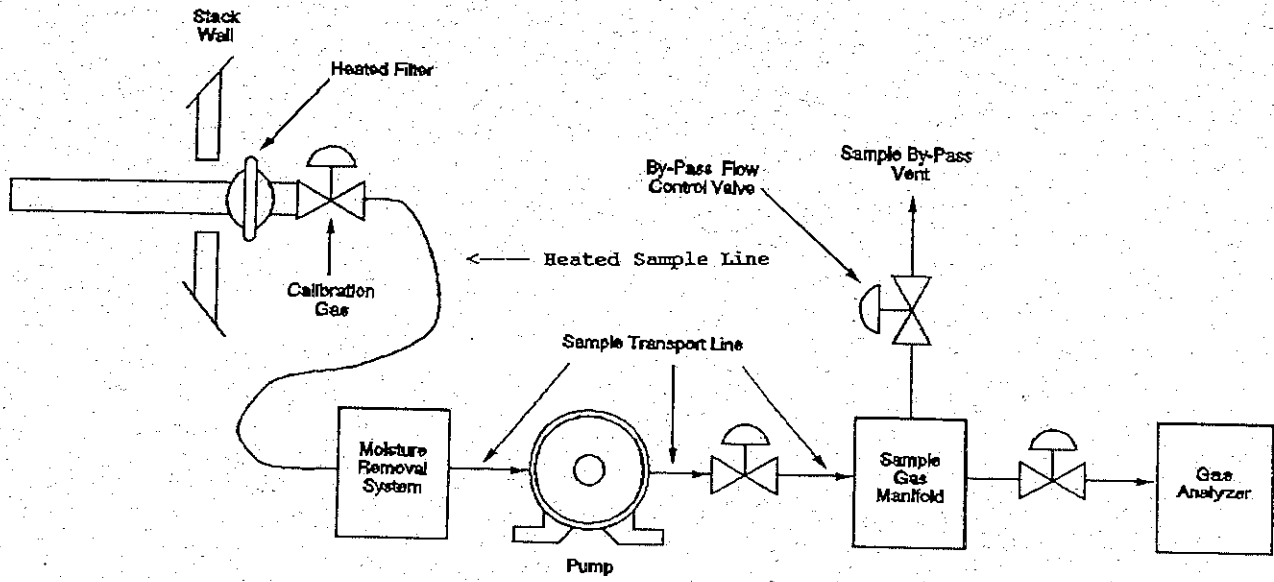
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**Figure 1**

**Particulate Sampling Train**



**Figure 2**  
**NO<sub>x</sub>, O<sub>2</sub> & CO<sub>2</sub> Sampling Train**