Pace Analytical®
Field Services Division

Pace Analytical Services, LLC
1700 Elm Street SE
Minneapolis, MN 55414
Phone: 612.607.1700
Fax: 612.607.6444
www.pacelabs.com

Comprehensive Emissions Test Report

Port Inland Plant
Particulate
Compliance Testing

Testing Date(s): October 2, 2018
Report Date: November 27, 2018
Revision Date: No revision to date

Report Prepared For:

Keith Miller
Graymont
800 Hill Avenue
Superior, WI 54880

Telephone No.: (715) 394-1719
E-mail Address: kmiller@graymont.com

Report Preparation Supervised By:

Terry Borgerding
Pace Analytical Services, LLC
1700 Elm Street, Suite 200
Minneapolis, MN 55414
Telephone No.: (612) 607-6374
E-mail Address: terry.borgerding@pacelabs.com

Pace Project No. 18-01077

ACCREDITED
Cert #3819.01 (ISO/IEC 17025:2005)
Cert #3819.02 (ASTM D7036)

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TNI

Subject Facility:
Graymont Western Lime
Port Inland Plant
181 W County Road 432
Gulliver, MI 49840

Regulatory Permit No.:
ROP: MI-ROP-N7362-2015
SRN: N7362

Subject Emission Sources:

Lime Kiln	Kiln 1

Test Locations:

Baghouse Exhaust	SV-2

Regulatory Summary

Subject Facility: Graymont Western Lime
Port Inland Plant
Plant Address: 181 W County Road 432
Gulliver, MI 49840

Air Permit No.: ROP: MI-ROP-N7362-2015
Facility ID No.: SRN: N7362

Emission Unit IDs	Emission Unit Name	Regulated Constituent	Regulatory Citations	Regulatory Limit	Average Test Result
Kiln 1	Lime Kiln	PM-10	40 CFR 52.21(j) R 336.1205 R 336.1331	≤0.1 LB/Ton of stone feed (TSF)	0.075 LB/TSF
				≤7.5 LB/HR	4.84 LB/HR

Introduction

Pace Analytical Services, LLC personnel conducted particulate emission compliance testing on the Lime Kiln Baghouse exhaust at the Graymont Western Lime (Graymont) facility located in Gulliver, Michigan. Dan Schoess, Nate Hibbard, and Isaac Prichett performed on-site testing activities on October 2, 2018. Terry Borgerding provided administrative project management. Keith Miller with Graymont coordinated plant activities during testing. Jeremy Howe with the Michigan Department of Environmental Quality (MDEQ) was on-site to witness testing. Pace Analytical Services, LLC prepared a comprehensive test protocol that was submitted to the MDEQ and approved prior to testing. On-site activities consisted of the following measurements:

- Particulate, three independent one-hour samplings.
- Oxygen, monitoring periods concurrent with above.
- Carbon dioxide, integrated bags collected concurrent with above and analyzed by FTIR.
- Volumetric airflow, measurements collected in conjunction with isokinetic testing.

The project objectives were to quantify particulate emission constituents and compare them to applicable air emissions regulations stipulated by MDEQ and the facility permit. These measurements were performed while processing 64.4 TPH of limestone. Quality protocols comply with regulatory compliance testing requirements.

Subsequent sections summarize the test results and provide descriptions of the process and test methods. Supporting information and raw data are in the appendices.

Results Summary

Results of PM-10 determinations are summarized in Table 1. The PM-10 emission rate averaged 4.84 LB/HR and 0.075 LB/TSF at 0.011 GR/DSCF. The PM-10 emission limits for this source are 0.1 LB/TSF and 7.5 LB/HR. Subsequent tables provide expanded detail of the testing results.

Less than PM-10 filterable (EPA Method 201A), organic wet catch and inorganic wet catch (EPA Method 202) were combined to report PM-10.

The glass lined sample probe of the EPA Method 201A/202 sample train was accidentally broken during the port change of Run 1. The test team replaced the probe (causing a three hour delay) and attempted to continue the run but experienced CPM filter plugging issues when the run was restarted and could not complete the run. Though the samples were processed, the run was invalid as only 7 of 12 traverse points were sampled and replacing the broken probe caused a significant delay in purging and processing per EPA Method 202. An additional run (Run 4) was performed and Runs 2, 3 and 4 are reported to determine compliance.

The data in this report are indicative of emission characteristics of the measured sources for process conditions at the time of the test. Representations to other sources and test conditions are beyond the scope of this report.

Graymont Western Lime

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Table 1

Results Summary
Lime Kiln Baghouse Exhaust
Test 1

Parameter	Run 2	Run 3	Run 4	Average
Date of Run	10/2/18	10/2/18	10/2/18	
Time of Run	1420-1610	1700-1834	1920-2050	
Limestone Feed, TPH	64.4	64.4	64.4	64.4
Volumetric Flow Rate (Rounded to 100 CFM)				
ACFM	87,700	87,000	86,000	86,900
DSCFM	50,100	50,500	49,800	50,100
Gas Temperature, °F	379	373	373	375
Gas Moisture Content, %v/v	7.7	6.8	7.1	7.2
Gas Composition, %v/v, dry				
Carbon Dioxide, CO_2	24.0	23.3	24.2	23.8
Oxygen, O_2	6.7	6.6	6.5	6.6
Nitrogen, N_2 (by difference)	69.3	70.1	69.3	69.6
Particulate Concentration, GR/DSCF				
< 10 µm Particulate Matter	0.0114	0.0111	0.0113	0.0113
Particulate Mass Rate, LB/HR				
< 10 µm Particulate Matter	4.91	4.82	4.80	4.84
Regulatory Units, LB/Ton Stone Feed				
< 10 µm Particulate Matter	0.0762	0.0748	0.0745	0.0752

Graymont Western Lime

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Gulliver, MI
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Table 2

Major Gases and Moisture Results
Lime Kiln Baghouse Exhaust
Test 1

Parameter	**Run 2**	**Run 3**	**Run 4**
Date of Run	10/2/18	10/2/18	10/2/18
Time of Run	1420-1610	1700-1834	1920-2050
Major Gas Constituents - Instrumental, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	24.00	23.30	24.20
Oxygen	6.70	6.60	6.50
Nitrogen (by difference)	69.30	70.10	69.30
Wet Basis (calculated)			
Carbon Dioxide	22.16	21.71	22.47
Oxygen	6.19	6.15	6.04
Nitrogen	63.98	65.30	64.36
Portable Oxygen Monitor Result			
Time Weighted Average, $\%O_2$	6.7	6.6	6.5
Moisture Collected, ml	61.0	51.0	51.5
Moisture Content, %v/v	7.68	6.85	7.14
Moisture Content if Saturated, %v/v	*NA (T>BP)*	*NA (T>BP)*	*NA (T>BP)*
Relative Humidity, % rH	*NA (T>BP)*	*NA (T>BP)*	*NA (T>BP)*
Molecular Weight of Flue Gas, lb/lb-mole			
Dry	32.11	31.99	32.13
Wet	31.03	31.03	31.12

NA (T>BP) = Not applicable, gas temperature is greater than boiling point of water (supersaturation is possible).

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Table 3

Particulate Results
Lime Kiln Baghouse Exhaust
Test 1

Parameter	**Run 2**	**Run 3**	**Run 4**
Date of Run	10/2/18	10/2/18	10/2/18
Time of Run	1420-1610	1700-1834	1920-2050
Sample Duration, Minutes	94.9	89.6	87.2
Average Flue Gas Temperature, °F	378.6	373.2	373.3
Moisture Content of Flue Gas, %v/v	7.7	6.8	7.1
Volumetric Flow Rate (Rounded to 100 CFM)			
ACFM	87,700	87,000	86,000
SCFM	54,300	54,200	53,600
DSCFM	50,100	50,500	49,800
Particulate Collected, mg Blank Corrected			
PM_{10} Cyclone - >10 µm Filterable	NTP	NTP	NTP
$PM_{2.5}$ Cyclone - 2.5 - 10 µm Filterable	NTP	NTP	NTP
Filter Catch - <2.5 µm Filterable	0.7	0.9	1.0
CPM_{ORG} - Organic Condensible	0.87	1.05	0.71
CPM_{INORG} - Inorganic Condensible	24.0	21.6	21.3
Actual PM10 Cut Diameter, µm	10.4	10.4	10.5
Actual PM2.5 Cut Diameter, µm	2.41	2.43	2.44
Particulate Concentration, GR/DSCF			
< 10 µm Filterable PM	0.000298	0.000439	0.000481
Inorganic Condensible PM	0.0107	0.0102	0.0104
Organic Condensible PM	0.00039	0.00050	0.00035
Particulate Emission Rate, LB/HR			
< 10 µm Filterable PM	0.13	0.19	0.21
Inorganic Condensible PM	4.61	4.41	4.45
Organic Condensible PM	0.17	0.21	0.15

NTP = Non-Target Parameter, intentionally excluded from the test protocol.

Process Description

Graymont Western Lime operates a rotary lime kiln near Gulliver, Michigan. The operations at this facility are subject to the requirements of air quality operating permit MI-ROP-N7362-2015, issued October 6, 2015. The plant has a maximum lime production rate of 870 tons per day (TPD) and 292,000 tons of lime production per year.

A rotary kiln is a long, cylindrical, refractory-lined furnace that is slightly inclined. The limestone and hot gases pass counter-currently through the kiln. The lime plant consists of a single 235-foot long rotary kiln with a pre-heater and lime cooler. The kiln is fired with coal or a mixture of coal and petroleum coke. Coal and/or petroleum coke is burned near the discharge end of the kiln to provide the necessary heat for the process. The kiln rotates continuously to prevent the drum from sagging, to improve the product contact with the hot gases, and to move the product through the kiln. To maximize fuel efficiency, a product cooler and limestone pre-heater are used to recover heat from the product and the hot gasses. The lime product is discharged from the kiln and then conveyed to various storage silos, where it is screened to size and then shipped to the end user. Lime is used in the metallurgical, pulp and paper, construction, and waste treatment industries.

Emissions from the process consist primarily of particulate matter (PM), carbon monoxide (CO), nitrogen oxides (NO_x), and sulfur dioxide (SO_2) from fuel combustion. Emission controls for the kiln consist of a fabric filter baghouse for PM control, a fuel sulfur content limit and combustion optimization to reduce CO and NO_x emissions. The majority of the SO_2 is collected within the process, owing to reactions with calcium oxide in the kiln.

Test related process and operational details were collected by Graymont personnel and included in Appendix E.