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Comprehensive Emissions Test Report

Port Inland Plant
Nitrogen Oxides and Carbon Monoxide
Relative Accuracy Testing

Testing Date(s): September 23, 2015
Report Date: October 21, 2015
Revision Date: No revision to date

GRAYMONT

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

Regulatory Permit No.:
Air Permit 26-04A

Subject Emission Sources:
Lime Kiln — Kiln 1

Test Locations:
Baghouse Exhaust — SV-2

Report Prepared For:

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Pace Project No. 12-15-1013

Executive Summary

Graymont Western Lime contracted Pace Analytical Services, Inc. to perform relative accuracy test audits (RATA) on the continuous emissions monitoring system (CEMS) for the Lime Kiln Stack at the Graymont Western Lime facility in Gulliver, Michigan. Two CEM data collection systems (DAQ system and PI system) were audited. Testing was performed on September 23, 2015. Summary results are highlighted in the following table:

Test Results Summary

Parameter	RM Average	CEMS Average	RA	Status
DAQ Data System				
Oxides of Nitrogen				
LB/HR	41.9	39.2	7.44%	Pass[1]
Carbon Monoxide				
LB/HR	27.6	27.7	7.78%	Pass[1]
PI Data System				
Oxides of Nitrogen				
LB/HR	41.9	39.1	7.61%	Pass[1]
Carbon Monoxide				
LB/HR	27.6	27.5	6.13%	Pass[1]

[1]Relative Accuracy performance criterion is ≤20% of reference method.

Introduction

Pace Analytical Services, Inc. personnel conducted oxides of nitrogen (NO_x) and carbon monoxide (CO) continuous emissions monitoring system (CEMS) relative accuracy test audits (RATA). Testing was conducted on the Lime Kiln Stack at the Graymont Western Lime facility in Gulliver, Michigan. Two CEM data collection systems (DAQ system and PI system) were audited. Mike Walter and Jake Nelson performed on-site testing activities. Terry Borgerding provided administrative project management. Ross Olson with Graymont Western Lime coordinated plant activities for testing. Pace Analytical Services, Inc. prepared a comprehensive test protocol that was submitted to the Michigan Department of Environmental Quality prior to testing. On-site activities consisted of the following measurements:

- Oxygen/carbon dioxide, ten 21-minute monitoring periods.
- Oxides of nitrogen, ten 21-minute monitoring periods
- Carbon monoxide, ten 21-minute monitoring periods.
- Moisture measurements in conjunction with each set of three constituent test runs.
- Volumetric airflow, measurements in conjunction with each constituent test run.

The project objectives were to quantify oxides of nitrogen and carbon monoxide emissions and compare them to the CEMS data results (two systems) to verify relative accuracy (RA) of the systems. These measurements were performed at greater than 50% normal operating condition. 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 NO_x and CO CEMS relative accuracy (RA) determinations for the DAQ system are summarized in Tables 1 and 2. The NO_x CEMS RA averaged 7.44% for LB/HR based on the reference method average. The CO CEMS RA averaged 7.78% for LB/HR based on the reference method average.

Results of NO_x and CO CEMS RA determinations for the PI system are summarized in Tables 3 and 4. The NO_x CEMS RA averaged 7.61% for LB/HR based on the reference method average. The CO CEMS RA averaged 6.13% for LB/HR based on the reference method average. EPA Performance Specification 6 requires that CEMS RA be ≤ 20% of the reference method average.

Ten 21-minute runs were performed and Run 7 was not used in the RA calculation due to unstable operation causing a high CO concentration. Tables 4 and 5 show results of moisture and airflow measurements used to calculate NO_x and CO mass rate (LB/HR).

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.

Summary Tables

Graymont Western Lime

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Table 1

CEMS Relative Accuracy Results
Lime Kiln Baghouse Exhaust
Test 1
DAQ System

Volumetric Flow Rate — Airflow, DSCFM

Run	Date	Start	End	Duration	RM Result	CEM Result	Difference
1	9/23/15	8:00	8:21	0:21	46,338	50,943	4,605
2	9/23/15	8:22	8:43	0:21	47,599	51,174	3,575
3	9/23/15	8:44	9:05	0:21	47,355	50,417	3,062
4	9/23/15	9:20	9:41	0:21	46,907	50,964	4,057
5	9/23/15	9:42	10:03	0:21	47,620	51,165	3,545
6	9/23/15	10:04	10:25	0:21	47,515	50,736	3,221
8	9/23/15	11:07	11:28	0:21	48,098	51,103	3,005
9	9/23/15	11:29	11:50	0:21	48,032	50,901	2,869
10	9/23/15	11:51	12:12	0:21	48,788	51,147	2,359
			Run Average		47,583	50,950	3,367
			Standard Deviation				670
			Confidence Coefficient				515
			Relative Accuracy	(% of RM Avg)			**8.16**
			RA Requirement				≤ 20% of RM Average
			RA Status				**Pass**

Nitrogen Oxides as NO2 — LB/HR

Run	Date	Start	End	Duration	RM Result	CEM Result	Difference
1	9/23/15	8:00	8:21	0:21	40.9	39.2	-1.71
2	9/23/15	8:22	8:43	0:21	41.9	39.4	-2.55
3	9/23/15	8:44	9:05	0:21	42.4	39.5	-2.89
4	9/23/15	9:20	9:41	0:21	41.7	39.4	-2.35
5	9/23/15	9:42	10:03	0:21	42.3	39.4	-2.96
6	9/23/15	10:04	10:25	0:21	41.5	38.5	-3.00
8	9/23/15	11:07	11:28	0:21	41.4	38.4	-3.01
9	9/23/15	11:29	11:50	0:21	41.9	38.8	-3.13
10	9/23/15	11:51	12:12	0:21	43.4	40.2	-3.19
			Run Average		41.9	39.2	-2.76
			Standard Deviation				0.475
			Confidence Coefficient				0.365
			Relative Accuracy	(% of RM Avg)			**7.44**
			RA Requirement				≤ 20% of RM Average
			RA Status				**Pass**

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Table 2

CEMS Relative Accuracy Results
Lime Kiln Baghouse Exhaust
Test 1
DAQ System

Volumetric Flow Rate

Airflow, DSCFM

Run	Date	Start	End	Duration	RM Result	CEM Result	Difference
1	9/23/15	8:00	8:21	0:21	46,338	50,943	4,605
2	9/23/15	8:22	8:43	0:21	47,599	51,174	3,575
3	9/23/15	8:44	9:05	0:21	47,355	50,417	3,062
4	9/23/15	9:20	9:41	0:21	46,907	50,964	4,057
5	9/23/15	9:42	10:03	0:21	47,620	51,165	3,545
6	9/23/15	10:04	10:25	0:21	47,515	50,736	3,221
8	9/23/15	11:07	11:28	0:21	48,098	51,103	3,005
9	9/23/15	11:29	11:50	0:21	48,032	50,901	2,869
10	9/23/15	11:51	12:12	0:21	48,788	51,147	2,359
			Run Average		47,583	50,950	3,367
			Standard Deviation				670
			Confidence Coefficient				515
			Relative Accuracy	(% of RM Avg)			**8.16**
			RA Requirement				≤ 20% of RM Average
			RA Status				**Pass**

Carbon Monoxide

LB/HR

Run	Date	Start	End	Duration	RM Result	CEM Result	Difference
1	9/23/15	8:00	8:21	0:21	24.2	25.2	0.983
2	9/23/15	8:22	8:43	0:21	23.8	25.1	1.30
3	9/23/15	8:44	9:05	0:21	24.0	24.0	-0.0359
4	9/23/15	9:20	9:41	0:21	26.8	26.2	-0.611
5	9/23/15	9:42	10:03	0:21	24.8	24.6	-0.235
6	9/23/15	10:04	10:25	0:21	30.2	26.8	-3.35
8	9/23/15	11:07	11:28	0:21	38.0	44.0	6.00
9	9/23/15	11:29	11:50	0:21	30.6	28.8	-1.83
10	9/23/15	11:51	12:12	0:21	25.5	24.6	-0.974
			Run Average		27.6	27.7	0.139
			Standard Deviation				2.61
			Confidence Coefficient				2.01
			Relative Accuracy	(% of RM Avg)			**7.78**
			RA Requirement				≤ 20% of RM Average
			RA Status				**Pass**

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Table 3

CEMS Relative Accuracy Results
Lime Kiln Baghouse Exhaust
Test 1
PI System

Volumetric Flow Rate — Airflow, DSCFM

Run	Date	Start	End	Duration	RM Result	CEM Result	Difference
1	9/23/15	8:00	8:21	0:21	46,338	50,999	4,661
2	9/23/15	8:22	8:43	0:21	47,599	50,794	3,195
3	9/23/15	8:44	9:05	0:21	47,355	50,182	2,827
4	9/23/15	9:20	9:41	0:21	46,907	50,746	3,839
5	9/23/15	9:42	10:03	0:21	47,620	51,119	3,499
6	9/23/15	10:04	10:25	0:21	47,515	51,337	3,822
8	9/23/15	11:07	11:28	0:21	48,098	50,813	2,715
9	9/23/15	11:29	11:50	0:21	48,032	51,217	3,185
10	9/23/15	11:51	12:12	0:21	48,788	51,473	2,685
			Run Average		47,583	50,964	3,381
			Standard Deviation				649
			Confidence Coefficient				498
			Relative Accuracy	(% of RM Avg)			**8.15**
			RA Requirement				≤ 20% of RM Average
			RA Status				**Pass**

Nitrogen Oxides as NO2 — LB/HR

Run	Date	Start	End	Duration	RM Result	CEM Result	Difference
1	9/23/15	8:00	8:21	0:21	40.9	39.2	-1.72
2	9/23/15	8:22	8:43	0:21	41.9	39.0	-2.91
3	9/23/15	8:44	9:05	0:21	42.4	39.5	-2.89
4	9/23/15	9:20	9:41	0:21	41.7	39.4	-2.31
5	9/23/15	9:42	10:03	0:21	42.3	39.2	-3.13
6	9/23/15	10:04	10:25	0:21	41.5	38.5	-2.97
8	9/23/15	11:07	11:28	0:21	41.4	38.3	-3.13
9	9/23/15	11:29	11:50	0:21	41.9	38.8	-3.12
10	9/23/15	11:51	12:12	0:21	43.4	40.2	-3.16
			Run Average		41.9	39.1	-2.82
			Standard Deviation				0.486
			Confidence Coefficient				0.374
			Relative Accuracy	(% of RM Avg)			**7.61**
			RA Requirement				≤ 20% of RM Average
			RA Status				**Pass**

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Table 4

CEMS Relative Accuracy Results
Lime Kiln Baghouse Exhaust
Test 1
PI System

Volumetric Flow Rate — Airflow, DSCFM

Run	Date	Start	End	Duration	RM Result	CEM Result	Difference
1	9/23/15	8:00	8:21	0:21	46,338	50,999	4,661
2	9/23/15	8:22	8:43	0:21	47,599	50,794	3,195
3	9/23/15	8:44	9:05	0:21	47,355	50,182	2,827
4	9/23/15	9:20	9:41	0:21	46,907	50,746	3,839
5	9/23/15	9:42	10:03	0:21	47,620	51,119	3,499
6	9/23/15	10:04	10:25	0:21	47,515	51,337	3,822
8	9/23/15	11:07	11:28	0:21	48,098	50,813	2,715
9	9/23/15	11:29	11:50	0:21	48,032	51,217	3,185
10	9/23/15	11:51	12:12	0:21	48,788	51,473	2,685
			Run Average		47,583	50,964	3,381
			Standard Deviation				649
			Confidence Coefficient				498
			Relative Accuracy	(% of RM Avg)			**8.15**
			RA Requirement				≤ 20% of RM Average
			RA Status				**Pass**

Carbon Monoxide — LB/HR

Run	Date	Start	End	Duration	RM Result	CEM Result	Difference
1	9/23/15	8:00	8:21	0:21	24.2	25.1	0.873
2	9/23/15	8:22	8:43	0:21	23.8	24.9	1.06
3	9/23/15	8:44	9:05	0:21	24.0	24.1	0.0941
4	9/23/15	9:20	9:41	0:21	26.8	26.2	-0.591
5	9/23/15	9:42	10:03	0:21	24.8	24.4	-0.435
6	9/23/15	10:04	10:25	0:21	30.2	27.1	-3.06
8	9/23/15	11:07	11:28	0:21	38.0	42.2	4.16
9	9/23/15	11:29	11:50	0:21	30.6	28.8	-1.83
10	9/23/15	11:51	12:12	0:21	25.5	24.3	-1.23
			Run Average		27.6	27.5	-0.107
			Standard Deviation				2.06
			Confidence Coefficient				1.58
			Relative Accuracy	(% of RM Avg)			**6.13**
			RA Requirement				≤ 20% of RM Average
			RA Status				**Pass**

Detail Tables

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Table 5

Major Gases and Moisture Results
Lime Kiln Baghouse Exhaust
Test 1

Parameter	**Run 1**	**Run 2**	**Run 3**
Date of Run	9/23/15	9/23/15	9/23/15
Time of Run	0800-0900	0920-1020	1045-1145
Sample Duration, Minutes	60	60	60
Average Flue Gas Temperature, °F	396	392	386
Major Gas Constituents - Instrumental, % v/v			
Dry Basis (as measured)			
Carbon Dioxide	25.37	25.80	25.80
Oxygen	6.88	6.60	6.60
Nitrogen (by difference)	67.75	67.60	67.60
Wet Basis (calculated)			
Carbon Dioxide	23.64	23.97	24.01
Oxygen	6.41	6.13	6.14
Nitrogen	63.14	62.80	62.92
Portable O_2 Monitor Average, $\%O_2$	6.8	6.8	6.7
Sample Volume, Meter Conditions, Ft^3	41.47	39.64	39.47
Sample Volume, Dry Standard, Ft^3	41.23	39.38	39.21
Moisture Collected, ml	64.0	64.0	62.0
Moisture Content of Gas Stream, %v/v	6.81	7.11	6.93
Moisture Content if Saturated, %v/v	NA (>BP)	NA (>BP)	NA (>BP)
Relative Humidity, % rH	NA (>BP)	NA (>BP)	NA (>BP)
Molecular Weight of Flue Gas, lb/lb-mole			
Dry	32.33	32.39	32.39
Wet	31.36	31.37	31.39

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Table 6

Airflow Measurement Results
Lime Kiln Baghouse Exhaust
Test 1

Parameter	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10
Date of Run	9/23/15	9/23/15	9/23/15	9/23/15	9/23/15	9/23/15	9/23/15	9/23/15	9/23/15	9/23/15
Time of Measurement	0800	0822	0844	0920	0942	1004	1045	1107	1129	1151
Barometric Pressure, Inches Hg	29.65	29.65	29.65	29.65	29.65	29.65	29.65	29.65	29.65	29.65
Static Pressure, Inches WC	-0.43	-0.41	-0.42	-0.42	-0.42	-0.40	-0.44	-0.40	-0.40	-0.39
Absolute Gas Pressure (In. Hg)	29.62	29.62	29.62	29.62	29.62	29.62	29.62	29.62	29.62	29.62
Average Gas Temperature, °F	398	396	395	393	393	391	386	385	385	385
Corresponding M-4 Run Number	1	1	1	2	2	2	3	3	3	3
Average Moisture Content, %v/v	6.8	6.8	6.8	7.1	7.1	7.1	6.9	6.9	6.9	6.9
Gas Molecular Weight (Instrumental), lb/lb-mole										
Dry	32.32	32.33	32.35	32.39	32.39	32.39	32.39	32.39	32.39	32.39
Wet	31.35	31.35	31.37	31.37	31.37	31.37	31.39	31.39	31.39	31.39
Flue Gas Average Velocity, FPS	37.08	38.00	37.76	37.44	38.00	37.83	37.65	37.95	37.90	38.49
Duct Cross-sectional Area, Sq. Ft	36.67	36.67	36.67	36.67	36.67	36.67	36.67	36.67	36.67	36.67
Volumetric Flow Rate (Rounded to 10 CFM)										
ACFM	81,590	83,610	83,090	82,370	83,630	83,240	82,840	83,510	83,390	84,700
SCFM	49,720	51,080	50,810	50,500	51,260	51,150	51,200	51,680	51,610	52,420
DSCFM	46,340	47,600	47,360	46,910	47,620	47,510	47,650	48,100	48,030	48,790