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EMISSIONS COMPLIANCE STUDY

Performed At The
Carmeuse Lime & Stone
River Rouge
Kilns 1 & 2 Combined Emissions Stack
River Rouge, Michigan

Test Date(s)
December 4, 2018

Report No.
TRC Environmental Corporation Report 294369

Report Submittal Date
January 10, 2019

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Report Certification

I certify that to the best of my knowledge:

- Testing data and all corresponding information have been checked for accuracy and completeness.
- Sampling and analysis have been conducted in accordance with the approved protocol and applicable reference methods (as applicable).
- All deviations, method modifications, or sampling and analytical anomalies are summarized in the appropriate report narrative(s).

Christian W. Bartley
Project Manager

January 10, 2018
Date

TRC was operating in conformance with the requirements of ASTM D7036-04 during this test program.

Bruce Randall
TRC Emission Testing Technical Director

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APPENDIX

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EMISSIONS COMPLIANCE STUDY

1.0 INTRODUCTION

TRC Environmental Corporation (TRC) performed an emission compliance test program on the Kilns 1 & 2 Combined Emissions Stack at the Carmeuse Lime & Stone (Carmeuse) River Rouge facility in River Rouge, Michigan on December 4, 2018. The tests were authorized by and performed for Carmeuse.

The purpose of this test program was to determine filterable particulate matter (FPM), visible emissions (VE) and sulfur dioxide (SO_2) emissions during normal operating conditions. The results of the test program will be used in order to determine compliance with the Michigan Department of Environmental Quality (MDEQ) Permit No. MI-ROP-B2169-2013. The test program was conducted according to the TRC Protocol dated July 9, 2018.

1.1 Project Contact Information

Participants		
Test Facility	Carmeuse Lime & Stone River Rouge 25 Marion Avenue River Rouge, Michigan 48218 Permit No. MI-ROP-B2169-2013 Facility No. B2169	Kris Milner Area Environmental Manager (859) 472-8100 kris.milner@carmeusena.com
Air Emissions Testing Body (AETB)	TRC Environmental Corporation 2500 Eldo Road, Suite 2 Monroeville, Pennsylvania 15146	Christian W. Bartley, QI Project Manager (412) 738-4139 (phone) CBartley@TRCSolutions.com

The tests were conducted by Craig L. Grunden, QI, Justin G. Bryan, QI and Robert K. Dornenburg of TRC. Documentation of the on-site ASTM D7036-04 Qualified Individual (QI) can be located in the appendix to this report.

Regina Hines of the MDEQ observed the testing.

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1.2 Facility and Process Description

Lime is the product of the high-temperature calcination of limestone. The basic procedures in the production of lime are (1) quarrying the raw limestone, (2) preparing the limestone for the kilns by crushing and sizing, (3) calcining the limestone to quicklime (CaO) and (4) miscellaneous transfer, storage and handling operations. Carmeuse operates two rotary kilns at their River Rouge facility. Emissions from Rotary Kilns 1 and 2 each duct into a combined stack after separate fabric filter baghouse control devices. Coal is used as the fuel for both kilns.

2.0 SUMMARY OF RESULTS

The results of this test program are summarized in the table below. Detailed individual run results are presented in Section 6.0.

Unit ID	Pollutant Tested	Measured Emissions	Permitted Emission Limit
EUKILNNUMBER1 and EUKILNNUMBER2 (Combined Exhaust Stack)	FPM	0.0056 lb/tsf*	0.12 lb/tsf*
	SO_2	198.20 ppm in exhaust to gas (corrected to 50% excess Oxygen)	300 ppm in exhaust to gas (corrected to 50% excess Oxygen)
		164.61 lb/hr	470 lb/hr
		0.45 lb/MMBtu**	2.4 lb/MMBtu**
	VE	0 % over a 6-minute average One 6-minute average >27%/hr	15% over a 6-minute average One 6-minute average >27%/hr

*pounds per ton of stone feed
**pounds per million BTU

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The table below summarizes the test methods used, as well as the number and duration of each at each test location:

Unit ID/ Sample Location	Parameter Measured	USEPA Test Method	No. of Runs	Run Duration (Mins)
EUKILNNUMBER1 and EUKILNNUMBER2 Combined Exhaust Stack	Sample / Velocity Traverses	1	3	N/A
	Velocity – S-type Pitot	2		
	CO_2, O_2, and Dry Molecular Weight	3A		60
	Moisture Content	4		
	Particulate Matter	5		
	Sulfur Dioxide	6C		
	Visible Emissions	9		
	Fuel Flow Emission Rates	19		NA

3.0 DISCUSSION OF RESULTS

No problems were encountered with the testing equipment during the test program. Source operation appeared normal during the entire test program. No changes or problems were encountered that required modification of any procedures presented in the test plan. No adverse test or environmental conditions were encountered during the conduct of this test program.

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4.0 SAMPLING AND ANALYSIS PROCEDURES

All testing, sampling, analytical, and calibration procedures used for this test program were performed in accordance with the methods presented in the following sections. Where applicable, the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods, USEPA 600/R-94/038c, September 1994 was used to supplement procedures.

4.1 Determination of Sample Point Locations by USEPA Method 1

This method is applicable to gas streams flowing in ducts, stacks, and flues and is designed to provide guidance for the selection of sampling ports and traverse points at which sampling for air pollutants will be performed. Sample ports must be located at least two duct diameters downstream and a half a duct diameter upstream from any flow disturbance.

The cross-section of the measurement site was divided into a number of equal areas, and the traverse points were located in the center of each area. The minimum number of points were determined from Figure 1-1 (particulate) of the Method.

4.2 Volumetric Flow Rate Determination by USEPA Method 2

This method is applicable for the determination of the average velocity and the volumetric flow rate of a gas stream.

The gas velocity head (ΔP) and temperature were measured at traverse points defined by USEPA Method 1. The velocity head was measured with a Type S (Stausscheibe or reverse type) pitot tube and oil-filled manometer; and the gas temperature was measured with a Type K thermocouple. The average gas velocity in the flue was calculated based on: the gas density (as determined by USEPA Methods 3 and 4); the flue gas pressure; the average of the square roots of the velocity heads at each traverse point, and the average flue gas temperature.

4.3 Determination of the Concentration of Gaseous Pollutants Using a Multi-Pollutant Sampling System

Concentrations of the pollutants in the following sub-sections were determined using one sampling system. The number of points at which sample was collected was determined in accordance with Method 7E specifications.

A straight-extractive sampling system was used. A data logger continuously recorded pollutant concentrations and generated one-minute averages of those concentrations. All calibrations and system checks were conducted using USEPA Protocol gases. A calibration gas dilution system certified in accordance with USEPA Method 205 was used

to dilute USEPA Protocol gases to generate the required calibration concentrations. Three-point linearity checks were performed prior to sampling, and in the event of a failing system bias or drift test (and subsequent corrective action). System bias and drift checks were performed using the low-level gas and either the high- or mid-level gas (as specified in the appendices) prior to and following each test run.

The Low Concentration Analyzers (those that routinely operate with a calibration span of less than 20 ppm) used by TRC are ambient-level analyzers. Per Section 3.12 of Method 7E, a Manufacturer's Stability Test is not required for ambient-level analyzers. Analyzer interference tests were conducted in accordance with the regulations in effect at the time that TRC placed an analyzer model in service.

4.3.1 CO_2 Determination by USEPA Method 3A

This method is applicable for the determination of CO_2 concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The CO_2 analyzer was equipped with a non-dispersive infrared (IR) detector.

4.3.2 O_2 Determination by USEPA Method 3A

This method is applicable for the determination of O_2 concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The O_2 analyzer was equipped with a paramagnetic-based detector.

4.3.3 SO_2 Determination by USEPA Method 6C

This method is applicable for the determination of SO_2 concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The SO_2 analyzer was equipped with an ultraviolet (UV) detector.

4.4 Moisture Determination by USEPA Method 4

This method is applicable for the determination of the moisture content of stack gas.

A gas sample was extracted at a constant rate from the source. Moisture was removed from the sample stream by a series of pre-weighed impingers immersed in an ice bath. A minimum of 21 dry standard cubic feet of flue gas was collected during each sample run.

4.5 Filterable PM Determination by USEPA Method 5

This method is applicable for the determination of PM emissions from stationary sources. USEPA Methods 2-4 were performed concurrently with, and as an integral part of, these determinations.

Flue gas was withdrawn isokinetically from the source at traverse points determined per USEPA Method 1, and PM was collected in the nozzle, probe liner, and on a glass fiber

filter. The probe liner and filter were maintained at a temperature of 120±14°C (248 + 25°F). The PM mass, which included any material that condensed at or above the filtration temperature, was determined gravimetrically after the removal of uncombined water.

4.6 Visible Emissions Determination by USEPA Method 9

This method is applicable for the determination of the opacity of emissions from stationary sources pursuant to § 60.11(b) and for visually determining opacity of emissions.

Opacity observations were made by a qualified observer. Observations were made at the point of greatest opacity in the portion of the plume where condensed water vapor was not present. Observations were made at 15-second intervals for the duration of the test period.

4.7 Determination of SO2 Removal Efficiency and PM, SO_2 and NO_x Emission Rates by USEPA Method 19

Where specified by an applicable subpart of the regulations, this method is applicable for the determination of (a) PM, SO_2, and NO_x emission rates; (b) sulfur removal efficiencies of fuel pretreatment and SO_2 control devices; and (c) overall reduction of potential SO_2 emissions.

Emission Rates. Oxygen (O_2) or carbon dioxide (CO_2) concentrations and appropriate F factors (ratios of combustion gas volumes to heat inputs) were used to calculate pollutant emission rates from pollutant concentrations.

Sulfur Reduction Efficiency and SO_2 Removal Efficiency. An overall SO_2 emission reduction efficiency was computed from the efficiency of fuel pretreatment systems, where applicable, and the efficiency of SO_2 control devices. The sulfur removal efficiency of a fuel pretreatment system was determined by fuel sampling and analysis of the sulfur and heat contents of the fuel before and after the pretreatment system. The SO_2 removal efficiency of a control device was determined by measuring the SO_2 rates before and after the control device.

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5.0 QUALITY ASSURANCE PROCEDURES

TRC integrates our Quality Management System (QMS) into every aspect of our testing service. We follow the procedures specified in current published versions of the test Method(s) referenced in this report. Any modifications or deviations are specifically identified in the body of the report. We routinely participate in independent, third party audits of our activities, and maintain accreditation from the Stack Testing Accreditation Council (STAC) and the American Association for Laboratory Accreditation (A2LA) that our operations conform with the requirements of ASTM D 7036 as an Air Emission Testing Body (AETB).

These accreditations demonstrate that our systems for training, equipment maintenance and calibration, document control and project management will fully ensure that project objectives are achieved in a timely and efficient manner with a strict commitment to quality.

All calibrations are performed in accordance with the test Method(s) identified in this report. If a Method allows for more than one calibration approach, or if approved alternatives are available, the calibration documentation in the appendices specifies which approach was used. All measurement devices are calibrated or verified at set intervals against standards traceable to the National Institute of Standards and Technology (NIST). NIST traceability information is available upon request.

ASTM D7036-04 specifies that: *"AETBs shall have and shall apply procedures for estimating the uncertainty of measurement. Conformance with this section may be demonstrated by the use of approved test protocols for all tests. When such protocols are used, reference shall be made to published literature, when available, where estimates of uncertainty for test methods may be found."* TRC conforms with this section by using approved test protocols for all tests.

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6.0 TEST RESULTS SUMMARY

PARTICULATE TEST RESULTS SUMMARY

Company: Carmeuse Lime & Stone
Plant: River Rouge
Unit: Kilns 1 and 2 Combined Stack
Location: Stack

Test Run Number:	1	2	3	Average
Source Condition:	MNOC	MNOC	MNOC	
Date:	12/4/2018	12/4/2018	12/4/2018	
Start Time:	8:03	9:40	11:13	
End Time:	9:05	10:43	12:18	
Sample Duration (min):	60.0	60.0	60.0	60.0
Average Gas Temp, T_s, (°F):	396.9	396.8	395.8	396.5
Fractional Gas Moisture Content, B_{ws}:	0.12	0.11	0.12	0.11
Gas CO_2 Content (%vol):	17.6	17.4	17.7	17.6
Gas O_2 Content (%vol):	9.2	9.3	9.2	9.2
Gas Wet MW, M_s, (lb/lbmole-mole):	29.67	29.71	29.67	29.68
Average Gas Velocty, V_s, (ft/sec):	50.58	52.78	50.37	51.24
Measured Volumetric Flow Rate:				
Q (actual ft^3/min):	193,048	201,473	192,270	195,597
Q_{std} (std ft^3/min):	116,870	121,981	116,546	118,465
$Q_{std(dry)}$ (dry std ft^3/min):	103,413	108,549	103,084	105,015
Process Rate (tons stone feed/hr):	86.1	90.7	91.2	89.3
Sample Volume, $V_{m(std)}$, (dry std ft^3):	49.353	53.648	51.053	51.351
PM Collected, m_n, (mg):				
Filterable	2.69	1.53	1.24	1.82
PM Concentration, C_s, (gr/dscf):				
Filterable	0.0008	0.0004	0.0004	0.0006
PM Emission Rate, ER_{M2}, (lb/hr based on measured volumetric flow rate):				
Filterable:	0.7455	0.4094	0.3311	0.4953
PM Emission Rate, ER, (lb/process rate):	(lb/tons stone feed)			
Filterable:	0.0087	0.0045	0.0036	0.0056
Isokinetic Variance (I)	95.4	98.8	99.0	97.7

TRS 1. Emission Test Results; Carmeuse Lime & Stone, River Rouge Facility, River Rouge, Michigan

Source: Kilns 1 and 2 Permit ID#: MI-ROP-B2169-2013

Test Data		Run 1	Run 2	Run 3	Average
Test Date		12/4/2018	12/4/2018	12/4/2018	
Test Run Start Time		8:35 AM	12:15 PM	3:40 PM	
Test Run End Time		10:49 AM	2:45 PM	5:55 PM	
Oxygen (O_2)	(dry volume %)	9.17	9.31	9.15	9.21
Carbon Dioxide (CO_2)	(dry volume %)	17.62	17.42	17.68	17.57
Flow Rate	(DSCFM)	103,413	108,549	103,084	105,015
Coal F-Factor (F_d)	(dscf/MMBtu)	9,656	9,677	9,682	9,672
Heat Input Based on Coal F_d	(MMBtu/hr)	360.6	373.2	359.3	364.4

		Calculated Results				Limits	Compliant / Non-Compliant
Sulfur Dioxide (SO_2)							
Emission Concentration	(ppm_{dv})	153.29	137.47	181.69	157.48		
Emission Concentration	($ppm_{dv\ @\ 0\%\ excess\ air}$)	273.58	248.27	323.55	281.80		
Emission Concentration *	($ppm_{dv\ @\ 50\%\ excess\ air}$)	192.42	174.62	227.57	198.20	300	Compliant
Emission Rate	(lb/hr)	158.13	148.86	186.83	164.61	470	Compliant
Emission Factor	(lb/MMBtu)	0.44	0.40	0.52	0.45	2.4	Compliant

* Calculation utilizes an agreed upon O_2 @ 50% excess air of 6.20%

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