



EMISSIONS COMPLIANCE STUDY

Performed At The
Carmeuse Lime, Inc.
River Rouge Facility
Kilns 1 and 2
River Rouge, Michigan

Test Date
October 31, 2023

Report No.
TRC Environmental Corporation Report 555553

Report Submittal Date
December 6, 2023

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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).

A handwritten signature in black ink, appearing to read "Craig L. Grunden", written over a horizontal line.

Craig L. Grunden, QI
Project Manager

December 6, 2023

Date

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

A handwritten signature in black ink, appearing to read "Bruce Randall", written over a horizontal line.

Bruce Randall
TRC Emission Testing Technical Director



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EMISSIONS COMPLIANCE STUDY

1.0 INTRODUCTION

TRC Environmental Corporation (TRC) performed an emissions compliance test program on Kilns 1 and 2 at the River Rouge Facility of Carmeuse Lime, Inc. (Carmeuse) in River Rouge, Michigan on October 31, 2023. The tests were authorized by - and performed for Carmeuse Lime, Inc.

The purpose of this test program was to determine total particulate matter (TPM), particulate matter less than 10 microns (PM₁₀), particulate matter less than 2.5 microns (PM_{2.5}), condensable particulate matter (CPM), sulfur dioxide (SO₂) and Visible Emissions (VE) on Kilns 1 and 2 combined exhaust during normal operating conditions. The results of the test program will be used in order to determine compliance with Michigan Department of Environmental Quality (MDEQ) The test program was conducted according to the TRC Test Protocol dated July 19, 2023.

1.1 Project Contact Information

Participants		
Test Facility	Carmeuse Lime, Inc. River Rouge Facility 25 Marion Ave River Rouge, Michigan 48218 Permit No. 128-17 Facility No. B2169	Raymond Rummel Area Environmental Manager (219) 292-5206 (phone) raymond.rummel@carmeuse.com
Air Emissions Testing Body (AETB)	TRC Environmental Corporation 2500 Eldo Road Monroeville, Pennsylvania 15146	Craig L. Grunden, QI Project Manager (412) 925-0066 (phone) (844) 625-4557 (fax) CGrunden@TRCCompanies.com

The tests were conducted by Aaron M. Blum, QI, Gavin Lewis, Andrew J. Stapfer and M. Beck Heil of TRC. Documentation of the on-site ASTM D7036-04 Qualified Individual(s) (QI) can be located in the appendix to this report.

Steve Weiss from the MDEQ was present to observe the testing.



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	Emission Point	Pollutant Tested	Emissions Result	Emission Limit
EUKILNNUMBER1 and EUKILNNUMBER2	Combined Exhaust Stack	FPM ³	0.004 lb/tsf ¹	0.12 lb/tsf ¹
		VE	0% over a 6-minute average	15% over a 6-minute average
		SO ₂	193.23 ppm in exhaust to gas (corrected to 50% excess O ₂)	300 ppm in exhaust to gas (corrected to 50% excess O ₂)
			155 lb/hr	470 lb/hr
			0.441 lb/MMBtu ²	2.4 lb/MMBtu ²
		PM ₁₀ ³	1.73 lb/hr	23.45 lb/hr
		PM _{2.5} ³	1.73 lb/hr	23.45 lb/hr

¹ Pounds per ton of stone feed

² Pounds per million BTU

³ All PM collected in the M5/202 train were considered less than PM_{2.5} and used to comply with the PM/PM₁₀/PM_{2.5} limits



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	NA
	Velocity – S-type Pitot	2		
	O ₂ , CO ₂	3A		60
	Moisture Content	4		
	Particulate Matter ⁴	5 and 202		
	SO ₂	6C		
	VE	9		
	Fuel Flow Emission Rates	19		

⁴All PM collected in the M5/202 train were considered less than PM_{2.5} and used to comply with the PM/PM₁₀/PM_{2.5} limits.

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.

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 3A 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.

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 CO₂ Determination by USEPA Method 3A

This method is applicable for the determination of CO₂ concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The CO₂ analyzer was equipped with a non-dispersive infrared (IR) detector.

4.3.2 O₂ Determination by USEPA Method 3A

This method is applicable for the determination of O₂ concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The O₂ analyzer was equipped with a paramagnetic-based detector.

4.3.3 SO₂ Determination by USEPA Method 6C

This method is applicable for the determination of SO₂ concentrations in controlled and uncontrolled emissions from stationary sources only when specified within the regulations. The SO₂ 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) or the temperature specified in the test protocol. 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 Condensable PM Determination by USEPA Method 202

This method is applicable for the determination of condensable particulate matter (CPM) from stationary sources. CPM is measured in the emissions after removal from the stack and after passing through a filter.



The CPM was collected in dry impingers after filterable particulate material had been collected on filters maintained above 30°C (85°F) using the previously identified Method. The CPM sample train included a Method 23 type condenser capable of cooling the stack gas to less than 85°F, followed by a water dropout impinger. One modified Greenburg Smith impinger and a CPM filter followed the water dropout impinger. Prior to recovery, the impinger contents were immediately purged after the run with nitrogen (N₂) to remove dissolved sulfur dioxide. The impinger solution was then extracted with hexane, and the CPM filter was extracted with water and hexane. The organic and aqueous fractions were then taken to dryness and the residues weighed. A correction, if necessary, was made for any ammonia present due to laboratory analysis procedures. The total of all fractions represented the CPM.

4.7 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.

4.8 Determination of SO₂ Removal Efficiency and PM, SO₂ 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, SO₂, and NO_x emission rates; (b) sulfur removal efficiencies of fuel pretreatment and SO₂ control devices; and (c) overall reduction of potential SO₂ emissions.

Emission Rates. Oxygen (O₂) or carbon dioxide (CO₂) 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 SO₂ Removal Efficiency. An overall SO₂ emission reduction efficiency was computed from the efficiency of fuel pretreatment systems, where applicable, and the efficiency of SO₂ 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 SO₂ removal efficiency of a control device was determined by measuring the SO₂ rates before and after the control device.



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 Louisiana Environmental Laboratory Accreditation Program (LELAP);
- 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.



6.0 TEST RESULTS SUMMARY



PARTICULATE TEST RESULTS SUMMARY

Company: Carmeuse
 Plant: River Rouge
 Unit: Kilns 1 & 2
 Location: Outlet

Test Run Number:	Run 1	2	3	Average
Source Condition:	MNOC	MNOC	MNOC	
Date:	10/31/2023	10/31/2023	10/31/2023	
Start Time:	10:42	13:00	15:15	
End Time:	12:20	14:15	16:50	
Sample Duration (min):	60.0	60.0	60.0	60.0
Average Gas Temp, T _s , (°F):	368.3	367.3	371.0	368.9
Fractional Gas Moisture Content, B _{ws} :	0.080	0.080	0.085	0.082
Gas O ₂ Content (%vol):	8.6	9.0	9.1	8.9
Gas Wet MW, M _s , (lb/lb-mole):	30.15	30.06	29.99	30.07
Average Gas Velocity, V _s , (ft/sec):	45.10	43.88	46.09	45.03
Measured Volumetric Flow Rate:				
Q (actual ft ³ /min):	172,159	167,501	175,942	171,867
Q _{std} (std ft ³ /min):	107,466	104,695	109,250	107,137
Q _{std(dry)} (dry std ft ³ /min):	98,839	96,285	100,009	98,378
Process Rate (ton stone feed/hr):	80.70	80.57	79.78	80.35
Sample Volume, V _{m(std)} , (dry std ft ³):	48.850	47.193	49.403	48.482
PM Collected, (mg):				
Filterable, m _n :	0.30	2.90	0.30	1.17
Condensable, m _{cpm} :	2.50	6.50	6.80	5.27
Total, m _{total} :	2.80	9.40	7.10	6.43
PM Concentration, (gr/dscf):				
Filterable, C _s :	0.0001	0.0009	0.0001	0.0004
Condensable, C _{cpm} :	0.0008	0.0021	0.0021	0.0017
Total, C:	0.0009	0.0031	0.0022	0.0021
PM Emission Rate, ER_{M2}, (lb/hr based on measured volumetric flow rate):				
Filterable:	0.08	0.78	0.08	0.31
Condensable:	0.67	1.75	1.82	1.41
Total:	0.75	2.54	1.90	1.73
PM Emission Rate, ER, (lb/process rate): (lb/ton stone feed)				
Filterable:	0.001	0.010	0.001	0.004
Condensable:	0.008	0.022	0.023	0.018
Total:	0.009	0.031	0.024	0.022
Isokinetic Variance, I:	100.0	99.1	99.9	99.7


**Instrumental Reference Method
Calibration Corrected Test Data**

Project Number: 555553
 Customer: Carmeuse
 Unit Identification: Kilns 1 & 2
 Sample Location: Outlet
 Load Level/Condition: MNOC

Start Date: 10/31/23
 End Date: 10/31/23
 Facility: River Rouge
 Recorded by: Aaron M. Blum, QI
 Fd Factor: Varies

Reference Method Results, As Measured Moisture Basis

Run #	Date	Start Time	End Time	NOX ppmvd	SO2 ppmvd	CO ppmvd	CO2 % v/v dry	O2 % v/v dry
1	10/31/23	10:42	11:41	-	185.0	-	17.9	8.6
2	10/31/23	13:00	13:59	-	167.4	-	17.2	9.0
3	10/31/23	15:06	16:05	-	121.1	-	17.1	9.1
Average				-	157.85	-	17.39	8.92

Moisture Correction Applied To "As Measured Data": None
Reference Method Results, CEM Moisture Basis

Run #	NOX ppmvd	SO2 ppmvd	CO ppmvd	CO2 % v/v dry	O2 % v/v dry	Bws	Fc Factor	Fd Factor	
1	-	185.0	-	17.9	8.6	0.080	-	9672	
2	-	167.4	-	17.2	9.0	0.080	-	9662	
3	-	121.1	-	17.1	9.1	0.085	-	9682	
Average		-	157.85	-	17.39	8.92	0.082	-	9672

Emission Rate Calculation Summary

Run #	NOX lb/MMBtu	SO2 lb/MMBtu	CO lb/MMBtu	NOX lb/hr	SO2 lb/hr	CO lb/hr	Flow DSCFM
1	-	0.505	-	-	182.67	-	99112
2	-	0.473	-	-	160.52	-	96285
3	-	0.346	-	-	120.65	-	100009
Average		-	0.441	-	154.613	-	98,468.7

Emission Rate Test Calculation Summary
lb/hr Determined Using lb/MMBtu Emission Factor and Heat Input

Run #	Heat Input MMBtu/Hr	NO _x lb/hr	SO ₂ lb/hr	CO lb/hr
1	361.98	-	183	-
2	339.62	-	161	-
3	348.86	-	121	-
Average		350.2	-	155

Emission Rate Test Calculation Summary
lb/MMBtu Determined Using lb/hr Emission Rate and Heat Input

Run #	Heat Input MMBtu/Hr	NOX lb/MMBtu	SO2 lb/MMBtu	CO lb/MMBtu
1	362.0	-	0.505	-
2	339.6	-	0.473	-
3	348.9	-	0.346	-
Average		350.152	-	0.441

Sulfur Dioxide (SO₂), ppm corrected to 50% excess air

Customer:		Carmeuse	River Rouge		
Unit ID:		Kilns 1 & 2			
Sample Loc:		Outlet			
Use? 1 = Y 0 = N	Test Run	Date	Start Time	End Time	RM SO ₂ ppm corrected to 50% excess air
0	1	10/31/2023	10:42	11:41	221.07
0	2	10/31/2023	13:00	13:59	207.27
0	3	10/31/2023	15:06	16:05	151.34
Average:					193.23