FINAL REPORT

ST MARYS CEMENT

CHARLEVOIX, MICHIGAN

SOURCE TESTING REPORT: EUCLINKERCOOL PARTICULATE MATTER

RWDI #2409155

August 13, 2024

SUBMITTED TO

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EXECUTIVE SUMMARY

RWDI USA LLC (RWDI) has been retained by St Marys Cement (SMC) to complete the emission sampling program at their facility located at 16000 Bells Bay Road, Charlevoix, Michigan. The purpose of the emissions test program was to verify emissions required by Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit MI-ROP-B1559-2014 and Permit to Install 140-15C. The performance testing was completed in accordance with the NESHAP for Portland Cement Manufacturing Industry, 40 CFR Part 63, Subpart LLL, and Standards for Performance for Portland Cement Plants, 40 CFR Part 60, Subpart F. The NESHAP test program consisted of testing for Particulate Matter (PM) (filterable only) for the Clinker Cooler (EUCLINKERCOOL). The program also included the additional testing for PM/PM_{10}/$PM_{2.5}$ for the Main Kiln and Finish Mill 4 as outlined in Permit to Install 140-15C. The testing for the Main Kiln and Finish Mill 4 is scheduled to be completed in August of 2024 and will be provided under separate cover. This report only includes the filterable PM emissions from the Clinker Cooler.

In addition, the report also provides the Site-Specific Operating Limit (SSOL) for filterable PM as outlined in **§ 63.1349(b)(1) Performance testing requirements.:**

> (i) For your PM CPMS, you will establish a site-specific operating limit. If your PM performance test demonstrates your PM emission levels to be below 75 percent of your emission limit you will use the average PM CPMS value recorded during the PM compliance test, the milliamp or digital equivalent of zero output from your PM CPMS, and the average PM result of your compliance test to establish your operating limit. If your PM compliance test demonstrates your PM emission levels to be at or above 75 percent of your emission limit you will use the average PM CPMS value recorded during the PM compliance test to establish your operating limit. You will use the PM CPMS to demonstrate continuous compliance with your operating limit. You must repeat the performance test annually and reassess and adjust the site-specific operating limit in accordance with the results of the performance test.

The testing program for the Clinker Cooler was conducted on June 18th, 2024.

Executive Table i: Test Results – Particulate Matter Clinker Cooler

Location	Parameter	Emission Rate				
		Test 1	Test 2	Test 3	Average Results	Permit Limit
Clinker Cooler	Particulate Matter (Filterable Only) (Measured)	0.71 lb/hr	0.54 lb/hr	0.52 lb/hr	0.59 lb/hr	Not Applicable
		0.0005 gr/dscf	0.0004 gr/dscf	0.0004 gr/dscf	0.0004 gr/dscf	Not Applicable
		243.01 tons of Clinker	243.03 tons of Clinker	244.95 tons of Clinker	243.66 tons of Clinker	Not Applicable
		0.0029 lb of PM / ton of Clinker	0.0022 lb of PM / ton of Clinker	0.0021 lb of PM / ton of Clinker	0.0024 lb of PM / ton of Clinker	0.02 lb of PM / ton of Clinker
	CPMS 3-Run Average	N/A			0.16	N/A
	SSOL	N/A			0.99	N/A

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Appendix F: Example Calculations
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1 INTRODUCTION

RWDI USA LLC (RWDI) has been retained by St Marys Cement (SMC) to complete the emission sampling program at their facility located at 16000 Bells Bay Road, Charlevoix, Michigan. The purpose of the emissions test program was to verify emissions required by Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit MI-ROP-B1559-2014 and Permit to Install 140-15C. The performance testing was completed in accordance with the NESHAP for Portland Cement Manufacturing Industry, 40 CFR Part 63, Subpart LLL, and Standards for Performance for Portland Cement Plants, 40 CFR Part 60, Subpart F. The NESHAP test program consisted of testing for Particulate Matter (PM) (filterable only) for the Clinker Cooler. The program also included the additional testing for PM/PM_{10}/$PM_{2.5}$ for the Main Kiln and Finish Mill Stack as outlined in Permit to Install (PTI) 140-15C. The testing for the Main Stack and Finish Mill Stack is scheduled to be completed in August of 2024 and will be provided under separate cover. This report only includes the filterable PM emissions from the Clinker Cooler.

In addition, the report also provides the Site-Specific Operating Limit (SSOL) for filterable PM as outlined in **§ 63.1349(b)(1) Performance testing requirements.:**

> (i) For your PM CPMS, you will establish a site-specific operating limit. If your PM performance test demonstrates your PM emission levels to be below 75 percent of your emission limit you will use the average PM CPMS value recorded during the PM compliance test, the milliamp or digital equivalent of zero output from your PM CPMS, and the average PM result of your compliance test to establish your operating limit. If your PM compliance test demonstrates your PM emission levels to be at or above 75 percent of your emission limit you will use the average PM CPMS value recorded during the PM compliance test to establish your operating limit. You will use the PM CPMS to demonstrate continuous compliance with your operating limit. You must repeat the performance test annually and reassess and adjust the site-specific operating limit in accordance with the results of the performance test.

1.1 Location and Dates of Testing

The testing program for the Clinker Cooler was conducted on June 18th, 2024.

1.2 Purpose of Testing

The purpose of the emissions test program was to verify emissions required by Michigan Department of Environment, Great Lakes, and Energy (EGLE) Renewable Operating Permit MI-ROP-B1559-2014, PTI 140-15C and in accordance with the NESHAP for Portland Cement Manufacturing Industry, 40 CFR Part 63, Subpart LLL, and Standards for Performance for Portland Cement Plants, 40 CFR Part 60, Subpart F.

1.3 Description of Source

The hot clinker produced in the inline kiln is transferred to the clinker cooler, where it is cooled by air blowers before being conveyed to storage or one of four cement mills. Exhaust gases from the clinker cooler are routed to a fabric filter baghouse for particulate matter control.

1.4 Personnel Involved in Testing

Table 1.4: Testing Personnel

Laurie Leaman Environmental Manager	**St Mary Cement** **Charlevoix Plant**	(231) 237-1387 Laurie.Leaman@vcimentos.com
Brad Bergeron Technical Director	**RWDI USA LLC** 2239 Star Court Rochester Hills, MI 48309	(248) 234-3885 Brad.Bergeron@rwdi.com
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Roy Zimmer Field Technician		Roy.Zimmer@rwdi.com
Cade Smith Field Technician		Cade.Smith@rwdi.com
Shane Rabideau Field Technician		Shane.Rabideau@rwdi.com

2 SUMMARY OF RESULTS

2.1 Operating Data

SMC personnel monitored the process during the testing. All process data can be found in **Appendix A**. During the testing, production averaged 243.66 TPH of clinker.

2.2 Applicable Permit Number

MI-ROP-B1559-2014, PTI 140-15C, and NESHAP for Portland Cement Manufacturing Industry, 40 CFR Part 63, Subpart LLL, and Standards for Performance for Portland Cement Plants, 40 CFR Part 60, Subpart F.

3 SOURCE DESCRIPTION

3.1 Description of Process and Emission Control Equipment

The clinker cooler consists of equipment associated with the cooling of clinker and the treatment of the cooler gases, including: clinker cooler, clinker heat exchanger, and baghouse.

3.2 Process Flow Sheet or Diagram (if applicable)

Process flow diagram can be provided upon request.

3.3 Type and Quantity of Raw and Finished Materials

Approximately 250 tons of clinker is produced at the facility per hour. The clinker is ground and used to produce Portland cement in one of the facilities finish mills.

3.4 Normal Rated Capacity of Process

Approximately 250 tons clinker processed per hour.

3.5 Process Instrumentation Monitored During the Test

The process data recorded during the testing can be found in **Appendix A**. The following parameters were recorded:

- Clinker production rate, TPH
- Particulate Concentrations from PM continuous parametric monitoring system (CPMS), mg/m^3

4 SAMPLING AND ANALYTICAL PROCEDURES

4.1 Stack Velocity, Temperature, and Volumetric Flow Rate Determination USEPA Method 1-4

The exhaust velocities and flow rates were determined following the USEPA Method 2, "Determination of Stack Gas Velocity and Flow Rate (Type S Pitot Tube)". Velocity measurements were taken with a pre-calibrated S-Type pitot tube. The volumetric flow rate was determined following the equal area method as outlined in USEPA Method 1. Temperature measurements were made simultaneously with the velocity measurement and was conducted using a chromel-alumel type "k" thermocouple in conjunction with a digital temperature indicator.

The dry molecular weight of the stack gas was determined following calculations outlined in and USEPA Method 3 (Fyrite). RWDI collected integrated sample bags over the duration of each test period for the Clinker Cooler using the orsat pump from the sampling consoles. The bag samples were analyzed on-site using a Fyrite for CO_2 and O_2 measurements. The analysis confirmed that oxygen and carbon dioxide levels in the Clinker Cooler were at ambient conditions.

Stack moisture content was determined through direct condensation from the PM sampling trains according to USEPA Method 4, "Determination of Moisture Content of Stack Gases".

4.2 Particulate Matter USEPA Method 5

For USEPA Method 5, the particulate matter was withdrawn isokinetically from the source and collected on a quartz filter maintained at a temperature of 120 ±14 °C (248 ±25 °F). The PM mass, which includes any material that condenses at or above the filtration temperature, was determined gravimetrically after the removal of uncombined water. The sampling train consisted of the following: nozzle (Teflon), probe liner (borosilicate glass) with heating system, quartz filter, modified GS impinger with 100 ml of water, standard GS impinger with 100 ml of water, empty modified GS impinger, silica gel impinger, and the metering system. At the end of each test a leak check was performed. The filter and probe/nozzle acetone rinses were analyzed at the RWDI in-house laboratory.

A schematic of the sampling train is included in **Figure Section** (**Figure 3**).

4.3 Method Deviations

No deviations.

4.4 Description of Recovery and Analytical Procedures

The recovery followed USEPA Method 5. Results were analyzed gravimetrically at the RWDI in-house laboratory.

4.5 Sampling Port Description

The clinker cooler stack, SVCOOLER is a circular stack with an inner diameter of 122 inches. Four (4) ports were used for testing.

5 TEST RESULTS AND DISCUSSION

Table 5.1: Test Results – Particulate Matter Clinker Cooler

Location	Parameter	Emission Rate				
		Test 1	Test 2	Test 3	Average Results	Permit Limit
Clinker Cooler	Particulate Matter (Filterable Only) (Measured)	0.71 lb/hr	0.54 lb/hr	0.52 lb/hr	0.59 lb/hr	Not Applicable
		0.0005 gr/dscf	0.0004 gr/dscf	0.0004 gr/dscf	0.0004 gr/dscf	Not Applicable
		243.01 tons of Clinker	243.03 tons of Clinker	244.95 tons of Clinker	243.66 tons of Clinker	Not Applicable
		0.0029 lb of PM / ton of Clinker	0.0022 lb of PM / ton of Clinker	0.0021 lb of PM / ton of Clinker	0.0024 lb of PM / ton of Clinker	0.02 lb of PM / ton of Clinker
	CPMS 3-Run Average	N/A			0.16	N/A
	SSOL	N/A			0.99	N/A

Detailed results for the program are provided in the following Appendices:

- Clinker Cooler Particulate Matter Results – **Appendix B**

5.1 Process Upset Conditions During Testing

There were regular process breaks during testing.

5.2 Maintenance Performed in Last Three Months

Only routine maintenance has been performed within the last three months on EUCLINKERCOOL process.

5.3 Audit Samples

This test did not require any audit samples.

5.4 Calibration Data

Calibration sheets can be found in **Appendix C**.

5.5 Field Data Sheets

Field data sheets can be found in **Appendix D**.

5.6 Laboratory Data

Laboratory data can be found in **Appendix E**.

5.7 Sample Calculations

Sample calculations can be found in **Appendix F**.

5.8 Test Plan and EGLE Correspondence

The submitted test plan and all EGLE correspondence in regards to this project are included in **Appendix G.**

5.9 Particulate Matter Continuous Parameter Monitoring System

Pursuant to the NESHAP for Portland Cement Manufacturing Industry 40 CFR Part 63, Subpart LLL all data recorded and used to establish parameters for monitoring are to be submitted, including the following, per §63.1349(b)(1)(vii):

- Make and Model
  - Sick SP100
- Serial Number
  - Clinker PM Monitor s/n 17278571 Probe 17258401
- Analytical Principal
  - The measuring system works according to the *scattered light measurement* principle (i.e., forward dispersion). A laser diode beams the dust particles in the gas flow with modulated light in the visual range (wavelength approximately 650 nanometers [nm]). A highly sensitive detector registers the light scattered by the particles, amplifies the light electrically, and feeds it to the measuring channel of a microprocessor as a central part of the measuring, control, and evaluation electronics. The measuring volume in the gas duct is defined through the intersection of the sender beam and the receiving aperture.
  - Continuous monitoring of the sender output registers the smallest changes in brightness of the light beam sent, which then serves to determine the measurement signal
- Span of Primary Analytical Range
  - The original system specifications were for a range of 0 to 200 milligrams per dry standard cubic meter (mg/dscm)
- Milliamp Value or Digital Equivalent to the Zero Output
  - The monitor output is in milligrams, with zero equal to zero
- Technique to Determine the Zero Value
  - The sender diode is switched off for *zero-point control* so that no signal is received. This means possible *drifts* or zero-point deviations are reliably detected in the overall system (e.g., due to an electronic defect). An error signal is generated when the *zero value* is outside the specified range.
- Average Milliamp or Digital Equivalent Signals Corresponding to Each PM Compliance Run
  - See Appendix A, raw data recorded by the CPMS monitors is attached.

TABLES

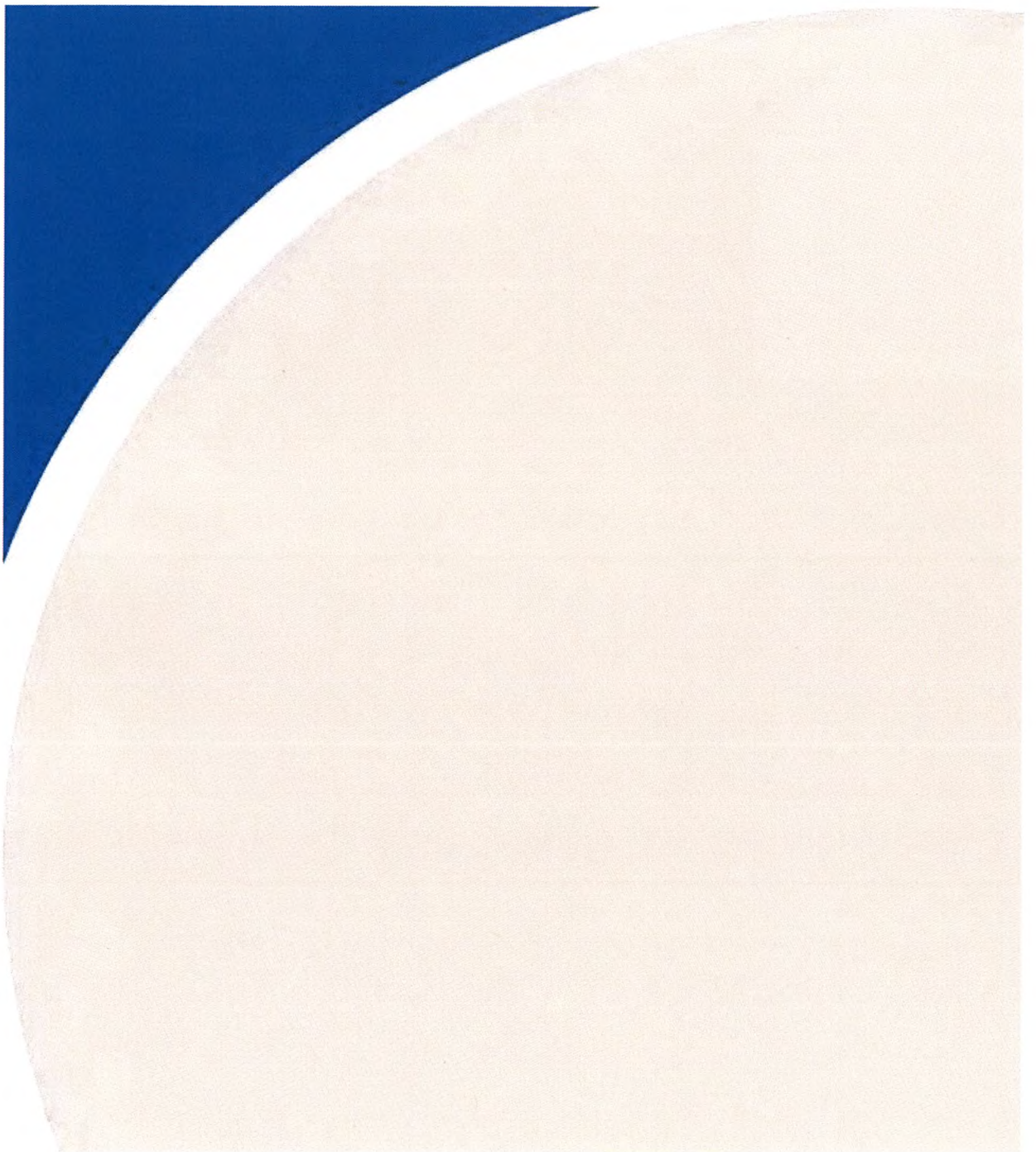


Table 1: Summary of Sampling Parameters and Methodology

Source Location	No. of Tests per Stack	Sampling Parameter	Sampling Method
Clinker Cooler	3	Velocity & Temperature	U.S. EPA [1] Methods 1 & 2
		Oxygen & Carbon Dioxide	U.S. EPA [1] Method 3
		Moisture	U.S. EPA [1] Method 4
		Particulate Matter	U.S. EPA [1] Method 5

Notes:

[1] U.S. EPA - United States Environmental Protection Agency

Table 2: Sampling Summary and Sample Log

Source and Test #	Sampling Date	Start Time	End Time	Filter ID / Trap ID
Clinker Cooler - Particulate Matter				
Blank	18-Jun-24	-	-	QZ 223
Test #1	18-Jun-24	8:34 AM	10:47 AM	QZ 224
Test #2	18-Jun-24	11:20 AM	1:28 PM	QZ 225
Test #3	18-Jun-24	1:45 PM	3:53 PM	QZ 226

Table 3: Sampling Summary - Flow Characteristics

Stack Gas Parameter		Test No. 1 Filterable PM	Test No. 2 Filterable PM	Test No. 3 Filterable PM	Average
Testing Date		18-Jun-24	18-Jun-24	18-Jun-24	
Stack Temperature	°F	229	242	222	231
Moisture	%	2.5%	2.2%	2.3%	2.3%
Velocity	ft/s	45.1	45.0	43.1	44.4
Referenced Flow Rate	CFM	160,614	157,992	155,380	157,995
Oxygen	%	21.0	21.0	21.0	21.0
Carbon Dioxide	%	0.0	0.0	0.0	0.0
Sampling Isokinetic Rate	%	101.2	100.2	99.6	100.4

Notes:

[1] Referenced flow rate expressed as dry at 101.3 kPa, 68 °F, and Actual Oxygen

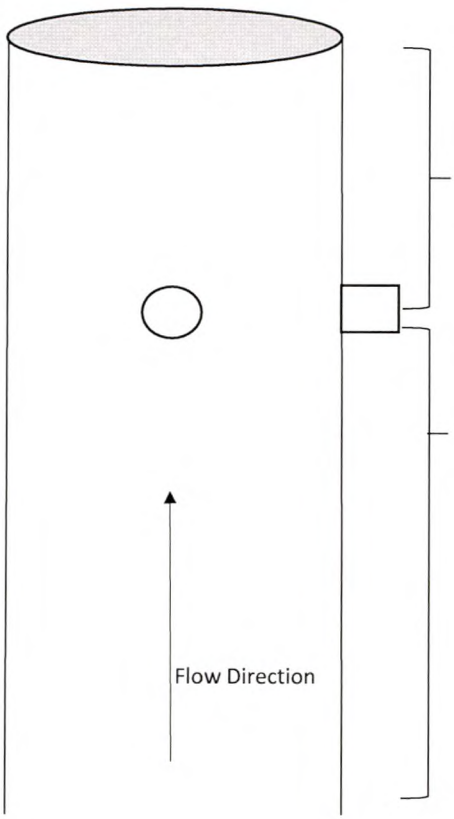
Tables 4: Total Particulate Matter (Filterable) Results - Clinker Cooler

Company	St. Marys			
Source	Clinker Cooler			
Date	18-Jun-24	18-Jun-24	18-Jun-24	
Test Number	Test 1	Test 2	Test 3	Average
Start Time	8:34	11:20	13:45	-
End Time	10:47	13:28	15:53	-
Stack Information				
Flow Rate (ft^3/min) (Actual)	219,489	219,316	209,888	216,231
Flow (ft^3/min) (Standard Wet)	164,728	161,618	159,110	161,819
Flow (ft^3/min) (Standard Dry)	160,614	157,992	155,380	157,995
Flow (m^3/min) (Standard Dry)	4,548	4,474	4,400	4,474
Percent Moisture (%)	2.5	2.2	2.3	2.4
Pressure Ps ("Hg)	29.31	29.31	29.31	29.31
Average Stack Temperature (T_s) (^oF)	229.2	241.9	222.3	231.2
Molecular Weight of Stack Gas dry ($M_{d)}$ (g/mole)	28.84	28.84	28.84	28.84
Molecular Weight of Stack Gas wet (M_s) (g/mole)	28.57	28.60	28.59	28.58
Stack Gas Specific Gravity (G_s) (kg/L)	1.0	1.0	1.0	1.0
Water Vapor Volume Fraction (%)	0.0	0.0	0.0	0.0
Average Stack Velocity (V_s) (ft/sec)	45.1	45.0	43.1	44.4
Cross Section Area of Stack (ft^2)	81.2	81.2	81.2	81.2
Percent Carbon Dioxide (%)	0.0	0.0	0.0	0.0
Percent Oxygen (%)	21.0	21.0	21.0	21.0
Percent Carbon Monoxide (%)	0.0	0.0	0.0	0.0
Percent Excess Air at Test Location (%)	-	-	-	-
Meter Info				
Isokinetic Variation I (%)	101.2	100.2	99.6	100.4
Meter Pressure Pm ("Hg)	29.4	29.4	29.4	29.4
Meter Temperature Tm (^oF)	66.4	72.6	73.0	70.7
Measured Sample Volume Vm (ft^3)	79.76	78.65	76.96	78.46
Sample Volume (Vm St ft^3)	75.47	73.54	71.90	73.64
Sample Volume (Vm St m^3)	2.14	2.08	2.04	2.09
Total Weight of Sampled Gas (lbs) wet	5.72	5.56	5.44	5.57
Total Weight of Sampled Gas (lbs) dry	5.63	5.48	5.36	5.49
Gas Density Ps wet ("Hg)	0.07	0.07	0.07	0.07
Gas Density Ps dry ("Hg)	0.07	0.07	0.07	0.07
Condensate Volume (ft^3)	1.93	1.69	1.73	1.78
Nozzle Size (in^2)	0.00031	0.00031	0.00031	0.00
Impinger Gain (g)	26.3	23.3	21.1	23.6
Silica Gel Gain (g)	14.7	12.5	15.5	14.2
Total Gas Sampled (vm st ft^3 + condensate volume)	77.40	75.23	73.63	75.42
Particulate Results				
Nozzle/Probe/Filter Weight (mg)	2.5	1.9	1.8	2.1
Total Particulate (mg)	2.5	1.9	1.8	2.1
Total Particulate Emission Rate (lb/hr)	0.71	0.54	0.52	0.59
Total Particulate Concentration lb/1000 lb (wet)	9.64E-04	7.53E-04	7.29E-04	8.16E-04
Total Particulate Concentration lb/1000 lb (dry)	9.80E-04	7.64E-04	7.40E-04	8.28E-04
Total Particulate Concentration mg/dscm (dry)	1.17	0.91	0.88	0.99
Total Particulate Concentration (gr/dscf)	5.11E-04	3.99E-04	3.86E-04	4.32E-04
Production Rate (tons/hr of clinker)	243.01	243.03	244.95	243.66
Emission Rate (lb of PM / ton of clinker)	0.0029	0.0022	0.0021	0.0024
PM CPMS Readout (mg/m^3)	0.17	0.16	0.14	0.16
Site Specific Operating Limit (SSOL) (based on 3-test average)	-	-	-	0.9913

Limit
0.02

FIGURES

Figure No. 1: Sampling Locations and Traverse Points - Clinker Cooler

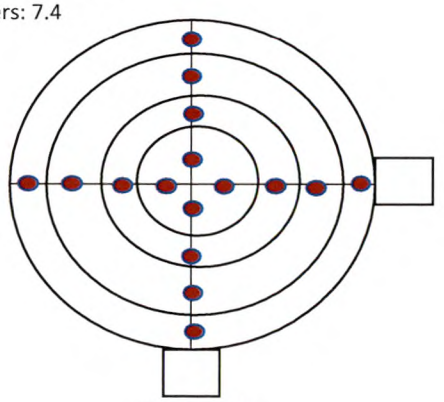


Diameter: 122

Upstream (ft.): 60
Diameters: 5.9

Downstream (ft.): 75
Diameters: 7.4

Sampling Points (in.)	
1	3.90
2	12.81
3	23.67
4	39.41
5	82.59
6	98.33
7	109.19
8	118.10



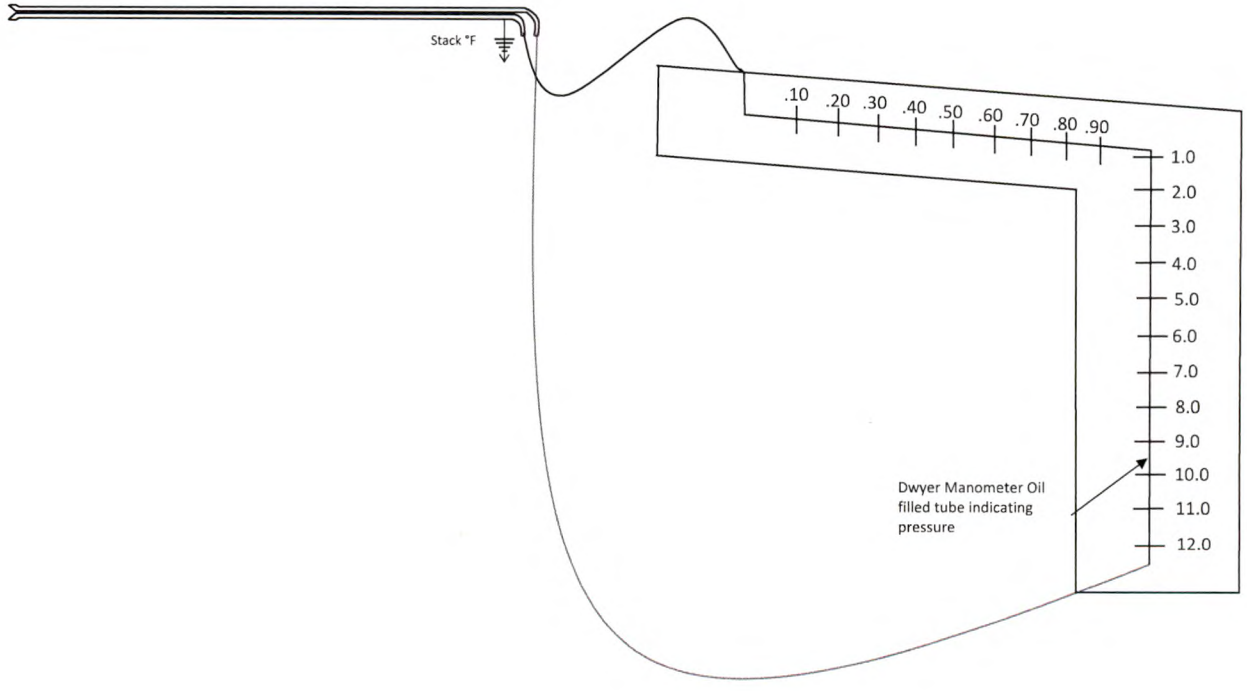
Not to scale

Clinker Cooler
St. Mary's Cement U.S. LLC
Charlevoix Plant
Charlevoix, MI

Date:
6/18/2024

RWDI USA LLC
2239 Star Court
Rochester Hills, MI 48309

Figure No. 2: Schematic of USEPA Method 2 Sampling Train



USEPA Method 2

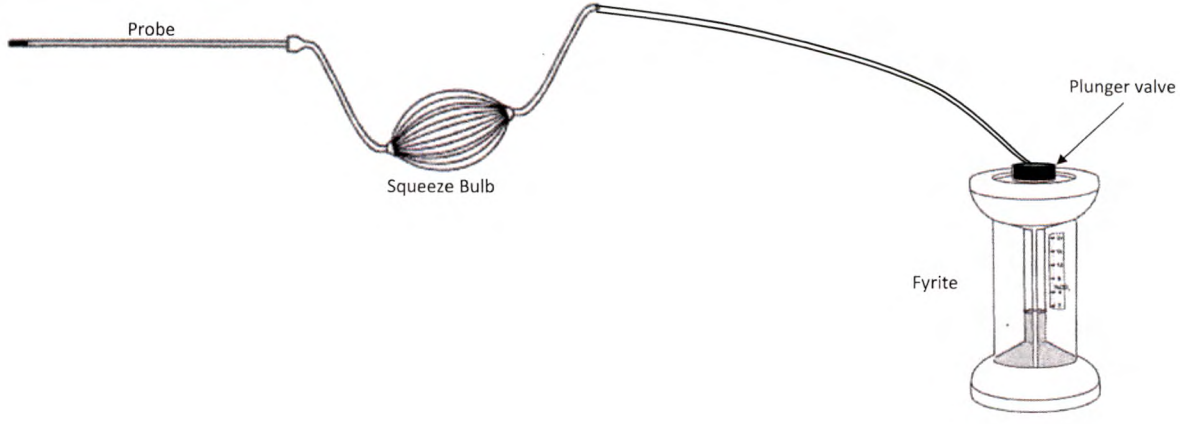
Saint Mary's Cement U.S. LLC

Charlevoix Plant

Charlevoix, MI

Figure No. 2

Figure No. 3: Schematic of USEPA Method 3 Sampling Train (Fyrite)



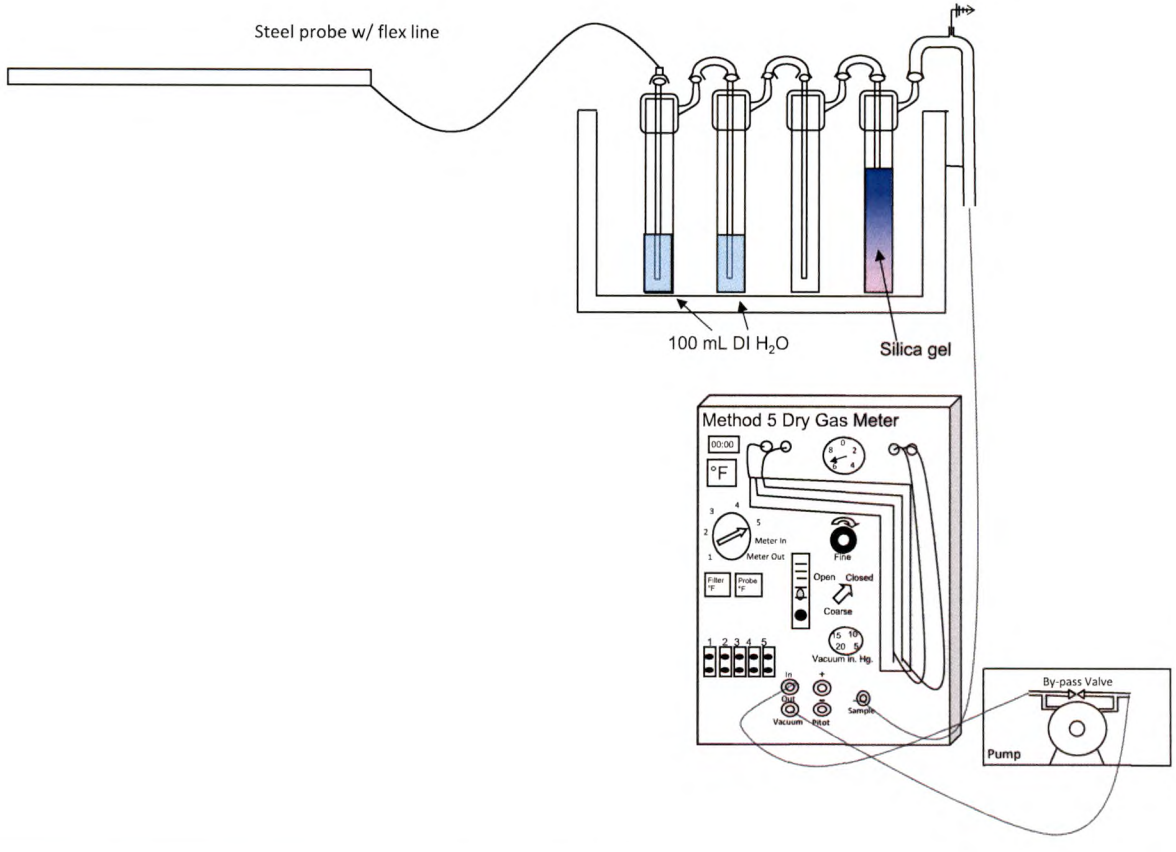
USEPA Method 3

Saint Mary's Cement U.S. LLC
Charlevoix Plant
Charlevoix, MI

Figure No. 3

Date: 6/18/2024

Figure No. 4: Schematic of USEPA Method 4 Sampling Train



USEPA Method 4

Saint Mary's Cement U.S. LLC

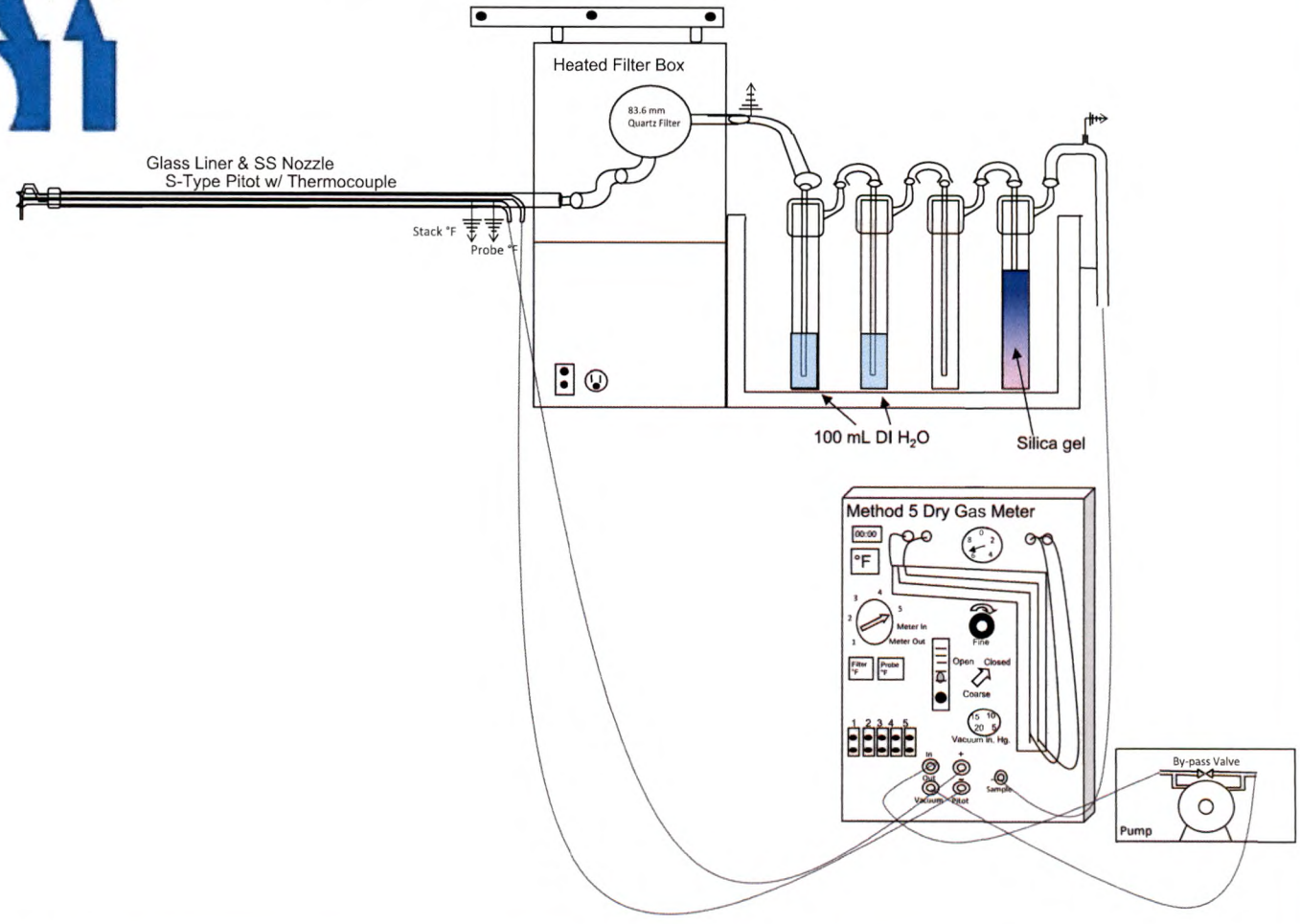
Charlevoix Plant

Charlevoix, MI

Figure No. 4

June 18, 2024

Figure No. 5: Schematic of USEPA Method 5 Sampling Train



USEPA Method 5

Saint Mary's Cement U.S. LLC

Charlevoix Plant

Charlevoix, MI

Figure No. 5

June 18, 2024