RECEIVED
DEC 0 4 2014
AIR QUALITY DIV.

LAFARGE NORTH AMERICA, Inc.
ALPENA, MICHIGAN

TEST REPORT:

EMISSIONS OF HYDROGEN CHLORIDE, CHLORIDE AND PARTICULATE MATTER
From the
Wet Gas Scrubber
(Kilns 22 and 23 Common Exhaust)

PREPARED FOR:

LAFARGE NORTH AMERICA, INC.
1435 FORD AVENUE
ALPENA, MICHIGAN 49707

PREPARED BY:

URS
1600 PERIMETER PARK, SUITE 400
MORRISVILLE, NORTH CAROLINA 27560

NOVEMBER 2014

1.0 INTRODUCTION

The Lafarge Alpena plant operates under the Michigan Department of Environmental Quality (MDEQ) ROP No: MI-ROP-B1477-2012 regulating air emissions from Kilns 22 and 23 collectively known as Kiln Group 6. Kilns 22 and 23 exhaust through a common stack, referred to as the scrubber stack equipped with a Flue Gas Desulfurization and also referred to as a Wet Gas Scrubber (WGS). The WGS stack was brought into commission in 2014.

Lafarge operates under the Renewable Operating Permit (ROP) MI-ROP-B1477-2012, requiring testing for hydrogen chloride (HCl), Chloride (Cl-), Particulate Matter (PM) and opacity. Testing was performed to both confirm compliance the WGS which is now the emissions point for Kiln 22 and Kiln 23.

A URS test team consisting of Robert Griffin, Sam Warnock, and Fran Cobo performed the emissions testing. Josh Strapec of Lafarge provided oversight to the sampling. Rob Dickman of MDEQ observed a portion of the field testing activities.

Section 2 includes a summary of the results, Section 3 contains the source and process descriptions, Section 4 sampling and analytical procedures, Section 5 discusses the test results in detail, and Section 6 discusses quality assurance and quality control practices. Questions regarding this test report should be directed to the following individuals

URS Corporation	MDEQ - Air Quality Division	Lafarge Corporation
1. Bob Jongleux Senior Scientist Direct: 919.461.1242 Main: 919.461.1100 bob.jongleux@urs.com	1. Karen Kajiya-Mills Compliance Support Unit 517-335-4874	1. Joshua Strapec Compliance Engineer 989.358.3356 joshua.strapec@lafarge.com
2. Jerry Workman, PE Measurements Dept. Mgr. Direct: 919.461-1289 Main: 919-461-1100 jerry.workman@urs.com	2. Rob Dickman Air Quality Division (231) 876-4412 dickmanr@michigan.gov	2. Robert Budnik Area Environment and Public Affairs Manager 989.358.3321 robert.budnik@lafarge.com

2.0 SUMMARY OF RESULTS

The WGS stack volumetric flow rate were derived from the EPA Method 5 volumetric flow results that were run in conjunction with the EPA Method 26A sampling train.

Emission rate in pounds per hour is based on 8760 hours of operation and a constant stack gas volumetric flow rate as measured during the test period. Michigan Rule 1003 (R 336.2003) Section 2, states: "for purposes of determining compliance with an applicable emission limit, rule, or permit condition, the arithmetic mean of results of the three samples shall apply." Tables 2-1 through 2-3 summarize the test results, operating conditions and production data, respectively of the each source tested.

Table 2-1. Summary of WGS Test Results

Source	Units	Emission Results			
		PM	HCL	CL-	Opacity (%)
WGS	(lbs/Metric Tons)	0.05	0.0034	<0.0012	
	lb/hr	5.2	0.35	<0.12	
	%				< 1.17

Table 2-2. Summary of Kiln Operating Conditions During HCl and PM Testing (October 2014)

Kiln	Date	Fuel Used	Run	Burning Zone Temperature (°C)	Raw Material Feed Rate (Metric tons/hr)	Kiln Dust Recycle Rate (Metric tons/hr)
WGS – K22[a]	10/21/2014	Coal/Coke/Plastic	Run 1	1364	109.9	6.80
			Run 2	1368	110.6	6.75
			Run 3	1461	110.2	6.79
			Average	**1398**	**110.2**	**6.79**
WGS – K23[a]	10/21/2014	Coal/Coke	Run 1	1336	97.2	10.3
			Run 2	1327	94.7	10.1
			Run 3	1337	95.4	10.1
			Average	**1333**	**95.8**	**10.2**

[a] Wet Gas Scrubber is based on an average of Kiln 22 and Kiln 23 operating conditions.

Table 2-3. Summary of Production Data During HCl and PM Testing (October 2014)

Kiln	Date	Fuel Used	Run	Clinker Produced (Metric Tons)	Plastics Feed (STPH)	Coal/Coke Feed (MTPH)
WGS – K22	10/21/2014	Coal/Coke/Plastic	Run 1	590.09	0.62	9.38
			Run 2	781.51	0.62	10.44
			Run 3	946.55	0.62	9.28
			Average	**772.72**	**0.62**	**9.70**
WGS – K23	10/21/2014	Coal/Coke	Run 1	592.64	0.0[a]	9.23
			Run 2	784.55	0.0[a]	9.16
			Run 3	946.48	0.0[a]	9.14
			Average	**774.56**	**0.0**	**9.15**

[a] Only 1 kiln is capable of firing with plastics at a time due to mechanical feed limitations

3.0 SOURCE AND PROCESS DESCRIPTIONS

Lafarge's Alpena, Michigan plant operates five rotary kilns, which manufacture Portland cement clinker using the dry process. A mixture of pulverized bituminous coal and petroleum coke, with a heating value of approximately 11,750 Btu per pound, serves as the primary fuel fed to the kilns. Coal and coke were fed to a Raymond bowl mill and ground to a fineness of approximately 95% passing a 200-mesh sieve.

3.1 Sampling Location (WGS)

The WGS stack location is located at the 200 foot level of the scrubber tower assembly and is accessible by stairwell. Test equipment is brought to the test location by an installed hoist assembly. The WGS test location houses a semi-enclosed platform with a heated work shelter. Additional test ports located around the non-enclosed platform were used for the EPA Method 2 volumetric flow traverses. The test location is adequate for conducting volumetric flow traverse. The flow profile is non-cyclonic per EPA Method 2 specifications. The sampling ports are under positive pressure. The MIRS sample probes extend approximately 45 inches into the duct, which meets requirements of the Performance Specifications 2 and 3. The extraction line is heated from the heated extraction probe down to the CEM shelter which is located ~ 200 feet below at grade level.

Figure 3-1 depicts the stack sampling location and the nearest disturbances upstream and downstream. The nearest disturbance upstream is 4.5 effective diameters (E_d) and the nearest disturbance downstream is 6 E_d. The scrubber stack and ports are fabricated of reinforced thermoplastic resin. The scrubber stack diameter is 12 feet at approximately the 200 foot level on the new scrubber tower. There are four 4-inch diameter ports with 8-bolt flanges at 90° spacing around the stack, adjacent to the CEMS probe ports.

3.2 Kiln Group 6

Kiln Group 6 at the Lafarge Alpena plant consists of two rotary kilns (#22 and #23). Specific components of Kiln Group 6 were:

- Coal/petroleum coke and combustion air delivery;
- Raw mix preparation and delivery;
- Two rotary kilns
- Kiln burners;
- Waste heat recovery boiler and
- Air pollution control system, consisting of the following components:
  - SNCR (mid-kiln);
  - Multiclone dust collectors;
  - Baghouses;
  - Induced draft (ID) fans;
  - Wet gas Scrubber (WGS); and
  - Common exhaust stack.

The pulverized coal/coke is pneumatically conveyed by heated air, recycled from the clinker cooler, through the outer ring of a concentric burner torch. Both rotary kilns in Kiln Group 6 were manufactured by Fuller Co. and are identical in design and operation. The kilns are 500 feet long and have a 19.6-foot inner diameter and 17 feet for the remainder. The kilns were lined with high-temperature refractory brick. The kiln design is based on a throughput of 4.8 million Btu per ton of clinker. An induced draft fan pulls combustion gases from each kiln. After exiting the kiln, the gases pass through a drop out chamber, a boiler then a set of multiclones before entering a fabric filter baghouse.

The kilns rotate at a rate up to 80 revolutions per hour using two 350-hp motors. The kilns' associated air pollution control systems (APCS) are identical in all aspects of design, operation, and maintenance. The APCS for Kilns 22 and 23 are identical ten-compartment baghouses. Each baghouse, manufactured by Wheelabrator-Frye, consists of two parallel sets of five chambers and has design airflow of 285,000 cfm at 400°F.

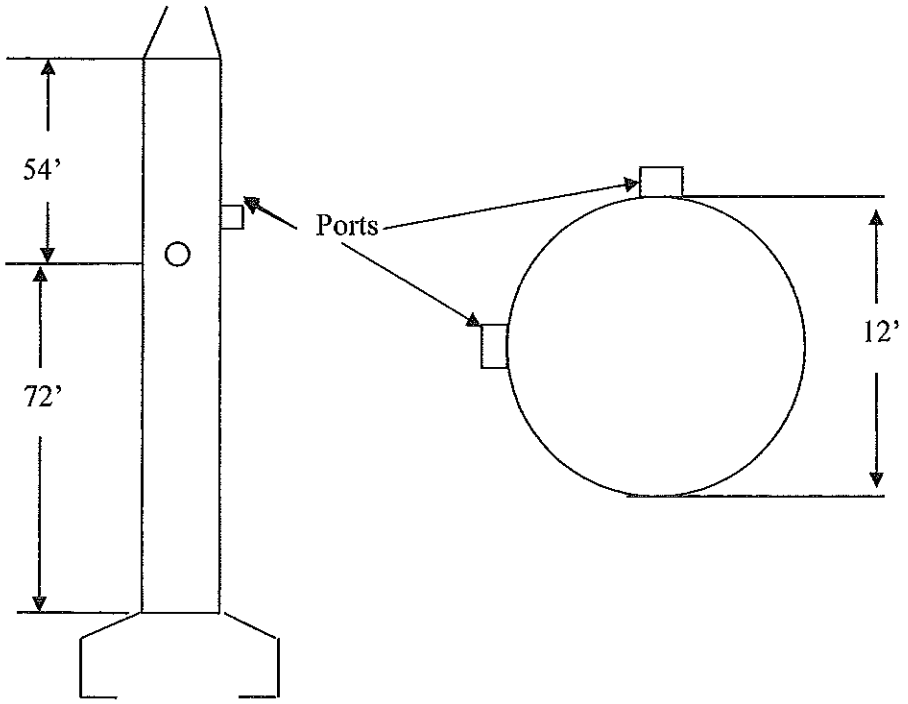

Figure 3-1. Kiln Group 6 Scrubber Stack Port Locations

4.0 SAMPLING AND ANALYTICAL PROCEDURES

URS Corporation (URS) conducted emissions measurements in accordance with procedures specified in the United States Environmental Protection Agency's (U.S. EPA's), and MDEQ's "General Rules, Part 10, Intermittent Testing and Sampling." The test methods used to perform the sampling and analysis are provided in Table 4-1.

Table 4-1. Test Methods

Parameter Measured	Method	Method Description
PM / Hydrogen Chloride	EPA Method 5 / 26A	Determination of Particulate Matter and Hydrogen Chloride Emissions From Stationary Sources
Velocity	Certified Plant Instrumentation / EPA Method 2	Determination of Stack Gas Velocity and Volumetric Flow Rate
Moisture	40 CFR 60 Appendix A: Method 4	Determination of Moisture Content In Stack Gases in conjunction with EPA Method 26A
Opacity	EPA Method 9	Determination of Visible Emissions

5.0 TEST RESULTS AND DISCUSSION

Table 5-1 and 5-2 summarize the results of the HCl/Cl- and the PM results, respectively. Example calculations can be found in Appendix D. Both HCl and Cl- concentration were determined, and that HCl equivalent concentrations are reported using the following equation:

$$\text{HCl Equivalents (Cl-)} = \text{HCl} + 2 \times \text{Cl}_2$$

The O_2 concentrations were used to correct the as-measured results to obtain 7% O_2 as specified in the Title V permit.

Only the kiln average results are compared to the permit limit in accordance with Michigan Rule 1003 (R 336.2003) Section 2, which states: "for purposes of determining compliance with an applicable emission limit, rule, or permit condition, the arithmetic mean of the results of the three samples shall apply." The process operating data conditions during the entire emission testing program were recorded by Lafarge.

The EPA Method 26A testing for HCl and Cl_2 met all sampling and analytical QA/QC parameters. The measured HCl concentration continues to be the predominate species which comprises over 99.9 % of the measured HCl equivalents. Both the HCl and Cl_2 measured were negligible and were at or below the method analytical reporting limit.

Table 5-1. Hydrogen Chloride Test Results

Kiln	Run	O_2 Conc. (% dry basis)	HCl Concentrations		Cl⁻ Concentrations		HCl Equivalent Permit Limit (ppmv,dry @7% O_2)	HCl Equivalent Emission Rate (lb/hr)	HCl Equivalent Emission Rate Permit Limit (lb/hr)[b]
			Uncorrected (ppmv, dry)	Corrected (ppmv,dry @7% O_2)	Uncorrected (ppmv, dry)	Corrected (ppmv,dry @7% O_2			
WGS	1	7.7	0.21	0.22	0.08	0.08		0.385	
	2	7.8	0.21	0.21	0.09	0.09		0.402	
	3	7.8	0.20	0.21	0.06	0.06		0.336	
	Average	**7.8**	**0.20**	**0.22**	**0.07**	**0.08**	**170[a]**	**0.374**	**162[a]**

[a] WGS now controls Kiln 22 and Kiln 23 emission points to the atmosphere. Existing permit limit is for each kiln.
[b] HCl + 2 x (Cl2) = HCl Equivalents.

Table 5-2. Particulate Matter and Opacity Test Results

Kiln	Run	O_2 Conc. (% dry basis)	PM Concentration (gr/dscf)	Flow Rate (dscfm)	PM Emissions (lb/hr)	Opacity[a] (%)
WGS	1	7.7	0.0026	300,727	6.7	3.5
	2	7.8	0.0017	301,900	4.4	0.0
	3	7.8	0.0018	300,622	4.5	0.0
	Average	**7.8**	**0.0020**	**301,083**	**5.2**	**< 1.17**

[a] Opacity read after water vapor plume per EPA Method 9 guidelines – see Appendices for detailed observations

6.0 QUALITY ASSURANCE/QUALITY CONTROL

Specific quality assurance and quality control (QA/QC) procedures that were identified in the test plan were followed during this test episode to ensure collection of useful and valid data. Table 6-1 lists the acceptance criteria and control limits for the program, ion chromatography QC results for the test period. Leak checks were performed on the sampling trains before and after every sample run. The measured leakage rate for all of the checks was within the allowable method rate for all reported samples. Visible opacity emissions were performed by a certified opacity evaluator. Certificates of the opacity evaluator can be found in Appendix A-5.

6.1 Laboratory QC

Enthalpy Analytical of Durham North Carolina analyzed the acid and basic fractions of the Method 26A samples by ion chromatography (IC), following EPA Method 300.1 procedures. The caustic samples were collected and archived per agreement with MDEQ.

The correlation coefficient is indicative of the linearity of the curve. An acceptable calibration curve has a correlation coefficient ≥ 0.995. The correlation curve for all analyses met this requirement. Also, the daily calibration verification results were all within the acceptance criteria. All samples were analyzed in duplicate. RPD is then calculated for each duplicate pair of samples to indicate the precision of the analyses. RPD is calculated from the equation:

$$RPD = \frac{|R1 - R2|}{(R1 + R2)/2} \times 100$$

Where:

R1 and R2 represent initial and duplicate analytical results, respectively.

Table 6-1. Summary of QA/QC Procedures and Results for Analysis

Calibration and QC Analysis	Description	Frequency	Acceptance Criteria	Laboratory IC Result
Initial Calibration (ICAL)	5-point calibration proceeding from lowest to highest.	Daily, preceding and again following sample analysis.	Correlation coefficient ≥0.995.	$R^2 \geq 0.9998$
Duplicate Analyses	Duplicate analyses of all field samples.	Every sample and blank.	<10% RPD	≤ 0.1 % RPD
LCS/LCSD Duplicate	Extracted blank matrix samples spiked with second source standard.	One LCS per standard calibration preparation.	85 – 115% recovery.	100% recovery for H_2SO_4 fraction 95% for NaOH fraction
Method Blank	Analysis of eluent used for dilutions and standards.	Daily.	Measured concentrations must be < MDL.	Method blank results were < reporting limit*

*Method blanks were less than the lowest level standard of the initial calibration.

LCS Laboratory Control Sample
LCSD Laboratory Control Sample Duplicate
RPD Relative Percent Difference
H_2S0_4 Sulfuric Acid
IC Ion Chromatography
QC Quality Control