LAFARGE NORTH AMERICA, Inc.
ALPENA, MICHIGAN

TEST REPORT:

EMISSIONS OF HYDROGEN CHLORIDE AND PARTICULATE MATTER
From Kilns, Raw Mills, and Wet Gas Scrubber

PREPARED FOR:

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1.0 SUMMARY

1.1 Introduction

Lafarge North America (Lafarge) operates five dry process cement kilns (Kilns 19-23) at its plant in Alpena, Michigan (EPA Facility ID #MID005379607). Kilns Nos. 19, 20, and 21 are collectively known as Kiln Group 5 (KG5). Kiln Nos. 22 and 23 are collectively known as Kiln Group 6 (KG6). All five kilns operate with waste-heat boilers for energy recovery and fabric filter baghouses for control of particulate matter emissions.

Table 1-1 addresses the test program parameters that were tested in the July 2015 test program. Lafarge operates under the Renewable Operating Permit (ROP) MI-ROP-B1477-2012 as well as the Permit to Install Number 106-08A, requiring testing for hydrogen chloride (HCl) and particulate matter (PM) on multiple sources. Testing was performed to both confirm compliance with the kiln's HCl emission limits and to assess the current emissions of particulate matter (PM) on Kilns 19-21, Raw Mill 14 (RG14) and Raw Mill 15 (RG15), and the Wet Gas Scrubber (WGS) which is now the emissions point for Kiln 22 and Kiln 23.

Table 1-1. Test Program Parameters and Locations

Parameter	Kiln 19	Kiln 20	Kiln 21	Kiln 22	Kiln 23	WGS	Raw Mill 14	Raw Mill 15
Flow Rate	•	•	•	•	•	•	•	•
Moisture	•	•	•	•	•	•	•	•
HCl	•	•	•			•		
PM	•	•	•			•	•	•

An AECOM test team consisting of Bob Jongleux, Pat Turner, Sam Warnock, Fran Cobo, Willie Lea, Lance Burleson and David Marzec performed the emissions testing. Josh Strapec of Lafarge provided oversight to the sampling. Rob Dickman and Gloria Torello 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 discusses sampling locations, Section 5 describes the sampling and analytical procedures, Section 6 discusses the test results in detail, and Section 7 discusses quality assurance and quality control practices. Questions regarding this test report should be directed to the following individuals:

2.0 HCL AND PARTICULATE MATTER RESULTS

Testing for HCl and PM was conducted by AECOM during the time period of July 14-August 13, 2015.The objective was to sample HCl concentrations by utilizing EPA Method 26A and PM concentrations by EPA Method 5.

Tables 2-1 and 2-7 summarizes the test results and operating conditions of the each source tested.

Table 2-1. Summary of Kiln HCl Test Results

Source	O_2 (%)	HCl Concentration		Cl Concentration		HCl Equivalent Emission (ppmvd, dry) @ 7% O2	HCl Equivalent Permit Limit (ppmvd @7%O_2)	HCl Equivalent Emission Rate (lb/hr)	HCl[a] Equivalent Emission Permit Limit (lb/hr)
		ppmvd	Ppmvd @7%O_2	ppmvd	Ppmvd @7%O_2				
K19	7.4	13.72	14.13	0.02	0.02	14.15	**65**	5.76	**36**
K20	8.8	1.10	1.27	0.01	0.01	1.29	**65**	0.56	**36**
K21	8.9	8.96	10.38	0.02	0.02	10.42	**65**	4.26	**36**
WGS	7.9	1.335	1.46	0.02	0.02	1.50	**170[a]**	2.28	**162[a]**

[a] HCl + 2 x (Cl2) = HCL Equivalents

Table 2-2. Summary of Kiln and WGS Operating Conditions During HCl Testing

Kiln	Date	Fuel Used	Burning Zone Temperature (°C)	Raw Material Feed Rate (metric tons/hr)	Kiln Dust Recycle Rate (metric tons/hr)
K19	7/17/15	coal/coke/plastics/shingles	1431	74.64	5.04
K20	7/18/15	coal/coke/plastics/shingles	1304	66.85	5.98
K21	7/18/15	coal/coke/plastics	1369	65.28	9.11
WGS – K22[a]	8/13/15	coal/coke/shingles	1426	120.3	6.87
WGS – K23[a]	8/13/15	coal/coke/plastics/shingles	1368	120.6	7.05

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

Table 2-3. Summary of Fuel Usage and Production Data During HCl Testing

Kiln	Date	Fuel Used	Clinker Produced (metric Tons)[b]	Plastics Feed (mt/h)	Coal/Coke Feed (mt/h)
K19	7/17/15	coal/coke/plastics/shingles	519	1.91E-04	6.44
K20	7/18/15	coal/coke/plastics/shingles	375	2.81E-04	7.54
K21	7/18/15	coal/coke/plastics	403	2.81E-04	7.07
WGS – K22	8/13/15	coal/coke/shingles	788	--[a]	9.74
WGS – K23	8/13/15	coal/coke/plastics	776	--[a]	11.11

Data system indicated plastic feed activated during testing

[b] Supporting data in Appendix D

Table 2-4. Summary of Kiln and WGS Particulate Matter Results (2015)

Source	Pemit Limit	Units of Measurement	PM Result
K19	0.25	lb/1000 lb exhaust dry gas	0.02
K20	0.25	lb/1000 lb exhaust dry gas	0.01
K21	0.25	lb/1000 lb exhaust dry gas	0.02
Raw Mill 14	0.15	lb/1000 lb exhaust dry gas	0.002
Raw Mill 15	0.15	lb/1000 lb exhaust dry gas	0.005
WGS	--	lb/1000 lb exhaust dry gas	0.003

Table 2-5. Summary of Kiln and WGS Operating Conditions During PM Testing

Kiln	Date	Average Stack Volumetric Flow Rate (dscfm)	Burning Zone Temperature (°C)	Raw Material Feed Rate (metric tons/hr)	Kiln Dust Recycle Rate (metric tons/hr)
K19	7/17/15	73,905	1431	74.64	5.04
K20	7/16/15	84,135	1364	66.85	5.80
K21	7/15/15	85,989	1340	70.40	9.14
WGS K22	7/14/15	294,825[a]	1362	121.85	4.50
WGS K23	7/14/15	294,825[a]	1400	121.72	6.39

[a] Average Stack Volumetric Flow Rate is sum of K22 and K23

Table 2-6. Summary of Fuel Usage and Production Data During Particulate Matter Testing

Source	Date	Fuel Used	Clinker[a] Produced (metric Tons)	Plastics Feed (mt/h)	Coal/Coke Feed (mt/h)
K19	7/17/15	coal/coke/plastics/shingles	519	1.45E-04	6.44
K20	7/16/15	coal/coke/plastics/shingles	479	1.40E-04	7.57
K21	7/15/15	coal/coke/plastics	647	1.40E-04	7.22
WGS K22[a]	7/14/15	coal/coke	859	NA	11.61
WGS K23[a]	7/14/15	coal/coke	857	NA	12.14

[a] Supporting data in Appendix D

Table 2-7. Summary of Raw Mill Particulate Matter Results (2015)

Source	Date	Test	Permit Limit	Units of Measurement	Emission Results
RG14	7/20/15	PM	0.15	lb/1000 lb exhaust dry gas	0.002
RG15	7/19/15	PM	0.15	lb/1000 lb exhaust dry gas	0.005
RG14	7/20/15	PM	27.5	lb/hr	0.51
RG15	7/19/15	PM	27.5	lb/hr	1.24

Table 2-8. Summary of Raw Mill Operating Data During Particulate Matter Testing

Source	Date	Test	Tons of Raw Feed (mt/hr)	Baghouse Inlet Differential Pressure (kpa)	Baghouse Inlet Temp. (°C)
RG14	7/20/15	PM	245	0.99	82.7
RG15	7/19/15	PM	278	0.83	87.6

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 Kiln Group 5

Kiln Group 5 at the Lafarge Alpena plant consists of three rotary kilns (#19, #20, and #21). Specific components of Kiln Group 5 were:

- Coal/petroleum coke and combustion air delivery;
- Raw mix preparation and delivery;
- Three rotary kilns;
- Kiln burners;
- Waste heat recovery boilers and
- Air pollution control system, consisting of the following components:
  - Multiclone dust collectors;
  - Baghouses
  - DAA (hydrated lime) injection
  - SNCR
  - Induced draft (ID) fans; and
  - Exhaust stacks.

Allis Chalmers manufactured all kilns identified as #19, #20, and #21. Each kiln is 460.5 feet long. Each kiln shell has an inside diameter of 15 feet at the feed end and 13 feet at the firing end. The kilns in Kiln Group 5 rotate at speeds of greater than 40 revolutions per hour and were driven by an electric motor.

Dracco manufactured the baghouse for Kiln 19. The baghouse has two parallel sets of six chambers and design airflow of 175,000 cubic feet per minute (cfm) at 400°F. The maximum operating temperature is 550°F. The baghouses for kilns 20 and 21, manufactured by Wheelabrator-Frye were identical in design and construction, with two parallel sets of six chambers. Each baghouse has a design air flow of 166,000 cfm at 400°F. The maximum operating temperature is 550°F.

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. After exiting the baghouse, the gases were routed through a breaching duct that connects the baghouse to a common reinforced concrete stack.

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.

3.3 Kiln Process Instrumentation

Instruments used to monitor kiln operating parameters were located throughout the kiln system. Parameters that were recorded during testing were the baghouse inlet temperature, production rate, and baghouse change in pressure (delta P). Each kiln system is equipped with a differential pressure indicator system, with measurement points located in the duct prior to and exiting the baghouse. The differential pressure devices are used to monitor the pressure drop across the baghouse.

Figure 3-1 is a detailed diagram of the process flow indicating where the air quality control equipment is located for KG5 and KG6 as well as the identification numbers of each device. Figure 3-2 is a schematic of the plant's SNCR system and Figure 3-3 is an example diagram of the raw mill process.

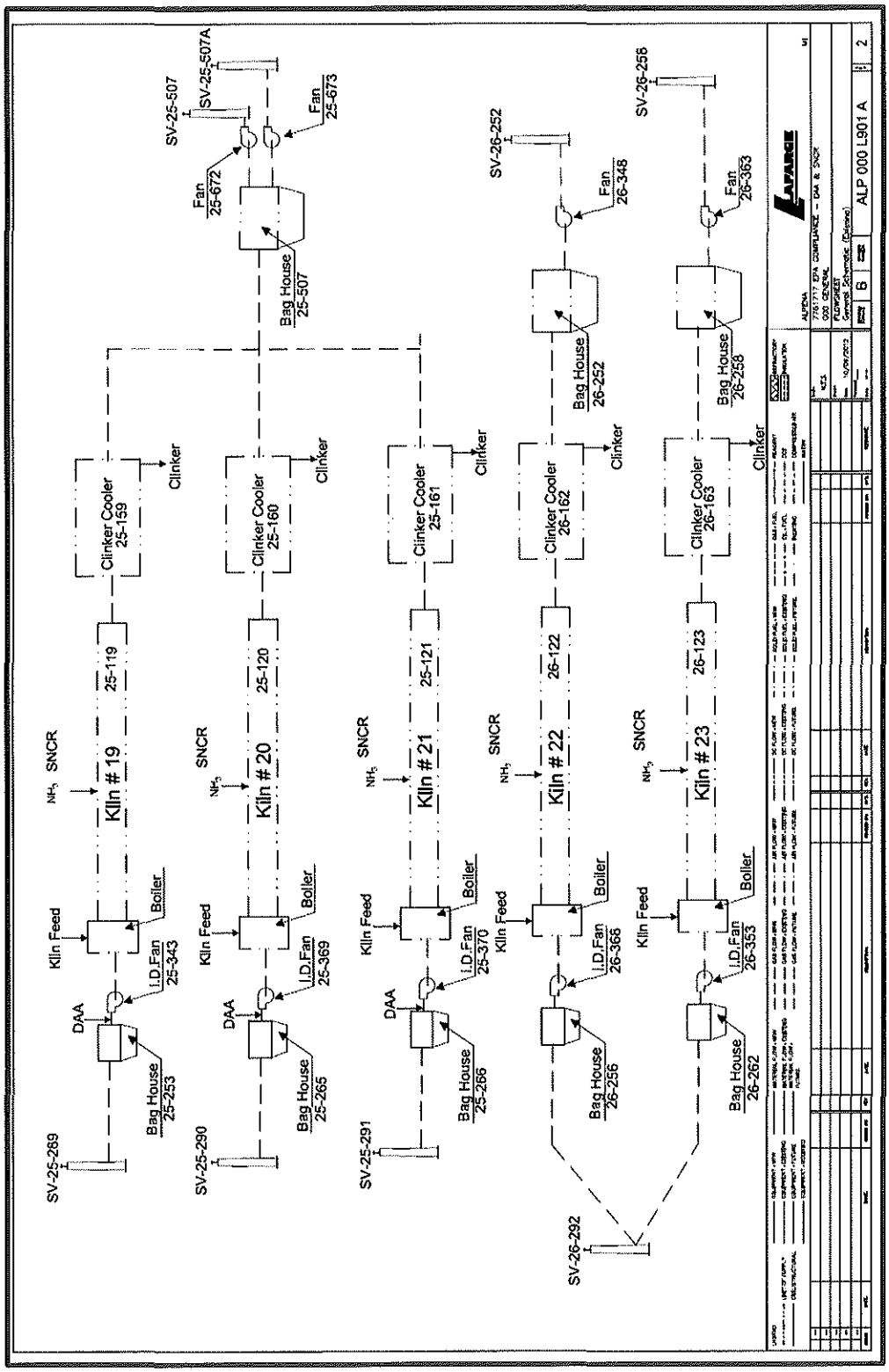

Figure 3-1. Detailed Process Flow Diagram for Kiln Group 5 and Kiln Group 6

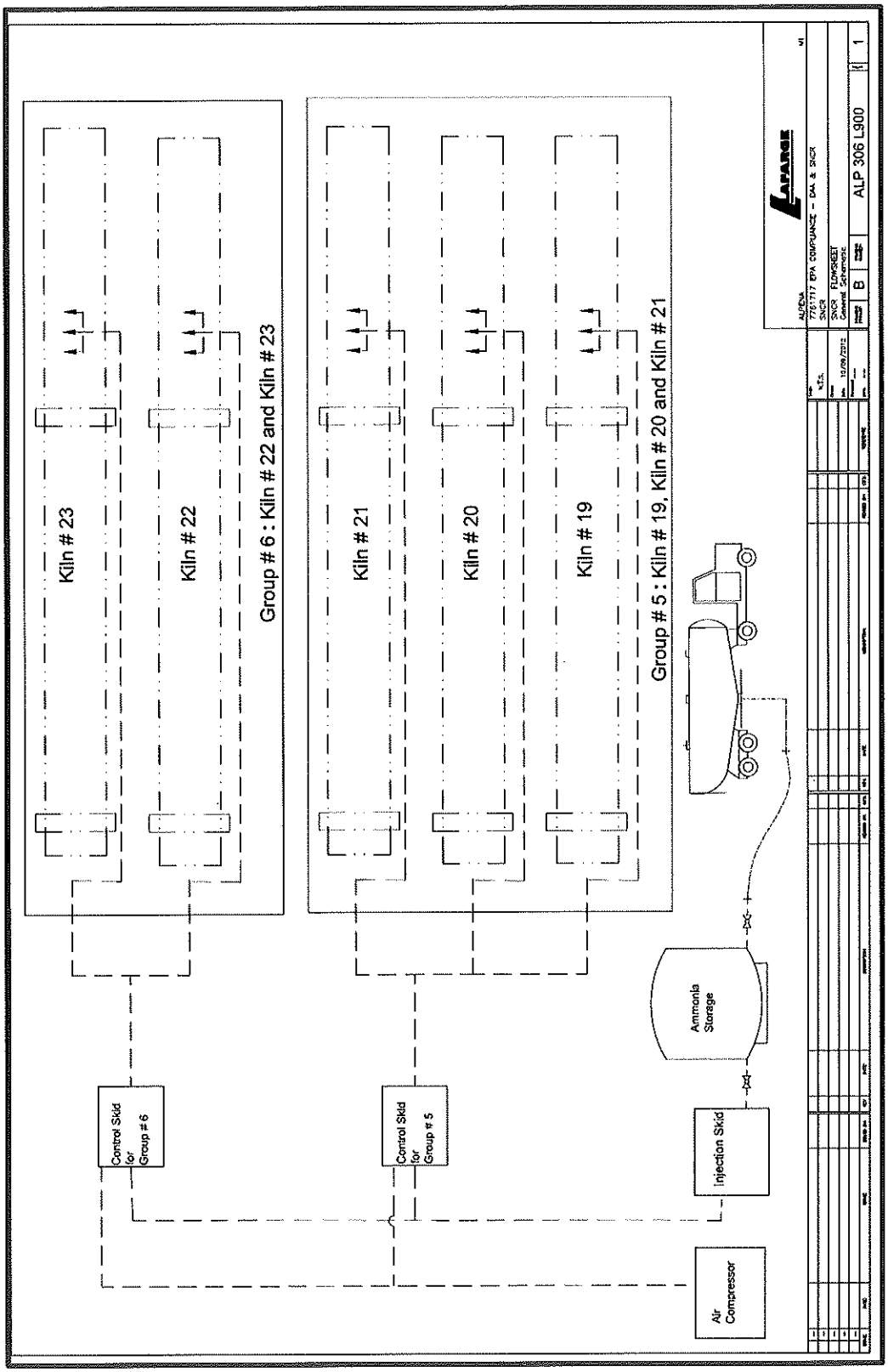

Figure 3-2. Schematic of Kiln Group 5 and Kiln Group 6 SNCR System

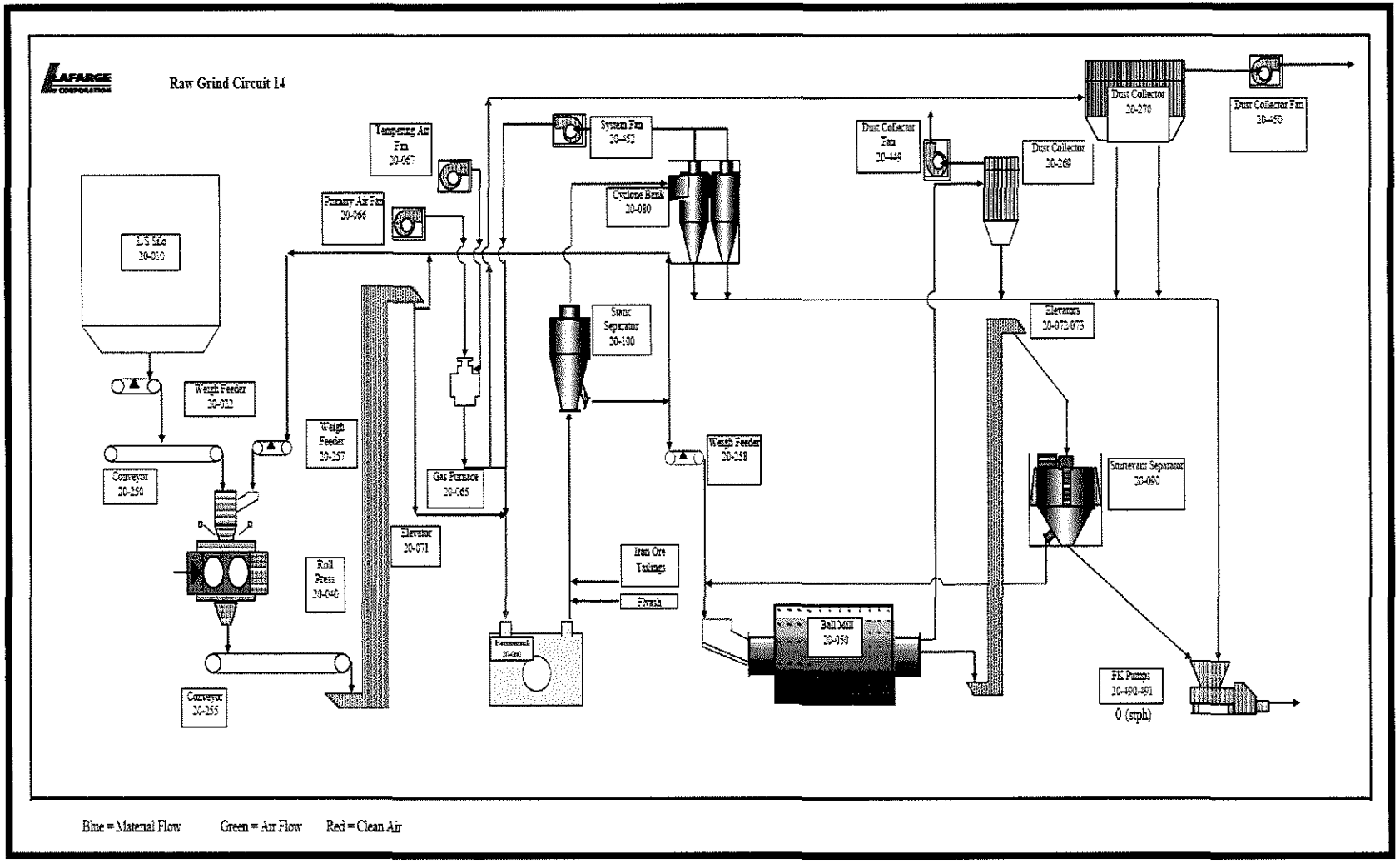

Figure 3-3. Raw Mill Process Diagram

4.0 SAMPLING LOCATIONS

For all kilns, the sampling location was in the breeching duct between each kiln's baghouse and discharge stack.

The sampling locations for the Kilns are illustrated in Figure 4-1 through Figure 4-5.

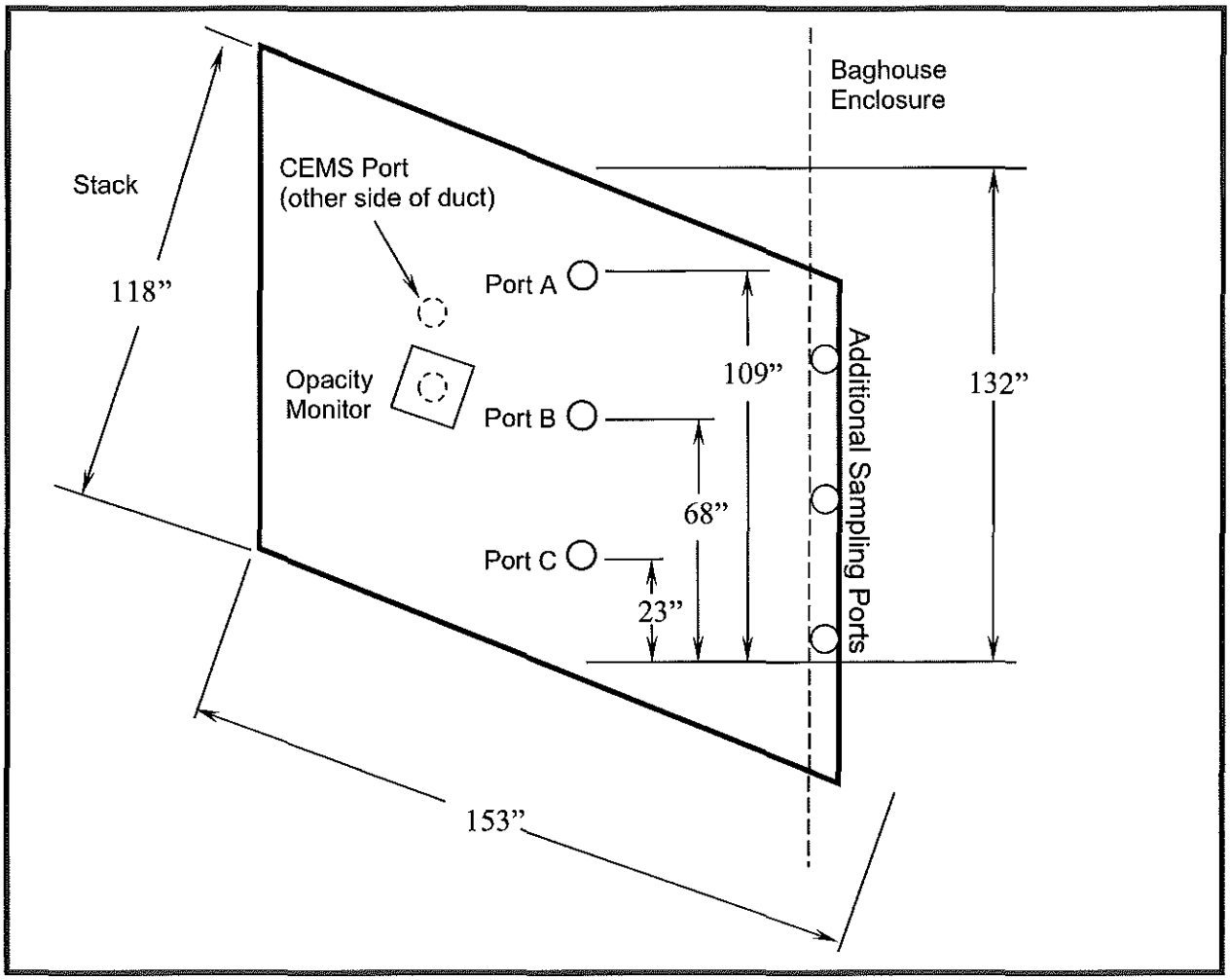

Figure 4-1. Kiln 19 Test Port Locations (side view)

Figure 4-2. Kiln 19 Breeching Duct

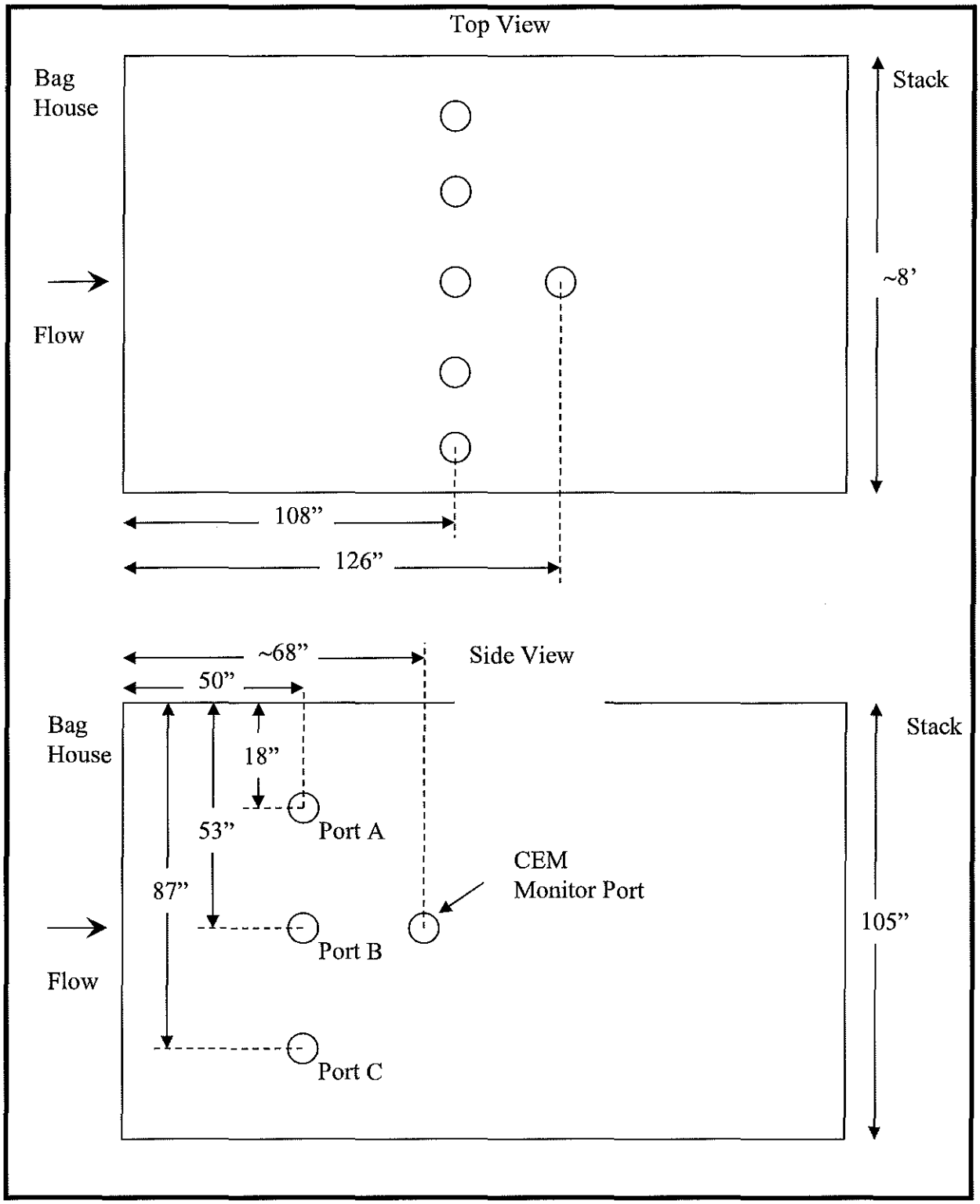

Figure 4-3. Lafarge Alpena Kilns 20 and 21 Breeching - Test Port Locations

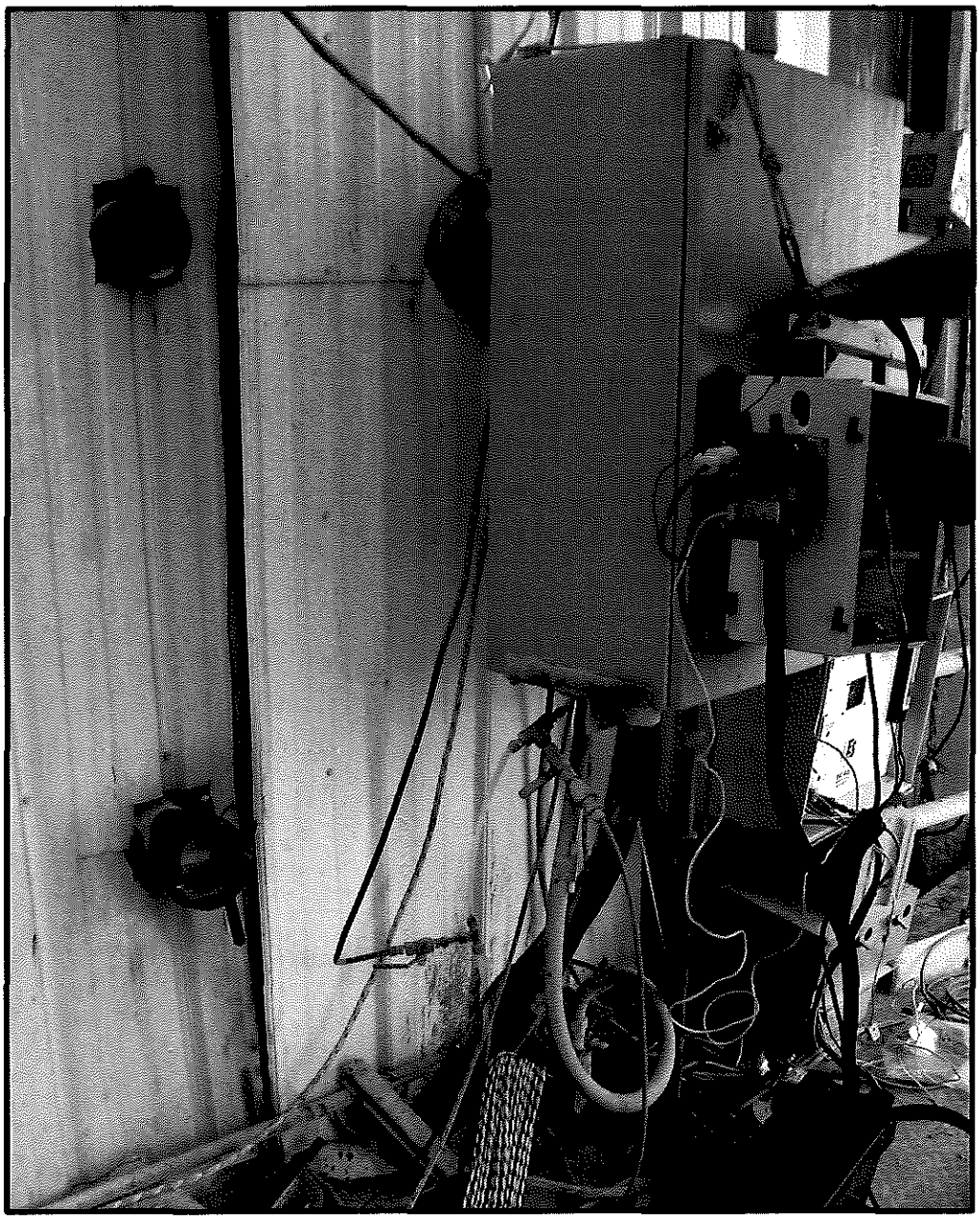

Figure 4-4. Kiln 21 Breaching Duct – Lower Test Ports

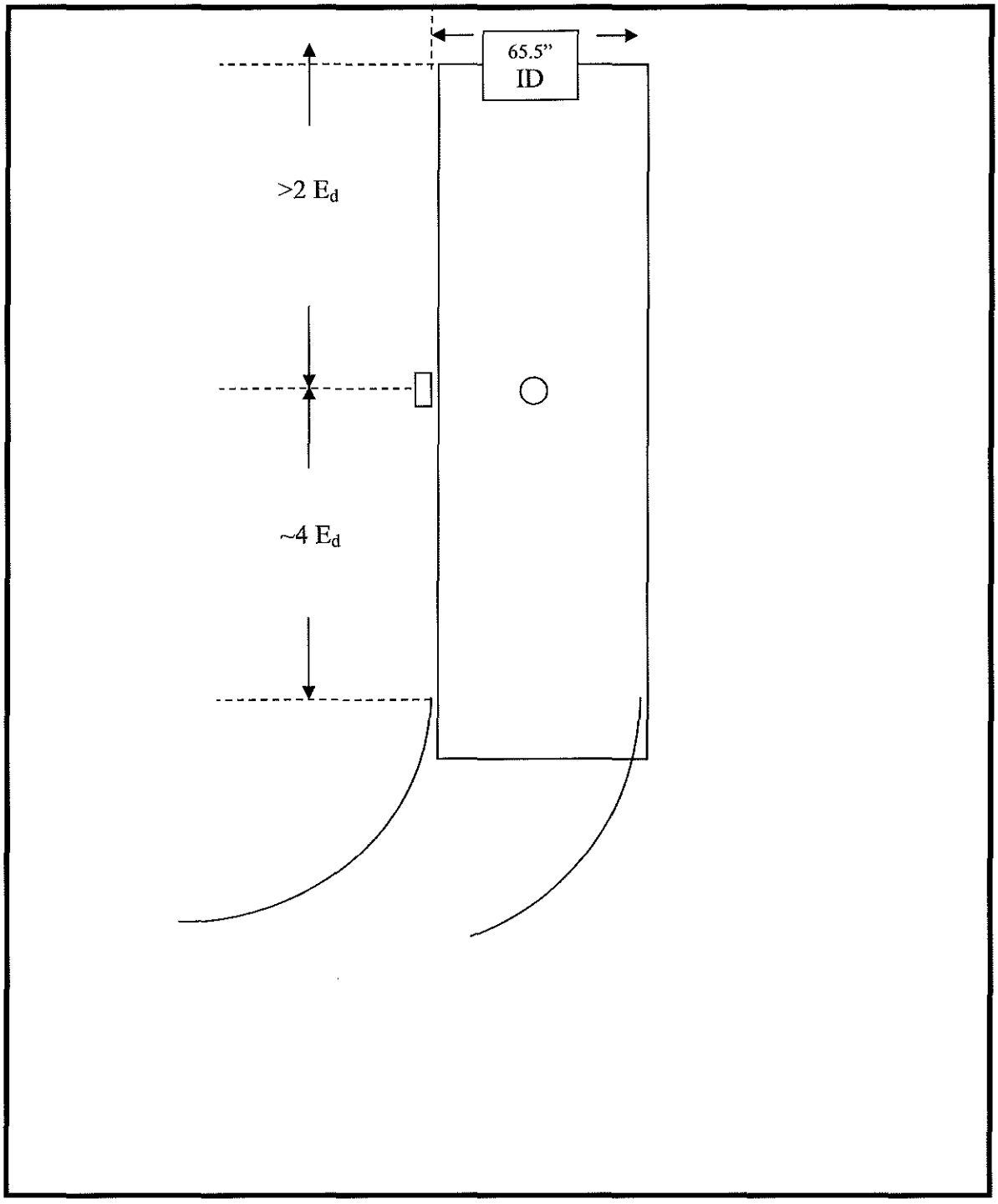

Figure 4-5. Raw Mill Stack Locations

5.0 SAMPLING AND ANALYTICAL PROCEDURES

AECOM Corporation (AECOM) 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 5-1.

Table 5-1. Test Methods

Parameter Measured	Method	Method Description
Hydrogen Chloride	EPA Method 26A	Determination of Hydrogen Chloride Emissions From Stationary Sources
Particulate Matter	EPA Method 5	Determination of Particulate Matter Emissions from Stationary Sources
Velocity	Certified Plant Instrumentation / EPA Method 2	Determination of Stack Gas Velocity and Volumetric Flow Rate
Oxygen and Carbon Dioxide	Certified Plant Instrumentation / 40 CFR 60 Appendix A: Method 3A	Certified Plant Instrumentation monitoring for Oxygen and Carbon Dioxide
Moisture	40 CFR 60 Appendix A: Method 4	Determination of Moisture Content In Stack Gases in conjunction with EPA Method 26A

5.1 Audit Sample

Audit samples through the Source Sampling Audit Sample (SSAS) program were acquired from an Accredited Audit Sample Provider (AASP). One HCl audit sample was requested for this element of the test program. The SSAS was analyzed in conjunction with the field samples in the laboratory. Table 5-2 summarizes the results from the SSAS. Both SSAS results were "acceptable" by definition from the AASP.

Table 5-2. Summary of SSAS Audit Results

Parameter	Units	Laboratory Result	Acceptable Range	Assigned Value
Hydrogen Chloride	mg/L (ppm)	10.5	9.45 - 11.6	10.5

6.0 TEST RESULTS AND DISCUSSION

Table 6-1 summarizes the detailed results of the HCl emission testing program. Example calculations can be found in Appendix E. 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 measured by the plant monitors were used to correct the as-measured results to obtain 7% O_2 as specified in the Title V permit. The plant O_2 monitor(s) accuracy was verified by the subsequent CERMS RATA conducted contemporaneous with the the annual HCl and PM testing.

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. Table 6-2 presents the kiln operating conditions during each test run.

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. The Cl_2 measured component of the EPA Method 26A sampling train was negligible and is at or below the method analytical reporting limit.

Testing was originally completed utilizing a front half Method 5 and back half Method 26A impingers for the WGS and Kiln 19. During testing for the WGS, a production error occurred and plastics were not included in the kiln feeds for the original July test deployment. Therefore the WGS test location was retested individually for HCl during the second deployment in August as requested by MDEQ. Of the three runs conducted on the retest on August 13, 2015, the first HCl test run had a result in the halide fraction that was an outlier compared to the successive runs. An internal review of recovery proceedures indicates a potential for contamination from the previous source in the impinger glassware, which likely caused a false postive in theanalytical result for the first test run. The average HCl test result for the WGS although potential biased high, still remains at an insignificant level.

Testing for Kilns 20-21 were sampled independently for HCl. That is, HCl by Method 26A without combination with EPA Method 5 for PM. This was a field change implemented to accomdate the facility's available fuel supply during the test week. The HCl testing was delayed by several days to accomdate the cofiring with plastics. Kilns 19-21 showed test results that were consistent with previous data. All KG5 sources were in compliance with the established HCl Equivalent Emission Limits.

The EPA Method 5 PM testing was conducted on Kilns 19-21, the WGS (KG6) and Raw Mill 14 and 15 during the initial July testing deployment. The PM sampling and analytical results met standard method specifications and quality control proceedures. The detailed PM results are shown in Table 6-3 for the kilns and in Table 6-5 for the raw mills. Tables 6-4 and 6-6 indicate the process operating conditions for each PM test run for the kilns and the raw mills, respectively.

Table 6-1. Hydrogen Chloride Annual Verification Test Results (July - August 2015)

Kiln	Run	O_2 Conc. (% dry basis)	HCl Concentrations		Cl⁻ Concentrations		HCl Equivalent Emission (ppmv,dry @7% O2)	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				
19	1	7.4	11.52	11.86	0.02	0.02	11.90		5.02	
	2	7.4	15.70	16.16	0.03	0.03	16.22		6.41	
	3	7.4	13.96	14.37	0.02	0.03	14.43		5.86	
	Avg	7.4	13.72	14.13	0.02	0.02	**14.17**	**65**	**5.76**	**36**
20	1	8.8	1.15	1.32	0.01	0.01	1.34		0.56	
	2	8.8	1.46	1.68	0.01	0.01	1.70		0.72	
	3	8.8	0.69	0.79	0.01	0.01	0.81		0.35	
	Avg	8.8	1.10	1.27	0.01	0.01	**1.29**	**65**	**0.54**	**36**
21	1	8.9	14.35	16.62	0.01	0.01	16.64		6.92	
	2	8.9	4.07	4.71	0.02	0.02	4.75		2.12	
	3	8.9	8.46	9.80	0.02	0.02	9.84		3.76	
	Avg	8.9	8.96	10.38	0.02	0.02	**10.42**	**65**	**4.27**	**36**
WGS	1	7.9	3.61	3.76	0.02	0.02	3.81		6.04	
	2	7.9	0.24	0.26	0.02	0.02	0.30		0.49	
	3	7.8	0.24	0.26	0.03	0.03	0.32		0.48	
	Avg	7.9	1.34	1.43	0.02	0.02	**1.47**	**170[a]**	**2.34**	**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 6-2. Detailed Operating Conditions during HCl Testing (July - August 2015)

Kiln	Run	Date	Run Start Time (EDT)	Run End Time (EDT)	Kiln BZT (°C)	Kiln Feed (Metric tons/hr)	Kiln Dust (Metric tons/hr)	Baghouse Inlet Temp (°C)	Opacity (%)
19	1	7/17/2015	11:05	12:19	1419.59	67.58	4.95	231.9	6.50
	2	7/17/2015	14:10	15:24	1435.32	86.37	5.22	233.8	6.10
	3	7/17/2015	16:04	17:14	1438.50	69.98	4.95	234.1	6.00
	Average				1431.14	74.64	5.04	233.2	6.55
20	1	7/18/2015	9:20	10:20	1288.55	65.80	5.96	259.0	3.51
	2	7/18/2015	10:45	11:45	1325.13	63.13	5.98	257.7	3.45
	3	7/18/2015	12:00	13:00	1299.14	71.62	6.00	257.9	3.35
	Average				1304.27	66.85	5.98	258.2	3.44
21	1	7/18/2015	10:20	11:20	1362.97	62.86	9.13	227.0	1.59
	2	7/18/2015	11:25	12:25	1375.76	69.90	9.10	227.4	1.61
	3	7/18/2015	12:48	13:55	1368.03	63.08	9.11	228.0	1.46
	Average				1368.92	65.28	9.11	227.4	1.55
22	1	8/13/2015	11:30	12:30	1361.53	119.42	6.97	264.5	ND
	2	8/13/2015	14:40	15:40	1411.18	122.36	6.82	262.7	ND
	3	8/13/2015	16:20	17:20	1504.86	119.12	6.81	260.9	ND
	Average				1425.86	120.30	6.87	262.7	ND
23	1	8/13/2015	11:30	12:30	1375.87	120.07	7.09	233.2	ND
	2	8/13/2015	14:40	15:40	1358.18	122.32	7.03	233.9	ND
	3	8/13/2015	16:20	17:20	1370.58	119.43	7.03	233.4	ND
	Average				1368.21	120.61	7.05	233.5	ND

Table 6-3. Detailed Kiln Particulate Matter Test Results (July 2015)

Source	Date	Time start - end		Run	PM Result	PM Limit	Units of Measurement
19	7/17/2015	11:05	12:19	1	0.02	0.25	lb/1000 lb exhaust gas (dry basis)
	7/17/2015	14:10	15:24	2	0.02		
	7/17/2015	16:04	17:14	3	0.02		
				Avg:	0.02		
20	7/16/2015	10:40	11:57	1	0.02	0.25	lb/1000 lb exhaust gas (dry basis)
	7/16/2015	12:45	13:58	2	0.00		
	7/16/2015	15:48	17:01	3	0.01		
				Avg:	0.01		
21	7/15/2015	17:15	18:22	1	0.03	0.25	lb/1000 lb exhaust gas (dry basis)
	7/15/2015	18:50	20:00	2	0.02		
	7/18/2015	15:04	16:06	3	0.01		
				Avg:	0.02		
WGS	7/14/2015	11:30	12:30	1	0.002	--	lb/1000 lb exhaust gas (dry basis)
	7/14/2015	14:40	15:40	2	0.003		
	7/14/2015	16:20	17:20	3	0.003		
				Avg:	0.003		

Table 6-4. Detailed Operating Conditions During Kiln PM Testing (July 2015)

Source	Date	Time start - end		Run	Fuel Used	Burning Zone Temperature (°C)	Kiln Dust Recycle Rate (Mtons/hr)	Raw Feed (mtons/hr)	Clinker Produced (Mtons/hr)	Plastic Feed Stons/hr	Coal/Coke Feed (mtons/hr)
19	7/17/2015	11:05	12:19	1	coal/coke/plastics/shingles	1420	4.95	67.58	40.89	0.00E+00	6.99
	7/17/2015	14:10	15:24	2	coal/coke/plastics/shingles	1435	5.22	86.37	52.25	1.45E-04	6.98
	7/17/2015	16:04	17:14	3	coal/coke/plastics/shingles	1438	4.95	69.98	42.33	1.45E-04	5.36
				Avg:		**1431**	**5.04**	**74.64**	**45.16**	**1.45E-04**	**6.44**
20	7/16/2015	10:40	11:57	1	coal/coke/plastics/shingles	1366	5.90	64.78	40.13	1.41E-04	7.56
	7/16/2015	12:45	13:58	2	coal/coke/plastics/shingles	1381	5.59	65.64	40.66	1.40E-04	7.68
	7/16/2015	15:48	17:01	3	coal/coke/plastics/shingles	1345	5.91	67.88	42.04	1.39E-04	7.46
				Avg:		**1364**	**5.80**	**66.10**	**40.94**	**1.40E-04**	**7.57**
21	7/15/2015	17:15	18:22	1	coal/coke/plastics	1329	9.14	69.84	42.25	0.00E+00	7.31
	7/15/2015	18:50	20:00	2	coal/coke/plastics	1331	9.14	69.89	42.28	0.00E+00	7.29
	7/18/2015	15:04	16:06	3	coal/coke/plastics	1359	9.15	71.47	44.27	1.40E-04	7.07
				Avg:		**1340**	**9.14**	**70.40**	**42.93**	**1.40E-04**	**7.22**
22	7/14/2015	11:30	12:30	1	coal/coke	1352	4.50	124.56	75.36	NA	11.57
	7/14/2015	14:40	15:40	2	coal/coke	1338	4.53	128.60	77.80	NA	11.65
	7/14/2015	16:20	17:20	3	coal/coke	1396	4.47	112.40	68.00	NA	11.56
				Avg:		**1362**	**4.50**	**121.85**	**73.72**	NA	**11.59**
23	7/14/2015	11:30	12:30	1	coal/coke	1398	6.24	124.24	75.16	NA	12.08
	7/14/2015	14:40	15:40	2	coal/coke	1399	6.55	128.61	77.80	NA	12.19
	7/14/2015	16:20	17:20	3	coal/coke	1404	6.38	112.31	67.94	NA	12.02
				Avg:		**1400**	**6.39**	**121.72**	**73.64**	NA	**12.10**
WGS	7/14/2015	11:30	12:30	1	coal/coke	1375	5.37	124.40	150.52	NA	23.65
	7/14/2015	14:40	15:40	2	coal/coke	1369	6.82	128.61	155.60	NA	23.84
	7/14/2015	16:20	17:20	3	coal/coke	1400	6.81	112.35	135.94	NA	23.58
				Avg:		**1381**	**6.34**	121.79	**147.35**	NA	**23.69**

Table 6-5. Detailed Raw Mill Particulate Matter Test Results (July 2015)

Source	Date	Time start - end		Run	PM Result (lb/hr)	PM Limit (lb/hr)	PM Result (lb/1000 lb exhaust gas dry)	PM Limit (lb/1000 lb exhaust gas dry)
RG 14	7/20/2015	9:15	10:20	1	0.45	27.5	0.002	0.15
	7/20/2015	10:53	11:58	2	0.56		0.003	
	7/20/2015	12:20	13:25	3	0.51		0.002	
				Avg:	0.51		0.002	
RG 15	7/19/2015	11:30	12:30	1	1.39	27.5	0.006	0.15
	7/19/2015	14:40	15:40	2	1.17		0.005	
	7/19/2015	16:20	17:20	3	1.17		0.005	
				Avg:	1.24		0.005	

Table 6-6. Detailed Operating Conditions during Raw Mill PM Testing (July 2015)

Source	Date	Time start - end		Run	Raw Mill Production (mton/hr)	20/270 Inlet Pressure (kPa)	Inlet temp (°C)
RG 14	7/20/2015	9:15	10:20	1	242.300	1.001	82.58
	7/20/2015	10:53	11:58	2	244.517	0.999	82.93
	7/20/2015	12:20	13:25	3	247.802	0.999	82.60
				Avg:	**244.873**	**0.999**	**82.70**
RG 15	7/19/2015	11:30	12:30	1	277.631	0.813	88.84
	7/19/2015	14:40	15:40	2	277.978	0.820	87.26
	7/19/2015	16:20	17:20	3	278.061	0.841	86.82
				Avg:	**277.890**	**0.825**	**87.64**

7.0 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 7-1 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.

7.1 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 analyzed as required by MDEQ. Table 7- lists the results of all of the QC procedures that were conducted as part of the analysis. QC results were within the acceptance criteria. All samples were analyzed within their required hold times. Method blank results were less than the method detection limit.

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 7-1. Summary of QA/QC Procedures and Results for Chloride Analysis (July 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.	$R^2 \geq 0.9999$
Duplicate Analyses	Duplicate analyses of all field samples.	Every sample and blank.	<10% RPD	≤ 1.1 % RPD
LCS/LCSD Duplicate	Extracted blank matrix samples spiked with second source standard.	One LCS per standard calibration preparation.	85 – 115% recovery.	105-106 % recovery for H_2SO_4 fraction 96.0-98.7 % 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

Table 7-2. Summary of QA/QC Procedures and Results for Chloride Analysis (August 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.	$R^2 \geq 0.9999$
Duplicate Analyses	Duplicate analyses of all field samples.	Every sample and blank.	<10% RPD	≤ 6.2 % RPD
LCS/LCSD Duplicate	Extracted blank matrix samples spiked with second source standard.	One LCS per standard calibration preparation.	85 – 115% recovery.	99.8-98.5 % recovery for H_2SO_4 fraction 102-100 % 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*