1.0 EXECUTIVE SUMMARY

Mostardi Platt conducted a hydrogen chloride (HCl) compliance emissions test program on the Wet Gas Scrubber for Holcim (US) Inc. Lafarge Alpena at the Alpena Cement Plant in Alpena, Michigan. This report summarizes the results of the test program and test methods used.

The test location, test date, and test parameters are summarized below.

TEST PARAMETERS		
Test Locations	**Test Dates**	**Test Parameters**
Wet Gas Scrubber	August 29, 2022	HCl and Oxygen (O_2)

The purpose of the test program was to establish the source specific operating limit for hydrogen chloride (HCl) during normal operating conditions to satisfy the regulatory requirements of the operating permit. Selected results of the test program are summarized below. A complete summary of emission test results follows the narrative portion of this report.

TEST RESULTS					
Test Location	**Test Date**	**Operating Condition**	**Test Parameter**	**Emission Limit**	**Emission Rate**
Wet Gas Scrubber	8/29/22	Normal	HCl	3 ppmvd@7%O_2	1.72 ppmvd@7%O_2

Operating data as provided by Holcim (US) Inc. is included in Appendix A.

TEST PERSONNEL INFORMATION		
Location	**Address**	**Contact**
Test Facility	Holcim (US) Inc. Alpena Plant 1435 Ford Avenue Alpena, MI 49707	Mallory Miller Area Environmental Engineer (224) 517-6896 mallory.miller@holcim.com
Testing Company Supervisor	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Stuart Sands Senior Project Manager 630-993-2663 (phone) ssands@mp-mail.com

The test crew consisted of Messrs. W. Drake, J. Priez, J. Kukla, A. Benninghoff, and S. Sands.

2.0 TEST METHODOLOGY

Emission testing was conducted following the methods specified in 40 CFR, Part 60, Appendix A. Schematics of the test section diagrams and sampling trains used are included in Appendix B and C, respectively. Calculation examples and nomenclature are included in Appendix D. Copies of analyzer print-outs for each test run are included in Appendix E.

The following methodologies were used during the test program:

Method 1 Traverse Point Determination

Test measurement points were selected in accordance with Method 1. The characteristics of the measurement location are summarized below.

TEST POINT INFORMATION							
Test Location	Stack Dimensions	No. of Ports	Port Length (Inches)	Upstream Diameters	Downstream Diameters	Test Parameter	Number of Sampling Points
WGS Stack	12 Feet	2	5	6.0	4.5	HCl	3

Method 3A Oxygen (O_2) Determination

Stack gas molecular weight was determined in accordance with Method 3A. A Servomex analyzer was used to determine stack gas oxygen content. All of the equipment used was calibrated in accordance with the specifications of the Method and calibration data are included in Appendix F. Copies of the gas cylinder certifications are included in Appendix G.

Method 320/321 Fourier Transform Infrared (FTIR) Detector for HCl Determination

Extractive Fourier transform infrared (FTIR) spectrometry following USEPA Methods 320 and 321 was performed for determination of HCl.

FTIR technology works on the principle that most gases absorb infrared light. This is true for all compounds with the exception of homonuclear diatomic molecules and noble gases such as: N_2, O_2, H_2, He, Ne, and Ar. Vibrations, stretches, bends, and rotations within the bonds of a molecule determine the infrared absorption distinctiveness. The absorption creates a "fingerprint" which is unique to each given compound. The quantity of infrared light absorbed is proportional to the gas concentration. Most compounds have absorbencies at different infrared frequencies, thus allowing the simultaneous analysis of multiple compounds at one time. The FTIR software compares each sample spectrum to a user-selected list of calibration references and concentration data is generated.

FTIR data was collected using an MKS MultiGas 2030 FTIR spectrometer. Analyte spiking was performed to assure the ability of the FTIR to quantify analytes in the presence of effluent gas. All analyte spikes were introduced using an instrument grade stainless steel rotometer. All QA/QC procedures were within the acceptance criteria allowance of Methods 320 and 321.

FTIR QA/QC PROCEDURES						
QA/QC Specification	**Purpose**	**Calibration Gas Analyte**	**Delivery**	**Frequency**	**Acceptance Criteria**	**Result**
M320: Zero	Verify that the FTIR is free of contaminants & zero the FTIR	Nitrogen (zero)	Direct to FTIR	pre/post test	< MDL or Noise	**Pass**
M320: Calibration Transfer Standard (CTS) Direct	Verify FTIR stability, confirm optical path length	Ethylene	Direct to FTIR	Pretest	+/- 5% cert. value	**Pass**
M320: CTS Response	Verify system stability, recovery, response time	Ethylene	Sampling System	Daily, pre/post test	+/- 5% of Direct Measurement	**Pass**
M320: Zero Response	Verify system is free of contaminants, system bias	Nitrogen (zero)	Sampling System	Pretest	Bias correct data	**Pass**
M320: Analyte Spike	Verify system ability to deliver and quantify analyte of interest in the presence of other effluent gases	HCl	Dynamic Addition to Sampling System, ~1:10 effluent	pre test	+/- 30% theoretical recovery	**Pass**

Note: The determined concentrations from direct analyses were used in all system/spike recovery calculations.

CALIBRATION GAS STANDARDS				
Components	**Concentration (ppm)**	**Vendor**	**Cylinder #**	**Standard Type**
Ethylene	99.88	Airgas	CC714117	Primary +/- 2%
HCl/SF_6	101.9/5.032	Airgas	CC509786	Certified Standard-Spec +/- 5%

Analyte Spiking
HCl spiking was performed prior to testing and before and after each test run to verify the ability of the sampling system to quantitatively deliver a sample containing HCl from the base of the probe to the FTIR. Analyte spiking assures the ability of the FTIR sampling system to recover acid gases in the presence of effluent gas.

As part of the spiking procedure, samples were measured to determine native HCl concentrations to be used in the spike recovery calculations. The analyte spiking gases contained a low concentration of sulfur hexafluoride (SF_6). The determined SF_6 concentration in the spiked sample was used to calculate the dilution factor of the spike and thus used to calculate the concentration of the spiked HCl. The spike target dilution ratio was 1:10 or less.
The following equation illustrates the percent recovery calculation.

$$DF = \frac{SF6(spk)}{SF6(direct)} \quad \text{(Sec. 9.2.3 (3) USEPA Method 320)}$$

$$CS = DF * Spike(dir) + Unspike(1 - DF) \quad \text{(Sec. 9.2.3 (4) USEPA Method 320)}$$

DF = Dilution factor of the spike gas
$SF_{6(dir)}$ = SF_6 concentration measured directly in undiluted spike gas
$SF_{6(spk)}$ = Diluted SF_6 concentration measured in a spiked sample
$Spike_{dir}$ = Concentration of the analyte in the spike standard measure by the FTIR directly
CS = Expected concentration of the spiked samples
Unspike = Native concentration of analytes in unspiked samples

Detection Limit

The detection limit of each analyte was calculated following Annex A2 of ASTM D6348-12 procedure using spectra that contained similar amounts of moisture.

FTIR DETECTION LIMITS			
Analyte	**Detection Limit (ppmv wet)**	**Detection Limit (%v)**	**Detection Limit (%v wet)**
Hydrogen Chloride	0.2	—	—
Water	—	**0.1**	**N/A**

QA/QC data are found in Appendix F. Copies of gas cylinder certifications are found in Appendix G. All concentration data were recorded on a wet, volume basis. The sample and data collection followed the procedures outlined in Methods 320 and 321.

3.0 TEST RESULT SUMMARY

Holcim (US) Inc. Alpena Cement Plant Wet Gas Scrubber Gaseous Summary								
Test No.	Date	Start Time	End Time	HCl ppmvw	HCl ppmvd	O_2, % (dry)	H_2O %	HCl ppmvd@7% O_2
*N/A	8/29/2022	9:34	10:04	2.78	3.21	10.03	13.39%	4.1
*N/A	8/29/2022	10:04	10:34	2.37	2.74	10.21	13.79%	3.6
*Averages				2.57	2.98	10.12	13.59%	3.8
1	8/29/2022	15:10	15:39	1.55	1.81	11.62	14.18%	2.7
1	8/29/2022	15:40	16:09	1.39	1.63	11.45	14.54%	2.4
Averages				1.47	1.72	11.54	14.36%	2.6
2	8/29/2022	17:13	17:42	0.94	1.09	11.26	14.33%	1.6
2	8/29/2022	17:43	18:12	0.88	1.02	11.20	14.23%	1.5
Averages				0.91	1.06	11.23	14.28%	1.5
3	8/29/2022	19:20	19:49	0.83	0.96	10.03	13.41%	1.2
3	8/29/2022	19:50	20:19	0.65	0.75	10.21	13.18%	1.0
Averages				0.74	0.85	10.12	13.30%	1.1
Three Run Average				1.04	1.21	10.96	13.98%	1.72

*Aborted Run 1 due to Method 320/321 temperatures below 180 degrees Celsius

4.0 CERTIFICATION

Mostardi Platt is pleased to have been of service to Holcim (US) Inc. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

MOSTARDI PLATT

Stuart Sands — Program Manager

Eric Ehlers — Quality Assurance