

Section 114 Information Collection Request Emissions Test Report

Heidelberg Materials US Cement, LLC
Mitchell Cement Manufacturing Facility
EPA Registry ID: 110043798744
Kiln 4 Stack
180 N Meridian Road
Mitchell, Indiana 47446
Report No. M234006A





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**Report Submittal Date:
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1.0 INTRODUCTION

Mostardi Platt conducted an air emissions test program for Heidelberg Materials US Cement, LLC at the Mitchell Cement Manufacturing Facility located in Mitchell, Indiana. All testing was performed as described in the *Code of Federal Regulations*, Title 40, Part 60, Appendix A (40CFR60), Methods 1, 2, 3A, 4, 26A, and 40CFR63, Appendix A, (40CFR63) Method 320.

The Heidelberg Material US Mitchell Cement Plant includes one KHD 5 stage dual string preheater/precalciner kiln equipped with a low NO_x burner and calciner. Additionally, the kiln is equipped with a baghouse, selective non-catalytic reduction, and activated carbon. Cooler emissions are exhausted through the kiln. The kiln is expected to process approximately 7,000 tons/hour.

This test program was completed to satisfy the requirements of the United States Environmental Protection Agency (USEPA) Section 114 Information Collection Request for Portland Cement Manufacturing facilities as described in "Attachment 3 Source Testing Request for Portland Cement: Reporting Requirements".

The identification of individuals associated with the test program is summarized below:

Location	Address	Contact
Facility Representative	Heidelberg Materials US Cement, LLC Mitchell Cement Manufacturing Facility 180 N Meridian Rd Mitchell, Indiana 47446	Michael Harding, CHMM Environmental Manager (812) 620-8714 Michael.Harding@heidelbergmaterials.com
Testing Company Representative	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Eric Ehlers VP, Field Operations (630) 993-2100 eehlers@mp-mail.com

2.0 TEST RESULTS

Testing was performed at the Kiln 4 exhaust stack. The following table presents a list of the parameters to tested, the applicable methodologies utilized, and average test results:

Source	Parameter Tested	Test Results	Method/Regulation Citation
Kiln 4 Mill On	Hydrogen Fluoride (HF)	≤ 0.10 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		≤ 0.19 ppmvd @7% O ₂	
		≤ 0.23 lb/hr	
		≤ 0.0008 lb/ton clinker	
	HF ¹	≤ 0.15 ppmvd	Method 26A, 40CFR60, Appendix A
		≤ 0.24 ppmvd @7% O ₂	
		≤ 0.27 lb/hr	
		≤ 0.0009 lb/ton clinker	
	Chlorine (Cl ₂) ¹	≤ 0.04 ppmvw	USEPA Method 26A, 40CFR60, Appendix A
		≤ 0.06 ppmvd @7% O ₂	
		≤ 0.26 lb/hr	
		≤ 0.0009 lb/ton clinker	
	Hydrogen Cyanide (HCN)	8.14 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		15.68 ppmvd @7% O ₂	
		25.20 lb/hr	
		0.0907 lb/ton clinker	
	Oxygen (O ₂)	10.5 % (dry)	USEPA Method 3A, 40CFR60, Appendix A
	Carbon Dioxide (CO ₂)	13.3 % (dry)	USEPA Method 320, 40CFR63, Appendix A
	Moisture (H ₂ O)	15.5 %	USEPA Method 320, 40CFR63, Appendix A
	Cyclonic Flow Determination	PASS	USEPA Method 1, 40CFR60, Appendix A, Section 11.4
	Three-point O ₂ Stratification Determination	< 5 %	USEPA Method 3A, 40CFR60, Appendix A and Method 7E, Section 8.1.2

¹ HF and Cl₂ Method 26A results are reported as the average from Train A and Train B.

Source	Parameter Tested	Test Results	Method/Regulation Citation
Kiln 4 Mill Off	Hydrogen Fluoride (HF)	≤ 0.10 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		≤ 0.19 ppmvd @7% O ₂	
		≤ 0.21 lb/hr	
		≤ 0.0007 lb/ton clinker	
	HF ²	≤ 0.15 ppmvd	Method 26A, 40CFR60, Appendix A
		≤ 0.22 ppmvd @7% O ₂	
		≤ 0.22 lb/hr	
		≤ 0.0015 lb/ton clinker	
	Chlorine (Cl ₂) ¹	≤ 0.04 ppmvw	USEPA Method 26A, 40CFR60, Appendix A
		≤ 0.06 ppmvd @7% O ₂	
		≤ 0.22 lb/hr	
		≤ 0.0015 lb/ton clinker	
	Hydrogen Cyanide (HCN)	11.00 ppmvw	USEPA Method 320, 40CFR63, Appendix A
		20.42 ppmvd @7% O ₂	
		31.50 lb/hr	
		0.1079 lb/ton clinker	
	Oxygen (O ₂)	10.6 % (dry)	USEPA Method 3A, 40CFR60, Appendix A
	Carbon Dioxide (CO ₂)	13.7 % (dry)	USEPA Method 320, 40CFR63, Appendix A
	Moisture (H ₂ O)	13.5 %	USEPA Method 320, 40CFR63, Appendix A

² HF and Cl₂ Method 26A results are reported as the average from Train A and Train B.

3.0 QA SPECIFICATIONS AND PROCESS DIAGRAM

3-1 QA/QC Specifications

Parameter	Method	QA/QC Specification	Acceptance Criteria	Actual Result
HCN	320	Method Detection Limit	0.5 ppm	0.2 ppmvw
		SNR	>2500 at 64 scans	4510 (Run 1 Average)
		S Beam	>0.9	0.9 (Run 1 Average)
		Direct HCN Analysis	±5% of tag value	-2.2%
		Dynamic Spike Analysis	≤10% of total sample volume	< 10% for all spikes
			Spike gas ~twice native concentration or 3-4 ppm addition to native concentration	2x native concentration
			≤±20% of expected value or ≤±0.5 ppm, whichever is less restrictive	≤+/-20% of expected value
HF/Cl ₂	26A	Residuals	≤±0.3 ppm, or ≤±5% of measured value, whichever is less restrictive	≤±0.3 ppm
		Method Detection Limit	300 ug	150 ug ³
		Paired Train Agreement	≤10% Relative Deviation or ≤0.2 ppm, whichever is less restrictive.	2.0%

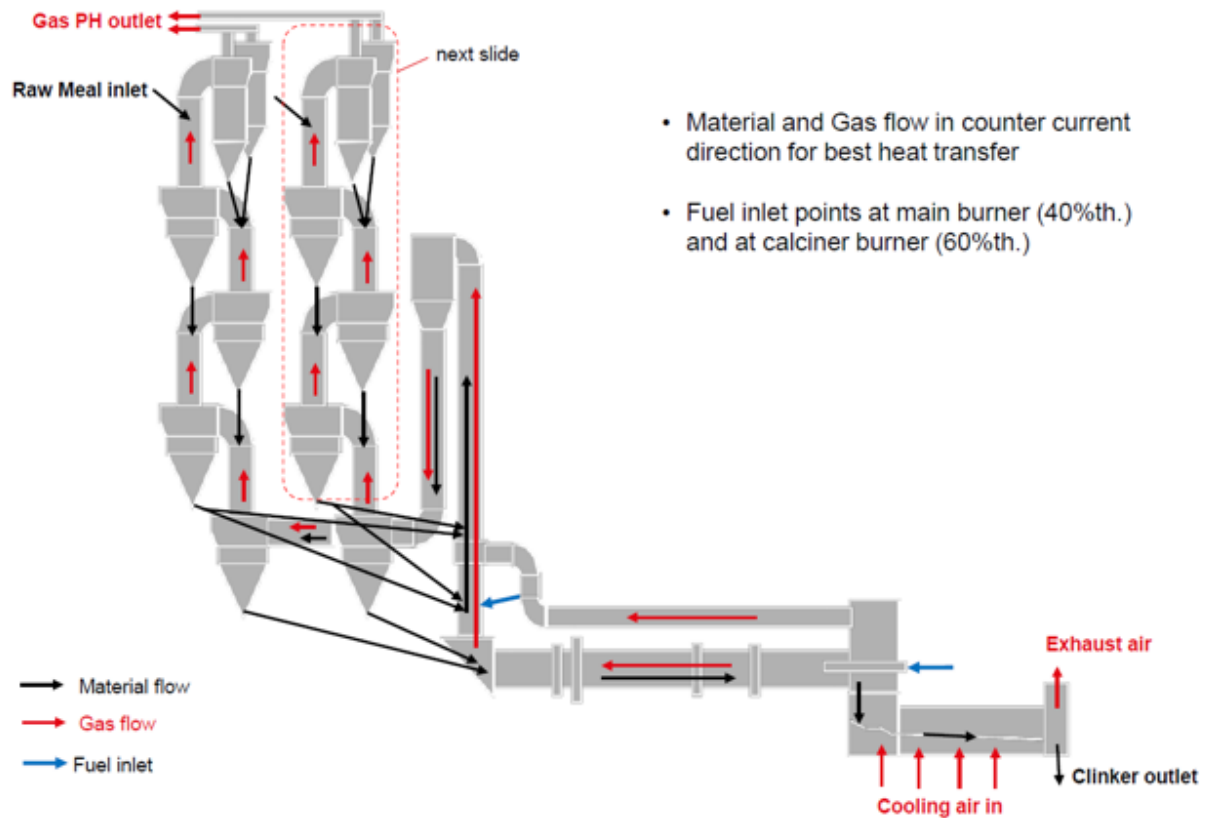
³ Determined by procedures outlined in USEPA Office of Water document 821-R-16-006 "Definition and Procedure for the Determination of the Method Detection Limit, Revision 2" Published in December 2016.

3-2 Process Flow Diagram

Material and Gas Flows

Lehigh Hanson
HEIDELBERGCEMENT Group

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WEDAG



4.0 TEST PROCEDURES

All testing, sampling, analytical, and calibration procedures used for this test program were performed as described in the Title 40, *Code of Federal Regulations*, Part 60, Appendix A (40CFR60), Methods 1, 2, 3A, 4, 26A, and 40CFR63, Appendix A, Method 320; and the latest revisions thereof. Where applicable, the *Quality Assurance Handbook for Air Pollution Measurement Systems*, Volume III, Stationary Source Specific Methods, United States Environmental Protection Agency (USEPA) 600/R-94/038c, September 1994 was used to supplement procedures in addition to the appended "Draft General Test Plan".

4.1 Method 1 Sample and Velocity Traverse Determination

Sample points for testing are determined using USEPA Test Method 1, 40CFR60, Appendix A. The characteristics of the measurement location is summarized below.

Sample Point Selection

Test Location	Duct Dimensions (Feet)	Upstream Diameters	Downstream Diameters	Test Parameter	Number of Sampling Points
Kiln 4 Stack	19.685 Feet	1.5 diameters	15.2 diameters	HF/Cl ₂ (26A)	24
				O ₂ (3A)	3 (stratification)
				HCN/HF/O ₂ (320/3A)	1

A cyclonic flow check was performed in accordance with Section 11.4, which demonstrated it meets the criteria of an average value of less than 20° and therefore is considered to be a suitable testing location for flow rate measurements.

4.2 Method 2 Volumetric Flow Rate Determination

The gas velocity and volumetric flowrate were determined using Method 2, 40CFR60, Appendix A, as an integrated part of the HF/Cl₂ sampling system.

Velocity pressures were determined by traversing the duct with wind tunnel calibrated S-type pitot tube. Temperatures were measured using K-type thermocouples with calibrated digital temperature indicators. The molecular weight and moisture content of the gases were also determined to permit the calculation of the volumetric flowrate.

4.3 Method 3A Oxygen (O₂) and Carbon Dioxide (CO₂) Determination

O₂ and CO₂ concentrations were determined in accordance with Method 3A, 40CFR60, Appendix A and Method 320, 40CFR63, Appendix A, respectively. A Servomex analyzer was used to determine O₂ concentrations while the MKS 2030 analyzer was used to determine CO₂ concentrations. The O₂ instrument has a paramagnetic detector and operates in a nominal range of 0-25%.

A list of calibration gases used and the results of all calibration and other required quality assurance checks are found in the appendix of this report. Copies of calibration gas certifications are also appended.

4.4 Method 26A Hydrogen Fluoride (HF) and Chlorine (Cl₂)

Determination

HF and Cl₂ concentrations and emission rates were determined in accordance with Method 26A, 40CFR60, Appendix A. Paired sampling trains were used to collect the samples. A total of twenty-four (24) test points were sampled per run on the Kiln 4 stack. The sample was extracted isokinetically from the gas stream and passed through dilute sulfuric acid (0.1N H₂SO₄). HF was collected in the dilute acid. Cl₂ was collected in the dilute sodium hydroxide (0.1N NaOH) solution. The sample train consisted of a Teflon coated nozzle, a heated borosilicate glass probe liner, a Teflon® filter placed on the outlet of the glass probe liner, and six impingers. The first two impingers contained the 0.1N H₂SO₄, the third remained empty (and was recovered with the first two impingers), the fourth and fifth impingers contained the 0.1N NaOH, while the sixth impinger contained silica gel to absorb any remaining moisture. A de-ionized water rinse was performed on each set of impingers, and samples were stored in Nalgene sample containers for transport. The 0.1N H₂SO₄ impinger catch samples were analyzed for HF while the 0.1N NaOH impinger catch samples were analyzed for Cl₂. The method detection limit (MDL) was determined for both HF and Cl₂ using the "Definition and Procedure for the Determination of the Method Detection Limit, Revision 2". A value of 150ug was used for both compounds. All equipment used was calibrated in accordance with the specifications of the method. Calibration data is appended.

Hand recorded field data sheets were reviewed and scans are retained on the Mostardi Platt network. Copies of this data is available upon request.

4.5 Method 320 Speciated Flue Gas Concentration Determinations

The sampling procedures for HCN and HF were performed in accordance with USEPA Method 320, 40CFR63, Appendix A. Data was continuously recorded with a data logging system throughout sampling, with brief interruption to properly label reference spectra.

The average gas effluent concentrations were determined from the average gas concentration displayed by the MKS 2030 analyzer. The Method 320 sampling system vaporizes water droplets similar to Method 26A. The difference is that Method 320 is an extractive method that calculates concentration based on compounds continuously flowing through the FTIR gas cell where the Method 26A captures water vapor in an impinger train. Calculating Method 320 concentrations on a dry basis uses the water vapor contained in the FTIR gas cell. In order to calculate lb/hr, the dry FTIR concentration is used in combination with the dry stack gas volumetric flow rate.

All sampling system components were heated to 375°F +/- 25°F, including: stainless steel sample probe, stainless steel calibration tee, in line glass fiber particulate filter, Teflon® sample line, heated head sample pump, and FTIR detector cell. The sample pump distributes the gas sample to the instrument at a steady sample flow rate (+/- 10%). All components of the sampling system are constructed of stainless steel, glass, or Teflon®.

FTIR technology works on the principle that most gases absorb infrared light. This is true for all compounds except for homonuclear diatomic molecules and noble gases such as: N₂, O₂, H₂, 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 for 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. Data was generated at 0.5 cm^{-1} . Each Spectra was derived from the coaddition of 62-64 scans with a new data point generated approximately every minute. HCN analyte spiking assured the ability of the FTIR to quantify HCN in the presence of effluent gas. All analyte spikes were introduced using an instrument grade stainless steel rotameter. All QA/QC procedures were within the acceptance criteria allowance of the applicable methodology and the "General Test Plan."

5.0 TEST RESULTS SUMMARIES

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack (Train A)
 Test Method: 26A

	Source Condition	Mill On	Mill On	Mill On	
	Date	10/4/23	10/4/23	10/4/23	
	Start Time	12:30	14:00	15:20	
	End Time	13:40	15:09	16:32	
	Run 1A	Run 2A	Run 3A	Average	
Stack Conditions					
Average Gas Temperature, °F	240.1	227.6	225.0	230.9	
Flue Gas Moisture, percent by volume	15.4%	16.2%	14.6%	15.4%	
Average Flue Pressure, in. Hg	28.74	29.16	29.16	29.02	
Gas Sample Volume, dscf	45.006	46.410	45.700	45.705	
Average Gas Velocity, ft/sec	56.313	54.388	54.067	54.923	
Gas Volumetric Flow Rate, acfm	1,027,774	992,653	986,779	1,002,402	
Gas Volumetric Flow Rate, dscfm	629,721	622,522	632,803	628,349	
Gas Volumetric Flow Rate, scfm	744,654	742,938	741,326	742,973	
Average %CO ₂ by volume, dry basis	13.3	13.2	13.5	13.3	
Average %O ₂ by volume, dry basis	12.4	12.4	12.3	12.4	
Isokinetic Variance	99.9	104.2	100.9	101.7	
Hydrogen Fluoride (HF) Emissions					
ug of sample collected	≤ 150.00	≤ 150.00	≤ 150.00	≤ 150.00	
ppm	≤ 0.14	≤ 0.14	≤ 0.14	≤ 0.14	
Chlorine (Cl₂) Emissions					
ug of sample collected	≤ 150.00	≤ 150.00	≤ 150.00	≤ 150.00	
ppm	≤ 0.04	≤ 0.04	≤ 0.04	≤ 0.04	

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack (Train B)
 Test Method: 26A

Source Condition	Mill On	Mill On	Mill On	
Date	10/4/23	10/4/23	10/4/23	
Start Time	12:30	14:00	15:20	
End Time	13:40	15:10	16:28	
	Run 1B	Run 2B	Run 3B	Average
Stack Conditions				
Average Gas Temperature, °F	240.9	232.3	231.4	234.9
Flue Gas Moisture, percent by volume	20.1%	14.2%	18.2%	17.5%
Average Flue Pressure, in. Hg	29.16	29.16	29.16	29.16
Gas Sample Volume, dscf	44.973	47.320	47.918	46.737
Average Gas Velocity, ft/sec	55.730	54.838	55.196	55.255
Gas Volumetric Flow Rate, acfm	1,017,137	1,000,861	1,007,385	1,008,461
Gas Volumetric Flow Rate, dscfm	596,716	638,583	613,178	616,159
Gas Volumetric Flow Rate, scfm	746,827	744,032	749,874	746,911
Average %CO ₂ by volume, dry basis	7.5	7.5	7.5	7.5
Average %O ₂ by volume, dry basis	15.9	15.8	15.8	15.8
Isokinetic Variance	105.3	103.5	109.2	106.0
Hydrogen Fluoride (HF) Emissions				
ug of sample collected	≤ 150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm	≤ 0.14	≤ 0.13	≤ 0.13	≤ 0.14
Chlorine (Cl₂) Emissions				
ug of sample collected	≤ 150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm	≤ 0.04	≤ 0.04	≤ 0.04	≤ 0.04

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Test Method: 26A - Combined Results

Source Condition	Mill On	Mill On	Mill On	
Date	10/4/23	10/4/23	10/4/23	
Start Time	12:30	14:00	15:20	
End Time	13:40	15:09	16:32	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Velocity, ft/sec	56.022	54.613	54.632	55.089
Gas Volumetric Flow Rate, acfm	1,022,456	996,757	997,082	1,005,432
Gas Volumetric Flow Rate, dscfm	613,219	630,553	622,991	622,254
Gas Volumetric Flow Rate, scfm	745,741	743,485	745,600	744,942
Average %CO ₂ by volume, dry basis	13.3	13.2	13.5	13.3
Average %O ₂ by volume, dry basis	12.4	12.4	12.3	12.4
Clinker Production, ton/hr	280.0	272.3	280.8	277.7
Hydrogen Fluoride (HF) Emissions				
ppm ≤	0.14	≤ 0.14	≤ 0.14	≤ 0.14
ppm@7%O ₂ ≤	0.23	≤ 0.23	≤ 0.23	≤ 0.23
lb/hr ≤	0.9478	≤ 0.9746	≤ 0.9629	≤ 0.9618
lb/ton of clinker ≤	0.0034	≤ 0.0036	≤ 0.0034	≤ 0.0035
Chlorine (Cl₂) Emissions				
ppm ≤	0.04	≤ 0.04	≤ 0.04	≤ 0.04
ppm@7%O ₂ ≤	0.07	≤ 0.07	≤ 0.06	≤ 0.07
lb/hr ≤	0.0764	≤ 0.0786	≤ 0.0776	≤ 0.0776
lb/ton of clinker ≤	0.0003	≤ 0.0003	≤ 0.0003	≤ 0.0003

Heidelberg Materials Mitchell Cement Plant Kiln 4 Stack Mill On Reference Method Test Data									
Test No.	Date	Start Time	End Time	O2 % (wet)	Moisture %	HCN ppmvw	HCN ppmvd @ 7% O2	HF ppmvw	HF ppmvd @ 7% O2
1	10/4/2023	12:30	13:29	10.6	15.0%	8.42	16.23	≤ 0.10	≤ 0.19
2	10/4/2023	14:00	14:59	10.5	15.7%	7.66	14.89	≤ 0.10	≤ 0.19
3	10/4/2023	15:20	16:19	10.4	15.6%	8.34	15.93	≤ 0.10	≤ 0.19
Average				10.5	15.5%	8.14	15.68	≤ 0.10	≤ 0.19

Test No.	Date	Start Time	End Time	Volumetric Flow, DSCFM	Clinker Production, ton/hr	HCN lb/hr	HCN lb/ton	HF lb/hr	HF lb/ton
1	10/4/2023	12:30	13:29	613,219	280.0	25.55	0.0912	≤ 0.22	≤ 0.0008
2	10/4/2023	14:00	14:59	630,553	272.3	24.12	0.0886	≤ 0.23	≤ 0.0009
3	10/4/2023	15:20	16:19	622,991	280.8	25.92	0.0923	≤ 0.23	≤ 0.0008
Average				622,254	277.7	25.20	0.0907	≤ 0.23	≤ 0.0008

Client: Heidelberg Materials
Facility: Mitchell Cement Plant
Test Location: Kiln 4 Stack (Train A)
Test Method: 26A

Source Condition	Mill Off	Mill Off	Mill Off	
Date	10/3/23	10/3/23	10/4/23	
Start Time	21:12	22:39	0:05	
End Time	22:21	23:48	1:14	
	Run 1A	Run 2A	Run 3A	Average
Stack Conditions				
Average Gas Temperature, °F	317.7	313.5	313.2	314.8
Flue Gas Moisture, percent by volume	14.1%	13.7%	14.3%	14.0%
Average Flue Pressure, in. Hg	29.05	29.05	29.05	29.05
Gas Sample Volume, dscf	40.837	41.067	40.978	40.961
Average Gas Velocity, ft/sec	55.984	55.900	55.829	55.904
Gas Volumetric Flow Rate, acfm	1,021,779	1,020,250	1,018,939	1,020,323
Gas Volumetric Flow Rate, dscfm	578,351	583,938	579,124	580,471
Gas Volumetric Flow Rate, scfm	673,606	676,293	675,642	675,180
Average %CO ₂ by volume, dry basis	13.5	13.8	13.9	13.7
Average %O ₂ by volume, dry basis	12.5	12.2	12.0	12.2
Isokinetic Variance	98.7	98.3	98.9	98.6
Hydrogen Fluoride (HF) Emissions				
ug of sample collected ≤	150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm ≤	0.16	≤ 0.16	≤ 0.16	≤ 0.16
Chlorine (Cl₂) Emissions				
ug of sample collected ≤	150.0	≤ 150.0	≤ 150.0	≤ 150.0
ppm ≤	0.04	≤ 0.04	≤ 0.04	≤ 0.04

Client: Heidelberg Materials
Facility: Mitchell Cement Plant
Test Location: Kiln 4 Stack (Train B)
Test Method: 26A

Source Condition	Mill Off	Mill Off	Mill Off	
Date	10/3/23	10/3/23	10/4/23	
Start Time	21:12	22:39	0:05	
End Time	22:21	23:48	1:14	
	Run 1B	Run 2B	Run 3B	Average
Stack Conditions				
Average Gas Temperature, °F	308.8	310.7	309.7	309.7
Flue Gas Moisture, percent by volume	13.8%	14.3%	15.1%	14.4%
Average Flue Pressure, in. Hg	29.05	29.05	29.05	29.05
Gas Sample Volume, dscf	42.545	42.823	42.709	42.692
Average Gas Velocity, ft/sec	56.814	57.457	57.506	57.259
Gas Volumetric Flow Rate, acfm	1,036,926	1,048,650	1,049,554	1,045,043
Gas Volumetric Flow Rate, dscfm	596,038	598,161	593,339	595,846
Gas Volumetric Flow Rate, scfm	691,520	697,637	699,146	696,101
Average %CO ₂ by volume, dry basis	13.0	13.5	13.9	13.5
Average %O ₂ by volume, dry basis	12.5	12.2	12.0	12.2
Isokinetic Variance	99.7	100.0	100.6	100.1
Hydrogen Fluoride (HF) Emissions				
ug of sample collected ≤	150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm ≤	0.15	≤ 0.15	≤ 0.15	≤ 0.15
Chlorine (Cl₂) Emissions				
ug of sample collected ≤	150.00	≤ 150.00	≤ 150.00	≤ 150.00
ppm ≤	0.04	≤ 0.04	≤ 0.04	≤ 0.04

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Test Method: 26A - Combined Results

Source Condition	Mill Off	Mill Off	Mill Off	
Date	10/3/23	10/3/23	10/4/23	
Start Time	21:12	22:39	0:05	
End Time	22:21	23:48	1:14	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Velocity, ft/sec	56.399	56.679	56.668	56.582
Gas Volumetric Flow Rate, acfm	1,029,353	1,034,450	1,034,247	1,032,683
Gas Volumetric Flow Rate, dscfm	587,195	591,050	586,232	588,159
Gas Volumetric Flow Rate, scfm	682,563	686,965	687,394	685,641
Average %CO ₂ by volume, dry basis	13.5	13.8	13.9	13.7
Average %O ₂ by volume, dry basis	12.5	12.2	12.0	12.2
Clinker Production (ton/hr)	291.8	291.8	291.8	291.8
Hydrogen Fluoride (HF) Emissions				
ppm ≤	0.15	≤ 0.15	≤ 0.15	≤ 0.15
ppm@7%O ₂ ≤	0.25	≤ 0.24	≤ 0.23	≤ 0.24
lb/hr ≤	0.9724	≤ 0.9788	≤ 0.9708	≤ 0.9740
lb/ton ≤	0.0033	≤ 0.0034	≤ 0.0033	≤ 0.0033
Chlorine (Cl₂) Emissions				
ppm ≤	0.04	≤ 0.04	≤ 0.04	≤ 0.04
ppm@7%O ₂ ≤	0.07	≤ 0.06	≤ 0.06	≤ 0.06
lb/hr ≤	0.0732	≤ 0.0737	≤ 0.0731	≤ 0.0733
lb/ton ≤	0.0003	≤ 0.0003	≤ 0.0003	≤ 0.0003

Heidelberg Materials Mitchell Cement Plant Kiln 4 Stack Mill Off Reference Method Test Data									
Test No.	Date	Start Time	End Time	O2 % (wet)	Moisture %	HCN ppmvw	HCN ppmvd @ 7% O2	HF ppmvw	HF ppmvd @ 7% O2
1	10/3/2023	21:12	22:11	10.9	13.2%	10.96	20.91	≤ 0.10	≤ 0.19
2	10/3/2023	22:39	23:38	10.6	13.6%	11.03	20.30	≤ 0.10	≤ 0.18
3	10/4/2023	0:05	1:04	10.4	13.8%	11.03	20.03	≤ 0.10	≤ 0.18
Average				10.6	13.5%	11.00	20.42	≤ 0.10	≤ 0.19

Test No.	Date	Start Time	End Time	Volumetric Flow, DSCFM	Clinker Production, ton/hr	HCN lb/hr	HCN lb/ton	HF lb/hr	HF lb/ton
1	10/3/2023	21:12	22:11	587,195	291.8	31.20	0.1069	≤ 0.21	≤ 0.0007
2	10/3/2023	22:39	23:38	591,050	291.8	31.72	0.1087	≤ 0.21	≤ 0.0007
3	10/4/2023	0:05	1:04	586,232	291.8	31.56	0.1082	≤ 0.21	≤ 0.0007
Average				588,159	291.8	31.50	0.1079	≤ 0.21	≤ 0.0007

6.0 CERTIFICATION

Mostardi Platt is pleased to have been of service to Heidelberg Materials US Cement, LLC. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.

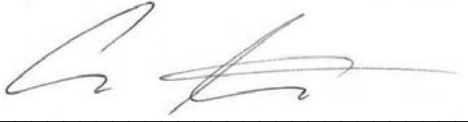
As project manager, I hereby certify that this test report represents a true and accurate summary of emissions test results and the methodologies employed to obtain those results, and the test program was performed in accordance with the methods specified in this test report.

MOSTARDI PLATT



Eric L. Ehlers

Project Manager



Chet A. Gutwein

Quality Assurance

APPENDICES

Appendix A – Plant Operating Data

Date/Time	KILN_CEMS: CLINKER_PROD (TNHR) Raw Value
10/03/2023 21:12	291.85
10/03/2023 21:13	291.83
10/03/2023 21:14	291.85
10/03/2023 21:15	291.82
10/03/2023 21:16	291.82
10/03/2023 21:17	291.90
10/03/2023 21:18	291.82
10/03/2023 21:19	291.90
10/03/2023 21:20	291.82
10/03/2023 21:21	291.87
10/03/2023 21:22	291.85
10/03/2023 21:23	291.83
10/03/2023 21:24	291.83
10/03/2023 21:25	291.90
10/03/2023 21:26	291.83
10/03/2023 21:27	291.85
10/03/2023 21:28	291.83
10/03/2023 21:29	291.78
10/03/2023 21:30	291.88
10/03/2023 21:31	291.80
10/03/2023 21:32	291.83
10/03/2023 21:33	291.80
10/03/2023 21:34	291.82
10/03/2023 21:35	291.83
10/03/2023 21:36	291.80
10/03/2023 21:37	291.82
10/03/2023 21:38	291.82
10/03/2023 21:39	291.87
10/03/2023 21:40	291.82
10/03/2023 21:41	291.87
10/03/2023 21:42	291.85
10/03/2023 21:43	291.82
10/03/2023 21:44	291.80
10/03/2023 21:45	291.82
10/03/2023 21:46	291.83
10/03/2023 21:47	291.82
10/03/2023 21:48	291.78
10/03/2023 21:49	291.83
10/03/2023 21:50	291.85
10/03/2023 21:51	291.82
10/03/2023 21:52	291.85
10/03/2023 21:53	291.85
10/03/2023 21:54	291.82
10/03/2023 21:55	291.85
10/03/2023 21:56	291.87
10/03/2023 21:57	291.82
10/03/2023 21:58	291.82
10/03/2023 21:59	291.85
10/03/2023 22:00	291.82
10/03/2023 22:01	291.80
10/03/2023 22:02	291.80
10/03/2023 22:03	291.80
10/03/2023 22:04	291.87
10/03/2023 22:05	291.88
10/03/2023 22:06	291.85
10/03/2023 22:07	291.80
10/03/2023 22:08	291.85
10/03/2023 22:09	291.85
10/03/2023 22:10	291.87
10/03/2023 22:11	291.82
Mill Off Run 1 Avg	291.84

Date/Time	KILN_CEMS: CLINKER_PROD (TNHR) Raw Value
10/03/2023 22:39	291.82
10/03/2023 22:40	291.83
10/03/2023 22:41	291.82
10/03/2023 22:42	291.83
10/03/2023 22:43	291.82
10/03/2023 22:44	291.80
10/03/2023 22:45	291.83
10/03/2023 22:46	291.80
10/03/2023 22:47	291.83
10/03/2023 22:48	291.85
10/03/2023 22:49	291.85
10/03/2023 22:50	291.83
10/03/2023 22:51	291.83
10/03/2023 22:52	291.83
10/03/2023 22:53	291.83
10/03/2023 22:54	291.83
10/03/2023 22:55	291.85
10/03/2023 22:56	291.82
10/03/2023 22:57	291.82
10/03/2023 22:58	291.87
10/03/2023 22:59	291.83
10/03/2023 23:00	291.82
10/03/2023 23:01	291.82
10/03/2023 23:02	291.87
10/03/2023 23:03	291.87
10/03/2023 23:04	291.83
10/03/2023 23:05	291.83
10/03/2023 23:06	291.80
10/03/2023 23:07	291.88
10/03/2023 23:08	291.83
10/03/2023 23:09	291.83
10/03/2023 23:10	291.80
10/03/2023 23:11	291.83
10/03/2023 23:12	291.87
10/03/2023 23:13	291.82
10/03/2023 23:14	291.83
10/03/2023 23:15	291.85
10/03/2023 23:16	291.82
10/03/2023 23:17	291.82
10/03/2023 23:18	291.80
10/03/2023 23:19	291.85
10/03/2023 23:20	291.87
10/03/2023 23:21	291.85
10/03/2023 23:22	291.87
10/03/2023 23:23	291.80
10/03/2023 23:24	291.83
10/03/2023 23:25	291.83
10/03/2023 23:26	291.80
10/03/2023 23:27	291.82
10/03/2023 23:28	291.80
10/03/2023 23:29	291.93
10/03/2023 23:30	291.87
10/03/2023 23:31	291.85
10/03/2023 23:32	291.87
10/03/2023 23:33	291.85
10/03/2023 23:34	291.88
10/03/2023 23:35	291.83
10/03/2023 23:36	291.82
10/03/2023 23:37	291.87
10/03/2023 23:38	291.82
Mill Off Run 2 Avg	291.84

Date/Time	KILN_CEMS: CLINKER_PROD (TNHR) Raw Value
10/04/2023 00:05	291.82
10/04/2023 00:06	291.83
10/04/2023 00:07	291.82
10/04/2023 00:08	291.82
10/04/2023 00:09	291.85
10/04/2023 00:10	291.85
10/04/2023 00:11	291.83
10/04/2023 00:12	291.85
10/04/2023 00:13	291.83
10/04/2023 00:14	291.83
10/04/2023 00:15	291.83
10/04/2023 00:16	291.85
10/04/2023 00:17	291.83
10/04/2023 00:18	291.85
10/04/2023 00:19	291.82
10/04/2023 00:20	291.83
10/04/2023 00:21	291.87
10/04/2023 00:22	291.83
10/04/2023 00:23	291.83
10/04/2023 00:24	291.83
10/04/2023 00:25	291.85
10/04/2023 00:26	291.83
10/04/2023 00:27	291.85
10/04/2023 00:28	291.83
10/04/2023 00:29	291.87
10/04/2023 00:30	291.90
10/04/2023 00:31	291.82
10/04/2023 00:32	291.87
10/04/2023 00:33	291.83
10/04/2023 00:34	291.82
10/04/2023 00:35	291.83
10/04/2023 00:36	291.80
10/04/2023 00:37	291.83
10/04/2023 00:38	291.82
10/04/2023 00:39	291.85
10/04/2023 00:40	291.83
10/04/2023 00:41	291.83
10/04/2023 00:42	291.88
10/04/2023 00:43	291.83
10/04/2023 00:44	291.80
10/04/2023 00:45	291.80
10/04/2023 00:46	291.83
10/04/2023 00:47	291.85
10/04/2023 00:48	291.83
10/04/2023 00:49	291.85
10/04/2023 00:50	291.82
10/04/2023 00:51	291.83
10/04/2023 00:52	291.83
10/04/2023 00:53	291.85
10/04/2023 00:54	291.87
10/04/2023 00:55	291.88
10/04/2023 00:56	291.80
10/04/2023 00:57	291.87
10/04/2023 00:58	291.80
10/04/2023 00:59	291.83
10/04/2023 01:00	291.83
10/04/2023 01:01	291.83
10/04/2023 01:02	291.85
10/04/2023 01:03	291.85
10/04/2023 01:04	291.80
Mill Off Run 3 Avg	291.84

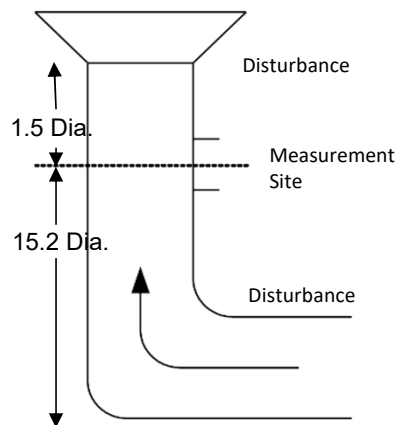
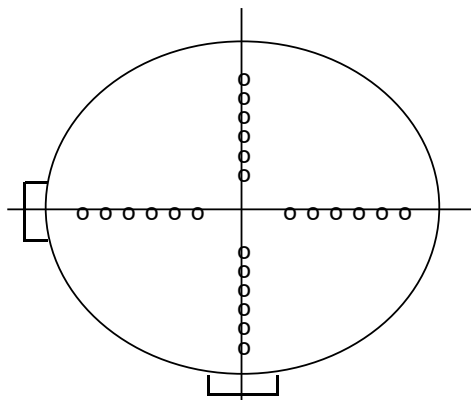
Date/Time	KILN_CEMS: CLINKER_PROD (TNHR) Raw Value
10/04/2023 12:30	291.82
10/04/2023 12:31	291.82
10/04/2023 12:32	291.85
10/04/2023 12:33	291.82
10/04/2023 12:34	291.88
10/04/2023 12:35	291.83
10/04/2023 12:36	291.85
10/04/2023 12:37	291.85
10/04/2023 12:38	291.80
10/04/2023 12:39	291.83
10/04/2023 12:40	291.80
10/04/2023 12:41	291.82
10/04/2023 12:42	291.83
10/04/2023 12:43	291.83
10/04/2023 12:44	291.80
10/04/2023 12:45	291.82
10/04/2023 12:46	291.85
10/04/2023 12:47	291.85
10/04/2023 12:48	291.85
10/04/2023 12:49	291.85
10/04/2023 12:50	291.82
10/04/2023 12:51	291.78
10/04/2023 12:52	291.90
10/04/2023 12:53	291.85
10/04/2023 12:54	291.80
10/04/2023 12:55	271.47
10/04/2023 12:56	271.50
10/04/2023 12:57	271.50
10/04/2023 12:58	271.48
10/04/2023 12:59	271.52
10/04/2023 13:00	271.47
10/04/2023 13:01	271.48
10/04/2023 13:02	271.45
10/04/2023 13:03	271.48
10/04/2023 13:04	271.50
10/04/2023 13:05	271.50
10/04/2023 13:06	271.47
10/04/2023 13:07	271.47
10/04/2023 13:08	271.50
10/04/2023 13:09	271.48
10/04/2023 13:10	271.50
10/04/2023 13:11	271.48
10/04/2023 13:12	271.52
10/04/2023 13:13	271.50
10/04/2023 13:14	271.47
10/04/2023 13:15	271.48
10/04/2023 13:16	271.50
10/04/2023 13:17	271.48
10/04/2023 13:18	271.52
10/04/2023 13:19	271.52
10/04/2023 13:20	271.45
10/04/2023 13:21	271.48
10/04/2023 13:22	271.52
10/04/2023 13:23	271.43
10/04/2023 13:24	271.48
10/04/2023 13:25	271.50
10/04/2023 13:26	271.48
10/04/2023 13:27	271.48
10/04/2023 13:28	271.47
10/04/2023 13:29	271.52
Mill On Run 1 Avg	279.96

Date/Time	KILN_CEMS: CLINKER_PROD (TNHR) Raw Value
10/04/2023 14:00	278.25
10/04/2023 14:01	278.25
10/04/2023 14:02	278.22
10/04/2023 14:03	278.25
10/04/2023 14:04	278.27
10/04/2023 14:05	278.22
10/04/2023 14:06	278.30
10/04/2023 14:07	273.07
10/04/2023 14:08	271.50
10/04/2023 14:09	271.45
10/04/2023 14:10	271.48
10/04/2023 14:11	271.45
10/04/2023 14:12	271.45
10/04/2023 14:13	271.47
10/04/2023 14:14	271.50
10/04/2023 14:15	271.48
10/04/2023 14:16	271.48
10/04/2023 14:17	271.47
10/04/2023 14:18	271.50
10/04/2023 14:19	271.42
10/04/2023 14:20	271.45
10/04/2023 14:21	271.52
10/04/2023 14:22	271.50
10/04/2023 14:23	271.47
10/04/2023 14:24	271.47
10/04/2023 14:25	271.52
10/04/2023 14:26	271.50
10/04/2023 14:27	271.45
10/04/2023 14:28	271.48
10/04/2023 14:29	271.53
10/04/2023 14:30	271.47
10/04/2023 14:31	271.48
10/04/2023 14:32	271.48
10/04/2023 14:33	271.48
10/04/2023 14:34	271.47
10/04/2023 14:35	271.50
10/04/2023 14:36	271.50
10/04/2023 14:37	271.47
10/04/2023 14:38	271.48
10/04/2023 14:39	271.53
10/04/2023 14:40	271.47
10/04/2023 14:41	271.43
10/04/2023 14:42	271.50
10/04/2023 14:43	271.45
10/04/2023 14:44	271.47
10/04/2023 14:45	271.50
10/04/2023 14:46	271.55
10/04/2023 14:47	271.47
10/04/2023 14:48	271.50
10/04/2023 14:49	271.47
10/04/2023 14:50	271.50
10/04/2023 14:51	271.47
10/04/2023 14:52	271.48
10/04/2023 14:53	271.50
10/04/2023 14:54	271.43
10/04/2023 14:55	271.47
10/04/2023 14:56	271.50
10/04/2023 14:57	271.48
10/04/2023 14:58	271.47
10/04/2023 14:59	271.50
Mill On Run 2 Avg	272.30

Date/Time	KILN_CEMS: CLINKER_PROD (TNHR) Raw Value
10/04/2023 15:20	278.30
10/04/2023 15:21	278.27
10/04/2023 15:22	278.35
10/04/2023 15:23	278.25
10/04/2023 15:24	278.25
10/04/2023 15:25	278.22
10/04/2023 15:26	278.27
10/04/2023 15:27	278.22
10/04/2023 15:28	278.23
10/04/2023 15:29	278.23
10/04/2023 15:30	278.20
10/04/2023 15:31	278.30
10/04/2023 15:32	278.28
10/04/2023 15:33	278.30
10/04/2023 15:34	278.25
10/04/2023 15:35	278.27
10/04/2023 15:36	278.28
10/04/2023 15:37	278.27
10/04/2023 15:38	278.28
10/04/2023 15:39	278.30
10/04/2023 15:40	278.25
10/04/2023 15:41	278.25
10/04/2023 15:42	278.28
10/04/2023 15:43	278.28
10/04/2023 15:44	278.27
10/04/2023 15:45	278.23
10/04/2023 15:46	278.27
10/04/2023 15:47	278.25
10/04/2023 15:48	278.30
10/04/2023 15:49	278.25
10/04/2023 15:50	278.23
10/04/2023 15:51	278.28
10/04/2023 15:52	278.27
10/04/2023 15:53	278.28
10/04/2023 15:54	278.25
10/04/2023 15:55	278.23
10/04/2023 15:56	278.28
10/04/2023 15:57	279.40
10/04/2023 15:58	285.08
10/04/2023 15:59	285.10
10/04/2023 16:00	285.07
10/04/2023 16:01	285.02
10/04/2023 16:02	285.03
10/04/2023 16:03	285.07
10/04/2023 16:04	285.07
10/04/2023 16:05	285.12
10/04/2023 16:06	285.07
10/04/2023 16:07	285.05
10/04/2023 16:08	285.08
10/04/2023 16:09	285.05
10/04/2023 16:10	285.02
10/04/2023 16:11	285.07
10/04/2023 16:12	285.07
10/04/2023 16:13	285.05
10/04/2023 16:14	285.00
10/04/2023 16:15	285.02
10/04/2023 16:16	285.08
10/04/2023 16:17	285.05
10/04/2023 16:18	285.05
10/04/2023 16:19	285.03
Mill On Run 3 Avg	280.77

Appendix B – Test Section Diagrams

EQUAL AREA TRAVERSE FOR ROUND DUCTS



Client: Heidelberg Materials

Facility: Mitchell Cement Plant

Test Location: Kiln 4 Stack

Date: 10/03/23 and 10/04/23

Diameter (Feet): 19.680

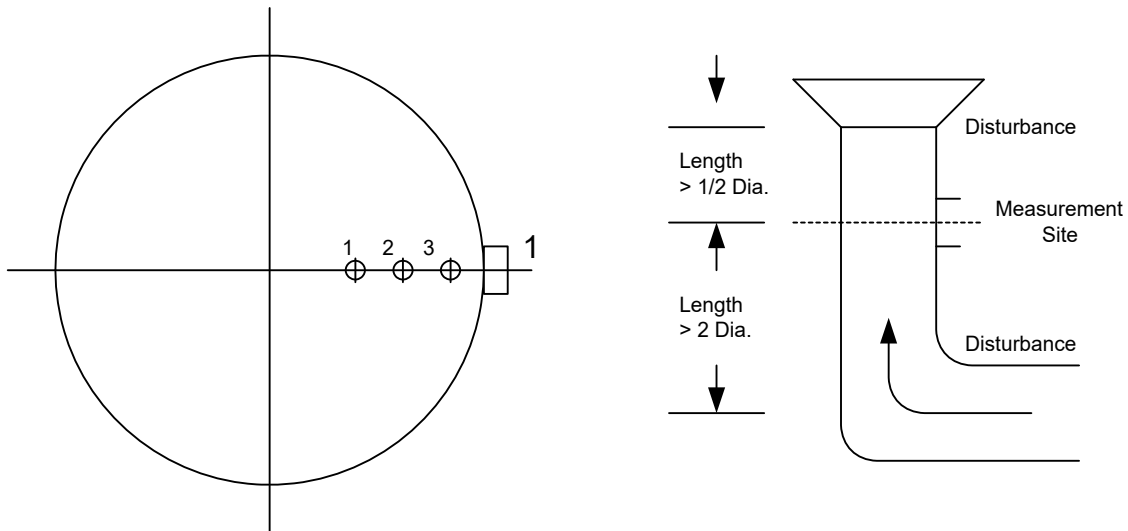
Port Length (In): 6.00

Ports Sampled: 4

Points/Port: 6

Point Markings		
	From inside wall (in.)	% of Diameter
1	4.96	2.10
2	15.82	6.70
3	27.87	11.80
4	41.80	17.70
5	59.04	25.00
6	84.07	35.60

GASEOUS TRAVERSE FOR ROUND DUCTS



Project: M234006

Date: October 3 and 4, 2023

Test Location: Mitchell Cement Plant
Kiln 4 Stack

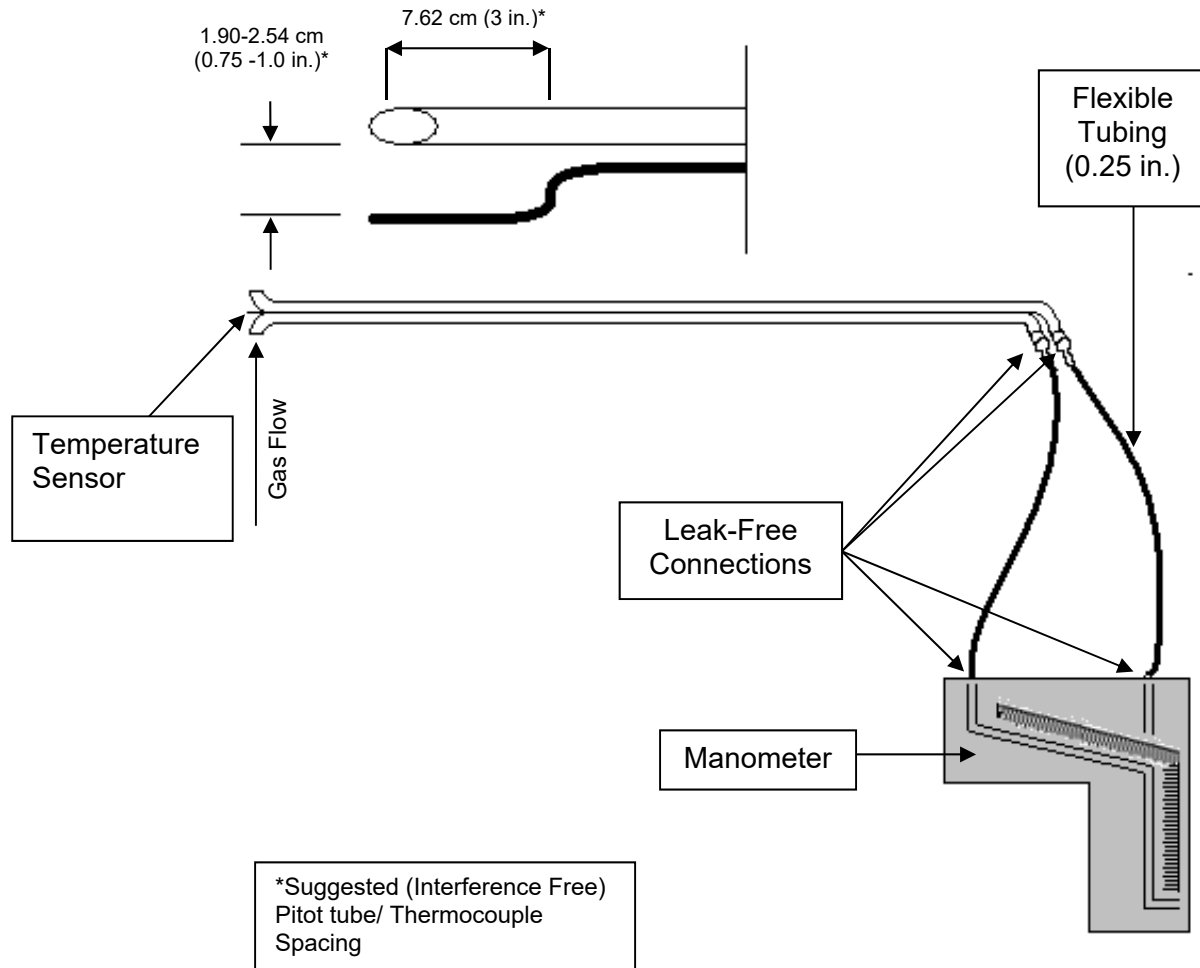
Duct Diameter: 19.680 Feet

Duct Area: 304.187 Square Feet

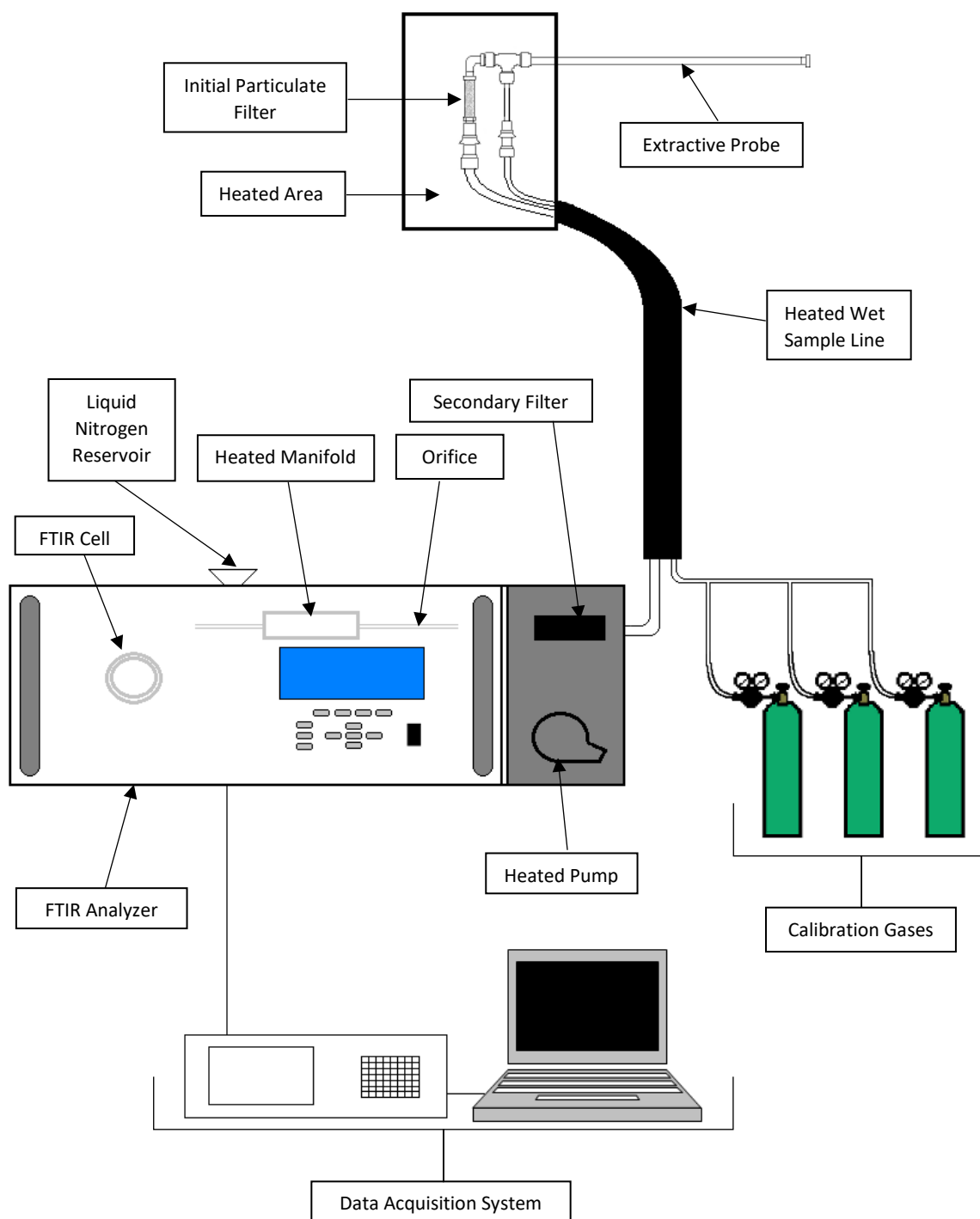
No. Sample Points: 3

Appendix C – Sample Train Diagrams

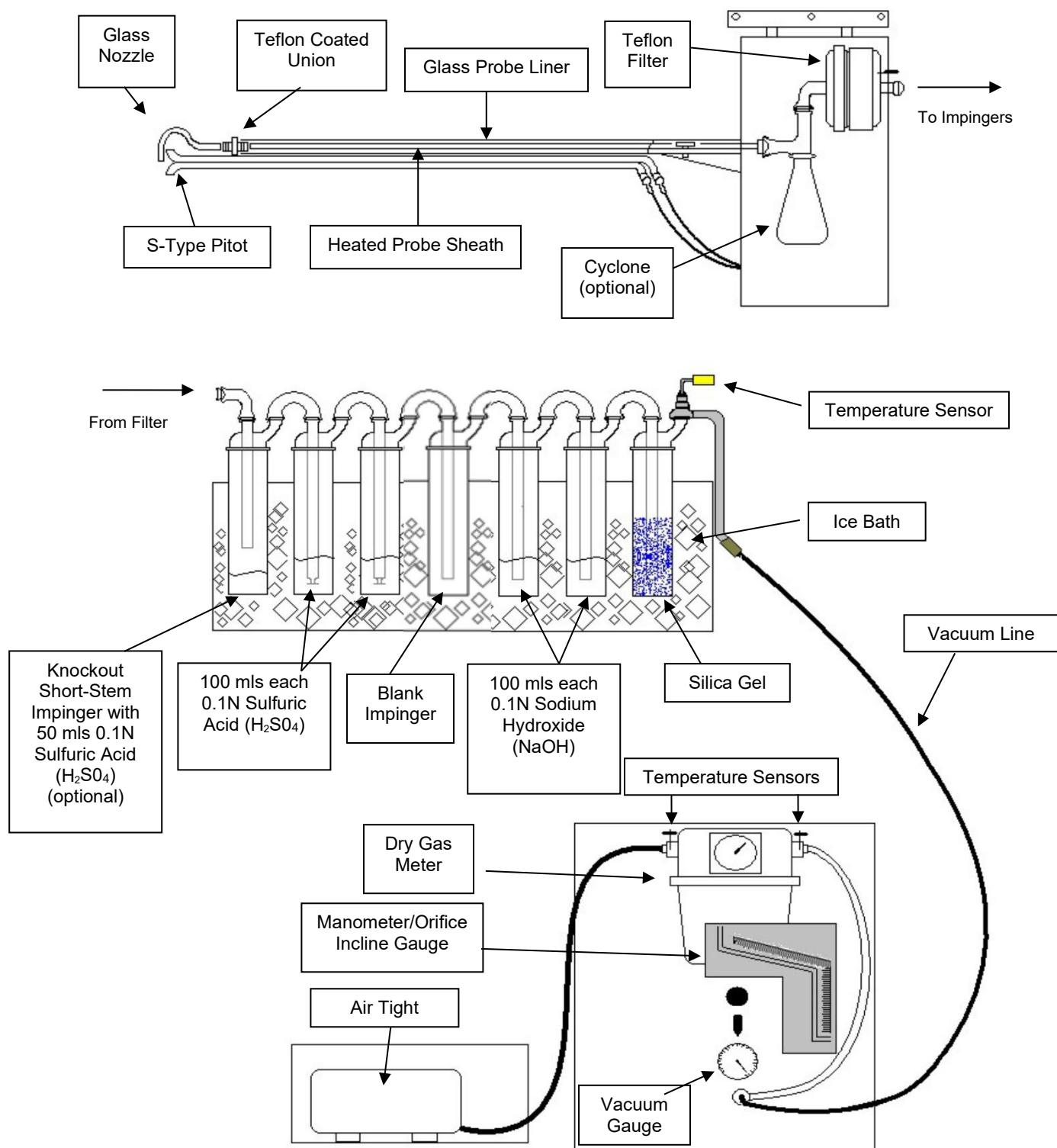
USEPA Method 2 – Type S Pitot Tube Manometer Assembly



USEPA Method 320 – Vapor Phase Organic and Inorganic Emissions by Extractive Fourier Transform Infrared (FTIR) Spectroscopy Sample Train Diagram



USEPA Method 26A – HCl and HF Sample Train Diagram



Appendix D – Calculation Nomenclature and Formulas

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Run: 1A
 Date: 10/4/2023
 Method: 26A
 Source Condition: Mill on

Dry Molecular Weight

$$Md = 0.44 \times (\%CO_2) + 0.32 \times (\%O_2) + 0.28 \times \%N_2$$

$$\%CO_2 = \underline{13.3} \qquad \%O_2 = \underline{12.4} \qquad \%N_2 = \underline{74.2}$$

$$Md = \underline{30.631}$$

Wet Molecular Weight

$$Ms = Md \times (1 - Bws) + (18.0 \times Bws)$$

$$Md = \underline{30.631} \qquad Bws = \underline{0.154}$$

$$Ms = \underline{28.682}$$

Meter Volume at Standard Conditions

$$Vm(std) = 17.647 \times Y \times Vm \times \frac{(Pbar + DH/13.6)}{Tm}$$

$$Y = \frac{1.003}{2.0} \qquad Vm = \frac{47.877}{84.7} \qquad Pbar = \underline{28.8}$$

$$Vm(std) = \underline{45.006}$$

Volume of Water Vapor Condensed

$$Vw(std) = 0.0471 \times (\text{net H}_2\text{O gain})$$

$$\text{Net H}_2\text{O} = \underline{174.4}$$

$$Vw(std) = \underline{8.214}$$

Moisture Content

$$Bws = \frac{Vw(std)}{Vw(std) + Vm(std)}$$

$$Vw(std) = \underline{8.214} \qquad Vm(std) = \underline{45.006}$$

$$Bws = \underline{0.154}$$

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Run: 1A
 Date: 10/4/2023
 Method: 26A
 Source Condition: Mill on

Average Duct Velocity

$$V_s = 85.49 \times C_p \times \sqrt{DP \text{ (avg)}} \times (T_s \text{ (avg)} + 460 / (P_s \times M_s))^{1/2}$$

$C_p = \frac{0.834}{28.74}$	$T_s \text{ (avg)} = \frac{240.1}{28.682}$	$\sqrt{DP \text{ (avg)}} = 0.857$
$P_s = 28.74$	$M_s = 28.682$	
$V_s = 56.313$		

Volumetric Flow Rate (Actual Basis)

$$Q = V_s \times A \times 60$$

$V_s = 56.313$	$A = 304.187$
$Q = 1,027,774$	

Volumetric Flow Rate (Standard Basis)

$$Q_{std} = 17.647 \times Q \times \frac{P_s}{T_s \text{ (avg)} + 460}$$

$Q = 1,027,774$	$P_s = 28.74$	$T_s \text{ (avg)} = 240.1$
$Q_{std} = 744,654$		

Volumetric Flow Rate (Standard Dry Basis)

$$Q_{std(dry)} = Q_{std} \times (1 - Bws)$$

$Q_{std} = 744,654$	$Bws = 0.154$
$Q_{std(dry)} = 629,721$	

Isokinetic Variation:

$$\%ISO = \frac{0.0945 \times (T_s + 460) \times V_m(std)}{V_s \times \theta \times A_n \times P_s \times (1 - Bws)}$$

$T_s = 240.1$	$V_m(std) = 45.006$	$V_s = 56.313$
$A_n = 0.0003630$	$\theta = 60$	$P_s = 28.74$
$Bws = 0.154$		
$\%ISO = 99.9$		

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Run: 1A
 Date: 10/4/2023
 Method: 26A
 Source Condition: Mill on

Chloride (Cl₂) Concentration:

$$\begin{aligned}
 \text{mg/m}^3 &= \frac{\text{mg of Chloride (Cl}_2\text{)}}{\text{Vm(std) x 0.02832 m}^3/\text{ft}^3} \\
 \text{mg} &= \underline{0.15} \quad \text{Vm(std)} = \underline{45.006} \\
 \text{mg/m}^3 &= \underline{0.12}
 \end{aligned}$$

Chloride (Cl₂) Emission Rate:

$$\begin{aligned}
 \text{lb of Chloride (Cl}_2\text{)} &= \frac{\mu\text{g of sample x } 10^6 \text{ grams}/\mu\text{g}}{453.6 \text{ grams/lb}} \\
 \text{Emission Rate lb/hr} &= \frac{\text{lb of Chloride (Cl}_2\text{)}}{\text{Vm(std)}} \times \text{dscfm} \times 60 \text{ min/hr} \\
 \text{lb of Chloride (Cl}_2\text{)} &= \underline{3.31\text{E-}10} \quad \text{dscfm} = \underline{629,721} \\
 \text{Emission Rate lb/hr} &= \underline{0.2776}
 \end{aligned}$$

Client: Heidelberg Materials
Facility: Mitchell, IN
Project #: M234006
Test Location: Kiln 4 Stack
Date: 10/3/23

Sample Calculations

$$(10.8 \text{ ppm} - 0.2 \text{ ppm}) \times \frac{\text{O2 \% (wet)} \quad 10.1 \text{ ppm}}{10.1 \text{ ppm} - 0.2 \text{ ppm}} = 10.9 \text{ ppm}$$

$$C_{\text{gas}} = (C - C_o) \times \frac{C_{\text{ma}}}{C_m - C_o}$$

where:

C_{gas} = Effluent gas concentration, dry basis, ppm or %

C = Average gas concentration indicated by gas analyzer, dry basis, ppm or %

C_o = Average of initial and final system calibration bias check responses for the zero gas, ppm or %

C_m = Average of initial and final system calibration bias check responses for the upscale calibration gas, ppm or %

C_{ma} = Actual concentration of the upscale calibration gas, ppm or %

Client: Heidelberg Materials
 Facility: Mitchell, IN
 Project #: M234006
 Test Location: Kiln 4 Stack
 Date: 10/3/23

FTIR Sample Calculations

Direct Recovery % of Calibration Transfer Standard

$$DR_{cts} = \frac{D_{cts}}{Cma} \times 100$$

$$Cma = \underline{100.0}$$

$$D_{cts} = \underline{96.3}$$

$$DR_{cts} = \underline{96.3\%}$$

Recovery % with Calibration Transfer Standard System Purge

$$R_{cts} = \frac{Sys_{cts}}{D_{cts}} \times 100$$

$$Sys_{cts} = \underline{95.1}$$

$$D_{cts} = \underline{96.3}$$

$$R_{cts} = \underline{99\%}$$

Direct Recovery % of Analyte Spike Gas

SF6

$$DR_{sf6} = \frac{D_{sf6}}{Cma} \times 100$$

$$Cma = \underline{10.0}$$

$$D_{sf6} = \underline{9.5}$$

$$DR_{sf6} = \underline{95\%}$$

HCN

$$DR_{asg} = \frac{D_{asg}}{Cma} \times 100$$

$$Cma = \underline{197.7}$$

$$D_{asg} = \underline{194.3}$$

$$DR_{asg} = \underline{98.3\%}$$

Dilution Factor for Analyte Spiking

$$DF = \frac{Spk_{sf6}}{D_{sf6}}$$

$$Spk_{sf6} = \underline{0.924}$$

$$D_{sf6} = \underline{9.486}$$

$$DF = \underline{0.097}$$

Recovery % for Analyte Spike With HCN

$$R_x = \frac{Spk_x}{(N_x \times (1-DF) + D_{asg} \times DF)}$$

$$Spk_x = \underline{28.0}$$

$$N_x = \underline{11.7}$$

$$DF = \underline{0.097}$$

$$D_{asg} = \underline{194.3}$$

$$R_x = \underline{94.8} \quad \%$$

where:

DR_{cts} = Recovery % of the calibration transfer standard directly to the analyzer

Cma = certified concentration of calibration gas, ppm

D_{cts} = Concentration of the calibration transfer standard gas directly to the analyzer, ppm

R_{cts} = Recovery % of the calibration transfer standard through the sampling system

Sys_{cts} = Concentration of the calibration transfer standard gas through the system, ppm

DF = Dilution Factor of analyte spike gas

Spk_{sf6} = SF6 concentration in effluent during spiking

Spk_x = Analyte concentration in effluent during spiking

D_{asg} = Concentration of the analyte spike gas directly to the analyzer, ppm

D_{sf6} = Concentration of the SF6 directly to the analyzer, ppm

R_x = Recovery % of the analyte spike gas

N_x = Native effluent (HCN) concentration prior to analyte spike

MOSTARDI PLATT

Moisture Calculations

$$V_{wc(std)} = \frac{(V_f - V_i)\rho_w RT_{std}}{P_{std}M_w} = 0.04707(V_f - V_i)$$

$$V_{wsg(std)} = \frac{(W_f - W_i)\rho_w RT_{std}}{P_{std}M_w} = 0.04715(W_f - W_i)$$

$$V_{m(std)} = 17.64 V_m Y \frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}$$

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{wc(std)} + V_{wsg(std)} + V_{m(std)}}$$

Where:

B_{ws} = Water vapor in gas stream, proportion by volume

M_w = Molecular weight of water, 18.015 lb/lb-mole

P_{bar} = Barometric pressure at the testing site, in. Hg

P_{std} = Standard absolute pressure, 29.92 in. Hg

R = Ideal gas constant, $0.048137 \text{ (in. Hg)(ft}^3\text{)/(g-mole)(}^\circ\text{R)} =$
 $[21.8348 \text{ (in. Hg)(ft}^3\text{)/(lb-mole)(}^\circ\text{R)}]/453.592 \text{ g-mole/lb-mole}$

T_m = Absolute average dry gas meter temperature, $^\circ\text{R}$

T_{std} = Standard absolute temperature, 528 $^\circ\text{R}$

V_f = Final volume of condenser water, ml

V_i = Initial volume of condenser water, ml

V_m = Dry gas volume measured by dry gas meter, dcf

$V_{m(std)}$ = Dry gas volume measured by dry gas meter, corrected to standard conditions, scf

$V_{wc(std)}$ = Volume of condensed water vapor, corrected to standard conditions, scf

$V_{wsg(std)}$ = Volume of water vapor collected in silica gel, corrected to standard conditions, scf

W_f = Final weight of silica gel, g

W_i = Initial weight of silica gel, g

Y = Dry gas meter calibration factor

ΔH = Average pressure exerted on dry gas meter outlet by gas sample bag, in. H_2O

ρ_w = Density of water, 0.9982 g/ml

13.6 = Specific gravity of mercury (Hg)

17.64 = T_{std}/P_{std}

0.04707 = ft^3/ml 0.04715 = ft^3/g

MOSTARDI PLATT

Volumetric Flow Nomenclature

- A = Cross-sectional area of stack or duct, ft²
- Bws = Water vapor in gas stream, proportion by volume
- Cp = Pitot tube coefficient, dimensionless
- Md = Dry molecular weight of gas, lb/lb-mole
- Ms = Molecular weight of gas, wet basis, lb/lb-mole
- Mw = Molecular weight of water, 18.0 lb/lb-mole
- Pbar = Barometric pressure at testing site, in. Hg
- Pg = Static pressure of gas, in. Hg (in. H₂O/13.6)
- DH= Static pressure of gas, in.H₂O
- Ps = Absolute pressure of gas, in. Hg = Pbar + Pg
- Pstd = Standard absolute pressure, 29.92 in. Hg
- Acfm = Actual volumetric gas flow rate
- Scfm= Volumetric gas flow rate, corrected to standard conditions
- Dscfm = Standard volumetric flow rate, corrected to dry conditions
- R = Ideal gas constant, 21.85 in. Hg-ft³/°R-lb-mole
- Ts = Average stack gas temperature, °F
- Tm = Average dry gas meter temperature, °F
- Tstd = Standard absolute temperature, 528°R
- vs = Gas velocity, ft/sec
- Vm(std)= Volume of gas sampled, corrected to standard conditions, scf
- Vw(std) = Volume of water vapor in gas sample, corrected to standard conditions, scf
- Vlc= Volume of liquid collected
- Y = Dry gas meter calibration factor
- Δp = Velocity head of gas, in. H₂O
- K1 = 17.647 °R/in. Hg
- %EA = Percent excess air
- %CO₂ = Percent carbon dioxide by volume, dry basis
- %O₂ = Percent oxygen by volume, dry basis
- %N₂ = Percent nitrogen by volume, dry basis
- 0.264 = Ratio of O₂ to N₂ in air, v/v
- 0.28 = Molecular weight of N₂ or CO, divided by 100
- 0.32 = Molecular weight of O₂ divided by 100
- 0.44 = Molecular weight of CO₂ divided by 100
- 13.6 = Specific gravity of mercury (Hg)

MOSTARDI PLATT

Volumetric Air Flow Calculations

$$Vm (std) = 17.647 \times Vm \times \left[\frac{\left(P_{bar} + \left[\frac{DH}{13.6} \right] \right)}{(460 + Tm)} \right] \times Y$$

$$Vw (std) = 0.0471 \times Vlc$$

$$Bws = \left[\frac{Vw (std)}{Vw (std) + Vm (std)} \right]$$

$$Md = (0.44 \times \%CO_2) + (0.32 \times \%O_2) + [0.28 \times (100 - \%CO_2 - \%O_2)]$$

$$Ms = Md \times (1 - Bws) + (18 \times Bws)$$

$$Vs = \sqrt{\frac{(Ts + 460)}{Ms \times Ps}} \times \sqrt{DP} \times Cp \times 85.49$$

$$Acfm = Vs \times Area (of stack or duct) \times 60$$

$$Scfm = Acfm \times 17.647 \times \left[\frac{Ps}{(460 + Ts)} \right]$$

$$Scfh = Scfm \times 60 \frac{min}{hr}$$

$$Dscfm = Scfm \times (1 - Bws)$$

MOSTARDI PLATT

Isokinetic Calculation Formulas

$$1. V_{w(std)} = V_{lc} \left(\frac{\rho_w}{M_w} \right) \left(\frac{RT_{std}}{P_{std}} \right) = K_2 V_{lc}$$

$$2. V_{m(std)} = V_m Y \left(\frac{T_{std}}{T_m} \right) \left(\frac{(P_{bar} + (\frac{\Delta H}{13.6}))}{P_{std}} \right) = K_1 V_m Y \frac{(P_{bar} + (\frac{\Delta H}{13.6}))}{T_m}$$

$$3. B_{ws} = \frac{V_{w(std)}}{(V_{m(std)} + V_{w(std)})}$$

$$4. M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$$

$$5. M_s = M_d(1 - B_{ws}) + 18.0(B_{ws})$$

$$6. C_a = \frac{m_a}{V_a \rho_a}$$

$$7. W_a = C_a V_{aw} \rho_a$$

$$8. C_{acf} = 15.43 K_i \left(\frac{m_n P_s}{V_{w(std)} + V_{m(std)} T_s} \right)$$

$$9. C_s = (15.43 \text{ grains/gram}) (m_n / V_{m(std)})$$

$$10. v_s = K_p C_p \sqrt{\frac{\Delta P T_s}{P_s M_s}}$$

$$11. Q_{acfm} = v_s A (60_{\text{sec/min}})$$

$$12. Q_{sd} = (3600_{\text{sec/hr}})(1 - B_{ws}) v_s \left(\frac{T_{std} P_s}{T_s P_{std}} \right) A$$

$$13. E (\text{emission rate, lbs/hr}) = Q_{std} (C_s / 7000 \text{ grains/lb})$$

$$14. IKV = \frac{T_s V_{m(std)} P_{std}}{T_{std} v_s \theta A_n P_s 60(1 - B_{ws})} = K_4 \frac{T_s V_{m(std)}}{P_s v_s A_n \theta (1 - B_{ws})}$$

$$15. \%EA = \left(\frac{\%O_2 - (0.5 \%CO)}{0.264 \%N_2 - (\%O_2 - 0.5 \%CO)} \right) \times 100$$

MOSTARDI PLATT

Isokinetic Nomenclature

- A = Cross-sectional area of stack or duct, square feet
A_n = Cross-sectional area of nozzle, square feet
B_{ws} = Water vapor in gas stream, by volume
C_a = Acetone blank residue concentration, g/g
C_{act} = Concentration of particulate matter in gas stream at actual conditions, gr/acf
C_p = Pitot tube coefficient
C_s = Concentration of particulate matter in gas stream, dry basis, corrected to standard conditions, gr/dscf
IKV = Isokinetic sampling variance, must be 90.0 % ≤ IKV ≤ 110.0%
M_d = Dry molecular weight of gas, lb/lb-mole
M_s = Molecular weight of gas, wet basis, lb/lb-mole
M_w = Molecular weight of water, 18.0 lb/lb-mole
m_a = Mass of residue of acetone after evaporation, grams
P_{bar} = Barometric pressure at testing site, inches mercury
P_g = Static pressure of gas, inches mercury (inches water/13.6)
P_s = Absolute pressure of gas, inches mercury = P_{bar} + P_g
P_{std} = Standard absolute pressure, 29.92 inches mercury
Q_{acfm} = Actual volumetric gas flow rate, acfm
Q_{sd} = Dry volumetric gas flow rate corrected to standard conditions, dscfh
R = Ideal gas constant, 21.85 inches mercury cubic foot/°R-lb-mole
T_m = Dry gas meter temperature, °R
T_s = Gas temperature, °R
T_{std} = Absolute temperature, 528°R
V_a = Volume of acetone blank, ml
V_{aw} = Volume of acetone used in wash, ml
W_a = Weight of residue in acetone wash, grams
m_n = Total amount of particulate matter collected, grams
V_{1c} = Total volume of liquid collected in impingers and silica gel, ml
V_m = Volume of gas sample as measured by dry gas meter, dcf
V_{m(std)} = Volume of gas sample measured by dry gas meter, corrected to standard conditions, dscf
V_s = Gas velocity, ft/sec
V_{w(std)} = Volume of water vapor in gas sample, corrected to standard conditions, scf
Y = Dry gas meter calibration factor
ΔH = Average pressure differential across the orifice meter, inches water
Δp = Velocity head of gas, inches water
ρ_a = Density of acetone, 0.7855 g/ml (average)
ρ_w = Density of water, 0.002201 lb/ml
θ = Total sampling time, minutes
K₁ = 17.647 °R/in. Hg
K₂ = 0.04707 ft³/ml
K₄ = 0.09450/100 = 0.000945
K_p = Pitot tube constant, $85.49 \frac{ft}{sec} \left[\frac{(lb/lb-mole)(in. Hg)}{(°R)(in. H_2O)} \right]^{1/2}$
%EA = Percent excess air
%CO₂ = Percent carbon dioxide by volume, dry basis
%O₂ = Percent oxygen by volume, dry basis
%CO = Percent carbon monoxide by volume, dry basis
%N₂ = Percent nitrogen by volume, dry basis
0.264 = Ratio of O₂ to N₂ in air, v/v
28 = Molecular weight of N₂ or CO
32 = Molecular weight of O₂
44 = Molecular weight of CO₂
13.6 = Specific gravity of mercury (Hg)

MOSTARDI PLATT

Calculations for Hydrogen Fluoride By Method 26 or 26A

Concentration

$$\frac{\text{lbs HF}}{\text{dscf}} = \frac{\mu\text{g HF in sample}}{4.536 \times 10^8 \times \text{dscf}}$$

where:

$$4.536 \times 10^8 = \mu\text{g/lb}$$

dscf = Volume of gas sampled

$$\mu\text{g/lb HF} = \mu\text{g F} \times \frac{20.008}{19.000}$$

Parts Per Million

$$\text{ppm HF} = \frac{\text{lbs HF}}{\text{dscf}} \div \frac{20.008}{385 \times 10^6}$$

where:

385 = Volume of 1 lb mole of gas at 68°F and 29.92 in. Hg

106 = Conversion of ppm v/v

Emission Rate

$$\text{lbs HF /dscf} \times \text{dscfm} \times 60 \text{ min/hr} = \text{lbs/hr HF}$$

MOSTARDI PLATT

Pollutant Concentration Correction 7% for Percent Oxygen

$$C_{adj} = C_d \frac{20.9 - 7\%}{20.9 - \%O_2}$$

where:

C_{adj} = Pollutant concentration corrected to percent O_2

$20.9 - 7\%$ = Percent O_2 , the defined O_2 correction value, percent

20.9 = Percent O_2 in air

$\%O_2$ = Measured O_2 concentration dry basis, percent

C_d = Pollutant concentration measured, dry basis, ppm.

Appendix E- Laboratory Sample Analysis

Chain-of-Custody Form						
Project Number: M234006				Date Results Required:		
Client: Heidelberg - Mitchell				TAT Required:		
Plant/Test Location: Kiln 4				Project Supervisor: Eric E		
Sample Number	Sample Date	Sample Point Identification	# of Conts	Sub Lab	Analysis Required	Volume, mls
001	10/3/23	#1A 26A Mill off 0.1N H2SO4	1		M26A (HF)	
002	10/3/23	#1A 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	
003	10/3/23	#2A 26A Mill off 0.1N H2SO4	1		M26A (HF)	
004	10/3/23	#2A 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	
005	10/3/23	#3A 26A Mill off 0.1N H2SO4	1		M26A (HF)	
006	10/3/23	#3A 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	
007	10/3/23	#1B 26A Mill off 0.1N H2SO4	1		M26A (HF)	
008	10/3/23	#1B 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	
009	10/3/23	#2B 26A Mill off 0.1N H2SO4	1		M26A (HF)	
010	10/3/23	#2B 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	
011	10/3/23	#3B 26A Mill off 0.1N H2SO4	1		M26A (HF)	
012	10/3/23	#3B 26A Mill off 0.1N NaOH	1		M26A (Cl ₂)	
013	10/4/23	#1A 26A Mill on 0.1N H2SO4	1		M26A (HF)	
014	10/4/23	#1A 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	
015	10/4/23	#2A 26A Mill on 0.1N H2SO4	1		M26A (HF)	
016	10/4/23	#2A 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	
017	10/4/23	#3A 26A Mill on 0.1N H2SO4	1		M26A (HF)	
018	10/4/23	#3A 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	
019	10/4/23	#1B 26A Mill on 0.1N H2SO4	1		M26A (HF)	
020	10/4/23	#1B 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	
021	10/4/23	#2B 26A Mill on 0.1N H2SO4	1		M26A (HF)	
022	10/4/23	#2B 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	
023	10/4/23	#3B 26A Mill on 0.1N H2SO4	1		M26A (HF)	
024	10/4/23	#3B 26A Mill on 0.1N NaOH	1		M26A (Cl ₂)	

025	10/4/23	A Train Field Blank 0.1N H ₂ SO ₄	1		M26A (HF)	
026	10/4/23	A Train Field Blank 0.1N NaOH	1		M26A (Cl ₂)	
027	10/4/23	B Train Field Blank 0.1N H ₂ SO ₄	1		M26A (HF)	
028	10/4/23	B Train Field Blank 0.1N NaOH	1		M26A (Cl ₂)	
029	10/4/23	0.1N H ₂ SO ₄ Reagent Blank	1		M26A (HF)	
030	10/4/23	0.1N NaOH Reagent Blank	1		M26A (Cl ₂)	
031	10/4/23	DI Water Reagent Blank	1		M26A (HF and Cl ₂)	
Delivered to Lab by: Date/Time:		Received by: Date/Time:		Processed by: Date/Time:		

Laboratory Notes:

Main Kiln-Mill On

Client:	Heidelberg	Analysis Date:	10/17/2023
Facility:	Mitchell	Analysis Location:	Elmhurst
Test Location:	Main Kiln-Mill On	Analyst:	JMG
Project Number:	M234006		
Method:	M26A-RTR		
Date Samples Received:	10/6/2023		

Train A

Sampling Date		10/4/2023	10/4/2023	10/4/2023	10/4/2023		
	UNITS	M26A DI Blank	M26A H2SO4 Blank	M26A H2SO4-R1	M26A H2SO4-R1 Dup	RDL	MDL
Sulfuric Acid Volume	ml	207	215	450	450		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		10/4/2023	10/4/2023	10/4/2023			
	UNITS	M26A- H2SO4 R2	M26A- H2SO4 R3	Side A Train Blank		RDL	MDL
Sulfuric Acid Volume	ml	449	398	183			
Hydrofluoric Acid	ug	<150	<150	<150		150	15

Train B

Sampling Date		10/4/2023	10/4/2023	10/4/2023	10/4/2023		
	UNITS	M26A DI Blank	M26A H2SO4 Blank	M26A H2SO4-R1	M26A H2SO4-R1 Dup	RDL	MDL
Sulfuric Acid Volume	ml	207	215	459	459		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		10/4/2023	10/4/2023	10/4/2023			
	UNITS	M26A- H2SO4 R2	M26A- H2SO4 R3	Side B Train Blank		RDL	MDL
Sulfuric Acid Volume	ml	486	435	178			
Hydrofluoric Acid	ug	<150	<150	<150		150	15

Client:	Heidelberg	Analysis Date:	10/17/2023										
Facility:	Mitchell	Analysis Location:	Elmhurst										
Test Location:	Main Kiln-Mill On	Analyst:	JMG										
Project Number:	M234006												
Method:	M26A-RTR												
Date Samples Received:	10/6/2023												
Standard ppm HF	Area	Response Factor	Calculated Value	lope of Regression Curve									
1	0.2105	0.2105	0.95	0.2223									
2	0.4362	0.2181	1.96										
5	1.1127	0.2225	5.00	Response Factor Ave									
8	1.8424	0.2303	8.29	0.2223									
10	2.2994	0.2299	10.34										
Lot Number	Ricca 8209004												
R ²		0.9998											
Sample Number	Sample Date	Sample ID	Sample Area	PPM F	PPM X Dilution Factor	Dilution Factor	Total ml	mg F in soln	mg HF in soln	mg HF in soln avg	ug HF in soln		
031	10/4/2023	DI Reagent Blank	0.0055	0.0247	0.0247	1	207	0.0051	0.0054				
031	10/4/2023	DI Reagent Blank	0.0030	0.0135	0.0135	1	207	0.0028	0.0029	0.0042	4.167947505		
029	10/4/2023	H2SO4 Reagent Blank	0.0046	0.0207	0.0207	1	215	0.0044	0.0047				
029	10/4/2023	H2SO4 Reagent Blank	0.0019	0.0085	0.0085	1	215	0.0018	0.0019	0.0033	3.310432872		
013	10/4/2023	Test 1 H2SO4 Imp	0.0582	0.2618	0.2618	1	450	0.1178	0.1241				
013	10/4/2023	Test 1 H2SO4 Imp	0.0453	0.2038	0.2038	1	450	0.0917	0.0966	0.1103	110.3280222		
013	10/4/2023	Test 1 H2SO4 Imp	0.0477	0.2146	0.2146	1	450	0.0966	0.1017				
013	10/4/2023	Test 1 H2SO4 Imp	0.0492	0.2213	0.2213	1	450	0.0996	0.1049	0.1033	103.2926121		
015	10/4/2023	Test 2 H2SO4 Imp	0.0590	0.2654	0.2654	1	449	0.1192	0.1255				
015	10/4/2023	Test 2 H2SO4 Imp	0.0550	0.2474	0.2474	1	449	0.1111	0.1170	0.1213	121.250674		
017	10/4/2023	Test 3 H2SO4 Imp	0.0497	0.2236	0.2236	1	398	0.0890	0.0937				
017	10/4/2023	Test 3 H2SO4 Imp	0.0480	0.2159	0.2159	1	398	0.0859	0.0905	0.0921	92.11081077		
025	10/4/2023	H2SO4 Side A Train Blank	0.0252	0.1134	0.1134	1	183	0.0207	0.0218				
025	10/4/2023	H2SO4 Side A Train Blank	0.0315	0.1417	0.1417	1	183	0.0259	0.0273	0.0246	24.5791646		
					Expected Value	% Difference							
		Run 1 H2SO4 Spike W/ 2ppm	0.2265	1.0188	1.0974								
Lot Number: Thermo 211-191JKS		Run 1 H2SO4 Spike W/ 2ppm	0.2390	1.0750	1.0974	4.60%							
CCV ppm F	Area	PPM F											
1 ppm ICV	0.2216	0.9968											
5 ppm CCV	1.1214	5.0441											
5 ppm CCV	1.1074	4.9811											
5 ppm CCV	1.1048	4.9694											
Standard ppm F	Area	Difference											
1	0.2071	0.82%											
2	0.4239	1.45%											
5	1.1100	0.12%											
8	1.8479	0.15%											
10	2.3535	1.15%											

Client:	Heidelberg	Analysis Date:	10/17/2023									
Facility:	Mitchell	Analysis Location:	Elmhurst									
Test Location:	Main Kiln-Mill On	Analyst:	JMG									
Project Number:	M234006											
Method:	M26A-RTR											
Date Samples Received:	10/5/2023											
Standard ppm HF	Area	Response Factor	Calculated Value	lope of Regression Curve								
1	0.2105	0.2105	0.95	0.2223								
2	0.4362	0.2181	1.96									
5	1.1127	0.2225	5.00	Response Factor Ave								
8	1.8424	0.2303	8.29	0.2223								
10	2.2994	0.2299	10.34									
	Ricca 8209004											
R²		0.9998										
Sample Number	Sample Date	Sample ID	Sample Area	PPM F	PPM X Dilution Factor	Dilution Factor	Total ml	mg F in soln	mg HF in soln	mg HF in soln avg	ug HF in soln	
031	10/4/2023	DI Reagent Blank	0.0055	0.0247	0.0247	1	207	0.0051	0.0054			
031	10/4/2023	DI Reagent Blank	0.0030	0.0135	0.0135	1	207	0.0028	0.0029	0.0042	4.167947505	
029	10/4/2023	H2SO4 Reagent Blank	0.0046	0.0207	0.0207	1	199	0.0041	0.0043			
029	10/4/2023	H2SO4 Reagent Blank	0.0019	0.0085	0.0085	1	199	0.0017	0.0018	0.0031	3.064075077	
019	10/4/2023	Test 1 H2SO4 Imp	0.0550	0.2474	0.2474	1	459	0.1136	0.1196			
019	10/4/2023	Test 1 H2SO4 Imp	0.0528	0.2375	0.2375	1	459	0.1090	0.1148	0.1172	117.2099324	
019	10/4/2023	Test 1 H2SO4 Imp	0.0507	0.2281	0.2281	1	459	0.1047	0.1103			
019	10/4/2023	Test 1 H2SO4 Imp	0.0527	0.2370	0.2370	1	459	0.1088	0.1146	0.1124	112.4258536	
021	10/4/2023	Test 2 H2SO4 Imp	0.0462	0.2168	0.2168	1	486	0.1054	0.1110			
021	10/4/2023	Test 2 H2SO4 Imp	0.0490	0.2204	0.2204	1	486	0.1071	0.1128	0.1119	111.9013957	
023	10/4/2023	Test 3 H2SO4 Imp	0.0482	0.2168	0.2168	1	435	0.0943	0.0993			
023	10/4/2023	Test 3 H2SO4 Imp	0.0490	0.2204	0.2204	1	435	0.0959	0.1010	0.1002	100.1586567	
027	10/4/2023	H2SO4 Side B Train Blank	0.0022	0.0099	0.0099	1	178	0.0018	0.0019			
027	10/4/2023	H2SO4 Side B Train Blank	0.0020	0.0090	0.0090	1	178	0.0016	0.0017	0.0018	1.770933535	
CCV ppm F	Area	PPM F										
1 ppm ICV	0.2216	0.9968										
5 ppm CCV	1.1214	5.0441										
5 ppm CCV	1.1074	4.9811										
5 ppm CCV	1.1048	4.9694										
5 ppm CCV	0	0.0000										
Standard ppm F	Area	Difference										
1	0.2071	0.82%										
2	0.4239	1.45%										
5	1.1100	0.12%										
8	1.8479	0.15%										
10	2.3535	1.15%										

Main Kiln-Mill On

Client:	Heidelberg	Analysis Date:	10/17/2023
Facility:	Mitchell	Analysis Location:	Elmhurst
Test Location:	Main Kiln-Mill On	Analyst:	JMG
Project Number:	M234006		
Method:	M26A-RTR		
Date Samples Received:	10/6/2023		

Train A

Sampling Date		10/4/2023	10/4/2023	10/4/2023	10/4/2023		
	UNITS	M26A DI Blank	M26A NaOH Blank	M26A NaOH-R1	M26A NaOH-R1 Dup	RDL	MDL
Sodium Hydroxide Volume	ml	207	199	264	264		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		10/4/2023	10/4/2023	10/4/2023			
	UNITS	M26A- NaOH R2	M26A- NaOH R3	Side A Train Blank		RDL	MDL
Sodium Hydroxide Volume	ml	273	209	183			
Chlorine	ug	<150	<150	<150		150	15

Train B

Sampling Date		10/4/2023	10/4/2023	10/4/2023	10/4/2023		
	UNITS	M26A DI Blank	M26A NaOH Blank	M26A NaOH-R1	M26A NaOH-R1 Dup	RDL	MDL
Sodium Hydroxide Volume	ml	207	199	284	284		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		10/4/2023	10/4/2023	10/4/2023			
	UNITS	M26A- NaOH R2	M26A- NaOH R3	Side B Train Blank		RDL	MDL
Sodium Hydroxide Volume	ml	292	265	183			
Chlorine	ug	<150	<150	<150		150	15

Client:	Heidelberg	Analysis Date:	10/17/2023							
Facility:	Mitchell	Analysis Location:	Elmhurst Lab							
Test Location:	Main Kiln-Mill On	Analyst:	JMG							
Project Number:	M234006									
Method:	M26a-RTR									
Date Samples Received:	10/6/2023									
Standard ppm Cl	Area	Response Factor	Calculated Value	lope of Regression Curve						
1	0.1377	0.1377	0.99	0.1396						
2	0.2835	0.1418	2.03							
5	0.6895	0.1379	4.94	Response Factor Ave						
8	1.1226	0.1403	8.04	0.1396						
10	1.4033	0.1403	10.05							
	Ricca 8209004									
R ²		0.9999								
Sample Number	Sample Date	Sample ID	Sample Area	PPM Cl	PPM X Dilution Factor	Dilution Factor	Total ml	mg Cl in soln	mg Cl2 in soln avg	ug Cl2 in soln
031	10/4/2023	DI Reagent Blank	0.0047	0.0337	0.0337	1	207	0.0070		
031	10/4/2023	DI Reagent Blank	0.0016	0.0115	0.0115	1	207	0.0024	0.0047	4.670273553
030	10/4/2023	NaOH Reagent Blank	0.0199	0.1425	0.1425	1	199	0.0284		
030	10/4/2023	NaOH Reagent Blank	0.0217	0.1554	0.1554	1	199	0.0309	0.0296	29.64680054
014	10/4/2023	Test 1 NaOH Imp	0.0396	0.2836	0.2836	1	264	0.0749		
014	10/4/2023	Test 1 NaOH Imp	0.0375	0.2686	0.2686	1	264	0.0709	0.0729	72.89365539
014	10/4/2023	Test 1 NaOH Imp	0.0386	0.2765	0.2765	1	264	0.0730		
014	10/4/2023	Test 1 NaOH Imp	0.0387	0.2772	0.2772	1	264	0.0732	0.0731	73.08274399
016	10/4/2023	Test 2 NaOH Imp	0.0171	0.1225	0.1225	1	273	0.0334		
016	10/4/2023	Test 2 NaOH Imp	0.0134	0.0960	0.0960	1	273	0.0262	0.0298	29.81905738
018	10/4/2023	Test 3 NaOH Imp	0.0323	0.2313	0.2313	1	209	0.0484		
018	10/4/2023	Test 3 NaOH Imp	0.0318	0.2278	0.2278	1	209	0.0476	0.0480	47.97729297
026	10/4/2023	NaOH Side A Train Blank	0.0115	0.0824	0.0824	1	183	0.0151		
026	10/4/2023	NaOH Side A Train Blank	0.0116	0.0831	0.0831	1	183	0.0152	0.0151	15.13890606
					Expected Value	% Difference				
		Run 1 H2SO4 Spike W/ 2ppm	0.1588	1.1374	1.1533					
		Run 1 H2SO4 Spike W/ 2ppm	0.1594	1.1417	1.1533	1.20%				
CCV ppm Cl	Area	PPM Cl								
5 ppm ICV	0.6954	4.9808								
5 ppm CCV	0.6886	4.9321								
5 ppm CCV	0.6899	4.9414								
5 ppm CCV	0.681	4.8776								
Standard ppm Cl	Area	Difference								
1	0.1413	1.27%								
2	0.2902	1.15%								
5	0.6971	0.55%								
8	1.1264	0.17%								
10	1.4066	0.12%								

Client:	Heidelberg	Analysis Date:	10/17/2023							
Facility:	Mitchell	Analysis Location:	Elmhurst Lab							
Test Location:	Main Kiln-Mill On	Analyst:	JMG							
Project Number:	M234006									
Method:	M26a-RTR									
Date Samples Received:	10/6/2023									
Standard ppm Cl	Area	Response Factor	Calculated Value	lope of Regression Curve						
1	0.1377	0.1377	0.99	0.1396						
2	0.2835	0.1418	2.03							
5	0.6895	0.1379	4.94	Response Factor Ave						
8	1.1226	0.1403	8.04	0.1396						
10	1.4033	0.1403	10.05							
	Ricca 8209004									
R²		0.9999								
Sample Number	Sample Date	Sample ID	Sample Area	PPM Cl	PPM X Dilution Factor	Dilution Factor	Total ml	mg Cl in soln	mg Cl2 in soln avg	ug Cl2 in soln
031	10/4/2023	DI Reagent Blank	0.0047	0.0337	0.0337	1	207	0.0070		
031	10/4/2023	DI Reagent Blank	0.0016	0.0115	0.0115	1	207	0.0024	0.0047	4.670273553
030	10/4/2023	NaOH Reagent Blank	0.0199	0.1425	0.1425	1	199	0.0284		
030	10/4/2023	NaOH Reagent Blank	0.0217	0.1554	0.1554	1	199	0.0309	0.0296	29.64680054
020	10/4/2023	Test 1 NaOH Imp	0.0253	0.1812	0.1812	1	284	0.0515		
020	10/4/2023	Test 1 NaOH Imp	0.0228	0.1633	0.1633	1	284	0.0464	0.0489	48.92094536
020	10/4/2023	Test 1 NaOH Imp	0.0259	0.1855	0.1855	1	284	0.0527		
020	10/4/2023	Test 1 NaOH Imp	0.0238	0.1705	0.1705	1	284	0.0484	0.0505	50.54825331
022	10/4/2023	Test 2 NaOH Imp	0.0263	0.1884	0.1884	1	292	0.0550		
022	10/4/2023	Test 2 NaOH Imp	0.0258	0.1848	0.1848	1	292	0.0540	0.0545	54.48186919
024	10/4/2023	Test 3 NaOH Imp	0.0168	0.1203	0.1203	1	265	0.0319		
024	10/4/2023	Test 3 NaOH Imp	0.0170	0.1218	0.1218	1	265	0.0323	0.0321	32.07701879
028	10/4/2023	NaOH Side B Train Blank	0.0297	0.2127	0.2127	1	183	0.0389		
028	10/4/2023	NaOH Side B Train Blank	0.0305	0.2185	0.2185	1	183	0.0400	0.0395	39.45290669
CCV ppm Cl	Area	PPM Cl								
5 ppm ICV	0.6954	4.9808								
5 ppm CCV	0.6886	4.9321								
5 ppm CCV	0.6899	4.9414								
5 ppm CCV	0.681	4.8776								
Standard ppm Cl	Area	Difference								
1	0.1413	1.27%								
2	0.2902	1.15%								
5	0.6971	0.55%								
8	1.1264	0.17%								
10	1.4066	0.12%								

Main Kiln-Mill Off

Client:	Heidelberg	Analysis Date:	10/18/2023
Facility:	Mitchell	Analysis Location:	Elmhurst
Test Location:	Main Kiln-Mill Off	Analyst:	JMG
Project Number:	M234006		
Method:	M26A-RTR		
Date Samples Received:	10/6/2023		

Train A

Sampling Date		10/4/2023	10/4/2023	10/3/2023	10/3/2023		
	UNITS	M26A DI Blank	M26A H2SO4 Blank	M26A H2SO4-R1	M26A H2SO4-R1 Dup	RDL	MDL
Sulfuric Acid Volume	ml	207	215	381	381		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		10/3/2023	10/4/2023	10/4/2023			
	UNITS	M26A- H2SO4 R2	M26A- H2SO4 R3	Side A Train Blank		RDL	MDL
Sulfuric Acid Volume	ml	423	406	183			
Hydrofluoric Acid	ug	<150	<150	<150		150	15

Train B

Sampling Date		10/4/2023	10/4/2023	10/4/2023	10/3/2023		
	UNITS	M26A DI Blank	M26A H2SO4 Blank	M26A H2SO4-R1	M26A H2SO4-R1 Dup	RDL	MDL
Sulfuric Acid Volume	ml	207	199	351	351		
Hydrofluoric Acid	ug	<150	<150	<150	<150	150	15

Sampling Date		10/3/2023	10/4/2023	10/4/2023			
	UNITS	M26A- H2SO4 R2	M26A- H2SO4 R3	Side B Train Blank		RDL	MDL
Sulfuric Acid Volume	ml	421	418	178			
Hydrofluoric Acid	ug	<150	<150	<150		150	15

Client:	Heidelberg	Analysis Date:	10/18/2023									
Facility:	Mitchell	Analysis Location:	Elmhurst									
Test Location:	Main Kiln-Mill Off	Analyst:	JMG									
Project Number:	M234006											
Method:	M26A-RTR											
Date Samples Received:	10/6/2023											
Standard ppm HF	Area	Response Factor	Calculated Value	Slope of Regression Curve								
1	0.2105	0.2105	0.95	0.2223								
2	0.4362	0.2181	1.96									
5	1.1127	0.2225	5.00	Response Factor Ave								
8	1.8424	0.2303	8.29	0.2223								
10	2.2994	0.2299	10.34									
Lot Number	Ricca 8209004											
R²		0.9998										
Sample Number	Sample Date	Sample ID	Sample Area	PPM F	PPM X Dilution Factor	Dilution Factor	Total ml	mg F in soln	mg HF in soln	mg HF in soln avg	ug HF in soln	
031	10/4/2023	DI Reagent Blank	0.0055	0.0247	0.0247	1	207	0.0051	0.0054			
031	10/4/2023	DI Reagent Blank	0.0030	0.0135	0.0135	1	207	0.0028	0.0029	0.0042	4.167947505	
029	10/4/2023	H2SO4 Reagent Blank	0.0046	0.0207	0.0207	1	215	0.0044	0.0047			
029	10/4/2023	H2SO4 Reagent Blank	0.0019	0.0085	0.0085	1	215	0.0018	0.0019	0.0033	3.310432872	
001	10/3/2023	Test 1 H2SO4 Imp	0.0689	0.3099	0.3099	1	381	0.1181	0.1244			
001	10/3/2023	Test 1 H2SO4 Imp	0.0644	0.2897	0.2897	1	381	0.1104	0.1162	0.1203	120.3062235	
001	10/3/2023	Test 1 H2SO4 Imp	0.0659	0.2964	0.2964	1	381	0.1129	0.1190			
001	10/3/2023	Test 1 H2SO4 Imp	0.0620	0.2789	0.2789	1	381	0.1063	0.1119	0.1154	115.4326031	
003	10/3/2023	Test 2 H2SO4 Imp	0.0460	0.2069	0.2069	1	423	0.0875	0.0922			
003	10/3/2023	Test 2 H2SO4 Imp	0.0442	0.1988	0.1988	1	423	0.0841	0.0886	0.0904	90.38156856	
005	10/4/2023	Test 3 H2SO4 Imp	0.0705	0.3171	0.3171	1	406	0.1287	0.1356			
005	10/4/2023	Test 3 H2SO4 Imp	0.0714	0.3212	0.3212	1	406	0.1304	0.1373	0.1365	136.4713219	
025	10/4/2023	H2SO4 Side A Train Blank	0.0252	0.1134	0.1134	1	183	0.0207	0.0218			
025	10/4/2023	H2SO4 Side A Train Blank	0.0315	0.1417	0.1417	1	183	0.0259	0.0273	0.0246	24.5791646	
					Expected Value	% Difference						
		Run 1 H2SO4 Spike W/ 2ppm	0.2536	1.1407	1.1309							
Lot Number: Thermo 21-191JKS		Run 1 H2SO4 Spike W/ 2ppm	0.2526	1.1362	1.1309	0.67%						
CCV ppm F	Area	PPM F										
1 ppm ICV	0.2216	0.9968										
5 ppm CCV	1.1214	5.0441										
5 ppm CCV	1.1074	4.9811										
5 ppm CCV	1.1048	4.9694										
5 ppm CCV	1.108	4.9838										
Standard ppm F	Area	Difference										
1	0.2071	0.82%										
2	0.4239	1.45%										
5	1.1100	0.12%										
8	1.8479	0.15%										
10	2.3535	1.15%										

Client:	Heidelberg	Analysis Date:	10/18/2023										
Facility:	Mitchell	Analysis Location:	Elmhurst										
Test Location:	Main Kiln-Mill Off	Analyst:	JMG										
Project Number:	M234006												
Method:	M26A-RTR												
Date Samples Received:	10/5/2023												
Standard ppm HF	Area	Response Factor	Calculated Value	ope of Regression Curve									
1	0.2105	0.2105	0.95	0.2223									
2	0.4362	0.2181	1.96										
5	1.1127	0.2225	5.00	Response Factor Ave									
8	1.8424	0.2303	8.29	0.2223									
10	2.2994	0.2299	10.34										
	Ricca 8209004												
R²		0.9998											
COC Number	Sample Date	Sample ID	Sample Area	PPM F	PPM X Dilution Factor	Dilution Factor	Total ml	mg F in soln	mg HF in soln	mg HF in soln avg	ug HF in soln		
031	10/4/2023	DI Reagent Blank	0.0055	0.0247	0.0247	1	207	0.0051	0.0054				
031	10/4/2023	DI Reagent Blank	0.0030	0.0135	0.0135	1	207	0.0028	0.0029	0.0042	4.167947505		
029	10/4/2023	H2SO4 Reagent Blank	0.0046	0.0207	0.0207	1	199	0.0041	0.0043				
029	10/4/2023	H2SO4 Reagent Blank	0.0019	0.0085	0.0085	1	199	0.0017	0.0018	0.0031	3.064075077		
007	10/3/2023	Test 1 H2SO4 Imp	0.0535	0.2406	0.2406	1	351	0.0845	0.0890				
007	10/3/2023	Test 1 H2SO4 Imp	0.0508	0.2285	0.2285	1	351	0.0802	0.0845	0.0867	86.72102336		
007	10/3/2023	Test 1 H2SO4 Imp	0.0545	0.2451	0.2451	1	351	0.0860	0.0906				
009	10/3/2023	Test 2 H2SO4 Imp	0.0521	0.2343	0.2343	1	351	0.0823	0.0866	0.0886	88.63337574		
009	10/3/2023	Test 2 H2SO4 Imp	0.0462	0.2078	0.2078	1	421	0.0875	0.0921				
009	10/3/2023	Test 2 H2SO4 Imp	0.0407	0.1831	0.1831	1	421	0.0771	0.0812	0.0867	86.66322403		
011	10/4/2023	Test 3 H2SO4 Imp	0.0556	0.2501	0.2501	1	418	0.1045	0.1101				
011	10/4/2023	Test 3 H2SO4 Imp	0.0560	0.2519	0.2519	1	418	0.1053	0.1109	0.1105	110.5028415		
027	10/4/2023	H2SO4 Side B Train Blank	0.0022	0.0099	0.0099	1	178	0.0018	0.0019				
027	10/4/2023	H2SO4 Side B Train Blank	0.0020	0.0090	0.0090	1	178	0.0016	0.0017	0.0018	1.770933535		
CCV ppm F	Area	PPM CI											
1 ppm ICV	0.2216	0.9968											
5 ppm CCV	1.1214	5.0441											
5 ppm CCV	1.1074	4.9811											
5 ppm CCV	1.1048	4.9694											
5 ppm CCV	1.108	4.9838											
Standard ppm CI	Area	Difference											
1	0.2071	0.82%											
2	0.4239	1.45%											
5	1.1100	0.12%											
8	1.8479	0.15%											
10	2.3535	1.15%											

Main Kiln-Mill Off

Client:	Heidelberg	Analysis Date:	10/18/2023
Facility:	Mitchell	Analysis Location:	Elmhurst
Test Location:	Main Kiln-Mill Off	Analyst:	JMG
Project Number:	M234006		
Method:	M26A-RTR		
Date Samples Received:	10/6/2023		

Train A

Sampling Date		10/4/2023	10/4/2023	10/3/2023	10/3/2023		
	UNITS	M26A DI Blank	M26A NaOH Blank	M26A NaOH-R1	M26A NaOH-R1 Dup	RDL	MDL
Sodium Hydroxide Volume	ml	207	199	246	246		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		10/3/2023	10/4/2023	10/4/2023			
	UNITS	M26A- NaOH R2	M26A- NaOH R3	Side A Train Blank		RDL	MDL
Sodium Hydroxide Volume	ml	295	233	183			
Chlorine	ug	<150	<150	<150		150	15

Train B

Sampling Date		10/3/2023	10/4/2023	10/3/2023	10/3/2023		
	UNITS	M26A DI Blank	M26A NaOH Blank	M26A NaOH-R1	M26A NaOH-R1 Dup	RDL	MDL
Sodium Hydroxide Volume	ml	207	199	242	242		
Chlorine	ug	<150	<150	<150	<150	150	15

Sampling Date		10/3/2023	10/4/2023	10/4/2023			
	UNITS	M26A- NaOH R2	M26A- NaOH R3	Side B Train Blank		RDL	MDL
Sodium Hydroxide Volume	ml	274	243	183			
Chlorine	ug	<150	<150	<150		150	15

Client:	Heidelberg	Analysis Date:	10/18/2023								
Facility:	Mitchell	Analysis Location:	Elmhurst Lab								
Test Location:	Main Kiln-Mill Off	Analyst:	JMG								
Project Number:	M234006										
Method:	M26a-RTR										
Date Samples Received:	10/6/2023										
Standard ppm Cl	Area	Response Factor	Calculated Value	lope of Regression Curve							
1	0.1377	0.1377	0.99	0.1396							
2	0.2835	0.1418	2.03								
5	0.6895	0.1379	4.94	Response Factor Ave							
8	1.1226	0.1403	8.04	0.1396							
10	1.4033	0.1403	10.05								
	Ricca 8209004										
R ²		0.9999									
Sample Number	Sample Date	Sample ID	Sample Area	PPM Cl	PPM X Dilution Factor	Dilution Factor	Total ml	mg Cl in soln	mg Cl2 in soln avg	ug Cl2 in soln	
031	10/4/2023	DI Reagent Blank	0.0047	0.0337	0.0337	1	207	0.0070			
031	10/4/2023	DI Reagent Blank	0.0016	0.0115	0.0115	1	207	0.0024	0.0047	4.670273553	
030	10/4/2023	NaOH Reagent Blank	0.0199	0.1425	0.1425	1	199	0.0284			
030	10/4/2023	NaOH Reagent Blank	0.0217	0.1554	0.1554	1	199	0.0309	0.0296	29.64680054	
002	10/3/2023	Test 1 NaOH Imp	0.0114	0.0817	0.0817	1	246	0.0201			
002	10/3/2023	Test 1 NaOH Imp	0.0108	0.0774	0.0774	1	246	0.0190	0.0196	19.55777772	
002	10/3/2023	Test 1 NaOH Imp	0.0082	0.0587	0.0587	1	246	0.0144			
002	10/3/2023	Test 1 NaOH Imp	0.0109	0.0781	0.0781	1	246	0.0192	0.0168	16.82673669	
004	10/3/2023	Test 2 NaOH Imp	0.0052	0.0372	0.0372	1	295	0.0110			
004	10/3/2023	Test 2 NaOH Imp	0.0045	0.0322	0.0322	1	295	0.0095	0.0102	10.24767102	
006	10/4/2023	Test 3 NaOH Imp	0.0707	0.5064	0.5064	1	233	0.1180			
006	10/4/2023	Test 3 NaOH Imp	0.0663	0.4749	0.4749	1	233	0.1106	0.1143	114.316235	
026	10/4/2023	NaOH Side A Train Blank	0.0115	0.0824	0.0824	1	183	0.0151			
026	10/4/2023	NaOH Side A Train Blank	0.0116	0.0831	0.0831	1	183	0.0152	0.0151	15.13890606	
					Expected Value	% Difference					
		Run 1 H2SO4 Spike W/ 2ppm	0.1377	0.9863	1.0550						
		Run 1 H2SO4 Spike W/ 2ppm	0.1347	0.9648	1.0550	7.54%					
CCV ppm Cl	Area	PPM Cl									
5 ppm ICV	0.6954	4.9808									
5 ppm CCV	0.6886	4.9321									
5 ppm CCV	0.6899	4.9414									
5 ppm CCV	0.6805	4.8740									
5 ppm CCV	0.681	4.8776									
Standard ppm Cl	Area	Difference									
1	0.1413	1.27%									
2	0.2902	1.15%									
5	0.6971	0.55%									
8	1.1264	0.17%									
10	1.4066	0.12%									

Client:	Heidelberg	Analysis Date:	10/18/2023								
Facility:	Mitchell	Analysis Location:	Elmhurst Lab								
Test Location:	Main Kiln-Mill Off	Analyst:	JMG								
Project Number:	M234006										
Method:	M26a-RTR										
Date Samples Received:	10/6/2023										
Standard ppm Cl	Area	Response Factor	Calculated Value	lope of Regression Curve							
1	0.1377	0.1377	0.99	0.1396							
2	0.2835	0.1418	2.03								
5	0.6895	0.1379	4.94	Response Factor Ave							
8	1.1226	0.1403	8.04	0.1396							
10	1.4033	0.1403	10.05								
	Ricca 8209004										
R²		0.9999									
Sample Number	Sample Date	Sample ID	Sample Area	PPM Cl	PPM X Dilution Factor	Dilution Factor	Total ml	mg Cl in soln	mg Cl2 in soln avg	ug Cl2 in soln	
031	10/4/2023	DI Reagent Blank	0.0047	0.0337	0.0337	1	207	0.0070			
031	10/4/2023	DI Reagent Blank	0.0016	0.0115	0.0115	1	207	0.0024	0.0047	4.670273553	
030	10/4/2023	NaOH Reagent Blank	0.0199	0.1425	0.1425	1	199	0.0284			
030	10/4/2023	NaOH Reagent Blank	0.0217	0.1554	0.1554	1	199	0.0309	0.0296	29.64680054	
008	10/3/2023	Test 1 NaOH Imp	0.0088	0.0630	0.0630	1	242	0.0153			
008	10/3/2023	Test 1 NaOH Imp	0.0109	0.0781	0.0781	1	242	0.0189	0.0171	17.07312486	
008	10/3/2023	Test 1 NaOH Imp	0.0100	0.0716	0.0716	1	242	0.0173			
008	10/3/2023	Test 1 NaOH Imp	0.0092	0.0659	0.0659	1	242	0.0159	0.0166	16.63979682	
010	10/3/2023	Test 2 NaOH Imp	0.0121	0.0867	0.0867	1	274	0.0237			
010	10/3/2023	Test 2 NaOH Imp	0.0164	0.1175	0.1175	1	274	0.0322	0.0280	27.96577423	
012	10/4/2023	Test 3 NaOH Imp	0.0705	0.5050	0.5050	1	243	0.1227			
012	10/4/2023	Test 3 NaOH Imp	0.0742	0.5315	0.5315	1	243	0.1291	0.1259	125.9233385	
028	10/4/2023	NaOH Side B Train Blank	0.0297	0.2127	0.2127	1	183	0.0389			
028	10/4/2023	NaOH Side B Train Blank	0.0305	0.2185	0.2185	1	183	0.0400	0.0395	39.45290669	
CCV ppm Cl	Area	PPM Cl									
5 ppm ICV	0.6954	4.9808									
5 ppm CCV	0.6886	4.9321									
5 ppm CCV	0.6899	4.9414									
5 ppm CCV	0.6805	4.8740									
5 ppm CCV	0.681	4.8776									
Standard ppm Cl	Area	Difference									
1	0.1413	1.27%									
2	0.2902	1.15%									
5	0.6971	0.55%									
8	1.1264	0.17%									
10	1.4066	0.12%									

Appendix F - Reference Method Test Data

Client:
Facility:
Test Location:
Project #:
Test Method:
Test Engineer:
Test Technician:

Heidelberg Materials
Mitchell Cement Plant
Kiln 4 Stack
M234006
26A
JSK
EEO

	<u>Run 1A</u>	<u>Run 2A</u>	<u>Run 3A</u>
Temp ID:	CM47	CM47	CM47
Meter ID:	CM47	CM47	CM47
Pitot ID:	S8-058-A	S8-058-A	S8-058-A
Nozzle Diameter (Inches):	0.258	0.258	0.258
Meter Calibration Date:	8/11/2023	8/11/2023	8/11/2023
Meter Calibration Factor (Y):	1.003	1.003	1.003
Meter Orifice Setting (Delta H):	1.901	1.901	1.901
Pitot Tube Coefficient:		0.834	
Probe Length (Feet):		8.0	
Probe Liner Material:		Glass	
Sample Plane:		Horizontal	
Port Length (Inches):		6.00	
Port Size (Diameter, Inches):		6.00	
Port Type:		Flange	
Duct Shape:		Circular	
Diameter (Feet):		19.68	
Duct Area (Square Feet):		304.187	
Upstream Diameters:		1.5	
Downstream Diameters:		15.2	
Number of Ports Sampled:		4	
Number of Points per Port:		6	
Minutes per Point:		2.5	
Minutes per Reading:		2.5	
Total Number of Traverse Points:		24	
Test Length (Minutes):		60	
Train Type:		Anderson Box	
Source Condition:		Mill on	
Diluent Model/Serial Number:		Servomex 1440D and MKS 2030	
Moisture Balance ID:		S168	
# of Runs		3	

Run 1A - Method 26A

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Source Condition: Mill on

Date: 10/4/23
 Start Time: 12:30
 End Time: 13:40

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH :	2.00	in. H ₂ O		Static Pressure	-0.50	in. H ₂ O
Meter Temperature, Tm:	84.7	°F		Flue Pressure (Ps):	28.74	in. Hg. abs.
Sqrt ΔP :	0.857	in. H ₂ O		Carbon Dioxide:	13.34	%
Stack Temperature, Ts:	240.1	°F		Oxygen:	12.42	%
Meter Volume, Vm:	47.877	ft ³		Nitrogen:	74.24	%
Meter Volume, Vmstd:	45.006	dscf		Gas Weight dry, Md:	30.631	lb/lb mole
Meter Volume, Vwstd:	8.214	wscf		Gas Weight wet, Ms:	28.682	lb/lb mole
Isokinetic Variance:	99.9	%I		Excess Air:	---	%
Test Length:	60.00	in mins.		Gas Velocity, Vs:	56.313	fps
Nozzle Diameter:	0.258	in inches		Volumetric Flow:	1,027,774	acfm
Barometric Pressure:	28.78	in Hg		Volumetric Flow:	629,721	dscfm
				Volumetric Flow:	744,654	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3474.7	ml	Silica Initial Wt.	833.6	grams
Final Impinger Content:	3638.9	ml	Silica Final Wt.	843.8	grams
Impinger Difference:	164.2	ml	Silica Difference:	10.2	grams
Total Water Gain:	174.4		Moisture, Bws:	0.154	

Port- Point No.	Clock Time	Velocity Head Δp in. H ₂ O	Orifice ΔH in. H ₂ O	Actual Meter Vol. ft ³	Stack Temp °F	Meter Temp Inlet Outlet °F °F		Probe Temp °F	Filter Exit Temp °F	Impinger Exit Temp °F
1-1	12:30:00	0.69	2.00	1.642	247	83	83	250	251	67
1-2	12:32:30	0.71	2.00	3.500	245	84	84	250	250	67
1-3	12:35:00	0.71	2.00	5.510	244	84	84	255	250	65
1-4	12:37:30	0.72	2.00	7.550	244	84	84	250	256	64
1-5	12:40:00	0.71	2.00	9.400	243	84	84	254	256	64
1-6	12:42:30	0.70	2.00	11.460	242	84	84	256	256	65
	12:45:00			13.576						
2-1	12:49:00	0.69	2.00	13.576	242	84	84	250	255	67
2	12:51:30	0.71	2.00	15.590	242	85	85	251	257	62
3	12:54:00	0.70	2.00	17.600	241	85	85	250	260	61
4	12:56:30	0.71	2.00	19.590	240	85	85	252	256	61
5	12:59:00	0.72	2.10	21.560	240	85	85	250	252	62
6	13:01:30	0.68	1.90	23.660	240	85	85	257	256	62
	13:04:00			25.589						
3-1	13:07:00	0.68	1.90	25.589	240	85	85	261	258	67
2	13:09:30	0.70	2.00	27.490	240	85	85	257	256	61
3	13:12:00	0.69	2.00	29.580	239	85	85	256	258	60
4	13:14:30	0.71	2.00	31.550	239	85	85	256	258	60
5	13:17:00	0.71	2.00	33.450	239	85	85	258	255	61
6	13:19:30	0.70	2.00	35.430	238	85	85	262	255	61
	13:22:00			37.515						
4-1	13:25:00	0.70	2.00	37.515	237	85	85	257	258	67
2	13:27:30	0.69	2.00	39.540	237	85	85	260	255	62
3	13:30:00	0.71	2.00	41.580	236	85	85	257	262	63
4	13:32:30	0.72	2.10	43.590	236	85	85	259	255	63
5	13:35:00	0.71	2.00	45.650	236	85	85	257	256	64
6	13:37:30	0.71	2.00	47.500	235	85	85	252	254	65
	13:40:00			49.519						
Total		1:00:00		47.877		84.7	84.7			
Average			2.00		240.1	84.7				
Min			1.90		235.0	83.0				
Max			2.10		247.0	85.0				

Impinger Weight Sheet - Run 1A

Client: Heidelberg Materials Facility: Mitchell Cement Plant Test Location: Kiln 4 Stack Project #: M234006 Date: 10/4/2023 Test Method: 26A Weighed/Measured By: ELE Balance ID: S168	Scale Calibration Check Date: <u>10/4/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">250</td> <td style="text-align: center; border-bottom: 1px solid black;">250.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">750</td> <td style="text-align: center; border-bottom: 1px solid black;">750.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	250	250.0	500	500.0	750	750.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
250	250.0								
500	500.0								
750	750.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	845.4	750.0	95.4
0.1N H2SO4	749.6	700.6	49.0
Empty	592.9	580.9	12.0
0.1N NaOH	715.2	710.3	4.9
0.1N NaOH	735.8	732.9	2.9
Silica Gel	843.8	833.6	10.2

<u>3,638.9</u> Liquid Final	<u>3,474.7</u> Liquid Initial	<u>164.2</u> Liquid Gain
<u>843.8</u> Silica Final	<u>833.6</u> Silica Initial	<u>10.2</u> Silica Gain

Run 2A - Method 26A

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Source Condition: Mill on

Date: 10/4/23
 Start Time: 14:00
 End Time: 15:09

DRY GAS METER CONDITIONS			STACK CONDITIONS		
ΔH :	2.05	In. H ₂ O	Static Pressure	-0.50	in. H ₂ O
Meter Temperature, Tm:	83.9	°F	Flue Pressure (Ps):	29.16	in. Hg. abs.
Sqrt ΔP :	0.840	In. H ₂ O	Carbon Dioxide:	13.20	%
Stack Temperature, Ts:	227.6	°F	Oxygen:	12.41	%
Meter Volume, Vm:	48.591	ft ³	Nitrogen:	74.4	%
Meter Volume, Vmstd:	46.410	dscf	Gas Weight dry, Md:	30.608	lb/lb mole
Meter Volume, Vwstd:	8.977	wscf	Gas Weight wet, Ms:	28.565	lb/lb mole
Isokinetic Variance:	104.2	%I	Excess Air:	---	%
Test Length:	60.00	in mins.	Gas Velocity, Vs:	54,388	fps
Nozzle Diameter:	0.258	in inches	Volumetric Flow:	992,653	acfm
Barometric Pressure:	29.20	in Hg	Volumetric Flow:	622,522	dscfm
			Volumetric Flow:	742,938	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3587.9	ml	Silica Initial Wt.	801.2	grams
Final Impinger Content:	3764.8	ml	Silica Final Wt.	814.9	grams
Impinger Difference:	176.9	ml	Silica Difference:	13.7	grams
Total Water Gain:	190.6		Moisture, Bws:	0.162	

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head ΔP in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	14:00:00	0.70	2.00	54.005	230	84	84	260	256	67
1-2	14:02:30	0.69	2.00	55.910	230	85	85	264	260	67
1-3	14:05:00	0.71	2.10	57.940	229	85	85	256	251	66
1-4	14:07:30	0.72	2.10	59.890	228	85	85	263	262	65
1-5	14:10:00	0.71	2.10	62.040	228	85	85	259	263	65
1-6	14:12:30	0.70	2.00	63.900	228	85	85	256	257	62
	14:15:00			66.128						
2-1	14:18:00	0.69	2.00	66.128	228	84	84	260	258	67
2	14:20:30	0.71	2.10	68.150	227	84	84	262	257	62
3	14:23:00	0.71	2.10	70.110	228	84	84	255	257	62
4	14:25:30	0.72	2.10	72.150	228	84	84	256	256	62
5	14:28:00	0.70	2.00	74.110	228	84	84	260	254	63
6	14:30:30	0.69	2.00	76.080	228	84	84	256	253	64
	14:33:00			78.174						
3-1	14:36:00	0.69	2.00	78.174	228	83	83	260	256	67
2	14:38:30	0.72	2.10	80.030	228	84	84	254	255	63
3	14:41:00	0.71	2.10	82.110	228	84	84	262	252	63
4	14:43:30	0.70	2.00	84.080	227	84	84	256	255	62
5	14:46:00	0.71	2.10	86.100	227	84	84	252	257	62
6	14:48:30	0.70	2.00	88.090	227	84	84	257	258	60
	14:51:00			90.163						
4-1	14:54:00	0.70	2.00	90.163	227	83	83	260	252	63
2	14:56:30	0.71	2.10	92.200	226	83	83	256	258	61
3	14:59:00	0.72	2.10	94.210	227	83	83	261	261	62
4	15:01:30	0.72	2.10	96.200	226	83	83	259	255	63
5	15:04:00	0.70	2.00	98.230	226	83	83	262	254	64
6	15:06:30	0.69	2.00	100.240	226	83	83	256	255	64
	15:09:00			102.596						

Total	1:00:00			48.591		83.9	83.9			
Average			2.05		227.6	83.9				
Min			2.00		226.0	83.0				
Max			2.10		230.0	85.0				

Impinger Weight Sheet - Run 2A

Client: Heidelberg Materials Facility: Mitchell Cement Plant Test Location: Kiln 4 Stack Project #: M234006 Date: 10/4/2023 Test Method: 26A Weighed/Measured By: ELE Balance ID: S168	Scale Calibration Check Date: <u>10/4/2023</u> <u>Scale Calibration Check (see QS-6.05C for procedure)</u> must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">250</td> <td style="text-align: center; border-bottom: 1px solid black;">250.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">750</td> <td style="text-align: center; border-bottom: 1px solid black;">750.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	250	250.0	500	500.0	750	750.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
250	250.0								
500	500.0								
750	750.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	840.2	722.0	118.2
0.1N H2SO4	781.9	738.7	43.2
Empty	638.9	628.8	10.1
0.1N NaOH	754.3	752.1	2.2
0.1N NaOH	749.5	746.3	3.2
Silica Gel	814.9	801.2	13.7

<u>3,764.8</u> Liquid Final	<u>3,587.9</u> Liquid Initial	<u>176.9</u> Liquid Gain
<u>814.9</u> Silica Final	<u>801.2</u> Silica Initial	<u>13.7</u> Silica Gain

Run 3A - Method 26A

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Source Condition: Mill on

Date: 10/4/23
 Start Time: 15:20
 End Time: 16:32

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH :	2.05	In. H ₂ O		Static Pressure	-0.50	in. H ₂ O
Meter Temperature, Tm:	83.2	°F		Flue Pressure (Ps):	29.16	in. Hg. abs.
Sqrt ΔP :	0.840	In. H ₂ O		Carbon Dioxide:	13.49	%
Stack Temperature, Ts:	225.0	°F		Oxygen:	12.27	%
Meter Volume, Vm:	47.785	ft ³		Nitrogen:	74.24	%
Meter Volume, Vmstd:	45.700	dscf		Gas Weight dry, Md:	30.649	lb/lb mole
Meter Volume, Vwstd:	7.837	wscf		Gas Weight wet, Ms:	28.797	lb/lb mole
Isokinetic Variance:	100.9	%I		Excess Air:	---	%
Test Length:	60.00	in mins.		Gas Velocity, Vs:	54.067	fps
Nozzle Diameter:	0.258	in inches		Volumetric Flow:	986,779	acfm
Barometric Pressure:	29.20	in Hg		Volumetric Flow:	632,803	dscfm
				Volumetric Flow:	741,326	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3349.3	ml	Silica Initial Wt.	843.8	grams
Final Impinger Content:	3505.1	ml	Silica Final Wt.	854.4	grams
Impinger Difference:	155.8	ml	Silica Difference:	10.6	grams
Total Water Gain:	166.4		Moisture, Bws:	0.146	

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head Δp in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	15:20:00	0.70	2.00	3.110	224	82	82	260	252	67
1-2	15:22:30	0.71	2.10	5.120	224	83	83	263	258	62
1-3	15:25:00	0.71	2.10	7.160	224	83	83	255	263	60
1-4	15:27:30	0.72	2.10	9.140	224	83	83	255	259	60
1-5	15:30:00	0.71	2.10	11.180	224	83	83	262	257	60
1-6	15:32:30	0.71	2.10	13.100	224	83	83	259	256	60
	15:35:00			15.006						
2-1	15:39:00	0.69	2.00	15.006	224	83	83	253	260	67
2	15:41:30	0.70	2.00	16.970	224	83	83	261	259	62
3	15:44:00	0.72	2.10	18.890	225	84	84	261	250	61
4	15:46:30	0.72	2.10	20.900	225	84	84	265	254	61
5	15:49:00	0.71	2.10	22.890	225	84	84	259	256	62
6	15:51:30	0.69	2.00	24.900	225	84	84	261	257	63
	15:54:00			26.969						
3-1	15:59:00	0.70	2.00	26.969	225	84	84	261	255	67
2	16:01:30	0.70	2.00	28.990	225	84	84	258	258	65
3	16:04:00	0.71	2.10	30.970	225	84	84	261	260	65
4	16:06:30	0.71	2.10	32.920	225	84	84	256	252	65
5	16:09:00	0.72	2.10	35.020	226	84	84	260	255	66
6	16:11:30	0.69	2.00	37.050	227	84	84	253	257	66
	16:14:00			38.952						
4-1	16:17:00	0.71	2.10	38.952	226	83	83	260	253	67
2	16:19:30	0.70	2.00	40.890	226	83	83	260	254	62
3	16:22:00	0.70	2.00	42.900	226	82	82	261	256	62
4	16:24:30	0.71	2.10	44.280	226	82	82	261	255	63
5	16:27:00	0.69	2.00	46.860	226	82	82	259	257	64
6	16:29:30	0.69	2.00	48.870	226	82	82	264	253	64
	16:32:00			50.895						

Total	1:00:00			47.785		83.2	83.2			
Average			2.05		225.0	83.2				
Min			2.00		224.0	82.0				
Max			2.10		227.0	84.0				

Impinger Weight Sheet - Run 3A

Client: Heidelberg Materials Facility: Mitchell Cement Plant Test Location: Kiln 4 Stack Project #: M234006 Date: 10/4/2023 Test Method: 26A Weighed/Measured By: ELE Balance ID: S168	Scale Calibration Check Date: <u>10/4/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">250</td> <td style="text-align: center; border-bottom: 1px solid black;">250.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">750</td> <td style="text-align: center; border-bottom: 1px solid black;">750.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	250	250.0	500	500.0	750	750.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
250	250.0								
500	500.0								
750	750.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	842.6	719.1	123.5
0.1N H2SO4	699.4	675.1	24.3
Empty	581.9	577.6	4.3
0.1N NaOH	662.8	662.2	0.6
0.1N NaOH	718.4	715.3	3.1
Silica Gel	854.4	843.8	10.6

<u>3,505.1</u> Liquid Final	<u>3,349.3</u> Liquid Initial	<u>155.8</u> Liquid Gain
<u>854.4</u> Silica Final	<u>843.8</u> Silica Initial	<u>10.6</u> Silica Gain

Client:	Heidelberg Materials
Facility:	Mitchell Cement Plant
Test Location:	Kiln 4 Stack
Project #:	M234006
Test Method:	26A
Test Engineer:	PPP
Test Technician:	EEO

	<u>Run 1B</u>	<u>Run 2B</u>	<u>Run 3B</u>
Temp ID:	CM36	CM36	CM36
Meter ID:	CM36	CM36	CM36
Pitot ID:	S8-059-A	S8-059-A	S8-059-A
Nozzle Diameter (Inches):	0.258	0.258	0.258
Meter Calibration Date:	9/28/2023	9/28/2023	9/28/2023
Meter Calibration Factor (Y):	0.991	0.991	0.991
Meter Orifice Setting (Delta H):	1.864	1.864	1.864
Pitot Tube Coefficient:		0.839	
Probe Length (Feet):		8.0	
Probe Liner Material:		Glass	
Sample Plane:		Horizontal	
Port Length (Inches):		6.00	
Port Size (Diameter, Inches):		6.00	
Port Type:		Flange	
Duct Shape:		Circular	
Diameter (Feet):		19.68	
Duct Area (Square Feet):		304.187	
Upstream Diameters:		1.5	
Downstream Diameters:		15.2	
Number of Ports Sampled:		4	
Number of Points per Port:		6	
Minutes per Point:		2.5	
Minutes per Reading:		2.5	
Total Number of Traverse Points:		24	
Test Length (Minutes):		60	
Train Type:		Anderson Box	
Source Condition:		Mill on	
Diluent Model/Serial Number:		Servomex 1440D and MKS 2030	
Moisture Balance ID:		S168	
# of Runs		3	

Run 1B - Method 26A

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Source Condition: Mill on

Date: 10/4/23
 Start Time: 12:30
 End Time: 13:40

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH :	2.06	in. H ₂ O		Static Pressure	-0.50	in. H ₂ O
Meter Temperature, Tm:	84.5	°F		Flue Pressure (Ps):	29.16	in. Hg. abs.
Sqrt ΔP :	0.830	in. H ₂ O		Carbon Dioxide:	7.47	%
Stack Temperature, Ts:	240.9	°F		Oxygen:	15.88	%
Meter Volume, Vm:	47.710	ft ³		Nitrogen:	76.65	%
Meter Volume, Vmstd:	44.973	dscf		Gas Weight dry, Md:	29.830	lb/lb mole
Meter Volume, Vwstd:	11.313	wscf		Gas Weight wet, Ms:	27.453	lb/lb mole
Isokinetic Variance:	105.3	%I		Excess Air:	---	%
Test Length:	60.00	in mins.		Gas Velocity, Vs:	55.730	fps
Nozzle Diameter:	0.258	in inches		Volumetric Flow:	1,017,137	acfm
Barometric Pressure:	29.20	in Hg		Volumetric Flow:	596,716	dscfm
				Volumetric Flow:	746,827	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3588.8	ml	Silica Initial Wt.	899.3	grams
Final Impinger Content:	3817.6	ml	Silica Final Wt.	910.7	grams
Impinger Difference:	228.8	ml	Silica Difference:	11.4	grams
Total Water Gain:	240.2		Moisture, Bws:	0.201	

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head ΔP in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	12:30:00	0.65	2.10	43.224	243	85	85	253	253	61
1-2	12:32:30	0.70	2.20	45.130	243	85	85	252	252	60
1-3	12:35:00	0.72	2.30	47.240	242	85	85	254	253	59
1-4	12:37:30	0.74	2.40	49.290	242	85	85	255	253	59
1-5	12:40:00	0.65	2.10	51.330	240	85	85	253	254	58
1-6	12:42:30	0.64	1.70	53.160	240	85	85	252	253	57
	12:45:00			55.095						
2-1	12:48:00	0.65	2.10	55.095	240	85	85	253	255	56
2-2	12:50:30	0.71	2.30	57.130	241	85	85	250	254	54
2-3	12:53:00	0.70	2.20	59.240	243	85	85	250	253	55
2-4	12:55:30	0.73	2.20	61.310	242	85	85	251	253	56
2-5	12:58:00	0.71	2.20	63.010	245	85	85	250	250	55
2-6	13:00:30	0.65	1.80	64.990	244	85	85	251	251	56
	13:03:00			67.010						
3-1	13:07:00	0.64	2.00	67.010	238	84	84	253	251	58
3-2	13:09:30	0.70	2.00	68.910	240	84	84	251	253	57
3-3	13:12:00	0.71	2.00	70.840	241	84	84	251	256	58
3-4	13:14:30	0.74	2.10	72.730	243	83	83	253	254	59
3-5	13:17:00	0.71	2.00	74.680	242	83	83	253	255	60
3-6	13:19:30	0.66	1.80	76.960	240	83	83	252	254	60
	13:22:00			78.960						
4-1	13:25:00	0.65	1.90	78.960	235	84	84	252	253	60
4-2	13:27:30	0.70	2.20	80.840	237	84	84	252	254	61
4-3	13:30:00	0.72	2.00	82.810	240	85	85	253	253	62
4-4	13:32:30	0.73	2.00	84.730	242	85	85	254	254	61
4-5	13:35:00	0.71	2.00	86.810	240	85	85	254	253	61
4-6	13:37:30	0.64	1.80	88.990	239	85	85	253	253	62
	13:40:00			90.934						

Total	1:00:00			47.710		84.5	84.5			
Average			2.06		240.9	84.5				
Min			1.70		235.0	83.0				
Max			2.40		245.0	85.0				

Impinger Weight Sheet - Run 1B

Client:	Heidelberg Materials	Scale Calibration Check Date:	10/4/2023
Facility:	Mitchell Cement Plant	<u>Scale Calibration Check (see QS-6.05C for procedure)</u>	
Test Location:	Kiln 4 Stack	must be within $\pm 0.5g$ of certified mass	
Project #:	M234006	<u>Certified Weight, grams</u>	<u>Result, grams</u>
Date:	10/4/2023	250	250.0
Test Method:	26A		
Weighed/Measured By:	ELE	500	500.0
Balance ID:	S168	750	750.0

IMPINGER		FINAL		INITIAL		GAIN	
CONTENTS		MLS / GRAMS		MLS / GRAMS		MLS / GRAMS	
0.1N H2SO4		882.6		736.0		146.6	
0.1N H2SO4		782.1		730.3		51.8	
Empty		663.0		646.7		16.3	
0.1N NaOH		727.7		721.2		6.5	
0.1N NaOH		762.2		754.6		7.6	
Silica Gel		910.7		899.3		11.4	

3,817.6	3,588.8	228.8
Liquid Final	Liquid Initial	Liquid Gain
910.7	899.3	11.4
Silica Final	Silica Initial	Silica Gain

Run 2B - Method 26A

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Source Condition: Mill on

Date: 10/4/23
 Start Time: 14:00
 End Time: 15:10

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH :	2.10	In. H ₂ O		Static Pressure	-0.50	in. H ₂ O
Meter Temperature, Tm:	84.8	°F		Flue Pressure (Ps):	29.16	in. Hg. abs.
Sqrt ΔP :	0.833	In. H ₂ O		Carbon Dioxide:	7.50	%
Stack Temperature, Ts:	232.3	°F		Oxygen:	15.84	%
Meter Volume, Vm:	50.214	ft ³		Nitrogen:	76.7	%
Meter Volume, Vmstd:	47.320	dscf		Gas Weight dry, Md:	29.834	lb/lb mole
Meter Volume, Vwstd:	7.814	wscf		Gas Weight wet, Ms:	28.156	lb/lb mole
Isokinetic Variance:	103.5	%I		Excess Air:	---	%
Test Length:	60.00	in mins.		Gas Velocity, Vs:	54.838	fps
Nozzle Diameter:	0.258	in inches		Volumetric Flow:	1,000,861	acfm
Barometric Pressure:	29.20	in Hg		Volumetric Flow:	638,583	dscfm
				Volumetric Flow:	744,032	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3657.6	ml	Silica Initial Wt.	853.6	grams
Final Impinger Content:	3811.0	ml	Silica Final Wt.	866.1	grams
Impinger Difference:	153.4	ml	Silica Difference:	12.5	grams
Total Water Gain:	165.9		Moisture, Bws:	0.142	

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head Δp in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	14:00:00	0.65	2.10	93.800	227	84	84	253	254	59
1-2	14:02:30	0.71	2.30	95.870	230	84	84	253	252	60
1-3	14:05:00	0.73	2.40	98.230	229	84	84	252	253	60
1-4	14:07:30	0.74	2.40	100.250	233	84	84	251	252	61
1-5	14:10:00	0.71	2.10	102.420	231	84	84	251	252	61
1-6	14:12:30	0.65	2.10	104.630	230	84	84	253	253	62
	14:15:00			106.534						
2-1	14:18:00	0.64	2.10	106.534	230	84	84	253	250	63
2-2	14:20:30	0.70	2.20	108.740	233	85	85	254	252	62
2-3	14:23:00	0.73	2.30	110.820	234	85	85	253	253	60
2-4	14:25:30	0.74	2.40	112.940	235	85	85	252	254	61
2-5	14:28:00	0.70	2.20	115.230	235	85	85	253	253	61
2-6	14:30:30	0.65	2.10	117.230	233	85	85	253	254	60
	14:33:00			119.255						
3-1	14:37:00	0.65	1.80	119.255	229	84	84	251	253	60
3-2	14:39:30	0.70	2.00	121.430	230	84	84	253	253	61
3-3	14:42:00	0.72	2.10	123.520	233	84	84	253	254	62
3-4	14:44:30	0.73	2.10	125.610	235	85	85	254	253	63
3-5	14:47:00	0.71	2.00	127.640	234	85	85	256	253	63
3-6	14:49:30	0.64	1.80	129.850	233	85	85	253	252	64
	14:52:00			131.953						
4-1	14:55:00	0.66	1.90	131.953	230	85	85	253	252	64
4-2	14:57:30	0.69	2.00	134.230	233	85	85	254	253	64
4-3	15:00:00	0.71	2.00	136.320	235	86	86	256	255	65
4-4	15:02:30	0.73	2.10	138.490	234	86	86	254	254	63
4-5	15:05:00	0.71	2.00	140.620	234	86	86	253	254	62
4-6	15:07:30	0.65	1.90	142.630	235	86	86	253	252	62
	15:10:00			144.014						

Total	1:00:00			50.214		84.8	84.8			
Average			2.10		232.3	84.8				
Min			1.80		227.0	84.0				
Max			2.40		235.0	86.0				

Impinger Weight Sheet - Run 2B

Client: Heidelberg Materials Facility: Mitchell Cement Plant Test Location: Kiln 4 Stack Project #: M234006 Date: 10/4/2023 Test Method: 26A Weighed/Measured By: ELE Balance ID: S168	Scale Calibration Check Date: <u>10/4/2023</u> <u>Scale Calibration Check (see QS-6.05C for procedure)</u> must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">250</td> <td style="text-align: center; border-bottom: 1px solid black;">250.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">750</td> <td style="text-align: center; border-bottom: 1px solid black;">750.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	250	250.0	500	500.0	750	750.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
250	250.0								
500	500.0								
750	750.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	880.6	776.9	103.7
0.1N H2SO4	802.5	753.0	49.5
Empty	663.9	674.1	-10.2
0.1N NaOH	721.8	714.9	6.9
0.1N NaOH	742.2	738.7	3.5
Silica Gel	866.1	853.6	12.5

<u>3,811.0</u> Liquid Final	<u>3,657.6</u> Liquid Initial	<u>153.4</u> Liquid Gain
<u>866.1</u> Silica Final	<u>853.6</u> Silica Initial	<u>12.5</u> Silica Gain

Run 3B - Method 26A

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Source Condition: Mill on

Date: 10/4/23
 Start Time: 15:20
 End Time: 16:28

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH :	2.00	In. H ₂ O		Static Pressure	-0.50	in. H ₂ O
Meter Temperature, Tm:	88.7	°F		Flue Pressure (Ps):	29.16	in. Hg. abs.
Sqrt ΔP :	0.831	In. H ₂ O		Carbon Dioxide:	7.49	%
Stack Temperature, Ts:	231.4	°F		Oxygen:	15.80	%
Meter Volume, Vm:	51.226	ft ³		Nitrogen:	76.71	%
Meter Volume, Vmstd:	47.918	dscf		Gas Weight dry, Md:	29.830	lb/lb mole
Meter Volume, Vwstd:	10.682	wscf		Gas Weight wet, Ms:	27.674	lb/lb mole
Isokinetic Variance:	109.2	%I		Excess Air:	---	%
Test Length:	60.00	in mins.		Gas Velocity, Vs:	55.196	fps
Nozzle Diameter:	0.258	in inches		Volumetric Flow:	1,007,385	acfm
Barometric Pressure:	29.20	in Hg		Volumetric Flow:	613,178	dscfm
				Volumetric Flow:	749,874	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3548.7	ml	Silica Initial Wt.	910.7	grams
Final Impinger Content:	3765.2	ml	Silica Final Wt.	921.0	grams
Impinger Difference:	216.5	ml	Silica Difference:	10.3	grams
Total Water Gain:	226.8		Moisture, Bws:	0.182	

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head ΔP in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	15:20:00	0.66	1.90	145.514	230	87	87	253	252	54
1-2	15:22:30	0.70	2.00	147.720	230	87	87	254	254	55
1-3	15:25:00	0.71	2.00	149.830	233	87	87	252	255	56
1-4	15:27:30	0.73	2.10	151.950	233	87	87	252	254	55
1-5	15:30:00	0.68	2.00	154.370	234	87	87	253	255	56
1-6	15:32:30	0.65	1.90	156.140	232	87	87	253	252	56
	15:35:00			158.255						
2-1	15:37:00	0.64	1.90	158.255	229	88	88	253	253	57
2-2	15:39:30	0.69	2.00	160.390	230	88	88	254	255	57
2-3	15:42:00	0.71	2.10	162.530	231	89	89	253	254	58
2-4	15:44:30	0.74	2.10	164.780	230	89	89	252	253	57
2-5	15:47:00	0.71	2.10	166.840	229	89	89	252	253	57
2-6	15:49:30	0.65	1.90	168.910	231	89	89	253	254	57
	15:52:00			171.033						
3-1	15:55:00	0.65	1.90	171.033	230	89	89	253	253	58
3-2	15:57:30	0.70	2.00	173.130	231	89	89	254	255	58
3-3	16:00:00	0.73	2.10	175.340	233	89	89	255	253	59
3-4	16:02:30	0.73	2.10	177.620	234	89	89	253	253	60
3-5	16:05:00	0.69	2.00	179.650	233	90	90	253	252	60
3-6	16:07:30	0.64	1.90	181.720	232	90	90	254	253	61
	16:10:00			183.860						
4-1	16:13:00	0.66	1.90	183.860	229	89	89	252	252	62
4-2	16:15:30	0.70	2.00	186.120	230	89	89	254	254	62
4-3	16:18:00	0.73	2.10	188.340	231	90	90	254	253	63
4-4	16:20:30	0.74	2.10	190.560	233	90	90	253	254	63
4-5	16:23:00	0.71	2.10	192.610	233	90	90	253	254	63
4-6	16:25:30	0.65	1.90	194.690	232	90	90	252	253	63
	16:28:00			196.740						

Total	1:00:00			51.226		88.7	88.7			
Average			2.00		231.4	88.7				
Min			1.90		229.0	87.0				
Max			2.10		234.0	90.0				

Impinger Weight Sheet - Run 3B

Client: Heidelberg Materials Facility: Mitchell Cement Plant Test Location: Kiln 4 Stack Project #: M234006 Date: 10/4/2023 Test Method: 26A Weighed/Measured By: ELE Balance ID: S168	Scale Calibration Check Date: <u>10/4/2023</u> <u>Scale Calibration Check (see QS-6.05C for procedure)</u> must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">250</td> <td style="text-align: center; border-bottom: 1px solid black;">250.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">750</td> <td style="text-align: center; border-bottom: 1px solid black;">750.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	250	250.0	500	500.0	750	750.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
250	250.0								
500	500.0								
750	750.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	858.1	727.9	130.2
0.1N H2SO4	786.6	717.1	69.5
Empty	652.5	644.0	8.5
0.1N NaOH	742.2	738.3	3.9
0.1N NaOH	725.8	721.4	4.4
Silica Gel	921.0	910.7	10.3

<u>3,765.2</u> Liquid Final	<u>3,548.7</u> Liquid Initial	<u>216.5</u> Liquid Gain
<u>921.0</u> Silica Final	<u>910.7</u> Silica Initial	<u>10.3</u> Silica Gain

Client: Heidelberg Materials
Facility: Mitchell Cement Plant
Project #: M234006
Test Location: Kiln 4 Stack
Date: 10/4/23

Run 1 - Mill on

Spectrum	Time	H2O %	FTIR Data			Cell Temp	Pressure	Analyzer Data
			CO2 % (wet)	HCN ppmvw	HF ppmvw			O2 % (wet)
RUN 1 MILL ON_002755.LAB	12:30	14.15	11.31	9.66	0.10	190.94	0.99	10.90
RUN 1 MILL ON_002756.LAB	12:31	14.02	11.61	9.26	0.10	190.95	0.99	10.90
RUN 1 MILL ON_002757.LAB	12:32	13.72	11.21	9.33	0.10	191.05	0.99	10.90
RUN 1 MILL ON_002758.LAB	12:33	13.60	10.95	9.35	0.10	191.05	0.99	10.90
RUN 1 MILL ON_002759.LAB	12:34	13.55	10.92	9.55	0.10	191.05	0.99	11.10
RUN 1 MILL ON_002760.LAB	12:35	13.39	11.18	9.32	0.10	191.05	0.99	11.30
RUN 1 MILL ON_002761.LAB	12:36	13.62	11.92	9.35	0.10	190.97	0.99	11.30
RUN 1 MILL ON_002762.LAB	12:37	13.84	12.00	9.21	0.10	190.94	0.99	11.40
RUN 1 MILL ON_002763.LAB	12:38	13.95	11.92	9.30	0.10	190.85	0.99	11.30
RUN 1 MILL ON_002764.LAB	12:39	14.68	11.80	9.20	0.10	190.89	0.99	11.00
RUN 1 MILL ON_002765.LAB	12:40	15.18	11.79	9.13	0.10	191.05	0.99	10.90
RUN 1 MILL ON_002766.LAB	12:41	14.87	11.52	9.06	0.10	191.15	0.99	10.80
RUN 1 MILL ON_002767.LAB	12:42	14.64	11.74	9.13	0.10	191.15	0.99	10.50
RUN 1 MILL ON_002768.LAB	12:43	14.62	11.49	9.06	0.10	191.13	0.99	10.40
RUN 1 MILL ON_002769.LAB	12:44	14.54	11.47	8.82	0.10	191.05	0.99	10.50
RUN 1 MILL ON_002770.LAB	12:45	14.47	11.29	8.98	0.10	190.98	0.99	10.60
RUN 1 MILL ON_002771.LAB	12:46	14.23	11.31	8.74	0.10	190.90	0.99	10.60
RUN 1 MILL ON_002772.LAB	12:47	14.11	11.21	8.95	0.10	190.84	0.99	10.80
RUN 1 MILL ON_002773.LAB	12:48	14.29	11.28	8.90	0.10	190.84	0.99	10.70
RUN 1 MILL ON_002774.LAB	12:49	14.26	11.29	9.01	0.10	190.84	0.99	10.80
RUN 1 MILL ON_002775.LAB	12:50	14.20	11.24	8.74	0.10	190.93	0.99	10.70
RUN 1 MILL ON_002776.LAB	12:51	14.20	11.38	9.08	0.10	191.05	0.99	10.80
RUN 1 MILL ON_002777.LAB	12:52	14.19	11.82	9.14	0.10	191.05	0.99	10.60
RUN 1 MILL ON_002778.LAB	12:53	14.10	11.54	9.28	0.10	191.15	0.99	10.70
RUN 1 MILL ON_002779.LAB	12:54	14.39	11.98	8.42	0.10	191.15	0.99	10.80
RUN 1 MILL ON_002780.LAB	12:55	14.55	12.04	8.62	0.10	191.10	0.99	10.80
RUN 1 MILL ON_002781.LAB	12:56	14.70	11.48	8.17	0.10	190.97	0.99	10.70
RUN 1 MILL ON_002782.LAB	12:57	14.73	11.38	8.35	0.10	190.90	0.99	10.90
RUN 1 MILL ON_002783.LAB	12:58	14.94	11.38	8.21	0.10	191.02	0.99	10.70
RUN 1 MILL ON_002784.LAB	12:59	15.20	11.23	8.26	0.10	191.03	0.99	10.50
RUN 1 MILL ON_002785.LAB	13:00	15.44	11.08	8.13	0.10	191.05	0.99	10.60
RUN 1 MILL ON_002786.LAB	13:01	15.54	11.03	8.04	0.10	190.97	0.99	10.60
RUN 1 MILL ON_002787.LAB	13:02	15.45	11.15	8.12	0.10	191.01	0.99	10.60
RUN 1 MILL ON_002788.LAB	13:03	15.31	11.07	8.05	0.10	191.04	0.99	10.70
RUN 1 MILL ON_002789.LAB	13:04	15.28	10.99	8.00	0.10	190.94	0.99	10.70
RUN 1 MILL ON_002790.LAB	13:05	15.41	11.01	7.97	0.10	191.00	0.99	10.70
RUN 1 MILL ON_002791.LAB	13:06	15.59	11.04	8.06	0.10	190.95	0.99	10.70
RUN 1 MILL ON_002792.LAB	13:07	15.61	11.08	7.76	0.10	190.94	0.99	10.60
RUN 1 MILL ON_002793.LAB	13:08	16.31	10.95	7.72	0.10	190.94	0.99	10.70
RUN 1 MILL ON_002794.LAB	13:09	16.09	11.17	7.76	0.10	190.94	0.99	10.60
RUN 1 MILL ON_002795.LAB	13:10	16.11	11.24	7.74	0.10	190.94	0.99	10.50
RUN 1 MILL ON_002796.LAB	13:11	16.27	11.29	7.51	0.10	190.96	0.99	10.40
RUN 1 MILL ON_002797.LAB	13:12	16.10	11.45	7.71	0.10	191.05	0.99	10.30
RUN 1 MILL ON_002798.LAB	13:13	16.11	11.45	7.48	0.10	191.05	0.99	10.30
RUN 1 MILL ON_002799.LAB	13:14	16.26	11.44	7.55	0.10	191.08	0.99	10.20
RUN 1 MILL ON_002800.LAB	13:15	16.31	11.56	7.48	0.10	191.03	0.99	10.10
RUN 1 MILL ON_002801.LAB	13:16	15.99	11.49	7.58	0.10	190.94	0.99	10.00
RUN 1 MILL ON_002802.LAB	13:17	15.68	11.37	7.36	0.10	190.97	0.99	10.00
RUN 1 MILL ON_002803.LAB	13:18	15.52	11.27	7.72	0.10	191.05	0.99	9.90
RUN 1 MILL ON_002804.LAB	13:19	15.30	11.17	7.62	0.10	191.05	0.99	9.90
RUN 1 MILL ON_002805.LAB	13:20	15.19	11.27	7.91	0.10	191.05	0.99	9.80
RUN 1 MILL ON_002806.LAB	13:21	15.13	11.18	8.21	0.10	191.05	0.99	9.90
RUN 1 MILL ON_002807.LAB	13:22	15.18	11.29	8.51	0.10	191.00	0.99	10.10
RUN 1 MILL ON_002808.LAB	13:23	15.34	11.12	8.24	0.10	190.94	0.99	10.20
RUN 1 MILL ON_002809.LAB	13:24	15.35	11.21	8.20	0.10	190.94	0.99	10.30
RUN 1 MILL ON_002810.LAB	13:25	15.41	11.13	7.95	0.10	191.00	0.99	10.50
RUN 1 MILL ON_002811.LAB	13:26	15.49	11.15	7.87	0.10	191.12	0.99	10.50
RUN 1 MILL ON_002812.LAB	13:27	15.55	11.06	7.87	0.10	191.15	0.99	10.60
RUN 1 MILL ON_002813.LAB	13:28	15.56	11.13	7.60	0.10	191.14	0.99	10.50
RUN 1 MILL ON_002814.LAB	13:29	15.63	10.97	7.71	0.10	191.02	0.99	10.60
Average		14.97	11.34	8.42	0.10	191.01	0.99	10.60

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Project #: M234006
 Test Location: Kiln 4 Stack
 Date: 10/4/23

Run 2 - Mill on

Spectrum	Time	H2O %	FTIR Data			Cell Temp	Pressure	Analyzer Data
			CO2 % (wet)	HCN ppmvw	HF ppmvw			O2 % (wet)
RUN 2_002907.LAB	14:00	16.20	11.0	7.32	0.10	191.0	0.99	10.50
RUN 2_002908.LAB	14:01	15.97	11.0	7.67	0.10	191.0	0.99	10.50
RUN 2_002909.LAB	14:02	15.76	11.2	7.80	0.10	191.0	0.99	10.40
RUN 2_002910.LAB	14:03	15.61	11.2	7.85	0.10	191.0	0.99	10.20
RUN 2_002911.LAB	14:04	16.62	11.1	7.55	0.10	190.9	0.99	10.20
RUN 2_002912.LAB	14:05	16.07	11.2	7.87	0.10	190.9	0.99	10.20
RUN 2_002913.LAB	14:06	16.01	11.4	7.71	0.10	191.0	0.99	10.30
RUN 2_002914.LAB	14:07	15.88	11.3	7.88	0.10	191.0	0.99	10.20
RUN 2_002915.LAB	14:08	15.87	11.4	7.76	0.10	191.0	0.99	10.30
RUN 2_002916.LAB	14:09	15.74	11.3	7.89	0.10	191.0	0.99	10.40
RUN 2_002917.LAB	14:10	15.75	11.3	7.73	0.10	191.0	0.99	10.40
RUN 2_002918.LAB	14:11	15.62	11.3	7.77	0.10	191.0	0.99	10.40
RUN 2_002919.LAB	14:12	15.68	11.2	7.43	0.10	191.0	0.99	10.40
RUN 2_002920.LAB	14:13	15.96	11.2	7.52	0.10	191.1	0.99	10.40
RUN 2_002921.LAB	14:14	15.86	11.1	7.40	0.10	191.1	0.99	10.40
RUN 2_002922.LAB	14:15	15.71	11.1	7.51	0.10	191.0	0.99	10.50
RUN 2_002923.LAB	14:16	15.88	11.0	7.44	0.10	190.9	0.99	10.40
RUN 2_002924.LAB	14:17	15.67	11.2	7.61	0.10	190.9	0.99	10.60
RUN 2_002925.LAB	14:18	15.60	11.0	7.50	0.10	190.9	0.99	10.50
RUN 2_002926.LAB	14:19	15.47	11.3	7.60	0.10	190.9	0.99	10.50
RUN 2_002927.LAB	14:20	15.56	11.1	7.72	0.10	190.9	0.99	10.50
RUN 2_002928.LAB	14:21	15.53	11.2	7.68	0.10	190.9	0.99	10.50
RUN 2_002929.LAB	14:22	15.41	11.1	7.75	0.10	190.9	0.99	10.60
RUN 2_002930.LAB	14:23	15.55	11.2	7.66	0.10	190.9	0.99	10.40
RUN 2_002931.LAB	14:24	15.57	11.1	7.73	0.10	190.9	0.99	10.50
RUN 2_002932.LAB	14:25	15.73	11.1	7.62	0.10	191.0	0.99	10.40
RUN 2_002933.LAB	14:26	15.45	11.1	7.78	0.10	191.0	0.99	10.50
RUN 2_002934.LAB	14:27	15.61	11.1	7.62	0.10	191.0	0.99	10.50
RUN 2_002935.LAB	14:28	15.73	10.9	7.68	0.10	191.0	0.99	10.50
RUN 2_002936.LAB	14:29	15.71	11.0	7.48	0.10	191.0	0.99	10.50
RUN 2_002937.LAB	14:30	15.80	10.9	7.59	0.10	191.0	0.99	10.50
RUN 2_002938.LAB	14:31	15.78	11.0	7.52	0.10	191.0	0.99	10.50
RUN 2_002939.LAB	14:32	15.73	11.1	7.72	0.10	191.0	0.99	10.50
RUN 2_002940.LAB	14:33	15.71	11.1	7.71	0.10	191.0	0.99	10.40
RUN 2_002941.LAB	14:34	15.79	11.1	7.64	0.10	191.0	0.99	10.50
RUN 2_002942.LAB	14:35	15.77	11.1	7.47	0.10	191.0	0.99	10.40
RUN 2_002943.LAB	14:36	15.84	11.1	7.69	0.10	191.0	0.99	10.40
RUN 2_002944.LAB	14:37	16.03	11.0	7.68	0.10	191.0	0.99	10.40
RUN 2_002945.LAB	14:38	15.91	11.0	7.62	0.10	191.0	0.99	10.50
RUN 2_002946.LAB	14:39	15.89	10.9	7.53	0.10	191.0	0.99	10.50
RUN 2_002947.LAB	14:40	15.94	11.1	7.73	0.10	191.1	0.99	10.60
RUN 2_002948.LAB	14:41	15.65	11.0	7.71	0.10	191.0	0.99	10.50
RUN 2_002949.LAB	14:42	15.37	11.2	7.70	0.10	191.0	0.99	10.50
RUN 2_002950.LAB	14:43	15.33	11.2	7.82	0.10	191.0	0.99	10.40
RUN 2_002951.LAB	14:44	15.30	11.3	7.64	0.10	190.9	0.99	10.50
RUN 2_002952.LAB	14:45	15.13	11.1	7.74	0.10	190.9	0.99	10.40
RUN 2_002953.LAB	14:46	15.48	11.2	7.67	0.10	190.8	0.99	10.60
RUN 2_002954.LAB	14:47	15.65	11.0	7.73	0.10	191.0	0.99	10.50
RUN 2_002955.LAB	14:48	15.47	11.2	7.64	0.10	191.0	0.99	10.50
RUN 2_002956.LAB	14:49	15.65	11.2	7.87	0.10	191.0	0.99	10.50
RUN 2_002957.LAB	14:50	15.52	11.2	7.65	0.10	191.0	0.99	10.40
RUN 2_002958.LAB	14:51	15.67	11.2	7.86	0.10	191.0	0.99	10.40
RUN 2_002959.LAB	14:52	15.86	11.0	7.56	0.10	191.0	0.99	10.50
RUN 2_002960.LAB	14:53	15.87	11.1	7.77	0.10	191.0	0.99	10.40
RUN 2_002961.LAB	14:54	16.47	11.0	7.53	0.10	190.9	0.99	10.40
RUN 2_002962.LAB	14:55	15.84	11.0	7.75	0.10	190.9	0.99	10.40
RUN 2_002963.LAB	14:56	15.82	11.0	7.53	0.10	190.9	0.99	10.40
RUN 2_002964.LAB	14:57	15.82	11.0	7.63	0.10	191.0	0.99	10.50
RUN 2_002965.LAB	14:58	15.83	11.0	7.62	0.10	191.1	0.99	10.50
RUN 2_002966.LAB	14:59	15.61	11.1	7.74	0.10	191.1	0.99	10.50
Average		15.74	11.12	7.66	0.10	191.01	0.99	10.44

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Project #: M234006
 Test Location: Kiln 4 Stack
 Date: 10/4/23

Run 3 - Mil on

Spectrum	Time	FTIR Data				Cell Temp	Pressure	Analyzer Data
		H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw			O2 % (wet)
RUN 3_003038.LAB	15:20	14.84	11.5	8.3	0.10	191.0	0.99	10.50
RUN 3_003039.LAB	15:21	14.79	11.5	8.1	0.10	191.0	0.99	10.50
RUN 3_003040.LAB	15:22	14.87	11.5	8.4	0.10	191.0	0.99	10.50
RUN 3_003041.LAB	15:23	15.06	11.4	8.1	0.10	191.0	0.99	10.30
RUN 3_003042.LAB	15:24	16.24	11.3	8.3	0.10	190.9	0.99	10.40
RUN 3_003043.LAB	15:25	16.28	11.0	8.2	0.10	190.9	0.99	10.40
RUN 3_003044.LAB	15:26	15.89	11.4	8.6	0.10	191.0	0.99	10.40
RUN 3_003045.LAB	15:27	15.80	11.2	8.6	0.10	191.1	0.99	10.50
RUN 3_003046.LAB	15:28	15.79	11.3	8.7	0.10	191.1	0.99	10.40
RUN 3_003047.LAB	15:29	15.61	11.3	8.6	0.10	191.0	0.99	10.50
RUN 3_003048.LAB	15:30	15.53	11.3	8.5	0.10	191.0	0.99	10.40
RUN 3_003049.LAB	15:31	15.52	11.3	8.5	0.10	191.0	0.99	10.40
RUN 3_003050.LAB	15:32	15.49	11.4	8.3	0.10	191.0	0.99	10.40
RUN 3_003051.LAB	15:33	15.50	11.3	8.3	0.10	191.0	0.99	10.40
RUN 3_003052.LAB	15:34	15.57	11.4	8.2	0.10	191.0	0.99	10.40
RUN 3_003053.LAB	15:35	15.44	11.2	8.3	0.10	191.0	0.99	10.50
RUN 3_003054.LAB	15:36	15.44	11.4	8.2	0.10	191.0	0.99	10.40
RUN 3_003055.LAB	15:37	15.61	11.2	8.4	0.10	191.0	0.99	10.50
RUN 3_003056.LAB	15:38	15.61	11.3	8.5	0.10	191.0	0.99	10.40
RUN 3_003057.LAB	15:39	15.59	11.2	8.6	0.10	191.0	0.99	10.50
RUN 3_003058.LAB	15:40	15.54	11.2	8.3	0.10	190.9	0.99	10.50
RUN 3_003059.LAB	15:41	15.57	11.2	8.5	0.10	190.9	0.99	10.50
RUN 3_003060.LAB	15:42	15.43	11.2	8.1	0.10	190.9	0.99	10.60
RUN 3_003061.LAB	15:43	15.00	11.3	8.4	0.10	191.0	0.99	10.60
RUN 3_003062.LAB	15:44	15.16	11.4	8.3	0.10	191.0	0.99	10.60
RUN 3_003063.LAB	15:45	15.42	11.4	8.3	0.10	190.9	0.99	10.50
RUN 3_003064.LAB	15:46	15.76	11.3	8.0	0.10	191.0	0.99	10.40
RUN 3_003065.LAB	15:47	16.02	11.3	8.0	0.10	191.0	0.99	10.40
RUN 3_003066.LAB	15:48	15.65	11.3	8.0	0.10	191.0	0.99	10.30
RUN 3_003067.LAB	15:49	15.72	11.4	8.2	0.10	191.0	0.99	10.40
RUN 3_003068.LAB	15:50	15.79	11.2	8.1	0.10	191.0	0.99	10.40
RUN 3_003069.LAB	15:51	15.47	11.3	8.3	0.10	191.0	0.99	10.40
RUN 3_003070.LAB	15:52	15.54	11.3	8.4	0.10	191.0	0.99	10.40
RUN 3_003071.LAB	15:53	15.61	11.3	8.4	0.10	190.9	0.99	10.50
RUN 3_003072.LAB	15:54	15.52	11.2	8.4	0.10	190.8	0.99	10.40
RUN 3_003073.LAB	15:55	15.67	11.3	8.3	0.10	190.9	0.99	10.50
RUN 3_003074.LAB	15:56	15.87	11.2	8.4	0.10	190.9	0.99	10.50
RUN 3_003075.LAB	15:57	15.90	11.2	8.1	0.10	191.0	0.99	10.40
RUN 3_003076.LAB	15:58	15.74	11.2	8.3	0.10	191.0	0.99	10.40
RUN 3_003077.LAB	15:59	15.36	11.3	8.1	0.10	191.0	0.99	10.50
RUN 3_003078.LAB	16:00	15.55	11.4	8.5	0.10	191.0	0.99	10.50
RUN 3_003079.LAB	16:01	15.66	11.5	8.4	0.10	191.0	0.99	10.40
RUN 3_003080.LAB	16:02	15.44	11.5	8.6	0.10	191.0	0.99	10.30
RUN 3_003081.LAB	16:03	15.60	11.5	8.3	0.10	191.0	0.99	10.40
RUN 3_003082.LAB	16:04	15.74	11.5	8.3	0.10	191.0	0.99	10.30
RUN 3_003083.LAB	16:05	15.60	11.5	8.2	0.10	191.0	0.99	10.30
RUN 3_003084.LAB	16:06	15.62	11.5	8.4	0.10	191.0	0.99	10.20
RUN 3_003085.LAB	16:07	15.64	11.5	8.2	0.10	191.0	0.99	10.30
RUN 3_003086.LAB	16:08	15.95	11.5	8.4	0.10	190.9	0.99	10.30
RUN 3_003087.LAB	16:09	16.17	11.5	8.3	0.10	190.9	0.99	10.30
RUN 3_003088.LAB	16:10	16.08	11.5	8.4	0.10	190.9	0.99	10.20
RUN 3_003089.LAB	16:11	15.92	11.5	8.5	0.10	190.9	0.99	10.20
RUN 3_003090.LAB	16:12	15.92	11.7	8.5	0.10	191.0	0.99	10.20
RUN 3_003091.LAB	16:13	15.76	11.5	8.4	0.10	191.0	0.99	10.20
RUN 3_003092.LAB	16:14	15.74	11.7	8.4	0.10	191.0	0.99	10.20
RUN 3_003093.LAB	16:15	15.70	11.6	8.5	0.10	191.0	0.99	10.20
RUN 3_003094.LAB	16:16	15.97	11.6	8.4	0.10	191.0	0.99	10.20
RUN 3_003095.LAB	16:17	16.00	11.6	8.5	0.10	191.0	0.99	10.20
RUN 3_003096.LAB	16:18	15.92	11.5	8.3	0.10	190.9	0.99	10.20
RUN 3_003097.LAB	16:19	16.14	11.5	8.5	0.10	191.0	0.99	10.20
Average		15.64	11.38	8.34	0.10	191.01	0.99	10.39

Client:	Lehigh Cement Company		
Facility:	Mitchell		
Test Location:	Kiln 4		
Project #:	M232807		
Test Method:	26A		
Test Engineer:	JXJ		
Test Technician:	CLC		
	<u>Run 1A</u>	<u>Run 2A</u>	<u>Run 3A</u>
Temp ID:	CM47	CM47	CM47
Meter ID:	CM47	CM47	CM47
Pitot ID:	468	468	468
Nozzle Diameter (Inches):	0.258	0.258	0.258
Meter Calibration Date:	8/11/2023	8/11/2023	8/11/2023
Meter Calibration Factor (Y):	1.003	1.003	1.003
Meter Orifice Setting (Delta H):	1.901	1.901	1.901
Nozzle Kit ID Number and Material:	glass #297	glass #297	glass #297
Pitot Tube Coefficient:		0.840	
Probe Length (Feet):		8.0	
Probe Liner Material:		Glass	
Sample Plane:		Horizontal	
Port Length (Inches):		6.00	
Port Size (Diameter, Inches):		6.00	
Port Type:		Flange	
Duct Shape:		Circular	
Diameter (Feet):		19.68	
Duct Area (Square Feet):		304.187	
Upstream Diameters:		1.5	
Downstream Diameters:		15.2	
Number of Ports Sampled:		4	
Number of Points per Port:		6	
Minutes per Point:		2.5	
Minutes per Reading:		2.5	
Total Number of Traverse Points:		24	
Test Length (Minutes):		60	
Train Type:		Anderson Box	
Source Condition:		Mill Off	
Diluent Model/Serial Number:		Servomex 1440D and MKS 2030	
Moisture Balance ID:		S168	
# of Runs		3	

Run 1A - Method 26A

Client: Lehigh Cement Company
 Facility: Mitchell
 Test Location: Kiln 4
 Source Condition: Mill Off

Date: 10/3/23
 Start Time: 21:12
 End Time: 22:21

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH :	1.65	in. H ₂ O		Static Pressure	-0.50	in. H ₂ O
Meter Temperature, T _m :	82.0	°F		Flue Pressure (Ps):	29.05	in. Hg. abs.
Sqrt ΔP :	0.810	in. H ₂ O		Carbon Dioxide:	13.46	%
Stack Temperature, T _s :	317.7	°F		Oxygen:	12.51	%
Meter Volume, V _m :	42.808	ft ³		Nitrogen:	74.03	%
Meter Volume, V _{mstd} :	40.837	dscf		Gas Weight dry, Md:	30.654	lb/lb mole
Meter Volume, V _{wstd} :	6.726	wscf		Gas Weight wet, Ms:	28.865	lb/lb mole
Isokinetic Variance:	98.7	%I		Excess Air:	---	%
Test Length:	60.00	in mins.		Gas Velocity, V _s :	55.984	fps
Nozzle Diameter:	0.258	in inches		Volumetric Flow:	1,021,779	acfm
Barometric Pressure:	29.09	in Hg		Volumetric Flow:	578,351	dscfm
				Volumetric Flow:	673,606	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3591.3	ml	Silica Initial Wt.	813.4	grams
Final Impinger Content:	3719.1	ml	Silica Final Wt.	828.4	grams
Impinger Difference:	127.8	ml	Silica Difference:	15.0	grams
Total Water Gain:	142.8		Moisture, Bws:	0.141	

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head ΔP in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	21:12:00	0.60	1.50	70.807	319	82	82	261	255	54
1-2	21:14:30	0.63	1.60	72.515	319	82	82	257	255	55
1-3	21:17:00	0.65	1.60	74.260	319	82	82	257	252	56
1-4	21:19:30	0.70	1.80	76.035	319	82	82	250	252	57
1-5	21:22:00	0.68	1.70	77.875	319	82	82	252	251	58
1-6	21:24:30	0.66	1.70	79.690	318	82	82	254	250	60
	21:27:00			81.480						
2-1	21:30:00	0.59	1.50	81.480	319	82	82	254	250	58
2-2	21:32:30	0.62	1.60	83.175	319	82	82	250	250	58
2-3	21:35:00	0.66	1.70	84.905	319	82	82	253	251	57
2-4	21:37:30	0.70	1.80	86.695	320	82	82	250	252	56
2-5	21:40:00	0.69	1.70	88.535	319	82	82	250	251	55
2-6	21:42:30	0.68	1.70	90.365	318	82	82	252	252	56
	21:45:00			92.177						
3-1	21:48:00	0.60	1.50	92.177	318	82	82	255	251	55
3-2	21:50:30	0.62	1.60	93.885	318	82	82	250	250	56
3-3	21:53:00	0.65	1.60	95.620	319	82	82	250	253	57
3-4	21:55:30	0.71	1.80	97.395	318	82	82	254	257	58
3-5	21:58:00	0.68	1.70	99.250	319	82	82	254	250	59
3-6	22:00:30	0.67	1.70	101.065	319	82	82	251	253	60
	22:03:00			102.870						
4-1	22:06:00	0.61	1.50	102.870	319	82	82	252	256	56
4-2	22:08:30	0.64	1.60	104.590	318	82	82	252	254	57
4-3	22:11:00	0.67	1.70	106.355	312	82	82	252	251	58
4-4	22:13:30	0.70	1.80	108.165	312	82	82	251	250	59
4-5	22:16:00	0.68	1.70	110.015	312	82	82	255	250	60
4-6	22:18:30	0.65	1.60	111.835	314	82	82	252	251	61
	22:21:00			113.615						

Total	1:00:00			42.808		82.0	82.0			
Average			1.65		317.7	82.0				
Min			1.50		312.0	82.0				
Max			1.80		320.0	82.0				

Impinger Weight Sheet - Run 1A

Client: Lehigh Cement Company
 Facility: Mitchell
 Test Location: Kiln 4
 Project #: M232807
 Date: 10/3/2023
 Test Method: 26A
 Weighed/Measured By: MLIP
 Balance ID: S168

Scale Calibration Check Date: 10/3/2023

Scale Calibration Check (see QS-6.05C for procedure)

must be within $\pm 0.5g$ of certified mass

<u>Certified Weight, grams</u>	<u>Result, grams</u>
250	250.0
500	500.0
750	750.0

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	761.3	718.8	42.5
0.1N H2SO4	794.0	750.4	43.6
Empty	649.9	620.0	29.9
0.1N NaOH	764.9	756.1	8.8
0.1N NaOH	749.0	746.0	3.0
Silica Gel	828.4	813.4	15.0

3,719.1	3,591.3	127.8
<u>Liquid Final</u>	<u>Liquid Initial</u>	<u>Liquid Gain</u>
828.4	813.4	15.0
<u>Silica Final</u>	<u>Silica Initial</u>	<u>Silica Gain</u>

Run 2A - Method 26A

Client: Lehigh Cement Company
 Facility: Mitchell
 Test Location: Kiln 4
 Source Condition: Mill Off

Date: 10/3/23
 Start Time: 22:39
 End Time: 23:48

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH:	1.67	In. H ₂ O		Static Pressure	-0.50	in. H ₂ O
Meter Temperature, Tm:	78.8	°F		Flue Pressure (Ps):	29.05	in. Hg. abs.
Sqrt ΔP:	0.812	In. H ₂ O		Carbon Dioxide:	13.79	%
Stack Temperature, Ts:	313.5	°F		Oxygen:	12.17	%
Meter Volume, Vm:	42.796	ft ³		Nitrogen:	74.0	%
Meter Volume, Vmstd:	41.067	dscf		Gas Weight dry, Md:	30.693	lb/lb mole
Meter Volume, Vwstd:	6.495	wscf		Gas Weight wet, Ms:	28.960	lb/lb mole
Isokinetic Variance:	98.3	%I		Excess Air:	---	%
Test Length:	60.00	in mins.		Gas Velocity, Vs:	55.900	fps
Nozzle Diameter:	0.258	in inches		Volumetric Flow:	1,020,250	acfm
Barometric Pressure:	29.09	in Hg		Volumetric Flow:	583,938	dscfm
				Volumetric Flow:	676,293	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3521.0	ml	Silica Initial Wt.	815.4	grams
Final Impinger Content:	3640.7	ml	Silica Final Wt.	833.6	grams
Impinger Difference:	119.7	ml	Silica Difference:	18.2	grams
Total Water Gain:	137.9		Moisture, Bws:	0.137	

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head Δp in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	22:39:00	0.61	1.50	13.825	315	79	79	250	251	59
1-2	22:41:30	0.64	1.60	15.540	315	79	79	256	250	60
1-3	22:44:00	0.66	1.70	17.295	315	79	79	253	256	60
1-4	22:46:30	0.71	1.80	19.080	315	79	79	256	256	61
1-5	22:49:00	0.68	1.70	20.930	315	79	79	253	257	62
1-6	22:51:30	0.67	1.70	22.740	315	79	79	253	256	61
	22:54:00			24.533						
2-1	22:57:00	0.60	1.50	24.533	314	79	79	251	251	59
2-2	22:59:30	0.64	1.60	26.235	313	79	79	251	255	60
2-3	23:02:00	0.67	1.70	27.995	314	79	79	252	251	60
2-4	23:04:30	0.70	1.80	29.790	313	79	79	253	250	61
2-5	23:07:00	0.68	1.70	31.630	313	79	79	251	253	62
2-6	23:09:30	0.66	1.70	33.445	313	79	79	250	251	63
	23:12:00			35.230						
3-1	23:15:00	0.62	1.60	35.230	312	79	79	250	252	57
3-2	23:17:30	0.64	1.60	36.965	312	79	79	250	250	58
3-3	23:20:00	0.66	1.70	38.725	313	79	79	250	250	59
3-4	23:22:30	0.70	1.80	40.510	313	79	79	257	250	60
3-5	23:25:00	0.69	1.70	42.345	312	79	79	251	250	60
3-6	23:27:30	0.67	1.70	44.175	313	79	79	254	257	61
	23:30:00			45.969						
4-1	23:33:00	0.59	1.50	45.969	313	79	79	250	251	56
4-2	23:35:30	0.62	1.60	47.660	313	79	79	250	252	57
4-3	23:38:00	0.65	1.60	49.390	313	78	78	254	250	58
4-4	23:40:30	0.69	1.70	51.155	313	78	78	255	258	60
4-5	23:43:00	0.70	1.80	52.980	313	78	78	252	251	61
4-6	23:45:30	0.68	1.70	54.815	313	78	78	255	250	62
	23:48:00			56.621						
Total		1:00:00		42.796		78.8	78.8			
Average			1.67		313.5	78.8				
Min			1.50		312.0	78.0				
Max			1.80		315.0	79.0				

Impinger Weight Sheet - Run 2A

Client: Lehigh Cement Company Facility: Mitchell Test Location: Kiln 4 Project #: M232807 Date: 10/3/2023 Test Method: 26A Weighed/Measured By: MLIP Balance ID: S168	Scale Calibration Check Date: <u>10/3/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">250</td> <td style="text-align: center; border-bottom: 1px solid black;">250.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">750</td> <td style="text-align: center; border-bottom: 1px solid black;">750.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	250	250.0	500	500.0	750	750.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
250	250.0								
500	500.0								
750	750.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	825.7	772.8	52.9
0.1N H2SO4	751.9	709.2	42.7
Empty	590.0	574.5	15.5
0.1N NaOH	723.1	715.5	7.6
0.1N NaOH	750.0	749.0	1.0
Silica Gel	833.6	815.4	18.2

<u>3,640.7</u> Liquid Final	<u>3,521.0</u> Liquid Initial	<u>119.7</u> Liquid Gain
<u>833.6</u> Silica Final	<u>815.4</u> Silica Initial	<u>18.2</u> Silica Gain

Run 3A - Method 26A

Client: Lehigh Cement Company
 Facility: Mitchell
 Test Location: Kiln 4
 Source Condition: Mill Off

Date: 10/4/23
 Start Time: 0:05
 End Time: 1:14

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH:	1.66	In. H ₂ O		Static Pressure	-0.50	in. H ₂ O
Meter Temperature, Tm:	77.3	°F		Flue Pressure (Ps):	29.05	in. Hg. abs.
Sqrt ΔP:	0.810	In. H ₂ O		Carbon Dioxide:	13.93	%
Stack Temperature, Ts:	313.2	°F		Oxygen:	12.02	%
Meter Volume, Vm:	42.579	ft ³		Nitrogen:	74.05	%
Meter Volume, Vmstd:	40.978	dscf		Gas Weight dry, Md:	30.710	lb/lb mole
Meter Volume, Vwstd:	6.829	wscf		Gas Weight wet, Ms:	28.894	lb/lb mole
Isokinetic Variance:	98.9	%I		Excess Air:	---	%
Test Length:	60.00	in mins.		Gas Velocity, Vs:	55.829	fps
Nozzle Diameter:	0.258	in inches		Volumetric Flow:	1,018,939	acfm
Barometric Pressure:	29.09	in Hg		Volumetric Flow:	579,124	dscfm
				Volumetric Flow:	675,642	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3581.0	ml	Silica Initial Wt.	828.5	grams
Final Impinger Content:	3714.7	ml	Silica Final Wt.	839.8	grams
Impinger Difference:	133.7	ml	Silica Difference:	11.3	grams
Total Water Gain:	145.0		Moisture, Bws:	0.143	

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head Δp in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	0:05:00	0.60	1.50	58.586	311	77	77	254	252	56
1-2	0:07:30	0.62	1.60	60.285	311	77	77	252	250	55
1-3	0:10:00	0.65	1.60	62.010	312	77	77	256	250	56
1-4	0:12:30	0.71	1.80	63.777	312	77	77	252	251	57
1-5	0:15:00	0.68	1.70	65.625	312	77	77	253	252	58
1-6	0:17:30	0.67	1.70	67.430	312	77	77	255	251	59
	0:20:00			69.222						
2-1	0:23:00	0.61	1.50	69.222	312	77	77	251	250	60
2-2	0:25:30	0.64	1.60	70.935	311	77	77	253	250	60
2-3	0:28:00	0.67	1.70	72.687	311	77	77	250	251	61
2-4	0:30:30	0.70	1.80	74.485	311	77	77	250	250	62
2-5	0:33:00	0.67	1.70	76.315	312	78	78	253	250	63
2-6	0:35:30	0.66	1.70	78.115	312	78	78	254	252	61
	0:38:00			79.895						
3-1	0:41:00	0.60	1.50	79.895	313	78	78	253	250	58
3-2	0:43:30	0.63	1.60	81.595	313	78	78	254	250	59
3-3	0:46:00	0.65	1.60	83.335	314	78	78	253	251	60
3-4	0:48:30	0.70	1.80	85.105	314	78	78	252	250	61
3-5	0:51:00	0.69	1.70	86.936	314	77	77	252	255	62
3-6	0:53:30	0.68	1.70	88.755	315	77	77	253	254	61
	0:56:00			90.556						
4-1	0:59:00	0.59	1.50	90.556	315	77	77	255	253	58
4-2	1:01:30	0.62	1.60	92.240	315	77	77	255	251	59
4-3	1:04:00	0.66	1.70	93.960	315	77	77	254	252	60
4-4	1:06:30	0.71	1.80	95.735	316	77	77	255	250	61
4-5	1:09:00	0.68	1.70	97.575	317	77	77	254	250	61
4-6	1:11:30	0.67	1.70	99.375	317	77	77	253	250	62
	1:14:00			101.165						
Total	1:00:00			42.579		77.3	77.3			
Average			1.66		313.2	77.3				
Min			1.50		311.0	77.0				
Max			1.80		317.0	78.0				

Impinger Weight Sheet - Run 3A

Client: Lehigh Cement Company Facility: Mitchell Test Location: Kiln 4 Project #: M232807 Date: 10/4/2023 Test Method: 26A Weighed/Measured By: MLIP Balance ID: S168	Scale Calibration Check Date: <u>10/3/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">250</td> <td style="text-align: center; border-bottom: 1px solid black;">250.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">750</td> <td style="text-align: center; border-bottom: 1px solid black;">750.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	250	250.0	500	500.0	750	750.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
250	250.0								
500	500.0								
750	750.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	802.2	709.8	92.4
0.1N H2SO4	782.5	752.0	30.5
Empty	634.6	627.9	6.7
0.1N NaOH	756.3	754.2	2.1
0.1N NaOH	739.1	737.1	2.0
Silica Gel	839.8	828.5	11.3

<u>3,714.7</u> Liquid Final	<u>3,581.0</u> Liquid Initial	<u>133.7</u> Liquid Gain
<u>839.8</u> Silica Final	<u>828.5</u> Silica Initial	<u>11.3</u> Silica Gain

Client:	Lehigh Cement Company		
Facility:	Mitchell		
Test Location:	Kiln 4		
Project #:	M232807		
Test Method:	26A		
Test Engineer:	JVC		
Test Technician:	CLC		
	<u>Run 1B</u>	<u>Run 2B</u>	<u>Run 3B</u>
Temp ID:	CM36	CM36	CM36
Meter ID:	CM36	CM36	CM36
Pitot ID:	468	468	468
Nozzle Diameter (Inches):	0.258	0.258	0.258
Meter Calibration Date:	9/28/2023	9/28/2023	9/28/2023
Meter Calibration Factor (Y):	0.991	0.991	0.991
Meter Orifice Setting (Delta H):	1.864	1.864	1.864
Nozzle Kit ID Number and Material:	Glass #7	Glass #7	Glass #7
Pitot Tube Coefficient:		0.840	
Probe Length (Feet):		8.0	
Probe Liner Material:		Glass	
Sample Plane:		Horizontal	
Port Length (Inches):		6.00	
Port Size (Diameter, Inches):		6.00	
Port Type:		Flange	
Duct Shape:		Circular	
Diameter (Feet):		19.68	
Duct Area (Square Feet):		304.187	
Upstream Diameters:		1.5	
Downstream Diameters:		15.2	
Number of Ports Sampled:		4	
Number of Points per Port:		6	
Minutes per Point:		2.5	
Minutes per Reading:		2.5	
Total Number of Traverse Points:		24	
Test Length (Minutes):		60	
Train Type:		Anderson Box	
Source Condition:		Mill off	
Diluent Model/Serial Number:		Servomex 1440D and MKS 2030	
Moisture Balance ID:		S168	
# of Runs		3	

Run 1B - Method 26A

Client: Lehigh Cement Company
 Facility: Mitchell
 Test Location: Kiln 4
 Source Condition: Mill off

Date: 10/3/23
 Start Time: 21:12
 End Time: 22:21

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH :	1.74	in. H ₂ O		Static Pressure	-0.50	in. H ₂ O
Meter Temperature, Tm:	82.5	°F		Flue Pressure (Ps):	29.05	in. Hg. abs.
Sqrt ΔP :	0.826	in. H ₂ O		Carbon Dioxide:	13.00	%
Stack Temperature, Ts:	308.8	°F		Oxygen:	12.50	%
Meter Volume, Vm:	45.167	ft ³		Nitrogen:	74.50	%
Meter Volume, Vmstd:	42.545	dscf		Gas Weight dry, Md:	30.580	lb/lb mole
Meter Volume, Vwstd:	6.815	wscf		Gas Weight wet, Ms:	28.843	lb/lb mole
Isokinetic Variance:	99.7	%I		Excess Air:	---	%
Test Length:	60.00	in mins.		Gas Velocity, Vs:	56.814	fps
Nozzle Diameter:	0.258	in inches		Volumetric Flow:	1,036,926	acfm
Barometric Pressure:	29.09	in Hg		Volumetric Flow:	596,038	dscfm
				Volumetric Flow:	691,520	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3598.2	ml	Silica Initial Wt.	851.9	grams
Final Impinger Content:	3728.3	ml	Silica Final Wt.	866.5	grams
Impinger Difference:	130.1	ml	Silica Difference:	14.6	grams
Total Water Gain:	144.7		Moisture, Bws:	0.138	

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head ΔP in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	21:12:00	0.65	1.60	7.152	320	87	87	252	250	55
1-2	21:14:30	0.67	1.70	9.050	315	85	85	253	254	56
1-3	21:17:00	0.70	1.80	10.870	314	85	85	250	252	56
1-4	21:19:30	0.72	1.80	12.660	312	84	84	252	251	56
1-5	21:22:00	0.70	1.80	14.710	311	84	84	254	255	57
1-6	21:24:30	0.68	1.70	16.610	311	83	83	253	251	57
	21:27:00			18.491						
2-1	21:30:00	0.66	1.70	18.491	310	83	83	252	255	57
2-2	21:32:30	0.68	1.70	20.380	309	82	82	254	252	58
2-3	21:35:00	0.71	1.80	22.140	309	82	82	251	254	58
2-4	21:37:30	0.73	1.90	24.050	306	82	82	250	250	59
2-5	21:40:00	0.70	1.80	26.090	306	82	82	252	252	59
2-6	21:42:30	0.68	1.70	27.890	307	82	82	251	254	59
	21:45:00			29.873						
3-1	21:48:00	0.63	1.60	29.873	306	82	82	250	256	60
3-2	21:50:30	0.66	1.70	31.730	307	82	82	251	254	60
3-3	21:53:00	0.69	1.80	33.570	308	82	82	252	253	61
3-4	21:55:30	0.71	1.80	35.440	306	82	82	254	250	61
3-5	21:58:00	0.68	1.70	37.380	306	81	81	253	254	62
3-6	22:00:30	0.66	1.70	39.220	307	81	81	255	252	61
	22:03:00			41.076						
4-1	22:06:00	0.64	1.60	41.076	308	81	81	253	251	61
4-2	22:08:30	0.66	1.70	42.960	307	81	81	250	254	62
4-3	22:11:00	0.69	1.80	44.800	306	81	81	254	252	61
4-4	22:13:30	0.72	1.80	46.640	307	82	82	256	252	62
4-5	22:16:00	0.69	1.80	48.590	307	82	82	255	253	62
4-6	22:18:30	0.67	1.70	50.460	306	81	81	254	255	63
	22:21:00			52.319						

Total	1:00:00			45.167		82.5	82.5			
Average			1.74		308.8	82.5				
Min			1.60		306.0	81.0				
Max			1.90		320.0	87.0				

Impinger Weight Sheet - Run 1B

Client: Lehigh Cement Company
 Facility: Mitchell
 Test Location: Kiln 4
 Project #: M232807
 Date: 10/3/2023
 Test Method: 26A
 Weighed/Measured By: MLIP
 Balance ID: S168

Scale Calibration Check Date: 10/3/2023

Scale Calibration Check (see QS-6.05C for procedure)

must be within $\pm 0.5g$ of certified mass

<u>Certified Weight, grams</u>	<u>Result, grams</u>
250	250.0
500	500.0
750	750.0

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	868.7	760.7	108.0
0.1N H2SO4	786.5	768.9	17.6
Empty	640.0	636.3	3.7
0.1N NaOH	718.3	719.5	-1.2
0.1N NaOH	714.8	712.8	2.0
Silica Gel	866.5	851.9	14.6

3,728.3	3,598.2	130.1
Liquid Final	Liquid Initial	Liquid Gain
866.5	851.9	14.6
Silica Final	Silica Initial	Silica Gain

Run 2B - Method 26A

Client: Lehigh Cement Company
 Facility: Mitchell
 Test Location: Kiln 4
 Source Condition: Mill off

Date: 10/3/23
 Start Time: 22:39
 End Time: 23:48

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH :	1.75	In. H ₂ O		Static Pressure	-0.50	in. H ₂ O
Meter Temperature, Tm:	75.8	°F		Flue Pressure (Ps):	29.05	in. Hg. abs.
Sqrt ΔP :	0.834	In. H ₂ O		Carbon Dioxide:	13.46	%
Stack Temperature, Ts:	310.7	°F		Oxygen:	12.17	%
Meter Volume, Vm:	44.898	ft ³		Nitrogen:	74.4	%
Meter Volume, Vmstd:	42.823	dscf		Gas Weight dry, Md:	30.640	lb/lb mole
Meter Volume, Vwstd:	7.122	wscf		Gas Weight wet, Ms:	28.838	lb/lb mole
Isokinetic Variance:	100.0	%I		Excess Air:	---	%
Test Length:	60.00	in mins.		Gas Velocity, Vs:	57.457	fps
Nozzle Diameter:	0.258	in inches		Volumetric Flow:	1,048,650	acfm
Barometric Pressure:	29.09	in Hg		Volumetric Flow:	598,161	dscfm
				Volumetric Flow:	697,637	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3547.9	ml	Silica Initial Wt.	881.9	grams
Final Impinger Content:	3681.7	ml	Silica Final Wt.	899.3	grams
Impinger Difference:	133.8	ml	Silica Difference:	17.4	grams
Total Water Gain:	151.2		Moisture, Bws:	0.143	

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head ΔP in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	22:39:00	0.69	1.70	52.571	312	77	77	252	255	56
1-2	22:41:30	0.71	1.80	54.480	312	77	77	254	256	56
1-3	22:44:00	0.73	1.80	56.380	313	77	77	255	253	56
1-4	22:46:30	0.74	1.90	58.170	313	77	77	252	250	57
1-5	22:49:00	0.71	1.80	60.220	313	77	77	256	251	57
1-6	22:51:30	0.68	1.70	62.090	312	77	77	254	253	57
	22:54:00			63.814						
2-1	22:57:00	0.65	1.60	63.814	311	76	76	252	254	58
2-2	22:59:30	0.67	1.70	65.660	311	76	76	253	256	58
2-3	23:02:00	0.70	1.80	67.510	312	76	76	251	257	59
2-4	23:04:30	0.73	1.80	69.380	311	75	75	254	255	59
2-5	23:07:00	0.75	1.90	71.170	312	75	75	250	256	59
2-6	23:09:30	0.72	1.90	73.240	312	75	75	252	254	59
	23:12:00			75.115						
3-1	23:15:00	0.67	1.70	75.114	311	75	75	254	255	59
3-2	23:17:30	0.70	1.80	76.880	311	75	75	250	252	60
3-3	23:20:00	0.73	1.80	78.860	310	75	75	256	255	61
3-4	23:22:30	0.72	1.80	80.640	310	76	76	251	253	60
3-5	23:25:00	0.69	1.70	82.550	310	76	76	253	256	61
3-6	23:27:30	0.66	1.70	84.520	310	76	76	255	254	61
	23:30:00			86.363						
4-1	23:33:00	0.66	1.70	86.363	309	75	75	250	253	61
4-2	23:35:30	0.67	1.70	88.240	308	75	75	251	256	61
4-3	23:38:00	0.69	1.70	90.090	308	75	75	254	254	62
4-4	23:40:30	0.71	1.80	91.810	309	75	75	251	253	61
4-5	23:43:00	0.68	1.70	93.790	308	75	75	254	255	62
4-6	23:45:30	0.65	1.60	95.550	308	75	75	253	252	62
	23:48:00			97.468						

Total	1:00:00			44.898		75.8	75.8			
Average			1.75		310.7	75.8				
Min			1.60		308.0	75.0				
Max			1.90		313.0	77.0				

Impinger Weight Sheet - Run 2B

Client: Lehigh Cement Company
 Facility: Mitchell
 Test Location: Kiln 4
 Project #: M232807
 Date: 10/3/2023
 Test Method: 26A
 Weighed/Measured By: MLIP
 Balance ID: S168

Scale Calibration Check Date: 10/3/2023

Scale Calibration Check (see QS-6.05C for procedure)

must be within $\pm 0.5g$ of certified mass

<u>Certified Weight, grams</u>	<u>Result, grams</u>
250	250.0
500	500.0
750	750.0

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	816.4	735.1	81.3
0.1N H2SO4	799.9	763.4	36.5
Empty	650.8	640.5	10.3
0.1N NaOH	643.8	640.6	3.2
0.1N NaOH	770.8	768.3	2.5
Silica Gel	899.3	881.9	17.4

3,681.7	3,547.9	133.8
Liquid Final	Liquid Initial	Liquid Gain
899.3	881.9	17.4
Silica Final	Silica Initial	Silica Gain

Run 3B - Method 26A

Client: Lehigh Cement Company
 Facility: Mitchell
 Test Location: Kiln 4
 Source Condition: Mill off

Date: 10/4/23
 Start Time: 0:05
 End Time: 1:14

DRY GAS METER CONDITIONS				STACK CONDITIONS		
ΔH :	1.76	In. H ₂ O		Static Pressure	-0.50	in. H ₂ O
Meter Temperature, Tm:	76.0	°F		Flue Pressure (Ps):	29.05	in. Hg. abs.
Sqrt ΔP :	0.835	In. H ₂ O		Carbon Dioxide:	13.93	%
Stack Temperature, Ts:	309.7	°F		Oxygen:	12.02	%
Meter Volume, Vm:	44.796	ft ³		Nitrogen:	74.05	%
Meter Volume, Vmstd:	42.709	dscf		Gas Weight dry, Md:	30.710	lb/lb mole
Meter Volume, Vwstd:	7.616	wscf		Gas Weight wet, Ms:	28.786	lb/lb mole
Isokinetic Variance:	100.6	%I		Excess Air:	---	%
Test Length:	60.00	in mins.		Gas Velocity, Vs:	57.506	fps
Nozzle Diameter:	0.258	in inches		Volumetric Flow:	1,049,554	acfm
Barometric Pressure:	29.09	in Hg		Volumetric Flow:	593,339	dscfm
				Volumetric Flow:	699,146	scfm

MOISTURE DETERMINATION

Initial Impinger Content:	3558.5	ml	Silica Initial Wt.	866.5	grams
Final Impinger Content:	3707.9	ml	Silica Final Wt.	878.8	grams
Impinger Difference:	149.4	ml	Silica Difference:	12.3	grams
Total Water Gain:	161.7		Moisture, Bws:	0.151	

Port- Point No.	Clock Time	Velocity	Orifice	Actual	Stack	Meter Temp		Probe	Filter	Impinger
		Head ΔP in. H ₂ O	ΔH in. H ₂ O	Meter Vol. ft ³	Temp °F	Inlet °F	Outlet °F	Temp °F	Exit Temp °F	Exit Temp °F
1-1	0:05:00	0.68	1.70	97.934	309	75	75	252	250	59
1-2	0:07:30	0.70	1.80	99.810	310	75	75	254	252	59
1-3	0:10:00	0.72	1.80	101.580	310	76	76	255	254	60
1-4	0:12:30	0.75	1.90	103.470	309	76	76	253	256	60
1-5	0:15:00	0.72	1.80	105.520	310	75	75	254	257	61
1-6	0:17:30	0.69	1.70	107.330	309	75	75	252	254	60
	0:20:00			109.294						
2-1	0:23:00	0.65	1.60	109.294	309	76	76	251	256	60
2-2	0:25:30	0.68	1.70	111.180	309	76	76	250	252	60
2-3	0:28:00	0.69	1.70	112.810	308	76	76	254	251	61
2-4	0:30:30	0.73	1.80	114.710	308	77	77	253	254	61
2-5	0:33:00	0.72	1.80	116.630	309	76	76	256	255	61
2-6	0:35:30	0.70	1.80	118.510	310	76	76	253	253	62
	0:38:00			120.382						
3-1	0:41:00	0.66	1.70	120.382	309	76	76	251	251	60
3-2	0:43:30	0.68	1.70	122.260	309	76	76	254	250	60
3-3	0:46:00	0.71	1.80	124.090	308	76	76	256	253	61
3-4	0:48:30	0.74	1.90	125.850	309	76	76	252	256	60
3-5	0:51:00	0.72	1.80	127.800	310	76	76	257	251	61
3-6	0:53:30	0.68	1.80	129.840	309	76	76	253	255	61
	0:56:00			131.684						
4-1	0:59:00	0.64	1.60	131.684	310	77	77	254	256	62
4-2	1:01:30	0.67	1.70	133.510	311	77	77	252	253	61
4-3	1:04:00	0.71	1.80	135.370	312	76	76	255	256	62
4-4	1:06:30	0.72	1.80	137.140	312	76	76	250	252	62
4-5	1:09:00	0.70	1.80	139.030	312	76	76	253	250	63
4-6	1:11:30	0.67	1.70	141.040	311	76	76	255	254	63
	1:14:00			142.730						

Total	1:00:00			44.796		76.0	76.0			
Average			1.76		309.7	76.0				
Min			1.60		308.0	75.0				
Max			1.90		312.0	77.0				

Impinger Weight Sheet - Run 3B

Client: Lehigh Cement Company Facility: Mitchell Test Location: Kiln 4 Project #: M232807 Date: 10/4/2023 Test Method: 26A Weighed/Measured By: MLIP Balance ID: S168	Scale Calibration Check Date: <u>10/3/2023</u> Scale Calibration Check (see QS-6.05C for procedure) must be within $\pm 0.5g$ of certified mass <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="text-align: left; border-bottom: 1px solid black;"><u>Certified Weight, grams</u></th> <th style="text-align: left; border-bottom: 1px solid black;"><u>Result, grams</u></th> </tr> <tr> <td style="text-align: center;">250</td> <td style="text-align: center; border-bottom: 1px solid black;">250.0</td> </tr> <tr> <td style="text-align: center;">500</td> <td style="text-align: center; border-bottom: 1px solid black;">500.0</td> </tr> <tr> <td style="text-align: center;">750</td> <td style="text-align: center; border-bottom: 1px solid black;">750.0</td> </tr> </table>	<u>Certified Weight, grams</u>	<u>Result, grams</u>	250	250.0	500	500.0	750	750.0
<u>Certified Weight, grams</u>	<u>Result, grams</u>								
250	250.0								
500	500.0								
750	750.0								

IMPINGER	FINAL	INITIAL	GAIN
CONTENTS	MLS / GRAMS	MLS / GRAMS	MLS / GRAMS
0.1N H2SO4	852.7	755.6	97.1
0.1N H2SO4	789.2	750.0	39.2
Empty	652.4	643.8	8.6
0.1N NaOH	695.0	692.0	3.0
0.1N NaOH	718.6	717.1	1.5
Silica Gel	878.8	866.5	12.3

<u>3,707.9</u> Liquid Final	<u>3,558.5</u> Liquid Initial	<u>149.4</u> Liquid Gain
<u>878.8</u> Silica Final	<u>866.5</u> Silica Initial	<u>12.3</u> Silica Gain

Client: Heidelberg Materials
Facility: Mitchell, IN
Project #: M234006
Test Location: Kiln 4 Stack
Date: 10/3/23

Run 1 - Mill off

Spectrum	Time	FTIR Data				Cell Temp	Pressure	Analyzer Data
		H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw			O2 % (wet)
RUN 1_002133.LAB	21:12	12.50	11.77	11.09	0.10	190.98	0.99	11.10
RUN 1_002134.LAB	21:13	12.54	11.67	11.17	0.10	191.05	0.99	11.10
RUN 1_002135.LAB	21:14	12.50	11.87	11.16	0.10	191.08	0.99	11.10
RUN 1_002136.LAB	21:15	12.48	11.66	11.11	0.10	191.05	0.99	11.10
RUN 1_002137.LAB	21:16	12.47	11.70	11.19	0.10	191.05	0.99	11.10
RUN 1_002138.LAB	21:18	13.28	11.42	11.06	0.10	191.05	0.99	11.00
RUN 1_002139.LAB	21:19	13.04	11.47	11.04	0.10	190.96	0.99	11.00
RUN 1_002140.LAB	21:20	12.94	11.38	11.19	0.10	190.94	0.99	11.00
RUN 1_002141.LAB	21:21	12.88	11.53	10.92	0.10	190.91	0.99	11.00
RUN 1_002142.LAB	21:22	12.92	11.63	11.07	0.10	190.94	0.99	10.90
RUN 1_002143.LAB	21:23	13.34	11.52	10.90	0.10	191.03	0.99	10.90
RUN 1_002144.LAB	21:24	13.03	11.79	11.27	0.10	190.99	0.99	11.00
RUN 1_002145.LAB	21:25	12.89	11.93	11.04	0.10	190.98	0.99	10.90
RUN 1_002146.LAB	21:26	12.93	12.02	11.30	0.10	191.05	0.99	11.00
RUN 1_002147.LAB	21:27	13.02	11.89	11.13	0.10	191.01	0.99	10.90
RUN 1_002148.LAB	21:28	13.09	11.73	11.37	0.10	190.96	0.99	10.90
RUN 1_002149.LAB	21:29	13.25	11.66	11.08	0.10	191.05	0.99	10.90
RUN 1_002150.LAB	21:30	13.16	11.59	11.07	0.10	191.05	0.99	10.90
RUN 1_002151.LAB	21:31	13.17	11.69	10.97	0.10	191.00	0.99	10.90
RUN 1_002152.LAB	21:32	13.11	11.59	11.08	0.10	191.00	0.99	10.90
RUN 1_002153.LAB	21:33	13.28	11.58	10.86	0.10	190.97	0.99	11.00
RUN 1_002154.LAB	21:34	13.19	11.54	11.07	0.10	191.04	0.99	10.90
RUN 1_002155.LAB	21:36	13.25	11.45	10.95	0.10	191.05	0.99	10.90
RUN 1_002156.LAB	21:37	13.34	11.59	11.02	0.10	191.05	0.99	10.80
RUN 1_002157.LAB	21:38	13.45	11.61	10.76	0.10	191.05	0.99	10.70
RUN 1_002158.LAB	21:39	13.41	11.80	10.63	0.10	191.04	0.99	10.60
RUN 1_002159.LAB	21:40	13.39	11.82	10.85	0.10	190.94	0.99	10.60
RUN 1_002160.LAB	21:41	13.34	11.75	10.64	0.10	190.97	0.99	10.50
RUN 1_002161.LAB	21:42	13.36	11.77	10.73	0.10	190.95	0.99	10.60
RUN 1_002162.LAB	21:43	13.37	11.97	10.61	0.10	191.05	0.99	10.60
RUN 1_002163.LAB	21:44	13.43	11.92	10.92	0.10	191.02	0.99	10.50
RUN 1_002164.LAB	21:45	13.41	11.85	10.75	0.10	190.94	0.99	10.50
RUN 1_002165.LAB	21:46	13.35	11.73	11.10	0.10	191.02	0.99	10.50
RUN 1_002166.LAB	21:47	13.30	11.70	10.92	0.10	191.05	0.99	10.60
RUN 1_002167.LAB	21:48	13.15	11.53	11.14	0.10	191.05	0.99	10.70
RUN 1_002168.LAB	21:49	13.21	11.58	11.02	0.10	191.05	0.99	10.90
RUN 1_002169.LAB	21:50	13.09	11.59	11.18	0.10	191.05	0.99	11.00
RUN 1_002170.LAB	21:51	13.23	11.61	10.96	0.10	191.05	0.99	11.00
RUN 1_002171.LAB	21:52	13.16	11.58	11.12	0.10	191.03	0.99	10.90
RUN 1_002172.LAB	21:54	13.28	11.67	10.75	0.10	190.94	0.99	10.90
RUN 1_002173.LAB	21:55	13.40	11.64	10.93	0.10	190.88	0.99	10.80
RUN 1_002174.LAB	21:56	13.46	11.69	10.75	0.10	190.85	0.99	10.70
RUN 1_002175.LAB	21:57	13.90	10.84	9.99	0.10	191.01	0.99	10.60
RUN 1_002176.LAB	21:58	14.83	11.87	9.83	0.10	191.02	0.99	10.60
RUN 1_002177.LAB	21:59	13.94	12.54	11.40	0.10	191.05	0.99	10.80
RUN 1_002178.LAB	22:00	13.38	12.21	11.12	0.10	190.98	0.99	10.70
RUN 1_002179.LAB	22:01	13.12	11.78	10.99	0.10	190.95	0.99	10.10
RUN 1_002180.LAB	22:02	13.19	11.67	11.02	0.10	190.99	0.99	10.60
RUN 1_002181.LAB	22:03	13.22	11.69	11.04	0.10	191.05	0.99	10.80
RUN 1_002182.LAB	22:04	13.19	11.41	10.95	0.10	191.05	0.99	10.80
RUN 1_002183.LAB	22:05	13.04	11.77	10.93	0.10	191.05	0.99	10.80
RUN 1_002184.LAB	22:06	13.17	11.48	11.10	0.10	191.05	0.99	10.90
RUN 1_002185.LAB	22:07	13.16	11.69	10.94	0.10	191.05	0.99	11.00
RUN 1_002186.LAB	22:08	13.20	11.63	11.15	0.10	190.95	0.99	10.90
RUN 1_002187.LAB	22:09	13.04	11.69	10.84	0.10	190.92	0.99	11.10
RUN 1_002188.LAB	22:10	13.63	11.59	11.04	0.10	190.84	0.99	11.00
RUN 1_002189.LAB	22:12	13.28	11.49	10.78	0.10	190.88	0.99	10.90
RUN 1_002190.LAB	22:13	13.42	11.59	10.93	0.10	190.97	0.99	10.90
RUN 1_002191.LAB	22:14	13.32	11.63	10.70	0.10	191.03	0.99	10.70
RUN 1_002192.LAB	22:15	13.26	11.72	10.91	0.10	191.05	0.99	10.80
Average		13.21	11.68	10.96	0.10	191.00	0.99	10.83

Client: Heidelberg Materials
 Facility: Mitchell, IN
 Project #: M234006
 Test Location: Kiln 4 Stack
 Date: 10/3/23

Run 2 - Mill off

Spectrum	Time	FTIR Data				Cell Temp	Pressure	Analyzer Data
		H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw			O2 % (wet)
RUN 2_002269.LAB	22:39	12.65	11.9	11.46	0.10	191.0	0.99	10.70
RUN 2_002270.LAB	22:40	12.66	11.7	11.06	0.10	191.0	0.99	10.90
RUN 2_002271.LAB	22:41	12.62	11.7	11.52	0.10	191.0	0.99	11.00
RUN 2_002272.LAB	22:42	12.57	11.8	11.11	0.10	191.0	0.99	11.10
RUN 2_002273.LAB	22:43	13.64	11.4	11.23	0.10	191.0	0.99	11.00
RUN 2_002274.LAB	22:44	13.18	11.7	10.97	0.10	191.0	0.99	10.90
RUN 2_002275.LAB	22:45	13.14	11.7	11.14	0.10	191.0	0.99	10.90
RUN 2_002276.LAB	22:46	13.20	11.7	10.93	0.10	191.0	0.99	10.90
RUN 2_002277.LAB	22:47	13.15	11.7	10.98	0.10	190.9	0.99	10.80
RUN 2_002278.LAB	22:48	13.25	11.7	10.85	0.10	191.0	0.99	10.70
RUN 2_002279.LAB	22:49	13.68	11.7	10.83	0.10	191.0	0.99	10.60
RUN 2_002280.LAB	22:50	13.38	11.8	10.62	0.10	191.0	0.99	10.60
RUN 2_002281.LAB	22:51	13.24	11.9	10.90	0.10	191.0	0.99	10.60
RUN 2_002282.LAB	22:53	13.57	11.8	10.69	0.10	191.0	0.99	10.50
RUN 2_002283.LAB	22:54	13.44	11.9	10.93	0.10	191.0	0.99	10.50
RUN 2_002284.LAB	22:55	13.40	11.8	10.86	0.10	191.0	0.99	10.60
RUN 2_002285.LAB	22:56	13.48	11.9	11.00	0.10	191.0	0.99	10.50
RUN 2_002286.LAB	22:57	13.37	11.7	10.94	0.10	191.0	0.99	10.70
RUN 2_002287.LAB	22:58	13.47	11.9	10.97	0.10	191.0	0.99	10.70
RUN 2_002288.LAB	22:59	13.46	11.5	10.85	0.10	191.0	0.99	10.80
RUN 2_002289.LAB	23:00	13.44	11.7	10.94	0.10	191.0	0.99	10.80
RUN 2_002290.LAB	23:01	13.29	11.7	11.15	0.10	191.0	0.99	10.90
RUN 2_002291.LAB	23:02	13.24	11.8	10.94	0.10	191.0	0.99	10.90
RUN 2_002292.LAB	23:03	13.34	11.7	10.91	0.10	191.0	0.99	10.80
RUN 2_002293.LAB	23:04	13.37	11.8	10.80	0.10	191.0	0.99	10.70
RUN 2_002294.LAB	23:05	13.43	11.7	10.82	0.10	191.0	0.99	10.70
RUN 2_002295.LAB	23:06	13.44	11.8	10.81	0.10	191.0	0.99	10.70
RUN 2_002296.LAB	23:07	13.38	11.8	11.04	0.10	191.0	0.99	10.60
RUN 2_002297.LAB	23:08	13.55	12.0	10.95	0.10	191.0	0.99	10.60
RUN 2_002298.LAB	23:09	13.58	12.0	11.20	0.10	191.0	0.99	10.40
RUN 2_002299.LAB	23:10	13.67	12.1	11.03	0.10	190.9	0.99	10.40
RUN 2_002300.LAB	23:11	13.77	12.1	11.22	0.10	190.9	0.99	10.30
RUN 2_002301.LAB	23:12	13.76	12.1	10.95	0.10	190.9	0.99	10.30
RUN 2_002302.LAB	23:13	13.79	12.0	11.18	0.10	190.9	0.99	10.30
RUN 2_002303.LAB	23:14	13.74	12.2	10.91	0.10	191.0	0.99	10.30
RUN 2_002304.LAB	23:15	13.70	12.0	11.20	0.10	191.0	0.99	10.30
RUN 2_002305.LAB	23:17	13.71	12.1	11.03	0.10	191.0	0.99	10.40
RUN 2_002306.LAB	23:18	13.73	12.1	11.24	0.10	191.0	0.99	10.40
RUN 2_002307.LAB	23:19	13.72	12.0	11.03	0.10	191.0	0.99	10.40
RUN 2_002308.LAB	23:20	13.75	12.1	11.29	0.10	191.0	0.99	10.40
RUN 2_002309.LAB	23:21	13.86	12.0	11.01	0.10	191.0	0.99	10.40
RUN 2_002310.LAB	23:22	13.78	12.1	11.27	0.10	190.9	0.99	10.40
RUN 2_002311.LAB	23:23	13.83	12.0	11.09	0.10	190.9	0.99	10.40
RUN 2_002312.LAB	23:24	13.83	12.1	11.23	0.10	190.9	0.99	10.30
RUN 2_002313.LAB	23:25	13.90	12.0	10.94	0.10	190.9	0.99	10.40
RUN 2_002314.LAB	23:26	13.88	12.1	11.08	0.10	190.9	0.99	10.30
RUN 2_002315.LAB	23:27	13.87	12.0	10.94	0.10	190.9	0.99	10.30
RUN 2_002316.LAB	23:28	13.86	12.1	11.14	0.10	190.9	0.99	10.30
RUN 2_002317.LAB	23:29	13.88	12.0	11.08	0.10	190.8	0.99	10.30
RUN 2_002318.LAB	23:30	13.87	12.1	11.10	0.10	190.9	0.99	10.30
RUN 2_002319.LAB	23:31	13.91	12.0	10.95	0.10	191.0	0.99	10.30
RUN 2_002320.LAB	23:32	13.90	12.1	11.16	0.10	191.0	0.99	10.30
RUN 2_002321.LAB	23:33	13.99	11.9	10.99	0.10	191.0	0.99	10.30
RUN 2_002322.LAB	23:34	13.91	12.1	11.08	0.10	191.0	0.99	10.30
RUN 2_002323.LAB	23:35	13.87	12.0	11.01	0.10	191.0	0.99	10.40
RUN 2_002324.LAB	23:36	13.87	12.2	10.93	0.10	191.0	0.99	10.30
RUN 2_002325.LAB	23:37	13.84	12.0	11.01	0.10	191.0	0.99	10.40
RUN 2_002326.LAB	23:38	13.80	12.2	10.99	0.10	190.9	0.99	10.30
RUN 2_002327.LAB	23:39	13.90	12.0	11.07	0.10	190.9	0.99	10.40
RUN 2_002328.LAB	23:41	13.87	12.2	10.95	0.10	190.9	0.99	10.40
Average		13.56	11.92	11.03	0.10	191.00	0.99	10.54

Client: Heidelberg Materials
Facility: Mitchell, IN
Project #: M234006
Test Location: Kiln 4 Stack
Date: 10/4/23

Run 3 - Mill off

Spectrum	Time	FTIR Data				Cell Temp	Pressure	Analyzer Data
		H2O %	CO2 % (wet)	HCN ppmvw	HF ppmvw			O2 % (wet)
RUN 3_002407.LAB	0:05	12.60	12.4	11.3	0.10	190.9	0.99	10.40
RUN 3_002408.LAB	0:06	14.10	11.9	11.1	0.10	190.9	0.99	10.10
RUN 3_002409.LAB	0:07	14.15	12.2	11.0	0.10	190.9	0.99	10.30
RUN 3_002410.LAB	0:08	13.89	12.2	11.1	0.10	191.0	0.99	10.40
RUN 3_002411.LAB	0:09	14.22	12.0	10.9	0.10	191.0	0.99	10.40
RUN 3_002412.LAB	0:10	13.68	11.9	11.2	0.10	191.0	0.99	10.40
RUN 3_002413.LAB	0:11	13.67	12.2	11.0	0.10	191.0	0.99	10.40
RUN 3_002414.LAB	0:12	13.78	12.0	11.1	0.10	191.0	0.99	10.40
RUN 3_002415.LAB	0:13	13.72	12.1	10.9	0.10	191.0	0.99	10.40
RUN 3_002416.LAB	0:14	13.69	12.0	11.1	0.10	191.0	0.99	10.40
RUN 3_002417.LAB	0:15	13.94	12.0	10.7	0.10	191.0	0.99	10.40
RUN 3_002418.LAB	0:16	14.18	12.0	11.0	0.10	191.0	0.99	10.40
RUN 3_002419.LAB	0:17	13.96	12.1	10.9	0.10	191.0	0.99	10.30
RUN 3_002420.LAB	0:18	13.88	12.0	11.2	0.10	191.0	0.99	10.40
RUN 3_002421.LAB	0:19	13.85	12.0	10.7	0.10	191.0	0.99	10.40
RUN 3_002422.LAB	0:21	13.98	12.0	11.0	0.10	190.9	0.99	10.40
RUN 3_002423.LAB	0:22	14.00	11.9	10.6	0.10	190.9	0.99	10.40
RUN 3_002424.LAB	0:23	13.88	12.0	11.0	0.10	190.9	0.99	10.40
RUN 3_002425.LAB	0:24	13.88	11.9	10.8	0.10	190.9	0.99	10.40
RUN 3_002426.LAB	0:25	13.84	11.9	10.8	0.10	190.9	0.99	10.40
RUN 3_002427.LAB	0:26	13.76	11.9	10.7	0.10	191.1	0.99	10.50
RUN 3_002428.LAB	0:27	13.75	12.1	11.0	0.10	191.1	0.99	10.40
RUN 3_002429.LAB	0:28	13.69	12.0	10.9	0.10	191.1	0.99	10.40
RUN 3_002430.LAB	0:29	13.66	12.1	11.0	0.10	191.0	0.99	10.40
RUN 3_002431.LAB	0:30	13.71	11.9	10.8	0.10	191.0	0.99	10.40
RUN 3_002432.LAB	0:31	13.77	12.0	10.9	0.10	191.0	0.99	10.40
RUN 3_002433.LAB	0:32	13.79	11.8	10.9	0.10	191.0	0.99	10.40
RUN 3_002434.LAB	0:33	13.65	12.0	10.9	0.10	191.0	0.99	10.50
RUN 3_002435.LAB	0:34	13.63	11.8	11.0	0.10	190.9	0.99	10.50
RUN 3_002436.LAB	0:35	13.51	12.0	11.0	0.10	190.9	0.99	10.60
RUN 3_002437.LAB	0:36	13.65	11.9	11.2	0.10	191.0	0.99	10.50
RUN 3_002438.LAB	0:37	13.65	12.2	11.0	0.10	191.0	0.99	10.50
RUN 3_002439.LAB	0:38	13.78	12.0	11.2	0.10	191.0	0.99	10.40
RUN 3_002440.LAB	0:39	13.78	12.2	11.1	0.10	191.0	0.99	10.40
RUN 3_002441.LAB	0:40	13.78	12.0	11.2	0.10	191.0	0.99	10.40
RUN 3_002442.LAB	0:41	13.82	12.1	11.0	0.10	191.0	0.99	10.40
RUN 3_002443.LAB	0:42	13.81	12.0	11.2	0.10	191.0	0.99	10.40
RUN 3_002444.LAB	0:43	13.83	12.1	11.0	0.10	191.0	0.99	10.40
RUN 3_002445.LAB	0:45	13.89	11.9	11.2	0.10	191.0	0.99	10.30
RUN 3_002446.LAB	0:46	13.90	12.0	11.1	0.10	191.0	0.99	10.40
RUN 3_002447.LAB	0:47	13.82	11.9	11.3	0.10	190.9	0.99	10.40
RUN 3_002448.LAB	0:48	13.89	12.0	11.0	0.10	190.9	0.99	10.50
RUN 3_002449.LAB	0:49	13.81	11.9	11.2	0.10	190.9	0.99	10.40
RUN 3_002450.LAB	0:50	13.73	12.0	10.9	0.10	190.9	0.99	10.50
RUN 3_002451.LAB	0:51	13.83	11.9	11.2	0.10	190.9	0.99	10.50
RUN 3_002452.LAB	0:52	13.58	12.1	11.3	0.10	190.9	0.99	10.50
RUN 3_002453.LAB	0:53	13.61	12.1	11.3	0.10	190.9	0.99	10.60
RUN 3_002454.LAB	0:54	13.71	12.0	11.1	0.10	191.0	0.99	10.50
RUN 3_002455.LAB	0:55	13.79	12.0	11.3	0.10	191.0	0.99	10.40
RUN 3_002456.LAB	0:56	13.78	12.0	11.0	0.10	191.0	0.99	10.40
RUN 3_002457.LAB	0:57	13.77	12.0	11.4	0.10	191.1	0.99	10.40
RUN 3_002458.LAB	0:58	13.73	12.0	11.1	0.10	191.1	0.99	10.40
Average		13.78	12.01	11.03	0.10	191.01	0.99	10.42

Method 1 and 2 Cyclonic Flow Check Data

Project Number	M234006	Source Condition:	Normal
Client:	Heidelberg Materials	Run No.:	1
Facility:	Mitchell Cement Plant	Date:	9/25/2023
Location:	Kiln 4 Stack	Start Time:	17:00
Pitot ID:	S8-058-A	End Time:	17:35
Pitot Coefficient:	0.834	RM Testers:	ATW/DCS
Probe Length:	8	Port Length:	6.00

Port	Point	DP (in. H ₂ O)	Sqrt. DP	Temp (°F)	Yaw (o)	Port	Point	DP (in. H ₂ O)	Sqrt. DP	Temp (°F)	Yaw (o)
A	1	0.70	0.8367	306.0	9.0	C	1	0.71	0.8426	295.0	9.0
A	2	0.61	0.7810	293.0	9.0	C	2	0.65	0.8062	306.0	9.0
A	3	0.46	0.6782	295.0	12.0	C	3	0.48	0.6928	297.0	10.0
B	1	0.66	0.8124	305.0	8.0	D	1	0.65	0.8062	295.0	9.0
B	2	0.55	0.7416	305.0	8.0	D	2	0.57	0.7550	305.0	7.0
B	3	0.45	0.6708	295.0	11.0	D	3	0.46	0.6782	296.0	10.0

Average Yaw Angle 9.3 °

Stratification Test Results Summary
Heidelberg Materials
Mitchell Cement Plant
Kiln 4 Stack
October 4, 2023

Number of Ports Sampled: 1
Number of Points per Port: 3
Total Number of Traverse Points: 3

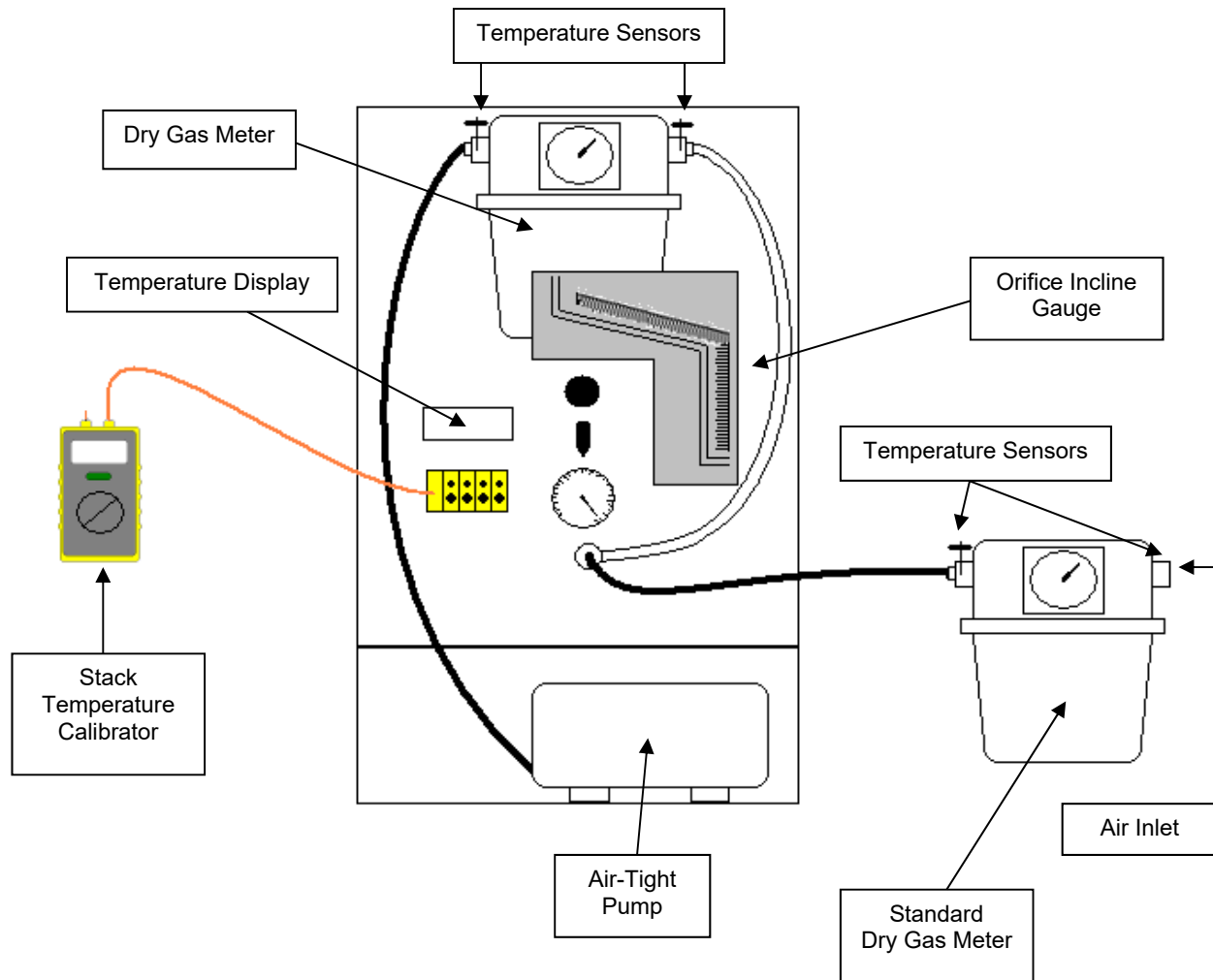
Port No.	Point No.	Time	O ₂ %	Actual % Difference O ₂ %	Mean Difference O ₂ %
1	1	12:45	10.60	0.93	0.10
	2	12:50	10.70	0.00	0.00
	3	12:55	10.80	0.93	0.10
Average			10.70		

One point traverse (<5% difference) 
Three point traverse (0.4, 1.2, and 2.0 meters), <10% difference 
Twelve point traverse (Method 1 points) >10% difference 

One point traverse (<0.3% mean difference) 
Three point traverse (0.4, 1.2, and 2.0 meters), < 0.5% mean difference for O₂ 
Twelve point traverse (Method 1 points) >0.5% mean difference for O₂ 

Appendix G - Calibration Data

Dry Gas Meter/Control Module Calibration Diagram



Meter Box Calibration

Dry Gas Meter Calibration Data

Dry Gas Meter No.

CM36

Date:

September 28, 2023

Standard Meter No.

16541852

Calibrated By:

JVC

Standard Meter (Y)

1.00440

Barometric Pressure:

29.38

Run Number	Orifice Setting in H ₂ O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final		41.427	72.836	68	74	74					
Initial		36.055	67.298	69	70	70					
Difference	1 0.20	5.372	5.538	69	72	72	72	22	36	0.980	1.997
Final		48.268	79.803	69	72	72					
Initial		41.544	72.952	69	72	72					
Difference	2 0.50	6.724	6.851	69	72	72	72	16	55	0.990	1.789
Final		55.379	87.056	69	72	72					
Initial		48.442	79.980	69	72	72					
Difference	3 0.70	6.937	7.076	69	72	72	72	15	4	0.989	1.867
Final		64.012	95.886	70	74	74					
Initial		55.537	87.219	69	73	73					
Difference	4 0.90	8.475	8.667	70	74	74	74	16	0	0.987	1.812
Final		69.862	101.845	70	73	73					
Initial		64.291	96.171	70	73	73					
Difference	5 1.20	5.571	5.674	70	73	73	73	9	12	0.989	1.854
Final		35.949	67.183	70	69	69					
Initial		27.710	59.051	70	69	69					
Difference	6 2.00	8.239	8.132	70	69	69	69	10	32	1.011	1.866

Average **0.991** **1.864**

Stack Temperature Sensor Calibration			
Temperature ID :	100769	Name :	JVC
Ambient Temperature, °F :	72.4	Date :	September 28, 2023

Temperature Calibrator			
Model # :	CL23A	Certification Date:	May 2, 2023
Serial # :	T-314718	Expiration Date:	May 1, 2024

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	3	0.7
250	254	0.6
600	599	0.1
1200	1198	0.1

$$\frac{(\text{Ref. Temp., } ^\circ\text{F} + 460) - (\text{Test Therm. Temp., } ^\circ\text{F} + 460)}{\text{Ref. Temp., } ^\circ\text{F} + 460} * 100 \leq 1.5 \%$$

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Test Method: 26A
 Meter ID: CM36

Alternative Method 5 Post Test Calibration - ALT-009

	Run Time (min):	Vm (dscf):	Tm (oR):	Pbar ("Hg):	DHavg ("H2O):	Md:	Orifice DH@:	Meter Y1:	Ycp:	Calibration Status:
Test Run 1	60	44.97	544.54	29.20	2.06	29.8304	1.864	0.9910	1.063	Pass
Test Run 2	60	47.32	544.75	29.20	2.10	29.8336	1.864	0.9910	1.021	
Test Run 3	60	47.92	548.67	29.20	2.00	29.8304	1.864	0.9910	0.989	
								0.9910	1.024	

Meter Box Calibration

Dry Gas Meter Calibration Data

Dry Gas Meter No. CM 47
 Standard Meter No. 18654530
 Standard Meter (Y) 0.99520

Date: August 11, 2023
 Calibrated By: BJE
 Barometric Pressure: 29.10

Run Number	Orifice Setting in H ₂ O Chg (H)	Standard Meter Gas Volume vr	Dry Gas Meter Gas Volume vd	Standard Meter Temp. F° tr	Dry Gas Meter Inlet Temp. F° tdi	Dry Gas Meter Outlet Temp. F° tdo	Dry Gas Meter Avg. Temp. F° td	Time Min	Time Sec	Y	Chg (H)
Final		57.441	15.151	78	79	79					
Initial		52.325	10.043	72	78	78					
Difference	1 0.20	5.116	5.108	75	79	79	79	20	24	1.003	1.868
Final		63.227	20.923	77	79	79					
Initial		57.654	15.376	77	79	79					
Difference	2 0.50	5.573	5.547	77	79	79	79	13	56	1.002	1.848
Final		68.699	26.364	77	79	79					
Initial		63.465	21.156	77	79	79					
Difference	3 0.70	5.234	5.208	77	79	79	79	11	4	1.002	1.851
Final		74.268	31.897	78	80	80					
Initial		68.871	26.535	77	80	80					
Difference	4 0.90	5.397	5.362	78	80	80	80	10	8	1.004	1.876
Final		79.926	37.512	78	80	80					
Initial		74.489	32.127	77	80	80					
Difference	5 1.20	5.437	5.385	78	80	80	80	9	10	1.006	2.017
Final		52.225	9.966	77	78	78					
Initial		46.419	4.226	77	77	77					
Difference	6 2.00	5.806	5.740	77	78	78	78	7	26	1.003	1.944

Average 1.003 1.901

Stack Temperature Sensor Calibration			
Temperature ID :	100769	Name :	BJE
Ambient Temperature, °F :	79.3	Date :	August 11, 2023

Temperature Calibrator			
Model # :	CL23A	Certification Date:	August 11, 2023
Serial # :	T-314718	Expiration Date:	August 10, 2024

Primary Standards Directly Traceable National Institute of Standards and Technology (NIST)

Reference Source Temperature (°F)	Test Thermometer Temperature (°F)	Temperature Difference %
0	0	0.0
250	250	0.0
600	600	0.0
1200	1203	0.2

$$\frac{(\text{Ref. Temp., } ^\circ\text{F} + 460) - (\text{Test Therm. Temp., } ^\circ\text{F} + 460)}{\text{Ref. Temp., } ^\circ\text{F} + 460} * 100 \leq 1.5 \%$$

Client: Heidelberg Materials
 Facility: Mitchell Cement Plant
 Test Location: Kiln 4 Stack
 Test Method: 26A
 Meter ID: CM47

Alternative Method 5 Post Test Calibration - ALT-009

	Run Time (min):	Vm (dscf):	Tm (oR):	Pbar ("Hg):	DHavg ("H2O):	Md:	Orifice DH@:	Meter Y1:	Ycp:	Calibration Status:
Test Run 1	60	45.01	544.67	28.78	2.00	30.6312	1.901	1.0030	1.031	Pass
Test Run 2	60	46.41	543.92	29.20	2.05	30.6084	1.901	1.0030	1.005	
Test Run 3	60	45.70	543.21	29.20	2.05	30.6492	1.901	1.0030	1.020	
								1.0030	1.019	



Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date: 9/21/2023
Temperature (°F): 72.6
Pressure ("Hg): 29.48
Personnel: wgj
Probe: S8-058-A

Wind Tunnel Target DP [I.W.C]	Wind Tunnel Actual DP [I.W.C]	S-Probe DP [I.W.C.]	C _p	C _{p(avg)}	C _p -C _{p(avg)}	σ _{max}	
0.81	0.81	1.15	0.831	0.832	0.000	0.000	Pass
0.81	0.81	1.15	0.832		0.000		
0.81	0.81	1.15	0.832		0.000		
1.81	1.82	2.55	0.837	0.837	0.000	0.001	Pass
1.81	1.82	2.55	0.837		0.000		
1.81	1.82	2.55	0.838		0.001		



Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date: 9/21/2023
Temperature (°F): 72.6
Pressure ("Hg): 29.48
Personnel: wgj
Probe: S8-058-B

Wind Tunnel Target DP [I.W.C]	Wind Tunnel Actual DP [I.W.C]	S-Probe DP [I.W.C.]	C _p	C _{p(avg)}	C _p -C _{p(avg)}	σ _{max}	
0.81	0.81	1.15	0.833	0.833	0.000	0.000	Pass
0.81	0.81	1.15	0.832		0.000		
0.81	0.81	1.15	0.833		0.000		
1.81	1.82	2.56	0.835	0.836	0.000	0.000	Pass
1.81	1.83	2.56	0.836		0.000		
1.81	1.83	2.56	0.836		0.000		



Airflow Sciences Corporation

Probe Calibration for Method 2

Wind Tunnel Facility: Airflow Sciences Corporation
 Wind Tunnel Location: Livonia, MI
 Probe Type: S-Type Pitot
 Probe ID: S8-058-A
 Probe Calibration Date: 09/21/23
 Test Point Location: center
 Ambient Temperature (°F): 72.6
 Barometric Pressure ("Hg): 29.48

Repetition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C _p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (°)	
1	60	0.81	72.6	1.15	0	0.83
2	60	0.81	72.6	1.15	0	0.83
3	60	0.81	72.6	1.15	0	0.83
Average (C _{p(avg-low)})						0.83

Repetition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C _p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (deg)	
1	90	1.82	72.6	2.55	0	0.84
2	90	1.82	72.6	2.55	0	0.84
3	90	1.82	72.6	2.55	0	0.84
Average (C _{p(avg-high)})						0.84

$$\% \text{ Difference} = \frac{C_{p(\text{avg-low})} - C_{p(\text{avg-high})}}{C_{p(\text{avg-low})}} \times 100\% = \underline{-0.67\%} \quad \text{Pass}$$

Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
 (2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0°.

$$C_p = \underline{0.834}$$



Airflow Sciences Corporation

Probe Calibration for Method 2

Wind Tunnel Facility: Airflow Sciences Corporation
 Wind Tunnel Location: Livonia, MI
 Probe Type: S-Type Pitot
 Probe ID: S8-058-B
 Probe Calibration Date: 09/21/23
 Test Point Location: center
 Ambient Temperature (°F): 72.6
 Barometric Pressure ("Hg): 29.48

Repetition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (°)	
1	60	0.81	72.6	1.15	0	0.83
2	60	0.81	72.6	1.15	0	0.83
3	60	0.81	72.6	1.15	0	0.83
Average ($C_{p(avg-low)}$)						0.83

Repetition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (deg)	
1	90	1.82	72.6	2.56	0	0.84
2	90	1.83	72.6	2.56	0	0.84
3	90	1.83	72.6	2.56	0	0.84
Average ($C_{p(avg-high)}$)						0.84

$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \underline{-0.37\%} \quad \text{Pass}$$

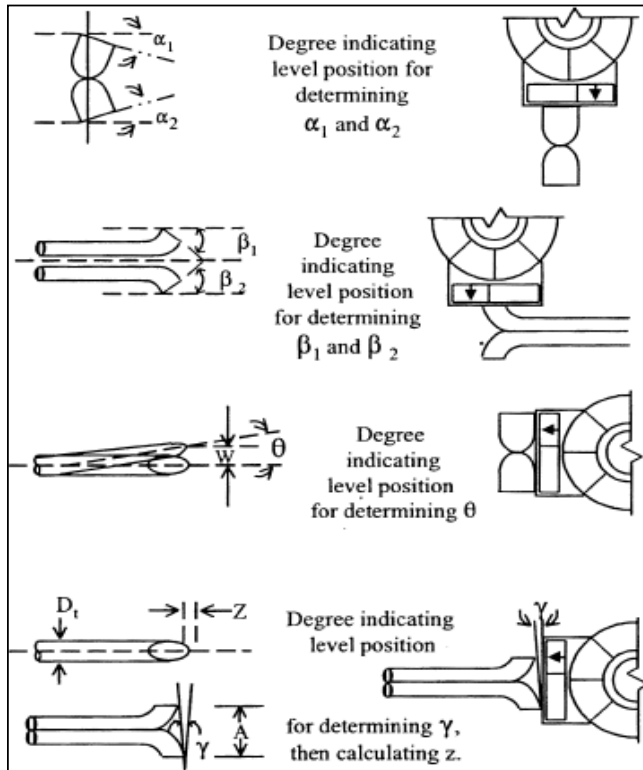
Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
 (2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0°.

$$C_p = \underline{0.834}$$

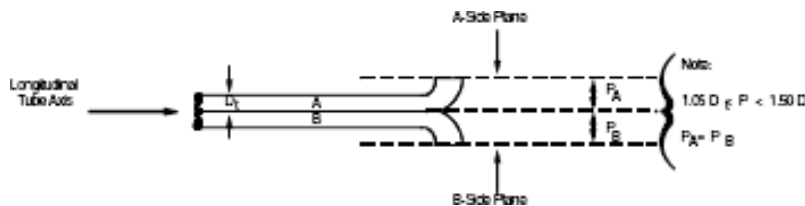


Airflow Sciences Corporation

Probe Inspection for Method 2G



α_1	0.4 ($^\circ$)	Pass
α_2	0.5 ($^\circ$)	Pass
β_1	0.3 ($^\circ$)	Pass
β_2	0.3 ($^\circ$)	Pass
D_t	0.375 (")	Pass
P_a	0.474 (")	Pass
P_b	0.474 (")	Pass
z	<0.02 (")	Pass
w	0.007 (")	Pass



Certification

I certify that Type S probe ID **S8-058** meets or exceeds all specifications, criteria, and applicable design features.

Certified by: W Jambeck

Date: 9/21/2023



Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date: 9/21/2023
Temperature (°F): 72.8
Pressure ("Hg): 29.48
Personnel: wgj
Probe: S8-059-A

Wind Tunnel Target DP [I.W.C]	Wind Tunnel Actual DP [I.W.C]	S-Probe DP [I.W.C.]	C _p	C _{p(avg)}	C _p -C _{p(avg)}	σ _{max}	
0.81	0.81	1.13	0.838	0.838	0.000	0.000	Pass
0.81	0.81	1.14	0.837		0.000		
0.81	0.81	1.14	0.838		0.000		
1.81	1.81	2.51	0.840	0.840	0.000	0.000	Pass
1.81	1.81	2.51	0.840		0.000		
1.81	1.81	2.51	0.840		0.000		



Airflow Sciences Corporation

Probe Calibration for Method 2

Data Collection and Analysis

Date: 9/21/2023
Temperature (°F): 73.1
Pressure ("Hg): 29.47
Personnel: wgj
Probe: S8-059-B

Wind Tunnel Target DP [I.W.C]	Wind Tunnel Actual DP [I.W.C]	S-Probe DP [I.W.C.]	C _p	C _{p(avg)}	C _p -C _{p(avg)}	σ _{max}	
0.81	0.81	1.16	0.828	0.828	0.000	0.000	Pass
0.81	0.81	1.16	0.828		0.000		
0.81	0.81	1.16	0.828		0.000		
1.81	1.81	2.58	0.829	0.829	0.000	0.000	Pass
1.81	1.81	2.58	0.829		0.000		
1.81	1.81	2.58	0.829		0.000		



Airflow Sciences Corporation

Probe Calibration for Method 2

Wind Tunnel Facility: Airflow Sciences Corporation
 Wind Tunnel Location: Livonia, MI
 Probe Type: S-Type Pitot
 Probe ID: S8-059-A
 Probe Calibration Date: 09/21/23
 Test Point Location: center
 Ambient Temperature (°F): 72.8
 Barometric Pressure ("Hg): 29.48

Repetition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C _p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (°)	
1	60	0.81	72.8	1.13	0	0.84
2	60	0.81	72.8	1.14	0	0.84
3	60	0.81	72.8	1.14	0	0.84
Average (C _{p(avg-low)})						0.84

Repetition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C _p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (deg)	
1	90	1.81	72.8	2.51	0	0.84
2	90	1.81	72.8	2.51	0	0.84
3	90	1.81	72.8	2.51	0	0.84
Average (C _{p(avg-high)})						0.84

$$\% \text{ Difference} = \frac{C_{p(\text{avg-low})} - C_{p(\text{avg-high})}}{C_{p(\text{avg-low})}} \times 100\% = \underline{-0.30\%} \quad \text{Pass}$$

Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
 (2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0°.

C _p = 0.839



Airflow Sciences Corporation

Probe Calibration for Method 2

Wind Tunnel Facility: Airflow Sciences Corporation
 Wind Tunnel Location: Livonia, MI
 Probe Type: S-Type Pitot
 Probe ID: S8-059-B
 Probe Calibration Date: 09/21/23
 Test Point Location: center
 Ambient Temperature (°F): 73.1
 Barometric Pressure ("Hg): 29.47

Repetition	Nominal Low Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (°)	
1	60	0.81	73.1	1.16	0	0.83
2	60	0.81	73.1	1.16	0	0.83
3	60	0.81	73.1	1.16	0	0.83
Average ($C_{p(avg-low)}$)						0.83

Repetition	Nominal High Velocity Setting (ft/s)	Calibration Pitot		Tested Probe		Calculated C_p
		DP _{std} ("H ₂ O)	Temperature (°F)	DP ("H ₂ O)	Yaw Angle (deg)	
1	90	1.81	73.1	2.58	0	0.83
2	90	1.81	73.1	2.58	0	0.83
3	90	1.81	73.1	2.58	0	0.83
Average ($C_{p(avg-high)}$)						0.83

$$\% \text{ Difference} = \frac{C_{p(avg-low)} - C_{p(avg-high)}}{C_{p(avg-low)}} \times 100\% = \underline{-0.17\%} \quad \text{Pass}$$

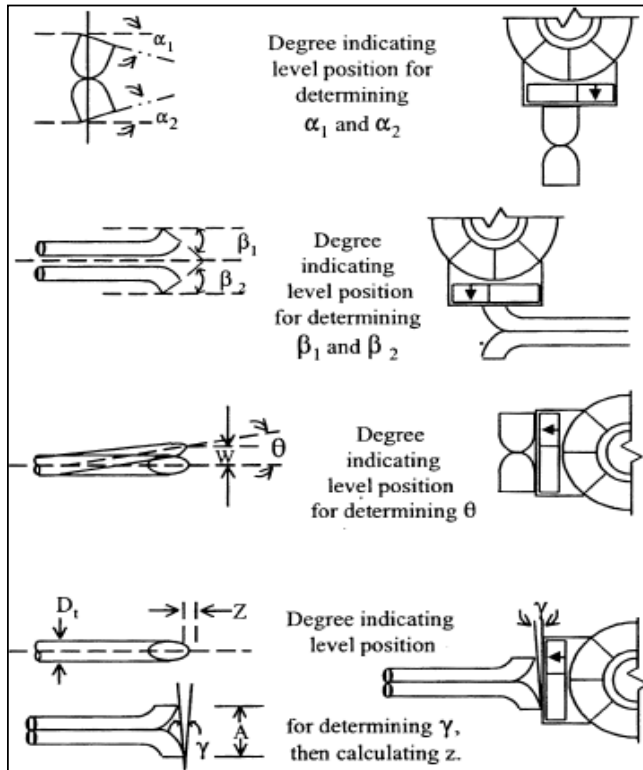
Note: (1) The percent difference between the low and high velocity setting C_p values shall be within +/- 3 %.
 (2) If calibrating a 3-D probe for this method, the pitch angle setting must be 0°.

$$C_p = \underline{0.829}$$

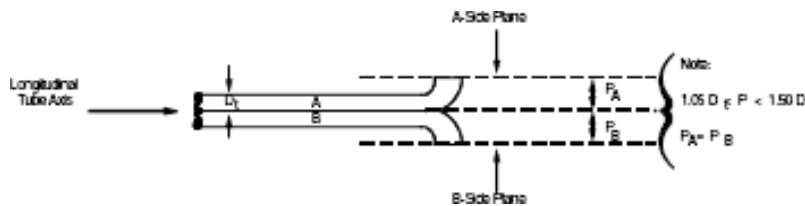


Airflow Sciences Corporation

Probe Inspection for Method 2G



α_1	0.9 ($^\circ$)	Pass
α_2	0.5 ($^\circ$)	Pass
β_1	0.7 ($^\circ$)	Pass
β_2	0.9 ($^\circ$)	Pass
D_t	0.375 (")	Pass
P_a	0.471 (")	Pass
P_b	0.471 (")	Pass
z	<0.02 (")	Pass
w	0.005 (")	Pass



Certification

I certify that Type S probe ID **S8-059** meets or exceeds all specifications, criteria, and applicable design features.

Certified by: W Jambeck

Date: 9/21/2023

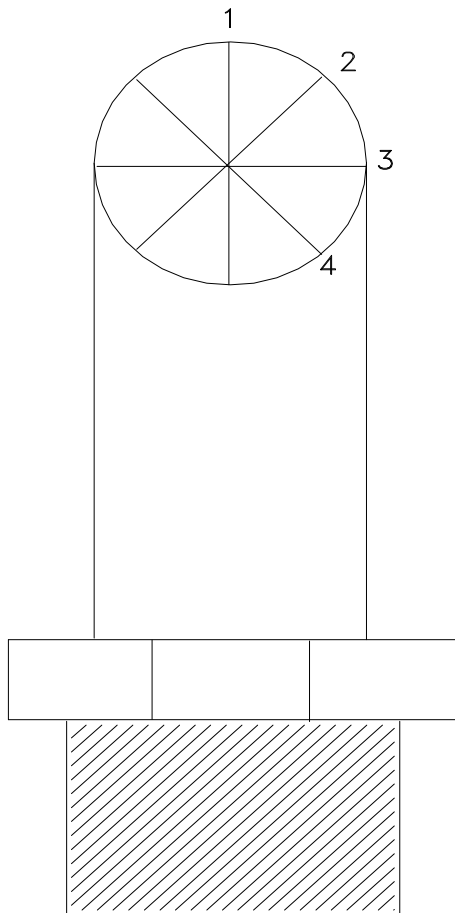
Nozzle Calibration

Date: 8/27/2020

Nozzle ID No.: 131

Analyst: CAM

Material/Type: Glass



0.257 1

0.258 2

0.258 3

0.258 4

Valid Data

Average

0.258

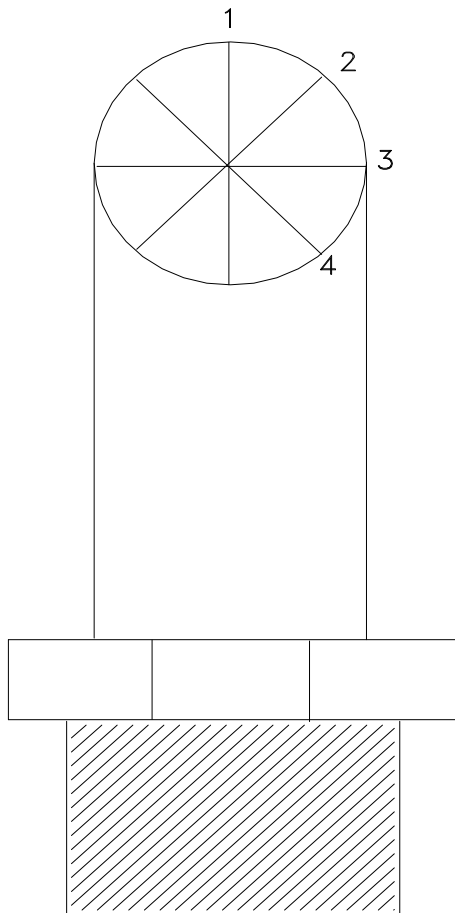
Nozzle Calibration

Date: 11/2/2020

Nozzle ID No.: 924

Analyst: DPP

Material/Type: Glass



0.258 1

0.259 2

0.258 3

0.258 4

Valid Data

Average

0.258

Client: Heidelberg Materials
Facility: Mitchell Cement Plant
Project #: M234006
Test Location: Kiln 4 Stack
Date: 10/4/2023
Operator: E. Ehlers
Operating Condition >Mill on

Sample System: FTIR
Probe Length: 8.0 ft
Probe Type: FTIR
Sample Plane: Horizontal
Port Type: Flange
Duct Shape: Circular

 Side of duct
Duct Area: Sq. Ft.
 Upstream Diameters: 0.50
 Downstream Diameters: 1.00
 Number of Ports Sampled: 1
 Number of Points per Port: 3
 Total Number of Traverse Points: 3

Calibration Gases

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder	Final Bottle Pressure, PSI
O2 % (wet)	Zero		0.0	0.00	0.00%			1500
	Mid	BLM-003080	10.11	10.10	0.05%	6/26/2031	52.85%	1800
	High	LL26626	19.13	19.10	0.16%	6/24/2029		1950

Type	Compound	Cylinder ID	Cylinder Value	Expiration Date	Final Bottle Pressure, PSI
Zero Gas	Nitrogen	Zero Nitrogen	0.0	N/A	
Calibration Transfer Standard	Ethylene	EB0158924	99.99	5/17/2031	
Analyte Spike Gas	HCN	CC768272	197.70	7/5/2024	
	SF6		10.000		

Response Time Data

Type	RM Analyzer Make/Model	RM Analyzer s/n	Analyzer Span	RM Gas Span
O2 % (wet)	Bmad Gaus 4710	00673	25	19.13
HCN ppmvw	MKS 2030	00583	100	N/A

Client: Heidelberg Materials
Facility: Mitchell Cement Plant
Project #: M234006
Diluent: O2 %

Test Location: Kiln 4 Stack
Date: 10/4/23
Operator: E. Ehlers
O2 % Correction: 7

O2 % (wet) Correction Data

Run #	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
1	10.11	10.20	10.10	0.20	0.10	0.15	10.15	10.60	10.6	0.00	-0.52	-0.52	-0.52
2	10.11	10.10	10.10	0.10	0.20	0.15	10.10	10.44	10.5	0.00	0.00	-1.05	0.52
3	10.11	10.10	10.20	0.20	0.20	0.20	10.15	10.39	10.4	-0.52	0.52	-1.05	0.00

Concentration of Cal Gas C = Average value of test Co=Average Pre and Post Zero
 erage Pre and Post Span Cgas = Corrected gas value of test

Calibration Corrected and Calculated Data

Run #	Run Date	Start Time	End Time	Moisture %	O2 % (wet)	CO2 % (wet)	CO2 % (dry)	O2 % (dry)	HCN ppmvw	HCN ppmvd @ 7% O2	HF ppmvw	HF ppmvd @ 7% O2
1	10/4/23	12:30	13:29	14.97%	10.56	11.34	13.34	12.42	8.42	16.23	0.10	0.19
2	10/4/23	14:00	14:59	15.74%	10.46	11.12	13.20	12.41	7.66	14.89	0.10	0.19
3	10/4/23	15:20	16:19	15.64%	10.35	11.38	13.49	12.27	8.34	15.93	0.10	0.19

Client: Heidelberg Materials
Facility: Mitchell Cement Plant
Test Location: Kiln 4 Stack
Date: 10/4/23
Project #: M234006
Conditon: Mill on

<u>Time</u>	<u>Linearity Cal/Pre 1 Cal</u> <u>O2 % (wet)</u>	
11:58	0.00	iz
11:59	0.00	
12:00	0.00	
12:01	0.00	
12:02	0.00	
12:03	0.00	
12:04	-2.70	
12:05	-2.70	
12:06	-2.00	
12:07	-2.50	
12:08	-2.70	
12:09	13.20	
12:10	19.10	ih
12:11	16.20	
12:12	10.10	im
12:13	14.10	
12:14	0.40	
12:15	0.20	z
12:16	11.50	
12:17	10.20	m

Client: Heidelberg Materials
Facility: Mitchell Cement Plant
Project #: M234006
Test Location: Kiln 4 Stack
Date: 10/4/23
Conditon: Mill on

Post 1/Pre 2			Post 2/Pre 3		
<u>Time</u>	<u>O2 % (wet)</u>		<u>Time</u>	<u>O2 % (wet)</u>	
13:43	0.20		15:10	0.20	
13:44	4.70		15:11	6.80	
13:45	10.10	m	15:12	10.10	m
13:46	6.80		15:13	5.60	
13:47	0.20		15:14	0.20	z
13:48	0.10				
13:49	0.10	z			

Post 3		
<u>Time</u>	<u>O2 % (wet)</u>	
16:30	0.20	
16:31	2.50	
16:32	10.00	
16:33	10.20	m
16:34	0.90	
16:35	0.20	z

Client: Heidelberg Materials
Facility: Mitchell, IN
Project #: M234006
Test Location: Kiln 4 Stack
Date: 10/3/23 to 10/4/23
Operator: MLIP
Operating Condition >Mill Off

Sample System: FTIR
Probe Length: 8.0 ft
Probe Type: FTIR
Sample Plane: Horizontal
Port Length: 6 in.
Port Size (diameter): 6 in.
Port Type: Flange
Duct Shape: Circular
Diameter: 19.68 ft
Side of duct
Duct Area: 304.19 Sq. Ft.
Upstream Diameters: 0.50 Minimum Upstream Distance 9.8 Feet
Downstream Diameters: 1.00 Minimum Downstream Distance 39.4 Feet
Number of Ports Sampled: 1 Ideal Upstream Distance 39.4 Feet
Number of Points per Port: 3 Ideal Downstream Distance 157.4 Feet
Total Number of Traverse Points: 3

Calibration Gases

Type	Setting	Cylinder ID	Cylinder Value	Analyzer Response	Difference, % of Span	Expiration Date	Mid cylinder % of high cylinder	Final Bottle Pressure, PSI
O2 % (wet)	Zero	Zero Nitrogen	0.0	0.00	0.00%	N/A		1500
	Mid	BLM-003080	10.11	10.20	-0.47%	6/26/2031	52.85%	1800
	High	LL26626	19.13	19.10	0.16%	6/24/2029		1950

Type	Compound	Cylinder ID	Cylinder Value	Expiration Date	Final Bottle Pressure, PSI
Zero Gas	Nitrogen	Zero Nitrogen	0.0	N/A	>500
Calibration Transfer Standard	Ethylene	EB0158924	99.99	5/17/2031	>500
Analyte Spike Gas	HCN	CC768272	197.70	3/8/2024	>500
	SF6		10.000		

Response Time Data

Type	RM Analyzer Make/Model	RM Analyzer s/n	Analyzer Span	RM Gas Span
O2 % (wet)	CAI 700	00673	25	19.13
HCN ppmvw	MKS 2030	00583	100	N/A

Client: Heidelberg Materials
 Facility: Mitchell, IN
 Project #: M234006
 Diluent: O2 %

Test Location: Kiln 4 Stack
 Date: 10/3/23 to 10/4/23
 Operator: MLIP
 O2 % Correction: 7

O2 % (wet) Correction Data

Run #	Cma	Precal	Postcal	Pre zero	Post zero	Co	Cm	C	Cgas	Span Bias	Span Drift	Zero Bias	Zero Drift
1	10.11	10.10	10.10	0.20	0.20	0.20	10.10	10.83	10.9	0.52	0.00	-1.05	0.00
2	10.11	10.10	10.10	0.20	0.20	0.20	10.10	10.54	10.6	0.52	0.00	-1.05	0.00
3	10.11	10.10	10.10	0.20	0.20	0.20	10.10	10.42	10.4	0.52	0.00	-1.05	0.00

Concentration of Cal Gas C = Average value of test Co=Average Pre and Post Zero
 erage Pre and Post Span Cgas = Corrected gas value of test

Calibration Corrected and Calculated Data

Run #	Run Date	Start Time	End Time	Moisture %	O2 % (wet)	CO2 % (wet)	CO2 % (dry)	HCN ppmvw	HCN ppmvd @ 7% O2	HF ppmvw	HF ppmvd @ 7% O2	O2 % (dry)
1	10/3/23	21:12	22:11	13.21%	10.86	11.68	13.46	10.96	20.91	0.10	0.19	12.51
2	10/3/23	22:39	23:38	13.56%	10.56	11.92	13.79	11.03	20.30	0.10	0.18	12.17
3	10/4/23	0:05	1:04	13.78%	10.44	12.01	13.93	11.03	20.03	0.10	0.18	12.02

Client: Heidelberg Materials
Facility: Mitchell, IN
Test Location: Kiln 4 Stack
Date: 10/3/23
Project #: M234006

Linearity Cal/Pre 1 Cal		
<u>Time</u>	<u>O2 % (wet)</u>	
7:17	19.10	ih
7:18	16.10	
7:19	0.00	iz
7:20	0.00	
7:21	0.00	
7:22	0.00	
7:23	5.20	im
7:24	10.20	
7:25	10.10	
7:26	10.10	
7:27	11.70	
7:28	21.30	
7:29	21.30	
7:30	21.30	
7:31	18.50	z
7:32	4.50	
7:33	3.90	
7:34	0.20	
7:35	1.90	
7:36	0.20	
7:37	1.50	
7:38	0.20	
7:39	1.30	
7:40	0.60	
7:41	3.80	m
7:42	10.10	

Client: Heidelberg Materials
Facility: Mitchell, IN
Project #: M234006
Test Location: Kiln 4 Stack
Date: 10/3/23 to 10/4/23

Post 1/Pre 2			Post 2/Pre 3		
<u>Time</u>	<u>O2 % (wet)</u>		<u>Time</u>	<u>O2 % (wet)</u>	
22:30	0.20	z	23:55	0.20	z
22:31	0.20		23:56	0.20	
22:32	9.50		23:57	7.00	
22:33	10.10	m	23:58	10.10	m
22:34	10.10				

Post 3		
<u>Time</u>	<u>O2 % (wet)</u>	
1:20	0.20	
1:21	0.20	z
1:22	6.50	
1:23	10.10	
1:24	10.10	m

Appendix H - FTIR QA/QC

Client: Heidelberg Materials
Facility: Mitchell Cement Plant
Project #: M234006
Operating Condition: Mill on

Test Location: Kiln 4 Stack
Date: 10/4/2023
Operator: E. Ehlers
FTIR s/n: 00583

System Leak Check: 0.0 mL/min

Nitrogen (Zero) Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
N2 DIR_002579.LAB	10/4/23	12:02:19	0.0	0.0	0.0	191.0	0.99	0.1	0.0	0.004
N2 DIR_002580.LAB	10/4/23	12:02:28	0.0	0.0	0.0	191.0	0.99	0.2	0.0	-0.002
N2 DIR_002581.LAB	10/4/23	12:02:36	0.0	0.0	0.0	191.0	0.99	0.0	0.1	-0.003
N2 DIR_002582.LAB	10/4/23	12:02:44	0.0	0.0	0.0	191.0	0.99	-0.2	-0.1	0.002
N2 DIR_002583.LAB	10/4/23	12:02:52	0.0	0.0	0.0	191.0	0.99	-0.1	0.0	0.002
N2 DIR_002584.LAB	10/4/23	12:03:00	0.0	0.0	0.0	191.0	0.99	-0.1	0.0	-0.003
N2 DIR_002585.LAB	10/4/23	12:03:09	0.0	0.0	0.0	191.1	0.99	-0.1	0.0	0.002
N2 DIR_002586.LAB	10/4/23	12:03:17	0.0	0.0	0.0	191.1	0.99	0.1	0.0	0.002
N2 DIR_002587.LAB	10/4/23	12:03:25	0.0	0.0	0.0	191.1	0.99	-0.1	0.0	0.004

Calibration Transfer Standard (CTS), Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS DIR_002596.LAB	10/4/23	12:05:01	0.0	0.0	0.0	190.9	0.99	97.6	0.0	-0.006	97.6%
CTS DIR_002597.LAB	10/4/23	12:05:09	0.0	0.0	0.0	190.9	0.99	97.8	-0.1	0.002	97.8%
CTS DIR_002598.LAB	10/4/23	12:05:18	0.0	0.0	0.0	190.9	0.99	97.3	0.0	0.009	97.3%
CTS DIR_002599.LAB	10/4/23	12:05:26	0.0	0.0	0.0	190.9	0.99	97.2	0.0	0.001	97.2%
CTS DIR_002600.LAB	10/4/23	12:05:34	0.0	0.0	0.0	190.9	0.99	96.9	0.0	-0.002	96.9%
CTS DIR_002601.LAB	10/4/23	12:05:42	0.0	0.0	0.0	190.9	0.99	97.2	0.0	0.001	97.2%
CTS DIR_002602.LAB	10/4/23	12:05:50	0.0	0.0	0.0	191.0	0.99	97.4	0.0	0.005	97.4%
Average								97.3			97.3%

Analyte Spike Gas (HCN) Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % HCN
HCN DIR_002617.LAB	10/4/23	12:08:16	0.0	0.0	0.0	190.9	0.99	-0.2	193.3	9.550	97.8%
HCN DIR_002618.LAB	10/4/23	12:08:24	0.0	0.0	0.0	190.9	0.99	-0.1	192.8	9.554	97.5%
HCN DIR_002619.LAB	10/4/23	12:08:32	0.0	0.0	0.0	190.9	0.99	0.0	193.4	9.589	97.8%
HCN DIR_002620.LAB	10/4/23	12:08:40	0.0	0.0	0.0	190.9	0.99	-0.1	193.7	9.572	98.0%
HCN DIR_002621.LAB	10/4/23	12:08:49	0.0	0.0	0.0	190.9	0.99	0.0	193.2	9.562	97.7%
HCN DIR_002622.LAB	10/4/23	12:08:57	0.0	0.0	0.0	190.9	0.99	0.0	193.8	9.562	98.0%
HCN DIR_002623.LAB	10/4/23	12:09:05	0.0	0.0	0.0	190.9	0.99	0.0	193.9	9.553	98.1%
HCN DIR_002624.LAB	10/4/23	12:09:13	0.0	0.0	0.0	190.9	0.99	-0.3	192.3	9.488	97.3%
Average									193.3	9.554	97.8%

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS REMOTE_002655.LAB	10/4/23	12:14:20	0.1	0.0	0.0	191.0	0.99	96.2	0.2	0.002	96.3%
CTS REMOTE_002656.LAB	10/4/23	12:14:29	0.0	0.0	0.0	190.9	0.99	96.1	0.1	0.003	96.1%
CTS REMOTE_002657.LAB	10/4/23	12:14:37	0.0	0.0	0.0	190.9	0.99	96.6	0.2	-0.001	99.3%
CTS REMOTE_002658.LAB	10/4/23	12:14:45	0.0	0.0	0.0	190.9	0.99	96.1	0.1	0.001	98.7%
CTS REMOTE_002659.LAB	10/4/23	12:14:53	0.0	0.0	0.0	190.9	0.99	95.8	0.1	-0.001	98.4%
CTS REMOTE_002660.LAB	10/4/23	12:15:02	0.0	0.0	0.0	190.9	0.99	95.8	0.1	0.000	98.4%
CTS REMOTE_002661.LAB	10/4/23	12:15:10	0.0	0.0	0.0	190.9	0.99	96.4	0.1	-0.001	99.1%
CTS REMOTE_002662.LAB	10/4/23	12:15:18	0.0	0.0	0.0	190.9	0.99	96.3	0.1	-0.004	98.9%

Response Time Test

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Response Time (sec)
CTS REMOTE_002653.LAB	10/4/23	12:14:04	1.3	0.1	0.0	191.0	0.99	26.0	0.6	0.003	-
CTS REMOTE_002654.LAB	10/4/23	12:14:12	0.1	0.0	0.0	191.0	0.99	95.2	0.2	0.005	16.233
CTS REMOTE_002655.LAB	10/4/23	12:14:20	0.1	0.0	0.0	191.0	0.99	96.2	0.2	0.002	24.233
CTS REMOTE_002656.LAB	10/4/23	12:14:29	0.0	0.0	0.0	190.9	0.99	96.1	0.1	0.003	
CTS REMOTE_002657.LAB	10/4/23	12:14:37	0.0	0.0	0.0	190.9	0.99	96.6	0.2	-0.001	
CTS REMOTE_002658.LAB	10/4/23	12:14:45	0.0	0.0	0.0	190.9	0.99	96.1	0.1	0.001	
CTS REMOTE_002659.LAB	10/4/23	12:14:53	0.0	0.0	0.0	190.9	0.99	95.8	0.1	-0.001	
CTS REMOTE_002660.LAB	10/4/23	12:15:02	0.0	0.0	0.0	190.9	0.99	95.8	0.1	0.000	
CTS REMOTE_002661.LAB	10/4/23	12:15:10	0.0	0.0	0.0	190.9	0.99	96.4	0.1	-0.001	

Client: Heidelberg Materials
Facility: Mitchell Cement Plant
Project #: M234006
Operating Condition: Mill on

Test Location: Kiln 4 Stack
Date: 10/4/2023
Operator: E. Ehlers
FTIR s/n: 00583

Pre 1 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
NATIVE_002712.LAB	10/4/23	12:23:22	13.1	12.1	-0.1	191.0	0.99	3.1	10.1	-0.009
NATIVE_002713.LAB	10/4/23	12:23:30	13.1	12.0	0.0	191.0	0.99	3.2	10.0	-0.010
NATIVE_002714.LAB	10/4/23	12:23:39	13.1	12.1	-0.1	191.0	0.99	3.3	9.8	-0.005
									10.0	-0.008

Pre 1 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
PRE 1 SPIKE_002736.LAB	10/4/23	12:27:03	12.8	10.8	0.0	191.1	0.99	2.9	22.4	0.709	0.074	95.0%
PRE 1 SPIKE_002737.LAB	10/4/23	12:27:11	12.8	10.9	-0.1	191.0	0.99	2.8	22.3	0.700	0.073	95.3%
PRE 1 SPIKE_002738.LAB	10/4/23	12:27:19	12.8	10.8	-0.1	191.0	0.99	2.9	22.8	0.725	0.076	95.4%
PRE 1 SPIKE_002739.LAB	10/4/23	12:27:27	12.8	10.8	0.0	191.0	0.99	2.7	23.8	0.798	0.084	94.1%
PRE 1 SPIKE_002740.LAB	10/4/23	12:27:35	12.8	10.8	0.0	191.0	0.99	2.7	23.9	0.796	0.083	94.5%
PRE 1 SPIKE_002741.LAB	10/4/23	12:27:44	12.9	10.8	0.0	191.0	0.99	2.7	23.9	0.793	0.083	94.8%
PRE 1 SPIKE_002742.LAB	10/4/23	12:27:52	12.9	10.8	-0.1	191.0	0.99	2.9	23.9	0.800	0.084	94.3%
PRE 1 SPIKE_002743.LAB	10/4/23	12:28:00	13.0	10.9	-0.1	190.9	0.99	2.8	23.7	0.787	0.082	94.3%

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
RUN 1 MILL ON_002813.LAB	10/4/23	13:35:11	15.6	11.1	-0.1	191.1	0.99	2.9	7.6	-0.003
RUN 1 MILL ON_002814.LAB	10/4/23	13:36:15	15.6	11.0	-0.1	191.0	0.99	3.0	7.7	-0.006
RUN 1 MILL ON_002815.LAB	10/4/23	13:37:19	16.1	11.1	-0.1	190.9	0.99	2.9	7.5	-0.006
									7.6	-0.005

Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
RUN 1 POST SPIKE_002833.LAB	10/4/23	13:40:35	14.6	10.1	-0.1	191.0	0.99	2.6	23.2	0.891	0.093	93.2%
RUN 1 POST SPIKE_002834.LAB	10/4/23	13:40:43	14.5	10.0	-0.1	191.0	0.99	2.5	22.9	0.892	0.093	91.8%
RUN 1 POST SPIKE_002835.LAB	10/4/23	13:40:51	14.3	9.9	-0.1	191.0	0.99	2.6	22.9	0.891	0.093	91.9%
RUN 1 POST SPIKE_002836.LAB	10/4/23	13:41:00	14.4	10.0	-0.1	191.0	0.99	2.5	22.9	0.887	0.093	91.9%
RUN 1 POST SPIKE_002837.LAB	10/4/23	13:41:08	14.4	10.0	-0.1	191.0	0.99	2.5	23.0	0.894	0.094	92.2%
RUN 1 POST SPIKE_002838.LAB	10/4/23	13:41:16	14.3	10.0	-0.1	191.0	0.99	2.5	22.9	0.893	0.094	91.8%
RUN 1 POST SPIKE_002839.LAB	10/4/23	13:41:24	14.4	10.0	-0.1	191.0	0.99	2.8	22.9	0.893	0.093	91.7%
RUN 1 POST SPIKE_002840.LAB	10/4/23	13:41:33	14.4	10.0	-0.1	190.9	0.99	2.7	23.0	0.897	0.094	91.8%

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
RUN 1 POST CTS_002850.LAB	10/4/23	13:43:12	0.4	0.0	0.0	191.0	0.99	95.8	0.5	0.004	98.4%
RUN 1 POST CTS_002851.LAB	10/4/23	13:43:20	0.3	0.0	0.0	190.9	0.99	96.0	0.4	0.000	98.7%
RUN 1 POST CTS_002852.LAB	10/4/23	13:43:28	0.3	0.0	0.0	190.9	0.99	95.7	0.3	-0.006	98.3%
RUN 1 POST CTS_002853.LAB	10/4/23	13:43:36	0.2	0.0	0.0	190.9	0.99	95.5	0.4	0.007	98.2%
RUN 1 POST CTS_002854.LAB	10/4/23	13:43:45	0.2	0.0	0.0	191.0	0.99	95.9	0.4	0.003	98.6%
RUN 1 POST CTS_002855.LAB	10/4/23	13:43:53	0.2	0.0	0.0	191.0	0.99	96.1	0.4	0.002	98.7%
RUN 1 POST CTS_002856.LAB	10/4/23	13:44:01	0.2	0.0	0.0	191.0	0.99	95.9	0.3	-0.001	98.5%
RUN 1 POST CTS_002857.LAB	10/4/23	13:44:09	0.2	0.0	0.0	191.0	0.99	96.0	0.4	0.003	98.6%

Client: Heidelberg Materials
Facility: Mitchell Cement Plant
Project #: M234006
Operating Condition: Mill on

Test Location: Kiln 4 Stack
Date: 10/4/2023
Operator: E. Ehlers
FTIR s/n: 00583

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
RUN 2_002965.LAB	10/4/23	15:01:01	15.8	11.0	-0.1	191.1	0.99	3.0	7.6	-0.004
RUN 2_002966.LAB	10/4/23	15:02:05	15.6	11.1	-0.1	191.1	0.99	3.1	7.7	-0.002
RUN 2_002967.LAB	10/4/23	15:03:09	15.5	11.2	-0.1	191.1	0.99	3.2	7.8	-0.003
									7.7	-0.003

Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
RUN 2 POST SPIKE_002990.LAB	10/4/23	15:07:38	13.9	10.1	0.0	190.9	0.99	3.2	23.8	0.915	0.096	93.4%
RUN 2 POST SPIKE_002991.LAB	10/4/23	15:07:46	14.7	10.1	-0.1	190.9	0.99	3.0	23.9	0.908	0.095	94.1%
RUN 2 POST SPIKE_002992.LAB	10/4/23	15:07:55	14.6	10.1	-0.1	190.9	0.99	3.2	23.8	0.909	0.095	93.9%
RUN 2 POST SPIKE_002993.LAB	10/4/23	15:08:03	14.6	10.2	-0.1	190.9	0.99	3.1	23.8	0.907	0.095	93.7%
RUN 2 POST SPIKE_002994.LAB	10/4/23	15:08:11	14.3	10.1	-0.1	190.9	0.99	3.0	23.8	0.907	0.095	94.0%
RUN 2 POST SPIKE_002995.LAB	10/4/23	15:08:19	14.1	10.1	-0.1	190.9	0.99	3.1	23.9	0.900	0.094	94.8%
RUN 2 POST SPIKE_002996.LAB	10/4/23	15:08:27	14.0	10.1	-0.1	190.9	0.99	2.9	23.9	0.902	0.094	94.8%
RUN 2 POST SPIKE_002997.LAB	10/4/23	15:08:36	14.1	10.0	-0.1	190.9	0.99	2.9	23.9	0.902	0.094	94.6%

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
RUN 2 POST CTS_003006.LAB	10/4/23	15:10:10	1.4	0.0	0.0	190.9	0.99	94.4	0.3	0.003	97.0%
RUN 2 POST CTS_003007.LAB	10/4/23	15:10:18	1.2	0.0	0.0	190.9	0.99	94.8	0.5	0.004	97.4%
RUN 2 POST CTS_003008.LAB	10/4/23	15:10:26	1.0	0.0	0.0	190.9	0.99	94.8	0.5	0.014	97.4%
RUN 2 POST CTS_003009.LAB	10/4/23	15:10:34	0.9	0.0	0.0	190.9	0.99	95.0	0.6	-0.001	97.6%
RUN 2 POST CTS_003010.LAB	10/4/23	15:10:42	0.7	0.0	0.0	190.9	0.99	95.3	0.5	0.002	97.9%
RUN 2 POST CTS_003011.LAB	10/4/23	15:10:51	0.5	0.0	0.0	190.9	0.99	95.4	0.5	0.006	98.0%
RUN 2 POST CTS_003012.LAB	10/4/23	15:10:59	0.4	0.0	0.0	190.9	0.99	95.3	0.4	0.002	97.9%
RUN 2 POST CTS_003013.LAB	10/4/23	15:11:07	0.4	0.0	0.0	190.9	0.99	95.6	0.5	0.006	98.2%

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
RUN 3_003098.LAB	10/4/23	16:23:33	15.9	11.6	-0.1	191.0	0.99	3.1	8.5	-0.003
RUN 3_003099.LAB	10/4/23	16:24:36	15.8	11.5	-0.1	191.0	0.99	3.3	8.8	-0.005
RUN 3_003100.LAB	10/4/23	16:25:40	15.6	11.5	-0.1	191.0	0.99	3.5	8.7	-0.004
									8.7	-0.004

Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
RUN 3 POST SPIKE_003108.LAB	10/4/23	16:27:54	14.3	10.4	-0.1	191.0	0.99	2.9	24.0	0.892	0.093	92.8%
RUN 3 POST SPIKE_003109.LAB	10/4/23	16:28:02	14.3	10.4	-0.1	191.0	0.99	3.0	24.1	0.884	0.093	93.6%
RUN 3 POST SPIKE_003110.LAB	10/4/23	16:28:11	14.3	10.5	-0.1	191.0	0.99	3.1	24.2	0.888	0.093	93.6%
RUN 3 POST SPIKE_003111.LAB	10/4/23	16:28:19	14.4	10.4	-0.1	191.0	0.99	2.8	24.1	0.887	0.093	93.4%
RUN 3 POST SPIKE_003112.LAB	10/4/23	16:28:27	14.4	10.4	-0.1	191.0	0.99	3.0	24.3	0.880	0.092	94.6%
RUN 3 POST SPIKE_003113.LAB	10/4/23	16:28:35	14.6	10.5	-0.1	191.0	0.99	3.1	24.1	0.876	0.092	94.1%
RUN 3 POST SPIKE_003114.LAB	10/4/23	16:28:43	14.6	10.5	-0.1	191.0	0.99	2.9	24.1	0.880	0.092	93.9%
RUN 3 POST SPIKE_003115.LAB	10/4/23	16:28:52	14.7	10.5	-0.1	191.0	0.99	2.8	24.0	0.888	0.093	92.9%

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
RUN 3 POST CTS_003123.LAB	10/4/23	16:30:47	0.8	0.0	0.0	191.0	0.99	94.8	0.6	0.006	97.4%
RUN 3 POST CTS_003124.LAB	10/4/23	16:30:55	0.6	0.0	0.0	191.0	0.99	95.5	0.6	0.007	98.1%
RUN 3 POST CTS_003125.LAB	10/4/23	16:31:03	0.5	0.0	0.0	191.0	0.99	95.4	0.4	0.004	98.0%
RUN 3 POST CTS_003126.LAB	10/4/23	16:31:11	0.4	0.0	0.0	191.0	0.99	95.7	0.5	0.008	98.3%
RUN 3 POST CTS_003127.LAB	10/4/23	16:31:19	0.3	0.0	0.0	191.0	0.99	95.7	0.5	0.001	98.3%
RUN 3 POST CTS_003128.LAB	10/4/23	16:31:28	0.3	0.0	0.0	191.0	0.99	95.7	0.3	0.005	98.3%
RUN 3 POST CTS_003129.LAB	10/4/23	16:31:36	0.2	0.0	-0.1	191.0	0.99	95.5	0.4	-0.001	98.2%
RUN 3 POST CTS_003130.LAB	10/4/23	16:31:44	0.2	0.0	0.0	191.0	0.99	95.7	0.3	-0.001	98.3%

Client: Heidelberg Materials
Facility: Mitchell Cement Plant
Project #: M234006
Operating Condition: Mill on

Test Location: Kiln 4 Stack
Date: 10/4/2023
Operator: E. Ehlers
FTIR s/n: 00583

Post Test CTS, Direct Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS DIR_003201.LAB	10/4/23	16:42:50	0.3	0.0	0.0	191.0	0.99	97.3	0.2	0.002	99.9%
CTS DIR_003202.LAB	10/4/23	16:42:58	0.2	0.0	0.0	191.0	0.99	97.3	0.2	-0.007	99.9%
CTS DIR_003203.LAB	10/4/23	16:43:07	0.2	0.0	0.0	191.0	0.99	97.5	0.2	-0.003	100.2%
CTS DIR_003204.LAB	10/4/23	16:43:15	0.2	0.0	0.0	190.9	0.99	97.4	0.3	-0.005	100.1%
CTS DIR_003205.LAB	10/4/23	16:43:23	0.2	0.0	0.0	190.9	0.99	97.3	0.2	-0.004	100.0%
CTS DIR_003206.LAB	10/4/23	16:43:31	0.2	0.0	0.0	190.9	0.99	96.9	0.2	0.001	99.5%
CTS DIR_003207.LAB	10/4/23	16:43:39	0.2	0.0	0.0	190.9	0.99	97.2	0.3	0.001	99.8%
CTS DIR_003208.LAB	10/4/23	16:43:48	0.2	0.0	0.0	190.9	0.99	97.4	0.2	-0.012	100.1%
Average								97.3			

Post Test N2, Direct Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
N2 DIR_003218.LAB	10/4/23	16:49:44	0.0	0.0	0.0	191.0	0.99	0.1	0.0	0.001
N2 DIR_003219.LAB	10/4/23	16:51:55	0.0	0.0	0.0	191.0	0.99	0.0	0.0	0.000
N2 DIR_003220.LAB	10/4/23	16:54:06	0.0	0.0	0.0	191.0	0.99	0.0	0.0	0.000

Client: Heidelberg Materials
Facility: Mitchell, IN
Project #: M234006
Operating Condition: >90% Production/Mill Off

Test Location: Kiln 4 Stack
Date: 10/3/23 to 10/4/23
Operator: MUP
FTIR s/n: 00583

System Leak Check: 0.0 mL/min

Nitrogen (Zero) Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
N2 DIR_001672.LAB	10/3/23	16:49:52	-0.5	0.0	0.0	191.0	0.99	0.0	0.0	0.002
N2 DIR_001673.LAB	10/3/23	16:50:01	-0.5	0.0	0.0	191.0	0.99	-0.1	0.0	-0.009
N2 DIR_001674.LAB	10/3/23	16:50:09	-0.5	0.0	0.0	191.0	0.99	0.1	-0.1	-0.009
N2 DIR_001675.LAB	10/3/23	16:50:17	-0.6	0.0	0.0	191.0	0.99	-0.1	0.0	-0.009
N2 DIR_001676.LAB	10/3/23	16:50:25	-0.6	0.0	-0.1	191.0	0.99	0.0	0.1	0.003
N2 DIR_001677.LAB	10/3/23	16:50:33	-0.6	0.0	0.0	191.0	0.99	0.0	-0.1	0.003
N2 DIR_001678.LAB	10/3/23	16:50:42	-0.6	0.0	0.0	191.0	0.99	0.0	-0.1	0.001
N2 DIR_001679.LAB	10/3/23	16:50:50	-0.6	0.0	0.0	191.0	0.99	0.0	-0.1	-0.001
N2 DIR_001680.LAB	10/3/23	16:50:58	-0.6	0.0	0.0	191.0	0.99	-0.1	-0.2	0.001

Calibration Transfer Standard (CTS), Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS DIR_001688.LAB	10/3/23	16:52:28	-0.7	0.0	0.0	191.0	0.99	95.4	-0.1	-0.005	95.4%
CTS DIR_001689.LAB	10/3/23	16:52:36	-0.8	0.0	0.0	191.0	0.99	96.0	-0.3	-0.001	96.0%
CTS DIR_001690.LAB	10/3/23	16:52:44	-0.9	0.0	0.0	191.0	0.99	96.8	-0.3	-0.010	96.8%
CTS DIR_001691.LAB	10/3/23	16:52:52	-0.9	0.0	0.0	191.0	0.99	96.0	-0.3	-0.001	96.1%
CTS DIR_001692.LAB	10/3/23	16:53:00	-0.9	0.0	0.0	191.0	0.99	96.6	-0.3	0.008	96.7%
CTS DIR_001693.LAB	10/3/23	16:53:09	-0.9	0.0	0.0	191.0	0.99	96.5	-0.4	-0.002	96.6%
CTS DIR_001694.LAB	10/3/23	16:53:17	-0.9	0.0	0.0	191.0	0.99	96.6	-0.3	-0.006	96.6%
Average								96.3			96.3%

Analyte Spike Gas (HCN) Direct to FTIR

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % HCN
HCN DIR_001709.LAB	10/3/23	16:55:46	-1.0	0.0	0.0	190.9	0.99	-0.2	193.9	9.497	98.1%
HCN DIR_001710.LAB	10/3/23	16:55:55	-1.0	0.0	0.0	190.9	0.99	-0.5	193.9	9.490	98.1%
HCN DIR_001711.LAB	10/3/23	16:56:03	-1.0	0.0	0.0	190.9	0.99	-0.4	194.3	9.491	98.3%
HCN DIR_001712.LAB	10/3/23	16:56:11	-1.0	0.0	0.0	190.9	0.99	-0.1	194.1	9.492	98.2%
HCN DIR_001713.LAB	10/3/23	16:56:19	-1.0	0.0	0.0	190.9	0.99	-0.3	194.1	9.471	98.2%
HCN DIR_001714.LAB	10/3/23	16:56:27	-1.0	0.0	0.0	190.8	0.99	-0.3	194.3	9.491	98.3%
HCN DIR_001715.LAB	10/3/23	16:56:36	-1.0	0.0	0.0	190.8	0.99	-0.2	194.4	9.484	98.3%
HCN DIR_001716.LAB	10/3/23	16:56:44	-1.0	0.0	0.0	190.8	0.99	0.0	195.1	9.473	98.7%
Average									194.3	9.486	98.3%

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
CTS REMOTE_001722.LAB	10/3/23	16:58:12	-0.1	0.0	-0.1	190.8	0.99	95.0	0.5	0.012	95.0%
CTS REMOTE_001723.LAB	10/3/23	16:58:20	-0.2	0.0	0.0	190.9	0.99	95.0	0.5	0.009	95.0%
CTS REMOTE_001724.LAB	10/3/23	16:58:28	-0.3	0.0	0.0	190.9	0.99	95.1	0.4	0.010	98.8%
CTS REMOTE_001725.LAB	10/3/23	16:58:37	-0.4	0.0	0.0	190.9	0.99	95.0	0.3	0.011	98.7%
CTS REMOTE_001726.LAB	10/3/23	16:58:45	-0.4	0.0	0.0	190.9	0.99	95.4	0.3	0.015	99.1%
CTS REMOTE_001727.LAB	10/3/23	16:58:53	-0.5	0.0	0.0	190.9	0.99	95.6	0.4	0.005	99.3%
CTS REMOTE_001728.LAB	10/3/23	16:59:01	-0.6	0.0	0.0	190.9	0.99	95.7	0.2	-0.002	99.5%
CTS REMOTE_001729.LAB	10/3/23	16:59:09	-0.7	0.0	0.0	190.9	0.99	95.6	0.1	0.006	99.3%

Response Time Test

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Response Time (sec)
CTS REMOTE_001720.LAB	10/3/23	16:57:56	0.2	0.0	0.0	190.8	0.99	94.7	0.6	0.018	-
CTS REMOTE_001721.LAB	10/3/23	16:58:04	0.0	0.0	0.0	190.8	0.99	94.9	0.5	0.014	16.19
CTS REMOTE_001722.LAB	10/3/23	16:58:12	-0.1	0.0	-0.1	190.8	0.99	95.0	0.5	0.012	24.19
CTS REMOTE_001723.LAB	10/3/23	16:58:20	-0.2	0.0	0.0	190.9	0.99	95.0	0.5	0.009	
CTS REMOTE_001724.LAB	10/3/23	16:58:28	-0.3	0.0	0.0	190.9	0.99	95.1	0.4	0.010	
CTS REMOTE_001725.LAB	10/3/23	16:58:37	-0.4	0.0	0.0	190.9	0.99	95.0	0.3	0.011	
CTS REMOTE_001726.LAB	10/3/23	16:58:45	-0.4	0.0	0.0	190.9	0.99	95.4	0.3	0.015	
CTS REMOTE_001727.LAB	10/3/23	16:58:53	-0.5	0.0	0.0	190.9	0.99	95.6	0.4	0.005	
CTS REMOTE_001728.LAB	10/3/23	16:59:01	-0.6	0.0	0.0	190.9	0.99	95.7	0.2	-0.002	

Client: Heidelberg Materials
Facility: Mitchell, IN
Project #: M234006
Operating Condition: >90% Production/Mill Off

Test Location: Kiln 4 Stack
Date: 10/3/23 to 10/4/23
Operator: MLIP
FTIR s/n: 00583

Pre 1 Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
NATIVE_001796.LAB	10/3/23	17:14:46	12.2	12.3	0.0	191.0	0.99	4.2	11.7	-0.010
NATIVE_001797.LAB	10/3/23	17:14:55	12.2	12.3	0.0	191.0	0.99	3.8	11.8	-0.014
NATIVE_001798.LAB	10/3/23	17:15:03	12.4	12.5	-0.1	191.0	0.99	4.1	11.7	-0.013
									11.7	-0.012

Pre 1 Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
PRE SPIKE RUN 1_002074.LAB	10/3/23	20:56:26	10.5	11.2	-0.1	190.9	0.99	2.9	28.0	0.924	0.097	94.8%
PRE SPIKE RUN 1_002075.LAB	10/3/23	20:56:34	10.5	11.2	-0.2	190.9	0.99	2.9	27.8	0.935	0.099	93.4%
PRE SPIKE RUN 1_002076.LAB	10/3/23	20:56:43	10.6	11.2	-0.2	190.9	0.99	2.8	27.8	0.933	0.098	93.8%
PRE SPIKE RUN 1_002077.LAB	10/3/23	20:56:51	10.6	11.2	-0.1	190.9	0.99	3.0	27.8	0.931	0.098	93.9%
PRE SPIKE RUN 1_002078.LAB	10/3/23	20:56:59	10.6	11.2	-0.1	190.9	0.99	3.0	27.8	0.945	0.100	93.0%
PRE SPIKE RUN 1_002079.LAB	10/3/23	20:57:07	10.7	11.1	-0.1	190.9	0.99	3.0	27.8	0.928	0.098	94.1%
PRE SPIKE RUN 1_002080.LAB	10/3/23	20:57:15	10.8	11.1	-0.1	190.9	0.99	2.8	28.3	0.935	0.099	95.1%
PRE SPIKE RUN 1_002081.LAB	10/3/23	20:57:24	10.8	10.9	-0.1	190.9	0.99	2.9	28.4	0.934	0.098	95.5%

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
RUN 1_002198.LAB	10/3/23	22:21:35	13.3	11.8	-0.1	191.0	0.99	3.7	11.2	-0.009
RUN 1_002199.LAB	10/3/23	22:22:39	13.4	11.7	-0.1	191.0	0.99	3.8	11.0	-0.007
RUN 1_002200.LAB	10/3/23	22:23:42	13.3	12.0	-0.1	191.0	0.99	3.6	11.2	-0.009
									11.1	-0.008

Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
POST 1 SPIKE_002216.LAB	10/3/23	22:26:54	12.1	10.7	-0.1	190.9	0.99	3.0	25.0	0.805	0.085	93.7%
POST 1 SPIKE_002217.LAB	10/3/23	22:27:02	12.1	10.8	-0.1	190.9	0.99	3.1	24.9	0.796	0.084	94.1%
POST 1 SPIKE_002218.LAB	10/3/23	22:27:10	12.2	10.8	-0.2	190.9	0.99	3.1	25.1	0.805	0.085	94.2%
POST 1 SPIKE_002219.LAB	10/3/23	22:27:18	12.2	10.9	-0.2	191.0	0.99	3.0	25.0	0.802	0.085	93.8%
POST 1 SPIKE_002220.LAB	10/3/23	22:27:26	12.2	10.9	-0.2	191.0	0.99	3.1	25.0	0.804	0.085	93.9%
POST 1 SPIKE_002221.LAB	10/3/23	22:27:35	12.2	10.8	-0.1	191.0	0.99	3.0	24.9	0.804	0.085	93.2%
POST 1 SPIKE_002222.LAB	10/3/23	22:27:43	12.2	10.7	-0.1	191.0	0.99	3.0	24.8	0.804	0.085	93.1%
POST 1 SPIKE_002223.LAB	10/3/23	22:27:51	12.2	10.7	-0.2	191.0	0.99	3.1	24.9	0.799	0.084	93.9%

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
POST 1 CTS_002233.LAB	10/3/23	22:30:19	0.5	0.0	0.0	191.0	0.99	95.5	0.4	-0.001	99.2%
POST 1 CTS_002234.LAB	10/3/23	22:30:27	0.4	0.0	0.0	191.0	0.99	95.5	0.4	0.005	99.2%
POST 1 CTS_002235.LAB	10/3/23	22:30:35	0.3	0.0	0.0	191.0	0.99	95.8	0.4	0.007	99.5%
POST 1 CTS_002236.LAB	10/3/23	22:30:43	0.2	0.0	0.0	191.0	0.99	96.2	0.4	-0.005	99.9%
POST 1 CTS_002237.LAB	10/3/23	22:30:52	0.2	0.0	0.0	191.0	0.99	95.9	0.2	0.003	99.6%
POST 1 CTS_002238.LAB	10/3/23	22:31:00	0.2	0.0	0.0	191.0	0.99	95.9	0.2	0.000	99.6%
POST 1 CTS_002239.LAB	10/3/23	22:31:08	0.1	0.0	0.0	191.0	0.99	96.4	0.2	-0.006	100.1%
POST 1 CTS_002240.LAB	10/3/23	22:31:16	0.1	0.0	0.0	191.0	0.99	96.1	0.2	-0.006	99.9%

Client: Heidelberg Materials
Facility: Mitchell, IN
Project #: M234006
Operating Condition: >90% Production/Mill Off

Test Location: Kiln 4 Stack
Date: 10/3/23 to 10/4/23
Operator: MLIP
FTIR s/n: 00583

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
RUN 2_002333.LAB	10/3/23	23:46:14	13.9	12.0	-0.1	191.1	0.99	4.2	11.1	-0.009
RUN 2_002334.LAB	10/3/23	23:47:17	13.9	12.1	-0.1	191.1	0.99	4.2	11.0	-0.009
RUN 2_002335.LAB	10/3/23	23:48:20	13.9	12.2	-0.1	191.1	0.99	4.1	11.2	-0.009
									11.1	-0.009

Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
POST 2 SPIKE_002348.LAB	10/3/23	23:51:51	12.7	10.9	-0.1	190.9	0.99	3.9	25.4	0.830	0.087	93.8%
POST 2 SPIKE_002349.LAB	10/3/23	23:51:59	12.7	10.9	-0.1	190.9	0.99	3.6	25.3	0.824	0.087	93.6%
POST 2 SPIKE_002350.LAB	10/3/23	23:52:07	12.6	11.0	-0.1	190.9	0.99	3.6	25.6	0.824	0.087	94.6%
POST 2 SPIKE_002351.LAB	10/3/23	23:52:16	12.7	11.2	-0.1	190.8	0.99	3.7	25.4	0.828	0.087	93.6%
POST 2 SPIKE_002352.LAB	10/3/23	23:52:24	12.7	11.2	-0.2	190.8	0.99	3.6	25.4	0.829	0.087	93.8%
POST 2 SPIKE_002353.LAB	10/3/23	23:52:32	12.7	11.1	-0.1	190.9	0.99	3.7	25.5	0.825	0.087	94.3%
POST 2 SPIKE_002354.LAB	10/3/23	23:52:40	12.7	11.1	-0.1	190.9	0.99	3.7	25.5	0.823	0.087	94.5%
POST 2 SPIKE_002355.LAB	10/3/23	23:52:48	12.7	11.0	-0.2	190.9	0.99	3.7	25.1	0.823	0.087	93.2%

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
POST 2 CTS_002368.LAB	10/3/23	23:55:30	0.5	0.0	0.0	190.9	0.99	96.0	0.5	0.004	99.8%
POST 2 CTS_002369.LAB	10/3/23	23:55:38	0.4	0.0	0.0	190.9	0.99	95.7	0.4	0.004	99.4%
POST 2 CTS_002370.LAB	10/3/23	23:55:46	0.3	0.0	0.0	190.9	0.99	95.7	0.3	0.010	99.4%
POST 2 CTS_002371.LAB	10/3/23	23:55:55	0.3	0.0	0.0	190.9	0.99	96.0	0.3	0.004	99.7%
POST 2 CTS_002372.LAB	10/3/23	23:56:03	0.2	0.0	-0.1	190.9	0.99	96.3	0.3	-0.002	100.0%
POST 2 CTS_002373.LAB	10/3/23	23:56:11	0.2	0.0	0.0	190.9	0.99	96.3	0.4	0.010	100.0%
POST 2 CTS_002374.LAB	10/3/23	23:56:19	0.2	0.0	0.0	190.9	0.99	96.0	0.2	0.010	99.7%
POST 2 CTS_002375.LAB	10/3/23	23:56:27	0.2	0.0	0.0	190.9	0.99	96.1	0.2	0.001	99.8%

Native Effluent Prior to Analyte Spike

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
RUN 3_002472.LAB	10/4/23	1:13:12	13.7	11.9	-0.1	190.9	0.99	4.1	11.3	-0.008
RUN 3_002473.LAB	10/4/23	1:14:14	13.7	12.1	-0.1	190.9	0.99	4.0	11.3	-0.010
RUN 3_002474.LAB	10/4/23	1:15:17	13.8	11.9	-0.1	191.0	0.99	4.2	11.3	-0.010
									11.3	-0.009

Effluent Spike Using Analyte

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Dilution Factor	Recovery % HCN
POST 3 SPIKE_002480.LAB	10/4/23	1:16:54	12.6	10.7	-0.1	191.0	0.99	3.8	23.2	0.874	0.092	82.4%
POST 3 SPIKE_002481.LAB	10/4/23	1:17:02	12.6	10.8	-0.1	191.0	0.99	3.4	23.7	0.880	0.093	83.9%
POST 3 SPIKE_002482.LAB	10/4/23	1:17:10	12.6	11.0	-0.1	191.0	0.99	3.6	24.6	0.880	0.093	86.9%
POST 3 SPIKE_002483.LAB	10/4/23	1:17:19	12.8	10.9	-0.1	191.0	0.99	3.6	25.0	0.884	0.093	88.3%
POST 3 SPIKE_002484.LAB	10/4/23	1:17:27	12.8	10.9	-0.1	191.0	0.99	3.7	25.2	0.871	0.092	89.7%
POST 3 SPIKE_002485.LAB	10/4/23	1:17:35	12.6	10.9	-0.1	191.0	0.99	3.6	25.5	0.873	0.092	90.7%
POST 3 SPIKE_002486.LAB	10/4/23	1:17:43	12.6	11.0	-0.2	191.0	0.99	3.5	25.5	0.877	0.092	90.3%
POST 3 SPIKE_002487.LAB	10/4/23	1:17:52	12.6	11.0	-0.1	191.0	0.99	3.4	25.7	0.879	0.093	90.9%

CTS, System Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
POST 3 CTS_002498.LAB	10/4/23	1:20:41	0.4	0.0	0.0	191.0	0.99	95.4	0.4	0.007	99.1%
POST 3 CTS_002499.LAB	10/4/23	1:20:49	0.4	0.0	0.0	191.0	0.99	95.9	0.5	0.013	99.6%
POST 3 CTS_002500.LAB	10/4/23	1:20:57	0.3	0.0	0.0	191.0	0.99	95.8	0.3	0.009	99.5%
POST 3 CTS_002501.LAB	10/4/23	1:21:06	0.2	0.0	0.0	191.0	0.99	95.9	0.3	0.001	99.6%
POST 3 CTS_002502.LAB	10/4/23	1:21:14	0.2	0.0	0.0	191.0	0.99	96.2	0.2	0.003	99.9%
POST 3 CTS_002503.LAB	10/4/23	1:21:22	0.2	0.0	0.0	191.0	0.99	95.8	0.1	0.009	99.6%
POST 3 CTS_002504.LAB	10/4/23	1:21:30	0.1	0.0	0.0	191.0	0.99	96.2	0.2	0.006	99.9%
POST 3 CTS_002505.LAB	10/4/23	1:21:38	0.1	0.0	0.0	191.0	0.99	96.1	0.2	0.011	99.8%

Client: Heidelberg Materials
 Facility: Mitchell, IN
 Project #: M234006
 Operating Condition: >90% Production/Mill Off

Test Location: Kiln 4 Stack
 Date: 10/3/23 to 10/4/23
 Operator: MLIP
 FTIR s/n: 00583

Post Test CTS, Direct Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet	Recovery % Ethylene
POST 3 CTS DIR_002542.LAB	10/4/23	1:33:23	1.5	0.0	0.0	191.0	0.99	94.8	0.1	0.002	98.5%
POST 3 CTS DIR_002543.LAB	10/4/23	1:33:31	1.4	0.0	-0.1	191.0	0.99	95.1	0.2	0.005	98.8%
POST 3 CTS DIR_002544.LAB	10/4/23	1:33:39	1.3	0.0	0.0	191.0	0.99	95.5	0.2	0.000	99.2%
POST 3 CTS DIR_002545.LAB	10/4/23	1:33:47	1.3	0.0	-0.1	190.9	0.99	95.4	0.2	0.004	99.1%
POST 3 CTS DIR_002546.LAB	10/4/23	1:33:56	1.3	0.0	0.0	190.9	0.99	95.6	0.4	0.003	99.3%
POST 3 CTS DIR_002547.LAB	10/4/23	1:34:04	1.2	0.0	0.0	190.9	0.99	95.0	0.2	-0.004	98.7%
POST 3 CTS DIR_002548.LAB	10/4/23	1:34:12	1.2	0.0	0.0	191.0	0.99	95.0	0.4	0.002	98.6%
POST 3 CTS DIR_002549.LAB	10/4/23	1:34:20	1.1	0.0	0.0	191.0	0.99	95.1	0.3	0.005	98.8%
Average								95.2			

Post Test N2, Direct Purge

Spectrum	Date	Time	H2O% %v	CO2 %v wet	HF ppmv wet	FTIR Gas Cell Temperature deg C	FTIR Gas Cell Pressure atm	Ethylene ppmv wet	HCN ppmv wet	SF6 ppmv wet
POST 3 N2_002532.LAB	10/4/23	1:28:32	0.0	0.0	0.0	191.0	0.99	0.0	0.0	0.005
POST 3 N2_002533.LAB	10/4/23	1:29:34	0.0	0.0	0.0	191.0	0.99	-0.1	0.1	-0.001
POST 3 N2_002534.LAB	10/4/23	1:30:37	0.0	0.0	0.0	191.0	0.99	0.0	0.0	0.004

Time	DL summary - zero gas		Time	DL summary - in stack	
	HF ppm (10) 191C	HCN (100) 191C		HF ppm (10) 191C	HCN (100) 191C
12:02:36 PM	-0.01	0.08	1:20:20 PM	-0.06	6.30
12:02:44 PM	0.03	-0.10	1:21:24 PM	-0.07	6.21
12:02:52 PM	-0.01	0.03	1:22:27 PM	-0.07	6.34
12:03:00 PM	0.03	0.02	1:23:31 PM	-0.07	6.05
12:03:09 PM	0.01	-0.04	1:24:35 PM	-0.07	6.33
12:03:17 PM	-0.02	-0.02	1:25:38 PM	-0.08	6.25
12:03:25 PM	-0.03	0.02	1:26:42 PM	-0.08	6.51
Standard Deviation	0.02	0.05	Standard Deviation	0.01	0.13
3x = DL	0.07	0.16	3x = DL	0.02	0.39

Appendix I - Gas Cylinder Certifications

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Part Number:	E03NI80E80A7767	Reference Number:	54-402773937-1
Cylinder Number:	BLM-003080	Cylinder Volume:	87.0 CF
Laboratory:	124 - Chicago (SAP) - IL	Cylinder Pressure:	2214 PSIG
PGVP Number:	B12023	Valve Outlet:	590
Gas Code:	CO2,O2,BALN	Certification Date:	Jun 26, 2023

Expiration Date: Jun 26, 2031

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	10.00 %	9.892 %	G1	+/- 0.7% NIST Traceable	06/26/2023
OXYGEN	10.00 %	10.11 %	G1	+/- 0.5% NIST Traceable	06/26/2023
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	190604-14	6162723Y	11.105 % CARBON DIOXIDE/NITROGEN	+/- 0.6%	Dec 04, 2025
NTRM	8010239	K026333	23.20 % OXYGEN/NITROGEN	+/- 0.4%	Jun 01, 2024

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
CO2-1 HORIBA VIA-510 V1E3H7P5	NDIR	Jun 07, 2023
O2-1 HORIBA VA-5003 YH82Y07B	PARAMAGNETIC	May 30, 2023

Triad Data Available Upon Request



Signature on file

Grade of Product: EPA PROTOCOL STANDARD

Reference Number: 54-402138652-1
Cylinder Volume: 92.2 CF
Cylinder Pressure: 2214 PSIG
Valve Outlet: 590
Certification Date: Jun 24, 2021

Expiration Date: Jun 24, 2029

Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
CARBON DIOXIDE	19.00 %	18.75 %	G1	+/- 0.6% NIST Traceable	06/24/2021
OXYGEN	19.00 %	19.13 %	G1	+/- 0.4% NIST Traceable	06/24/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	060118	K008299	23.04 % CARBON DIOXIDE/NITROGEN	+/- 0.5%	Jun 27, 2022
NTRM	11060614	CC340418	14.93 % OXYGEN/NITROGEN	+/- 0.2%	Dec 13, 2022

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
CO2-1 HORIBA VIA-510 V1E3H7P5	NDIR	Jun 17, 2021
O2-1 HORIBA MPA-510 3VUYL9NR	Paramagnetic	Jun 14, 2021



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CERTIFICATE OF ANALYSIS

Grade of Product: PRIMARY STANDARD

Part Number:	X02NI99P15AD524	Reference Number:	141-402746062-1
Cylinder Number:	EB0158924	Cylinder Volume:	140.0 CF
Laboratory:	124 - Stryker (SAP) - OH	Cylinder Pressure:	2015 PSIG
Analysis Date:	May 17, 2023	Valve Outlet:	350
Lot Number:	141-402746062-1		

Expiration Date: May 17, 2031

Primary Standard Gas Mixtures are traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Req Conc	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE	100.0 PPM	99.99 PPM	+/- 1%
NITROGEN	Balance		



Signature on file



an Air Liquide company

ASSAY LABORATORY

CERTIFICATE OF ACCURACY: *GMACS-c Calibration Standard*

CUSTOMER INFORMATION

AIRGAS SPECIALTY GASES
Exploratory Products Group
6141 Easton Road
Plumsteadville, PA 18949

Work Order #: 160-402841760-1
Sales Order #: 1123601834
PO #: 7100179560

Customer: Mostardi Platt-Elmhurst
Address 1: 888 Industrial Drive
Address 2:
City / State / Zip: Elmhurst, IL 60126

PRODUCT INFORMATION

COMPOSITION	CONCENTRATION	UNCERTAINTY (Abs)	UNCERTAINTY (Rel)
Hydrogen Cyanide	197.7 PPM	5.6 PPM	2.8 %
Sulfur Hexafluoride	10.0 PPM	0.07 PPM	0.7 %
Nitrogen	Balance		

CYLINDER #: CC768272
CYLINDER TYPE: 150A Aluminum
CGA: 350 SS
CYLINDER PRESSURE: 2000 psig

AIRGAS PART #: X03NI99C15AC0Y6
CERTIFICATION DATE: 8-Sep-2023
EXPIRATION DATE: 8-Mar-2024
MIXTURE DEW POINT: N/A

CERTIFICATION DATA

BLENDING PROCESS: GravStat™ Gravimetry

COMPONENT	CONCENTRATION	UNCERTAINTY (Abs)	UNCERTAINTY (Rel)
Hydrogen Cyanide	200.38 PPM	3.0 PPM	1.5 %
Sulfur Hexafluoride	10.04 PPM	0.07 PPM	0.7 %

CONFIRMING ANALYSIS: FTIR Spectroscopy
INSTRUMENT / MODEL: CAI Model 700 FTIR

COMPONENT	CONCENTRATION	UNCERTAINTY (Abs)	UNCERTAINTY (Rel)
Hydrogen Cyanide	195.0 PPM	4.7 PPM	2.4 %

REFERENCE STANDARD: GMPS-c 200 PPM Hydrogen Cyanide

CYLINDER NUMBER: CC768217

EXPIRATION DATE: 2/27/2024

COMPONENT	CONCENTRATION	UNCERTAINTY (Abs)	UNCERTAINTY (Rel)
Hydrogen Cyanide	197.1 PPM	4.8 PPM	2.4 %

CALIBRATION CURVE DATA	Curve Order	Correlation	Slope (X2)	Slope (X)	Intercept
Point-to-Point Matching Std	Linear / Direct Ratio	N/A	N/A	N/A	N/A

INTERLOCK STATISTICS

	CONCENTRATION	UNCERTAINTY (Abs)	UNCERTAINTY (Rel)
BLEND RESULT:	200.38 PPM	3.0 PPM	1.5 %
ANALYSIS RESULT:	195.0 PPM	4.7 PPM	2.4 %
INTERLOCK RESULT:	197.7 PPM	5.6 PPM	2.8 %

COMMENTS / SPECIAL INSTRUCTIONS

1. A GMACS-c ("Candidate GMACS") is made and certified according to the EPA GMACS Procedure (Alt-114) found at: <https://cfpub.epa.gov>
2. Do not use this standard if pressure is less than 200 psig.
3. Do not use or store this product at or below the stated dew point.

APPROVED BY: _____
Project No. M234006A
Kiln 4 Stack

140 of 149B GRASMEDER

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END OF THE REPORT