1.0 EXECUTIVE SUMMARY

MOSTARDI PLATT conducted a Hydrogen Chloride (HCl) compliance emissions test program for the Verso Corporation at the Escanaba Mill on the No. 11 Power Boiler in Escanaba, Michigan on September 29, 2020. This report summarizes the results of the test program and test methods used.

The test location, test date, test parameter, and test methods are summarized below.

TEST INFORMATION			
Test Location	**Test Date**	**Test Parameter**	**Test Methods**
No. 11 Power Boiler	September 29, 2020	Hydrogen Chloride (HCl)	USEPA Methods 26A and 320

The purpose of this test program was to determine hydrogen chloride (HCl) compliance in accordance with the Michigan Department of Environment, Great Lakes and Energy (EGLE) issued Renewable Operating Permit (ROP) Number MI-ROP-A0884-2016 and the emission limits established under 40 CFR 63 Subpart DDDDD – NESHAP for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters listed below:

TEST RESULTS				
Test Location	**Test Parameter**	**Emission Limits**	**Methodology**	**Emission Rate**
No. 11 Power Boiler	HCl	2.2E-02 lb/MMBtu	M26A	7.03E-03 lb/mmBtu
			M320	8.07E-03 lb/mmBtu

Method 320 analysis was also completed at the No. 11 Power Boiler in order to utilize Method 301 and validate M320 as an alternative test method. The Method 301 Summary can be found in Section 3.0 of the report.

Emissions on lb/mmBtu basis were determined using calculated F_d-Factors of 9,682, 9,689, and 9,665 dscf/mmBtu. Plant operating data as provided by Verso Corporation is included in Appendix A.

The Stationary Source Audit Sample Program audit sample was obtained by Mostardi Platt from ERA and analyzed by Mostardi Platt. The results of the audit sample were compared to the assigned value by ERA and found to be acceptable. The audit sample result and evaluation are appended to this report.

The identifications of the individuals associated with the test program are summarized below.

TEST PERSONNEL INFORMATION		
Location	Address	Contact
Test Facility	Verso Corporation Escanaba Mill 1097 N 950 W Escanaba, Michigan 47665-9747	Mr. Adam Becker Environmental Engineer (906) 233-2929 (phone) Adam.Becker@versoco.com
Testing Company Representative	Mostardi Platt 888 Industrial Drive Elmhurst, Illinois 60126	Mr. Richard J. Sollars II Senior Project Manager (630) 993-2100 (phone) rsollars@mp-mail.com

The test crew consisted of Messrs. N. Colangelo, R. Simon, J. Kukla, W. Petrovich, M. Sather, M. Friduss and R. Sollars of Mostardi Platt.

Ms. Lindsey Wells and Ms. Sydney Bruestle of EGLE were on site to observe testing.

2.0 TEST METHODOLOGY

Emissions testing was conducted following the methods specified in 40CFR60, Appendix A. A schematic of the test section diagram is found in Appendix B and schematics of the sampling trains used are included in Appendix C. Calculation nomenclature and sample calculations are included in Appendix D. Laboratory analysis data are found in Appendix E. Copies of analyzer print-outs for each test run are included in Appendix F and field data sheets are found in Appendix G.

The following methodologies were used during the test program:

Method 1 Traverse Point Determination
Test measurement points were selected in accordance with Method 1. The characteristics of the measurement locations are summarized below.

TEST POINT INFORMATION				
Location	Upstream Diameters	Downstream Diameters	Test Parameter	Number of Sampling Points
No. 11 Power Boiler	>2.0	>8.0	HCl	12 (26A) /1 (320)

Method 2 Volumetric Flowrate Determination
Gas velocity was measured following Method 2, for purposes of calculating stack gas volumetric flow rate and HCl emission rates. An S-type pitot tube, differential pressure gauge, thermocouple and temperature readout were used to determine gas velocity at each sample point. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

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

An ECOM analyzer was used to determine O_2 and CO_2 concentrations in the stack gas. Samples were taken from the exhaust of the dry gas meter of the USEPA Method 26A sample train. Linearity calibrations were performed prior to sampling, and mid-range and zero calibration checks were performed after each test run. Final O_2 and CO_2 concentrations were corrected for calibration error of the instrument. The instrument has a nondispersive infrared-based detector and operates in a range of 0-21% for O_2 and 0-20% for CO_2. Calibration data is presented in the Appendix H and copies of the gas cylinder certifications are found in Appendix I.

Method 26A Hydrogen Chloride (HCl) Determination

Stack gas HCl concentrations and emission rates were determined in accordance with Method 26A, 40CFR60, Appendix A. An Environmental Supply Company, Inc. sampling train was used to sample stack gas at an isokinetic rate. Five impingers were utilized. The first two impingers each contained 100 mL of 0.1N sulfuric acid (H_2SO_4), the following two impingers each contained 100 mL of sodium hydroxide (NaOH), and the final impinger contained approximately 200 grams of silica gel. The impingers were weighed prior to and after each test run in order to determine moisture content of the stack gas. The total sample time for each run was 60 minutes, with twelve sample points being utilized (3 points per port, 4 total ports).

After gravimetric weighing of the impinger train, samples were recovered by transferring the dilute H_2SO_4 and NaOH solutions into separate sample containers and performing deionized water washes on the impingers. Samples were analyzed by Mostardi Platt on-site, along with an audit sample. Sample analysis data are found in Appendix E. All of the equipment used was calibrated in accordance with the specifications of the Method. Calibration data are presented in Appendix H.

Method 301 Field Validation of Pollutant Measurement Methods from Various Waste Media

Method 301 includes minimum procedures to determine and document systematic error (bias) and random error (precision) of measured concentrations from exhaust gases, wastewater, sludge, and other media. It contains procedures for ensuring sample stability if such procedures are not included in the test method. This method also includes optional procedures for ruggedness and detection limits. The method is used to validate an alternative test method to meet requirements under 40CFR63. The Method 301 summary table can be found in Section 3.0 of this document.

Method 320 Fourier Transform Infrared (FTIR) Detector Multi-Gas Determination

FTIR data was collected using an MKS MultiGas 2030 FTIR spectrometer.

The FTIR was equipped with a temperature-controlled, 5.11 meter multi-pass gas cell maintained at 191°C. Gas flows and sampling system pressures were monitored using a rotameter and pressure transducer. All data was collected at 0.5 cm⁻¹ resolution. Each spectrum was derived from the coaddition of 64 scans, with a new data point generated approximately every one minute. Analyzer data for each run is present is Appendix F.

SAMPLING SYSTEM PARAMETERS				
MKS Serial #	**Sampling Line**	**Probe Assembly**	**Particulate Filter Media**	**Operating Temperatures**
019088195	100' 3/8" dia., heated Teflon	Heated 6', 3/8" dia. SS	0.01µ heated borosilicate glass fiber	191°C

QA/QC procedures followed US EPA Method 320. See below for QA/QC procedure details and list of calibration gas standards. All calibration gases were introduced to the analyzer and the sampling system using an instrument grade stainless steel rotameter. All QA/QC procedures were within the acceptance criteria allowance of the applicable EPA methodology. See Appendix H for FTIR QA/QC Data.

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

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

CALIBRATION GAS STANDARDS				
Components	**Concentration (ppm)**	**Vendor**	**Cylinder #**	**Standard Type**
Ethylene	100.0	Airgas	CC240155	Primary +/- 1%
HCl/SF6	99.76/5.169	Airgas	CC513810	Certified Standard-Spec +/- 5%
Nitrogen	zero gas	Airgas	N/A	UHP Grade

Analyte Spiking

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

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

The following equation illustrates the percent recovery calculation.

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

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

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

Post Collection Data Validation

As part of the data validation procedure, reference spectra are manually fit to that of the sample spectra and a concentration is determined. The reference spectra are scaled to match the peak amplitude of the sample, thus providing a scale factor. The scale factor multiplied by the reference spectra concentration is used to determine the concentration value for the sample spectra. Sample pressure and temperature corrections are then applied to compute the final sample concentration. The manually calculated results are then compared with the software-generated results. The data is then validated if the two concentrations are within ± 20% agreement. If there is a difference greater than ± 20% the spectra are reviewed for possible spectra interferences or any other possible causes leading to incorrectly quantified data.

Detection Limit

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

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

QA/QC data are found in Appendix H. Copies of gas cylinder certifications are found in Appendix I. All concentration data were recorded on a wet, volume basis. The FTIR measured carbon dioxide concentration to calculate HCl on a lb/mmBtu basis. HCl spiking was performed prior to testing to confirm the measurement system's ability to deliver and quantify HCl. The sample and data collection followed the procedures outlined in Method 320.

3.0 TEST RESULT SUMMARY

Client: Verso Corporation
Facility: Escanaba Mill
Test Location: No. 11 Power Boiler Stack
Test Method: 26A

	Source Condition	Normal	Normal	Normal	
	Date	9/29/20	9/29/20	9/29/20	
	Start Time	9:40	12:20	14:00	
	End Time	11:01	13:36	15:50	
		Run 1	Run 2	Run 3	Average
Stack Conditions					
Average Gas Temperature, °F		385.8	379.9	390.3	385.3
Flue Gas Moisture, percent by volume		14.5%	13.0%	15.9%	14.5%
Average Flue Pressure, in. Hg		28.83	28.83	28.83	28.83
Gas Sample Volume, dscf		51.996	54.515	61.343	55.951
Average Gas Velocity, ft/sec		26.934	27.895	31.759	28.863
Gas Volumetric Flow Rate, acfm		248,771	257,643	293,335	266,583
Gas Volumetric Flow Rate, dscfm		127,935	135,772	147,648	137,118
Gas Volumetric Flow Rate, scfm		149,641	156,054	175,514	160,403
Average %CO_2 by volume, dry basis		11.5	9.5	12.1	11.0
Average %O_2 by volume, dry basis		8.4	10.5	8.1	9.0
Isokinetic Variance		103.0	101.7	105.3	103.3
Calculated Fuel Factor Fd, dscf/mmBtu		9,682.0	9,689.0	9,665.0	9,678.7
Hydrogen Chloride (HCl) Emissions					
ug of sample collected		7383.34	11737.55	12048.98	10389.96
ppm		3.31	5.01	4.57	4.30
mg/dscm		5.01	7.60	6.94	6.52
lb/hr		2.4030	3.8668	3.8361	3.3686
lb/mmBtu (Calculated Fd Factor)		5.10E-03	9.20E-03	6.80E-03	7.03E-03

Client: Verson Corporation
Facility: Escanaba Mill
Test Location: No. 11 Power Boiler Stack
Test Methods: 3A, 320

Source Condition	Normal	Normal	Normal	
Date	9/29/20	9/29/20	9/29/20	
Start Time	9:40	12:20	14:00	
End Time	10:39	13:19	14:59	
	Run 1	Run 2	Run 3	Average
Stack Conditions				
Average Gas Temperature, °F	385.8	379.9	390.3	385.3
Flue Gas Moisture, percent by volume	13.8	13.3	16.1	14.4
Average Flue Pressure, in. Hg	28.83	28.83	28.83	28.83
Average Gas Velocity, ft/sec	26.934	27.895	31.759	28.863
Gas Volumetric Flow Rate, acfm	248,771	257,643	293,335	266,583
Gas Volumetric Flow Rate, dscfm	127,935	135,772	147,648	137,118
Gas Volumetric Flow Rate, scfm	149,641	156,054	175,514	160,403
Average %CO_2 by volume, wet basis	11.5	9.5	12.1	11.0
Average %O_2 by volume, dry basis	8.4	10.5	8.1	9.0
Calculated Fuel Factor Fd, dscf/mmBtu	9,682.0	9,689.0	9,665.0	9,678.7
Hydrogen Chloride (HCl) Emissions				
ppmv	3.9	4.5	4.3	4.2
ppmvd	4.6	5.2	5.1	5.0
lb/hr	3.35	4.00	4.27	3.87
lb/mmBtu (Calculated Fd Factor)	7.01E-03	9.59E-03	7.62E-03	8.07E-03

Client: Verso Corporation	Location: No. 11 Power Boiler
Facility: Escanaba Mill	Date: 9/29/20
Project #: M204004	Test Method: 26A, 320
Fuel Type: Coal/Bark	

HCl lb/mmbtu Method 301 camparison

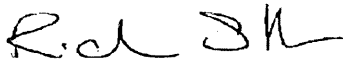| 1=accept 0=reject	Test Run	Test Date	Start Time	End Time	M26A HCl lb/MMBtu	M320 HCl lb/MMBtu	(M26A-M320) Difference (di)	(M26A-M320) Difference^2 (di^2)
1	1	09/29/20	09:40	11:01	0.0051	0.0070	-0.0019	0.00000361
1	2	09/29/20	12:20	13:36	0.0092	0.0096	-0.0004	0.00000016
1	3	09/29/20	14:00	15:50	0.0068	0.0076	-0.0008	0.00000064
				n	3			
				t critical	3.182			
				t calculated	2.245			
			Mean Method 26A Value		0.0070			
			Mean Method 320 Value		0.0081			
			Sum of Differences		-0.0031	di		
			Mean Difference		-0.0010	d		
			Sum of Differences Squared		0.000004	di^2		
			Standard Deviation		0.000777	sd		
			Relative Bias		14.8927	B$_R$		

4.0 CERTIFICATION

MOSTARDI PLATT is pleased to have been of service to Verso Corporation. If you have any questions regarding this test report, please do not hesitate to contact us at 630-993-2100.
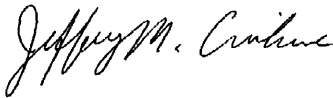
CERTIFICATION

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

_____ Project Supervisor
Richard J. Sollars II

_____ Quality Assurance
Jeffrey M. Crivlare