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Source Test Report

General Shale Brick, Inc. (Plant 66)
DBA Michigan Brick
3820 Serr Rd
Corunna, MI 48817

Source Tested: Kiln 1 DIFF
Test Date: May 9, 2023

Project No. AST-2023-1147

Prepared By
Alliance Technical Group, LLC
20 Parkway View Drive
Pittsburgh, PA 15205

AL6497-test-20230509

Regulatory Information

Permit No. EGLE Permit No. MI-ROP-A6497-2022a

Source Information

Source Name	Source ID	Target Parameters
Brick Tunnel Kiln	EUKILN01	PM, SO ₂ , HCl, HF, Cl ₂ , Non-Hg HAP Metals & Hg

Contact Information

Test Location	Test Company	Analytical Laboratories
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Alliance Technical Group, LLC (Alliance) has completed the source testing as described in this report. Results apply only to the source(s) tested and operating condition(s) for the specific test date(s) and time(s) identified within this report. All results are intended to be considered in their entirety, and Alliance is not responsible for use of less than the complete test report without written consent. This report shall not be reproduced in full or in part without written approval from the customer.

To the best of my knowledge and abilities, all information, facts and test data are correct. Data presented in this report has been checked for completeness and is accurate, error-free and legible. Onsite testing was conducted in accordance with approved internal Standard Operating Procedures. Any deviations or problems are detailed in the relevant sections in the test report.

This report is only considered valid once an authorized representative of Alliance has signed in the space provided below; any other version is considered draft. This document was prepared in portable document format (.pdf) and contains pages as identified in the bottom footer of this document.



Adam Robinson, QSTI
Alliance Technical Group, LLC

6/22/2023

Date

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Introduction

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1.0 Introduction

Alliance Technical Group, LLC (Alliance) was retained by General Shale Brick, Inc. (General Shale) to conduct compliance testing at the Corunna, Michigan facility. The facility operates under Michigan Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division (AQD) Permit No. MI-ROP-A6497-2022a. Testing was conducted to determine the emission rates of particulate matter (PM), hydrogen chloride (HCl), hydrogen fluoride (HF), chlorine (Cl₂), sulfur dioxide (SO₂), mercury (Hg), and non-Hg metal hazardous air pollutants (HAPS) at the exhaust of Kiln #1 Dry Injection Fabric Filter (DIFF) (EUKILN01). These non-Hg metal HAPS included antimony (Sb), arsenic (As), beryllium (Be), cadmium (Cd), chromium (Cr), cobalt (Co), lead (Pb), manganese (Mn), nickel (Ni), mercury (Hg) and selenium (Se).

1.1 Source and Control System Descriptions

General Shale owns two (2) natural gas fired brick tunnel kilns with associated dryers, lime injection systems and two (2) fabric filter collectors. One (1) kiln is permanently shut down.

1.2 Project Team

Personnel involved in this project are identified in the following table.

Table 1-1: Project Team

Facility Personnel	Bill Stevens – General Shale Jerry Greger – General Shale
Regulatory Personnel	Andrew Riley – EGLE Michelle Luplow – EGLE
Alliance Personnel	Kenji Kinoshita Dennis Haynes Lucas Kovach

1.3 Site Specific Test Plan & Notification

Testing was conducted in accordance with the Site-Specific Test Plan (SSTP) submitted to EGLE on March 15, 2023, and approved on April 28, 2023.

Summary of Results

2.0 Summary of Results

Alliance conducted compliance testing at the General Shale facility in Corunna, Michigan on May 9, 2023. Testing consisted of determining the emission rates of PM, HCl, HF, Cl₂, SO₂, Hg, and non-Hg metal hazardous air pollutants (HAPS) at the exhaust of EUKILN01.

Table 2-1 provides a summary of the emission testing results with comparisons to the applicable EGLE permit limits. Any difference between the summary results listed in the following table and the detailed results contained in appendices is due to rounding for presentation.

Table 2-1: Summary of Results

Run Number	Run 1	Run 2	Run 3	Average
Date	5/9/23	5/9/23	5/9/23	--
Particulate Matter Data				
Concentration, grain/dscf @ 17% O ₂	0.023	0.018	0.011	0.017
Concentration, mg/dscm @ 7% O ₂	184.8	147.7	86.3	139.6
Emission Rate, lb/hr	3.1	2.5	1.5	2.4
Emission Factor, lb/ton fired product	0.31	0.25	0.16	0.24
Emission Factor, lb/1,000 lb exhaust gas	0.034	0.027	0.017	0.026
Permit Limit, lb/1,000 lb exhaust gas	--	--	--	0.1
Percent of Limit, %	--	--	--	26
Mercury Data				
Concentration, ug/dscm @ 17% O ₂	9.1	10.4	10.7	10.1
Emission Rate, lb/hr	5.4E-04	6.3E-04	6.8E-04	6.2E-04
Emission Factor, lb/ton fired product	5.4E-05	6.4E-05	6.9E-05	6.2E-05
Total Non-Hg Metal HAPS Data ^{1,2}				
Concentration, ug/dscm	107.5	92.3	79.0	92.9
Emission Rate, lb/hr	8.3E-03	7.0E-03	6.2E-03	7.2E-03
Emission Factor, lb/ton fired product	8.4E-04	7.1E-04	6.2E-04	7.2E-04
Hydrogen Chloride-Equivalent Data				
HCl Emission Rate, lb/hr	0.64	0.60	0.67	0.64
Cl ₂ Emission Rate, lb/hr	0.011	0.013	0.0080	0.011
HF Emission Rate, lb/hr	4.4	3.2	3.4	3.7
HCl-Equivalent Emission Rate, lb/hr	8.4	6.9	6.6	7.3
Sulfur Dioxide Data				
Emission Rate, lb/hr	123.7	123.2	126.0	124.3
Permit Limit, lb/hr	--	--	--	241
Percent of Limit, %	--	--	--	52
Emission Rate, ton/yr	541.9	539.5	551.9	544.4
Permit Limit, ton/yr	--	--	--	650
Percent of Limit, %	--	--	--	84

¹ The laboratory results for beryllium for all runs were below the detection limit. The detection limit was used for emission calculation purposes.

² The total selected metals included Sb, As, Be, Cd, Cr, Co, Pb, Mn, Ni and Se.

Testing Methodology

3.0 Testing Methodology

The emission testing program was conducted in accordance with the test methods listed in Table 3-1. Method descriptions are provided below while quality assurance/quality control data is provided in Appendix D.

Table 3-1: Source Testing Methodology

Parameter	U.S. EPA Reference Test Methods	Notes/Remarks
Volumetric Flow Rate	1 & 2	Full Velocity Traverses
Oxygen/Carbon Dioxide	3A	Instrumental Analysis
Moisture Content	4	Volumetric / Gravimetric Analysis
Particulate Matter/Metals	5/29	Isokinetic Sampling
Sulfur Dioxide	6C	Instrumental Analysis
Hydrogen Chloride/Hydrogen Fluoride/Chlorine	26	Constant Rate / Full Size Impingers
Gas Dilution System Certification	205	--

3.1 U.S. EPA Reference Test Methods 1 and 2 – Volumetric Flow Rate

The sampling location and number of traverse (sampling) points were selected in accordance with U.S. EPA Reference Test Method 1. To determine the minimum number of traverse points, the upstream and downstream distances were equated into equivalent diameters and compared to Figure 1-1 in U.S. EPA Reference Test Method 1.

Full velocity traverses were conducted in accordance with U.S. EPA Reference Test Method 2 to determine the average stack gas velocity pressure, static pressure and temperature. The velocity and static pressure measurement system consisted of a pitot tube and inclined manometer. The stack gas temperature was measured with a K-type thermocouple and pyrometer.

Stack gas velocity pressure and temperature readings were recorded during each test run. The data collected was utilized to calculate the volumetric flow rate in accordance with U.S. EPA Reference Test Method 2.

3.2 U.S. EPA Reference Test Method 3A – Oxygen/Carbon Dioxide

The oxygen (O₂) and carbon dioxide (CO₂) testing was conducted in accordance with U.S. EPA Reference Test Method 3A. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, Teflon sample line(s), gas conditioning system and the identified gas analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the stack gas. If an unheated Teflon sample line was used, then a portable non-contact condenser was placed in the system directly after the probe. Otherwise, a heated Teflon sample line was used. The quality control measures are described in Section 3.8.

3.3 U.S. EPA Reference Test Method 4 – Moisture Content

The stack gas moisture content (BWS) was determined in accordance with U.S. EPA Reference Test Method 4. The gas conditioning train consisted of a series of chilled impingers. Prior to testing, each impinger was filled with a known quantity of water or silica gel. Each impinger was analyzed gravimetrically before and after each test run on the same balance to determine the amount of moisture condensed.

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3.4 U.S. EPA Reference Test Method 5/29 – Particulate Matter

The particulate matter and metals testing was conducted in accordance with U.S. EPA Reference Test Methods 5 and 29. The complete sampling system consisted of a glass nozzle, glass-lined probe, pre-weighed and pre-cleaned heated quartz filter, gas conditioning system, pump and calibrated dry gas meter. The gas conditioning train consisted of six (6) chilled impingers. The first and second impingers contained 100 mL of HNO₃/H₂O₂, the third was empty, the fourth and fifth contained 100 mL of acidic KMnO₄, and the sixth contained 200-300 grams of silica gel. The probe liner and filter heating systems were maintained at a temperature of 120 ± 14°C (248 ± 25°F), and the impinger temperature was maintained at 20°C (68°F) or less throughout testing. Prior to testing, all glassware was cleaned and sealed in a controlled environment as outlined in the test method.

Following the completion of each test run, the sample train was leak checked at a vacuum pressure equal to or greater than the highest vacuum pressure observed during the run and the contents of the impingers were measured for moisture gain. The quartz filter was carefully removed and placed into container 1. The probe and nozzle were rinsed and brushed three (3) times with acetone using a non-metallic brush and these rinses were placed in container 2. The front half of the filter holder was rinsed three (3) times with acetone and these rinses were added to container 2. The probe, nozzle and front half of the filter holder were then triple-rinsed with 0.1 N HNO₃. This rinse was recovered in container 3. The contents of impingers 1, 2, and 3 were placed in container 4. Impingers 1, 2 and 3 along with the filter support, back half of the filter holder and all connecting glassware were triple-rinsed with 0.1 N HNO₃ and these rinses were added to container 4. The contents of impinger 4 were placed in container 5A. The impinger and connecting glassware were triple-rinsed with 0.1 N HNO₃ and these rinses were added to container 5A. The contents of impingers 5 and 6 were placed in container 5B. The impingers and all connecting glassware were triple-rinsed with acidified KMnO₄ and then with de-ionized (DI) water and these rinses were added to container 5B. Impingers 5 and 6 were rinsed again with 25 mL of 8N HCl and this rinse was collected into container 5C, which contained 200 mL of DI water. All containers were sealed, labeled and liquid levels marked for transport to the identified laboratory for analysis.

3.5 U.S. EPA Reference Test Method 6C – Sulfur Dioxide

The sulfur dioxide (SO₂) testing was conducted in accordance with U.S. EPA Reference Test Method 6C. Data was collected online and reported in one-minute averages. The sampling system consisted of a heated stainless steel probe, Teflon sample line(s), gas conditioning system and the identified analyzer. The gas conditioning system was a non-contact condenser used to remove moisture from the source gas. If an unheated Teflon sample line was used, then a portable non-contact condenser was placed in the system directly after the probe. Otherwise, a heated Teflon sample line was used. The quality control measures are described in Section 3.8.

3.6 U.S. EPA Reference Test Method 26– HCl, HF, Cl₂

The HCl, HF, Cl₂ testing was conducted in accordance with EPA Reference Test Method 26. The complete sampling system consisted of a glass nozzle, heated glass-lined probe, heated Teflon filter, gas conditioning train, pump and calibrated dry gas meter. The gas conditioning train consisted of five (5) chilled impingers. The first and second impingers contained 100 mL of 0.1 N H₂SO₄, the third and fourth impingers contained 100 mL of 0.1 N NaOH and the fifth impinger contained 200-300 grams of silica gel. The probe liner and filter heating systems were maintained at 248-273°F, and the impinger temperature was maintained at 20°C (68°F) or less throughout the testing.

Following the completion of each test run, the sampling train was leak checked at a vacuum pressure greater than or equal to the highest vacuum pressure observed during the run and the contents of the impingers were measured for moisture gain. The absorbing solution (0.1 N H₂SO₄) from the first and second impingers and absorbing solution

(0.1 N NaOH) from the third and fourth impingers were placed into separate sample containers (container 3 and container 4). The back-half of the filter holder, first and second impingers and all glassware leading to the outlet of the second impinger were triple-rinsed with DI water. These rinses were placed in container 3. The third and fourth impingers and all associated glassware were triple-rinsed with DI water. These rinses were recovered in container 4. All containers were sealed, labeled and liquid levels marked for transport to the identified laboratory for analysis.

3.7 U.S. EPA Reference Test Method 205 – Gas Dilution System Certification

A calibration gas dilution system field check was conducted in accordance with U.S. EPA Reference Method 205. Multiple dilution rates and total gas flow rates were utilized to force the dilution system to perform two dilutions on each mass flow controller. The diluted calibration gases were sent directly to the analyzer, and the analyzer response recorded in an electronic field data sheet. The analyzer response agreed within 2% of the actual diluted gas concentration. A second Protocol 1 calibration gas, with a cylinder concentration within 10% of one of the gas divider settings described above, was introduced directly to the analyzer, and the analyzer response recorded in an electronic field data sheet. The cylinder concentration and the analyzer response agreed within 2%. These steps were repeated three (3) times. Copies of the Method 205 data can be found in the Quality Assurance/Quality Control Appendix.

3.8 Quality Assurance/Quality Control – U.S. EPA Reference Test Methods 3A and 6C

Cylinder calibration gases used met EPA Protocol 1 (+/- 2%) standards. Copies of all calibration gas certificates can be found in the Quality Assurance/Quality Control Appendix.

Low Level gas was introduced directly to the analyzer. After adjusting the analyzer to the Low-Level gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated for the High-Level gas. For the Calibration Error Test, Low, Mid, and High Level calibration gases were sequentially introduced directly to the analyzer. All values were within 2.0 percent of the Calibration Span or 0.5 ppmv/% absolute difference.

High or Mid Level gas (whichever was closer to the stack gas concentration) was introduced at the probe and the time required for the analyzer reading to reach 95 percent or 0.5 ppmv/% (whichever was less restrictive) of the gas concentration was recorded. The analyzer reading was observed until it reached a stable value, and this value was recorded. Next, Low Level gas was introduced at the probe and the time required for the analyzer reading to decrease to a value within 5.0 percent or 0.5 ppmv/% (whichever was less restrictive) was recorded. If the Low-Level gas was zero gas, the response was 0.5 ppmv/% or 5.0 percent of the upscale gas concentration (whichever was less restrictive). The analyzer reading was observed until it reached a stable value and this value was recorded. The measurement system response time and initial system bias were determined from these data. The System Bias was within 5.0 percent of the Calibration Span or 0.5 ppmv/% absolute difference.

High or Mid Level gas (whichever was closer to the stack gas concentration) was introduced at the probe. After the analyzer response was stable, the value was recorded. Next, Low Level gas was introduced at the probe, and the analyzer value recorded once it reached a stable response. The System Bias was within 5.0 percent of the Calibration Span or 0.5 ppmv/% absolute difference or the data was invalidated and the Calibration Error Test and System Bias were repeated.

Drift between pre- and post-run System Bias was within 3 percent of the Calibration Span or 0.5 ppmv/% absolute difference. If the drift exceeded 3 percent or 0.5 ppmv/%, the Calibration Error Test and System Bias were repeated.

To determine the number of sampling points, a gas stratification check was conducted prior to initiating testing. The pollutant concentrations were measured at three points (16.7, 50.0 and 83.3 percent of the measurement line). Each traverse point was sampled for a minimum of twice the system response time.

If the pollutant concentration at each traverse point did not differ more than 5 percent or 0.5 ppmv/0.3% (whichever was less restrictive) of the average pollutant concentration, then single point sampling was conducted during the test runs. If the pollutant concentration did not meet these specifications but differed less than 10 percent or 1.0 ppmv/0.5% from the average concentration, then three (3) point sampling was conducted (stacks less than 7.8 feet in diameter - 16.7, 50.0 and 83.3 percent of the measurement line; stacks greater than 7.8 feet in diameter – 0.4, 1.0, and 2.0 meters from the stack wall). If the pollutant concentration differed by more than 10 percent or 1.0 ppmv/0.5% from the average concentration, then sampling was conducted at a minimum of twelve (12) traverse points. Copies of stratification check data can be found in the Quality Assurance/Quality Control Appendix.

A Data Acquisition System with battery backup was used to record the instrument response in one (1) minute averages. The data was continuously stored as a *.CSV file in Excel format on the hard drive of a computer. At the completion of testing, the data was also saved to the Alliance server. All data was reviewed by the Field Team Leader before leaving the facility. Once arriving at Alliance's office, all written and electronic data was relinquished to the report coordinator and then a final review was performed by the Project Manager.