



Source Test Report

Michigan Foam Products, LLC
1820 Chicago Drive SW
Grand Rapids, Michigan 49519
For
Nestec, Inc.

Source Tested: Regenerative Thermal Oxidizer
Test Date: March 27, 2024

Project No. AST-2024-1311

Prepared By
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3000 Little Hills Expressway, Suite 102
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Regulatory Information

Permit No. Permit to Install (PTI) 211-02F

Source Information

Source Name

RTO

Target Parameters

THC (as Pentane), NMHC (as Pentane),
RE

Contact Information

Test Location

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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.



Nichoals Pichee, QSTI
Alliance Technical Group, LLC

August 28, 2024

Date

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Introduction

1.0 Introduction

Alliance Technical Group, LLC (Alliance) was retained by Michigan Foam Products, Inc. (MFP) to conduct compliance testing at the Grand Rapids, Michigan facility. MFP operates a one batch-type resin pre-expander (EUPLASTICRESIN) system for the manufacturing of foam products. Testing was conducted to determine the destruction efficiency (DE) of the regenerative thermal oxidizer (RTO) as required by the facility's State of Michigan Department of Environment, Great Lakes and Energy (EGLE) Permit to Install (PTI) 211-02F.

1.1 Facility Description

Michigan Foam operates EUPLASTICRESIN which is a Preex 9000 vacutrans batch-type resin pre-expander and other associated operations to produce expanded polystyrene (EPS) foam. The pre-expander is controlled by a regenerative thermal oxidizer (RTO). The pre-expander does not release emissions continuously, but rather intermittently as EPS blocks are processed and stream is released from the pre-expander chamber.

1.2 Project Team

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

Table 1-1: Project Team

| | |
|---|--|
| Facility Personnel | Jeff Meyer – President |
| Michigan Department EGLE Personnel | Jeremy Howe Trevor Drost Clayton DeRonne April Lazaro |
| Alliance Personnel | Chris Gray Ezzie Boyd Carl Bender |

1.3 Site Specific Test Plan & Notification

Testing was conducted in accordance with the Site Specific Test Plan (SSTP) submitted to EGLE.

Summary of Results

2.0 Summary of Results

Alliance conducted compliance testing at the MFP facility in Grand Rapids, MI on March 27, 2024. Testing consisted of determining the destruction efficiency (DE) of the regenerative thermal oxidizer (RTO).

Table 2-1 provides a summary of the emission testing results with comparisons to the applicable Michigan Department of 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 | 3/27/24 | 3/27/24 | 3/27/24 | -- |
| Non-Methane Hydrocarbon (as Pentane) Data | | | | |
| Emission Rate, lb/hr | 0.53 | 0.44 | 0.49 | 0.49 |
| Permit Limit, lb/hr | -- | -- | -- | 1.13 |
| Percent of Limit, % | -- | -- | -- | 43 |
| Reduction Efficiency Data | | | | |
| THCi (as Pentane) Emission Rate, lb/hr | 3.9 | 5.5 | 4.5 | 4.6 |
| NMHC (as Pentane) Emission Rate, lb/hr | 0.53 | 0.44 | 0.49 | 0.49 |
| Reduction Efficiency, HC (as Pentane), % | 86.5 | 91.9 | 89.1 | 89.2 |
| Permit Limit, % | -- | -- | -- | ≥ 98 |

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 | Gravimetric Analysis |
| Total Hydrocarbons | 25A | Instrumental Analysis |
| Non-Methane Hydrocarbons | ALT-096 | Instrumental Analysis |
| Gas Dilution System Certification | 205 | -- |

3.1 U.S. EPA Reference Test Methods 1 and 2 – Sampling/Traverse Points and Volumetric Flow Rate

The sampling location and number of traverse (sampling) points at the outlet location 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 (for isokinetic sampling) and/or Figure 1-2 (measuring velocity alone) in U.S. EPA Reference Test Method 1.

Full velocity traverses were conducted at the outlet location 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.

Volumetric flow exiting the pre-expander was calculated based on the interior volume of the sealed chamber and the pressure and temperature of the steam within the chamber prior to each steam release.

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 3.7.

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.

3.4 U.S. EPA Reference Test Method 25A –Total Hydrocarbons

Total Hydrocarbon at the inlet (THCi) testing was conducted in accordance with U.S. EPA Reference Test Method 25A. Data was collected online and reported in one-minute averages. The sampling system consisted of a stainless-steel probe, heated Teflon sample line(s) and the identified gas analyzer. The quality control measures are described in Section 3.8.

3.5 U.S. EPA Alternative Test Method ALT-096– Non-Methane Hydrocarbons

The non-methane hydrocarbons (NMHC) testing was conducted in accordance with U.S. EPA Alternate Test Method ALT-096. EPA Method 25A is incorporated by reference. The sampling system consisted of a stainless steel probe, heated Teflon sample line(s) and the Thermo 55i analyzer. The quality control measures are described in Section 3.9.

3.6 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.

3.7 Quality Assurance/Quality Control – U.S. EPA Reference Test Method 3A

EPA Protocol 1 Calibration Gases

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.

Direct Calibration & Calibration Error Test

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% absolute difference.

System Bias and Response Time

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% (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% (whichever was less restrictive) was recorded. If the Low-Level gas was zero gas, the response was 0.5% 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% absolute difference.

Post Test System Bias Checks

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% absolute difference or the data was invalidated and the Calibration Error Test and System Bias were repeated.

Post Test Drift Checks

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

Stratification Check

To determine the number of sampling points, a gas stratification check was conducted prior to initiating testing. The pollutant concentrations were measured at twelve traverse points (as described in Method 1). Each traverse point was sampled for a minimum of twice the system response time.

If the diluent concentration at each traverse point did not differ more than 5 percent or 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 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 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.

Data Collection

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.

3.8 Quality Assurance/Quality Control – U.S. EPA Reference Test Method 25A

EPA Protocol 1 Calibration Gases

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.

Calibration Error Test and Response Time

Within two (2) hours prior to testing, zero gas was introduced through the sampling system to the analyzer. After adjusting the analyzer to the Zero gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated for the High-Level gas, and the time required for the analyzer reading to reach 95 percent of the gas concentration was recorded to determine the response time. Next, Low and Mid-Level gases were introduced through the sampling system to the analyzer, and the response was recorded when it was stable. All values were less than +/- 5 percent of the calibration gas concentrations.

Post Test Drift Checks

Mid-Level gas was introduced through the sampling system. After the analyzer response was stable, the value was recorded. Next, Zero gas was introduced through the sampling system, and the analyzer value recorded once it reached a stable response. The Analyzer Drift was less than +/- 3 percent of the span value.

Data Collection

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.

3.9 Quality Assurance/Quality Control – U.S. EPA Reference Method ALT-096

EPA Protocol 1 Calibration Gases – Cylinder calibration gases used met EPA Protocol 1 (+/- 2%) standards. Copies of all calibration gas certificates are provided in the Quality Assurance/Quality Control Appendix.

Zero gas was introduced through the sampling system to the analyzer. After adjusting the analyzer to the Zero gas concentration and once the analyzer reading was stable, the analyzer value was recorded. This process was repeated for the High Level gas, and the time required for the analyzer reading to reach 95 percent of the gas concentration was recorded to determine the response time. Next, Mid and Low Level gases were introduced through the sampling system to the analyzer, and the response was recorded when it is stable. All values must be within +/- 5% of the calibration gas concentrations.

ALT-096: A separation efficiency check was performed using a certified (+/- 2%) blend of methane, ethane, acetylene, and propane in nitrogen. The recorded residual value must be within 5% of the predicted cylinder concentration.

Post Test Drift Checks – Mid Level gas were introduced through the sampling system. After the analyzer response was stable, the value was recorded. Next, Zero gas was introduced through the sampling system, and the analyzer value recorded once it reached a stable response. The Analyzer Drift must be less than 3 percent of the Calibration Span.

Data Collection – A Data Acquisition System with battery backup was used to record the instrument response (analog 0-10 volt signal) in one (1) minute averages. The data was continuously stored as a *.CSV file in Excel format on the hard drive of a desktop computer. At the completion of the emissions testing the data was also saved to disk.