# MI-ROP-B4942
# Renewable Operating Permit (ROP) Test Report

Corteva Agriscience ™

305 North Huron Avenue

Harbor Beach, Michigan 48441

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# 1.0 Introduction

Corteva Agriscience™ (Corteva) owns and operates the Dow AgroSciences facility in Harbor Beach, Michigan. Corteva conducted performance testing at this facility the week of October 21-25, 2019. The testing was performed to demonstrate ongoing compliance with the Pesticide Active Ingredient (PAI) MACT (40CFR63, Subpart MMM) emission standards. To comply with this standard, organic hazardous air pollutant (OHAP) emissions were maintained below 20 ppmv OHAP using catalytic incineration and thermal oxidation as controls. Measurements were also collected to assess compliance with Renewable Operating Permit (ROP) State Registration Number (SRN) B4942 for EU_PROCESS emission limits and to support emission factors used to develop emission estimates used in Michigan Air Emission Reporting System (MAERS) and EPCRA TRI reporting.

EU_PROCESS process vent emissions are collected in a common header and routed to one of five thermal treatment units (TTUs). Four of the TTUs are catalytic thermal treatment units (TTUs). These catalytic TTUs are designated TTU-850, TTU-855, TTU-860, and TTU-865. The remaining TTU is a regenerative thermal oxidizer (RTO). This unit is designated TTU-870.

In addition, the EU_PROCESS enclosed flare was tested to demonstrate compliance with PAI MACT requirements (see Section 6). This flare is used to treat Bioreactor R-722 wastewater treatment unit (WTU) vent emissions.

The Bioreactor R-722 WTU was tested to demonstrate acceptable treatment of the PAI MACT Group 1 wastewater stream prior to discharging to the City of Harbor Beach POTW (see Section 7).

Additional information can be found in the EGLE approved Test Plan submitted on August 23, 2019 and approved by EGLE October 14, 2019.

The following personnel are the facility and testing contacts for test report questions.

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## 2.0 Process Vent Emission Control Summary

EU-PROCESS complies with emission limits set forth in Renewable Operating Permit (ROP) MI-ROP-B4942 and Permit 107-18A. The table below presents the emission limits for EU-PROCESS.

| Pollutant | Limit | Time Period / Operating Scenario | Equipment | Monitoring / Testing Method | Underlying Applicable Requirement |
|---|---|---|---|---|---|
| 1. Organic HAP as defined in 40 CFR 63.1361 | 20 ppmv + | Hourly | EUPROCESS emissions exhaust through TTU-850 | SC IV.2.a, SC IV.3, SC V.2. | 40 CFR 63.1362(b) |
| 2. Organic HAP as defined in 40 CFR 63.1361 | 20 ppmv + | Hourly | EUPROCESS emissions exhaust through TTU-855 | SC IV.2.a, SC IV.3, SC V.2. | 40 CFR 63.1362(b) |
| 3. Organic HAP as defined in 40 CFR 63.1361 | 20 ppmv + | Hourly | EUPROCESS emissions exhaust through TTU-860 | SC IV.2.a, SC IV.3, SC V.2. | 40 CFR 63.1362(b) |
| 4. Organic HAP as defined in 40 CFR 63.1361 | 20 ppmv + | Hourly | EUPROCESS emissions exhaust through TTU-865 | SC IV.2.a, SC IV.3, SC V.2. | 40 CFR 63.1362(b) |
| 5. Organic HAP as defined in 40 CFR 63.1361 | 20 ppmv or 98% destruction | Hourly | EUPROCESS emissions exhaust through TTU-870 | SC IV.2.a, SC IV.3, SC V.2. | 40 CFR 63.1362(b) |
| 6. VOC | 8.7 lb/hr | Hourly | EUPROCESS emissions exhausted through each TTU: TTU850, TTU855, TTU860, TTU865, & TTU870 | SC IV.2, SC IV.3, SC V1 | R336.1225 R336.1702(a) |
| 7. Opacity | Visible emissions from the process shall not exceed a 6-minute average of 5% opacity. | 6-minutes | EUPROCESS | SC III.1, SC VI.1 | R336.1301(1)(c) |
| 8. Ammonia | 31 lb/hr[1] | Hourly | EUPROCESS | SC VI.1 | R336.1225 |
| 9. Ammonia | 2.0 tons per year[1] | 12-month rolling time period as determined at the end of each calendar month | EUPROCESS | SC V.1 | R336.1224 |
| 10. PM | 0.006 lb/1000 lb of exhaust gas, calculated on a dry gas basis | Hourly | EUPROCESS emissions exhausted through any individual TTU | SC. IV.2, SC VI.1 | R336.1331 |
| + Alternative Operating Parameter per Alternative Monitoring Request (AMR) (40 CFR 63.1362(b)(2)(iv)(A)) [1] This condition is state only enforceable and was established pursuant to Rule 201(1)(b). | | | | | |

Tables 1 through 5 summarize emission measurements calculated from the test data.

While all emission rates are acceptable, ammonia emission rates for TTU-865 and TTU-870 are higher than expected. Ammonia emission rates and the subsequent facility investigation is discussed in Section 5.

In Table 5, the carbon monoxide emission rate is high because the firebox temperature was minimized to establish a minimum firebox temperature per PAI MACT requirements.

## Table 1. TTU 850 Results

| TTU 850 | Run 1 10/25/2019 1007 - 1114 | Run 2 10/25/2019 1144 - 1251 | Run 3 10/25/2019 1317 - 1424 | Average |
|---|---|---|---|---|
| **PROCESS DATA** | | | | |
| Fire Box Temperature (°F) | 654.6 | 655.2 | 654.4 | 654.7 |
| Catalyst Inlet Temperature (°F) | 650.3 | 650.9 | 649.9 | 650.4 |
| Catalyst Outlet Temperature (°F) | 649.4 | 651.0 | 648.8 | 649.7 |
| Catalyst Temperature Differential (°F) | 0.9 | 0.1 | 1.1 | 0.7 |
| Natural Gas Flow (MMscf/hr) | 0.264 | 0.261 | 0.265 | 0.264 |
| **EMISSIONS DATA** | | | | |
| Stack Gas Flow (dscf/min) | 34,620 | 34,690 | 34,770 | 34,693 |
| Stack Gas Dry Molecular Weight (lb/lb-mol) | 29.07 | 29.07 | 29.07 | 29.07 |
| | | | | |
| NOx (ppmv) | 5.0 | 5.3 | 5.3 | 5.2 |
| NOx (lb/hr) | 1.25 | 1.31 | 1.32 | 1.29 |
| NOx Natural Gas Emission Factor (lb/MMscf) | 4.73E-06 | 5.02E-06 | 4.98E-06 | 4.89E-06 |
| | | | | |
| CO (ppmv) | 0.4 | 0.2 | 0.0 | 0.2 |
| CO (lb/hr) | 0.06 | 0.03 | 0.0 | 0.05 |
| CO Natural Gas Emission Factor (lb/MMscf) | 2.27E-07 | 1.15E-07 | 0.0 | 1.89E-07 |
| | | | | |
| VOC (ppmv) | 1.3 | 1.5 | 1.3 | 1.4 |
| VOC (lb/hr) | 0.33 | 0.38 | 0.32 | 0.34 |
| | | | | |
| PM (grains/dscf) | 0.00014 | 0.00024 | 0.000003 | 0.00013 |
| PM (lb/hr) | 0.042 | 0.071 | 0.001 | 0.038 |
| PM (lb/lb x $10^3$ stack gas) | 0.000268 | 0.000452 | 0.0000063 | 0.000242 |
| PM Emission Factor (lb/scf) | 1.59E-07 | 2.72E-07 | 3.77E-09 | 1.44E-07 |
| | | | | |
| NH3 (ppmv) | ND | ND | ND | ND |
| NH3 (lb/hr) | ND | ND | ND | ND |
| NH3 Emission Factor (lb/scf) | ND | ND | ND | ND |
| | | | | |
| MeOH (ppmv) | 1.4 | 1.8 | 1.8 | 1.6 |
| MeOH (lb/hr) | 0.23 | 0.27 | 0.27 | 0.26 |
| MeOH Emission Factor (lb/scf) | 8.71E-07 | 1.03E-06 | 1.02E-06 | 9.85E-07 |
| | | | | |
| Inlet Flow (dscf/min) | 55,783 | 55,675 | 55,069 | 55,509 |
| Inlet MeOH (ppmv) | 197.3 | 176.8 | 184.7 | 186.2 |
| Inlet MeOH (lb/hr) | 54.9 | 43.4 | 44.9 | 47.7 |
| Inlet MeOH Emission Factor (lb/dscf) | 0.059 | 0.047 | 0.49 | 0.52 |
| | | | | |
| MeOH DRE (%) | 99.57 | 99.38 | 99.40 | 99.45 |

## Table 2. TTU 855 Results

| TTU 855 | Run 1 10/24/2019 1425 - 1532 | Run 2 10/24/2019 1606 - 1714 | Run 3 10/25/2019 0755 - 0902 | Average |
|---|---|---|---|---|
| **PROCESS DATA** | | | | |
| Fire Box Temperature (°F) | 654.9 | 654.9 | 654.9 | 654.9 |
| Catalyst Inlet Temperature (°F) | 653.7 | 653.7 | 653.7 | 653.7 |
| Catalyst Outlet Temperature (°F) | 651.1 | 651.1 | 651.0 | 651.1 |
| Catalyst Temperature Differential (°F) | 2.6 | 2.6 | 2.7 | 2.6 |
| Natural Gas Flow (MMscf/hr) | 0.214 | 0.215 | 0.215 | 0.215 |
| **EMISSIONS DATA** | | | | |
| Stack Gas Flow (dscf/min) | 23,762 | 23,709 | 23,232 | 23,568 |
| Stack Gas Dry Molecular Weight (lb/lb-mol) | 29.06 | 29.07 | 29.08 | 29.07 |
| | | | | |
| NOx (ppmv) | 15.2 | 10.4 | 8.3 | 11.3 |
| NOx (lb/hr) | 2.60 | 1.76 | 1.38 | 1.91 |
| NOx Natural Gas Emission Factor (lb/MMscf) | 1.21E-05 | 8.19E-06 | 6.42E-06 | 8.88E-06 |
| | | | | |
| CO (ppmv) | 1.0 | 0.5 | 1.6 | 1.0 |
| CO (lb/hr) | 0.10 | 0.05 | 0.16 | 0.11 |
| CO Natural Gas Emission Factor (lb/MMscf) | 4.67E-07 | 2.33E-07 | 7.44E-07 | 5.12E-07 |
| | | | | |
| VOC (ppmv) | 5.5 | 4.5 | 5.2 | 5.0 |
| VOC (lb/hr) | 0.94 | 0.76 | 0.86 | 0.86 |
| | | | | |
| PM (grains/dscf) | 0.000004 | 0.000004 | 0.00085 | 0.00029 |
| PM (lb/hr) | 0.001 | 0.001 | 0.17 | 0.057 |
| PM (lb/lb x $10^3$ stack gas) | 0.0000093 | 0.0000093 | 0.00162 | 0.00055 |
| PM Emission Factor (lb/scf) | 4.67E-09 | 4.65E-09 | 7.91E-07 | 2.65E-07 |
| | | | | |
| NH3 (ppmv) | ND | ND | ND | ND |
| NH3 (lb/hr) | ND | ND | ND | ND |
| NH3 Emission Factor (lb/scf) | ND | ND | ND | ND |
| | | | | |
| MeOH (ppmv) | 16.3 | 17.8 | 18.0 | 17.4 |
| MeOH (lb/hr) | 1.93 | 1.86 | 1.84 | 1.88 |
| MeOH Emission Factor (lb/scf) | 9.02E-06 | 8.65E-06 | 8.56E-06 | 8.74E-06 |
| | | | | |
| Inlet Flow (dscf/min) | 32,488 | 32,017 | 29,290 | 31,265 |
| Inlet MeOH (ppmv) | 220.3 | 253.9 | 369.7 | 281.3 |
| Inlet MeOH (lb/hr) | 35.71 | 35.85 | 47.76 | 39.77 |
| Inlet MeOH Emission Factor (lb/dscf) | 0.066 | 0.067 | 0.098 | 0.076 |
| | | | | |
| MeOH DRE (%) | 94.59 | 94.80 | 96.14 | 95.18 |

## Table 3. TTU 860 Results

| TTU 860 | Run 1<br>10/23/2019<br>1648 - 1757 | Run 2<br>10/24/2019<br>0822 - 0928 | Run 3<br>10/24/2019<br>0957 - 1103 | Average |
|---|---|---|---|---|
| PROCESS DATA | | | | |
| Fire Box Temperature (°F) | 654.9 | 654.8 | 655.0 | 654.9 |
| Catalyst Inlet Temperature (°F) | 646.8 | 646.9 | 646.6 | 646.8 |
| Catalyst Outlet Temperature (°F) | 644.8 | 645.0 | 644.4 | 644.7 |
| Catalyst Temperature Differential (°F) | 2.0 | 1.9 | 2.2 | 2.0 |
| Natural Gas Flow (MMSCF/hr) | 0.119 | 0.129 | 0.131 | 0.126 |
| EMISSIONS DATA | | | | |
| Stack Gas Flow (dscf/min) | 25,547 | 29,110 | 27,085 | 27,248 |
| Stack Gas Dry Molecular Weight (lb/lb-mol) | 29.09 | 29.09 | 29.09 | 29.09 |
| | | | | |
| NOx (ppmv) | 13.0 | 9.9 | 11.1 | 11.3 |
| NOx (lb/hr) | 2.38 | 2.31 | 1.93 | 2.21 |
| NOx Natural Gas Emission Factor (lb/MMscf) | 2.00E-05 | 1.79E-05 | 1.47E-05 | 1.75E-05 |
| | | | | |
| CO (ppmv) | 1.4 | 1.6 | 1.5 | 1.5 |
| CO (lb/hr) | 0.15 | 0.19 | 0.19 | 0.18 |
| CO Natural Gas Emission Factor (lb/MMscf) | 1.26E-06 | 1.47E-06 | 1.45E-06 | 1.43E-06 |
| | | | | |
| VOC (ppmv) | 3.8 | 4.6 | 4.0 | 4.2 |
| VOC (lb/hr) | 0.71 | 0.97 | 0.82 | 0.83 |
| | | | | |
| PM (grains/dscf) | 0.0002 | 0.0005 | 0.00002 | 0.0002 |
| PM (lb/hr) | 0.04 | 0.11 | 0.004 | 0.05 |
| PM (lb/lb x $10^3$ stack gas) | 0.00035 | 0.00083 | 0.000033 | 0.00040 |
| PM Emission Factor (lb/scf) | 3.36E-07 | 8.53E-07 | 3.05E-08 | 3.97E-07 |
| | | | | |
| NH3 (ppmv) | ND | ND | ND | ND |
| NH3 (lb/hr) | ND | ND | ND | ND |
| NH3 Emission Factor (lb/scf) | ND | ND | ND | ND |
| | | | | |
| MeOH (ppmv) | 10.3 | 14.9 | 15.9 | 13.7 |
| MeOH (lb/hr) | 1.32 | 1.92 | 1.89 | 1.71 |
| MeOH Emission Factor (lb/scf) | 1.11E-05 | 1.49E-05 | 1.44E-05 | 1.36E-05 |
| | | | | |
| Inlet Flow (dscf/min) | 35,726 | 40,293 | 40,253 | 38,757 |
| Inlet MeOH (ppmv) | 275.3 | 342.0 | 295.9 | 304.4 |
| Inlet MeOH (lb/hr) | 49.07 | 60.77 | 52.53 | 54.12 |
| Inlet MeOH Emission Factor (lb/dscf) | 0.082 | 0.090 | 0.78 | 0.084 |
| | | | | |
| MeOH DRE (%) | 97.32 | 98.85 | 96.39 | 96.85 |

### Table 4. TTU 865 Results

| TTU 865 | Run 1 10/23/2019 1012 - 1120 | Run 2 10/23/2019 1144 - 1307 | Run 3 10/23/2019 1338 - 1446 | Average |
|---|---|---|---|---|
| **PROCESS DATA** | | | | |
| Fire Box Temperature (°F) | 656.7 | 656.4 | 657.0 | 656.7 |
| Catalyst Inlet Temperature (°F) | 647.2 | 646.4 | 646.2 | 646.6 |
| Catalyst Outlet Temperature (°F) | 642.0 | 640.9 | 640.6 | 641.2 |
| Catalyst Temperature Differential (°F) | 5.2 | 5.5 | 5.6 | 5.4 |
| Natural Gas Flow (MMscf/hr) | 0.170 | 0.174 | 0.176 | 0.173 |
| **EMISSIONS DATA** | | | | |
| Stack Gas Flow (dscf/min) | 30,178 | 30,409 | 28,513 | 29,700 |
| Stack Gas Dry Molecular Weight (lb/lb-mol) | 29.10 | 29.10 | 29.09 | 29.10 |
| | | | | |
| NOx (ppmv) | 23.3 | 22.8 | 24.1 | 23.4 |
| NOx (lb/hr) | 5.0 | 5.0 | 4.9 | 5.0 |
| NOx Natural Gas Emission Factor (lb/MMscf) | 2.94E-05 | 2.87E-05 | 2.78E-05 | 2.89E-05 |
| | | | | |
| CO (ppmv) | 1.6 | 1.6 | 0.9 | 1.4 |
| CO (lb/hr) | 0.22 | 0.22 | 0.11 | 0.18 |
| CO Natural Gas Emission Factor (lb/MMscf) | 1.29E-06 | 1.26E-06 | 6.25E-07 | 1.04E-06 |
| | | | | |
| VOC (ppmv) | 4.4 | 4.7 | 5.2 | 4.8 |
| VOC (lb/hr) | 0.97 | 1.03 | 1.06 | 1.02 |
| | | | | |
| PM (grains/dscf) | 0.000003 | 0.000039 | 0.000271 | 0.00010 |
| PM (lb/hr) | 0.001 | 0.010 | 0.066 | 0.026 |
| PM (lb/lb x $10^3$ stack gas) | 0.000007 | 0.00007 | 0.00051 | 0.000197 |
| PM Emission Factor (lb/scf) | 5.88E-09 | 5.75E-08 | 3.75E-07 | 1.50E-07 |
| | | | | |
| NH3 (ppmv) | 43.7 | 0.55 | ND | 14.8 |
| NH3 (lb/hr) | 0.21 | 0.003 | ND | 0.07 |
| NH3 Emission Factor (lb/scf) | 1.24E-06 | 1.72E-08 | ND | 6.29E-07 |
| | | | | |
| MeOH (ppmv) | 6.8 | 8.1 | 11.9 | 8.9 |
| MeOH (lb/hr) | 1.02 | 1.09 | 1.50 | 1.20 |
| MeOH Emission Factor (lb/scf) | 6.00E-06 | 6.26E-06 | 8.52E-06 | 6.94E-06 |
| | | | | |
| Inlet Flow (dscf/min) | 38,687 | 37,279 | 39,226 | 38,397 |
| Inlet MeOH (ppmv) | 148.1 | 296.5 | 334.7 | 259.8 |
| Inlet MeOH (lb/hr) | 28.59 | 48.75 | 57.91 | 45.08 |
| Inlet MeOH Emission Factor (lb/dscf) | 0.044 | 0.078 | 0.089 | 0.070 |
| | | | | |
| MeOH DRE (%) | 96.43 | 97.76 | 97.41 | 97.20 |

## Table 5. TTU 870 Results

| TTU 870 | Run 1 10/22/2019 1057 - 1214 | Run 2 10/22/2019 1647 - 1757 | Run 3 10/22/2019 1816 - 1925 | Average |
|---|---|---|---|---|
| PROCESS DATA | | | | |
| Fire Box Temperature (°F) | 1,500.4 | 1,500.5 | 1,500.9 | 1,500.6 |
| Natural Gas Flow (MMscf/Hr) | 0.228 | 0.193 | 0.225 | 0.215 |
| EMISSIONS DATA | | | | |
| Stack Gas Flow (dscf/min) | 33,951 | 42,892 | 43,382 | 40,075 |
| Stack Gas Dry Molecular Weight (lb/lb-mol) | 29.05 | 29.03 | 29.05 | 29.04 |
| | | | | |
| NOx (ppmv) | 6.8 | 5.9 | 5.6 | 6.1 |
| NOx (lb/hr) | 1.65 | 2.05 | 2.35 | 2.02 |
| NOx Natural Gas Emission Factor (lb/MMscf) | 7.24E-06 | 1.06E-05 | 1.04E-05 | 9.40E-06 |
| | | | | |
| CO (ppmv) | 116.3 | 112.4 | 121.0 | 116.6 |
| CO (lb/hr) | 17.2 | 22.0 | 23.2 | 20.8 |
| CO Natural Gas Emission Factor (lb/MMscf) | 7.54E-05 | 1.14E-04 | 1.03E-04 | 9.67E-05 |
| | | | | |
| VOC (ppmv) | 2.5 | 2.8 | 3.1 | 2.8 |
| VOC (lb/hr) | 0.62 | 0.86 | 0.97 | 0.82 |
| | | | | |
| PM (grains/dscf) | 0.0006 | 0.0002 | 0.0016 | 0.0008 |
| PM (lb/hr) | 0.18 | 0.06 | 0.61 | 0.28 |
| PM (lb/lb x $10^3$ stack gas) | 0.00117 | 0.000309 | 0.00311 | 0.00153 |
| PM Emission Factor (lb/scf) | 7.89E-07 | 3.11E-07 | 2.71E-06 | 1.30E-06 |
| | | | | |
| NH3 (ppmv) | 76.6 | 72.3 | 82.7 | 77.2 |
| NH3 (lb/hr) | 0.41 | 0.48 | 0.56 | 0.48 |
| NH3 Emission Factor (lb/scf) | 1.80E-06 | 2.49E-06 | 2.49E-06 | 2.26E-06 |
| | | | | |
| MeOH (ppmv) | 5.5 | 4.5 | 5.6 | 5.2 |
| MeOH (lb/hr) | 0.94 | 0.85 | 1.08 | 0.95 |
| MeOH Emission Factor (lb/scf) | 4.12E-06 | 4.40E-06 | 4.80E-06 | 4.42E-06 |
| | | | | |
| Inlet Flow (dscf/min) | 69,390 | 72,291 | 73,486 | 71,722 |
| Inlet MeOH (ppmv) | 247.4 | 299.3 | 261.3 | 269.3 |
| Inlet MeOH (lb/hr) | 85.66 | 95.43 | 84.68 | 88.59 |
| Inlet MeOH Emission Factor (lb/dscf) | 0.074 | 0.079 | 0.069 | 0.074 |
| | | | | |
| MeOH DRE (%) | 98.91 | 99.11 | 98.73 | 98.91 |

## 3.0 Source Description

EU_PROCESS process vent emissions are collected in a common header and routed to one of five thermal treatment units. Four of the units are catalytic thermal treatment units (TTUs). The fifth unit is a newly commissioned regenerative thermal oxidizer (RTO) installed under Permit 107-18A. The additional control device was installed to increase redundancy and to improve the reliability of the control system for EU_PROCESS.

Prior to venting to the atmosphere, all associated fermentation, crystallization, and packaging process vents are sent to one of the five TTUs. The 4 catalytic units currently operate at a minimum firebox temperature of 650°F. The RTO operates at a minimum firebox temperature of 1,550°F.

The TTUs primary function is to control VOC. VOC may include MeOH, organic acids, and cyclical volatiles. Ammonia may also be present in process vents routed to the TTUs.

Additional information can be found in the submitted August 2019 test protocol.

All sampling ports for the catalytic units are located 25 feet (6.3 stack diameters) downstream and 12 feet (3 stack diameters) from flow disturbances, while the sampling ports for TTU 870 are located 30 feet (5.5 stack diameters) downstream and 14 feet (2.8 stack diameters) from flow disturbances.

## 4.0 Sampling and Analytical Procedures

The pollutants measured and the associated sampling methods were:

- VOC – EPA Method 25A;
- PM – EPA Method 5;
- MeOH – EPA Method 308;
- $NH_3$ – CTM 027;
- NOx – EPA Method 7E; and
- CO – EPA Method 10.

The table below lists the pollutants and sampling trains used to collect measurements and samples during the performance test. These methods were performed according to the protocol listed in the appropriate Appendix A, 40 CFR 60 EPA Reference Test Method. Schematic diagrams can be found in the EPA Reference Test Methods.

Detailed descriptions of the sampling and analytical methods can be found in the Test Plan that was submitted August 23, 2019 and approved by EGLE October 14, 2019.

| Sampling Location | No. of Runs | Parameter | Run Duration (min) | Reference Method | Units of Measurement |
|---|---|---|---|---|---|
| Stack Exhaust | 3/unit | Flow Rate | 60 | EPA Methods 1-4 | dscfm |
| Stack Exhaust | 3/unit | VOC | 60 | EPA Method 25A | ppmv |
| Stack Exhaust | 3/unit | PM | 60 | EPA Method 5 | mg |
| Stack Exhaust | 3/unit | $NH_3$ | 60 | EPA CTM 027 | µg |
| TTU Inlet and Stack Exhaust | 3/unit | MeOH | 60 | EPA Method 308 | µg |
| Stack Exhaust | 3/unit | NOx | 60 | EPA Method 7E | ppmv |
| Stack Exhaust | 3/unit | CO | 60 | EPA Method 10 | ppmv |
| Stack Exhaust | 3/unit | $O_2/CO_2$ | 60 | EPA Method 3A | % |

## Sampling and Analytical Procedures

The sampling and analytical procedures to be followed during the performance test are designed to demonstrate compliance with emission limits.

| Sampling and Analytical Procedures | | | |
|---|---|---|---|
| **Sampling Method** | **Sampling Plan** | **Analytical Method** | **Analytical Plan** |
| Method 1 | Traverse locations determined prior to sampling | Not applicable | Not applicable |
| Method 2 | Velocity measurements collected by traversing the stack | Not applicable | Not applicable |
| Method 4 | Samples collected in conjunction with the PM and NH3 collection | Method 4 – Gravimetric | Samples completed on-site |
| Method 5 | Samples collected using isokinetic methodology | Method 5 – Isokinetic | Samples completed on-site and analyzed by off-site lab |
| CTM-027 | Samples collected using isokinetic methodology | CTM027 – Isokinetic | Samples completed on-site and analyzed by off-site lab |
| Method 308 | Samples collected from a single point at TTU Inlet and Stack Exhaust | Method 308 – Single point | Samples completed on-site and analyzed by off-site lab |
| Method 3A | Samples collected from a single center point to an analyzer system | Method 3A – Paramagnetic/ Infrared | Samples completed on-site |
| Method 7E | Samples collected from a single center point to an analyzer system | Method 7E – Chemiluminescent | Samples completed on-site |
| Method 10 | Samples collected from a single center point to an analyzer system | Method 10 – Non-dispersive Infrared | Samples completed on-site |
| Method 25A | Samples collected from a single center point to an analyzer system | Method 25A – Flame Ionization Detector | Samples completed on-site |

## 5.0 Test Results Discussion

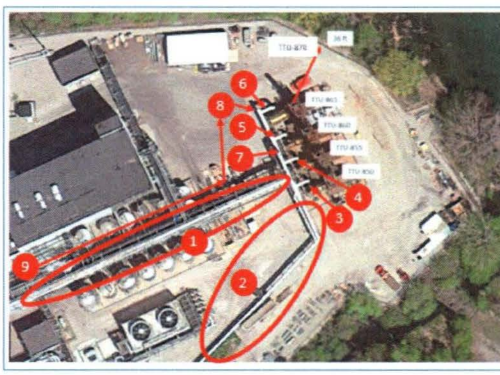
Section 2.0, Tables 1 through 5, summarize emission measurements calculated from the test data. As reported in these tables, all emission measurements are compliant with applicable limits. Table 5 shows that a minimum firebox temperature of 1,500 F is acceptable to meet OHAP control requirements.

Carbon monoxide (CO) emission rates reported in Table 5 are higher than normal levels. To establish a firebox operating parameter for RTO TTU-870, testing was performed at a minimum firebox temperature. This resulted in elevated CO emission rates.

The original laboratory report for the particulate matter samples was in error as a final review revealed. The error resulted from contamination of TTU 860 Runs 1 and 2 from the graphite ferrule used for sealing the sampling nozzle to the probe. Pieces of the ferrule were discovered in the probe and nozzle rinses that biased the actual weight gain. The ferrule pieces were carefully picked off the samples and the samples were re-weighed per the method procedure. The revised, final PM laboratory report is included in the appendix of this report.

Ammonia emission rates for TTU-865 and TTU-870 are higher than expected but acceptable. The facility is investigating. The illustration below shows the vent system. Closed Vent System (CVS) 9 was installed along with RTO TTU-870 pursuant to Permit 107-18A. This vent system routes fermentation vents to the TTU header. CVS-9 ties into the common header at the north end. CVS-2 also routes fermentation vents to the TTU header. CVS-2 ties into the common header at the south end.

The emission profiles of CVS-2 and CVS-9 should be essentially the same. The facility will investigate why the profiles, with respect to ammonia, appear to be different. Results from this investigation will be communicated to the EGLE Saginaw Bay District Office.




**Control or Treatment Devices Used**

All process vents are vented to thermal treatment units. The image shows the TTUs and close vent system (CVS). TTU-850 is the southernmost unit. Moving north is TTU-855, TTU-860, and TTU-865. The image includes:

1. Middle CVS
2. South CVS
3. TTU-850 CVS
4. TTU-855 CVS
5. TTU-860 CVS
6. TTU-865 CVS
7. Middle CVS Tie-in Point
8. TTU-870 CVS
9. North CVS

The thermal treatment units 850, 855, 860, 865 use EnviCat® 2201 catalyst manufactured by SUD-CHEMIE Inc. Thermal treatment unit 870 (TTIu-870) is a Regenerative Thermal Oxidizer (RTO) that was put into service on August 9, 2019.

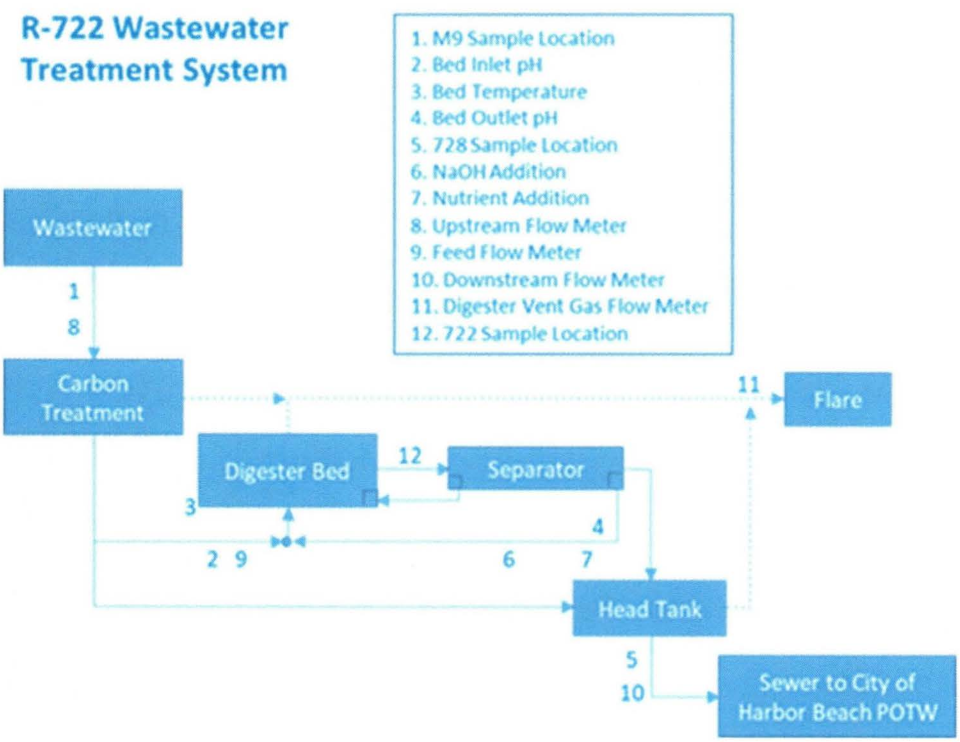
A comprehensive data appendix is attached to this report that includes:

- Detailed process and emissions results;
- Equipment calibrations including CEMS;
- Sample calculations used to generate the results;
- Copies of all field data sheets; and
- Copies of the laboratory data reports including QA/QC.

## 6.0 Enclosed Flare Testing

The SRN B4942 PAI process unit consists of fermentation, product recovery crystallization, filtration, product drying and packaging, and waste broth processing equipment. Wastewater from the PAI process unit is directed to a closed anaerobic biological treatment process (Bioreactor R-722) to reduce the chemical oxygen demand (COD) and remove methanol. Bioreactor R-722 is a recirculating fluidized bed reactor that utilizes microorganisms in an activated carbon media to aerobically convert organic material in the presence of water into methane and carbon dioxide. The bioreactor water effluent is discharged to the local publicly owned treatment works (POTW). The exhaust gas from the bioreactor is primarily methane and carbon dioxide with lesser amounts of hydrocarbons.

The flow chart below illustrates the wastewater treatment system.




Gases collect in the headspace of the bioreactor and are exhausted to a non-assisted enclosed flare. Prior to the flare, the bioreactor vent gas is combined with a nitrogen purge stream and sent to a separator vessel for water removal. The bioreactor vent gas and nitrogen purge flow rates are measured prior to being combined using separate permanently installed mass flow meters. Bioreactor vent gas flow is measured using a thermal mass flow meter and automated control valve. The nitrogen flow is maintained using a mass flow meter.

The flare was tested to demonstrate ongoing compliance with PAI MACT requirements. The following EPA methods were used for the sampling and analysis.

**Inlet Vent Flow Rate – EPA Alt-080/073**

The gas velocity and volumetric flow rate were determined using the plant on-line mass flow meters as allowed by EPA Alt-080/073. The bioreactor vent gas and nitrogen purge flow-rates are measured prior to being combined using separate permanently installed mass flow meters. Bioreactor vent gas flow is measured using the process meter.

### Visible Emissions Observations - EPA Method 22

Method 22 were performed by an observer educated on the general procedures for determining the presence of visible emissions (no certification required). The emissions were observed over a two-hour test period. The observer was required to take a five-minute break after every twenty minutes of observations.

### TOC Sampling and Analysis – ASTM D1946-90

TOC sampling was conducted on the flare inlet vent using evacuated stainless steel summa canisters, then analyses by ASTM D1946-90 to calculate the net heating value of the gas being combusted. Three runs of approximately 1-hour duration each were conducted. Samples were shipped to a contract laboratory for analysis.

The table below lists all the parameters and results during the flare performance test.

| Enclosed Flare Testing Results | | | | |
|---|---|---|---|---|
| **Parameter** | **Run 1** | **Run 2** | **Run 3** | **Average** |
| Bioreactor Vent Gas Flow | 64 lb/hr | 45 lb/hr | 45 lb/hr | 51 lb/hr |
| Flame Verification | >300°F | >300°F | >300°F | >300°F |
| Flare Vent Gas Net Heating Value | 806 BTU/scf | 806 BTU/scf | 804 BTU/scf | 805 BTU/scf |
| Visible Emissions Assessment | 0 minutes | 0 minutes | 0 minutes | 0 minutes |

## 7.0 Bioreactor R-722 Wastewater Treatment Sampling and Analysis

As summarized in Section 6, SRN B4942 wastewater from the PAI process unit is directed to a closed anaerobic biological treatment process (Bioreactor R-722) to reduce the chemical oxygen demand (COD) and remove methanol.

Bioreactor treatment efficiency sampling was initially accomplished in 2004. In June 2013, Corteva performed sampling to confirm ongoing compliance with the fraction removal requirements.

Samples were collected during the October 2019 test event, to again confirm ongoing compliance with fraction removal requirements. Refer to the flowchart in Section 6. Samples were collected at points 1 (M9 tank) and point 5 (V-728).

Results below confirmed ongoing compliance with the standard.

**Bioreactor R-722 Wastewater Treatment Sampling and Analysis Results**

| Parameter | 722 Run 1 (ug) | 728 Run 1 (ug) | M9 Run 1 (ug) | 722 Run 2 (ug) | 728 Run 2 (ug) | M9 Run 2 (ug) | 722 Run 3 (ug) | 728 Run 3 (ug) | M9 Run 3 (ug) |
|---|---|---|---|---|---|---|---|---|---|
| Methanol | ND | 7,220 | 69,373 | 32.1 | 1,663 | 62,820 | ND | 17,268 | 58,501 |
| m-Xylene | ND | ND | 26.2 | ND | ND | 26.1 | ND | ND | 23.0 |
| o-Xylene | ND | ND | 153 | ND | ND | 140 | ND | ND | 120 |
| p-Xylene | ND | ND | 102 | ND | ND | 101 | ND | ND | 87.7 |
| 1,2,4-TMB | ND | ND | 233 | ND | ND | 206 | ND | ND | 187 |
| $NH_3$ | 264 | 80.3 | 332 | 275 | 76.7 | 438 | 282 | 121 | 519 |
| Formic Acid | ND | 7.10 | 2,779 | ND | ND | 2,183 | ND | ND | 1,548 |
| Sulfate | 1,038 | 369 | 584 | 1,096 | 1,740 | 2,280 | 961 | 922 | 4,242 |

One (1) ug was used to calculate System Removal percentages for non-detect (ND) measurements.

**Bioreactor R-722 Wastewater Treatment System Removal Results**

| System Removal | Avg. Inlet (ug) | Avg. Outlet (ug) | System Removal |
|---|---|---|---|
| Methanol | 63,565 | 8,717 | 86.3% |
| m-Xylene | 25 | 1 | 96.0% |
| o-Xylene | 138 | 1 | 99.3% |
| p-Xylene | 97 | 1 | 99.0% |
| 1,2,4-TMB | 209 | 1 | 99.5% |
| $NH_3$ | 430 | 93 | 78.4% |
| Formic Acid | 2,170 | 3 | 99.9% |
| Sulfate | 2,369 | 1,010 | 57.3% |