**Derenzo and Associates, Inc.**
*Environmental Consultants*



M4148

# EMISSION TEST REPORT





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| Report Title | TEST REPORT FOR THE VERIFICATION OF AIR POLLUTANT EMISSION RATES FROM MUNICIPAL SOLID WASTE TO REFUSE DERIVED FUEL CONVERSION PROCESSES |
| Report Date | January 15, 2014 |
| Test Date(s) | December 12, 2013 |

| **Facility Information** | |
|---|---|
| Name | Detroit Renewable Power, LLC |
| Street Address | 5700 Russell Street |
| City, County | Detroit, Wayne |
| Phone | (313) 972-4336 |

| **Facility Permit Information** | | | |
|---|---|---|---|
| State Registration No.: | M4148 | Renewable Operating Permit No.: | MI-ROP-M4148-2011 |

| **Testing Contractor** | |
|---|---|
| Company Mailing Address | Derenzo and Associates, Inc.<br>39395 Schoolcraft Road<br>Livonia, Michigan 48150 |
| Phone | (734) 464-3880 |
| Project No. | 1311004 |

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VERIFICATION OF AIR POLLUTANT EMISSION RATES FROM MUNICIPAL SOLID WASTE TO REFUSE DERIVED FUEL CONVERSION PROCESSES

DETROIT RENEWABLE POWER, LLC.
DETROIT, MICHIGAN

Test Date(s): December 12, 2013

## 1.0 INTRODUCTION

Detroit Renewable Power, LLC (DRP) operates Municipal Solid Waste (MSW) to Refuse Derived Fuel conversion manufacturing processes at its facility located in Detroit, Wayne County, Michigan. The Michigan Department of Environmental Quality, Air Quality Division (MDEQ-AQD) has issued Renewable Operating Permit (ROP) No. MI-ROP-M4148-2011 (dated August 19, 2011) to the DRP facility for various emission units used for shredding, conveying, and combusting MSW.

Conditions of ROP No. MI-ROP-M4148-2011 require DRP to perform compliance testing for multiple emission units identified in the permit. This report is for the verification of particulate matter (PM) emission rates and opacity from the primary and secondary shredders (EUMSWPROC-LINE2).

The emission testing was performed December 12, 2013 by Derenzo and Associates, Inc., personnel Tyler Wilson, Michael Brack, and Patrick Triscari. Ms. Joyce Zhu from the MDEQ-AQD was on-site to observe portions of the compliance testing.

A test protocol was submitted to the MDEQ-AQD prior to the testing project and a test plan approval letter was issued by the regulatory agency. The following items provide information required in MDEQ-AQD *Format for Submittal of Source Emission Test Plans and Reports*, dated February 2008.

Appendix A provides a copy of the MDEQ-AQD test plan approval letter.

Questions concerning this emission report should be directed to:

Mr. William Alexander
Environmental Manager
Detroit Renewable Power, LLC
5700 Russell Street
Detroit, MI 48211
walexander@detroitrenewable.com
(313) 972-4336

Tyler J. Wilson
Environmental Consultant
Derenzo and Associates, Inc.
39395 Schoolcraft Road
Livonia, MI 48150
twilson@derenzo.com
(734) 464-3880

This test report was prepared by Derenzo, Associates, Inc. based on the field sampling data collected by Derenzo and Associates, Inc. Certain analyses were contracted to and performed by third parties and the results are presented in this report and its appendices. Facility process data were collected and provided by DRP employees or representatives.

Report Prepared By:

Tyler J. Wilson
Environmental Consultant

Reviewed By:

Michael Brack
Field Services Manager

## 2.0 SUMMARY OF TEST RESULTS

The exhaust gas from the tested emission unit EUMSWPROC-LINE2 (primary and secondary shredders) was sampled for filterable PM. Filterable PM emissions were captured with the USEPA Method 17 filter (USEPA Method 17) for comparison to the allowable PM exhaust gas concentration specified in MI-ROP-M4148-2011 (pounds of PM per thousand pounds of dry exhaust gas, lb/1000 lb).

Exhaust gas opacity observations were performed for both processes units using USEPA Method 9.

Table 2.1 presents a summary of measured particulate matter emission rates for each process and gaseous pollutant emission rates, respectively.

Table 2.2 presents a summary of the process operating conditions during the test dates.

Appendix B provides process operating records.

Table 2.1 Summary of measured particulate matter emission rates and exhaust plume opacity

| Emission Unit | PM Emission Rates (lb/hr) | PM Emission Rates (lb/1000 lb) | PM Permit Limit (lb/1000 lb) | Opacity (%) |
|---|---|---|---|---|
| Primary Shredder | 0.006 | 0.0003 | 0.0028 | 0% |
| Secondary Shredder | 0.042 | 0.0004 | 0.0028 | 0% |

Table 2.2 Summary of process operating conditions during the sampling periods

| | Primary Shredder Pressure Drop (in $H_2O$) | Secondary Shredder Pressure Drop (in $H_2O$) |
|---|---|---|
| 12/12/2013 | 5.50 | 1.03 |

## 3.0 SOURCE DESCRIPTION

### 3.1 General Process Descriptions

DRP receives MSW that is then shredded and combusted. The facility consists of three (3) emission units: EUMSWPROC-LINE1, EUMSWPROC-LINE2, and EUMSWPROC-LINE3, which each contain a:

- Primary shredder, and
- Secondary shredder.

Emission unit EUMSWPROC-LINE2 was tested during this compliance testing.

### 3.2 Type of Raw and Finished Materials

MSW is the primary raw material used in the process. The final product is a mixture of fly ash and bottom ash.

The individual emission units operate as continuous-type operations. MSW is fed continuously through the individual processes. There are conveyors between certain processes to control material flow to the next operation.

The rate at which MSW can be loaded is dependent on shredder efficiency. A plug in the line forces the process to shut down until the plug is manually removed.

### 3.3 Emission Control System Description

Particulate matter emissions from the identified emission units are controlled using a:

- Baghouse fabric filter system (primary shredder); or
- Baghouse fabric filter system and a cyclone (secondary shredder).

The high-efficiency cyclone collectors use centrifugal force and a cyclone design to mechanically separate particulate matter from the exhaust airstream. The baghouse dust collector uses filtration media to capture particulate matter from the air stream.

## 4.0 SUMMARY OF USEPA TEST METHODS

The following USEPA reference test methods and sampling trains were used to perform the emission compliance testing.

### 4.1 Exhaust Gas Flowrate and Particulate Matter Sampling Methods

| | |
|---|---|
| USEPA Method 1 | Velocity and sampling locations were selected based on physical stack measurements in accordance with USEPA Method 1. |
| USEPA Method 2 | Exhaust gas velocity pressure and temperature using a Type-S Pitot tube connected to a red oil incline manometer and K-type thermocouple. |
| USEPA Method 4 | Exhaust gas moisture determined using the chilled impinger method (as part of the particulate sampling train). |
| USEPA Method 17 | Isokinetic sampling and gravimetric analysis of recovered filterable PM. |

## 5.0 SAMPLING AND ANALYSIS PROCEDURES

Testing was performed to verify opacity and filterable PM emission rates from two (2) shredders from emission unit EUMSWPROC-LINE2. The exhaust gas from EUMSWPROC-LINE2 was sampled using isokinetic sampling methods. Filterable PM emissions (pounds per 1,000 pounds of exhaust gas) were determined based on the amount of filterable PM catch in the USEPA Method 17 filter.

### 5.1 Sampling Location and Velocity Measurements (USEPA Methods 1 and 2)

The sampling location for:

- Primary shredder was in the 17.25-inch diameter exhaust stack.
- Secondary shredder was in the 44.5-inch diameter exhaust stack.

The representative sample locations were determined in accordance with USEPA Method 1 based on the measured distance to upstream and downstream disturbances. The absence of significant cyclonic flow was determined at each sampling location.

Exhaust gas velocity was measured using USEPA Method 2 throughout each test period as part of the isokinetic sampling procedures. Velocity pressure measurements were performed at each stack traverse point using an S-type Pitot tube and red-oil manometer. Temperature measurements were performed at each traverse point using a K-type thermocouple and a calibrated digital thermometer.

Prior to performing the initial velocity traverse, and periodically throughout the test program, the S-type Pitot tube and manometer lines were leak-checked at the test site. These checks were made by blowing into the impact opening of the Pitot tube until 3 or more inches of water were recorded on the manometer, then capping the impact opening and holding it closed for 15 seconds to ensure that it was leak free. The static pressure side of the Pitot tube was leak-checked using the same procedure.

Appendix C provides drawings for each exhaust stack sampling location.

## 5.2 Moisture Determination (USEPA Method 4)

Moisture content was measured concurrently with the particulate matter sampling trains and determined in accordance with USEPA Method 4, with some slight modification to the moisture sampling trains. The impinger trains were constructed and charged as follows: one (1) empty modified Greenburg-Smith (GS) impinger followed by one (1) modified GS impinger containing approximately 200 – 300 grams of pre-dried silica gel and glass fiber. Moisture from the gas sample was removed by the impingers of the isokinetic sampling train. The net moisture gain from the gas sample was determined by either volumetric or gravimetric analytical techniques in the field. Percent moisture was calculated based on the measured net gain from the impingers and the metered gas sample volume of dry air.

## 5.3 Particulate Matter Sampling Procedures

### 5.3.1 Determination of Filterable Particulate Matter Emissions (USEPA Method 17)

USEPA Method 17 was used to determine filterable PM concentration in the primary shredder and secondary shredder exhaust gas. Exhaust gas was withdrawn from these emission unit exhaust stacks at an isokinetic sampling rate using an appropriately-sized sample nozzle. The collected exhaust gas was passed through an in-stack filter placed just after the "goose-neck" nozzle. PM in the sampled gas stream was collected onto a pre-tared glass fiber filter. The stainless steel in-stack filter holder was connected to a (unheated) sample probe. The outlet of the sample probe was connected to an impinger train (for moisture removal) via flexible tubing. The outlet of the impinger train was connected to a dry gas meter and metering console.

At the conclusion of each test, the filter was recovered and the nozzle and filter holder were brushed and rinsed with acetone. Recovered filters and acetone rinses of the nozzle, filter holder, and sample probe were sent to Bureau Veritas North America, Inc. (Novi, Michigan) for gravimetric measurements.

### 5.4 Opacity Observations (USEPA Method 9)

USEPA Method 9 procedures were used to evaluate the opacity of the exhaust gas during one (1) 60-minute test period on each exhaust stack. In accordance with USEPA Method 9, the qualified observer stood at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to his back. As much as possible, the line of vision was approximately perpendicular to the plume direction.

Opacity observations were made at the point of greatest opacity in the portion of the plume where condensed water vapor was not present. Observations were made at 15-second intervals for the duration of the 60-minute testing period.

All visible emissions determinations were performed by a qualified observer in accordance with USEPA Method 9, Section 3.

### 5.5 Number and Length of Sampling Runs

The emission verification tests each consisted of triplicate (3), one-hour sampling periods for each exhaust stack.

### 5.6 Quality Assurance/Quality Control Procedures

The Nutech® Model 2010 sampling consoles and dry gas meters, which were used to extract a metered amount of exhaust gas from the stacks were calibrated prior to and after the test event. The calibration procedure uses the critical orifice calibration technique presented in USEPA Method 17. The digital pyrometer in the Nutech metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator. The isokinetic variation was calculated for each one hour sampling period and determined to be within +/-10% of 100% as required by USEPA Method 17.

The Pitot tube used for velocity pressure measurements was inspected for mechanical integrity and physical design prior to the field measurements. The gas velocity measurement train (Pitot tube, connecting tubing and incline manometer) was leak-checked prior to the field measurements and periodically throughout the testing period.

Appendix D provides information and quality assurance data for the equipment used for the test periods (Pitot tube integrity inspection sheets, and meter box critical orifice calibration records).

All recovered particulate matter samples were stored and shipped in pre-rinsed glass sample bottles with Teflon® lined caps. The liquid level on each bottle was marked with permanent marker and the caps were secured closed with tape. Samples of the reagents used in the test project (200 milliliters each of deionized high-purity water and acetone) were sent to the

laboratory for analysis to verify that the reagents used to recover the samples have low particulate matter residue values.

The laboratory analyses were conducted by a qualified third-party laboratory (Bureau Veritas North America, Inc.) according to the appropriate QA/QC procedures of the associated USEPA methodologies and are included on the final laboratory report.

Appendix E provides a copy of the Bureau Veritas N.A. laboratory analytical report for gravimetric analysis of the filterable particulate matter samples.

## 6.0 TEST RESULTS AND DISCUSSION

### 6.1 Particulate Matter Emission Test Results

Filterable particulate matter emission rates (pounds per 1,000 pounds of exhaust gas) for each source were calculated based on the amount of dry stack gas metered through the sampling system and the laboratory results for particulate matter contained in the front half of the sampling train (filter and nozzle/probe/filter housing rinses).

Tables 6.1 and 6.2 present particulate matter test results for the one (1) emission unit (primary and secondary shredders) that was tested on December 12, 2013.

Appendix F provides field sampling data sheets and isokinetic mass emission rate calculations.

Appendix G provides visible emission data sheets and the observer certificate.

### 6.2 Permit Compliance Determination

The test results presented in Tables 6.1 and 6.2 indicate that EUMSWPROC-LINE2 operated in compliance with the applicable allowable PM emission rate (lb/1,000 pounds exhaust gas).

### 6.3 Variations from Normal Sampling Procedures or Operating Conditions

The testing was performed by Derenzo and Associates as described in the approved test plan provided by Testar Inc., and associated USEPA test methods.

Due to potentially unsafe conditions on the facility roof while the shredding processes were running, a single isokinetic sampling point was used for each stack. These points were selected by performing an initial velocity traverse on each stack while the shredding processes were not running, but the exhaust fans were running. For each stack, the velocity measurements were averaged and the traverse point closest to the average was used as the single isokinetic sampling point. For the primary shredder, point 4 in port 2 (port facing South-Southwest) was used for the

single isokinetic sampling point. For the secondary shredder, point 2 in port 2 (port facing South-Southwest) was used for the single isokinetic sampling point.

Moisture determination by USEPA Method 4 described in section 5.3, using a moisture train containing one (1) empty modified Greenburg-Smith (GS) impinger followed by one (1) modified GS impinger containing approximately 200 – 300 grams of pre-dried silica gel and glass fiber was discussed and approved prior to the test date by Mr. Thomas Maza of the MDEQ-AQD due to the below freezing temperatures expected for the test date.

Exhaust gas $CO_2$ and $O_2$ content for both stacks was assumed to be relatively close to that of ambient air (20.9% $O_2$ and trace amounts of $CO_2$). These estimates were approved prior to the test date by Mr. Thomas Maza of the MDEQ-AQD.

USEPA Method 17 filter weight results were negative for multiple test periods. For test number S-2 on the secondary shredder exhaust, the minimum detection limit for filter weight (0.5 mg) was used for the emissions calculations since the sum of the laboratory results for the filter weight plus the acetone rinse weight equaled a negative total weight when combined. For all other test periods that resulted in negative filter weights, actual filter weights were used for the emissions calculations since those tests resulted in positive final total weights when combined with the acetone rinse weights.

During the test periods the processes were operated at normal operating conditions, at or near maximum achievable capacity and satisfied the parameters specified in the MDEQ-AQD test plan approval letter. Process data collected by DRP representatives is provided in Appendix B and summarized in Table 2.2.

Table 6.1. Measured PM emission rates and opacity for the primary shredder exhaust (EUMSWPROC-LINE2)

| **Test No.**<br>Test Date: | **P-1**<br>12/12/2013 | **P-2**<br>12/12/2013 | **P-3**<br>12/12/2013 | **Avg** |
|---|---|---|---|---|
| **Exhaust Gas Properties** | | | | |
| Exhaust gas flow (dscfm) | 4,672 | 4.490 | 4.532 | 4,565 |
| Temperature (°F) | 29 | 28 | 30 | 29 |
| Moisture (%H2O) | 0.20 | 0.32 | 0.40 | 0.31 |
| **Filterable Emissions** | | | | |
| Sample volume (dscf) | 56.9 | 55.5 | 56.5 | 56.3 |
| PM Catch Primary filter (mg) | -0.07 | -0.05 | -0.01 | -0.04 |
| PM Catch Acetone Rinse (mg) | 0.5 | 0.5 | 0.9 | 0.6 |
| PM Emission Rate (lb/hr) | 0.004 | 0.005 | 0.009 | 0.006 |
| PM Concentration (lb/1,000 lb) | 0.0002 | 0.0003 | 0.0005 | 0.0003 |
| PM Permit Limit (lb/1,000 lb) | | | | 0.0028 |
| Observed Opacity | 0% | 0% | 0% | 0% |

Table 6.2. Measured PM emission rates and opacity for the secondary shredder exhaust (EUMSWPROC-LINE2)

| **Test No.**<br>Test Date: | **S-1**<br>12/12/2013 | **S-2**<br>12/12/2013 | **S-3**<br>12/12/2013 | **Avg** |
|---|---|---|---|---|
| **Exhaust Gas Properties** | | | | |
| Exhaust gas flow (dscfm) | 24,416 | 24,191 | 23,880 | 24,162 |
| Temperature (°F) | 43 | 44 | 44 | 44 |
| Moisture (%H2O) | 0.22 | 0.21 | 0.53 | 0.32 |
| **Filterable Emissions** | | | | |
| Sample volume (dscf) | 45.92 | 46.41 | 46.33 | 46.22 |
| PM Catch Primary filter (mg) | -0.70 | 0.05 | -0.25 | -0.15 |
| PM Catch Acetone Rinse (mg) | 1.1 | 0.5 | 0.7 | 0.8 |
| PM Emission Rate (lb/hr) | 0.028 | 0.069 | 0.031 | 0.042 |
| PM Concentration (lb/1,000 lb) | 0.0003 | 0.0006 | 0.0003 | 0.0004 |
| PM Permit Limit (lb/1,000 lb) | | | | 0.0028 |
| Observed Opacity | 0% | 0% | 0% | 0% |