

EMISSION TEST REPORT

RECEIVED
FEB 16 2017
AIR QUALITY DIV.

Report Title RESULTS OF REGENERATIVE THERMAL OXIDIZER VOC
DESTRUCTION EFFICIENCY DETERMINATION

Report Date February 6, 2017

Test Date January 11, 2017

RETEST

Facility Information	
Name	Plasan Carbon Composites
Street Address	3195 Wilson Dr
City, County	Walker, Kent
Phone	(616) 965-9450

Facility Permit Information	
State Registration No.:	P0374
Permit to Install:	130-12C

Testing Contractor	
Company	Derenzo Environmental Services
Mailing Address	39395 Schoolcraft Road Livonia, Michigan 48150
Phone	(734) 464-3880
Project No.	1612010

RESULTS OF
REGENERATIVE THERMAL OXIDIZER
VOC DESTRUCTION EFFICIENCY DETERMINATION

PLASAN CARBON COMPOSITES
WALKER, MICHIGAN

1.0 INTRODUCTION

Plasan Carbon Composites (Plasan) operates a facility in Walker, Kent County, Michigan (State Registration No. P0374) that manufactures carbon fiber parts that are used primarily in the transportation industry (automotive applications). The carbon fiber molding and coating process are identified as emission units in Permit to Install (PTI) No. 130-12C.

Emission Unit EU-PAINTLINE-1 uses coatings that contain volatile organic compounds (VOC). The applied VOC are volatilized, collected, and directed to a regenerative thermal oxidizer (RTO) for emission reduction.

Conditions of PTI No. 130-12C require Plasan to determine the VOC capture and destruction efficiency associated with the EU-PAINTLINE-1 emission control system. Initial testing was performed in September 2016 and the results submitted in a report dated October 18, 2016. Following the initial test, Plasan has made adjustments to the RTO to increase the VOC destruction efficiency. Subsequent RTO destruction efficiency testing was performed on January 11, 2017. This test report presents the results of the retest of the RTO VOC destruction efficiency.

The VOC destruction efficiency determination testing was performed January 11, 2017 by Derenzo Environmental Services representatives Andrew Rusnak and Clay Gaffey. The project was coordinated by Plasan representatives Randy Jesberg and Chuck Czarnecki.

Mr. David Patterson and Ms. Kaitlyn Devries of the Michigan Department of Environmental Quality, Air Quality Division (MDEQ-AQD) were on-site to observe the compliance testing. The exhaust gas sampling and analysis was performed using procedures specified in the Test Plan submitted to MDEQ-AQD dated December 30, 2016 and approved by the regulatory agency.

Appendix 1 provides a copy of the test plan approval letter issued by the MDEQ-AQD.

Derenzo Environmental Services

Plasan Carbon Composites
VOC Destruction Efficiency Test Report

February 6, 2017
Page 2

1.1 Project Contact Information

Questions regarding this emission test report should be directed to:

Andy Rusnak, QSTI
Technical Manager
Derenzo Environmental Services
4990 Northwind Drive, Suite 120
East Lansing, MI 48823
(517) 324-1880
arusnak@derenzo.com

Chuck Czarnecki
Paint Engineer
Plasan Carbon Composites
3195 Wilson Dr NW
Walker MI 49534
chuck.czarnecki@plasancarbon.com
(616) 965-9450

1.2 Report Certification

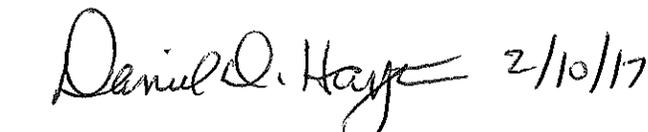
This test report was prepared by Derenzo, Associates, Inc. based on field sampling data collected by Derenzo Environmental Services. Facility process data were collected and provided by Plasan employees or representatives. This test report has been reviewed by Plasan representatives and approved for submittal to the MDEQ-AQD.

I certify that the testing was conducted in accordance with the approved test plan unless otherwise specified in this report. I believe the information provided in this report and its attachments are true, accurate, and complete.

Report Prepared By:


Andy Rusnak, QSTI
Technical Manager
Derenzo Environmental Services

I certify that the facility and emission units were operated at routine operating conditions for the test event. Based on information and belief formed after reasonable inquiry, the statements and information in this report are true, accurate and complete.


Daniel D. Hartzler
Vice President of Engineering
Plasan Carbon Composites

2.0 SOURCE AND SAMPLING LOCATION DESCRIPTION

2.1 Spray Coating Line

Plasan Carbon Composites (Plasan) operates a facility in Walker, Kent County, Michigan (State Registration No. P0374) that manufactures carbon fiber parts that are used primarily in the transportation industry (automotive applications). The carbon fiber molding and coating process are identified as emission units in Permit to Install (PTI) No. 130-12C.

EU-PAINTLINE-1 is a conveyORIZED coating line for spray-coating carbon fiber parts. The line consists of a single paint spray booth with automated and manual sections, an enclosed flash tunnel, and a cure oven with radiant and convection sections. The VOC emissions from this line are controlled by an RTO.

2.2 Type and Typical Quantity of Raw and Finished Materials Used in each Process

The carbon fiber part coating process applies VOC containing materials (conductive primer and hardener) to the carbon fiber parts in a continuous-type manner where parts are loaded onto a conveyor that travels through the coating booths and curing oven. The primer and hardener are mixed in a predetermined ratio prior to application.

2.3 Emission Control System Description

Solvent laden process air is collected from the EU-PAINTLINE-1 paint spray booth (both automated and manual sections), the flash tunnel, and the radiant cure zone and directed to the RTO for VOC emission reduction. The exhaust from the convection zone contains a minimal amount of VOC and is released to atmosphere.

The RTO is manufactured by TANN and has a rated airflow capacity of 14,000 scfm. The unit is fueled with natural gas to maintain the combustion chamber temperature above 1,400°F for the oxidation of VOC. Heat is recovered from the RTO exhaust gas in a ceramic heat exchange media and used to preheat the incoming collected process air.

PTI 130-12C specifies that satisfactory operation of the thermal oxidizer includes a minimum VOC capture efficiency of 92.5 percent (by weight), a minimum VOC destruction efficiency of 95 percent (by weight), and maintaining a minimum temperature of 1400°F and a minimum retention time of 0.5 seconds.

2.4 Sampling Locations and Velocity Measurements

The sampling location for the:

- RTO inlet was in the 35.5-inch diameter RTO inlet duct, prior to RTO system fan.
- RTO outlet was in the 41.5-inch diameter vertical exhaust stack.

Velocity traverse locations for each sampling point were determined in accordance with USEPA Method 1. A cyclonic flow check was performed for each measurement location to verify acceptability of the flow profile. Exhaust gas velocity pressure and temperature were measured at each sampling location in accordance with USEPA Method 2 using an S-type Pitot tube connected to a red-oil manometer. A K-type thermocouple mounted to the Pitot tube was used for temperature measurements. The Pitot tube and connective tubing were periodically leak-checked to verify the integrity of the measurement system.

Appendix 2 provides diagrams of the test sampling locations.

3.0 SUMMARY OF RESULTS

3.1 Purpose and Objectives of the Tests

PTI 130-12C specifies annual VOC emission limits and daily limits for specific air toxics. The design and operating requirements specify a required minimum VOC:

- Capture efficiency of 92.5%
- Destruction efficiency of 95%.

Special Condition V.2. states:

Within 180 days after commencement of trial operation of the RTO on EU-PAINTLINE-1, the permittee shall verify VOC capture efficiency and VOC destruction efficiency on EU-PAINTLINE-1 by testing at owner's expense...

Previous testing demonstrated compliance with the EU-PAINTLINE-1 VOC capture efficiency requirements. This testing was performed to determine VOC destruction efficiency of the RTO.

The VOC destruction efficiency was based on the measurement of volumetric flowrate and total hydrocarbon concentration of the RTO inlet and the volumetric flowrate and nonmethane hydrocarbon concentration of the RTO exhaust gas streams.

3.2 Variations from Normal Sampling Procedures or Operating Conditions

The testing was performed in accordance with the Test Protocol dated December 30, 2016 and specified USEPA test methods.

All instrument calibrations and sampling period results satisfied the quality assurance verifications required by USEPA Methods 3A and 25A. No variations from the normal operating conditions of the coating line or RTO occurred during the testing program.

3.3 Process Operating Conditions During the Compliance Testing

The coating applied during the emissions testing was a mixture of Akzonobel 47494 RH AP116 Grey Conductive Primer (VOC content 54.2% by wt.) and Akzonobel APC49797 Hardener Solution (VOC content 48.0% by wt.) The primer and hardener were mixed at a ratio of 3:1, respectively, resulting in an average VOC content of the applied coating of 52.6% by wt. and an average coating density of 9.57 lb/gal.

The coating line operated continuously during the compliance test. The average number of part carriers through the coating booth during the three test periods was 28 and the average amount of coating applied during the three test periods was 10.6 gallons. Process information was recorded with other operating data.

Table 3.1 presents a summary of the production data for the test day.

The average recorded RTO combustion chamber temperature was 1,598 °F.

Appendix 3 provides RTO operating records, production log sheets, coating EDS (environmental data sheets) and coating use rates taken during the emissions test program.

3.4 Summary of Air Pollutant Sampling Results

The RTO inlet and exhaust gas streams were monitored simultaneously during three (3) one-hour test periods to determine the VOC mass flowrate entering and exiting the RTO for VOC destruction efficiency (DE) determination. The calculated VOC DE for the RTO averaged 98.0% by weight. The RTO operated at an average chamber temperature of 1,598 °F.

Table 3.2 presents a summary of the compliance test results.

Derenzo Environmental ServicesPlasan Carbon Composites
VOC Destruction Efficiency Test ReportFebruary 6, 2017
Page 6

Table 3.1 Summary of production data for January 11, 2017

Run No.	Coating Applied	VOC Content of Coating (wt. %)	Amount of Coating (gal)	No. Part Carriers per Hour	Oxidizer Temp (°F)
Test No. 1	47494RH / APC 49797	52.6	15.9	29	1,599
Test No. 2	47494RH / APC 49797	52.6	7.08	27	1,598
Test No. 3	47494RH / APC 49797	52.6	8.94	27	1,598

Table 3.2 Summary of VOC destruction efficiency test results

Operating Parameter / Test Measurement	Test No.1 Results	Test No.2 Results	Test No.3 Results	Average
RTO Inlet THC mass flowrate (lb/hr)	40.1	19.7	28.3	29.3
RTO Exhaust NMHC mass flowrate (lb/hr)	0.60	0.50	0.53	0.54
Destruction Efficiency (%wt)	98.5	97.5	98.1	98.0
Permit Limit (%wt)	-	-	-	95%

4.0 SAMPLING AND ANALYTICAL PROCEDURES

The compliance testing consisted of the determination of total hydrocarbon (THC) and nonmethane hydrocarbon (NMHC) concentrations and air flowrate measurements for the gas streams entering and exiting the RTO emission control system.

4.1 Summary of USEPA Test Methods

Derenzo Environmental Services performed the exhaust gas and pollutant measurements in accordance with the following USEPA reference test methods:

- | | |
|------------|--|
| Method 1 | Velocity and sampling locations based on physical stack measurements. |
| Method 2 | Gas flowrate determined using a type S Pitot tube. |
| Method 3A | RTO exhaust gas O ₂ and CO ₂ content determined using instrumental analyzers. |
| Method 3 | RTO inlet and building enclosure exhaust O ₂ and CO ₂ content determined by Fyrite® combustion gas analyzers. |
| Method 4 | Gas moisture based on the water weight gain in chilled impingers for the RTO inlet and exhaust gas streams. Moisture for the RTO inlet sampling location was determined by wet bulb/dry bulb temperature measurements. |
| Method 25A | Total hydrocarbon concentration using a flame ionization analyzer (FIA) compared to a propane standard. |

RECEIVED
FEB 16 2017
AIR QUALITY DIV.

4.2 VOC Destruction Efficiency Determination

RTO VOC destruction efficiency was determined based on the simultaneous sampling of the RTO inlet and exhaust gas streams during three (3) one-hour sampling periods. THC concentration in the RTO inlet was measured by a Thermo Environment Instruments (TEI) Model 51c flame ionization detector (FID) according to USEPA Method 25A as described in Section 4.3 of this document. Nonmethane (NMHC) concentration in the RTO exhaust was measured by a TEI Model 55i methane/nonmethane flame ionization detector (FID) equipped with a gas chromatograph (GC) column, for methane separation, according to USEPA Method 25A as described in Section 4.3 of this document.

Diluent gas concentrations for the RTO inlet were assumed to be equal to ambient concentrations. RTO inlet moisture concentration was determined pursuant to the USEPA Method 4 wet bulb / dry bulb temperature approximation method. Gas properties for the RTO exhaust were determined pursuant to USEPA Methods 3A and 4 using instrumental analyzers to determine CO₂/O₂ content and moisture by the chilled impinger method.

Air velocity measurements for each sampling location were performed near the beginning and end of each one-hour test period using a type-S Pitot tube in accordance to USEPA Method 2.

4.3 Instrumental Analyzer Operating Procedures

THC concentration in the RTO inlet gas stream, identified in the previous section, was determined by USEPA Method 25A, *Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer*. Throughout each test period, a gas sample from the inlet measurement location was delivered to the instrument rack using a heated Teflon sample line and extractive gas sampling system. Hydrocarbon concentrations were determined using a TEI Model 51c instrument. The sampled gas stream was not dried prior to being introduced to the FID instrument; therefore, THC concentration measurements correspond to standard conditions with no moisture correction.

NMHC concentration in the RTO exhaust gas stream, identified in the previous section, was determined by USEPA Method 25A, *Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer*. Throughout each test period, a gas sample from the exhaust measurement location was delivered to the instrument rack using a heated Teflon sample line and extractive gas sampling system. NMHC concentrations were determined using a TEI Model 55i instrument. The TEI Model 55i analyzer contains an internal gas chromatograph column that separates methane from non-methane components. The concentration of NMHC in the sampled gas stream, after separation from methane, is determined relative to a propane standard using a flame ionization detector in accordance with USEPA Method 25A. The sampled gas stream was not dried prior to being introduced to the FID instrument; therefore, NMHC concentration measurements correspond to standard conditions with no moisture correction.

CO₂/O₂ content for the RTO exhaust was monitored continuously throughout the VOC DE test periods using a Servomex Model 4900 non-dispersion infrared (NDIR) analyzer for CO₂ and a Servomex Model 4900 paramagnetic analyzer for O₂ in accordance with USEPA Method 3A. The sampled gas stream was dried prior to analysis using a refrigerant-based condenser equipped with a peristaltic pump to remove moisture from the sampled gas stream. Therefore, CO₂ and O₂ concentration measurements were performed on a dry gas basis.

At the conclusion of each test period, instrument calibration was verified against a mid-range (or representative up-scale) calibration gas and zero gas. The FID instruments were calibrated with certified concentrations of propane in air and zeroed using hydrocarbon-free air. The CO₂/O₂ analyzer was calibrated using certified concentrations of CO₂ and O₂ in nitrogen and zeroed using nitrogen. Concentrations measured with the instrumental analyzers were adjusted for calibration error and zero drift using the procedures in Method 7E.

Instrument response for each analyzer was recorded on an ESC Model 8816 data logging system that monitored the analog output of the instrumental analyzers continuously and logged data as one-minute averages. A STEC Model SGD-710C ten-step gas divider was used to obtain intermediate calibration gas concentrations as needed.

4.4 Quality Assurance Procedures

Accuracy of the instrumental analyzers used to measure THC, NMHC, O₂ and CO₂ concentration was verified prior to and at the conclusion of each test period using the calibration procedures in Methods 25A, 3A and 7E. Prior to the first test period of each day, appropriate high-range, mid-range and low-range span gases (USEPA protocol 1 certified calibration gases) followed by a zero gas (hydrocarbon free air or nitrogen) were introduced into each sampling system to verify instrument response and sampling system integrity. In addition, the T55i analyzer used for the RTO outlet were challenged with an additional mixture of methane and propane calibration gas to demonstrate effective separation. The calibration gas was delivered to the sampling system through a spring-loaded check valve and a stainless steel "Tee" installed at the base of the sample probe.

The gas divider used to obtain intermediate calibration gas concentrations had been NIST-certified within the previous year with a primary flow standard in accordance with USEPA Method 205 and was verified in the field according the procedures in Method 205, Section 3.2.

The Pitot tubes used for velocity pressure measurements were inspected for mechanical integrity and physical design prior to the field measurements. The gas velocity measurement trains (Pitot tube, connecting tubing and incline manometer) were leak-checked prior to the field measurements and periodically throughout the testing period. The absence of cyclonic flow was also verified for each measurement point.

The Nutech® Model 2010 sampling console and dry gas meter, which were used to extract a metered amount of exhaust gas from the RTO exhaust stack for moisture determination, was calibrated prior to and after the test event using the critical orifice calibration technique specified in USEPA Method 5. The digital pyrometer in the Nutech metering console was calibrated using a NIST traceable Omega® Model CL 23A temperature calibrator.

Appendix 4 provides information and quality assurance data for the equipment and instrumental analyzers used for the destruction and capture efficiency test periods (calibration data, copies of calibration gas certificates, gas divider certification, Pitot tube integrity inspection sheets, and meter box critical orifice calibration records).

5.0 TEST RESULTS AND DISCUSSION

5.1 RTO VOC Destruction Efficiency

The RTO inlet and exhaust gas streams were sampled January 11, 2017 for three (3) one-hour test periods to determine THC/NMHC concentration and volumetric flowrate for each gas stream. Inlet and outlet THC/NMHC concentration was monitored continuously using flame ionization analyzers. Air flowrate measurements were performed near the beginning and end of each test period.

VOC mass flowrate (as propane) into and out of the control device was calculated using the following equation:

$$M_{VOC} = Q [C_{VOC}] MW (60 \text{ min/hr}) / V_M / 1E+06$$

Where:

M_{VOC} = Mass flowrate VOC (lb/hr)

Q = Volumetric flowrate corrected to standard conditions (scfm)

C_{VOC} = THC/NMHC concentration (ppmv as propane)

MW = Molecular weight of propane (44.1 lb/lb-mol)

V_M = Molar volume of ideal gas at standard conditions (385 scf/lb-mol)

VOC destruction efficiency was determined based on the ratio of the inlet and outlet VOC mass flowrate:

$$VOC \text{ DE} = [1 - (M_{VOC,out} / M_{VOC,in})] \times 100\%$$

The average measured THC concentration for the RTO inlet gas stream was 304 parts per million by volume (ppmv) measured as propane. The average measured volumetric flowrate into the

Derenzo Environmental Services

Plasan Carbon Composites
VOC Destruction Efficiency Test Report

February 6, 2017
Page 11

RTO was 14,011 standard cubic feet per minute (scfm), resulting in an average VOC mass flowrate of 29.34 pounds per hour (lb/hr) into the RTO.

The average measured NMHC concentration in the RTO exhaust was 5.31 ppmv as propane. Based on the measured flowrate of 14,813 scfm, the calculated exit VOC mass flowrate was 0.54 lb/hr, resulting in an average VOC DE of 98.0 percent by weight (% wt.)

Table 5.1 presents measured gas conditions and results for the VOC destruction efficiency test periods.

Appendix 5 provides calculations and field data sheets used to determine VOC mass flow rate and destruction efficiency for each one-hour test period.

Appendix 6 contains the raw instrument response data.

Derenzo Environmental Services

Plasan Carbon Composites
 VOC Destruction Efficiency Test Report

February 6, 2017
 Page 12

Table 5.1 Measured gas conditions and results for the VOC destruction efficiency test

Date	1/11/2017	1/11/2017	1/11/2017	
Test Times	819 - 919	1007 - 1107	1134 - 1234	
Operating Data				
	Test 1	Test 2	Test 3	Avg
Part Throughput (total carriers)	29	27	27	28
RTO Operating Temperature (°F)	1,599	1,598	1,598	1,598
Volume of Coating Applied (gal)	15.9	7.08	8.94	10.6
VOC Content of Coating (wt. %)	52.6	52.6	52.6	52.6
RTO Inlet Gas				
Temperature (°F)	77	78	78	77
Inlet Flowrate (scfm)	14,367	13,916	13,750	14,011
Average THC Conc. ¹ (ppmv C ₃)	406	206	299	304
Calculated VOC Mass Flow ² (lb/hr)	40.1	19.7	28.3	29.3
RTO Exhaust Gas				
Temperature (°F)	286	286	288	287
Exhaust Flowrate (scfm)	14,995	14,881	14,565	14,813
Average NMHC Conc. ¹ (ppmv C ₃)	5.81	4.86	5.27	5.31
Calculated VOC Mass Flow ² (lb/hr)	0.60	0.50	0.53	0.54
Calculated Destruction Efficiency³				
$[1 - (M_{VOC,out} / M_{VOC,in})] \times 100\%$	98.5	97.5	98.1	98.0

Table 5.1 Notes

1. Concentration as propane measured using a flame ionization analyzer in accordance with USEPA Method 25A.
2. VOC mass flowrate calculated as propane:
 (Gas Flowrate, scfm) (Concentration, ppmv) (44.1 lb/lbmol) (60 min/hr) / (385 scf/lbmol) / 1E+06
3. Based on VOC mass flowrate.