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ENGINEERING EMISSION TEST REPORT FOR VOLATILE ORGANIC COMPOUNDS (VOC) AND ACETALDEHYDE ON THE FERMENTATION SCRUBBER EXHAUST STACK AT THE CARBON GREEN BIO ENERGY (CGBE) FACILITY LOCATED IN LAKE ODESSA, MICHIGAN

Prepared for:

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MARCH 16, 2018
STACK TEST GROUP PROJECT NO. 18-3018

I certify that this report depicts the actual emissions of the processes testing during the times of the tests. I believe to the best of my knowledge, the results presented in this report are true and accurate.

Report Prepared By:

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Project Manager

Report Reviewed By:

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President

1.0 EXECUTIVE SUMMARY

On March 16, 2018, the Stack Test Group, Inc. performed volatile organic compounds (VOC), and acetaldehyde emission testing at the Carbon Green Bio Energy (CGBE) facility located in Lake Odessa, Michigan. Testing was conducted on the fermentation scrubber exhaust stack. Three tests were conducted on this unit. Presented below are the average results of these tests.

Fermentation Scrubber Exhaust Stack:

Total VOC (as propane):	0.72 Pounds per Hour
Acetaldehyde:	0.54 Pounds per Hour

2.0 INTRODUCTION

On March 16, 2018, the Stack Test Group, Inc. performed volatile organic compounds (VOC), and Acetaldehyde emission testing at the Carbon Green Bio Energy facility located in Lake Odessa, Michigan.

The purpose of the test program at the Carbon Green Bio Energy (CGBE) facility was to characterize the emissions of VOC and acetaldehyde from the fermentation scrubber while operating the plant at the maximum routine ethanol production rate at which the CGBE facility was capable of operating, and while maintaining the fermentation scrubber water flow rate and sodium bisulfite addition rate at settings which are representative of normal operation. During the previous day's compliance test these rates were fixed at the minimum settings for purposes of establishing the minimum required rates for achieving compliance with the permitted emission limits. Similar to the compliance test, three 2-hour test runs were performed to characterize the emissions of VOC and acetaldehyde. Refer to Appendix F for the process and control device data during the test program. During the third test run, Fermenter No. 2 was dropped, starting at 11:50.

Testing was supervised by Mr. Nicholas M. Sergenti, QSTI, of the Stack Test Group, Inc. and coordinated by Mr. Mark A. Horne, P.E., of Environmental Partners, Inc.

All testing followed the guidelines of U.S. EPA Reference Methods 1 through 4, 25A and 320. This report contains a summary of results for the above-mentioned tests and all the supporting field, process, and computer-generated data.

3.0 SAMPLING AND ANALYTICAL PROCEDURES

3.1 Exhaust Gas Parameters

3.1.1 Traverse and Sampling Points

The number of velocity traverse and sample measurement points for each stack was determined using EPA Method 1.

Fermentation Exhaust Stack:

The stack inside diameter measured 23 inches. Velocity and sample measurements were taken at each of 16 points, 8 points across each of the two ports set at 90° to each other. The test ports were located approximately greater than 2.0 diameters downstream and greater than 0.5 equivalent diameters upstream of the nearest flow disturbances.

3.1.2 Velocity Traverse

Velocity measurements were performed during each emission test in accordance with EPA Method 2. An "S" type Pitot Tube with an attached type "K" thermocouple was used to conduct the velocity traverse.

3.1.3 Gas Composition

Gas composition for oxygen, carbon dioxide, and nitrogen was determined employing EPA Method 3A. A continuous gas sample was collected during each emission test. Gas analysis was conducted using a calibrated Servomex Model 1440C oxygen/carbon dioxide analyzer.

3.1.4 Moisture Content

Moisture content of the gas stream for the fermentation scrubber exhaust stack was determined using Method 320.

3.2 Volatile Organic Compounds (VOC)

3.2.1 Sample Collection

Volatile organic compounds (VOC) emission testing was determined using U.S. EPA Method 25A. A gas sample was drawn from the exhaust stacks through a filter and transported to through a heated sample line directly to JUM 3-300 total hydrocarbon analyzers.

3.2.2 Sample Duration and Frequency

The samples were collected in triplicate with each test lasting one-hundred twenty minutes in duration. A sample was drawn at least twice as long as the response time before the beginning of each test. The response time for each FID was approximately 45 seconds.

3.2.3 Calibration

At the beginning of the test series, the analyzers were calibrated and then checked for calibration error by introducing zero, low-range, mid-range and high-range calibration gases to the back of the analyzer. Following each test run, a system bias was performed by introducing a zero and mid-range calibration gases to the outlet of the probe. Calibration gases used were U.S. EPA Protocol 1 certified.

3.2.4 Data Reduction

The analyzer outputs were recorded on datalogger and laptop computer. These one-minute datalogger readings were then averaged using an Excel spreadsheet. The raw datalogger readings are included in Appendix H.

3.3 Acetaldehyde by FTIR

3.3.1 Sample Collection

Acetaldehyde emissions were determined using U.S. EPA Method 320. The speciated compounds tested for were listed in the permit issued to this facility. The entire FTIR report is included in Appendix D.

3.3.2 Sample Duration and Frequency

The samples were collected in triplicate with each test lasting one-hundred twenty minutes in duration. The FTIR testing was conducted simultaneously with the VOC emission and destruction efficiency testing.

3.3.3 Calibration

The FTIR was calibrated according to the procedures outlined in Method 320. The calibrations along with the calibration gas certifications are included in Appendix D.

4.0 TEST RESULTS

Presented in this section are the results of this test series. Test results are reported in Tables 4.1. Table 4.1 reports the stack gas conditions for the fermentation scrubber exhaust stack including stack gas temperature, percent carbon dioxide and oxygen, percent moisture, molecular weight of the stack gas dry and wet, velocity in feet per second (fps), and flow rate in actual cubic feet per minute (acfm), standard cubic feet per minute (scfm), and dry standard cubic feet per minute (dscfm).

Table 4.1 also presents the volatile organic compound (VOC) and acetaldehyde results for the fermentation scrubber. Results are presented in terms of parts per million (PPM), pounds per dry standard cubic feet (LBS/DSCF), and pounds per (LBS/HR) hour for both VOC and acetaldehyde.

Copies of the calculations used to determine these emission rates may be found in Appendix A. Copies of the field data sheets are presented in Appendix B. Copies of FTIR data are presented in Appendix D. Copies of equipment calibrations are presented in Appendix E.

Table 4.1

VOC & Acetaldehyde Test Results

Carbon Green Bio Energy (CGBE)
Lake Odessa, Michigan
03/16/18
Scrubber Exhaust Stack

Test No:	T1	T2	T3	Avg.
Start Time:	06:05 AM	07:25 AM	11:15 AM	
Finish Time:	07:05 AM	08:25 AM	12:15 PM	
Stack Gas Temperature, degrees F:	51.3	51.6	52.5	51.8
% Carbon Dioxide:	91.4	91.1	90.8	91.1
% Oxygen:	0.2	0.2	0.1	0.2
% Moisture:	0.79	1.60	1.46	1.28
Molecular Weight dry, lb/lb-Mole:	42.63	42.58	42.53	42.58
Molecular Weight wet, lb/lb-Mole:	42.44	42.19	42.17	42.26
Velocity and Flow Results:				
Average Stack Gas Velocity FPS:	34.72	36.51	42.54	37.93
Stack Gas Flow Rate, ACFM:	6,020	6,331	7,376	6,576
Stack Gas Flow Rate, SCFM:	6,140	6,453	7,506	6,700
Stack Gas Flow Rate, DSCF/HR:	365,509	380,984	443,758	396,750
Stack Gas Flow Rate, DSCFM:	6,092	6,350	7,396	6,613
VOC Results:				
PPM as Propane:	13.3	12.3	20.5	15.4
LBS/DSCF:	1.52E-06	1.40E-06	2.34E-06	1.75E-06
LBS/HR (as Propane):	0.56	0.54	1.05	0.72
Acetaldehyde Results:				
PPM as Acetaldehyde:	1.58	1.62	29.04	10.75
LBS/DSCF:	1.80E-07	1.85E-07	3.32E-06	1.23E-06
LBS/HR (as Acetaldehyde):	0.07	0.07	1.49	0.54