BTEC Inc.



# EUBIOGASFLARE Emissions Test Report

*Prepared for:*

**Packaging Corporation of America**

Packaging Corporation of America
2246 Udell Street
Filer City, Michigan 49634

Project No. 17-4999.01
August 14, 2017

BT Environmental Consulting, Inc.
4949 Fernlee Avenue
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BTEC Inc.

## Executive Summary

BT Environmental Consulting, Inc. (BTEC) was retained by Packaging Corporation of America (PCA) to perform testing for heat content and hydrogen sulfide ($H_2S$), of the scrubber biogas routed to the EUBIOGASFLARE (biogas flare). The biogas flare is located at the PCA facility in Filer City, Michigan. Testing was conducted on June 22, 2017.

## 1.0 Introduction

BT Environmental Consulting, Inc. (BTEC) was retained by Packaging Corporation of America (PCA) to perform testing for heat content and hydrogen sulfide ($H_2S$), of the biogas routed to the EUBIOGASFLARE (biogas flare). The biogas flare is located at the PCA facility in Filer City, Michigan.

### 1.1 Purpose of Test

Testing was done to demonstrate compliance with MDEQ permit number is MI-ROP-B3692-2015b, special conditions V.2 and VI.1 of FGBIOGASSYSTEM. The $H_2S$ limit is 4.49 lb/hr before combustion in a boiler or flare. The SO2 limit is 8.45 lb/hr exiting the boiler or flare and is calculated by assuming complete combustion of $H_2S$ to $SO_2$. PCA is required by permit to document the BTU's in the biogas fuel on an annual basis.

### 1.2 Test Date

This test program was performed on June 22, 2017.

### 1.3 Project Contact Information

| Affiliation | Address | Contact |
|---|---|---|
| Test Facility | Packaging Corporation of America<br>2246 Udell Street<br>Flier City, Michigan 49634 | Ms. Sara Kaltunas<br>231-510-4689<br>skaltunas@packagingcorp.com |
| Test Company Representative | BT Environmental Consulting, Inc.<br>4949 Fernlee Avenue<br>Royal Oak, Michigan 48073 | Mr. Barry Boulianne<br>313-449-2361<br>bboulianne@btecinc.com |

This test program was performed by Todd Wessel and Mason Sakshaug of BTEC. Ms. Sara Kaltunas of PCA coordinated the test events for this project.

### 1.4 Summary of Results

A summary of H2S results is presented in Table 1. Detailed results can be found appended to this report.

**Table 1**
**Summary of EUBIOGASFLARE Emission Rates**

| Sampling Location | Target Analyte | Emission Rate (lb/hr) | Permit Limit (lb/hr) |
|---|---|---|---|
| SVBIOGASFLARE | post combustion $H_2S$ | 0.003 | 0.0449 |
| | pre combustion $H_2S$ | 0.309 | 4.49 |
| | $SO_2$ | 0.581 | 8.45 |

The average higher heating value (HHV) of the biogas was measured to be 724 British thermal units per dry standard cubic foot (Btu/dscf). Detailed results are contained in Appendix B.

## 2.0 Process Description

PCA operates the biogas flare as part of the FGBIOGASSYSTEM that is used to combust biogas during upset or malfunction conditions that may occur with the biogas generating system or the combustion boilers. If no upset conditions occur in the process, the biogas is directed to Boiler No. 4 (EUBOILER4A) and combined with natural gas to generate steam for various mill process operations, and for electrical generation.

## 3.0 Reference Methodologies

Triplicate fifty (50)-minute test runs were performed on the biogas prior to the scrubber in accordance with specifications stipulated in ASTM D-5504 and in accordance with MDEQ requirements.

A minimum vacuum of 5 inches of mercury is required on the evacuated summa canister to ensure proper sample collection. All test runs were stopped once the minimum vacuum was attained.

### 3.1 Hydrogen sulfide

Hydrogen Sulfide concentrations were determined following ASTM guidelines as described in ASTM D-5504. The samples were extracted using evacuated summa canisters with low flow regulators. The sample stream was vented and aspirated to the summa canister for collection. Samples were labeled and immediately shipped for analysis within the required 24-hour period.

## 4.0 Quality Assurance

Each promulgated method described above is accompanied by a statement indicating that to obtain reliable results, persons using these methods should have a thorough knowledge of the techniques associated with each. To that end, BTEC attempts to minimize any factors in the field that could increase error by implementing a quality assurance program into every testing activity segment.

## 5.0 Discussion of Results

The flow rate was measured at approximately 0 dcfm for the first 19 minutes of Run 2 due to a loss of wastewater influent feed during a paper machine break. Wastewater influent to the biogas facility is made up primarily of process dilution water for the mill's paper machines so if there is any paper machine equipment downtime, planned or unplanned, wastewater flow to the biogas facility is reduced during that time. Sampling for Run 2 was paused at 9:41am and resumed at 12:15 pm when the flow rate increased. The measured average biogas flare $H_2S$ emission rates are less than MDEQ permit Number MI-ROP-B3692-2016b requirements.

## Limitations

The information and opinions rendered in this report are exclusively for use by PCA. BTEC will not distribute or publish this report without PCA's consent except as required by law or court order. BTEC accepts responsibility for the competent performance of its duties in executing the assignment and preparing reports in accordance with the normal standards of the profession, but disclaims any responsibility for consequential damages.

This report was prepared by:

Mason Sakshaug
Environmental Technician

This report was reviewed by:

Brandon V. Chase
Senior Environmental Engineer

Table 2

EUBIOGASFLARE H2S and SO2 Concentrations and Emission Rates

| | Start | End |
|---|---|---|
| Test 1 | 6/22/2017 8:26 | 6/22/2017 9:16 |
| Test 2a | 6/22/2017 9:22 | 6/22/2017 9:42 |
| Test 2b | 6/22/2017 12:15 | 6/22/2017 12:45 |
| Test 3 | 6/22/2017 12:47 | 6/22/2017 13:37 |

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**RESULTS**

| | H2S Conc. | | Average Flow (60°F & 1 atm) | | Standard flow (70°F & 1 atm) | | Mass Flow (total) | | Emitted[1] | | Emitted[2] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Test 1 | 554 | ppm | 22.93 | dcfm | 23.367 | dscfm | **0.068** | **Lb/hr H2S** | **0.001** | **Lb/hr H2S** | **0.129** | **Lb/hr SO2** |
| Test 2 | 892 | ppm | 17.36 | dcfm | 17.697 | dscfm | **0.083** | **Lb/hr H2S** | **0.001** | **Lb/hr H2S** | **0.157** | **Lb/hr SO2** |
| Test 3 | 1899 | ppm | 75.85 | dcfm | 77.305 | dscfm | **0.775** | **Lb/hr H2S** | **0.008** | **Lb/hr H2S** | **1.459** | **Lb/hr SO2** |
| | | | | | | **Average** | **0.309** | **Lb/hr H2S** | **0.003** | **Lb/hr H2S** | **0.581** | **Lb/hr SO2** |

[1] Calculated by assuming 99% destruction of H2S during combustion

[2] Calculated by assuming complete combustion of H2S to SO2

**CALCULATIONS:**

Converting PPMvd to Lbs/Hr:

$$\frac{lb-mole\ pollutant}{MM\ lb-mole\ air}\times\frac{lb\ pollutant}{lb-mole\ pollutant}\times\frac{lb-mole\ air}{386.5\ ft^3\ air}\times\frac{ft^3\ air}{min}\times\frac{60\ min}{hr}=lb/hr$$

$$\frac{1899\ lb-mole\ H2S}{MM\ lb-mole\ biogas}\times\frac{34\ lbs\ H2S}{1\ lb-mol\ H2S}\times\frac{1\ lb-mole\ biogas}{386.5\ ft^3\ biogas}\times\frac{77.305 ft^3\ biogas}{min}\times\frac{60\ min}{hr}=0.775\frac{lb}{hr}H2S$$

Converting flow to DSCFM (70°F & 1 atm) from DCFM (60°F & 1 atm):

$$Q_{scfm}=Q_{acfm}\times\frac{460+70°F}{460+T_o}\times\frac{P_o}{P_s}$$

$$78.392_{scfm}=76.91_{acfm}\times\frac{460+70°F}{460+60°F}\times\frac{1\ atm}{1\ atm}$$

Where:

$P_o$ = Pressure at multivariable flow meter (1 atm)

$T_o$ = Temperature at multivariable flow meter (60°F)

Converting H2S lbs/hr to SO2 lbs/hr:

$$H_2S+1.5O_2\rightarrow SO_2+H_2O$$

$$\frac{lb\ H2S}{hr}\times\frac{1\ lb-mole\ H2S}{34\ lbs\ H2S}\times\frac{1\ lb-mole\ SO2}{1\ lb-mole\ H2S}\times\frac{64\ lbs\ SO2}{1\ lb-mole\ SO2}=\frac{lb}{hr}SO2$$

$$\frac{1.544\ lb\ H2S}{hr}\times\frac{1\ lb-mole\ H2S}{34\ lbs\ H2S}\times\frac{1\ lb-mole\ SO2}{1\ lb-mole\ H2S}\times\frac{64\ lbs\ SO2}{1\ lb-mole\ SO2}=2.907\frac{lb}{hr}SO2$$

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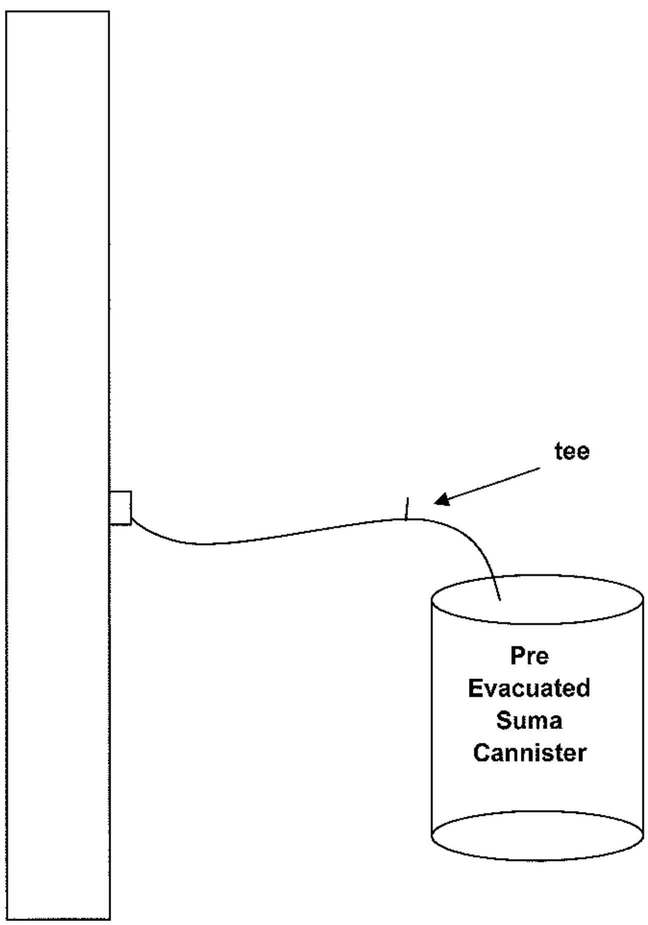


Figure No. 1

| Site: | Sampling Date: | |
|---|---|---|
| Sampling Schematic | June 22, 2017 | BT Environmental Consulting, Inc. |
| Packaging Corporation of America | | 4949 Fernlee Avenue |
| Filer City, Michigan | | Royal Oak, Michigan |