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. 16-4832.01
June 22, 2016

BT Environmental Consulting, Inc.
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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 May 10, 2016.

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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 210-15 special conditions V.2 and VI.1. The H_2S limit is 4.49 lb/hr before combustion in a boiler or flare. The SO_2 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 May 10, 2016.

1.3 Project Contact Information

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

Sampling Location	Target Analyte	Emission Rate (lb/hr)	Permit Limit (lb/hr)
SVBIOGASFLARE	post combustion H_2S	0.015	0.0449
	pre combustion H_2S	1.529	4.49
	SO_2	2.877	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 sixty (60)-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

No problems were encountered during testing. Operations appeared normal with no apparent problems. The measured average biogas flare H_2S emission rate was within MDEQ permit Number 210-15 requirements.

Table 2

RESULTS

	H2S Conc.		Average Flow (60°F & 1 atm)		Standard flow (70°F & 1 atm)		Mass Flow (total)		Emitted[1]		Emitted[2]	
Test 1	3732	ppm	76.91	dcfm	78.392	dscfm	**1.544**	**Lb/hr H2S**	**0.015**	**Lb/hr H2S**	**2.907**	**Lb/hr SO2**
Test 2	3872	ppm	74.32	dcfm	75.745	dscfm	**1.548**	**Lb/hr H2S**	**0.015**	**Lb/hr H2S**	**2.914**	**Lb/hr SO2**
Test 3	3854	ppm	72.04	dcfm	73.426	dscfm	**1.494**	**Lb/hr H2S**	**0.015**	**Lb/hr H2S**	**2.812**	**Lb/hr SO2**
						Average	**1.529**	**Lb/hr H2S**	**0.015**	**Lb/hr H2S**	**2.877**	**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:

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

$$\frac{3732\ lb-mole\ H2S}{MM\ lb-mole\ biogas}\times\frac{34\ lbs\ H2S}{1\ lb-mol\ H2S}\times\frac{1\ lb-mole\ biogas}{386.5\ ft^3\ biogas}\times\frac{78.392\ ft^3\ biogas}{min}\times\frac{60\ min}{hr}=1.544\frac{lb}{hr}H2S$$

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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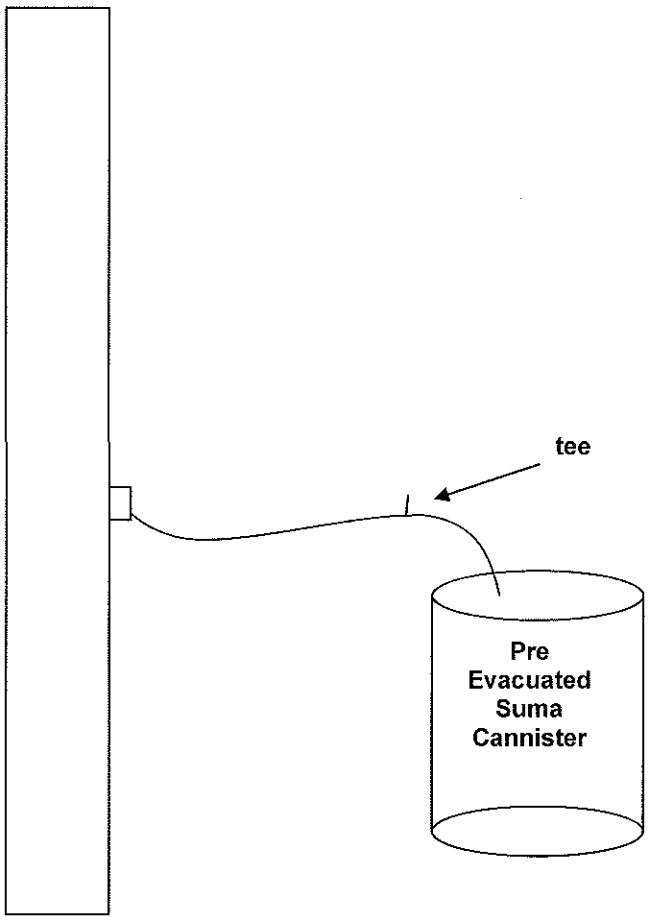

Figure No. 1

Site: Sampling Schematic Packaging Corporation of America Filer City, Michigan	Sampling Date: May 10, 2016
	BT Environmental Consulting, Inc. 4949 Fernlee Avenue Royal Oak, Michigan