Executive Summary

Battery Solutions Recovery, LLC (Battery Solutions) retained Bureau Veritas North America, Inc. to conduct air emissions testing on the EUALKALINE Baghouse at the Battery Solutions Recovery, LLC facility located at 4930 Holtz Drive in Wixom, Michigan. The purpose of the air emission testing was to evaluate compliance with certain emission limits in Permit to Install 248-09B, issued by Michigan Department of Environmental Quality on September 28, 2018.

The testing followed United States Environmental Protection Agency Reference Methods 1 through 5, 22, and 202. Three 60-minute runs were conducted to measure particulate matter concentrations and mass emission rates, and visual emissions at the EUALKALINE Baghouse source.

Detailed results are presented in Table 1 after the Table Tab of this report. The following table summarizes the results of the testing conducted on March 21 and 22, 2019.

EUALKALINE Baghouse Emissions Results

Parameter	Unit	Result	Emission Limit
Particulate matter	lb/1,000 lb gas	0.0011	0.01
PM_{10} and $PM_{2.5}$	lb/hr	0.069	0.16
Visible emissions	% opacity as a 6-minute average	0	10

$PM_{10/2.5}$: sum of total filterable particulate matter (Method 5) and condensable particulate matter (Method 202)
lb/1,000 lb gas: pounds per 1,000 pounds of gas, calculated on a dry gas basis
lb/hr: pound per hour

1.0 Introduction

1.1 Summary of Test Program

Battery Solutions Recovery, LLC (Battery Solutions) retained Bureau Veritas North America, Inc. (Bureau Veritas) to conduct air emissions testing on the EUALKALINE Baghouse at the Battery Solutions Recovery, LLC facility located at 4930 Holtz Drive in Wixom, Michigan. The purpose of the air emission testing was to evaluate compliance with certain emission limits in Permit to Install 248-09B, issued by Michigan Department of Environmental Quality (MDEQ) on September 28, 2018.

The testing followed United States Environmental Protection Agency Reference Methods 1 through 5, 22, and 202. Three 60-minute runs were conducted to measure particulate matter concentrations and mass emission rates, and visual emissions at the EUALKALINE Baghouse source.

1.2 Key Personnel

The key personnel involved in this test program are listed in Table 1-1. Mr. David Kawasaki, Staff Consultant with Bureau Veritas, led the emission testing program. Mr. Adam Hancock, Manager with Battery Solutions, provided process coordination and recorded operating parameters. Mr. David Patterson and Ms. Kaitlyn Leffert, with MDEQ, witnessed the testing.

Table 1-1
Key Personnel

Tom Edwards Manager, Quality Environmental Health & Safety Battery Solutions Recovery, LLC 4930 Holtz Drive Wixom, Michigan 48393 Tel: 248.446.5633 tom@batterysolutions.com	Adam Hancock Manager, Battery Solutions Recovery Battery Solutions Recovery, LLC 4930 Holtz Drive Wixom, Michigan 48393 Tel: 248.446.5684 ahancock@batterysolutions.com
David Patterson Environmental Quality Analyst Michigan Department of Environmental Quality 525 West Allegan Street Lansing, Michigan 48909 Tel. 517.284.6782 pattersond2@michigan.gov	Iranna Konanahalli Air Quality Division Michigan Department of Environmental Quality 27700 Donald Court Warren, Michigan 48092 Tel. 586.753.3741 konanahallii@michigan.gov
David Kawasaki, QSTI Staff Consultant Bureau Veritas North America, Inc. 22345 Roethel Drive Novi, Michigan 48375 Tel: 248.344.3081 david.kawasaki@us.bureauveritas.com	

2.0 Source and Sampling Locations

2.1 Process Description

Battery Solutions collects and recycles, or upcycles, batteries and repurposes the secondary commodities for reuse in steel manufacturing, agriculture, and new battery manufacturing. End-of-life batteries are collected, sorted, and processed at the facility. After sorting, batteries are sent to the EUALKALINE production line. The line grinds dry cell alkaline batteries into a powder for recovery and reuse as a saleable product.

2.2 Control Equipment

The EUALKALINE production line exhaust is controlled by a baghouse to capture particulate emissions. Operating parameters were measured and recorded by Battery Solutions personnel during testing. Table 2-1 summarizes the production rate and baghouse pressure drop during testing of the EUALKALINE baghouse. Operating parameters are included in Appendix F.

Table 2-1
Summary of EUALKALINE Operation Data

Run	Production Rate (lb/hr)	Pressure Drop (daPa)
1	1,744	103
2	1,972	109
3	1,826	105
Average	**1,847**	**106**

2.3 Flue Gas Sampling Locations

The EUALKALINE baghouse outlet duct is 18.75 inches in diameter and has two 4.5-inch-diameter sampling ports. The downstream and upstream distances from the sampling ports to the closest air flow disturbances meet USEPA Method 1 minimum criteria. Eight traverse points, four traverse points per sampling port, were used to measure flue gas velocity and particulate matter. Figure 1 in the Appendix depicts the source sampling ports and traverse point locations.

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2.4 Process Sampling Locations

Process sampling was not required during this test program. A process sample is a sample that is analyzed for operational parameters, such as calorific value of a fuel (e.g., natural gas, coal), organic compound content (e.g., paint coatings), or composition (e.g., polymers).

3.0 Summary and Discussion of Results

3.1 Objectives

The air emission testing was performed to satisfy testing requirements and to evaluate compliance with certain emission limits in Permit to Install 248-09B, issued by MDEQ, on September 28, 2018.

Table 3-1 summarizes the sampling and analytical matrix.

Table 3-1
Sampling and Analytical Test Matrix

Sampling Location	No. of Runs	Sample/Type of Pollutant	Sampling Method	Sampling Organization	Test Time (min)	Analytical Method	Analytical Laboratory
EUALKALINE Baghouse	3	Flowrate, particulate matter, visible emissions	USEPA 1-5, 22, 202	Bureau Veritas	60	Gravimetric	Bureau Veritas

3.2 Field Test Changes and Issues

Communication between Battery Solutions, Bureau Veritas, and MDEQ allowed the testing to be completed as proposed in the Intent-to-Test Plan, dated February 20, 2019. Test Run 2 was paused for approximately one hour, during the port change, due to a pause in production.

3.3 Summary of Results

The results of the testing are presented in Table 3-2. Detailed results are presented in Table 1 after the Table Tab in the Appendix of this report. Sample calculations are presented in Appendix B.

Table 3-2
EUALKALINE Emissions Results

Parameter	Unit	Result	Emission Limit
Particulate matter	lb/1,000 lb gas	0.0011	0.01
PM_{10} and $PM_{2.5}$	lb/hr	0.069	0.16
Visible emissions	% opacity as a 6-minute average	0	10

$PM_{10/2.5}$: sum of total filterable particulate matter (Method 5) and condensable particulate matter (Method 202)
lb/1,000 lb gas: pounds per 1,000 pounds of gas, calculated on a dry gas basis
lb/hr: pound per hour

4.0 Sampling and Analytical Procedures

Bureau Veritas used USEPA sampling Methods 1 through 5, 22, and 202. Table 4-1 presents the emissions test parameters and sampling methods.

Table 4-1
Emission Test Parameters

Parameter	EUALKALINE Baghouse	USEPA Reference	
		Method	Title
Sampling ports and traverse points	•	1	Sample and Velocity Traverses for Stationary Sources
Velocity and flowrate	•	2	Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)
Molecular weight	•	3	Gas Analysis for the Determination of Dry Molecular Weight
Moisture content	•	4	Determination of Moisture Content in Stack Gases
Particulate matter (PM)	•	5	Determination of Particulate Matter Emissions from Stationary Sources
Visible emissions	•	22	Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares
Particulate matter less than 10 or 2.5 microns ($PM_{10/2.5}$)	•	202	Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources

4.1 Test Methods

4.1.1 Volumetric Flowrate (USEPA Methods 1 and 2)

Method 1, "Sample and Velocity Traverses for Stationary Sources," from 40 CFR 60, Appendix A, was used to evaluate the sampling location and the number of traverse points for the measurement of velocity profiles. Details of the sampling location and number of velocity traverse points are presented in Table 4-2.

Table 4-2
Sampling Location and Number of Traverse Points

Sampling Locations	Duct Diameter (inch)	Distance to Upstream Flow Disturbance (diameter)	Distance to Downstream Flow Disturbance (diameter)	Number of Ports	Traverse Points per Port	Total Points
EUALKALINE Baghouse	18.75	15.4	2	2	4	8

Figure 1 in the Appendix depicts the sampling location and traverse points for the source tested.

Method 2, "Determination of Stack Gas Velocity and Volumetric Flow Rate (Type S Pitot Tube)," was used to measure flue gas velocity and calculate volumetric flowrate. S-type Pitot tubes and thermocouple assemblies calibrated in accordance with Method 2, Section 10.0, and connected to digital manometer, were used. Because the dimensions of the Pitot tube met the requirements outlined in Method 2, Section 10, and were within the specified limits, a baseline Pitot tube coefficient of 0.84 (dimensionless) was assigned.

The digital manometer and thermometer that were used are annually calibrated using calibration standards which are traceable to National Institute of Standards (NIST). Refer to Appendix A for the calibration and inspection sheets. Sample calculations and field data sheets are included in Appendices B and C. Appendix D provides the computer generated data sheets.

Cyclonic Flow Check. Bureau Veritas evaluated whether cyclonic flow is present at the sampling locations.

Cyclonic flow is defined as a flow condition with an average null angle greater than 20°. The direction of flow can be determined by aligning the Pitot tube to obtain zero (null) velocity head readings—the direction would be parallel to the Pitot tube face openings or perpendicular to the null position. By measuring the angle of the Pitot tube face openings in relation to the stack walls when a null angle is obtained, the direction of flow is measured. If the absolute average of the flow direction angles is greater than 20°, the flue gas flow is considered to be cyclonic at that sampling location and an alternative location should be found.

The average of the measured traverse point flue gas velocity null angles were less than 20° at the sampling location. The measurements indicate the absence of cyclonic flow.

4.1.2 Molecular Weight (USEPA Method 3)

Molecular weight was measured using USEPA Method 3, "Gas Analysis for the Determination of Dry Molecular Weight." Flue gas was extracted from the stack through a probe positioned near the centroid of the duct and directed into a Fyrite® gas analyzer. The concentrations of carbon dioxide (CO_2) and oxygen (O_2) were measured by chemical absorption with a Fyrite® gas analyzer to within ±0.5%. The average CO_2 and O_2 result of the grab samples were used to calculate molecular weight.

4.1.3 Moisture Content (USEPA Method 4)

The moisture content of the flue gas was measured following USEPA Method 4, "Determination of Moisture Content in Stack Gases," in conjunction with USEPA Methods 5 and 202. Prior to testing, Bureau Veritas estimated the moisture content using previous stack test data, wet bulb-dry bulb measurements, and/or psychrometric tables.

4.1.4 Filterable Particulate Matter (USEPA Methods 5 and 202)

USEPA Methods 5, "Determination of Particulate Matter Emissions from Stationary Sources" and 202, "Dry Impinger Method for Determining Condensable Particulate Emissions from Stationary Sources," were used to measure particulate matter emissions. USEPA Method 5 measures filterable particulate matter (FPM), while the Method 202 train collects condensable particulate matter (CPM).

CPM is defined as material that is in vapor phase at stack conditions, but that condenses and/or reacts upon cooling and dilution in the ambient air to form solid or liquid FPM immediately after discharge from the stack. Method 202 collects CPM using a water-dropout impinger, modified Greenburg-Smith impinger, and a Teflon filter.

The sum of the Method 5 (FPM) and Method 202 (CPM) mass collected represent total particulate matter, which was used as a conservative measurement of particulate matter with diameter less than 10 microns (PM_{10}) and particulate matter with diameter less than 2.5 microns ($PM_{2.5}$).

Bureau Veritas' modular Methods 5 and 202 isokinetic stack sampling system consists of the following (in order from the stack to the control case):

- A stainless steel button-hook nozzle.
- A heated (248±25°F) stainless steel probe.
- A desiccated and pre-weighed 83-millimeter-diameter glass fiber filter (manufactured to at least 99.95% efficiency (<0.05 % penetration) for 0.3-micron dioctyl phthalate smoke particles) in a heated (248±25°F) filter box.
- An USEPA Method 23-type stack gas condenser with water recirculation pump.
- A set of four GS impingers with the configuration shown in Table 4-3.

- A second (back-half) CPM Teflon filter inserted between the second and third impingers and maintained at a temperature between 65 and 85°F.

- A sampling line.

- An Environmental Supply® control case equipped with a pump, dry-gas meter, and calibrated orifice.

Figure 4-1 depicts the USEPA Methods 5 and 202 sampling train.

Table 4-3
USEPA Methods 5 and 202 Impinger Configuration

Impinger Order (Upstream to Downstream)	Impinger Type	Impinger Contents	Amount
1	Modified – dropout	Empty	0 milliliter
2	Modified	Empty	0 milliliter
CPM Filter			
3	Modified	HPLC water	100 milliliter
4	Modified	Silica gel desiccant	~200-300 grams

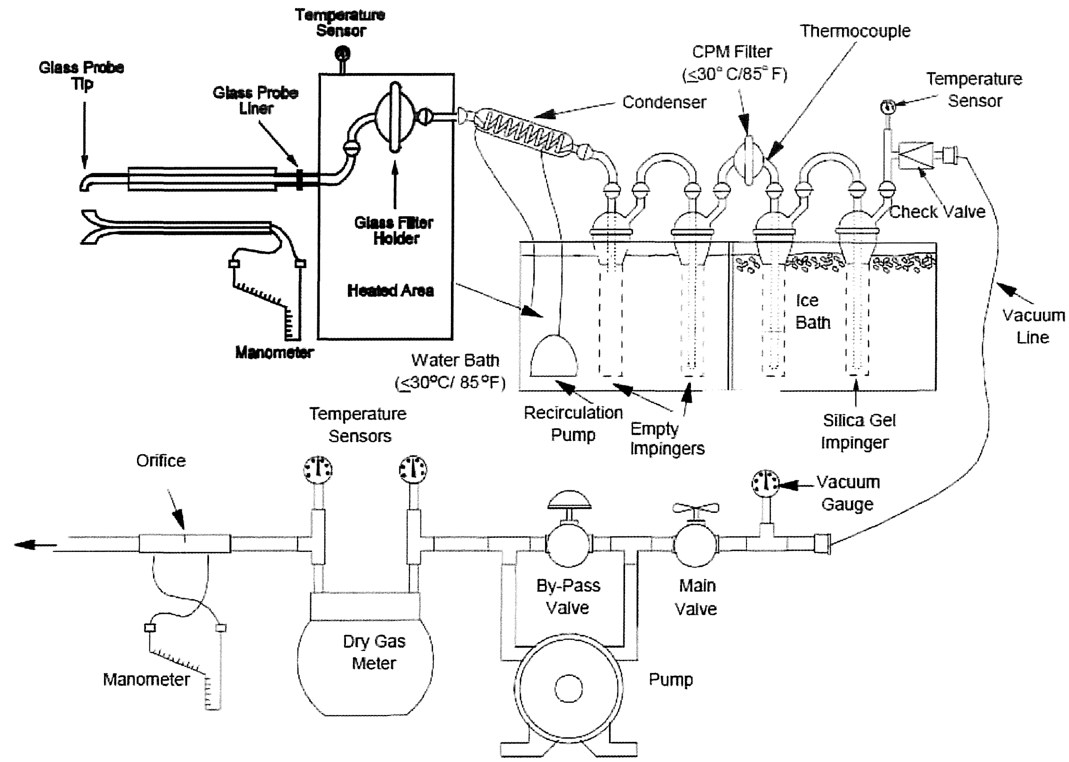

Figure 4-1. USEPA Methods 5 and 202 Sampling Train

4.1.5 Visible Emissions (USEPA Method 22)

Bureau Veritas determined visible emissions in accordance with USEPA Method 22, "Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares." Visible emissions were observed during three 60-minute test runs.

Fugitive emissions from the stack were observed from a position with a clear view of the potential emissions source. The observation location was at least 15 feet, but not more than 0.25 miles, from the emission source, at a point where the sunlight was not shining directly into the observer's eyes.

During the observation period, the observer continuously watched the emission source. Upon observing an emission, the amount of time the emission was observed was recorded. This procedure continued for the entire observation period. The observer recorded the accumulated time that emissions were observed on a field data sheet, which are included in Appendix C.

The observer recorded the emission location, facility type, observer's name and affiliation, and the date on a field data sheet. The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background were also recorded. The observer sketched the emission source being observed and indicated the potential and actual emission points, as well as, noted the observer's location relative to the source and the sun.

4.2 Procedures for Obtaining Process Data

Battery Solutions personnel recorded process data during testing. The process data are included within Appendix F.

4.3 Sampling Identification and Custody

Mr. David Kawasaki, Staff Consultant with Bureau Veritas, was responsible for the handling and procurement of the data collected in the field. Mr. Kawasaki ensured the data sheets were accounted for and completed in their entirety. Recovery and analytical procedures were applicable to the sampling methods used in this test program. Applicable Chain of Custody procedures followed guidelines outlined within ASTM D4840-99 (Reapproved 2010), "Standard Guide for Sample Chain-of-Custody Procedures." Detailed sampling and recovery procedures are described in Section 4.0. For each sample collected (i.e., filter and probe rinse) sample identification and custody procedures were completed as follows:

- Containers were sealed with Teflon tape to prevent contamination.
- Containers were labeled with test number, location, and test date.
- Samples were logged using guidelines outlined in ASTM D4840-99 (Reapproved 2010).
- Samples were transported to the laboratory under chain of custody.

Chains of custody and laboratory analytical results are included in Appendix E.