3rd Quarter Emissions Testing Report 2019

Infrabuild Recycling Hexham

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Client: Infrabuild Recycling Pty Ltd

ABN: 28 002 707 262

Prepared by

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30-Aug-2019

Job No.: 60493017

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Quality Information

Document	3rd Quarter Emissions Testing Report 2019
Ref	60493017
Date	29-Aug-2019
Prepared by	Colin Clarke
Reviewed by	Paul Wenta
AECOM Approved Signatory	Chad Whitburn

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
0	30-Aug-2019	Report for Issue	Chad Whitburn Associate Director - Compliance Services	

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1.0 Introduction

AECOM was appointed by Infrabuild Recycling Pty Ltd to conduct a series of measurements to determine air emissions from the Shredder Baghouse Stack (EPL Point 1) at the Hexham facility. Measurements were required for NSW EPA licence compliance (EPL No. 5345).

Testing was undertaken on 8 August 2019 to investigate emission concentrations for the following parameters:

- Fine Particulates (PM_{10});
- Total Particulate (TP); and
- Hazardous Substances (Metals) including Lead and Mercury.

Laboratory analysis was undertaken by the following laboratories which hold NATA accreditation for the specified tests:

- Steel River Testing, laboratory NATA accreditation number 18079, performed the following analysis detailed in report number 19485-0-M & 19485-0-P:
  - Total Particulate (TP);
  - Fine Particulates (PM_{10}); and
  - Moisture.
- SGS Australia Pty Ltd, NATA accreditation number 2562, performed the following analysis detailed in report number ME311573 R0:
  - Hazardous Substances (Metals).

2.0 Sampling Plane Requirements

The criteria for sampling planes are specified in AS 4323.1-1995 (R2014).

Table 1 Criteria for Selection of Sampling Planes (AS 4323.1)

Type of flow disturbance	Minimum distance upstream from disturbance, diameters (D)	Minimum distance downstream from disturbance, diameters (D)
Bend, connection, junction, direction change	>2D	>6D
Louvre, butterfly damper (partially closed or closed)	>3D	>6D
Axial fan	>3D	>8D (see Note)
Centrifugal fan	>3D	>6D

NOTE: The plane should be selected as far as practicable from a fan. Flow straighteners August be required to ensure the position chosen meets the check criteria listed in Items (a) to (f) below.

a. The gas flow is basically in the same direction at all points along each sampling traverse;

b. The gas velocity at all sampling points is greater than 3 m/s;

c. The gas flow profile at the sampling plane shall be steady, evenly distributed and not have a cyclonic component which exceeds an angle of 15^{o} to the duct axis, when measured near the periphery of a circular sampling plane;

d. The temperature difference between adjacent points of the survey along each sampling traverse is less than 10% of the absolute temperature, and the temperature at any point differs by less than 10% from the mean;

e. The ratio of the highest to lowest pitot pressure difference shall not exceed 9:1 and the ratio of highest to lowest gas velocities shall not exceed 3:1. For isokinetic testing with the use of impingers, the gas velocity ratio across the sampling plane should not exceed 1.6:1; and

f. The gas temperature at the sampling plane should preferably be above the dewpoint.

The sampling plane for EPL Point 1 was compliant with the AS4323.1.

3.0 Methodology

3.1 NATA Accredited Methods

The following methods are accredited with the National Association of Testing Authorities (NATA) (accreditation number 2778 (14391)) and are approved for the sampling and analysis of gases. Specific details of the methods are available on request.

All sampling and analysis is conducted according to the methods in **Table 2**.

Table 2 AECOM NATA Endorsed Methods

NSW EPA Approved Methods	USEPA Methods	Method Title
AS4323.1	USEPA (2000) Method 1	Selection of sampling positions
AS4323.2	USEPA (2000) Method 5	Determination of total particulate matter – isokinetic manual sampling – gravimetric method
NSW EPA TM-2	USEPA (2000) Method 2	Determination of stack gas velocity and volumetric flow rate (type s pitot tube)
NSW EPA TM-22	USEPA (2000) Method 4	Determination of moisture content in stack gases
NSW EPA TM-23	USEPA (2000) Method 3	Gas analysis for the determination of dry molecular weight
NSW EPA OM-5	USEPA (1997) Method 201A	Determination of PM_{10} emissions
NSW EPA TM-12,13 and 14	USEPA Method 29	Determination of metal emissions from stationary sources

All parameters are reported adjusted to 0°C at 1 atmosphere and dry gas.

3.2 Equipment Calibration

AECOM has a calibration schedule to ensure the emission testing equipment is maintained in good order and with known calibration. Equipment used in this project was calibrated according to the procedures and frequency identified in the AECOM calibration schedule. Details of the schedule and the calibration calculations are available on request.

4.0 Sampling Location

4.1 Sampling Location Summary

Table 3 provides a summary of the location sampled by AECOM on 8 August 2019.

Table 3 Sampling Location Summary

Discharge Description	Shredder Baghouse Stack (EPL Point 1)
Duct Shape	Circular
Construction Material	Metal
Duct Diameter (mm)	760
Minimum No. Sampling Points	12
Sampling Ports	2
Min. Points/Traverse	6
Disturbance	No
Distance from Upstream Disturbance	6.6D
Type of Disturbance	Bend
Distance from Downstream Disturbance	2.6D
Type of Disturbance	Stack Exit
Ideal Sampling Location	Yes
Correction Factors Applied	No
Total No. Points Sampled	12
Points/Traverse	6
Sampling Performed to Standard[1]	Yes

[1] AS 4323.1 Section 4.1
D = Diameters

5.0 Results

A summary of air emission test results is shown in **Table 4**. Detailed results along with gas stream properties during the testing period can be found in **Table 5**. Speciated Hazardous Substances (Metals) results are presented in **Table 6**. Emission concentrations are converted to standard conditions of 0°C, dry gas and 1 atm pressure for comparison with regulatory limits.

Field sheets and final calculations recorded during the project are attached as **Appendix A**. Laboratory reports can be referred to in **Appendix B**.

AECOM has a calculated limit of uncertainty in regards to results. The estimation of measurement uncertainty in source testing is conducted to provide an indication of the precision of the measurement result and a degree of confidence in the range of values the reported result August represent. The measurement of uncertainty has been calculated at ±13.6%.

Table 4 Shredder Baghouse Emission Results Summary, 8 August 2019

Parameter	Emission Concentration (EPL Point 1)	Emission Concentration Limit
Total Particulate (TP) (mg/m^3)	6.7	100
Fine Particulate (PM_{10}) (mg/m^3)	0.54	N/A
Lead (mg/m^3)	0.0027	5.0
Mercury (mg/m^3)	0.00011	1.0
Total Hazardous Substances (Metals) (mg/m^3)	0.019	N/A

Results from testing conducted on EPL Point 1 on 8 August 2019 are below the regulatory limits listed in EPL 5345.

Table 5 Fine Particulate (PM_{10}), Total Particulate and Hazardous Substance (Metals) Results, 8 August 2019

Sampling Conditions:			
Stack internal diameter at test location	760	mm	
Stack gas temperature (average)	22.0	°C	295.2 K
Stack pressure (average)	1005	hPa	
Stack gas velocity (average, stack conditions)	7.9	m/s	
Stack gas flowrate (stack conditions)	3.6	m^3/s	
Stack gas flowrate (0°C, dry gas, 1 atm pressure)	3.3	m^3/s	
Fine Particulate (PM_{10}) Testing			
Test Period	10:08	-	11:32
Fine Particulate (PM_{10}) Mass	0.6	mg	
Gas Volume Sampled	1.11	m^3	
Fine Particulate (PM_{10}) Emission*1	0.54	mg/m^3	
Fine Particulate (PM_{10}) Mass Emission Rate*2	1.8	mg/s	
Regulatory Limit	N/A	mg/m^3	
Total Particulate Testing			
Test Period	10:08	-	11:32
Total Particulate Mass	7.0	mg	
Gas Volume Sampled	1.04	m^3	
Total Particulate Emission*1	6.7	mg/m^3	
Total Particulate Mass Emission Rate*2	22	mg/s	
Regulatory Limit	100	mg/m^3	
Hazardous Substances (Metals) Testing			
Test Period	10:08	-	11:32
Hazardous Substances (Metals) Mass	0.025	mg	
Gas Volume Sampled	1.31	m^3	
Hazardous Substances (Metals) Emission*1	0.019	mg/m^3	
Hazardous Substances (Metals) Mass Emission Rate*2	0.062	mg/s	
Regulatory Limit	N/A		
Moisture Content (%)	**1.2**		
Gas Density (dry at 1 atmosphere)	**1.29**	**kg/m^3**	
Dry Molecular Weight	**28.8**	**g/g-mole**	

Notes *1 Emission concentration at Standard conditions of 0^0C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Table 6 Hazardous Substances (Metals) Elemental Analysis Results, 8 August 2019

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m^3)	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m^3)	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m^3)	Total (mg)	Total (mg/m^3)	Mass Emission Rate (mg/s)
Antimony	0.000080	0.000061	0.00020	0.00015			0.00028	0.00021	0.00069
Arsenic	<0.00081	<0.00062	<0.00020	<0.00015			<0.00010	<0.000076	<0.00025
Beryllium	<0.00005	<0.000038	<0.00010	<0.000076			<0.00010	<0.000076	<0.00025
Cadmium	0.012	0.0092	0.000050	0.000038			0.012	0.0092	0.030
Chromium	0.0011	0.00084	0.00080	0.00061			0.0019	0.0015	0.0047
Cobalt	0.000030	0.000023	<0.00010	<0.000076			0.00003	0.000023	0.000074
Copper	0.0013	0.00098	0.00045	0.00034			0.0017	0.0013	0.0042
Lead	0.0029	0.0022	0.00055	0.00042			0.0035	0.0027	0.0087
Magnesium	<0.28	<0.21	0.0032	0.0024			0.0032	0.0024	0.0079
Manganese	0.0036	0.0027	0.0014	0.0010			0.0050	0.0038	0.012
Mercury	<0.00010	<0.000076	<0.00010	<0.000076	0.00015	0.00012	0.00015	0.00011	0.00037
Nickel	0.0014	0.0011	0.00020	0.00015			0.0016	0.0012	0.0040
Selenium	<0.00010	<0.000076	0.00040	0.00031			0.00040	0.00031	0.00099
Thallium	<0.00010	<0.000076	<0.00010	<0.000076			<0.00010	<0.000076	<0.00025
Tin	0.00010	0.000076	<0.00010	<0.000076			0.00010	0.000076	0.00025
Vanadium	<0.0050	<0.0038	<0.0045	<0.0034			<0.00010	<0.000076	<0.00025
Zinc	<7.7	<5.9	0.011	0.0084			0.011	0.0084	0.027
Total Hazardous Metals*	**0.021**	**0.016**	**0.0036**	**0.0027**	**0.00015**	**0.00012**	**0.025**	**0.019**	**0.062**
Total Metals	**0.023**	**0.017**	**0.018**	**0.014**			**0.041**	**0.031**	**0.10**

* Total does not include Copper, Magnesium and Zinc as they are classed non-hazardous

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Appendix A

Field Sheets (19 pages)

Appendix A Field Sheets (19 pages)

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

Liberty Recycling Hexham

AECOM's Project Number: 60493017

Emission Source: Shredder Stack

Date Sampled: 8-Aug-19

ANALYTE(S)	METHOD
Fine Particulate (PM10)	NSW EPA OM - 5
Total Particulate	NSW EPA TM - 15
Hazardous Substances (Metals)	NSW EPA TM - 12, 13 & 14

Observations made during testing period:

Sampling Performed By:

Sharn Crosdale

for Sam Hamilton

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Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

STACK ANALYSIS - PRE-SAMPLING

Date: 8-Aug-19
Client: Liberty Recycling Hexham
AECOM's Project No: 60493017
Stack/Duct Description: Shredder Stack
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Hazardous Substances (Metals)

Measurement/Observations

Stack Internal Dimensions:

Diameter 760 mm
OR Length Width
Length/Width (mm)
Equivalent Diameter N/A mm

Cross Sectional Area : 0.45 m^2

Minimum No. of sampling points= 12

Distance from sampling plane to nearest disturbances:

Upstream (m) = 5
No. Diameters = 6.6
Type of Upstream Disturbance: Fan Entry
Downstream (m) = 2
No. Diameters = 2.6
Type of Down Stream Disturbance: Stack Exit

Total No. of sampling points = 12
PM2.5/10= 12
No. of sampling traverses/ports sampled = 2
PM2.5/10= 2
No. of sampling points on each traverse/port = 6
PM2.5/10= 6

Position of each sampling point, for each traverse:

Exclusion of any sample point numbers - comments:

No.	A Distance from wall	A S-type Pitot distances	PM10/2.5 A Distance from wall	PM2.5/10 B S-Type Pitot distances
1	33	3	33	3
2	111	81	111	81
3	225	195	225	195
4	535	505	535	505
5	649	619	649	619
6	727	697	727	697
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Check of total points against minimum, (yes/no) - comments:

General Comments:

Signed: .....

Checked: .....

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Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY PRE-SAMPLING

Date: 8-Aug-19
Client: Liberty Recycling Hexham
AECOM's Project No: 60493017
Stack/Duct Description: Shredder Stack
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Hazardous Substances (Metals)

Sampling time start:	9:30	Sampling port No.:	1	
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	9:30	0	20.9	0.0
2	9:31	0	20.9	0.0
3	9:32	0	20.9	0.0
4	9:33	0	20.9	0.0
5	9:34	0	20.9	0.0
6	9:35	0	20.9	0.0
7	9:36	0	20.9	0.0
8	9:37	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 1.00
Moisture percentage (M2): 0.20 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	78.9 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.9 %,(wet)
H_2O:	0.20 %(=M2)		
Therefore, stack gas density (GD) =		1.29 kg/m^3	(0^oC, wet, 1 atm pressure)
Therefore, stack gas density (GD) =		1.29 kg/m^3	(0^oC, dry, 1 atm pressure)

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Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - GAS COMPOSITION AND DENSITY POST-SAMPLING

Date: 8-Aug-19
Client: Liberty Recycling Hexham
AECOM's Project No: 60493017
Stack/Duct Description: Shredder Stack
Test 1: Fine Particulate (PM10)
Test 2: Total Particulate
Test 3: Hazardous Substances (Metals)

Sampling time start:	11:20	Sampling port No.:	1	
Measurement No.	Time sampled	CO (ppm). (dry)	O_2 (%), (dry)	CO_2 (%), (dry)
1	11:20	0	20.9	0.0
2	11:21	0	20.9	0.0
3	11:22	0	20.9	0.0
4	11:23	0	20.9	0.0
5	11:24	0	20.9	0.0
6	11:25	0	20.9	0.0
7	11:26	0	20.9	0.0
8	11:27	0	20.9	0.0
	Averages:	0.0 ppm	20.9 %	0.0 %

Moisture content (M3): 0.99
Moisture percentage (M2): 1.17 %

Measurements

CO:	0.0000 %,(dry)	N_2:	79.1 %,(dry)
CO_2:	0.0 %,(dry)	O_2:	20.9 %,(dry)
Gas Compositions converted to wet basis:			
CO:	0.0000 %,(wet)	N_2:	78.2 %,(wet)
CO_2:	0.0 %,(wet)	O_2:	20.7 %,(wet)
H_2O:	1.17 %(=M2)		
Therefore, stack gas density (GD) =	1.28 kg/m^3	(0^oC, wet, 1 atm pressure)	
Therefore, stack gas density (GD) =	1.29 kg/m^3	(0^oC, dry, 1 atm pressure)	

Emission Measurement Calculations Spreadsheet

Stack Analysis - Pre Sampling Pitot Tube and Temperature Traverses

Date: 8-Aug-19
Client: Liberty Recycling Hexham
AECOM's Project No: 60493017
Stack/Duct Description: Shredder Stack
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Hazardous Substances (Metals)

Time :	10:02	Barometric Pressure :		1006	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.29	kg/m^3
Pitot Tube Type :	s				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	3	0.034	20.0	293.2	6.4
1/2	81	0.040	20.0	293.2	6.9
1/3	195	0.040	20.0	293.2	6.9
1/4	505	0.041	20.0	293.2	7.0
1/5	619	0.040	20.0	293.2	6.9
1/6	697	0.042	20.0	293.2	7.1
2/1	3	0.043	20.0	293.2	7.2
2/2	81	0.046	20.0	293.2	7.4
2/3	195	0.046	20.0	293.2	7.4
2/4	505	0.051	20.0	293.2	7.8
2/5	619	0.057	20.0	293.2	8.2
2/6	697	0.048	20.0	293.2	7.6
Average			20.0	293.2	7.2

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -5.4 mm
Absolute pressure in stack (hPa) : 1005.47 hPa

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Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF FINE PARTICULATE (PM10)

Date: 8-Aug-19
Client: Liberty Recycling Hexham
AECOM's Project No: 60493017
Stack Description No.: Shredder Stack
Sample Nozzle No.: fine8
Sampling Port No.: 1 to 2
Page No: 1 of 1

Sample Nozzle Area (An): 3.55 x $10^{-5}m^2$
Thimble No: t11
Blank thimble No: 0

Leak Check (Pre-Sampling)
Meter start: 752.5778 Meter finish: 752.5778
Time start: 9:41 Time finish: 9:42

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 753.7762 Meter finish: 753.7762
Time start: 11:34 Time finish: 11:35

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1006 hPa (start); 1006 hPa (finish)
Meter start: 752.5812 Time start: 10:08
Meter correction factor (GMf) : 1.0094

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:06:15	33	14.0	18.0	16.0		Yes
1/2	0:06:45	111	14.0	19.0	16.0		Yes
1/3	0:06:45	225	14.0	20.0	16.0		Yes
1/4	0:06:45	535	14.0	23.0	17.0		Yes
1/5	0:06:45	649	14.0	25.0	18.0		Yes
1/6	0:06:45	727	14.0	25.0	19.0		Yes
2/1	0:07:00	33	14.0	26.0	19.0		Yes
2/2	0:07:15	111	14.0	26.0	20.0		Yes
2/3	0:07:15	225	14.0	26.0	20.0		Yes
2/4	0:07:30	535	14.0	27.0	21.0		Yes
2/5	0:08:00	649	14.0	27.0	21.0		Yes
2/6	0:07:15	727	14.0	27.0	21.0		Yes
Averages				24.1	18.7	no result	

Meter Finish: 753.7734 Time Finish: 11:32
Total Condensate collected: -2 ml Silica gel No(s) used: P3

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS
SAMPLING OF TOTAL PARTICULATE

Date: 8-Aug-19
Client: Liberty Recycling Hexham
AECOM's Project No: 60493017
Stack Description No.: Shredder Stack
Sample Nozzle No.: s3
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 2.93 x 10^{-5} m^2
Thimble No: m30
Blank thimble No:

Leak Check (Pre-Sampling)
Meter start: 22214.5122 Meter finish: 22214.5122
Time start: 9:43 Time finish: 9:44
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 22215.6312 Meter finish: 22215.6312
Time start: 11:36 Time finish: 11:37
Therefore, leakage rate = no leak L/min
(>0.1 l/min. is unacceptable)
Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1006 hPa (start); 1006 hPa (finish)
Meter start: 22214.5174 Time start: 10:08
Meter correction factor (GMf) : 1.0137

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:07:00	33	11.7	18.0	17.0		Yes
1/2	0:14:00	111	12.6	18.0	17.0		Yes
1/3	0:21:00	225	12.6	19.0	17.0		Yes
1/4	0:28:00	535	12.8	21.0	18.0		Yes
1/5	0:35:00	649	12.6	23.0	19.0		Yes
1/6	0:42:00	727	12.9	23.0	19.0		Yes
2/1	0:49:00	33	13.1	24.0	20.0		Yes
2/2	0:56:00	111	13.5	24.0	21.0		Yes
2/3	1:03:00	225	13.5	24.0	21.0		Yes
2/4	1:10:00	535	14.2	25.0	22.0		Yes
2/5	1:17:00	649	14.9	25.0	22.0		Yes
2/6	1:24:00	727	13.9	25.0	22.0		Yes
Averages				22.4	19.6	no result	

Meter Finish: 22215.6292 Time Finish: 11:32
Total Condensate collected: -4 ml Silica gel No(s) used: 007

ANZ

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS

SAMPLING OF HAZARDOUS SUBSTANCES (METALS)

Date: 8-Aug-19
Client: Liberty Recycling Hexham
AECOM's Project No: 60493017
Stack Description No.: Shredder Stack
Sample Nozzle No.: xi
Sampling Port No.: 1 to 2
Page No: 1 of 1
Sample Nozzle Area (An): 3.78 x $10^{-5}m^2$
Thimble No: 0
Blank thimble No:

Leak Check (Pre-Sampling)
Meter start: 5569.1218 Meter finish: 5569.1218
Time start: 9:45 Time finish: 9:46

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Leak Check (Post Sampling)
Meter start: 5570.5456 Meter finish: 5570.5456
Time start: 11:38 Time finish: 11:39

Therefore, leakage rate = no leak L/min

(>0.1 l/min. is unacceptable)

Repeat:
Comments:

Sampling Record Table

Barometric Pressure: 1006 hPa (start); 1006 hPa (finish)
Meter start: 5569.1260 Time start: 10:08
Meter correction factor (GMf) : 1.0020

Sampling Position No.	Stopwatch Time at Sampling Position	Distance from far wall (mm)	Isokinetic Flowrate (L/min)	Meter Inlet Temp. (°C)	Meter Outlet Temp. (°C)	Impinger Train Outlet Temp (°C)	Flowrate Attained (Y/N)
1/1	0:07:00	33	14.9	18.0	18.0		Yes
1/2	0:14:00	111	16.0	18.0	18.0		Yes
1/3	0:21:00	225	16.0	19.0	18.0		Yes
1/4	0:28:00	535	16.3	20.0	18.0		Yes
1/5	0:35:00	649	16.0	20.0	19.0		Yes
1/6	0:42:00	727	16.5	21.0	20.0		Yes
2/1	0:49:00	33	16.7	21.0	20.0		Yes
2/2	0:56:00	111	17.2	22.0	21.0		Yes
2/3	1:03:00	225	17.2	22.0	20.0		Yes
2/4	1:10:00	535	18.1	22.0	21.0		Yes
2/5	1:17:00	649	19.1	23.0	21.0		Yes
2/6	1:24:00	727	17.7	24.0	21.0		Yes
Averages				20.8	19.6	no result	

Meter Finish: 5570.5424 Time Finish: 11:32
Total Condensate collected: -2 ml Silica gel No(s) used: 018

ANZ

Emission Measurement Calculations Spreadsheet

Stack Analysis - Post Sampling Pitot Tube and Temperature Traverses

Date: 8-Aug-19
Client: Liberty Recycling Hexham
AECOM's Project No: 60493017
Stack/Duct Description: Shredder Stack
Test 1:Fine Particulate (PM10)
Test 2:Total Particulate
Test 3:Hazardous Substances (Metals)

Time :	11:40	Barometric Pressure :		1006	hPa
Page No. :	1 of 1	Pitot Correction Factor :		0.84	
Sampling Port No:	1 to 2	Stack Gas Density:		1.28	kg/m^3
Pitot Tube Type :	s				(0 °C, Wet, 1 Atm)

Sampling Position No.	Distance from far wall (mm)	Max. Differential Pressure ΔP, kilo Pascals	Max Temp. °C	Max Temp. (Ts) K	Corrected Velocity (Vs) m/s
1/1	3	0.073	24.0	297.2	9.4
1/2	81	0.064	24.0	297.2	8.8
1/3	195	0.065	24.0	297.2	8.8
1/4	505	0.070	24.0	297.2	9.2
1/5	619	0.068	24.0	297.2	9.0
1/6	697	0.065	24.0	297.2	8.8
2/1	3	0.062	24.0	297.2	8.6
2/2	81	0.058	24.0	297.2	8.4
2/3	195	0.060	24.0	297.2	8.5
2/4	505	0.047	24.0	297.2	7.5
2/5	619	0.051	24.0	297.2	7.8
2/6	697	0.053	24.0	297.2	8.0
Average			24.0	297.2	8.6

Static Pressure (Dwyer) (Pa): kPa
Static Pressure (U-tube, if required) : -6.1 mm
Absolute pressure in stack (hPa) : 1005.40 hPa

Emission Measurement Calculations Spreadsheet

Stack Analysis - Hazardous Substances Elemental Analysis Results

Date: 8-Aug-19 Client: Liberty Recycling Hexham
AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

	Particulate Metals Results	Gaseous Metals Results	Oxidisable Mercury Results		
Metal	Front Half, Filter, Acetone Rinses and Acid Rinses (mg). **Containers 1, 2 and 3**	Back Half, Impingers + Acid Rinses (mg) **Container 4**	KO Impinger + Acid Rinses (mg) **(5A)**	$KMnO_4$/ H_2SO_4 + Rinses (mg) **(5B)**	Residue Rinse 8N HCl (mg) (If Required) **(5C)**
Antimony	0.00008	0.0002			
Arsenic	<0.00081	<0.0002			
Beryllium	<0.00005	<0.0001			
Cadmium	0.012	0.00005			
Chromium	0.0011	0.0008			
Cobalt	0.00003	<0.0001			
Copper	0.00128	0.00045			
Lead	0.00291	0.00055			
Magnesium	<0.2801	0.0032			
Manganese	0.0036	0.00135			
Mercury	<0.0001	<0.0001	<0.0001	0.000153	<0.0001
Nickel	0.0014	0.0002			
Selenium	<0.0001	0.0004			
Thallium	<0.0001	<0.0001			
Tin	0.0001	<0.0001			
Vanadium	<0.005	<0.0045			
Zinc	<7.7002	0.011			

Note: Where the blank has returned a less than value, half of this value was subtracted from the sample result as a blank correction ie for a blank value of <0.0005, 0.00025 was subtracted from the sample result.

* Total does not include Copper, Magnesium and Zinc as they are classed non-hazardous

Stack Analysis - Hazardous Substances Elemental Analysis Results Continued

Date: 8-Aug-19 Client: Liberty Recycling Hexham
AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

Sample	Total Particulate Metals (mg)	Total Particulate Metals (mg/m^3)	Total Gaseous Metals (mg)	Total Gaseous Metals (mg/m^3)	Total Oxidisable Mercury (mg)	Total Oxidisable Mercury (mg/m^3)	Total (mg)	Total (mg/m^3)	Mass Emission Rate (mg/s)
Antimony	0.000080	0.000061	0.00020	0.00015			0.00028	0.00021	0.00069
Arsenic	<0.00081	<0.000617	<0.0002	<0.000152			<0.0001	<0.0000762	<0.000248
Beryllium	<0.00005	<0.0000381	<0.0001	<0.0000762			<0.0001	<0.0000762	<0.000248
Cadmium	0.012	0.0092	0.000050	0.000038			0.012	0.0092	0.030
Chromium	0.0011	0.00084	0.00080	0.00061			0.0019	0.0015	0.0047
Cobalt	0.000030	0.000023	<0.0001	<0.0000762			0.00003	0.000023	0.000074
Copper	0.0013	0.00098	0.00045	0.00034			0.0017	0.0013	0.0042
Lead	0.0029	0.0022	0.00055	0.00042			0.0035	0.0027	0.0087
Magnesium	<0.2801	<0.213	0.0032	0.0024			0.0032	0.0024	0.0079
Manganese	0.0036	0.0027	0.0014	0.0010			0.0050	0.0038	0.012
Mercury	<0.0001	<0.0000762	<0.0001	<0.0000762	0.00015	0.00012	0.00015	0.00011	0.00037
Nickel	0.0014	0.0011	0.00020	0.00015			0.0016	0.0012	0.0040
Selenium	<0.0001	<0.0000762	0.00040	0.00031			0.00040	0.00031	0.00099
Thallium	<0.0001	<0.0000762	<0.0001	<0.0000762			<0.0001	<0.0000762	<0.000248
Tin	0.00010	0.000076	<0.0001	<0.0000762			0.00010	0.000076	0.00025
Vanadium	<0.005	<0.00381	<0.0045	<0.00343			<0.0001	<0.0000762	<0.000248
Zinc	<7.7002	<5.87	0.011	0.0084			0.011	0.0084	0.027
Total Hazardous Metals*	0.021	0.016	0.0036	0.0027	0.00015	0.00012	0.025	0.019	0.062
Total Metals	0.023	0.017	0.018	0.014			0.041	0.031	0.10

* Total does not include Copper, Magnesium and Zinc as they are classed non-hazardous

STACK ANALYSIS - PM10 CALCULATIONS

Date:	6-Aug-19	Client:	Liberty Recycling Hexham
AECOM's Project No:	60493017	Stack/Duct Description:	Shredder Stack

1. Gas Analysis

	%		
$\%CO_2$	0.0		
$\%O_2$	20.9		
$\%N_2$+%CO	79.1		
Fraction Moisture Content, Bws	0.01	M_d=	0.99

2. Molecular Weight of Stack Gas (Dry Basis)

Mol. Wt. of Stack Gas (dry)	28.84
Mol. Wt. of Stack Gas (wet)	28.81

3. Absolute Stack Pressure

	Pascals	in. Hg
Barometric Pressure (Pbar)	100600	29.70
Stack Static Pressure (Pg)	100540	29.68
Absolute Stack Pressure		29.68

4. Viscosity of Stack Gas

	°C	°F
Average Stack Temp.	24.0	75.2
Average Meter Temperature:	21.4	
Stack Gas Viscosity		182.1

5. Cyclone Flow Rate

	ft^3/min	m^3/min	L/min	L/s
Cyclone Flow Rate	0.45	0.0159	15.89	0.26

6. Nozzle Velocity, Rmin and Rmax

Nozzle Number	Nozzle Diameter	Nozzle Velocity		Rmin	Rmax	Vmin	Vmin	Vmax	Vmax
	(inches)	ft/sec	m/s	[-]	[-]	ft/sec	m/s	ft/sec	m/s
0	0.000	########	#########	0.800	1.200	##########	########	########	########
1	0.140	70.39	23.17	0.749	1.235	52.73	17.30	86.92	28.52
2	0.159	54.62	17.98	0.724	1.251	39.53	12.97	68.31	22.41
3	0.169	48.20	15.87	0.706	1.261	34.05	11.17	60.76	19.93
4	0.190	38.03	12.52	0.660	1.285	25.09	8.23	48.87	16.03
5	0.000	########	#########	0.800	1.200	##########	########	########	########
6	0.220	28.49	9.38	0.559	1.328	15.92	5.22	37.83	12.41
7	0.243	23.30	7.67	0.402	1.369	11.65	3.82	31.89	10.46
8	0.265	19.64	6.47	#NUM!	1.412	9.82	3.22	27.74	9.10
9	0.304	14.88	4.90	#NUM!	1.505	7.44	2.44	22.33	7.33
10	0.343	11.67	3.84	#NUM!	1.615	5.83	1.91	17.50	5.74
11	0.388	9.14	3.01	#NUM!	1.757	4.57	1.50	13.71	4.50

	Nozzle Diameter	Nozzle Diameter	Nozzle Area	Sample Rate
Selected Nozzle	(inches)	(m)	(m^2)	(L/min)
8	0.265	0.007	0.000035	13.5

STACK ANALYSIS - PM10 CALCULATIONS CONTINUED

Date: 8-Aug-19 Client: Liberty Recycling Hexham
AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

7.Sampling Time Total Run Time 84 Number of points 12

Velocity Head (pitot) Pa	Vel Head in H20	Sqr Root	Dwell time mins
72.59	0.29	0.54	7.6
63.77	0.26	0.51	7.2
64.75	0.26	0.51	7.2
69.65	0.28	0.53	7.5
67.69	0.27	0.52	7.4
64.75	0.26	0.51	7.2
61.80	0.25	0.50	7.1
57.88	0.23	0.48	6.8
59.84	0.24	0.49	6.9
47.09	0.19	0.43	6.2
51.01	0.20	0.45	6.4
52.97	0.21	0.46	6.5
	Average	0.49	84.00
	Square	0.24	

Total time min	Full hours	Full minutes	Seconds
6.3	0	6	15
13.0	0	13	0
19.8	0	19	45
26.5	0	26	30
33.3	0	33	15
40.0	0	40	0
47.0	0	47	0
54.3	0	54	15
61.5	1	1	30
69.0	1	9	0
77.0	1	17	0
84.3	1	24	15

Aerodynamic Cut Size (u_{cyc})
182.9

PM_{10} Flow rate at actual cyclone conditions (Q_a)
0.0135

Actual D_{50}
9.6

STACK ANALYSIS - FINAL CALCULATIONS

Fine Particulate (PM10)

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Aug-19 Client: Liberty Recycling Hexham

AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.2034	m^3	Average barometric pressure (P_{BARO})	1006	hPa
Average gas meter temp. ($T_{M,2}$):	21.4	°C			
	294.6	K	Average pressure at meter ($P_{M,2}$)	1006.00	hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.1080	m^3			

(B) PM10 concentration at standard conditions

Blank thimble No.:	0		Blank weight:	g
Thimble No. used:	t11		PM10 Weight	0.0006 g
Final PM10 Weight (Mp1):	0.00060	g		
PM10 Concentration (C1):		$=M_{p1}/MV_4=$	0.00054	g/m^3 (0°C, dry gas, 1atm pressure)
		;and C_2 =	0.54	mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.00054 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 0.54 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.9 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.076 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 76 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: P3

V_v = 11 g (from laboratory report) V_w = -2 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = -0.0027

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0147

Therefore, $B_{ws} = \frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B_{ws} = 1.07 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Fine Particulate (PM10)

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling: 1.29 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.29 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

(iii) Gas density at stack conditions = (ii) x $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.185 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 7.23 m/s

(ii) Average of post-sampling velocities: 8.57 m/s

(iii) Average of while-sampling velocities: N/A m/s

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 7.90 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Qstack = Vs x A = 3.58 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_{ws})}{100}$$

Qstd = 3.3 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm = C_{1a} x Qstd = 0.0018 g/s (0°C, dry gas, 1 atm pressure)
= 1.8 mg/s (0°C, dry gas, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

STACK ANALYSIS - FINAL CALCULATIONS

Total Particulate

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Aug-19 Client: Liberty Recycling Hexham

AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.1270	m^3	Average barometric pressure (P_{BARO})	1006 hPa
Average gas meter temp. ($T_{M,2}$):	21.0	°C		
	294.2	K	Average pressure at meter ($P_{M,2}$)	1006.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.0391	m^3		

(B) Total Particulate concentration at standard conditions

Blank thimble No.: Blank weight: g

Thimble No. used: m30 Total Particulate Weight 0.0070 g

Final Total Particulate Weight (Mp1): 0.00700 g

Total Particulate Concentration (C1): $=M_{p1}/MV_4=$ 0.0067 g/m^3 (0°C, dry gas, 1atm pressure)

;and C_2 = 6.7 mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.0067 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and C_{c1} = 6.7 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.9 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.94 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and C_{b1} = 940 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: 007

V_v = 13.2 g (from laboratory report) V_w = -4 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = -0.0053

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0176

Therefore, $B_{ws} = \frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

B_{ws} = 1.17 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Total Particulate

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling: 1.29 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.29 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

(iii) Gas density at stack conditions = (ii) x $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.185 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 7.23 m/s

(ii) Average of post-sampling velocities: 8.57 m/s

(iii) Average of while-sampling velocities: N/A m/s

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 7.90 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Qstack = Vs x A = 3.58 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 3.3 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm = C_{1a} x Qstd = 0.022 g/s (0°C, dry gas, 1 atm pressure)
= 22 mg/s (0°C, dry gas, 1 atm pressure)

STACK ANALYSIS - FINAL CALCULATIONS

Hazardous Substances (Metals)

(Calculations performed in accordance with relevant test method as defined on cover page)

Date: 8-Aug-19 Client: Liberty Recycling Hexham

AECOM's Project No: 60493017 Stack/Duct Description: Shredder Stack

(A) Sample gas volume at standard conditions

Metered volume (MV_3):	1.4192	m^3	Average barometric pressure (P_{BARO})	1006 hPa
Average gas meter temp. ($T_{M,2}$):	20.2	°C		
	293.4	K	Average pressure at meter ($P_{M,2}$)	1006.00 hPa
Sample gas volume (MV_4); (0°C, dry gas, 1 atm pressure):	1.3120	m^3		

(B) Metals concentration at standard conditions

Blank thimble No.:			Blank weight:	g
Thimble No. used:	0		Metals Weight	0.000025 g
Final Metals Weight (Mp1):	0.00003	g		
Metals Concentration (C1):		$=M_{p1}/MV_4=$	0.000019	g/m^3 (0°C, dry gas, 1atm pressure)
		;and $C_2 =$	0.019	mg/m^3 (0°C, dry gas, 1atm pressure)

CO_2 Basis 12 %

Average CO_2%: 0.0 %

Therefore, C_c: $= C_a \times 12/CO_2\% =$ 0.000019 g/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

;and $C_{c1} =$ 0.019 mg/m^3 (0°C, dry gas, 1atm pressure, 12% CO_2)

O_2 Basis 7 %

Average O_2%: 20.9 %

Therefore, C_b: $=C_a \times (21 - O_{2ref}\%)/(21 - O_{2mea}\%)$ 0.0027 g/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

;and $C_{b1} =$ 2.7 mg/m^3 (0°C, dry gas, 1atm pressure, 7% O_2)

(C) Moisture content

Silica Gel Number: 018

$V_y =$ 14.6 g (from laboratory report) $V_w =$ -2 mL (=grams) (recorded on Laboratory Form 108)

Volume of Water Vapour Condensed ($V_{wc(std)}$) = -0.0027

Volume of Water Vapour Condensed ($V_{wsg(std)}$) = 0.0195

Therefore, $B_{ws} = \frac{(V_{wc(std)}+V_{wsg(std)})}{(V_{wc(std)}+V_{wsg(std)}+V_{m(std)})}$

$B_{ws} =$ 1.27 %

STACK ANALYSIS - FINAL CALCULATIONS CONTINUED

Hazardous Substances (Metals)

(D) Gas Composition and Density (Re-calculation)

(i) Initial gas density for sampling: 1.29 kg/m^3 (from Laboratory Form 107)

(ii) Re-calculated gas density based on moisture content in (c): 1.30 kg/m^3 (0°C, wet, 1 atm pressure)
1.29 kg/m^3 (0°C, dry, 1 atm pressure)

(iii) Gas density at stack conditions = (ii) x $\frac{(273.2)}{(273.2+Ts)}$ x $\frac{(Ps)}{(1013.25)}$

= 1.194 kg/m^3 (stack conditions, wet)

(E) Gas Velocities

(i) Average of pre-sampling velocities: 7.23 m/s

(ii) Average of post-sampling velocities: 8.57 m/s

(iii) Average of while-sampling velocities: N/A m/s

(iv) Overall average of pre-sampling and post-sampling velocities (Vs): 7.90 m/s (stack conditions, wet)
N/A m/s (stack conditions, wet)
(**Note**: (Vs) is from all individual data, **not** from (i) and (ii) alone.)

(F) Volumetric Flowrates (Reference Method US-EPA Method 2, NSW-EPA TM-2)

Qstack = Vs x A = 3.58 m^3/s (stack conditions)

$$Qstd = Qstack \times \frac{Ps}{(Pstd)} \times \frac{(Tstd)}{(Ts)} \times \frac{(100 - B_w)}{100}$$

Qstd = 3.2 m^3/s (0°C, dry gas, 1 atm pressure)

(G) Mass Emission Rate

Rm = C_{1a} x Qstd = 0.000062 g/s (0°C, dry gas, 1 atm pressure)
= 0.062 mg/s (0°C, dry gas, 1 atm pressure)

Emission Measurement Calculations Spreadsheet

Q4AN(EV)-332-FM31

EMISSION MONITORING RESULTS, SHREDDER STACK
LIBERTY RECYCLING HEXHAM
8-Aug-19
FINE PARTICULATE (PM10)
TOTAL PARTICULATE
HAZARDOUS SUBSTANCES (METALS)

Sampling Conditions:			
Stack internal diameter at test location	760 mm		
Stack gas temperature (average)	22.0 °C		295.2 K
Stack pressure (average)	1005 hPa		
Stack gas velocity (average, stack conditions)	7.9 m/s		
Stack gas flowrate (stack conditions)	3.6 m^3/s		
Stack gas flowrate (0^0C, dry gas, 1 atm pressure)	3.3 m^3/s		
Fine Particulate (PM10) Testing			
Test Period	10:08	-	11:32
Fine Particulate (PM10) Mass	0.6 mg		
Gas Volume Sampled	1.11 m^3		
Fine Particulate (PM10) Emission*1	0.54 mg/m^3		
Fine Particulate (PM10) Mass Emission Rate*2	1.8 mg/s		
Regulatory Limit	N/A		
Total Particulate Testing			
Test Period	10:08	-	11:32
Total Particulate Mass	7.0 mg		
Gas Volume Sampled	1.04 m^3		
Total Particulate Emission*1	6.7 mg/m^3		
Total Particulate Mass Emission Rate*2	22 mg/s		
Regulatory Limit	100 mg/m^3		
Hazardous Substances (Metals) Testing			
Test Period	10:08	-	11:32
Hazardous Substances (Metals) Mass	0.025 mg		
Gas Volume Sampled	1.31 m^3		
Hazardous Substances (Metals) Emission*1	0.019 mg/m^3		
Hazardous Substances (Metals) Mass Emission Rate*2	0.062 mg/s		
Regulatory Limit	N/A		
Moisture Content (%)	1.2		
Gas Density (dry at 1 atmosphere)	1.29 kg/m^3		
Dry Molecular Weight	28.8 g/g-mole		

Notes *1 Emission concentration at Standard conditions of 0^0C, 1 atm, dry gas

*2 Mass emission rate determined from pre and post test sampling flow measurements and the respective test moisture content. See Q_{std} in field sheets and final calculations "Stack Analysis - Final Calculations" for each test.

Appendix B

Laboratory Results
(8 pages)

Appendix B Laboratory Results (8 pages)

Steel River Testing

5/11 McIntosh Drive, Mayfield West, NSW 2304
Phone: 02 49677880

STACK EMISSION - PARTICULATES REPORT

Origin: AECOM - Newcastle
Project: **60493017/4.1**

Report : 19485-0-P

Description : Stack Emission Samples
Received: 14-Aug-19

Date : 16-Aug-19

Report To : Colin Clarke
17 Warabrook Blvd, Warabrook NSW 2304

Copy to: FILE

Thimble ID		Volume (mL)	Total Particulate Matter (g)
M30	Thimble	-	0.0070
T11	Thimble	-	0.0006

NATA Accredited Laboratory 18079
Accredited for compliance with ISO/IEC 17025 - Testing

Note : Sampled by Client

Reported By: J. Campbell

Jason Campbell - Manager

Determined in Accordance With:
Particulate matter - total in stack gases by gravimetric using in-house M300;
Acetone/Water Rinse using AS4323.2
Refer Form F422 - Measurement Uncertainty

Steel River Testing

5/11 McIntosh Drive, Mayfield West, NSW 2304
Phone: 02 49677880

STACK EMISSION - MOISTURE REPORT

Origin:	AECOM - Newcastle	**Report :**	19485-0-M	Page 1 of 1
Project:	**60493017/4.1**			
Description :	Stack Emission Samples Received: 14-Aug-19	**Date :**	16-Aug-19	
Report To :	Colin Clarke 17 Warabrook Blvd, Warabrook NSW 2304	**Copy to:**	FILE	

Jar ID	Moisture (g)
007	13.2
018	14.6
P3	11.0

NATA Accredited Laboratory 18079
Accredited for compliance with ISO/IEC 17025 - Testing

ACCREDITED FOR TECHNICAL COMPETENCE

Reported By: J. Campbell

Jason Campbell - Manager

Determined in Accordance With:
Moisture content in stack gases by gravimetric using in-house M301
Refer Form F422 - Measurement Uncertainty

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Colin Clarke	Manager	Adam Atkinson
Client	AECOM Australia Pty Ltd	Laboratory	SGS Melbourne EH&S
Address	17 Warabrook Boulevard Warabrook NSW 2304	Address	10/585 Blackburn Road Notting Hill Victoria 3168
Telephone	02 8295 3600	Telephone	+61395743200
Facsimile	02 8934 0001	Facsimile	+61395743399
Email	colin.clarke@aecom.com	Email	Au.SampleReceipt.Melbourne@sgs.com
Project	**60493017/4.1**	SGS Reference	**ME311573 R0**
Order Number	**60493017/4.1**	Date Received	15 Aug 2019
Samples	12	Date Reported	29 Aug 2019

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(14420).

SIGNATORIES

Adam Atkinson
Business Manager

Ryan Zhang
Team Leader

Parameter	Units	LOR	Sample Number: ME311573.001 Sample Matrix: Filter Sample Date: 08 Aug 2019 Sample Name: Metals_1	ME311573.002 Impinger 08 Aug 2019 Metals_3	ME311573.003 Impinger 08 Aug 2019 Metals_4	ME311573.004 Impinger 08 Aug 2019 Metals_5A
Metals in Filters M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT Tested: 26/8/2019						
Sb	µg total	0.05	0.13	-	-	-
As	µg total	0.05	0.49	-	-	-
Be	µg total	0.05	0.05	-	-	-
Cd	µg total	0.05	12	-	-	-
Cr	µg total	0.05	3.1	-	-	-
Co	µg total	0.05	0.08	-	-	-
Cu	µg total	0.05	1.8	-	-	-
Pb	µg total	0.05	2.8	-	-	-
Mg	µg total	0.05	270	-	-	-
Mn	µg total	0.05	3.8	-	-	-
Hg	µg total	0.05	<0.05	-	-	-
Ni	µg total	0.05	1.6	-	-	-
Se	µg total	0.05	<0.05	-	-	-
Tl	µg total	0.05	<0.05	-	-	-
Sn	µg total	0.05	0.18	-	-	-
V	µg total	0.25	2.0	-	-	-
Zn	µg total	0.05	7000	-	-	-
Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (ug total) Method: EPA29_METIMP Tested: 28/8/2019						
Sb	µg total	0.1	-	<0.1	0.3	-
As	µg total	0.1	-	<0.1	0.2	-
Be	µg total	0.1	-	<0.1	<0.1	-
Cd	µg total	0.1	-	<0.1	0.1	-
Cr	µg total	0.1	-	<0.1	1.4	-
Co	µg total	0.1	-	<0.1	<0.1	-
Cu	µg total	0.1	-	0.1	0.5	-
Pb	µg total	0.1	-	0.8	0.6	-
Mg	µg total	0.1	-	5.9	3.9	-
Mn	µg total	0.1	-	1.3	1.4	-
Hg	µg total	0.1	-	<0.1	<0.1	<0.1
Ni	µg total	0.1	-	<0.1	0.4	-
Se	µg total	0.1	-	<0.1	0.5	-
Tl	µg total	0.1	-	<0.1	<0.1	-
Sn	µg total	0.1	-	<0.1	<0.1	-
V	µg total	0.1	-	0.6	2.7	-
Zn	µg total	0.1	-	6.8	12	-
Sample Volume*	mL	-	-	96	300	96

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name ME311573.005 KMn04 08 Aug 2019 Metals_5B	ME311573.006 Impinger 08 Aug 2019 Metals_5C	ME311573.007 Impinger 08 Aug 2019 Metals_8A	ME311573.008 Impinger 08 Aug 2019 Metals_8B
Metals in Filters M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT Tested: 28/8/2019						
Sb	µg total	0.05	-	-	-	-
As	µg total	0.05	-	-	-	-
Be	µg total	0.05	-	-	-	-
Cd	µg total	0.05	-	-	-	-
Cr	µg total	0.05	-	-	-	-
Co	µg total	0.05	-	-	-	-
Cu	µg total	0.05	-	-	-	-
Pb	µg total	0.05	-	-	-	-
Mg	µg total	0.05	-	-	-	-
Mn	µg total	0.05	-	-	-	-
Hg	µg total	0.05	-	-	-	-
Ni	µg total	0.05	-	-	-	-
Se	µg total	0.05	-	-	-	-
Tl	µg total	0.05	-	-	-	-
Sn	µg total	0.05	-	-	-	-
V	µg total	0.25	-	-	-	-
Zn	µg total	0.05	-	-	-	-
Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (ug total) Method: EPA29_METIMP Tested: 26/8/2019						
Sb	µg total	0.1	-	-	<0.1	-
As	µg total	0.1	-	-	0.2	-
Be	µg total	0.1	-	-	<0.1	-
Cd	µg total	0.1	-	-	<0.1	-
Cr	µg total	0.1	-	-	<0.1	-
Co	µg total	0.1	-	-	<0.1	-
Cu	µg total	0.1	-	-	<0.1	-
Pb	µg total	0.1	-	-	<0.1	-
Mg	µg total	0.1	-	-	0.1	-
Mn	µg total	0.1	-	-	<0.1	-
Hg	µg total	0.1	0.2	<0.1	<0.1	<0.1
Ni	µg total	0.1	-	-	<0.1	-
Se	µg total	0.1	-	-	<0.1	-
Tl	µg total	0.1	-	-	<0.1	-
Sn	µg total	0.1	-	-	<0.1	-
V	µg total	0.1	-	-	3.5	-
Zn	µg total	0.1	-	-	0.2	-
Sample Volume*	mL	-	380	250	300	210

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name ME311573.009 Impinger 08 Aug 2019 Metals_9	ME311573.010 KMn04 08 Aug 2019 Metals_10	ME311573.011 Impinger 08 Aug 2019 Metals_11	ME311573.012 Filter 08 Aug 2019 Metals_12
Metals in Filters M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT Tested: 28/8/2019						
Sb	µg total	0.05	-	-	-	0.05
As	µg total	0.05	-	-	-	0.61
Be	µg total	0.05	-	-	-	0.05
Cd	µg total	0.05	-	-	-	<0.05
Cr	µg total	0.05	-	-	-	2.0
Co	µg total	0.05	-	-	-	<0.05
Cu	µg total	0.05	-	-	-	0.62
Pb	µg total	0.05	-	-	-	0.69
Mg	µg total	0.05	-	-	-	280
Mn	µg total	0.05	-	-	-	1.5
Hg	µg total	0.05	-	-	-	<0.05
Ni	µg total	0.05	-	-	-	0.20
Se	µg total	0.05	-	-	-	<0.05
Tl	µg total	0.05	-	-	-	<0.05
Sn	µg total	0.05	-	-	-	0.08
V	µg total	0.25	-	-	-	1.5
Zn	µg total	0.05	-	-	-	7700
Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (ug total) Method: EPA29_METIMP Tested: 26/8/2019						
Sb	µg total	0.1	**0.1**	-	-	-
As	µg total	0.1	<0.1	-	-	-
Be	µg total	0.1	<0.1	-	-	-
Cd	µg total	0.1	<0.1	-	-	-
Cr	µg total	0.1	**0.6**	-	-	-
Co	µg total	0.1	<0.1	-	-	-
Cu	µg total	0.1	<0.1	-	-	-
Pb	µg total	0.1	<0.1	-	-	-
Mg	µg total	0.1	**0.6**	-	-	-
Mn	µg total	0.1	<0.1	-	-	-
Hg	µg total	0.1	<0.1	<0.1	<0.1	-
Ni	µg total	0.1	**0.2**	-	-	-
Se	µg total	0.1	**0.1**	-	-	-
Tl	µg total	0.1	<0.1	-	-	-
Sn	µg total	0.1	<0.1	-	-	-
V	µg total	0.1	**1.0**	-	-	-
Zn	µg total	0.1	**0.8**	-	-	-
Sample Volume*	mL	-	**210**	**90**	**250**	-

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' . the results are less than the LOR and thus the RPD is not applicable.

Metals in Filters M29 ETC MA-1400.FL.M29.02 USEPA M29 Method: EPA29_FILT

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Sb	LB028276	µg total	0.05	<0.05	99%
As	LB028276	µg total	0.05	<0.05	96%
Be	LB028276	µg total	0.05	<0.05	97%
Cd	LB028276	µg total	0.05	<0.05	99%
Cr	LB028276	µg total	0.05	<0.05	100%
Co	LB028276	µg total	0.05	<0.05	102%
Cu	LB028276	µg total	0.05	<0.05	104%
Pb	LB028276	µg total	0.05	<0.05	102%
Mg	LB028276	µg total	0.05	<0.05	95%
Mn	LB028276	µg total	0.05	<0.05	100%
Hg	LB028276	µg total	0.05	<0.05	100%
Ni	LB028276	µg total	0.05	<0.05	101%
Se	LB028276	µg total	0.05	<0.05	102%
Tl	LB028276	µg total	0.05	<0.05	101%
Sn	LB028276	µg total	0.05	<0.05	101%
V	LB028276	µg total	0.25	<0.25	101%
Zn	LB028276	µg total	0.05	<0.05	104%

Metals in Impingers M29 ETC MA-1400.IMP.M29.06 (ug total) Method: EPA29_METIMP

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Sb	LB028277	µg total	0.1	<0.1	99%
As	LB028277	µg total	0.1	<0.1	96%
Be	LB028277	µg total	0.1	<0.1	97%
Cd	LB028277	µg total	0.1	<0.1	99%
Cr	LB028277	µg total	0.1	<0.1	100%
Co	LB028277	µg total	0.1	<0.1	102%
Cu	LB028277	µg total	0.1	<0.1	104%
Pb	LB028277	µg total	0.1	<0.1	102%
Mg	LB028277	µg total	0.1	<0.1	95%
Mn	LB028277	µg total	0.1	<0.1	100%
Hg	LB028277	µg total	0.1	<0.1	
Ni	LB028277	µg total	0.1	<0.1	101%
Se	LB028277	µg total	0.1	<0.1	102%
Tl	LB028277	µg total	0.1	<0.1	101%
Sn	LB028277	µg total	0.1	<0.1	101%
V	LB028277	µg total	0.1	<0.1	101%
Zn	LB028277	µg total	0.1	<0.1	104%
Sample Volume*	LB028277	mL	-	1.0	NA

METHOD	METHODOLOGY SUMMARY
EPA 29	Analysis of acid-leachable metals by Inductively Coupled Plasma-Mass Spectrometer (ICP-MS). This method is based on USEPA 3051A. USEPA M29. and USEPA 6020A. . Filters are digested using the appropriate sample preparation methods. A representative sample is extracted in concentrated acid using microwave heating by the CEM -MarsXPress (with Built-in USEPA method) Microwave Digestion system. The sample and acid are placed in a microwave vessel (TFM). which is then capped and heated in the microwave unit. After cooling. the vessel contents are diluted with DI water. then filtered/settled/centrifuged and analysed by ICP MS.
EPA29	This method covers the analysis of acid-leachable metals by Inductively Coupled Plasma-Mass Spectrometer (ICP-MS). This method is based on USEPA M29. USEPA 3015A and USEPA 6020A. Prior to analysis. samples are be solubilised or digested using the appropriate sample preparation methods.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed. but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
		QFL	QC result is below the lower tolerance
**	Indicative data. theoretical holding time exceeded.	-	The sample was not analysed for this analyte
		NVL	Not Validated

Unless it is reported that sampling has been performed by SGS. the samples have been analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example. Total PAHs. Total OC Pesticides) the total will be calculated as the sum of the individual analytes. with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example. where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg. the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed. the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported. measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2. providing a level of confidence of approximately 95%. unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP. radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP. less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC and MU criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: www.sgs.com.au/pv-sgsvr/en-gb/environment.

End of Report

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