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AUGUST 2021

SOURCE EMISSIONS MONITORING – GLOBAL RESOURCE RECOVERY

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Report Prepared by:

Assured Environmental
Unit 7, 142 Tennyson Memorial Avenue
Tennyson, QLD, 4105
ABN: 87 604 851 078

Report Prepared for:

Chiappalone Consulting
800 Berrimah Road
East Arm NT 0822

Report Author: Timon Berger

Report Reviewer: Curtis Profke

Table 1: History of Revisions

Revision	Date	Issued to	Changes
R_0	29/09/2021	C. Chiappalone	Formal report release
DRAFT_0	25/09/2021	C. Chiappalone	Draft release for comment.

ACCREDITED FOR COMPLIANCE TO ISO/IEC 17025 (TESTING)

The results of the tests, calibrations and/or measurements included in this document is traceable to Australian/national standards.

Accreditation number: 19703

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EXECUTIVE SUMMARY

Assured Environmental (AE) conducted source emissions monitoring at the Global Resource Recovery facility in East Arm, Darwin on 30th and 31st August 2021.

A summary of results and comparison against compliance levels is presented in Table 2 and Table 3 below from the testing conducted on the boiler stack and combined vent scrubber stack release points. The process is understood to have been operating at a stable and representative load for the duration of the monitoring.

In comparison to the emission limits, all measured parameters were within those limits specified. Results are reported at dry, 273.15°K and 101.325 kPa (STP).

Table 2: Summary of measured parameters – Boiler

Parameter		Average result Boiler Stack	Emission limit	Unit	Reference
Average source temperature		109	-	°C	-
Flue gas water vapour content		4.4	-	vol-%	-
Carbon dioxide concentration		1.5	-	vol-%	STP - dry
Oxygen concentration		18.6	-	vol-%	STP - dry
Flue gas molecular weight - dry		1.3	-	kg/Nm^3	STP - dry
Flue gas velocity		4.4	-	m/sec	STP - dry
Flue gas volume flow		69.4	-	Nm^3/min	STP - dry
Particulate matter	<	2	50	mg/Nm^3	STP - dry
- emission rate	<	0.12	-	g/min	
Oxides of nitrogen (as NO_2)		12	350	mg/Nm^3	STP - dry
- emission rate		0.85	-	g/min	
Carbon monoxide		9	125	mg/Nm^3	STP - dry
- emission rate		0.61	-	g/min	
Total heavy metals [1]	<	0.048	1.0	mg/Nm^3	STP - dry
- emission rate	<	0.0033	-	g/min	
Cadmium		0.0082	0.2	mg/Nm^3	STP - dry
- emission rate		5.7E-04	-	g/min	
Mercury		0.0020	0.2	mg/Nm^3	STP - dry
- emission rate		1.4E-04	-	g/min	
Hydrogen chloride	<	0.9	100	mg/Nm^3	STP - dry
- emission rate	<	0.06	-	g/min	
Sulfur dioxide	<	3	150	mg/Nm^3	STP - dry
- emission rate	<	0.2	-	g/min	
Total VOCs (as n-propane)	<	0.5	40	mg/Nm^3	STP - dry
- emission rate	<	0.04	-	g/min	

[1] Sum of Sb, As, Pb, Cr, Be, Se, Mn, Ni, Co

Table 3: Summary of measured parameters – Scrubber vent

Parameter		Average result Vent Stack	Emission limit	Unit	Reference
Average source temperature		27	-	°C	-
Flue gas water vapour content		3.5	-	vol-%	-
Carbon dioxide concentration		0.0	-	vol-%	STP - dry
Oxygen concentration		20.9	-	vol-%	STP - dry
Flue gas molecular weight - dry		1.3	-	kg/Nm^3	STP - dry
Flue gas velocity	<	1.1	-	m/sec	STP - dry
Flue gas volume flow	<	0.3	-	Nm^3/min	STP - dry
Total VOCs (as n-propane)		29.3	40	mg/Nm^3	STP - dry
- emission rate	<	0.009	-	g/min	

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1 INTRODUCTION

Assured Environmental (AE) was appointed by Chiappalone Consulting to sample and analyse source emissions at the Smorgon Fuels Global Resource Recovery facility in East Arm, Darwin. Sampling was conducted on the gas fired boiler stack and the combined vent scrubber stack by AE on 30th and 31st August 2021 during typical site operations.

AE was responsible for the collection and analysis of samples, unless otherwise indicated. The samples were recovered and stored in the appropriate manner until their return to the laboratory where the samples were prepared and analysed according to the methodologies listed below in this report.

2 METHODOLGY & EQUIPMENT

2.1 Sampling methodology

All sampling and analysis was carried out in accordance with the listed requirements in Table 4. Any specific comments about the sampling and analysis have been documented where required.

Table 4: Test methods

Parameter	Reference Test Method	Test Method (NSW)	NATA accreditation	Analysis by
Sample location	AS4323.1	TM-1	Yes	1
Velocity & flow rate	USEPA Method 2	TM-2	Yes	1
Stack gas density	USEPA Method 3	TM-23	Yes	1
Oxygen	USEPA Method 3A	TM-25	Yes	1
Carbon dioxide	USEPA Method 3A	TM-24	Yes	1
Water vapour content	USEPA Method 4	TM-22	Yes	1
Total solid particulates	AS 4323.2	TM-15	Yes	1
Sulphur dioxide	USEPA Method 6C	TM-4	Yes	1
Oxides of nitrogen (as NO_2)	USEPA Method 7E	TM-11	Yes	1
Carbon monoxide	USEPA Method 10	TM-32	Yes	1
Volatile organic compounds	USEPA Method 18	TM-34	Yes	2
Hydrogen chloride	USEPA Method 26A	TM-8	Yes	2
Heavy metals	USEPA Method 29	TM-12/13/14	Yes	2

Table 5: Analysis performed by

Note	Company	Work performed	NATA ID	Report Number
1	Assured Environmental	Sampling & analysis	19703	13849
2	Envirolab Services	Sample analysis	2901	268396 277326

Table 6: Sampling comments

Note	Comment
Sample location	Boiler – Sample location is compliant but non ideal as per AS4323.1. The sample location is greater than two, but less than six diameters downstream from a disturbance. The temperature and velocity survey showed that the sample position was in compliance to items (a) to (f) as per AS4323.1. Vent stack – Sample location is non-compliant, the gas flow is below the limit of detection.
Calibrations	Analyser calibration performed in the laboratory prior to conducting field work and post field work in AE lab.
Heavy metals	Sum of Antimony, Arsenic, Lead, Chromium, Beryllium, Selenium, Manganese, Nickel and Cobalt.
VOCs	Volatile organic compounds were sampled using the constant flow sample method USEPA 18. A sample for flue gas was passed at a known flow rate through a condensate removal trap and activated carbon tube. Both the condensate and tube are recovered in the laboratory and analysed for VOCs via GC-MS.

2.2 Sample Location

The images and figures below show the sample location and site details.

Figure 1: Boiler Stack

Figure 2: Scrubber Vent Stack

Table 7: Boiler sample location summary

Sample location	Boiler stack
Stack Shape	CIRCULAR
Stack Diameter (m)	0.70
Stack Cross Section Area (m^2)	0.38
Distance to upstream disturbance (m)	3.4
Diameters (D)	4.9
Distance to downstream disturbance (m)	5.0
Diameters (D)	7.0
Total traverse point factors	1.05 , 1.0 , 1.05
Port size (mm)	100
Port Thread Type	Flange end
Number of traverses	2
Number of points per traverse	6
Total number of traverse points	12
Condition check requirements (Section 4 – AS4323.1)	
(a) The gas flow is basically in the same direction	Yes
(b) The gas velocity at all points greater than 3 m/sec	Yes
(c) Gas flow profile is steady with <15° cyclonic flow component	Yes
(d) Temperature difference between points <10% of mean	Yes
(e) The highest to lowest pitot pressure and velocity < 9:1 and 1.6:1 respectively	Yes
(f) Gas temperature above dew point	Yes

Table 8: Scrubber vent sample location summary

Sample location	Scrubber vent
Stack Shape	CIRCULAR
Stack Diameter (m)	0.08
Stack Cross Section Area (m^2)	0.01
Distance to upstream disturbance (m)	3.2
Diameters (D)	39
Distance to downstream disturbance (m)	0.8
Diameters (D)	9.8
Total traverse point factors	1.0 , 1.0 , 1.0
Port size (mm)	25
Port Thread Type	Flange end
Number of traverses	1
Number of points per traverse	2
Total number of traverse points	2
Condition check requirements (Section 4 – AS4323.1)	
(a) The gas flow is basically in the same direction	Not determinable
(b) The gas velocity at all points greater than 3 m/sec	No
(c) Gas flow profile is steady with <15° cyclonic flow component	Not determinable
(d) Temperature difference between points <10% of mean	Yes
(e) The highest to lowest pitot pressure and velocity < 9:1 and 1.6:1 respectively	Not determinable
(f) Gas temperature above dew point	Saturated

2.3 Test equipment

The sampling equipment was transported to site and specifically setup at the test location. Sampling was performed using heated probes and filters, with a constant flow and isokinetic sample console.

Equipment used during the course of the testing is sourced from Apex Instruments and Testo, industry leaders in the supply of source testing equipment.

Figure 3: Manual sample equipment

Figure 4: Combustion gas analyser

3 MEASUREMENT UNCERTAINTY

There is an inherent uncertainty associated with any scientific measurement, including stack emissions monitoring. The measurement uncertainty can be controlled with strict adherence to the reference methodology along with utilising appropriate calibration standards with corresponding acceptable uncertainty reports.

Many source sampling methods do not outline exact procedures for establishing direct measurement uncertainty. In the absence of a defined procedure, the uncertainty budgets presented are based on estimations using ISO-GUM method.

Each individual source and test may have a unique associated uncertainty, due largely to the stack sample location in relation to the positioning requirements of AS4323.1.

Table 9: Sample specific uncertainty budgets

Parameter	Reference method	Limit of measurement	Unit of measure	Uncertainty ± %
Flue gas temperature	USEPA Method 2	1	m/sec	5.0
Flue gas velocity	USEPA Method 2	1.5	m/sec	10 [100[a]]
Oxygen	USEPA Method 3A	0.3	%-vol	5.0
Carbon dioxide	USEPA Method 3A	0.3	%-vol	8.0
Water vapour content	USEPA Method 4	0.5	%-vol	5.0
Total solid particulates	AS 4323.2	2	mg/sample	20
Sulphur dioxide	USEPA Method 6C	3.0	mg/sample	15
Oxides of nitrogen (as NO_2)	USEPA Method 7E	2.1	mg/sample	15
Carbon monoxide	USEPA Method 10	1.5	mg/sample	15
Total VOCs	USEPA Method 18	1.0	mg/sample	20
Hydrogen chloride	USEPA Method 26A	1.0	mg/sample	10
Heavy metals	USEPA Method 29	0.3 to 50	µg/sample	20

[a] Then Combine scrubber vent stack does not have an active forced flow, it only vents passively via the filling and natural 'breathing' of tanks. Therefore the air flow in the stack was measured at the limit of detection, resulting in an expanded uncertainty.

4 QUALITY ASSURANCE & QUALITY CONTROL (QA/QC)

AE operates within a quality system based upon the requirements of ISO17025. Our quality system defines specific procedures and methodologies to ensure any project undertaken by AE is conducted with the highest level of quality given the specific confines of each project. The overall objective of our QA/QC procedures is to representatively sample and accurately analyse components in the gas streams and therefore report valid measurements of emission concentrations.

To ensure representativeness of field work, our quality procedures target:

1. Correct sampling locations
2. Sample time
3. Frequency of samples and
4. Method selection & adherence

To ensure representativeness of lab work, our quality procedures target:

1. Sample preservation
2. Chain of custody (COC)
3. Sample preparation and
4. Analytical techniques

AE maintains strict quality assurance throughout all its sampling programs, covering on-site 'field work' and the analytical phase of our projects. Our QA program covers the calibration of all sampling and analytical apparatus where applicable and the use of spikes, replicate sample and reference standards. The test methodologies used for this project are outlined in section 2 of this document. Field test data has been recorded and calculated using direct entry into Microsoft Excel spreadsheets following the procedures of the appropriate test methods. Determination of emission concentrations has been performed using the same Microsoft Excel spreadsheets which are partially supplied as an attachment to this report. More detailed information can be supplied upon request.

QA/QC checks for this project will use validation techniques and criteria appropriate to the type of data and the purpose of the measurement to approve the test report. Records of all data will be maintained. Complete chain of custody (COC) procedures have been followed to document the entire custodial history of each sample. The COC forms also served as a laboratory sheet detailing sample ID and analysis requirements.

Table 10: Sampling data QA/QC checklist

Sampling Data QA/QC Checklist	Comment
Use of appropriate test methods	Yes
'Normal' operation of the process being tested	Yes – as instructed by client
Use of properly operating and calibrated test equipment	Yes
Use of high purity reagents	Yes
Performance of leak checks post sample (at least)	Yes

Table 11: Laboratory data QA/QC checklist

Laboratory Data QA/QC Checklist	Comment
Use of appropriate analytical methods	Yes
Use of properly operating and calibrated analytical equipment	Yes
Precision and accuracy comparable to that achieved in similar projects	Yes
Accurate reporting	Yes

4.1 Calibration gas details

The combustion gas analyser was calibrated using the below calibration gas cylinders.

Table 12: Calibration gas details

Parameter	Zero cylinder	Span cylinder 1	Span cylinder 2
Contents	Nitrogen (UHP)	Carbon dioxide 12.04 %	Nitrogen dioxide 101.3 ppm
		Carbon monoxide 495 ppm	Oxygen 14.99 %
		Nitric oxide 493 ppm	- -
Certificate number	na	EB0125264	CC516127
Expiry date	na	30/08/2027	04/09/2023

Calibration Data	Carbon dioxide	Oxygen	Carbon monoxide	Sulfur dioxide	Nitric oxide	Nitrogen dioxide	
Gas cylinder reference number	EB0125266	CC516127	CC516127	EB0125266	EB0125266	CC516127	
Certificate expiry date	19/09/2027	4/09/2022	4/09/2022	19/09/2027	19/09/2027	4/09/2022	dd.mm.yyyy
Upscale calibration gas value (Cma)	24.95	14.99	1000	985.6	2037	101.3	ppm / vol-%
Mid-point gas cylinder reference number	EB0125264	CC516127	EB0125264	CC516127	CC516127	CC516127	
Certificate expiry date	30/08/2027	4/09/2022	30/08/2027	4/09/2022	4/09/2022	4/09/2022	dd.mm.yyyy
Mid-point calibration gas value	12.04	7.495	495	406	493	50.65	ppm / vol-%
Initial zero check response	0.01	0.02	0	0	0	0	ppm / vol-%
Initial upscale calibration response	25.2	15.01	997	976	2024	100.1	ppm / vol-%
Initial mid-point calibration response	12	7.6	485	404	488	50	ppm / vol-%
Post sampling zero check response	0.03	0.03	0	0	0	0	ppm / vol-%
Post sampling upscale calibration response	25	14.97	995	970	2030	99.6	ppm / vol-%
Post sampling mid-point calibration response	11.98	7.7	490	400	479	51.1	ppm / vol-%
Average zero response (Co)	0.02	0.025	0	0	0	0	ppm / vol-%
Average upscale response (Cm)	25.1	14.99	996	973	2027	99.85	ppm / vol-%
Calibration error (zero point)	-0.04	-0.13	0.00	0.00	0.00	0.00	%
Zero point calibration error (post sampling)	-0.12	-0.20	0.00	0.00	0.00	0.00	%
Zero drift	0.08	0.07	0.00	0.00	0.00	0.00	%
Upscale calibration error (initial)	-1.00	-0.13	0.30	0.97	0.64	1.18	%
Upscale calibration error (post sampling)	-0.20	0.13	0.50	1.58	0.34	1.68	%
Upscale drift	0.80	0.27	0.20	0.61	0.29	0.49	%
Mid-point calibration error (initial)	0.16	-0.70	1.00	0.20	0.25	0.64	%
Mid-point calibration error (post sampling)	0.24	-1.37	0.50	0.61	0.69	-0.44	%
Mid-point drift	0.08	0.67	0.50	0.41	0.44	1.09	%

Figure 5: Analyser calibration details

5 DEFINITIONS

The following terms and abbreviations may be used in this report:

Table 13: Definitions

Symbol	Definition
<	The analytes tested for was not detected; the value stated is the reportable limit of detection
Am^3	Gas volume in cubic metres at measured conditions
AS	Australian Standard
BH	Back half of sample train (filter holder and impingers) (referred to during sample recovery)
°C	Degrees Celsius
CARB	California Air Resources Board methods
dscm	dry standard cubic meters
FH	Front half of sample train (probe and filter holder) (referred to during sample recovery)
g	Grams
Heavy metals	Sum of Antimony, Arsenic, Beryllium, Chromium, Cobalt, Lead, Manganese, Nickel, Selenium. Cadmium and mercury are reported individually.
kg	Kilograms
Lower range	The sum of a list of a particular group of compounds, where only those individual congeners/compounds that are detectable in the sample have been included in the total. Results below the limit of detection have not been included.
m	Metres
m^3	actual gas volume in cubic metres as measured
mbar	Millibars
mg	Milligrams (10^{-3} grams)
min	Minute
ml	Millilitres
mmH_2O	Millimetres of water
Mole	SI unit that measures the amount of substance
N/A	Not applicable
ng	Nanograms (10^{-9} grams)
Nm^3	Gas volume in dry cubic metres at standard temperature and pressure (0°C and 101.3 kPa)
NMI	National Measurement Institute
NM VOC	Non methane volatile organic compound
NR	Not required on this occasion
PM	Particulate matter
ppb	Parts per billion
ppm	Parts per million
sec	Second
Sm^3	Gas volume in dry cubic metres at standard temperature and pressure (0°C and 101.3 kPa) and corrected to a standardised value (e.g. 15% O_2)
STP	Standard temperature and pressure (0°C and 101.3 kPa) & dry
Upper range	The sum of a list of a particular group of compounds, all results, including those at the limit of detection are included in the summation.
USEPA	United States Environmental Protection Authority

6 RESULTS

6.1 Boiler Stack

Table 14: Boiler stack summary of test results

Parameter	Test 1 Boiler Stack	Test 2 Boiler Stack	Unit	Reference
Average source temperature	110	108	°C	-
Flue gas water vapour content	4.1	4.6	vol-%	-
Carbon dioxide concentration	1.6	1.4	vol-%	STP - dry
Oxygen concentration	18.6	18.6	vol-%	STP - dry
Flue gas molecular weight - dry	1.3	1.3	kg/Nm^3	STP - dry
Flue gas velocity	4.4	4.4	m/sec	STP - dry
Flue gas volume flow	69.2	69.6	Nm^3/min	STP - dry
Particulate matter	< 2	< 2	mg/Nm^3	STP - dry
- emission rate	< 0.12	< 0.12	g/min	
Oxides of nitrogen (as NO_2)	13	11	mg/Nm^3	STP - dry
- emission rate	0.9	0.8	g/min	
Carbon monoxide	9	8	mg/Nm^3	STP - dry
- emission rate	0.65	0.57	g/min	
Total heavy metals [1]	< 0.056	< 0.040	mg/Nm^3	STP - dry
- emission rate	< 0.0039	< 0.0028	g/min	
Cadmium	0.0008	0.0157	mg/Nm^3	STP - dry
- emission rate	5.6E-05	1.1E-03	g/min	
Mercury	0.00102	0.00290	mg/Nm^3	STP - dry
- emission rate	7.1E-05	2.0E-04	g/min	
Hydrogen chloride	< 0.9	< 0.8	mg/Nm^3	STP - dry
- emission rate	< 0.061	< 0.059	g/min	
Sulfur dioxide	< 3	< 3	mg/Nm^3	STP - dry
- emission rate	< 0.2	< 0.2	g/min	
Total VOCs (as n-propane)	0.7	< 0.4	mg/Nm^3	STP - dry
- emission rate	0.05	< 0.03	g/min	
[1] Sum of Sb, As, Pb, Cr, Be, Se, Mn, Ni, Co				

Table 15: Sample information – HCl run 1

Site		Smorgon Fuels Darwin
Sample Location		Boiler
Reference Method		USEPA Method 26a - ISOKINETIC
Run ID		9
Test Parameter		HCl
Test Date	dd/mm/yyyy	30/08/2021
Start Time	hh:mm	12:03
End Time	hh:mm	13:17
Average Stack Temperature	°C	110
Absolute Stack Pressure	mb	1011
Moisture Content	% v/v	4.2
Dry Gas Density	kg/Nm^3	1.29
Dry Gas Molecular Weight	g/g-mole	29.0
Sample Volume (dry gas meter)	Nm^3	1.11
Stack Gas Velocity	m/sec	4.3
Actual Stack Flow Rate	m^3/min	100
Dry Standard Stack Flow Rate	Nm^3/min	68
Percent Isokinetic Rate	%	94

Pollutant	Concentration standard conditions	Emission Rate standard conditions
HCl	mg/Nm^3	g/min
HCl	< 0.9	< 0.06

Table 16: Sample information – HCl run 2

Site		Smorgon Fuels Darwin
Sample Location		Boiler
Reference Method		USEPA Method 26a - ISOKINETIC
Run ID		10
Test Parameter		HCl
Test Date	dd/mm/yyyy	30/08/2021
Start Time	hh:mm	14:22
End Time	hh:mm	15:37
Average Stack Temperature	°C	109
Absolute Stack Pressure	mb	1011
Moisture Content	% v/v	4.8
Dry Gas Density	kg/Nm^3	1.29
Dry Gas Molecular Weight	g/g-mole	29.0
Sample Volume (dry gas meter)	Nm^3	1.18
Stack Gas Velocity	m/sec	4.5
Actual Stack Flow Rate	m^3/min	103
Dry Standard Stack Flow Rate	Nm^3/min	70
Percent Isokinetic Rate	%	98

Pollutant	Concentration standard conditions	Emission Rate standard conditions
HCl	mg/Nm^3	g/min
HCl	< 0.8	< 0.06

Table 17: Sample information – Metal run 1

Site		Smorgon Fuels Darwin
Sample Location		Boiler
Reference Method		USEPA Method 29 - ISOKINETIC
Run ID		7
Test Parameter		Metals
Test Date	dd/mm/yyyy	30/08/2021
Start Time	hh:mm	12:01
End Time	hh:mm	13:15
Average Stack Temperature	°C	110
Absolute Stack Pressure	mb	1012
Moisture Content	% v/v	4.0
Dry Gas Density	kg/Nm^3	1.29
Dry Gas Molecular Weight	g/g-mole	29.0
Sample Volume (dry gas meter)	Nm^3	1.13
Stack Gas Velocity	m/sec	4.4
Actual Stack Flow Rate	m^3/min	103
Dry Standard Stack Flow Rate	Nm^3/min	70
Percent Isokinetic Rate	%	99

Pollutant	Concentration standard conditions	Emission Rate standard conditions
Metals	µg/Nm^3	g/min
Antimony (Sb)	< 5.0	< 3.5E-04
Arsenic (As)	< 5.0	< 3.5E-04
Beryllium (Be)	< 0.4	< 2.6E-05
Cadmium (Cd)	0.8	5.6E-05
Chromium (Cr)	0.5	3.7E-05
Cobalt (Co)	< 0.4	< 2.6E-05
Copper (Cu)	< 3.7	< 2.6E-04
Lead (Pb)	27.4	1.9E-03
Manganese (Mn)	6.5	4.6E-04
Nickel (Ni)	6.3	4.4E-04
Selenium (Se)	< 5.0	< 3.5E-04
Thallium (Th)	< 18.7	< 1.3E-03
Tin (Sn)	< 12.5	< 8.7E-04
Vanadium (V)	< 6.4	< 4.4E-04
Zinc (Zn)	< 7.5	< 5.2E-04
Mercury	1.0	7.1E-05
Total Heavy Metals (upper bound)	56	3.9E-03

Table 18: Sample information – Metals run 2

Site		Smorgon Fuels Darwin
Sample Location		Boiler
Reference Method		USEPA Method 29 - ISOKINETIC
Run ID		8
Test Parameter		Metals
Test Date	dd/mm/yyyy	30/08/2021
Start Time	hh:mm	14:25
End Time	hh:mm	15:39
Average Stack Temperature	°C	108
Absolute Stack Pressure	mb	1012
Moisture Content	% v/v	4.4
Dry Gas Density	kg/Nm^3	1.29
Dry Gas Molecular Weight	g/g-mole	29.0
Sample Volume (dry gas meter)	Nm^3	1.13
Stack Gas Velocity	m/sec	4.4
Actual Stack Flow Rate	m^3/min	101
Dry Standard Stack Flow Rate	Nm^3/min	69
Percent Isokinetic Rate	%	100

Pollutant		Concentration standard conditions		Emission Rate standard conditions
Metals		µg/Nm^3		g/min
Antimony (Sb)	<	5.0	<	3.5E-04
Arsenic (As)	<	5.0	<	3.5E-04
Beryllium (Be)	<	0.4	<	2.6E-05
Cadmium (Cd)		15.7		1.1E-03
Chromium (Cr)	<	0.7	<	4.9E-05
Cobalt (Co)		0.9		6.1E-05
Copper (Cu)	<	3.8	<	2.6E-04
Lead (Pb)		3.5		2.4E-04
Manganese (Mn)		15.5		1.1E-03
Nickel (Ni)		4.7		3.2E-04
Selenium (Se)	<	5.0	<	3.5E-04
Thallium (Th)	<	18.8	<	1.3E-03
Tin (Sn)	<	12.5	<	8.7E-04
Vanadium (V)	<	6.3	<	4.3E-04
Zinc (Zn)	<	7.5	<	5.2E-04
Mercury		2.9		2.0E-04
Total Heavy Metals (upper bound)		40		2.8E-03

Table 19: Sample information – VOCs run 1

Site		Smorgon Fuels Darwin
Sample Location		Boiler
Reference Method		USEPA Method 18 - CONSTANT FLOW
Run ID		5
Test Parameter		VOCs
Test Date	dd/mm/yyyy	30/08/2021
Start Time	hh:mm	14:30
End Time	hh:mm	15:30
Average Stack Temperature	°C	108
Absolute Stack Pressure	mb	1011
Moisture Content	% v/v	4.3
Dry Gas Density	kg/Nm^3	1.29
Dry Gas Molecular Weight	g/g-mole	29.0
Sample Volume (dry gas meter)	Nm^3	0.03
Stack Gas Velocity	m/sec	4.4
Actual Stack Flow Rate	m^3/min	101
Dry Standard Stack Flow Rate	Nm^3/min	69
Percent Isokinetic Rate	%	N/A

Pollutant	Concentration standard conditions	Emission Rate standard conditions
Total (non-methane) VOCs	mg/Nm^3	g/min
Total VOCs - as n-propane	0.7	0.045

Table 20: Sample information – VOCs run 2

Site		Smorgon Fuels Darwin
Sample Location		Boiler
Reference Method		USEPA Method 18 - CONSTANT FLOW
Run ID		6
Test Parameter		VOCs
Test Date	dd/mm/yyyy	30/08/2021
Start Time	hh:mm	15:40
End Time	hh:mm	16:40
Average Stack Temperature	°C	109
Absolute Stack Pressure	mb	1012
Moisture Content	% v/v	4.3
Dry Gas Density	kg/Nm^3	1.29
Dry Gas Molecular Weight	g/g-mole	29.0
Sample Volume (dry gas meter)	Nm^3	0.03
Stack Gas Velocity	m/sec	4.5
Actual Stack Flow Rate	m^3/min	103
Dry Standard Stack Flow Rate	Nm^3/min	70
Percent Isokinetic Rate	%	N/A

Pollutant	Concentration standard conditions	Emission Rate standard conditions
VOCs	mg/Nm^3	g/min
Total VOCs - as n-propane	< 0.4	< 0.026

Table 21: Sample information – Gases run 1

Site		Smorgon Fuels Darwin
Sample Location		Boiler
Reference Method		USEPA Method 3A, 7E & 10
Run ID		Various
Test Parameter		O_2, CO_2, NOx, CO
Test Date	dd/mm/yyyy	30/08/2021
Start Time	hh:mm	12:03
End Time	hh:mm	13:17
Average Stack Temperature	°C	110
Absolute Stack Pressure	mb	1011
Moisture Content	% v/v	4.1
Dry Gas Density	kg/Nm^3	1.29
Dry Gas Molecular Weight	g/g-mole	29.0
Stack Gas Velocity	m/sec	4.4
Actual Stack Flow Rate	m^3/min	101
Dry Standard Stack Flow Rate	Nm^3/min	69

Pollutant O2, CO2, NOx, CO		Concentration standard conditions STP		Emission Rate standard conditions g/min
Oxygen (% v/v)		18.6		-
Carbon dioxide (% v/v)		1.6		-
Sulfur dioxide (mg/m^3)	<	2.9	<	0.20
Carbon monoxide (mg/m^3)		9		0.65
Oxides of nitrogen (mg/m^3)		13		0.92

Table 22: Sample information – Gases run 2

Site		Smorgon Fuels Darwin
Sample Location		Boiler
Reference Method		USEPA Method 3A, 7E & 10
Run ID		Various
Test Parameter		O2, CO2, NOx, CO
Test Date	dd/mm/yyyy	30/08/2021
Start Time	hh:mm	14:22
End Time	hh:mm	15:39
Average Stack Temperature	°C	110
Absolute Stack Pressure	mb	1011
Moisture Content	% v/v	4
Dry Gas Density	kg/Nm^3	1
Dry Gas Molecular Weight	g/g-mole	29
Stack Gas Velocity	m/sec	4
Actual Stack Flow Rate	m^3/min	101
Dry Standard Stack Flow Rate	Nm^3/min	69

Pollutant O2, CO2, NOx, CO		Concentration standard conditions STP		Emission Rate standard conditions g/min
Oxygen (% v/v)		18.6		-
Carbon dioxide (% v/v)		1.4		-
Sulfur dioxide (mg/m^3)	<	2.9	<	0.20
Carbon monoxide (mg/m^3)		8		0.57
Oxides of nitrogen (mg/m^3)		11		0.77

6.2 Combined Scrubber Vent Stack

Table 23: Combined scrubber vent stack summary of test results

Parameter		Test 1 Vent Stack		Test 2 Vent Stack	Unit	Reference
Average source temperature		27		27	°C	-
Flue gas water vapour content		3.5		3.5	vol-%	-
Carbon dioxide concentration		0.0		0.0	vol-%	STP - dry
Oxygen concentration		20.9		20.9	vol-%	STP - dry
Flue gas molecular weight - dry		1.3		1.3	kg/Nm^3	STP - dry
Flue gas velocity	<	1.1	<	1.1	m/sec	STP - dry
Flue gas volume flow	<	0.3	<	0.3	Nm^3/min	STP - dry
Total VOCs (as n-propane)		41.5		17.1	mg/Nm^3	STP - dry
- emission rate	<	0.013	<	0.005	g/min	

Table 24: Sample information – VOCs run 1

Site		Smorgon Fuels Darwin
Sample Location		Scrubber vent
Reference Method		USEPA Method 18 - CONSTANT FLOW
Run ID		1
Test Parameter		TVOCs
Test Date	dd/mm/yyyy	31/08/2021
Start Time	hh:mm	8:50
End Time	hh:mm	9:26
Average Stack Temperature	°C	27
Absolute Stack Pressure	mb	1011
Moisture Content	% v/v	3.5
Dry Gas Density	kg/Nm^3	1.29
Dry Gas Molecular Weight	g/g-mole	28.8
Sample Volume (dry gas meter)	Nm^3	0.03
Stack Gas Velocity	m/sec	< 1.1
Actual Stack Flow Rate	m^3/min	< 0.3
Dry Standard Stack Flow Rate	Nm^3/min	< 0.3
Percent Isokinetic Rate	%	N/A

Pollutant	Concentration standard conditions		Emission Rate standard conditions
Total (non-methane) VOCs	mg/Nm^3		g/min
Total VOCs - as n-propane	41.5	<	0.01

Table 25: Sample information – VOCs run 2

Site		Smorgon Fuels Darwin
Sample Location		Scrubber vent
Reference Method		USEPA Method 18 - CONSTANT FLOW
Run ID		2
Test Parameter		TVOCs
Test Date	dd/mm/yyyy	31/08/2021
Start Time	hh:mm	9:35
End Time	hh:mm	10:11
Average Stack Temperature	°C	27
Absolute Stack Pressure	mb	1011
Moisture Content	% v/v	3.5
Dry Gas Density	kg/Nm^3	1.29
Dry Gas Molecular Weight	g/g-mole	28.8
Sample Volume (dry gas meter)	Nm^3	0.03
Stack Gas Velocity	m/sec	< 1.1
Actual Stack Flow Rate	m^3/min	< 0.3
Dry Standard Stack Flow Rate	Nm^3/min	< 0.3
Percent Isokinetic Rate	%	N/A

Pollutant	Concentration standard conditions		Emission Rate standard conditions
Total (non-methane) VOCs	mg/Nm^3		g/min
Total VOCs - as n-propane	17.1	<	0.01