

# Report for the Periodic Monitoring of Emissions to Atmosphere

## Veolia ES Onyx Ltd

Permit No: BW 32811A  
Installation: Redbourn Treatment Plant  
Monitoring Dates: 26 September 2017  
Site Address: Redbourn Road, St Albans, Hertfordshire, AL3 6RP

Report Number: 11586  
Date of Report: 31 October 2017  
Report Author: Martin Ropka  
MCERTS No: MM 06 761

Version: 1      Visit: 2 in 2017

MCERTS Level: 2 (TE1, TE2, TE3, TE4)

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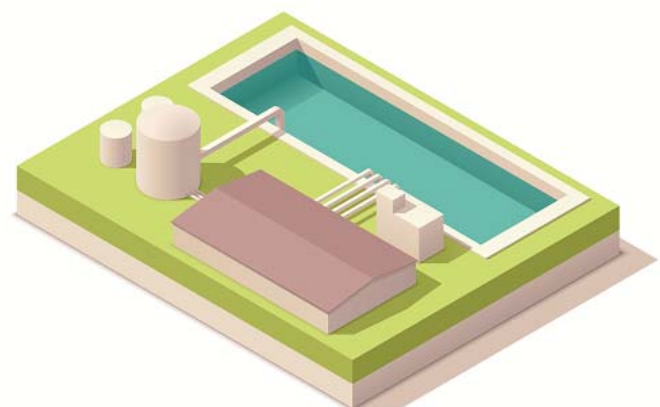
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# Executive Summary

## Monitoring Objectives

Veolia ES (UK) Ltd operates the Redbourn Treatment Plant near St Albans, where hazardous and non-hazardous waste liquids and sludges, from a broad variety of external processes, are brought by tanker to be unloaded and treated. As part of the environmental permit BW32811A issued to the site, Envirocare Technical Consultancy were contracted to test emissions to atmosphere from the lime silo dust filtration unit designated as emission point A2.

Testing was also conducted from the A1 Scrubber emission point, as part of an improvement program. Monitoring for potential pollutants in ambient air also took place at several key source points around the site.

The results of the testing form the basis of this report.

## Emission Point Identification

Substances to be Monitored	A1	A2	F3	F4	F5
	Scrubber	Dust Silo	Sample Gantry	Waste Discharge Area	Inner Bunding
Total Particulate Matter	✓	✓	✓	✓	✓
Ammonia	✓	-	✓	✓	✓
Hydrogen Chloride	✓	-	✓	✓	✓
Hydrogen Sulphide	✓	-	✓	✓	✓
Total VOCs	✓	-	✓	✓	✓
<b>Special requirements</b>	None				

Opinions and interpretations expressed within this report are outside the scope of Envirocare Technical Consultancy's MCERTS and UKAS accreditation.

## Monitoring Results

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
<b>A1 – Scrubber</b>	Total Particulate Matter	None	<b>15.5</b>	mg/Nm <sup>3</sup>	0.5 mg/Nm <sup>3</sup>	273K, 101.3kPa	26/09/17	10:48-11:48	BS EN 13284	MCERTS	Normal
	Ammonia	None	<b>4.0</b>	mg/Nm <sup>3</sup>	0.9 mg/Nm <sup>3</sup>	273K, 101.3kPa	26/09/17	12:19-13:19	BS EN 14791	MCERTS	Normal
	Hydrogen Chloride	None	<b>0.01</b>	mg/Nm <sup>3</sup>	0.2 mg/Nm <sup>3</sup>	273K, 101.3kPa	26/09/17	10:48-11:48	BS EN 1911	MCERTS	Normal
	Hydrogen Sulphide	None	<b>&lt;0.02</b>	mg/Nm <sup>3</sup>	0.004 mg/Nm <sup>3</sup>	273K, 101.3kPa	26/09/17	10:49-11:49	US EPA M11	MCERTS	Normal
	Total VOCs	None	<b>&lt;0.07</b>	mg/Nm <sup>3</sup>	0.02 mg/Nm <sup>3</sup>	273K, 101.3kPa	26/09/17	09:41-10:41	PD CEN TS 13649	MCERTS	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty (95% confidence)	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
<b>A2 – Dust Silo</b>	Total Particulate Matter	None	<b>&lt;0.3</b>	mg/Nm <sup>3</sup>	N/A	273K, 101.3kPa	26/09/17	10:52-12:13	MDHS 14/3	None	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
<b>F3 – Sample Gantry (Fugitive)</b>	Total Particulate Matter	None	<b>&lt;0.3</b>	mg/Nm <sup>3</sup>	273K, 101.3kPa	26/09/17	10:54-12:15	MDHS 14/3	None	Normal
	Ammonia	None	<b>&lt;0.01</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:38-14:43	Passive Sampling	None	Normal
	Hydrogen Chloride	None	<b>&lt;0.005</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:38-14:43	Passive Sampling	None	Normal
	Hydrogen Sulphide	None	<b>0.11</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:38-14:43	Passive Sampling	None	Normal
	Total VOCs	None	<b>0.37</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:38-14:43	Passive Sampling	None	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
<b>F4 – Waste Discharge Area (Fugitive)</b>	Total Particulate Matter	None	<b>&lt;0.3</b>	mg/Nm <sup>3</sup>	273K, 101.3kPa	26/09/17	10:49-12:10	MDHS 14/3	None	Normal
	Ammonia	None	<b>0.01</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:50-14:48	Passive Sampling	None	Normal
	Hydrogen Chloride	None	<b>&lt;0.005</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:50-14:48	Passive Sampling	None	Normal
	Hydrogen Sulphide	None	<b>&lt;0.02</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:50-14:48	Passive Sampling	None	Normal
	Total VOCs	None	<b>2.7</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:50-14:48	Passive Sampling	None	Normal

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Reference Conditions	Date of Sampling	Start and End Times	Monitoring Method Reference	Accreditation for use of Method	Operating Status
<b>F5 - Inner Bunding (Fugitive)</b>	Total Particulate Matter	None	<b>0.7</b>	mg/Nm <sup>3</sup>	273K, 101.3kPa	26/09/17	10:51-12:12	MDHS 14/3	None	Normal
	Ammonia	None	<b>0.01</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:58-14:51	Passive Sampling	None	Normal
	Hydrogen Chloride	None	<b>&lt;0.006</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:58-14:51	Passive Sampling	None	Normal
	Hydrogen Sulphide	None	<b>&lt;0.021</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:58-14:51	Passive Sampling	None	Normal
	Total VOCs	None	<b>2.8</b>	mg/m <sup>3</sup>	273K, 101.3kPa	26/09/17	08:58-14:51	Passive Sampling	None	Normal

## Operating Information

Emission Point Reference	Date	Process Type	Process Duration	Fuel	Feedstock	Abatement	Load	Comparison of Operator CEMS and Periodic Monitoring Results			
								Substance	CEMS Results	Periodic Monitoring Results	Units
A1 - Scrubber	26/09/17	Continuous	Dependent on deliveries	N/A	Hazardous & non-hazardous materials.	Chemical Absorption Scrubber	Unknown	N/A	N/A	N/A	N/A
A2 - Dust Silo	26/09/17	Continuous	Intermittent	N/A	Lime	Filter	Unknown	N/A	N/A	N/A	N/A
F3 - Sample Gantry (Fugitive)	26/09/17	Batch	Varies on tanker size and number	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F4 - Waste Discharge Area (Fugitive)	26/09/17	Batch	Varies on tanker size and number	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F5 - Inner Bunding (Fugitive)	26/09/17	Continuous	Continuous	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

## Monitoring Deviations

Emission Point Reference	Substance Deviations	Monitoring Deviations	Other Relevant Issues
A1 - Scrubber	None	Sampling of particulate, HCl and ammonia took place through one port however the number of points was doubled.	None
A2 - Lime Silo	None	None	None
F3 - Sample Gantry	None	None	None
F4 - Waste Discharge Area	None	None	None
F5 - Inner Bunding	None	None	None



# Supporting Information

## Appendix 1: General Information

### Monitoring Organisation Staff Detail

Personnel	Function in monitoring campaign	MCERTS Level	MCERTS Number
Mr D Taylor	Team Leader	MCERTS Level 2 (TE 1,TE3,TE4)	MM 15 1363
Ms D Keczynska	Technician	MCERTS Level 1 (TE1,TE4)	MM 15 1358

### Monitoring Methods

Pollutant Species	Standard	Technique	Envirocare Internal Procedure
Total Particulate Matter	BS EN 13284	Gravimetric	ETC-M-01
Total Particulate Matter	MDHS 14/3	Gravimetric	ETC-HS-01
Hydrogen Chloride	BS EN 1911	IC	ETC-M-13
Total VOCs	BS EN 13649	GC-MS	ETC-M-18
Hydrogen Sulphide	US EPA M11	Dist-VAS	ETC-M-30
Ammonia	BS EN 14791	Colorimetry	ETC-M-33
Stack Temperature + Velocity	BS EN ISO 16911-1	Pitot Tube + Thermocouple	ETC-M-46

### Equipment Checklist

Equipment ID	Model Number	Purpose
P54	Sidekick	Portable sampling pump
P83	Sidekick	Portable sampling pump
ENV8	Sidekick	Portable sampling pump
P51	Sidekick	Portable sampling pump
IP7	Westec Superprobe	Integrated Probe
CB7	Anderson Console	Isokinetic Sampler

## Appendix 2: A1 Scrubber Results and Calculations

Photograph of the sampling location and positions



## Flow Criteria Measurements

<b>Stack reference:</b>	<b>A1</b>
<b>Duct diameter :</b>	90.0 cm
<b>Cross sectional area :</b>	0.636 sq.metres
<b>Barometric pressure:</b>	1026 mbar
<b>Ambient Temperature:</b>	15.4 °C
<b>Molecular weight of Stack Gas</b>	29.000 g/gmole
<b>Pitot Coefficient:</b>	0.821

Sample Line	Traverse Point	Traverse Position (%D)	Differential Pressure DP cmH2O				Stack Velocity (m/s)	Stack Temp (°C)	Angle of Swirl (°)
			1	2	3	Average			
A	A1	0.067	0.150	0.150	0.150	0.150	4.0	17.0	0
	A2	0.150	0.200	0.200	0.200	0.200	4.6	17.0	0
	A3	0.250	0.200	0.200	0.200	0.200	4.6	17.0	0
	A4	0.350	0.200	0.200	0.200	0.200	4.6	17.0	0
	A5	0.450	0.200	0.200	0.200	0.200	4.6	17.0	0
	A6	0.550	0.175	0.175	0.175	0.175	4.3	17.0	0
	A7	0.650	0.175	0.175	0.175	0.175	4.3	17.0	0
	A8	0.750	0.160	0.160	0.160	0.160	4.1	17.0	0
	A9	0.850	0.150	0.150	0.150	0.150	4.0	17.0	0
	A10	0.933	0.150	0.150	0.150	0.150	4.0	17.0	0

Velocity and Temperature Calculations		
Mean Duct Velocity:	4.3	(m/s)
Ratio Highest:Lowest:	1.2	:1
Mean Stack Temperature:	17.0	(°C)
	290.0	(°K)
Volumetric Flow Rate:	9922.1	(m³/hr)
<b>Corrected Gas Volume Flow :</b>	<b>9460.3</b>	(Nm³/hr)

## Water Vapour Measurements

The water content was measured as a part of both the particulate and ammonia sampling processes, and was found to be between 1.0% and 1.2%.

Particulates and Hydrogen Chloride

**Sampling Run No: 1**

<b>Stack details: A1</b>	<b>Duct diameter:</b>	90.0 (cm)	<b>Date:</b>	26/09/2017
	<b>Cross-sectional area:</b>	0.636 (m <sup>2</sup> )	<b>Operators:</b>	DT, DK

Meter Box No:	CB7	g/gmole cm H2O	Barometric Pressure (mbar)		Ambient Temperature (°C)		Leak Check (l/min)		Time	
Gas Meter Coefficient:	0.969		Before	After	Before	After	Before	After	Start	End
Pitot Coefficient	0.821		1026	1023	15.3	16.0	0.10	0.10	10:48	11:48
Molecular weight of Stack Gas	29.00									
Static Pressure in Stack	-0.20									

<b>Nozzle diameter=</b>	<b>10.12</b>	<b>mm</b>
<b>Average Gas Meter Temperature=</b>	<b>20.97</b>	<b>°c</b>
<b>Average Stack Temperature</b>	<b>18.0</b>	<b>°c</b>
<b>Average Stack Velocity=</b>	<b>4.4</b>	<b>metres/second</b>
<b>Isokineticity =</b>	<b>102</b>	<b>%</b>
<b>Total Sampling Time=</b>	<b>60.0</b>	<b>minutes</b>
<b>Gasmeter Difference=</b>	<b>1353.0</b>	<b>litres</b>
<b>Corrected Gasmeter Volume</b>	<b>1311.1</b>	<b>(Gasmeter Coefficient)</b>
<b>Mean Sampling Rate =</b>	<b>21.9</b>	<b>litres/minute</b>

Number of sample points      4

Filter Reference	Type
2L	110mm QMA

<b>Emission Calculations</b>		
Corrected Total Dry Gas Volume =	1231.36	Litres (273K; 101.3kPa)
Mass of water collected Run1=	12.0	g
Volume of Mass of Water =	14.9	NLitres
Water Content =	1.2	%
<b>Corrected Total Particulate Matter Emission =</b>	<b>15.51</b>	<b>mg/Nm<sup>3</sup> (273K; 101.3kPa and dry gas)</b>
<b>Corrected Hydrogen Chloride Emission =</b>	<b>0.01</b>	<b>mg/Nm<sup>3</sup> (273K; 101.3kPa and dry gas)</b>

# Ammonia

## Sampling Run No: 1

<b>Stack details: A1</b>	<b>Duct diameter:</b> 90.0 (cm)	<b>Date:</b> 26th September 2017
	<b>Cross-sectional area:</b> 0.636 (m <sup>2</sup> )	<b>Operators:</b> DT / DK

Meter Box No:	CB7	g/gmole cm H2O	Barometric Pressure (mbar)		Ambient Temperature (°C)		Leak Check (l/min)		Time	
Gas Meter Coefficient:	0.963		Before	After	Before	After	Before	After	Start	End
Pitot Coefficient	0.821		1023	1019	15.5	15.5	0.00	0.00	12:19	13:19
Molecular weight of Stack Gas	29.00									
Static Pressure in Stack	0.20									

<b>Average Stack Velocity=</b>	<b>4.3</b>	<b>metres/second</b>
<b>Total Sampling Time=</b>	<b>60.0</b>	<b>minutes</b>
<b>Gasmeter Difference=</b>	<b>1225.0</b>	<b>litres</b>
<b>Corrected Gasmeter Volume</b>	<b>1179.7</b>	<b>(Gasmeter Coefficient)</b>
<b>Mean Sampling Rate =</b>	<b>19.7</b>	<b>litres/minute</b>

### Emission Calculations

Corrected Total Dry Gas Volume =	1092.91	Litres (273K; 101.3kPa)
Ammonia Emission =	4.0	mg/Nm <sup>3</sup> (273K; 101.3kPa; Dry)
Mass of water collected Run1=	8.9	g
Volume of Mass of Water =	11.1	NLitres
Water Content =	1.0	%
<b>Corrected Ammonia Emission =</b>	<b>4.0</b>	<b>mg/Nm<sup>3</sup> (273K; 101.3kPa and dry gas)</b>

## Hydrogen Sulphide

<b>Calculation of Emissions to Atmosphere</b> <b>Monitoring of Hydrogen Sulphide to US EPA M11</b> <b>Run 1</b>						
<b>Stack details:</b>	<b>A1</b>	Duct Diameter:	90.0	(cm)	Date:	26 September 2017
Job Number:	11586	CSA:	0.636	(m <sup>2</sup> )	Operators:	DT / DK

Collection Media	Pump Operating Temp (°C)	Barometric Pressure	Ambient Temperature	Leak Check (l/min)	Time	
		mbar	(°C)	PASS/FAIL	Start	End
2 x 15ml 4% Zinc Acetate	24	1026	15.5	PASS	10:49:00	11:49:00

<b>Sampling Details:</b>		
Sampling Rate:	1074.00	ml/min
Test duration:	60.0	mins
Sample Volume:	64.4	litres
Corr. Sample Volume:	60.0	N Litres
Average Stack Velocity:	4.3	m/s
Average Stack Temperature:	18.0	(°C)
Volumetric Flowrate:	9848.0	m <sup>3</sup> /hr
Corr. Volumetric Flowrate:	9357.4	Nm <sup>3</sup> /hr

<b>Analysis Details:</b>				
Pollutant Species:	Hydrogen Sulphide			
1st Impinger Sample Ref:	11586G	Analysis Result:	< 0.90	µg
2nd Impinger Sample Ref:	11586H	Analysis Result:	< 0.65	µg
Blank Impinger Sample Ref:	11586I	Analysis Result:	< 0.75	µg
Blank Concentration:	0.013	mg/Nm <sup>3</sup>		
Has Breakthrough Occurred:	<b>NO</b>			

<b>Emission Calculations</b>		
<b>Corrected Hydrogen Sulphide Emissions:</b>	<b>&lt; 0.02</b>	<b>mg/Nm<sup>3</sup></b>
<b>Hydrogen Sulphide Mass Emission Rate:</b>	<b>&lt; 0.14</b>	<b>g/hr</b>

## Total Volatile Organic Compounds

Calculation of Emissions to Atmosphere Monitoring of Total VOCs to PD CEN TS13649 Run 1					
<b>Stack details:</b> <b>A1</b>	Duct Diameter:	90.0	(cm)	Date:	26 September 2017
Job Number: 11586	CSA:	0.636	(m <sup>2</sup> )	Operators:	DT / DK

Collection Media	Pump Operating Temp (°C)	Barometric Pressure	Ambient Temperature	Leak Check (l/min)	Time	
		mbar	(°C)	PASS/FAIL	Start	End
SKC 226-09	16	1026	15.3	PASS	09:41:00	10:41:00

Sampling Details:		
Sampling Rate:	259.7	ml/min
Test duration:	60.0	mins
Sample Volume:	15.6	litres
Corr. Sample Volume:	14.9	N Litres
Average Stack Velocity:	4.3	m/s
Average Stack Temperature:	17.0	(°C)
Volumetric Flowrate:	9848.0	m <sup>3</sup> /hr
Corr. Volumetric Flowrate:	9389.6	Nm <sup>3</sup> /hr

Analysis Details:				
Pollutant Species:	Total VOCs			
1st Tube Sample Ref:	7118601224	Analysis Result:	< 1	µg
2nd Tube Sample Ref:	7118601218	Analysis Result:	< 1	µg
Blank Tube Sample Ref:	7118601223	Analysis Result:	< 1	µg
Blank Concentration:	0.067	mg/Nm <sup>3</sup>		
Has Breakthrough Occurred:		<b>NO</b>		

Emission Calculations		
<b>Corrected Total VOC Emissions:</b> <	<b>0.07</b>	<b>mg/Nm<sup>3</sup></b>
<b>Total VOC Mass Emission Rate:</b> <	<b>0.63</b>	<b>g/hr</b>

## Analysis Results

### Particulates

#### A1

#### Total Particulate Matter Weighing Analysis Results

##### FILTER WEIGHINGS

Filter type	110mm QMA	
Filter reference	2L	2K
	Run 1 (mg)	Blank (mg)
Filter weight change	< 0.10	< 0.10
Probe wash weight	19.00	< 0.30
<b>Total deposit</b>	<b>19.10</b>	< <b>0.40</b>

##### MOISTURE WEIGHINGS

	No.1 (g)	No.2(g)	No.3(g)	No.4(g)
Impinger end	601.6	851.4	770.2	982.7
Impinger start	608.3	848.5	768.8	968.3
Moisture in each impinger	-6.7	2.9	1.4	14.4
Total Moisture	12.0	g		

Emission Limit Value	N/A	mg/m <sup>3</sup>	Date of Analysis	12/10/2017
Overall Blank Value	0.32	mg/m <sup>3</sup>	Analytical Laboratory	CLS
Is overall blank less than 10% of emission limit value?	N/A		Analytical Method	Gravimetric
Data entered by:	MR		Accreditation	ISO 17025



**ANALYSIS RESULTS**

Sample Reference	11568 A	11568 B	11568 C
	Run 1	Run 1	BLANK
	1st Impinger	2nd Impinger	
	µg	µg <	<
Hydrogen Chloride	13	7	3
Impinger Efficiency Run 1 (%)	100	PASS	

Emission Limit Value                      N/A      mg/m<sup>3</sup>  
 Overall Blank Value                              0.00 mg/m<sup>3</sup>

## Ammonia

### ANALYSIS RESULTS

Sample Reference	11586D	11586E	11586F	
	Run 1	Run 1	BLANK	
	1st Impinger	2nd Impinger		
	µg	µg	µg	
Ammonia	4180	234	<	13
Impinger Efficiency Run 1 (%)	94	N/A		

### MOISTURE WEIGHINGS RUN 1

	No.1 (g)	No.2(g)	No.3(g)	No.4(g)
Impinger end	602.4	839.4	790.7	969.2
Impinger start	611.2	837.0	790.0	954.6
Moisture in each impinger	-8.8	2.4	0.7	14.6
<b>Moisture Run 1</b>	<b>8.9</b>			

Emission Limit Value	N/A	mg/m <sup>3</sup>
Overall Blank Value	0.01	mg/m <sup>3</sup>

### Instrumental Gas Analyser Site Calibration Measurements

Not applicable.

### Instrumental Gas Analyser Results

Not applicable.

# Uncertainty Calculations

## Particulates

### MEASUREMENT UNCERTAINTY CALCULATION - RUN 1

#### A1

Emission Limit value =	N/A	mg/Nm <sup>3</sup>	Mean Emission Concentration =	15.51	mg/Nm <sup>3</sup>
Mean Sampling Rate =	21.85	litres/minute	Monitoring Time =	60.0	mins
Leak Rate =	0.10	litres/minute	Envirocare Console used =	<b>CB7</b>	
Barometric Pressure =	1025	mbar	Temperature uncertainty =	0.24	°C
Duct Temperature =	17.0	°C	Gasmeter uncertainty =	0.37	%
Sampled Gas Volume =	1353.00	litres	Barometer used =	<b>BA12</b>	
			Barometer uncertainty =	1	mbar

Source of Uncertainty	ASD *	BS EN 13284		Envirocare Certified Value	Units	% Actual value	Source Uncert u	Combined Uncert u <sup>2</sup>
		Uncertainty Criteria	Max Uncert Value					
Weighing Procedure	Std	5% of limit value	2.5	0.091	mg	N/A	0.0910	0.00828
Leak Rate	Rect	<2% of sampling rate	0.44	0.10	l/min	0.46	0.0410	0.00168
Time	Std	1sec in 1hour = 0.028%	2	1.00	secs	0.03	0.0043	0.00002
Gasmeter Volume	Std	<2%	27.06	5.01	litres	0.37	0.0574	0.00329
Std Ref Conditions Corrections								
Temperature	Std	1% of value	2.9	0.24	°C	1.41	0.2190	0.04795
Pressure	Std	1% of value	10.245	1	mbar	0.10	0.0151	0.00023
<b>Total</b>								0.06146
<b>Combined Standard Uncertainty [(Sum u<sup>2</sup>)<sup>0.5</sup>]</b>								0.25
<b>Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)</b>								3.1
<b>Expanded Total Uncertainty (mg/Nm<sup>3</sup>) (95% Confidence)</b>								0.49

## Hydrogen Chloride

### HYDROGEN CHLORIDE SAMPLING TO BS EN 1911

#### MEASUREMENT UNCERTAINTY CALCULATION

##### Run 1

Emission Limit value =	N/A	mg/Nm <sup>3</sup>	Mean Emission Concentration =	0.01	mg/Nm <sup>3</sup>
Mean Sampling Rate =	21.85	litres/minute	Monitoring Time =	60.0	mins
Leak Rate =	0.10	litres/minute	Envirocare Console used =	<b>CB7</b>	
Barometric Pressure =	1025	mbar	Temperature uncertainty =	0.24	°C
Duct Temperature =	18.0	°C	Gasmeter uncertainty =	0.37	%
Sampled Gas Volume =	1231.36	litres	Barometer used =	<b>BA12</b>	
			Barometer uncertainty =	1	mbar

Source of Uncertainty	ASD *	BS EN 13284		Envirocare Certified Value	Units	% Actual value	Source Uncert u	Combined Uncert u <sup>2</sup>
		Uncertainty Criteria	Max Uncert Value					
Analysis Procedure	Std	5% of limit value	N/A	0.1	mg	N/A	0.1000	0.01000
Leak Rate	Rect	<2% of sampling rate	0.44	0.10	l/min	0.46	0.0000	0.00000
Time	Std	1sec in 1hour = 0.028%	2	1.00	secs	0.03	0.0000	0.00000
Gasmeter Volume	Std	<2%	24.63	4.56	litres	0.37	0.0000	0.00000
Std Ref Conditions Corrections								
Temperature	Std	1% of value	2.9	0.24	°C	1.33	0.0001	0.00000
Pressure	Std	1% of value	10.245	1	mbar	0.10	0.0000	0.00000
<b>Total</b>								0.01000
<b>Combined Standard Uncertainty [(Sum u<sup>2</sup>)<sup>0.5</sup>]</b>								0.10
<b>Expanded Total Uncertainty as a percentage of emission concentration(95% Confidence)</b>								1828.39
<b>Expanded Total Uncertainty (mg/Nm<sup>3</sup>) (95% Confidence)</b>								0.20

# Ammonia

## Ammonia Sampling to BS EN 14791 MEASUREMENT UNCERTAINTY CALCULATION

### A1 Run 1

Emission Limit value =	N/A	mg/Nm <sup>3</sup>	Mean Emission Concentration =	4.04	mg/Nm <sup>3</sup>
Mean Sampling Rate =	19.66	litres/minute	Monitoring Time =	60.0	mins
Leak Rate =	0.00	litres/minute	Envirocare Console used =	<b>CB7</b>	
Barometric Pressure =	1021	mbar	Temperature uncertainty =	0.24	°C
Duct Temperature =	18.0	°C	Gasmeter uncertainty =	0.37	%
Sampled Gas Volume =	1092.91	litres	Barometer used =	<b>BA12</b>	
			Barometer uncertainty =	1	mbar

Source of Uncertainty	ASD *	BS EN 14791		Envirocare Certified Value	Units	% Actual value	Source Uncert u	Combined Uncert u <sup>2</sup>
		Uncertainty Criteria	Max Uncert Value					
Leak Rate	Rect	<2% of sampling rate	0.39	0.00	l/min	0.00	0.0000	0.00000
Time	Std	1sec in 1hour = 0.028%	2	1.00	secs	0.03	0.0011	0.00000
Gasmeter Volume	Std	<2%	21.86	4.04	litres	0.37	0.0149	0.00022

#### Std Ref Conditions Corrections

Temperature	Std	1% of value	2.9	0.24	°C	1.33	0.0539	0.00290
Pressure	Std	1% of value	10.21	1	mbar	0.10	0.0040	0.00002
<b>Total</b>								<b>0.00</b>

	Analysis result mg	Analysis Uncertainty %	Analysis Uncertainty u mg	u <sup>2</sup>	Total Sampling Uncertainty	Combined Standard Uncertainty [(Sum u <sup>2</sup> ) <sup>0.5</sup> ]	Measurement Uncertainty (95% Confidence) (mg/Nm <sup>3</sup> )	Expanded Total Uncertainty as a percentage of ELV (95% Confidence)
NH3	4	10	0.4414	0.19	0.0031	0.44	<b>0.872</b>	N/A

# Hydrogen Sulphide

## Hydrogen Sulphide by pump and midget impinger MEASUREMENT UNCERTAINTY CALCULATION

### Run 1

Emission Limit value:	N/A	mg/Nm <sup>3</sup>	Stack Details:	A1
Mean Sampling Rate:	1.07	litres/minute	Actual Emission Concentration:	0.02 mg/Nm <sup>3</sup>
Barometric Pressure:	1026	mbar	Monitoring Time:	60 mins
Duct Temperature:	18.0	°C	Job No:	11586

Source of Uncertainty	Uncertainty Criteria		Actual Source Value	Units	% Actual value	Source Uncertainty u	Combined Uncertainty u <sup>2</sup>
Analysis	25	% of result (95%confidence)	0.00	mg	12.5	0.00	0.00000
Leak Rate	2	%> of sampling rate	0.01	l/min	0.93	0.000	0.00000
Time	1	min	0.50	min	0.01	0.000	0.00000
Sampling Rate Flow =	2	% of Value	0.01	l/min	0.93	0.000	0.00000
Std Ref Conditions							
Temperature	1	% of value	0.50	°C	0.17	0.000	0.00000
Pressure	1	% of value	5.00	mbar	0.49	0.000	0.00000

**Total** 0.00

<b>Combined Standard Uncertainty</b>							0.00
<b>Measurement Uncertainty (95% Confidence Value)</b>							<b>0.004</b> mg/Nm3
<b>Measurement Uncertainty (95% Confidence Value)</b>							<b>0.03</b> g/hr
<b>Relative Uncertainty</b>							<b>24.90</b> %
<b>Expanded Total Uncertainty as a percentage of ELV (95% Confidence)</b>							<b>N/A</b> %

## Total Volatile Organic Compounds

<b>Total VOC by pump and sorbent tube</b>							
<b>MEASUREMENT UNCERTAINTY CALCULATION</b>							
<b>Run 1</b>							
Emission Limit value: N/A mg/Nm <sup>3</sup>				Stack Details: A1			
Mean Sampling Rate: 0.26 litres/minute				Actual Emission Concentration: 0.07 mg/Nm <sup>3</sup>			
Barometric Pressure: 1026 mbar				Monitoring Time: 60 mins			
Duct Temperature: 17.0 °C				Job No: 11586			
Source of Uncertainty	Uncertainty Criteria		Actual Source Value	Units	% Actual value	Source Uncertainty u	Combined Uncertainty u <sup>2</sup>
Analysis	25	% of result (95%confidence)	0.01	mg	12.5	0.01	0.00007
Leak Rate	2	% of sampling rate	0.01	l/min	3.85	0.001	0.00000
Time	1	min	0.50	min	0.01	0.000	0.00000
Sampling Rate Flow = Std Ref Conditions	2	% of Value	0.01	l/min	3.85	0.003	0.00001
Temperature	1	% of value	0.50	°C	0.17	0.000	0.00000
Pressure	1	% of value	5.00	mbar	0.49	0.000	0.00000
<b>Total</b>							0.00
<b>Combined Standard Uncertainty</b>							0.01
<b>Measurement Uncertainty (95% Confidence Value)</b>							0.02 mg/Nm3
<b>Measurement Uncertainty (95% Confidence Value)</b>							0.16 g/hr
<b>Relative Uncertainty</b>							25.95 %

## Appendix 3: A2 Dust Silo Results and Calculations

Photograph of the sampling location and positions



Flow Criteria Measurements

Not applicable.

Water Vapour Measurements

Not applicable.

**Veolia**  
**PARTICULATE MATTER EMISSIONS TO ATMOSPHERE DATA (MDHS 14 METHOD)**

Date: 26/09/2017

Site: **Veolia Redbourn**  
Atmospheric Press: 1024 mbar

Air Temperature 15.4 °C

PARTICULATE MONITORING (MDHS-14)																
Duct Reference	Pump No.	Filter No.	Flow Checks		Average Flow (l/min)	Time ON (hr:m:s)	Time OFF (hr:m:s)	Elapsed Time (hr:m:s)	Elapsed Time (min)	Air Volume Sampled (m <sup>3</sup> )	Filter Masses			Concn. Partic. Matter (mg/m <sup>3</sup> )	Corr. Part.Matt. Concn. (mg/Nm <sup>3</sup> )	
			Start (l/min)	Finish (l/min)							Initial (mg)	Final (mg)	Difference (mg)			
<b>A2</b>	Dust Silo	83	<b>ET</b>	2.00	2.00	2.00	10:52:00	12:13:00	01:21:00	81.00	0.16	-	-	0.05	0.31	<b>0.3</b>

Analysis Results

Not applicable.

Instrumental Gas Analyser Site Calibration Measurements

Not applicable.

Instrumental Gas Analyser Results

Not applicable.

Uncertainty Calculations  
Not applicable.



## Appendix 4: F3 Sample Gantry (fugitive) Results and Calculations

Photograph of the sampling location and positions



Flow Criteria Measurements

Not applicable.

Water Vapour Measurements

Not applicable.

**Veolia**  
**PARTICULATE MATTER EMISSIONS TO ATMOSPHERE DATA (MDHS 14 METHOD)**

Date: 26/09/2017

Site: **Veolia Redbourn**  
Atmospheric Press: 1024 mbar

Air Temperature 15.4 °C

PARTICULATE MONITORING (MDHS-14)																
Duct Reference	Pump No.	Filter No.	Flow Checks		Average Flow (l/min)	Time ON (hr:m:s)	Time OFF (hr:m:s)	Elapsed Time (hr:m:s)	Elapsed Time (min)	Air Volume Sampled (m³)	Filter Masses			Concn. Partic. Matter (mg/m³)	Corr. Part.Matt. Concn. (mg/Nm³)	
			Start (l/min)	Finish (l/min)							Initial (mg)	Final (mg)	Difference (mg)			
<b>F3</b>	Sample Gantry	54	<b>EU</b>	2.00	2.00	2.00	10:54:00	12:15:00	01:21:00	81.00	0.16	-	-	0.05	0.31	<b>0.3</b>

Analysis Results

Not Applicable.

Instrumental Gas Analyser Site Calibration Measurements

Not Applicable.

Instrumental Gas Analyser Results

Not Applicable.

Uncertainty Calculations  
Not Applicable.

## Appendix 5: F4 Waste Discharge Area (fugitive) Results and Calculations

Photograph of the sampling location and positions



Flow Criteria Measurements  
Not applicable.

Water Vapour Measurements  
Not applicable.

**Veolia**  
**PARTICULATE MATTER EMISSIONS TO ATMOSPHERE DATA (MDHS 14 METHOD)**

Date: 26/09/2017

Site: **Veolia Redbourn**  
Atmospheric Press: 1024 mbar

Air Temperature 15.4 °C

PARTICULATE MONITORING (MDHS-14)		Pump No.	Filter No.	Flow Checks		Average Flow (l/min)	Time ON (hr:m:s)	Time OFF (hr:m:s)	Elapsed Time (hr:m:s)	Elapsed Time (min)	Air Volume Sampled (m <sup>3</sup> )	Filter Masses			Concn. Partic. Matter (mg/m <sup>3</sup> )	Corr. Part.Matt. Concn. (mg/Nm <sup>3</sup> )
Duct Reference	Start (l/min)			Finish (l/min)	Initial (mg)							Final (mg)	Difference (mg)			
<b>F4</b>	Waste Discharge	8	EV	2.00	2.00	2.00	10:49:00	12:10:00	01:21:00	81.00	0.16	-	-	0.05	0.31	<b>0.3</b>

Analysis Results

Not applicable.

Instrumental Gas Analyser Site Calibration Measurements

Not applicable.

Instrumental Gas Analyser Results

Not applicable.

Uncertainty Calculations  
Not applicable.

## Appendix 6: F5 Inner Bunding (fugitive) Results and Calculations

Photograph of the sampling location and positions



Flow Criteria Measurements  
Not applicable.

Water Vapour Measurements  
Not applicable.

**Veolia**  
**PARTICULATE MATTER EMISSIONS TO ATMOSPHERE DATA (MDHS 14 METHOD)**

Date: 26/09/2017

Site: **Veolia Redbourn**  
Atmospheric Press: 1024 mbar

Air Temperature 15.4 °C

PARTICULATE MONITORING (MDHS-14)		Pump No.	Filter No.	Flow Checks		Average Flow (l/min)	Time ON (hr:m:s)	Time OFF (hr:m:s)	Elapsed Time (hr:m:s)	Elapsed Time (min)	Air Volume Sampled (m³)	Filter Masses			Concn. Partic. Matter (mg/m³)	Corr. Part.Matt. Concn. (mg/Nm³)
Duct Reference	Start (l/min)			Finish (l/min)	Initial (mg)							Final (mg)	Difference (mg)			
<b>F5</b>	Inner Bunding	51	<b>ES</b>	2.00	2.00	2.00	10:51:00	12:12:00	01:21:00	81.00	0.16	-	-	0.11	0.68	<b>0.7</b>

Analysis Results

Not applicable.

Instrumental Gas Analyser Site Calibration Measurements

Not applicable.

Instrumental Gas Analyser Results

Not applicable.



Uncertainty Calculations  
Not applicable.

## Appendix 7: Laboratory Analysis Results



CONCEPT LIFE SCIENCES  
DELIVERING SCIENCE

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# Concept Life Sciences

## Certificate of Analysis

Hadfield House  
Hadfield Street  
Cornbrook  
Manchester  
M16 9FE  
Tel : 0161 874 2400  
Fax : 0161 874 2404

**Report Number:** 687343-1

**Date of Report:** 12-Oct-2017

**Customer:** Envirocare Technical Consultancy Ltd  
St Blaise House  
Vaughan Street  
BRADFORD  
West Yorks  
BD1 2LL

**Customer Contact:** Mr Martin Ropka

**Customer Job Reference:** 11586

**Customer Purchase Order:** 10598

**Date Job Received at Concept:** 04-Oct-2017

**Date Analysis Started:** 06-Oct-2017

**Date Analysis Completed:** 12-Oct-2017

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation

This report should not be reproduced except in full without the written approval of the laboratory

Tests covered by this certificate were conducted in accordance with Concept Life Sciences SOPs

All results have been reviewed in accordance with Section 25 of the Concept Life Sciences, Analytical Services Quality Manual



1549

Report checked  
and authorised by :  
Michael Goodman  
Customer Service Advisor

Issued by :  
Michael Goodman  
Customer Service Advisor

Concept Reference: 687343							
Customer Reference: 11586							
Radiello 168 tube      Analysed as Radiello 168 tube							
Ammonia expressed as NH3							
Concept Reference		687343 004	687343 005	687343 006			
Customer Sample Reference		A618B	A619B	A620B			
Test Sample		AR	AR	AR			
Sampling Time (min)		365	358	353			
Date Sampled		26-SEP-2017	26-SEP-2017	26-SEP-2017			
Determinand	Method	LOD	Units	Symbol			
Ammonia expressed as NH3	Colorimetry	1	µg	N	<1	1	1
	Calc	Calc	mg/m3	N	<0.01	0.01	0.01
	Calc	Calc	ppm	N	<0.017	0.020	0.021

Concept Reference: 687343							
Customer Reference: 11586							
Radiello 130 Tube      Analysed as Radiello 130 Tube							
TVOC							
Concept Reference		687343 001	687343 002	687343 003			
Customer Sample Reference		A442H	A446H	A447H			
Test Sample		AR	AR	AR			
Sampling Time (min)		353	365	358			
Date Sampled		26-SEP-2017	26-SEP-2017	26-SEP-2017			
Determinand	Method	LOD	Units	Symbol			
Volatile Organic Compounds (Total)	GC/MS	2	µg	N	73	10	71
	Calc	Calc	mg/m3	N	2.8	0.37	2.7
	Calc	Calc	ppm	N	0.74	0.098	0.71

Concept Reference: 687343							
Customer Reference: 11586							
Radiello 170 Tube      Analysed as Radiello 170 Tube							
Hydrogen sulphide							
Concept Reference		687343 010	687343 011	687343 012			
Customer Sample Reference		A909A	A912A	A915A			
Test Sample		AR	AR	AR			
Sampling Time (min)		365	358	353			
Date Sampled		26-SEP-2017	26-SEP-2017	26-SEP-2017			
Determinand	Method	LOD	Units	Symbol			
Hydrogen sulphide	Colorimetry	0.50	µg	N	2.8	<0.50	<0.50
	Calc	Calc	mg/m3	N	0.11	<0.020	<0.021
	Calc	Calc	ppm	N	0.080	<0.015	<0.015

Concept Reference: 687343							
Customer Reference: 11586							
Radiello 169 tube      Analysed as Radiello 169 tube							
Hydrochloric acid							
Concept Reference		687343 007	687343 008	687343 009			
Customer Sample Reference		040SK	041SK	043SK			
Test Sample		AR	AR	AR			
Sampling Time (min)		365	358	353			
Date Sampled		26-SEP-2017	26-SEP-2017	26-SEP-2017			
Determinand	Method	LOD	Units	Symbol			
Hydrochloric acid	IC	0.2	µg	N	(13) <0.2	(13) <0.2	(13) <0.2
	Calc	Calc	mg/m3	N	<0.005	<0.005	<0.006
	Calc	Calc	ppm	N	<0.0036	<0.0036	<0.0037

<b>Concept Reference:</b> 687343 <b>Customer Reference:</b> 11586  <b>Impinger (0.05M Sulphuric Acid)</b> Analysed as Impinger (0.1N Sulphuric Acid) <b>Ammonia expressed as NH3</b>							
<b>Concept Reference</b>		687343 021	687343 022	687343 023			
<b>Customer Sample Reference</b>		11586D	11586E	11586F			
<b>Test Sample</b>		AR	AR	AR			
<b>Date Sampled</b>		26-SEP-2017	26-SEP-2017	26-SEP-2017			
<b>Determinand</b>	<b>Method</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>			
Ammonia expressed as NH3	Colorimetry	0.1	mg/l	U	38	1.8	<0.1
Volume	Vol	1	ml	U	110	130	130

<b>Concept Reference:</b> 687343 <b>Customer Reference:</b> 11586  <b>Impinger(DI water)</b> Analysed as Impinger(DI water) <b>Hydrogen Chloride</b>							
<b>Concept Reference</b>		687343 018	687343 019	687343 020			
<b>Customer Sample Reference</b>		11586A	11586B	11586C			
<b>Test Sample</b>		AR	AR	AR			
<b>Date Sampled</b>		26-SEP-2017	26-SEP-2017	26-SEP-2017			
<b>Determinand</b>	<b>Method</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>			
Hydrogen Chloride	IC	0.05	mg/l	U	(13) 0.11	(13) <0.05	(13) <0.05
Volume	Vol	1	ml	U	120	130	67

<b>Concept Reference:</b> 687343 <b>Customer Reference:</b> 11586  <b>Tube (Charcoal 226-09)</b> Analysed as Tube (Charcoal 226-09) <b>TVOC</b>							
<b>Concept Reference</b>		687343 031	687343 032	687343 033			
<b>Customer Sample Reference</b>		7118601223	7118601224	7118601218			
<b>Test Sample</b>		AR	AR	AR			
<b>Date Sampled</b>		26-SEP-2017	26-SEP-2017	26-SEP-2017			
<b>Determinand</b>	<b>Method</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>			
Volatile Organic Compounds (Total)	GC/MS	1	µg	N	<1	<1	<1

<b>Concept Reference:</b> 687343 <b>Customer Reference:</b> 11586  <b>Impinger (zinc acetate)</b> Analysed as Impinger (zinc acetate) <b>Hydrogen sulphide</b>							
<b>Concept Reference</b>		687343 024	687343 025	687343 026			
<b>Customer Sample Reference</b>		11586G	11586H	11586I			
<b>Test Sample</b>		AR	AR	AR			
<b>Date Sampled</b>		26-SEP-2017	26-SEP-2017	26-SEP-2017			
<b>Determinand</b>	<b>Method</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>			
Hydrogen sulphide	Dist-VAS	0.05	mg/l	N	<0.05	<0.05	<0.05
Volume	Vol	1	ml	N	18	13	15

<b>Concept Reference:</b> 687343 <b>Customer Reference:</b> 11586  <b>Wash(Acetone)</b> Analysed as Wash(Acetone) <b>Particulates</b>							
<b>Concept Reference</b>		687343 028	687343 030				
<b>Customer Sample Reference</b>		2K	2L				
<b>Test Sample</b>		AR	AR				
<b>Date Sampled</b>		26-SEP-2017	26-SEP-2017				
<b>Determinand</b>	<b>Method</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>			
Particulates (Total)	Grav	0.3	mg	U	<0.3	19	

<b>Concept Reference:</b> 687343 <b>Customer Reference:</b> 11586  <b>Filter GFA 25mm</b> Analysed as Filter GFA 25mm <b>Miscellaneous</b>										
<b>Concept Reference</b>					687343 013	687343 014	687343 015	687343 016	687343 017	
<b>Customer Sample Reference</b>					ET	EU	EV	ES	EW	
<b>Test Sample</b>					AR	AR	AR	AR	AR	
<b>Date Sampled</b>					26-SEP-2017	26-SEP-2017	26-SEP-2017	26-SEP-2017	26-SEP-2017	
<b>Determinand</b>	<b>Method</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>						
Particulates (Total)	Grav (5 Dec)	0.05	mg	U	<0.05	<0.05	<0.05	0.11	<0.05	
Weight Gain	Grav		mg	U	-0.02	-0.63	-0.34	0.11	-0.41	

<b>Concept Reference:</b> 687343 <b>Customer Reference:</b> 11586  <b>Filter Quartz 110mm</b> Analysed as Filter Quartz 110mm <b>Miscellaneous</b>										
<b>Concept Reference</b>					687343 027	687343 029				
<b>Customer Sample Reference</b>					2K	2L				
<b>Test Sample</b>					AR	AR				
<b>Date Sampled</b>					26-SEP-2017	26-SEP-2017				
<b>Determinand</b>	<b>Method</b>	<b>LOD</b>	<b>Units</b>	<b>Symbol</b>						
Particulates (Total)	Grav (5 Dec)	0.10	mg	U	<0.10	<0.10				
Weight Gain	Grav		mg	U	-0.94	-2.3				

### Index to symbols used in 687343-1

Value	Description
AR	As Received
13	Results have been blank corrected.
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited
C	Calculation

### Notes

The lab have checked the results for Samples 027-030 and have confirmed the results are correct even though the particulate in the wash is higher than the filter and there is no visible damage to the filter.