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**MCERTs odour monitoring of 2 No. biofilters serving the Phase 1 IVC
and Phase 2 MBT at FCC Environment Wrexham**

Permit Number

Phase 1 IVC - EAWML100079 / Phase 2 MBT - ERP/BB3436RA

Client

FCC Environment

Installation/Site

FCC Environment, Wrexham

Date of Monitoring

20/11/2020

Type of Monitoring

Odour monitoring

Report Reference/Version

FCCE20A_MCERTS_REPORT_01

Date of Report Issue

07/12/2020

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Approved by

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Executive Summary	
Monitoring Objectives	3
Monitoring Results	4
Monitoring & Analysis Dates & Times	5
Monitoring & Analytical Methods	5
Operating Information & Monitoring Deviations	6
Appendix 1	
Monitoring Personnel	7
Methods & Technical Procedures Used	7
Equipment	7
Appendix 2	
Photos	8
Appendix 3	
Flow Criteria Measurements	9
Dilution Measurements	12
Appendix 4	
Odour Results	13
Details of Analysis	13
Appendix 5	
Uncertainty & Combined Uncertainty	14

Executive Summary

Monitoring Objectives

Overall Aim of Monitoring Campaign

FCC Environment (FCC) commissioned Olfasense UK Ltd to undertake MCERTS odour monitoring of the inlet and outlet of 2 No. biofilter odour control units (OCU) serving an in-vessel composting (IVC) facility and a mechanical and biological treatment (MBT) facility at an FCC site in Wrexham. This report presents the odour results from the monitoring conducted on the 20th November 2020.

Target Parameters

The target parameters were as follows:

- Odour.

Special Requirements

No special requirements.

Executive Summary

Monitoring Results

Concentration

Emission Point	Parameter	Units	Result	Uncertainty 95% (K=2)	
				Lower limit	Upper limit
Phase 1 IVC OCU - Inlet	Odour	ou _E /m ³	7,230	0.42	0.62
Phase 1 IVC OCU - Outlet	Odour	ou _E /m ³	<57	0.42	0.62
Phase 2 MBT - Inlet	Odour	ou _E /m ³	9,157	0.42	0.62
Phase 2 MBT - Outlet	Odour	ou _E /m ³	763	0.42	0.62

Mass Emission

Emission Point	Parameter	Units	Result	Uncertainty 95% (K=2)	
				Lower limit	Upper limit
Phase 1 IVC OCU - Inlet	Odour	ou _E /s	83,868	0.44	0.63
Phase 1 IVC OCU - Outlet	Odour	ou _E /s	<1,226	0.42	0.62
Phase 2 MBT - Inlet	Odour	ou _E /s	54,942	0.43	0.62
Phase 2 MBT - Outlet	Odour	ou _E /s	4,731	0.44	0.63

Physical Parameters

Emission Point	Actual volumetric airflow [m ³ /s]	Volumetric Airflow [Nm ³ /s] 273K 101.3 kPa	Volumetric Airflow [Nm ³ /s] 293K 101.3 kPa	Temperature [°C]
Phase 1 IVC OCU - Inlet	11.2	10.8	11.6	14.0
Phase 1 IVC OCU - Outlet	20.6	20.0	21.5	12.7
Phase 2 MBT - Inlet	6.1	5.6	6.0	25.0
Phase 2 MBT - Outlet	6.2	5.8	6.2	22.1

Reference Conditions

Parameter	Parameter	Standard conditions
Odour	BS EN 13725:2003	101.3 kPa, 293K, wet basis

Emission Limit Value

Emission Point	Units	Emission Limit Value
Phase 1 IVC OCU - Inlet	ou _E /s	N/A
Phase 1 IVC OCU - Outlet	ou _E /s	N/A
Phase 2 MTB - Inlet	ou _E /s	N/A
Phase 2 MTB - Outlet	ou _E /s	N/A

Executive Summary

Monitoring & Analysis Date & Times

Monitoring Date & Times

Emission Point	Parameter	Date	Times of sampling		Duration [HH:MM]
			Start	Finish	
Phase 1 IVC OCU - Inlet	Odour	20/11/2020	11:41	12:01	00:20
Phase 1 IVC OCU - Outlet	Odour	20/11/2020	11:41	12:01	00:20
Phase 2 MBT - Inlet	Odour	20/11/2020	13:43	14:01	00:18
Phase 2 MBT - Outlet	Odour	20/11/2020	13:43	14:01	00:18

Analysis Date & Start Times

Emission Point	Parameter	Date	Start time of analysis
Phase 1 IVC OCU - Inlet	Odour	20/11/2020	15:15
Phase 1 IVC OCU - Outlet	Odour	20/11/2020	15:48
Phase 2 MBT - Inlet	Odour	20/11/2020	16:30
Phase 2 MBT - Outlet	Odour	20/11/2020	17:01

Monitoring & Analytical Methods

General Information

Monitoring				Analysis			
Parameter	Standard	MCERTS #	UKAS lab #	Technique	UKAS lab #	LLOD*	Units
Odour	BS EN 13725: 2003	2430	2430	Olfactometry	2430	30	ou _E /m ³

*Lower limit of detection

Analysis Laboratories

Laboratory	Parameter	Accreditation and number
Olfasense UK Ltd, Northwich	Odour	UKAS laboratory 2430

Executive Summary

Operating Information & Monitoring Deviations

Operational Details at Time of Sampling

Phase 1 IVC OCU

Parameter	Value
Continuous/batch process	Continuous
Amount of batch sampled (if applicable)	N/A
Process status	Normal operating conditions
Feedstock (if applicable)	N/A
Normal load/throughput of plant	18,000T annually
Abatement system used	Biofilter
Fuel used (if applicable)	N/A
Details from operator's CEMS (if applicable)	N/A

Monitoring Deviations

Parameter	Sampling location	Deviation
Velocity (EN 16911)	Phase 1 IVC OCU - Outlet	Sampling could not be undertaken in a section of duct which was straight within 5 Dh upstream and 2 Dh downstream of sample ports.
		Only 1 sample line was available for flow measurement.
		Flow swirl angle of > 15 degrees.
Velocity (EN 16911)	Phase 1 IVC OCU - Outlet	Sampling could not be undertaken in a section of duct which was straight within 5 Dh upstream and 2 Dh downstream of sample ports.
		Only 1 sample line was available for flow measurement.
		Flow swirl angle of > 15 degrees.
Odour (EN 13725)		One sample analysed was below the lower limit of detection for olfactometry.

Phase 2 MBT OCU

Parameter	Value
Continuous/batch process	Continuous
Amount of batch sampled (if applicable)	N/A
Process status	Normal operating conditions
Feedstock (if applicable)	N/A
Normal load/throughput of plant	37,000T annually
Abatement system used	Scrubber and biofilter
Fuel used (if applicable)	N/A
Details from operator's CEMS (if applicable)	N/A

Monitoring Deviations

Parameter	Sampling location	Deviation
Velocity (EN 16911)	Phase 2 MBT - Inlet	Sampling could not be undertaken in a section of duct which was straight within 5 Dh upstream and 2 Dh downstream of sample ports.
		Flow swirl angle of > 15 degrees.
		Ratio of highest to lowest gas velocities was more than 3:1
		Negative flow was present at points along the measurement axis.
Velocity (EN 16911)	Phase 2 MBT - Outlet	Sampling could not be undertaken in a section of duct which was straight within 5 Dh upstream and 2 Dh downstream of sample ports.
		Flow swirl angle of > 15 degrees.

Appendix 1

Monitoring Personnel

Monitoring Personnel

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Head of Sampling	Thomas Carter	Level 2	MM16 1372	TE1, TE3
Sampling Technician	Ryan Guppy	Level 2	MM16 1443	TE1, LTE3

Methods and Technical Procedures Used

Parameter	Standard	Technical Procedure
Odour	BS EN 13725:2003	QD18
Volume Flow Rate	BS EN ISO 16911-1:2013	QD19

Sampling Equipment

Description	I.D
Toughbook	TB16
Sampling barrel (for "lung sampling")	BARR09, BARR20
Sampling Pumps	PUMP12, PUMP01
Temperature meter	TEMP05
Temperature probe	TEMP05J
Pitot tube	PT08
Micromanometer	FLOW15
Humidity probe	GM25
Barometer	BAR02

Instrumental Analysers

Description	I.D
TESTO350 flue gas analyser (oxygen)	GM46

Miscellaneous Items

Description	I.D
Transport temperature logger	TEMP34
Gas alert monitors	GM61, GM66

Appendix 2

Photos

Phase 1 IVC OCU - Inlet



Phase 1 IVC OCU - Outlet



Phase 2 MBT - Inlet



Phase 2 MBT - outlet



Appendix 3

Flow Criteria Measurements

Flow Criteria Measurements - Summary

Parameter	Units	Emission Point	
		Phase 1 IVC OCU - Inlet	Phase 1 IVC OCU - Outlet
Duct diameter/depth	m	1.50	1.40
Cross-sectional area	m ²	1.77	1.54
Average gas temperature	°C	14.0	12.7
Average gas pressure	Pa	36.3	163.0
Average static pressure	Pa	-104.3	286.2
Pitot tube coefficient	-	0.839	0.839
Gas velocity	m/s	6.4	13.5
Actual volume flow rate	m ³ /s	11.2	20.6
Standardised volume flow rate [273K, 101.3kPa]	Nm ³ /s	10.8	20.0
Standardised volume flow rate [293K, 101.3kPa]	Nm ³ /s	11.6	21.5
Relative humidity	%	92.2	91.8
Average ambient temp	°C	10.8	10.8
Average barometric pressure	hPa	1026.0	1026.0

Parameter	Units	Emission Point	
		Phase 2 MBT - Inlet	Phase 2 MBT - Outlet
Duct diameter/depth	m	1.10	1.10
Cross-sectional area	m ²	0.95	0.95
Average gas temperature	°C	25.0	22.1
Average gas pressure	Pa	38.4	36.7
Average static pressure	Pa	-290.4	-28.0
Pitot tube coefficient	-	0.839	0.839
Gas velocity	m/s	6.4	6.5
Actual volume flow rate	m ³ /s	6.1	6.2
Standardised volume flow rate [273K, 101.3kPa]	Nm ³ /s	5.6	5.8
Standardised volume flow rate [293K, 101.3kPa]	Nm ³ /s	6.0	6.2
Relative humidity	%	99.9	99.9
Average ambient temp	°C	14.6	12.0
Average barometric pressure	hPa	1023.9	1023.0

Appendix 3

Flow Criteria Measurements

Flow Criteria Measurements - Average Velocity [Pa]

Traverse Point	Emission Point					
	Phase 1 IVC OCU - Inlet			Phase 1 IVC OCU - Outlet		
	Distance [m]	Traverse 1	Traverse 2	Distance [m]	Traverse 1	Traverse 2
1	0.07	42.9	-	0.06	245.2	-
2	0.14	44.6	-	0.13	225.0	-
3	0.22	41.2	-	0.20	193.6	-
4	0.33	39.3	-	0.31	190.2	-
5	0.44	42.5	-	0.41	181.7	-
6	0.65	46.3	-	0.60	129.8	-
7	0.85	41.3	-	0.80	123.8	-
8	1.06	35.2	-	0.99	136.3	-
9	1.17	22.9	-	1.09	146.5	-
10	1.28	21.4	-	1.20	126.9	-
11	1.36	30.6	-	1.27	143.6	-
12	1.43	27.8	-	1.34	113.8	-

Traverse Point	Emission Point					
	Phase 2 MBT - Inlet			Phase 2 MBT - Outlet		
	Distance [m]	Traverse 1	Traverse 2	Distance [m]	Traverse 1	Traverse 2
1	0.05	48.5	0.0	0.05	32.7	31.3
2	0.16	44.1	49.8	0.16	32.5	29.1
3	0.33	45.8	40.5	0.33	31.4	28.8
4	0.77	36.1	42.0	0.77	38.2	39.1
5	0.94	34.1	42.9	0.94	51.2	48.3
6	1.05	34.0	43.4	1.05	33.3	44.5

Appendix 3

Flow Criteria Measurements

Flow Criteria Measurements - Temperature [°C]

Traverse Point	Emission Point					
	Phase 1 IVC OCU - Inlet			Phase 1 IVC OCU - Outlet		
	Distance [m]	Traverse 1	Traverse 2	Distance [m]	Traverse 1	Traverse 2
1	0.07	13.9	-	0.06	12.6	-
2	0.14	13.9	-	0.13	12.6	-
3	0.22	13.9	-	0.20	12.6	-
4	0.33	14.0	-	0.31	12.6	-
5	0.44	14.1	-	0.41	12.7	-
6	0.65	14.1	-	0.60	12.7	-
7	0.85	13.9	-	0.80	12.7	-
8	1.06	14.1	-	0.99	12.7	-
9	1.17	14.1	-	1.09	12.7	-
10	1.28	14.0	-	1.20	12.8	-
11	1.36	13.9	-	1.27	12.7	-
12	1.43	13.9	-	1.34	12.7	-

Traverse Point	Emission Point					
	Phase 2 MBT - Inlet			Phase 2 MBT - Outlet		
	Distance [m]	Traverse 1	Traverse 2	Distance [m]	Traverse 1	Traverse 2
1	0.05	24.9	25.1	0.05	22.0	22.0
2	0.16	24.8	25.0	0.16	22.0	22.0
3	0.33	24.8	25.0	0.33	22.0	22.1
4	0.77	24.9	25.1	0.77	22.2	22.1
5	0.94	24.9	25.0	0.94	22.1	22.1
6	1.05	25.0	25.1	1.05	22.0	22.0

Appendix 3

Dilution Measurements

Sample Dilution

No dilution of samples was required.

Appendix 4

Odour Results

Odour Results

Emission Point	Date of analysis	Odour Concentration [ou _e /m ³]				Odour Emission Rate [ou _e /s]			
		Geomean	Sample 1	Sample 2	Sample 3	Geomean	Sample 1	Sample 2	Sample 3
Phase 1 IVC OCU - Inlet	20/11/2020	7,230	6,012	3,738	16,820	83,868	69,739	43,361	195,112
Phase 1 IVC OCU - Outlet	20/11/2020	57	110	55	<30	1,226	2,365	1,183	<645
Phase 2 MBT - Inlet	20/11/2020	9,157	15,502	7,852	6,308	54,942	93,012	47,112	37,848
Phase 2 MBT - Outlet	20/11/2020	763	790	682	823	4,731	4,898	4,228	5,103

Details of Analysis

Parameter	Laboratory	UKAS lab #	Analysis standard	Date of Analysis	Reference Odourant
Odour	Olfasense UK Ltd, Northwich	2430	BS EN 13725 : 2003	20/11/2020	Butanol

Analysis Dates and Start Times

Emission Point	Parameter	Date	Start time of analysis
Phase 1 IVC OCU - Inlet	Odour	20/11/2020	15:15
Phase 1 IVC OCU - Outlet	Odour	20/11/2020	15:48
Phase 2 MBT - Inlet	Odour	20/11/2020	16:30
Phase 2 MBT - Outlet	Odour	20/11/2020	17:01

Appendix 5

Uncertainty & Combined Uncertainty - Odour

The uncertainty values quoted below have been calculated based upon a confidence interval of 95%.

Uncertainty Sources

Quantifiable Sources of Uncertainty	Non-quantifiable Sources of Uncertainty
Uncertainty of measurement of the volume flow.	Uncertainty associated with the representation of the sample in a temporal sense.
Uncertainty of the odour analysis according to BSEN 13725.	Uncertainty associated with the conservation of the sample whilst the sample is drawn through the line.
Uncertainty of ancillary measurements.	Uncertainty associated with the conservation of the sample during transportation and storage.

Airflow Velocity >5m/s

Measurement	Device	Uncertainty	Source
Gas velocity measurement	Micromanometer	0.06	Manufacturers specification
	Pitot tube	0.05	Calibration uncertainty
Gas density calculation	Testo 350 combustion analyser	0.02	Manufacturer's specification
	Thermocouple	0.01	In-house measurement
	Barometer	0.01	In-house measurement
	Micromanometer	0.06	Manufacturer's specification
Cross-sectional area A (determined from measurement of diameter)	Tape measure	0.01	In-house measurement
	Thermocouple	0.01	In-house measurement
Correction to reference conditions	Barometer	0.01	In-house measurement
	Micromanometer	0.06	Manufacturer's specification
	Thermocouple	0.01	In-house measurement
Odour (replicates n=3) lower limit / upper limit	Olfactometer	0.22 / 0.31	Analytical uncertainty

Lung Method >5m/s

Source of uncertainty	Relative standard uncertainty	
	Upper limit	Lower limit
Combined relative standard uncertainty of result	0.31	0.22
Expanded combined relative uncertainty of result 95% (k = 2)	0.62	0.43

*This uncertainty has been calculated based upon a total number of 24 measurement over the velocity traverse.

The uncertainty may vary for each sampling location, as this calculation of uncertainty is affected by the number of measurements on the velocity traverse for the calculation of flow rate. For source specific uncertainties, please see the 'Monitoring results' section.