EMISSIONS MONITORING SURVEY

(In Association with Advance Environmental Consulting Limited)

Prepared for:

Aggregate Industries UK Limited.
Doyle Drive
Coventry
West Midlands
CV6 6NW

Coating Plant Bag Filter Exhaust

Permit Number	**: …**
Variation Number	**: …**
Installation	**: Coventry Coating Plant**
Visit Details	**: Emissions Monitoring 2021**
Job Number	**: P4941**
Report Number	**: R001**
Report Issue Date	**: 6th September 2021**
Survey Dates	**: 30th July 2021**

Prepared by:

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Report Issue:		**FINAL**	
Report Prepared by:		**Report Reviewed & Approved by** **MCERTS Level Two** **Technical Endorsements TE1, TE2, TE3 & TE4**	
Name:	Gavin Hibbert	***Name:***	J Litterick
		MCERTS No:	MM 03 236
Date:	20th August 2021	***Date:***	6th September 2021

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All testing has been undertaken to the main procedural requirements of:

- BS EN 16911-1:2013 & MID
- BS EN 13284-1:2017 & MID

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PART 1 - EXECUTIVE SUMMARY

1 Monitoring Objectives

Environmental Compliance Ltd (ECL) was commissioned by Advance Environmental Consulting Limited, to undertake an emission monitoring survey for **Aggregate Industries UK Limited** at their **Coventry** facility.

This report presents the findings of the survey on **Coating Plant Bag Filter Exhaust**.

The monitoring at this installation was carried out in accordance with our quotation reference **AM/P4514/Q004**, for compliance check monitoring of emissions to air.

Aggregate Industries UK Limited
Permit No : ...
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1.1 Monitoring Results

Emission Point Reference	Substance to be Monitored	Emission Limit Value	Periodic Monitoring Result	Units	Uncertainty %	Reference Conditions 273 K, 101.3 kPa	Date of Sampling	Start and End Times	Monitoring Method Reference	Operating Status
Coating Plant Bag Filter Exhaust	Volumetric Flowrate	...	7.71329	m^3/sec	4	Stack Conditions	30/07/2021	07:10 – 07:26	BS EN 16911-1:2013 & MID	Normal
	Volumetric Flowrate	...	6.18531	m^3/sec	5	STP & Wet Gas				
	Particulates Run 1	50	5.80	mg/m^3	16			07:50 – 08:23	BS EN 13284-1:2017 & MID	
	Particulates Run 2	50	2.64	mg/m^3	35			08:44 – 09:17		
	Particulates Average	...	4.22	mg/m^3	...			...		
	Particulates Run 1	...	0.13	Kg/hr	...			07:50 – 08:23		
	Particulates Run 2	...	0.06	Kg/hr	...			08:44 – 09:17		
	Particulates Average	...	0.10	Kg/hr	...			...		

The volumetric flowrate shown above is that from the initial pitot traverse.

1.2 CEMS Data

CEMS data below has been supplied to ECL.

Comparison of Operator CEMS and Periodic Monitoring Results									
Parameter	Date	Time	CEMS Results (Maximum)	CEMS Results (Average)	Periodic Monitoring Result	Units	CEM Model	Current Cal Factor	New Cal Factor
Particulates Run 1	30/07/2021	07:50 – 08:23	25.1650	11.8316	5.80	mg/m³	PCME 370	2.3552	0.5197
Particulates Run 2		08:44 – 09:17	47.8525	26.4197	2.64	mg/m³			
Particulates Average		...	36.50875	19.1257	4.22	mg/m³			

*Calibration factor calculation: **New Cal Factor = Current Cal Factor x (Monitoring Result / PCME Reading)**

1.3 Operating Information & Observations

Operating information below has been supplied by the client. Observations have been made by ECL

Emission Point Reference	Process Type	Total Batch Size	Process Comments	Fuel	Feedstock	Abatement	Load	Appearance of Plume	Appearance of Filter
Coating Plant Bag Filter Exhaust	Batch	...	...	...	Dust, 6mm & 20mm sand	Bag Filter	35 - 40 Tph	Light grey	Moderately Soiled

1.4 Monitoring Methods

Determinand	External Reference Method	ECL Technical Procedure Number
Velocity and Flowrate	BS EN 16911-1:2013 & MID	ECL/ TPD/ 022A
Particulates (Stackmite)	BS EN 13284-1:2017 & MID	ECL / TPD / 027A

1.5 Photograph of Sample Location


Stack

2 Monitoring Deviations

The objective of the survey was to measure the concentrations of pollutants from the processes / locations as detailed in Section 1. This survey meets the requirements of the site's **PPC Permit Number: ...**

There were modifications to the sampling procedures (TPDs) listed in section 1.4, these are as follows:-

Due to high duct gas velocity, in order to maintain isokinetic sampling, it was necessary to use a nozzle with diameter smaller than the recommended minimum of 8mm minimum stated in BS EN 13284-1:2017. Note that there is no absolute minimum nozzle size stated in the standard, as long as the uncertainty of the nozzle area is $<5\%$. **So this does not need to be described as a non-conforming test.**

There were no non-conforming tests.

The Uncertainty of the reported concentrations for these pollutant results DOES NOT take into account the effect of non-conformities or sample location limitations.

PART 2 – SUPPORTING INFORMATION

3 SAMPLING STAFF DETAILS

Site Sampling Team

Names of Site Team	Dates on Site	MCERTS No.	LEVEL	Technical Endorsements
Lee Harper	30/07/2021	MM 17 1423	2	TE1
Alex Fairfield	30/07/2021	MM 20 1589	1	...

Report Reviewer

Name	MCERTS No.	LEVEL	Technical Endorsements
J Litterick	MM 03 236	2	TE1, TE2, TE3, TE4

Technical Endorsement Key:-

TE1 – **Isokinetic** Particulates, Temperature & Velocity Profiles, Oxygen.
TE2 – **Isokinetic** Extractive Pollutants: - Metals, Dioxin & Furans, PAHs, PCBs, HCl, HF.
TE3 – **Non-Isokinetic** Extractive Pollutants: - Speciated VOCs, HF, HCl, Cyanide.
TE4 – **Continuous Analysers** (Combustion Gases): - TVOC, CO, NOx, SO_2.

4 SAMPLE POINT DESCRIPTIONS

Coating Plant Bag Filter Exhaust

Duct Details	
Shape	Circular
Depth	0.90m
Width	…
Area	0.64m^2
Port Recess	0.09m
Port Size & Type	4″ BSP
Height of Ports Above Platform	1.40m
Clearance Behind Ports	0.5m
Number of Sample Lines Used/Available	2 (2)
Number of Points Used Per Line	2
Duct Orientation	Vertical
Filtration	In Stack
Access to Sample Location	Ladders
Location of Nearest Power Supply & Voltage/Amperage	110V/16A in portacabin

EQUIPMENT IDs

Aggregate Industries UK Limited
Permit No : ...
Variation No : ...
Report Ref : P4941 : R001

Installation Name : Coventry Coating Plant
Visit Details : Emissions Monitoring 2021
Survey Dates : 30th July 2021
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PRE SITE EQUIPMENT CHECKLIST/ EQUIPMENT USED

Equipment	Equip. Type	ID No:	ID No:	ID No:	ID No:	ID No:	ID No:	ID No:	ID No:
MST console/pump	E001	...							
MST Nozzle set		...							
MST "S" Type Pitot		...							
MST Probe		...							
MST Hot Box		...							
MST Impinger Arm		...							
		...							
Barometer		1221							
Site Balance		...							
Site Check weights		...							
		...							
Horiba	E002								
Heated Probe / Filter									
Chiller									
MFC									
Heated Line									
FID	E003								
Heated Line									
Heated Probe / Filter									
Testo	E004								
FTIR	E005								
Heated Probe / Filter									
Heated Line									
Stackmite	E006	1280							
"L" Type Pitot		1096							
Digital Manometer		1007							
Stack Thermocouple		1248							
Thermocouple Reader		1100							
Nozzle Set		1201							
Workhorse Pumps	E007								
Stack Thermocouple									
Tube Thermocouple									
Meter Thermocouple									
High Vac Gauge									
Dioxin Thermocouple									

Quantity of Ice Required / Used for Survey	NA	Bags (2kg bags)

TABLES

Aggregate Industries UK Limited			Installation Name	: Coventry Coating Plant	
Permit No	: ...		Visit Details	: Emissions Monitoring 2021	
Variation No	: ...		Survey Dates	: 30th July 2021	
Report Ref	: P4941	: R001	Report Issue Date	: 6th September 2021	

Table 1 – Particulates Run 1

Data Recorded from Coventry - Bag Filter Exhaust

Emission Parameter	Units	TPM 1	Blank
Stack Diameter	metres	0.90	...
			...
Area of Sample Plane	m^2	0.636	...
Moisture Content	%	3.48	...
Oxygen Content	%	20.90	...
Stack Temperature	^oC	79	...
Gas Velocity (at Stack Conditions)	m/sec	12.5683	...
Gas Velocity (Reference Conditions)	m/sec*	9.5447	...
Volumetric Flowrate (Stack Conditions)	m^3/sec	7.9956	...
Volumetric Flowrate (Reference Conditions)	m^3/sec*	6.0721	...
Sample Date	...	30/07/2021	...
Sample Period	...	07:50 - 08:23	...
Sample Volume (at Stack)	m^3	0.74	...
Sample Volume (reference Conditions)	m^3*	0.57	0.57
Isokinetic Sampling Rate	%	107.8	...
Sample Reference (ECL ID)	ECL/21/	4371 & 4372	4375 & 4376
Mass of Particulate Matter Collected	mg	3.28	0.54
Concentration of Particulate Matter	mg/m^3*	**5.80**	0.96
Emission Rate of Particulate Matter	kg/hr	0.13	...
Expanded Uncertainty (% Relative)	%	16	...
Emission Limit Value (ELV)	mg/m^3*	50	...
Blank Concentration as Percentage of ELV	%	...	1.91

***Reference Conditions (273K, 101.3kPa, Wet Gas)**

Aggregate Industries UK Limited
Permit No : ...
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Installation Name : Coventry Coating Plant
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Survey Dates : 30th July 2021
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Table 2 – Particulates Run 2

Data Recorded from Coventry - Bag Filter Exhaust

Emission Parameter	Units	TPM 2	Blank
Stack Diameter	metres	0.90	...
			...
Area of Sample Plane	m^2	0.636	...
Moisture Content	%	3.48	...
Oxygen Content	%	20.90	...
Stack Temperature	^oC	80	...
Gas Velocity (at Stack Conditions)	m/sec	12.5768	...
Gas Velocity (Reference Conditions)	m/sec*	9.5241	...
Volumetric Flowrate (Stack Conditions)	m^3/sec	8.0010	...
Volumetric Flowrate (Reference Conditions)	m^3/sec*	6.0589	...
Sample Date	...	30/07/2021	...
Sample Period	...	08:44 - 09:17	...
Sample Volume (at Stack)	m^3	0.73	...
Sample Volume (reference Conditions)	m^3*	0.55	0.55
Isokinetic Sampling Rate	%	105.6	...
Sample Reference (ECL ID)	ECL/21/	4373 & 4374	4375 & 4376
Mass of Particulate Matter Collected	mg	1.46	0.54
Concentration of Particulate Matter	mg/m^3*	**2.64**	0.98
Emission Rate of Particulate Matter	kg/hr	0.06	...
Expanded Uncertainty (% Relative)	%	35	...
Emission Limit Value (ELV)	mg/m^3*	50	...
Blank Concentration as Percentage of ELV	%	...	1.96

***Reference Conditions (273K, 101.3kPa, Wet Gas)**

VELOCITY TRAVERSE PROFILES

Environmental Compliance Limited

Aggregate Industries UK Limited		**Installation Name**	**: Coventry Coating Plant**
Permit No	**: ...**	**Visit Details**	**: Emissions Monitoring 2021**
Variation No	**: ...**	**Survey Dates**	**: 30th July 2021**
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Environmental Compliance Limited	Traverse Data Profoma	Date of Measurement	30/07/2021

Company	Advance Environmental	Stack Diameter Port A (mm)	900	Average Stack Diameter (mm)	900	Pitot tube coefficient	0.99
Site	Aggregate Industries UK Ltd	Stack Diameter Port B (mm)	900	Port Length (mm)	90	Pitot Id	1096
Location	Coventry	Duct Length Port A (mm)		Average Duct Length (mm) L		Stack Thermocouple ID	1248
Stack	Bag Filter Exhaust	Duct Length Port B (mm)		Duct width (mm) B		Stack Temp Reader ID	1100
Job No	P4941	Duct Length Port C (mm)		Barometric Pressure. (mb)	991	Manometer ID	1007
Operators	LH & AF	Duct Length Port D (mm)		Ave Static Press. (mm H_20)	-1.43	Barometer ID	1221

Pre - Traverse Checks Carried Out	Time	Pass/ Fail
Pre - Traverse PITOT Visual Inspection	07:10:00	Pass
Pre - Traverse PITOT Leak Check	07:12:00	Pass

Smooth Walls

Static Pressure Readings (Pascals)			
Port A	Port B	Port C	Port D
-14.00	-14.00		

Port/ Point	Distance to Point (mm)	Time	Temperature Readings (°C)			(ΔP) Pitot Readings (Pa)			Average Temp. (°C)	Average (ΔP) (Pa)	Swirl Test ° From Reference
			1	2	3	1	2	3			
A1	132	07:14:00	60.0	60.0	60.0	77.1	76.8	78.8	60.0	77.6	2
A2	768	07:16:00	60.0	60.0	60.0	81.3	80.4	82.0	60.0	81.2	1
B1	132	07:18:00	60.0	60.0	60.0	80.4	81.4	80.7	60.0	80.8	2
B2	768	07:20:00	60.0	60.0	60.0	68.7	70.1	69.9	60.0	69.6	2
Blockage Check @ A1 (L-Type Pitot Only)		07:22:00	60.0	60.0	60.0	78.1	77.0	78.6	240.0	309.2	Total
			Mean		60.0	Mean		77.9	60.0	81.2	Max
			Difference <5% from Initial ?		0.00	Difference <5% from Initial ?		0.43	60.0	69.6	Min
									60.0	77.3	Average

Stagnation Check (S-type Pitot Only)	Time	Reading
Static Pressure Via Positive Leg (Pa)		
Static Pressure Via Negative Leg (Pa)		
Difference (Pa) < 10Pa ?		

Post - Traverse Checks Carried Out	Time	Pass/ Fail
Post - Traverse Visual Inspection	07:24:00	Pass
Post - Traverse PITOT Leak Check	07:26:00	Pass

Average temp (K)	333.000

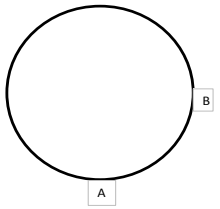
Suitability of Sampling Position	Actual Stack Conditions
Highest:lowest flow pressure ratio < 9:1?	1.18:1
Maximum deviation of flow from axis < 15° ?	2
X-sectional area for stacks = πr2	0.64 m^2
X-sectional area for ducts = L x B	m^2
Suitability of Position for Sampling	OK

Stack Moisture	3.48	%	Gas Velocity (as Measured) Adjusted for Smooth Walls	12.12453	m/sec
Measured Oxygen	20.9	%	Gas Velocity (Reference Conditions) Adjusted for Smooth Walls	9.72269	m/sec*
Measured Carbon Dioxide	0.1	%	Volumetric Flowrate (as Measured) Adjusted for Smooth Walls	7.71329	m^3/sec
Dry Gas Molecular Weight	28.85200	g/g mole	Volumetric Flowrate (Ref Cond) Adjusted for Smooth Walls	6.18531	m^3/sec*

*Reference Conditions: 273K, 101.3kPa, Wet Gas

NOTE: Velocity / volume flowrate calculations exclude contributions from the measurement point(s) where swirl > 15°

Diagram/ Description of Cross Section of Stack/Duct



Notes

Including expected or actual deviations from procedures / non-conformities

Compliance With Positional Requirements?

Height of sample ports from Platform	1.4m
Number of sample ports	2
Width of platform (port back to handrail)	0.5m

Nearest downstream disturbance	Exit	3.0m
Nearest upstream disturbance	Fan	5.0m

Disturbances are classed as bends, fans or diameter variations

SAMPLING DATA

Aggregate Industries UK Limited — **Installation Name : Coventry Coating Plant**
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Environmental Compliance Limited	PARTICULATE DATA SAMPLING PROFORMA	Date of Measurement	30/07/2021

ECL/TPD/	27a	Time taken to change Ports?	1	Start Time	07:50	End Time	08:23	Duration (mins)	32

Client	Advance Environmental	Stack Profile	Circular	Pitot ID	1096	Stack Thermocouple ID	1248
Site	Aggregate Industries UK Ltd	Stack Area (m^2)	0.64	Manometer ID	1007	Stack Temp Reader ID	1100
Location	Coventry	Barometric Pressure (mb)	991	Barometer ID	1221	Meter Thermocouple ID	1286
Stack ID	Bag Filter Exhaust	Stat Pres. (mm $H^2$0) (Pa/9.807)	-1.428	DGM Yd	0.9856	Meter Temp Reader ID	1287
Test No.	TPM 1	Pitot coefficient	0.99	Nozzle ID	1201	Dry Gas Meter ID	1284
Job No	P4941	Balance ID	n/a	Nozzle Size (mm)	6.02	Timer ID	1288
ECL Site Staff	LH & AF	Console ID	1283	Filter ID	224670-2699	Rotameter ID	1285

Impingers	Unweighed Silica
SOL/	
Start Weight (g)	0.00
End Weight (g)	15.85
Total weight (g)	15.85

If moisture was not measured and gas was dried before entering the gas meter, impinger weights must be included to produce the moisture concentration used in the isokinetic calculations. If the gas was not dried before it entered the gas meter then impinger weights MUST be included to produce a nominal 0.1% moisture value.

	Sample Volume
Start Volume	109052.0
Final Volume	109662.0
Total Volume	610.0

Note that once the sample has started, no further SAMPLE TRAIN leak checks are allowed, neither when changing ports (even if disconnections are required) nor at the end of the test.

Total	Volume (litres) @ STP Dry	
	Expected Sample Volume	506.00
	Actual Sample Volume	545.42
610.0	Isokinetic Percentage	107.79

Leak Check	Pre Sample
Measured Leak Rate* l/min	0
Set Sampling Rate* (l/min)	25
Time Of Leak Check	07:48
Leak % of set rate	0.0

* During sample train leak check, set the sample flowrate above the maximum EXPECTED sampling flowrate.

Maximum allowed leak rate is 2% of the set rate				
	Measured O_2	20.90	Moisture	3.48
	Measured CO_2 %	0.10	Ref O_2	n/a
	Measured CO ppm	0.1	Dry Gas Molecular Weight	28.85

Smooth Walls

DI Water SOL/	4335
Acetone SOL/	4249

TPD/27A is carried out with an unheated sampling system only.

Traverse Point	A1	A1	A2	A2	B1	B1	B2	B2	Total
Time Interval (mins)	4	4	4	4	4	4	4	4	
Time/Point (mins)	0 - 4	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	
ΔP (Pa)	79.80	81.40	81.60	82.40	68.40	70.50	82.40	83.00	78.7
Velocity at Stack (m/s)	12.72	12.84	12.86	12.94	11.79	11.97	12.94	12.99	
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas	17.2	17.3	17.4	17.5	15.9	16.2	17.5	17.6	17.1
Meter (Tm)	21	21	21	22	22	22	22	22	21.6
Stack Temp (Ts)	78	78	78	79	79	79	79	79	78.6

Original Flowrate Settings	
Tm	40
Ts	60
% moisture	0.1

Pitot Quality Control Checks	
PRE-Sample PITOT Visual Inspection	
Time	07:24
Pass ? (Y/N)	Y

Traverse Point									Total
Time Interval (mins)									
Time/Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

PRE-Sample PITOT Leak Check	
Time	07:26
Pass ? (Y/N)	Y

Post-Sample Blockage Check (L-type)	
Time	08:25
Reading (Pa)	77.8
Pass (< 5%) ?	-2.5

Traverse Point									Total
Time Interval (mins)									
Time/Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

POST-Sample PITOT Visual Inspection	
Time	08:27
Pass ? (Y/N)	Y

POST-Sample PITOT Leak Check	
Time	08:29
Pass ? (Y/N)	Y

Environmental Compliance Limited	PARTICULATE DATA SAMPLING PROFORMA	Date of Measurement	30/07/2021

ECL/TPD/	27a	Time taken to change Ports?	1	Start Time	08:44	End Time	09:17	Duration (mins)	32

Client	Advance Environmental	Stack Profile	Circular	Pitot ID	1096	Stack Thermocouple ID	1248
Site	Aggregate Industries UK Ltd	Stack Area (m^2)	0.64	Manometer ID	1007	Stack Temp Reader ID	1100
Location	Coventry	Barometric Pressure (mb)	991	Barometer ID	1221	Meter Thermocouple ID	1286
Stack ID	Bag Filter Exhaust	Stat Pres. (mm $H^2$0) (Pa/9.807)	-1.428	DGM Yd	0.9856	Meter Temp Reader ID	1287
Test No.	TPM 2	Pitot coefficient	0.99	Nozzle ID	1201	Dry Gas Meter ID	1284
Job No	P4941	Balance ID	n/a	Nozzle Size (mm)	6.02	Timer ID	1288
ECL Site Staff	LH & AF	Console ID	1283	Filter ID	224687-2699	Rotameter ID	1285

Impingers	Unweighed Silica
SOL/	
Start Weight (g)	0.00
End Weight (g)	15.50
Total weight (g)	15.50

If moisture was not measured and gas was dried before entering the gas meter, impinger weights must be included to produce the moisture concentration used in the isokinetic calculations. If the gas was not dried before it entered the gas meter then impinger weights MUST be included to produce a nominal 0.1% moisture value.

	Sample Volume
Start Volume	109828.0
Final Volume	110427.0
Total Volume	599.0

Note that once the sample has started, no further SAMPLE TRAIN leak checks are allowed, neither when changing ports (even if disconnections are required) nor at the end of the test.

Total	Volume (litres) @ STP Dry	
	Expected Sample Volume	504.90
	Actual Sample Volume	533.10
599.0	Isokinetic Percentage	105.58

Leak Check	Pre Sample
Measured Leak Rate* l/min	0
Set Sampling Rate* (l/min)	25
Time Of Leak Check	08:40
Leak % of set rate	0.0

* During sample train leak check, set the sample flowrate above the maximum EXPECTED sampling flowrate.

Maximum allowed leak rate is 2% of the set rate				
	Measured O_2	20.90	Moisture	3.48
	Measured CO_2 %	0.10	Ref O_2	n/a
	Measured CO ppm	0.1	Dry Gas Molecular Weight	28.85

Smooth Walls

DI Water SOL/	4335
Acetone SOL/	4249

TPD/27A is carried out with an unheated sampling system only.

Traverse Point	A1	A1	A2	A2	B1	B1	B2	B2	Total
Time Interval (mins)	4	4	4	4	4	4	4	4	
Time/Point (mins)	0 - 4	4 - 8	8 - 12	12 - 16	16 - 20	20 - 24	24 - 28	28 - 32	
ΔP (Pa)	77.50	80.10	82.20	84.10	70.70	72.40	78.90	82.40	78.5
Velocity at Stack (m/s)	12.55	12.76	12.94	13.09	12.00	12.15	12.68	12.94	
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas	17.0	17.3	17.5	17.7	16.2	16.4	17.1	17.5	17.1
Meter (Tm)	23	23	23	23	23	23	23	23	23.0
Stack Temp (Ts)	79	79	80	80	80	80	80	79	79.6

Original Flowrate Settings	
Tm	40
Ts	60
% moisture	0.1

Pitot Quality Control Checks	
PRE-Sample PITOT Visual Inspection	
Time	08:27
Pass ? (Y/N)	Y

Traverse Point									Total
Time Interval (mins)									
Time/Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

PRE-Sample PITOT Leak Check	
Time	08:29
Pass ? (Y/N)	Y

Post-Sample Blockage Check (L-type)	
Time	09:19
Reading (Pa)	78.1
Pass (< 5%) ?	0.8

Traverse Point									Total
Time Interval (mins)									
Time/Point (mins)									
ΔP (Pa)									
Velocity at Stack (m/s)									
Sample Rate (l/min) 101.3 mbar, Tm, Dry Gas									
Meter (Tm)									
Stack Temp (Ts)									

POST-Sample PITOT Visual Inspection	
Time	09:21
Pass ? (Y/N)	Y

POST-Sample PITOT Leak Check	
Time	09:23
Pass ? (Y/N)	Y

LABORATORY ANALYSIS RESULTS

Laboratory analysis was subcontracted to RPS laboratories, a UKAS Accredited Testing Laboratory, Number 0605.

Aggregate Industries UK Limited
Permit No : ...
Variation No : ...
Report Ref : P4941 : R001

Installation Name : Coventry Coating Plant
Visit Details : Emissions Monitoring 2021
Survey Dates : 30th July 2021
Report Issue Date : 6th September 2021

Customer Sample No	ECL/21/4371	ECL/21/4372	ECL/21/4373	ECL/21/4374	ECL/21/4375	ECL/21/4376	ECL/21/4377	ECL/21/4378
RPS Sample No	53526	53527	53528	53529	53530	53531	53532	53533
Sample Matrix	FILTER	SOLUTION	FILTER	SOLUTION	FILTER	SOLUTION	FILTER	SOLUTION
Sampling Date	30/07/2021	30/07/2021	30/07/2021	30/07/2021	30/07/2021	30/07/2021	30/07/2021	30/07/2021

Determinand	CAS No	Codes	SOP	RL	Units								
particulates		UM	D9	0.04	mg	1.38		0.86		< 0.04		< 0.04	
particulates		UM	D9	0.5	mg		1.9		0.6		< 0.5		< 0.5

UNCERTAINTY CALCULATIONS

Aggregate Industries UK Limited			Installation Name	: Coventry Coating Plant
Permit No	: ...		Visit Details	: Emissions Monitoring 2021
Variation No	: ...		Survey Dates	: 30th July 2021
Report Ref	: P4941	: R001	Report Issue Date	: 6th September 2021

Stack Reference Bag Filter Exhaust

Measurement Uncertainty Calculations - Velocity at Stack Conditions

Contribution From	Standard u/c (Pa)	
Pitot Calibration Uncertainty Contribution	0.39	A
Manometer Calibration Uncertainty Contribution	0.3865	B
Variation in Actual Pitot reading at sample points	0.75	C
Combined u/c (Pa) =	**Combined u/c (Pa)**	
SQRT $(A/\sqrt{3})^2 + (B/\sqrt{3})^2 + (C/\sqrt{3})^2$	0.54	
Expanded Uncertainty of Flow Measurements Pa	**1.07**	
	Standard u/c (K)	
Temperature Calibration (K)	1.67	D
Variation in Actual Temp reading at sample points	0.00	E
Combined u/c of Temp (K)	**Combined u/c (K)**	
SQRT $((D/\sqrt{3}^2) + (E/\sqrt{3})^2)$	0.96	
Expanded Uncertainty of Temp Measurements (K)	**1.92**	
Measured Average Velocity (m/s) at Stack Conds	12.19	
Maximum Average Velocity (m/s) at Stack Conds	12.31	
Standard Uncertainty Velocity at Stack Conditions (%)	0.98	
Expanded Uncertainty Velocity (at Stack Conditions)	**1.96 (%)**	

Measurement Uncertainty Calculations - Flowrate at Stack Conditions

Contribution From	Standard u/c (m^2)
Area (m2)	0.00636
Measured Average Flowrate (m^3/s) at Stack Conds	7.75
Maximum Average Flowrate (m^3/s) at Stack Conds	7.91
Standard Uncertainty Flowrate (m^3/s) at Stack Conditions (%)	1.99
Expanded Uncertainty Flowrate (m^3/s) at Stack Conditions	**3.98 (%)**

Measurement Uncertainty Calculations - Flowrate at STP & Wet Gas

Contribution From	Standard u/c (%)
Temperature Calibration (K)	0.5
Barometer Calibration	0.5
Measured Average Flowrate (m^3/s) at STP Wet	6.22
Maximum Average Flowrate (m^3/s) at STP Wet	6.37
Standard Uncertainty Flowrate (m^3/s) at STP Wet	2.41
Expanded Uncertainty Flowrate (m^3/s) at STP Wet	**4.82 (%)**

Aggregate Industries UK Limited		**Installation Name**	**: Coventry Coating Plant**
Permit No	**: ...**	**Visit Details**	**: Emissions Monitoring 2021**
Variation No	**: ...**	**Survey Dates**	**: 30th July 2021**
Report Ref	**: P4941 : R001**	**Report Issue Date**	**: 6th September 2021**

Site: Advance Environmental, Aggregate Industries UK Ltd
Location: Coventry , Stack ID: Bag Filter Exhaust

$$u_{mass} = \sqrt{\sum (u_{filter})^2 + (u_{solution})^2}$$

Determinand	Filter mg	Solution mg	Recovered Mass mg	LAB Method Uncert (%) K = 2 Filter mg	LAB Method Uncert (%) K = 2 Solution mg	Standard Uncertainty Filter mg	Standard Uncertainty Solution mg	Combined Uncertainty mg
				TPM 1				
Particulates	1.38	1.90	3.28	0.10	0.50	0.0500	0.25	0.25

	TPM 1				
			Standard Uncertainty @ 95%		
Sampled Volume (V_m)	0.61	m^3	uV_m	0.001	m^3
Meter Correction Factor (Yd)	0.99	...		...	...
Meter Temperature (T_m)	294.78	k	uT_m	1.5	k
Static Pressure of Stack P_{static}	-1.428E+00	mmH_2O	uP_{static}	0.25	mmH_2O
Absolute Stack Pressure ρ_s	743.31	mmHg	up_s	0.8	mmHg
Barometric Pressure ρ_b	743.49	mmHg	up_b	3.8	mmHg
Average Differential Pressure (ΔP) + ρs	100.17	mmH_2O	uΔH	0.25	mmH_2O
Oxygen content ($O_{2,m}$)	20.90	% by volume	$uO_{2,m} = \sigma/\sqrt{n}$	0.00	% by volume
Moisture Content (H_2O)	3.48	% by volume	uH_2O	0.34	% by volume

Note: In the following calculations, the sensitivity coefficient (C) is estimated using:

$$C_i = \frac{\partial f}{\partial x_i}$$

For each factor, uncertainty is then calculated by $C_i u_i$ where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.g. $i = uV_m, uT_m$ etc.

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = 1.04$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured static pressure uncertainty component (uPstatic) & measured temperature of dry gas uncertainty component (uT_m)

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = 0.934$$

	Maximum	Minimum	Sensitivity	ufstp
uΔH	0.49	0.49	0.0000475	0.0000119
up_b	0.49	0.48	0.000646	0.00242
uT_m	0.49	0.48	0.000854	0.00128
H_2O	0.49	0.48	0.00503	0.00171

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (uP_s)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = 0.00297$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = 0.5699$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uV_{std}	0.57	0.57	0.61	0.00181
Effect of uV_m	0.57	0.57	0.93	0.000934

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = 0.00141$$

Uncertainty of correction factor to reference oxygen due to measured oxygen uncertainty component (uf_{O2}) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$f_{o_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} = 1.00$$

$$uCorr^n_{o_2} = \frac{20.9\% - O_{2,ref}}{(20.9\% - O_{2,measured}) x (20.9\% - O_{2,measured})} x Uncertainty\ of\ O_2\ Measurement = 1.00$$

$$uf_{o_2} = \frac{uCorr^n_{o_2}}{f_{o_2}} x100 = 0.00$$

Uncertainty in final measurement @ reference conditions due to mass uncertainty component (uM), oxygen correction uncertainty component (uf_{Oxy}) and STP volume uncertainty component (uVstp)

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}} = 5.76$$

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	u mg/Nm³
uM	6.20	5.31	1.75	0.45
uV_{stp}	5.77	5.74	10.10	0.0142

Measurement Uncertainty of Determinand (excluding correction for oxygen)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration	Uncertainty as Percent of ELV
0.45	0.90	5.76	15.6%	1.8%

Measurement Uncertainty of Determinand (including correction for oxygen)

$$u_{combined} = \sqrt{\sum (uf_{o_2})^2 + (Uncertainty\ of\ Measurement\ of\ Determinand)^2}$$

Determinand	Measurement Uncertainty of Determinand	Measurement Uncertainty of Oxygen Corr^n Factor	Overall Measurement Uncertainty inc O_2 Corr^n factor ($U_{combined}$) %
Particulates	15.6	0.0	15.6

Aggregate Industries UK Limited		**Installation Name**	**: Coventry Coating Plant**
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Report Ref	**: P4941 : R001**	**Report Issue Date**	**: 6th September 2021**

Site: Advance Environmental, Aggregate Industries UK Ltd
Location: Coventry , Stack ID: Bag Filter Exhaust

$$u_{mass} = \sqrt{\sum (u_{filter})^2 + (u_{solution})^2}$$

Determinand	Filter mg	Solution mg	Recovered Mass mg	LAB Method Uncert (%) K=2 Filter mg	LAB Method Uncert (%) K=2 Solution mg	Standard Uncertainty Filter mg	Standard Uncertainty Solution mg	Combined Uncertainty mg
			TPM 2					
Particulates	0.86	0.60	1.46	0.10	0.50	0.0500	0.25	0.25

	TPM 2			Standard Uncertainty @ 95%		
Sampled Volume (V_m)	0.60	m^3	uV_m	0.001	m^3
Meter Correction Factor (Yd)	0.99	...		...	...
Meter Temperature (T_m)	296.15	k	uT_m	1.5	k
Static Pressure of Stack P_{static}	-1.428E+00	mmH_2O	uP_{static}	0.25	mmH_2O
Absolute Stack Pressure ρ_s	743.31	mmHg	up_s	0.8	mmHg
Barometric Pressure ρ_b	743.49	mmHg	up_b	3.8	mmHg
Average Differential Pressure (ΔP) + ρs	100.17	mmH_2O	uΔH	0.25	mmH_2O
Oxygen content ($O_{2,m}$)	20.90	% by volume	$uO_{2,m} = \sigma/\sqrt{n}$	0.00	% by volume
Moisture Content (H_2O)	3.48	% by volume	uH_2O	0.35	% by volume

Note: In the following calculations, the sensitivity coefficient (C) is estimated using: $C_i = \frac{\partial f}{\partial x_i}$

For each factor, uncertainty is then calculated by $C_i u_i$ where C is the sensitivity coefficient, u is the standard uncertainty and i is the index identifying the contributing factor e.g. i = uV_m, uT_m etc.

Where results are required at wet conditions, the following correction factor is used to convert the data from the dry gas meter:

$$f_{s,wet} = \frac{100}{(100 - H_2O)} = \quad 1.04$$

Uncertainty in correction factor to STP due to measured barometric pressure uncertainty component (upb), measured static pressure uncertainty component (uPstatic) & measured temperature of dry gas uncertainty component (uT_m)

$$f_s = \frac{273}{760} \times \frac{P_b + \frac{\Delta H}{13.6}}{T_m} \times Y_d = \quad 0.930$$

	Maximum	Minimum	Sensitivity	ufstp
uΔH	0.48	0.48	0.0000474	0.0000118
up_b	0.49	0.48	0.000644	0.00242
uT_m	0.49	0.48	0.000850	0.00128
H_2O	0.49	0.48	0.00501	0.00173

$$\frac{uf_s}{f_s} = \sqrt{\left(\frac{\sqrt{(u\Delta H)^2 + (uP_s)^2}}{(P_m/101.3)}\right)^2 + \left(\frac{uT_m}{(T_m/273.15)}\right)^2 + \left(\frac{uH_2O}{100/(100 - H_2O)}\right)^2} = \quad 0.00296$$

Uncertainty in volume @ STP due to volume correction factor uncertainty component (uVstd) & volume uncertainty component (uVm)

$$V_{std} = V_{measured} \times f_s = \quad 0.5571$$

	Maximum m^3	Minimum m^3	Sensitivity	Standard Uncertainty (m^3)
Effect of uV_{std}	0.56	0.56	0.60	0.00177
Effect of uV_m	0.56	0.56	0.93	0.000930

$$\frac{uV_{std}}{V_{std}} = \sqrt{\left(\frac{uV_{std}}{f_s}\right)^2 + \left(\frac{uV_m}{V_m}\right)^2} = \quad 0.00137$$

Uncertainty of correction factor to reference oxygen due to measured oxygen uncertainty component (uf_{O2}) & Uncertainty in final measurement @ reference conditions due to uncertainty component arrising from leak and/or loss (assumed 2% max) in the sample system (uL)

$$f_{o_2} = \frac{20.9\% - O_{2,ref}}{20.9\% - O_{2,measured}} = \quad 1.00$$

$$uCorr^n{}_{o_2} = \frac{20.9\% - O_{2,ref}}{(20.9\% - O_{2,measured}) x (20.9\% - O_{2,measured})} x Uncertainty\ of\ O_2\ Measurement = \quad 1.00$$

$$uf_{o_2} = \frac{uCorr^n{}_{o_2}}{f_{o_2}} x100 = \quad 0.00$$

Uncertainty in final measurement @ reference conditions due to mass uncertainty component (uM), oxygen correction uncertainty component (uf_{Oxy}) and STP volume uncertainty component (uVstp)

$$Conc = \frac{M_{Recovered}}{V_m \times f_s \times f_{O_2}} = \quad 2.62$$

	Maximum mg/Nm³	Minimum mg/Nm³	Sensitivity	u mg/Nm³
uM	3.08	2.16	1.80	0.46
uV_{stp}	2.63	2.61	4.70	0.00645

Measurement Uncertainty of Determinand (excluding correction for oxygen)

$$u_{combined} = \sqrt{\sum (u_M)^2 + (u_L)^2 + (uV_{stp})^2}$$

Combined Uncertainty mg/Nm³	Expanded Uncertainty mg/Nm³	Measured Concentration mg/Nm³	Percent of Measured Concentration	Uncertainty as Percent of ELV
0.46	0.92	2.62	34.9%	1.8%

Measurement Uncertainty of Determinand (including correction for oxygen)

$$u_{combined} = \sqrt{\sum (uf_{o_2})^2 + (Uncertainty\ of\ Measurement\ of\ Determinand)^2}$$

Determinand	Measurement Uncertainty of Determinand	Measurement Uncertainty of Oxygen Corrⁿ Factor	Overall Measurement Uncertainty inc O_2 Corrⁿ factor ($U_{combined}$) %
Particulates	34.9	0.0	34.9