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ENVIRONMENTAL SERVICES

Report for the Periodic Monitoring of Emissions to Atmosphere

Stack Emissions Test Report Commissioned by: Trademark Yorkshire Ltd

Trademark Yorkshire Ltd

EP1 - Acid Rinse LEV 06

Permit No:	N/A
Installation:	ITM Power LTd. (Sheffield)
Monitoring Dates:	25th - 26th July 2023
Site Address:	ITM Power Ltd, 22 Atlas Way, Sheffield, S4 7QQ

Report Number:	ES-1429	Version: 1	Visit: 1 in 2023
Date of Report:	17th August 2023		
Report Author:	Ryan Bromwell		
MCERTS No:	MM 20 1592	MCERTS Level:	2 (TE1, TE2, TE3, TE4)
Approved By:	Andy Dykes	Function:	Operations Manager
MCERTS No:	MM 04 500	MCERTS Level:	2 (TE1, TE2, TE3, TE4)

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YOUR INDUSTRY EXPERTS

MCERTS THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING 2522

Contents

Executive Summary

Monitoring Objectives

Envirocare Technical Consultancy were contracted by Trademark Yorkshire Ltd to carry out emissions monitoring, to determine the release of prescribed pollutants at EP1 - Acid Rinse LEV 06. There are no emission limits set for any of the pollutants at this time. The methodologies utilised and the results obtained form the basis of this report.

The substances requested for monitoring are listed below.

Emission Point Identification

Substances to be Monitored	EP1 - Acid Rinse LEV 06
Sulphuric Acid	✓
Water Vapour	✓
Volumetric Flow	✓

Special requirements: none

Opinions and interpretations expressed within this report are outside the scope of Envirocare Technical Consultancy's MCERTS and UKAS accreditation. Envirocare accepts no responsibility for information in this report that was provided by the client, the client's representative or employees of the client. Where such information has been provided by external sources this is identified in footnotes of the respective tables.

Executive Summary

Monitoring Results

where MU = Measurement Uncertainty associated with the result (95% Confidence)

		Concentration				Mass Emission				
Substance		**Limit (mg/m³)**	**Result (mg/m³)**	**Measurement Uncertainty (MU) +/-**	**Reference Conditions**	**Limit (g/hr)**	**Result (g/hr)**	**Measurement Uncertainty (MU) +/-**	**Sampling Date**	**Sampling Times**
Sulphuric Acid	R1	-	1.0	0.09	273k, 101.3kPa, Wet Gas	-	2.3	0.21	25/07/2023	14:40-15:40
Water Vapour	R1	-	2.1%	-	As Measured	-	-	-	-	-
Volumetric Flow (Actual)	R1	-	2,389 m³/h	108	As Measured	-	-	-	25/07/2023	14:35-14:40
Volumetric Flow (REF)	R1	-	2,175 m³/h	98.6	273k, 101.3kPa, Wet Gas	-	-	-	25/07/2023	14:35-14:40

Reference conditions (REF) are: 273k, 101.3kPa, Wet Gas

Supporting Information

Appendix 1: General Information

Operating Information

Parameter	Process Details
Process Type	Acid Rinse
Continuous or Batch Process	Batch
Operating Status	Normal
Feedstock	Various metal Componants and Solvents
Normal Load, Throughput or Continuous Rating	24 plates
Abatement System	N/A
Abatement System Status	N/A
Process Fuel	N/A
Plume Appearance	None

Monitoring Deviations

Parameter	Run	Deviation
H2SO4	Run 1	The absorption efficiency was less than the required 95%, however, it should be noted that the results were of a low order.

Monitoring Organisation Staff Details

Personnel	Position	MCERTS Level	MCERTS Number
Mr R Bromwell	Team Leader	2 (TE1, TE2, TE3, TE4)	MM 20 1592
Mr J Doyle	Team Leader	Trainee	MM 22 1757

Monitoring Methods

Pollutant Species	Standard	Technical Procedure	Testing MCERTS	Analysis Laboratory	Analytical Procedure	Analytical Technique	Analysis MCERTS
Volumetric Flow	BS EN ISO 16911-1	ETC-SE-24a	Yes	Pitot Tube and Thermocouple			
Sulphuric Acid	US EPA M8	ETC-SE-31	No	RPS	EPA M8	IC	No
Water Vapour	BS EN 14790	ETC-SE-11	Yes	ENV	ETC-SE-11	Gravimetric	Yes

Envirocare: 2522 | RPS Laboratories Ltd (RPS): 0605

Equipment Checklist

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	**Equipment I.D.**	**Equipment Type**	**Equipment I.D.**	**Equipment Type**	**Equipment I.D.**
Control Box DGM	8.09	Horiba PG-250	12.04	Tape Measure	17.12
Box Thermocouples	2.01a	Horiba PG-250 SRM	-	Bevel Box	-
Box Thermocouple In	3.35	Horiba PG-350	-	Stopwatch	10.01
Box Thermocouple Out	3.36	JCT JCC Cooler	3.40b	Barometer	11.1
Control Box Timer	10.01a	MAK10 Cooler	-	Digital Manometer	24.04
Umbilical	2.01a	Horiba PS200 Cooler	-	Digital Temperature Meter	24.04
Oven Box	9.07	M&C PSS Gas Preparation	-	Dual Channel Heat Controller	6.04
Heated Probe (1)	4.07	Gasmet DX4000 FTIR	-	1m Heated Line	-
Heated Probe (2)	4.22	Gasmet Sampling System	-	3m Heated Line	-
Stack Thermocouple (1)	1.07	SK-Thermo FID	13.04	5m Heated Line	-
Stack Thermocouple (2)	-	Bernath 3006 FID	-	10m Heated Line	5.08
S-Type Pitot (1)	10-17-19-8	Testo 350XL	-	20m Heated Line	-
S-Type Pitot (2)	8.10(b)	M&C PSP 4000	-	30m Heated Line	7.04
L-Type Pitot	20.05L	Easylogger EN-EL-12 Bit	-	Impinger Arm Thermocouple (1)	3.04
Site Balance	18.09	Hioki 5043 (V)	-	Impinger Arm Thermocouple (2)	-
500g Check Weight	18.09a	Analyser Temperature Logger	19.1	Dioxins Kit Thermocouple	-
1KG Check Weight	18.09b	-	-	Sample Temperature Logger	-
Digital Callipers	16.08	-	-	Laboratory Balance	SE--

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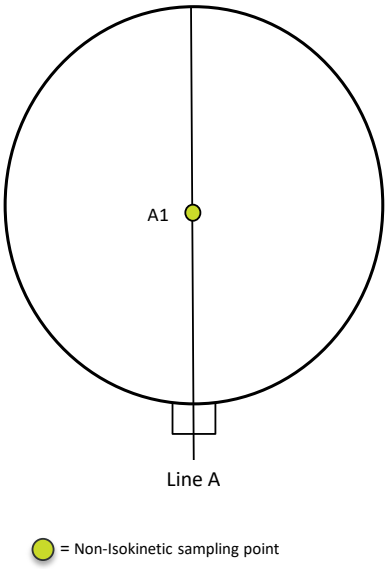
Appendix 2: EP1 - Acid Rinse LEV 06 Results and Calculations

Picture of the sampling location

Sampling Points Diagram



Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.24
Width	m	-
Area	m²	0.05
Port Depth	cm	10.0
Orientation of Stack / Duct	-	Horizontal
Sampling Port Size	-	4" BSP
Number of Ports	-	1

Manual Sampling Points	Used / Required
Number of Sampling Lines	1 / 1
Number of Sampling Points	1 / 1
Instrumental Sampling Points	**Used / Required**
Number of Sampling Lines	1 / 1
Number of Sampling Points	1 / 1

Platform Type and Location	
Platform Type - Permanent / Temporary	Temporary
Location - Inside / Outside	Inside

EA Technical Guidance Note M1 Platform Requirements		
Load Baring Capacity	Load baring capacity of platform sufficient to fulfil the measurement objective	Yes
Position & Work Space	Sufficient work area to manipulate probe & operate the measurement instruments	Yes
	Depth of work area > internal diameter of stack and wall thickness plus 1.5m	Yes
	Ports on vertical ducts 1.2m to 1.5m above platform floor	No
	Platform has chains / self closing gates at top of ladders	N/A
	Platform has adequate drainage to prevent accumulation of free-standing water	N/A
Fall Prevention	Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
	Gaps between handrails not >0,5m	N/A
Access	Platform has vertical base boards (approx. 0.25m high)	N/A
	Access to sampling ports unhindered by obstructions	Yes
	Easy & safe access and egress available	Yes

Sampling Location / Platform Recommendations

The Sampling location meets all the requirements specified in Environment Agency Guidance Note M1 and BS EN 15259, and no improvement actions are required.

Flow Criteria Measurements

Duct Diameter (m)	Cross Sectional Area (m^2)	Barometric Pressure (mbar)	Ambient Temperature (°C)	Mean Oxygen (%)	Mean Carbon Dioxide (%)	Mean Water Vapour (%)	Stack Gas Molecular mass (g/mol)	Pitot Coefficient
0.24	0.05	1010	23.0	20.9	0.50	2.1	28.7	0.994

Sample Line	Traverse Point	Position (cm)	Differential Pressure Reading (Pa)				Stack Velocity (m/s)	Stack Temp (°C)	Angle of Swirl
			1	2	3	Av.(cmH2O)			
A	A1	12.0	127	127	127	1.3	14.7	26	2

Parameter	Mean Duct Velocity	Velocity Ratio (Max:Min)	Mean Stack Temperature	Mean Stack Temperature	Stack Gas Volume Flow	Stack Gas Volume Flow (STP Wet)	Stack Gas Volume Flow (REF)
Value	14.7	1.0:1	26.0	299	2389	2175	2175
Units	m/s	-	°C	K	m^3/hr	Nm^3/hr	Nm^3/hr

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Sulphuric Acid - Run 1 Calculations

Sampling Details		
Meter Box Number	8.10(b)	-
Gas Meter Coefficient	0.939	-
Pitot Coefficient	0.994	-
Stack Gas Molecular Weight	28.8	g/mole
Static Pressure in Stack	1.2	cmH_2O

Analysis Details		
Collection Media	Isopropanol	
1st Collector Reference	Imp A&B	
1st Collector Concentration	472.851	µg
2nd Collector Reference	Imp C	
2nd Collector Concentration	148.52	µg
Blank Concentration	0.32	mg/Nm³
Has breakthrough occurred?	Yes	-

Isokineticity Details		
Nozzle Diameter	-	mm
Average Gas Meter Temperature	23.8	°C
Average Stack Temperature	23.4	°C
Average Stack Velocity	14.7	m/s
Isokineticity	-	%

Date	Operators
25/07/2023	RB / JD

Parameter	Before	After	Unit
Barometric Pressure	1010	1010	mbar
Ambient Temperature	23.0	23.0	°C
Leak Check	0.02	0.01	L/min
Time	14:40	15:40	-

Emissions Calculations		
Total Sampling Time	60	min
Gas Meter Difference	674	L
Corrected Gas Meter Volume	633	L
Mean Sampling Rate	10.5	L/min
Gas Meter Volume (STP Dry)	0.581	Nm³
Gas Meter Volume (REF)	0.593	Nm³
Stack Gas Water Vapour Content	2.1	% v/v
Stack Gas Oxygen Content	N/A	% v/v
Emission Limit Value	-	mg/Nm³
Concentration (REF)	1.05	mg/Nm³
Mass Emissions (REF)	2.3	g/hr

Reference conditions (REF) are: 273k, 101.3kPa, Wet Gas

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Uncertainty

Uncertainty of Sulphuric Acid - Run 1

Parameter	Value	Unit
Emission Limit Value (ELV)	-	mg/m³
Mean Sampling Rate	10.5	L/min
Leak Rate	0.02	L/min
Barometric Pressure	1010	mbar
Average Stack Temperature	23.4	°C
Sampled Stack Gas Volume	674	L

Parameter	Value	Unit
Mean Emission Concentration	1.05	mg/m³
Monitoring Duration	60	min
Console ID	8.10(b)	-
Temperature Uncertainty	0.24	°C
Gas Meter Uncertainty	0.37	%
Barometer Uncertainty	1.0	mbar

Source of Uncertainty	ASD*	CEN/TS 17340		Certified Value	Units	% Actual Value	Source Uncertainty u	Combined Uncertainty u²
		Uncertainty Criteria	Max. Value					
Analysis Procedure	Std	-	-	7.9	%	4.0	0.04	0.002
Leak Rate	Rect	<2% of sampling rate	0.21	0.02	L/min	0.14	0.0009	0.0000007
Time	Std	1sec in 1hour = 0.028%	2.0	1.0	sec	0.03	0.0003	0.00000008
Gasmeter Volume	Std	<2% actual volume	13.5	2.5	L	0.37	0.004	0.00002
Temperature	Std	<1% absolute temperature	0.23	0.24	k	1.0	0.01	0.0001
Pressure	Std	<1% absolute pressure	10.1	1.0	mbar	0.10	0.001	0.000001
							Total	0.002
							Combined Standard Uncertainty [(sum u²)$^{0.5}$]	0.04
							Expanded Total Uncertainty as a % of emission conc. (95% confidence)	8.2
							Expanded Total Uncertainty (mg/m³) (95% confidence)	0.09
							Expanded Total Uncertainty as a % of emission limit value (95% confidence)	-

Uncertainty of Volumetric Flow - Run 1

Parameter	Value	Unit
Measured Volumetric Flow Rate Actual	2389	m³/hr

Performance Characteristics & Source Value	Value	Units
Standard Uncertainty - Pitot tube Coefficient	0.005	-
Standard Uncertainty - Mean Local Dynamic Pressure	1.1	Pa
Standard Uncertainty - Molar Mass of Stack Gas	0.00003	-
Standard Uncertainty - Stack Gas Temperature	0.50	K
Standard Uncertainty - Absolute Pressure in Duct	176	Pa
Standard Uncertainty - Density of Stack Gas	0.02	-
Standard Uncertainty - Mean Velocity	0.16	m/s
Expanded Uncertainty Mean Velocity (95% confidence)	0.31	m/s
Expanded Uncertainty Mean Velocity (95% Confidence), Relative	2.1	%
Standard Uncertainty - Volumetric Flow Rate	55.2	-
Standard Uncertainty - Volumetric Flow Rate (95% Confidence)	108	m³/hr
Standard Uncertainty - Volumetric Flow Rate (95% Confidence), Relative	4.5	%
95% confidence interval factor - 1.96		

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Document Version Number	Record of change within different version numbers
V1	Original version of the document issued to client.