

Stack Emissions Testing Summary Sheet

CAT-1636: VIP-Polymers Ltd, Huntingdon

		Particulate Matter		Total VOCs				Test Dates	Flow Rate (REF)	Reference Conditions	
Release Point	Units	Result	Limit	Result	Limit				m³/hr		
Stack 10	mg/m³	0.73	10	5.2	50				24/09/2013 to 25/09/2013	12897	STP Wet Gas
	g/hr	9.4	-	67.6	-						
Stack 14	mg/m³	0.35	10	0.61	50				24/09/2013	8598	STP Wet Gas
	g/hr	3.0	-	5.2	-						
Stack 23	mg/m³	0.60	10	2.0	50				25/09/2013	6510	STP Wet Gas
	g/hr	3.9	-	12.7	-						
Stack 35d	mg/m³	1.1	10	0.96	50				24/09/2013	9416	STP Wet Gas
	g/hr	10.3	-	9.1	-						
Stack 40a	mg/m³	0.51	10	2.5	50				24/09/2013	4438	STP Wet Gas
	g/hr	2.3	-	11.1	-						
Stack 41	mg/m³	0.37	10	2.0	50				25/09/2013	13347	STP Wet Gas
	g/hr	5.0	-	27.2	-						
Stack 44	mg/m³	1.7	10	4.6	50				25/09/2013	8411	STP Wet Gas
	g/hr	14.3	-	38.5	-						
Stack 46	mg/m³	0.68	10	15.7	50				25/09/2013	9166	STP Wet Gas
	g/hr	6.3	-	144	-						
Stack 55	mg/m³	0.58	10	2.1	50				24/09/2013	10461	STP Wet Gas
	g/hr	6.0	-	21.6	-						
Standard Reference Method		BS EN 13284-1		BS EN 12619							
Accreditation Status of Test		UKAS & MCERTS		UKAS & MCERTS							

Summary Writer	Adam Dixon	MCERTS Accreditation	MCERTS Level 2	MCERTS Number	MM 10 1079	Report Date	30th September 2013
Summary Approver	Matthew Pendlebury	MCERTS Accreditation	MCERTS Level 2	MCERTS Number	MM 04 535	Report Version	Version 1



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Stack Emissions Testing Report Commissioned by

Air Tech Environmental Consultancy Services

Installation Name & Address

VIP-Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7DA

PPC Permit: 11/94

Stack Reference

Stack No.23

Dates of the Monitoring Campaign

25th September 2013

Job Reference Number

CAT-1636

Report Written by
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Report Date
30th September 2013

Version
Version 1

Signature of Report Approver


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Executive Summary

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MONITORING OBJECTIVES

VIP-Polymers Ltd, Huntingdon

Stack No.23

25th September 2013

Overall Aim of the Monitoring Campaign

Catalyst Environmental Ltd, in partnership with Air Tech Environmental Consultancy Services, were commissioned to carry out stack emissions testing on the Stack No.23 by VIP-Polymers Ltd at Huntingdon.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP-Polymers Ltd, Huntingdon

Stack No.23

25th September 2013

where MU = Measurement Uncertainty associated with the Result

Parameter	Concentration				Mass Emission			
	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter ¹	mg/m ³	0.60	11.0	10	g/hr	3.9	71.8	-
Total VOCs (as Carbon) ¹	mg/m ³	2.0	0.28	50	g/hr	12.7	1.9	-
Water Vapour	% v/v	0.89	0.09					
Stack Gas Temperature	°C	31.0						
Stack Gas Velocity	m/s	11.2						
Volumetric Flow Rate (ACTUAL)	m ³ /hr	7276						
Volumetric Flow Rate (REF) ¹	m ³ /hr	6510						

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

¹ Reference Conditions (REF) are: 273K, 101.3kPa, without correction for water vapour content.

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MONITORING DATE(S) & TIMES

VIP-Polymers Ltd, Huntingdon
Stack No.23
25th September 2013

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.60	g/hr	3.9	25/09/2013	09:37 - 10:07, 10:10 - 10:40	60
Total VOCs (as Carbon)	R1	mg/m³	2.0	g/hr	12.7	25/09/2013	09:30 - 10:30	60
Velocity & Volumetric Flow Rate	R1					25/09/2013	09:15 - 09:22	

All results are expressed at the respective reference conditions.

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PROCESS DETAILS

VIP-Polymers Ltd, Huntingdon
Stack No.23
25th September 2013

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Full Production
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Rubber
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

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MONITORING & ANALYTICAL METHODS

VIP-Polymers Ltd, Huntingdon

Stack No.23

25th September 2013

	Monitoring				Analysis					
Parameter	Standard	Technical Procedure	UKAS Testing	Testing Lab	Analytical Procedure	Analytical Technique	UKAS Analysis	Analysis Lab	MCERTS Testing	LOD (Average)
Total Particulate Matter	BS EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.10 mg/m³
Water Vapour	BS EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.10 % v/v
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.13 mg/m³
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04	Yes	CAT	Pitot Tube and Thermocouple				Yes	N/A

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Catalyst Environmental Ltd (CAT)	UKAS Accreditation Number: 4279
----------------------------------	---------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All Parameters	All Runs	The sample points where negative flow was measured during the preliminary traverse were omitted from the sampling exercise.
Total Particulate Matter	All Runs	The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.
Total Particulate Matter	All Runs	Ratio highest to lowest velocities > 5 : 1.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.48
IEDth	m	-
Area	m ²	0.18
Port Depth	cm	5
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	On Roof
Inside / Outside	Outside

Platform Details

EA Technical Guidance Note M1 / BS EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location does not meet all of the Flow Criteria requirements in BS EN 13284-1 (see Validation Criteria Table below).

BS EN 15259 Homogeneity Test Requirements

There is no requirement to perform a BS EN 15259 Homogeneity Test on this Stack.

Sampling Plane Validation Criteria (from EA Technical Guidance Document (Monitoring) M1)

Criteria in M1	Units	Traverse 1		Required	Compliant
Lowest Differential Pressure	Pa	-23.0		> 5 Pa	No
Mean Velocity	m/s	11.2		-	-
Lowest Gas Velocity	m/s	1.58		-	-
Highest Gas Velocity	m/s	15.8		-	-
Ratio of Above	: 1	9.97		< 3 : 1	No
Maximum Angle of Swirl	°	90		< 15°	No
No Local Negative Flow	-	No		-	No

Executive Summary

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PLANT PHOTOS

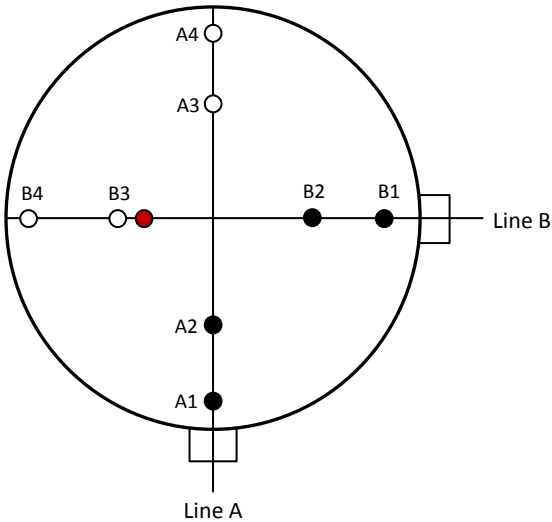
Photo 1



Photo 2



SAMPLE POINTS



where

○ = isokinetic point sampled at

● = isokinetic point not sampled at

● = combustion gases sample point

● = non-isokinetic sample point

APPENDICES

APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 1

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Adam Dixon	MCERTS Level 2	MM 10 1079	TE1 TE2 TE3 TE4
Trainee	James Birks	MCERTS Trainee	MM 13 1239	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM	CAT 7.5	Horiba PG-250 SRM	-	Digital Manometer (1)	CAT 3.47
Box Thermocouples	CAT 3.12	Servomex 4900	-	Digital Manometer (2)	-
Umbilical	CAT 3.12	Eco Physics CLD 822Mh	-	Digital Temperature Meter	CAT 3.47
Oven Box	-	Testo 350 XL	-	Stopwatch	CAT 14.18
Probe	CAT 5.18	Servomex 5200MP	-	Barometer	CAT 13.6
S-Pitot (1)	CAT 21S.15	JCT JCC P1 Cooler	-	Stack Thermocouple (1)	CAT 4.464
S-Pitot (2)	CAT 21P.40	FT-IR	-	Stack Thermocouple (2)	-
L-Pitot	-	FT-IR Sampling System	-	1m Heated Line (1)	-
500g Check Weight	CAT 17.20	Bernath 3006 FID	CAT 8.5	1m Heated Line (2)	-
1Kg Check Weight	CAT 17.20	Heated Head Filter	CAT 12.91	1m Heated Line (3)	-
Last Impinger Arm	-	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	CAT 20.19
Callipers	CAT 23.7	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	-
Tubes Kit Thermocouple	-	Mass View (1)	-	15m Heated Line (2)	-
Laboratory Balance	CAT 1.18 / 1.18a	Mass View (2)	-	20m Heated Line (1)	-
Tape Measure	CAT 16.91	Easylogger EN-EL-12 Bit	CAT 11.13	Dual Channel Heater Controller	-

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	BS EN 13284-1	CAT-TP-01
Water Vapour	BS EN 14790	CAT-TP-05
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04

APPENDIX 2

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.48
Stack IEDth, W	m	-
Stack Area, A	m ²	0.18
Average Stack Gas Temperature, T _a	°C	31.0
Average Stack Gas Pressure	Pa	84.7
Average Stack Static Pressure, P _{static}	kPa	-0.08
Average Barometric Pressure, P _b	kPa	101.0
Average Pitot Tube Calibration Coefficient, C _p	-	0.85

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.0012
O ₂ (Estimated)	-	20.80	20.61	0.2080	32.00	1.4277	0.2970
N ₂	-	79.14	78.44	0.7914	28.01	1.2498	0.9891
Moisture (H ₂ O)	-	-	0.89	0.0089	18.02	0.8037	0.0072

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.287
Wet Density (STP), P _{STW}	kg/m ³	1.283
Dry Density (Actual), P _{Actual}	kg/m ³	1.152
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.148

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

$P_{ActualW}$ (at each sampling point) = P_{STW} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	31.0	0.00
Total Pressure	kPa	100.9	101.3
Moisture	%	0.89	0.89

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	7276
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	6510
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	6452
Gas Volumetric Flowrate REF ¹	m ³ /hr	6510

APPENDIX 2

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE

(1 of 1)

Parameter	Units	Value
Date of Survey	-	25/09/2013
Time of Survey	-	09:15 - 09:22
Atmospheric Pressure	kPa	101.0
Stack Static Pressure	Pa	-81
Type of Pitot Used	-	S-Type Pitot
Are Water Droplets Present?	-	No

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.85
Number of Lines Available	-	2
Number of Lines Used	-	2

Swirl Point (taken at the sampling points used during testing)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Angle of Swirl (°)	90	48	10	11	80	50	15	15												

Sampling Line A						Sampling Line B			
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s
1	0.02	136.0	30.5	1.150	13.02	121.0	31.0	1.148	12.29
2	0.07	11.0	30.7	1.149	3.70	-3.0	31.0	1.148	-IVE
3	0.12	-7.0	30.8	1.149	-IVE	-10.0	31.0	1.148	-IVE
4	0.17	-23.0	30.9	1.148	-IVE	-11.0	31.0	1.148	-IVE
5	0.22	8.0	30.9	1.148	3.16	2.0	31.0	1.148	1.58
6	0.26	114.0	31.0	1.148	11.93	50.0	31.0	1.148	7.90
7	0.31	149.0	31.0	1.148	13.64	122.0	31.0	1.148	12.34
8	0.36	199.0	31.0	1.148	15.76	178.0	31.0	1.148	14.90
9	0.41	145.0	31.1	1.147	13.45	182.0	31.0	1.148	15.07
10	0.46	168.0	31.1	1.147	14.48	163.0	31.0	1.148	14.26
Mean		90.0	30.9	1.148	11.14	79.4	31.0	1.148	11.19

APPENDIX 2

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon
Stack No.23

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.60		0.60
Uncertainty	±mg/m ³	11.0		11.0
Mass Emission	g/hr	3.9		3.9
Uncertainty	±g/hr	71.8		71.8

NOTE: Where the maximum Blank concentration is higher than the Sample concentration, the maximum Blank concentration has been reported.

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.89		0.89
Uncertainty	±% v/v	0.09		0.09

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.60		0.60

General Sampling Information

Parameter	Value	
Standard	BS EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	2 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 8	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B3, B4, A3, A4	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

APPENDIX 2

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	757.5	
Stack static pressure, P_{static}	mmH ₂ O	-8.3	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	756.9	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	7.3	
Total mass collected in impingers (silica trap)	g	0.9	
Total mass of liquid collected, V_{lc}	g	8.2	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0102	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.3175	
Gas meter correction factor, Y_d	-	0.9350	
Average dry gas meter temperature, T_m	°C	22.9	
Average pressure drop across orifice, ΔH	mmH ₂ O	47.9	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	1.1381	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0089	
B_{wo} as a percentage	% v/v	0.89	
Reported Water Vapour, checked with Tables in BS EN 14790, R_{wv}	% v/v	0.89	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	1.1484	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.75	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.84	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	14.60	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	3.82	
Average stack gas temperature, T_s	°C	37.4	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	13.41	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	0.18	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	145.6	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	127.5	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	126.4	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)(O_{2REFw})$	m ³ /min	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)(O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	5.93	
Nozzle area, A_n	mm ²	27.62	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	98.3	

APPENDIX 2

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	09:37 - 10:07, 10:10 - 10:40	
Sampling Dates	-	25/09/2013	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	1.1484	
Filter I.D. Number	-	47-15093	
Start Filter Mass	g	0.14027	
End Filter Mass	g	0.14040	
Total Mass on Filter	g	0.00013	
Probe Rinse I.D. Number	-	PR-47-15093	
Start Probe Rinse Mass	g	2.90342	
End Probe Rinse Mass	g	2.90344	
Total Mass in Probe Rinse	g	0.00002	
Total Mass Collected	mg	0.15	
Calculated Concentration	mg/m ³	0.13	
Balance Uncertainty / LOD	mg/m ³	0.10	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	25/09/2013	
Average Volume Sampled (REF)	m ³	1.1484	
Filter I.D. Number	-	47-15504	
Start Filter Mass	g	0.14221	
End Filter Mass	g	0.14231	
Total Mass on Filter	g	0.00010	
Probe Rinse I.D. Number	-	PR-47-15504	
Start Probe Rinse Mass	g	3.02322	
End Probe Rinse Mass	g	3.02381	
Total Mass in Probe Rinse	g	0.00059	
Total Mass Collected	mg	0.69	
Calculated Concentration	mg/m ³	0.60	
Balance Uncertainty / LOD	mg/m ³	0.10	

APPENDIX 2

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

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Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	20.5	
Pre-Sampling Leak Rate	l/min	0.20	
Post-Sampling Leak Rate	l/min	0.21	
Allowable Leak Rate	l/min	0.41	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	9.8	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	98.3	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.21	
ELV [Daily ELV for IED]	mg/m ³	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	37	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE
(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20.0	
Pre-Sampling Leak Rate	l/min	0.09	
Post-Sampling Leak Rate	l/min	0.15	
Allowable Leak Rate	l/min	0.40	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
Blank Acceptable	-	Yes	

Acetone / Water Rinse Blank	Units	Blank
Acetone / Water Rinse Value	mg/l	2.7
Allowable Blank	mg/l	10
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation	Run Number	
	1	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)		
The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.	x	
The sample points where negative flow was measured during the preliminary traverse were omitted from the sampling exercise.	wx	
Ratio highest to lowest velocities > 5 : 1.	x	

APPENDIX 2

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V_m	1.32		uV_m	m^3	0.03	
Sampled Gas Temperature	T_m	295.9		uT_m	K	2.00	
Sampled Gas Pressure	p_m	100.9		up_m	kPa	0.50	
Sampled Gas Humidity	H_m	0.00		uH_m	% v/v	1.00	
Leak	L	1.02		uL	%	-	
Mass of Particulate	m	0.15		um	mg	0.12	
Oxygen Content	$O_{2,m}$	N/A		$uO_{2,m}$	% v/v	N/A	
Uncollected Mass	UCM	0.69		$uUCM$	mg	-	

Uncertainty as a Percentage				
Measured Quantities	Units	Run 1		Requirement of Standard
Sampled Volume (Actual)	%	2.00		$\leq 2\%$
Sampled Gas Temperature	%	0.68		$\leq 1\%$
Sampled Gas Pressure	%	0.50		$\leq 1\%$
Sampled Gas Humidity	%	1.00		$\leq 1\%$
Leak	%	1.02		$\leq 2\%$
Mass of Particulate	%	4.81		$< 5\%$ of ELV
Oxygen Content	%	N/A		$\leq 5\%$
Uncollected Mass	%	-		-

Uncertainty in Measurement Units				Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1	Run 1	
Sampled Volume (STP)	V_m	m^3	1.14	0.53	
Leak	L	mg/m^3	0.004	1.00	
Mass of Particulate	L_r	mg	0.15	4.01	
Factor for O_2 Correction	$O_{2,m}$	% v/v	N/A	N/A	
Uncollected Mass	UCM	mg	0.40	4.01	

Uncertainty in Result		
Measured Quantities	Units	Run 1
Sampled Volume (STP)	mg/m^3	0.02
Leak	mg/m^3	0.00
Mass of Particulate	mg/m^3	0.48
Factor for O_2 Correction	mg/m^3	N/A
Uncollected Mass	mg/m^3	1.60

Parameter	Units	Run 1	
Combined uncertainty	mg/m^3	1.7	
Expanded uncertainty (95% confidence)	mg/m^3	3.3	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	11.0	
Reported Uncertainty	mg/m^3	11.0	
Expanded uncertainty (95% confidence)	%	543.7	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	1834.9	
Reported Uncertainty	%	1834.9	

APPENDIX 2

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon
Stack No.23

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	2.0		2.0
Uncertainty	±mg/m ³	0.28		0.28
Mass Emission	g/hr	12.7		12.7
Uncertainty	±g/hr	1.9		1.9

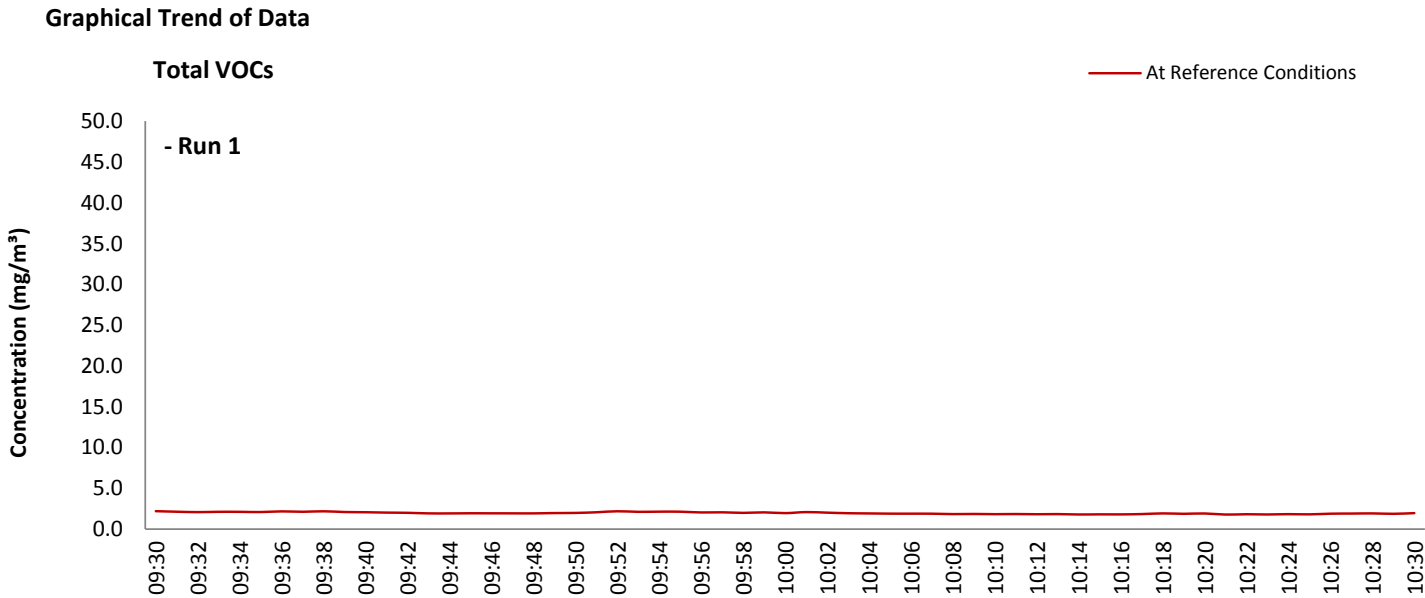
General Sampling Information

Parameter	Value	
Standard	BS EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Reference Number	CYL 1.0035	
Span Gas Expiry Date	05/12/2013	
Span Gas Start Pressure (bar)	80	
Gas Cylinder Concentration (ppm)	80.3	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Synthetic Air (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B3	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

TOTAL VOCs (as CARBON): DATA TREND



TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	09:30 - 10:30	
Sampling Dates	-	25/09/2013	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.3	

Quality Assurance

Zero Drift		Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.20	
	Zero Down Sampling Line (Post)	ppm	0.50	
	Zero Drift	ppm	0.30	
	Allowable Zero Drift	± ppm	4.02	
	Zero Drift Acceptable	-	Yes	
Span Drift		Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	80.2	
	Span Down Sampling Line (Post)	ppm	80.8	
	Span Drift	ppm	0.60	
	Allowable Span Drift	± ppm	4.02	
	Span Drift Acceptable	-	Yes	
Test Conditions		Units	Run 1	
Run Ambient Temperature Range		°C	12 - 13	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	1	
Negative flow was measured during the preliminary traverse.	x	

APPENDIX 2

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			
	Units	Run 1	Run 2	Run 3
MCERTS Certified Range of Analyser	ppm	9.3		
Operational Range of Analyser	ppm	100		
Measured Reading	ppm	1.2		

Measured Quantities	Individual Errors as Standard Uncertainties			
	Units	Run 1	Run 2	Run 3
Nonlinearity	ppm	0.04		
Temperature Dependent Zero Drift	ppm	0.03		
Temperature Dependent Span Drift	ppm	0.03		
Cross-Sensitivity	ppm	0.03		
Leak	ppm	0.00		
Calibration Gas Uncertainty	ppm	0.01		
Mass Flow Controllers (dilution) Uncertainty	ppm	0.01		

Parameter	Units	Run 1	Run 2	Run 3
Combined uncertainty	ppm	0.06		
Expanded uncertainty (95% confidence)	ppm	0.12		
Expanded uncertainty (95% confidence), estimated with Method Deviations	ppm	0.18		
Reported Uncertainty	ppm	0.18		
Expanded uncertainty (95% confidence)	%	9.7		
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	14.5		
Reported Uncertainty	%	14.5		



Air Tech Environmental Consultancy Services

Unit C6, Emery Court, The Embankment Business Park, Heaton Mersey, Stockport, SK4 3GL

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Your Catalyst Contact: Toby Campbell (07825 130 074)

Stack Emissions Testing Report Commissioned by

Air Tech Environmental Consultancy Services

Installation Name & Address

VIP Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7DA

PPC Permit: 11/94

Stack Reference

Stack No.10

Dates of the Monitoring Campaign

24th - 25th September 2013

Job Reference Number

CAT-1636

Report Written by
Adam Dixon Team Leader MCERTS Level 2 MM 10 1079 TE1 TE2 TE3 TE4

Report Approved by
Rober Haworth Team Leader MCERTS Level 2 MM 07 797 TE1 TE2 TE3 TE4

Report Date
30th September 2013

Version
Version 1

Signature of Report Approver


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Executive Summary

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MONITORING OBJECTIVES

VIP Polymers Ltd, Huntingdon

Stack No.10

24th - 25th September 2013

Overall Aim of the Monitoring Campaign

Catalyst Environmental Ltd, in partnership with Air Tech Environmental Consultancy Services, were commissioned to carry out stack emissions testing on the Stack No.10 by VIP Polymers Ltd at Huntingdon.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP Polymers Ltd, Huntingdon

Stack No.10

24th - 25th September 2013

where MU = Measurement Uncertainty associated with the Result

		Concentration				Mass Emission			
Parameter		Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	¹	mg/m³	0.73	1.3	10	g/hr	9.4	16.1	-
Total VOCs (as Carbon)	¹	mg/m³	5.2	0.46	50	g/hr	67.6	5.9	-
Water Vapour		% v/v	0.65	0.08					
Stack Gas Temperature		°C	33.1						
Stack Gas Velocity		m/s	9.1						
Volumetric Flow Rate (ACTUAL)		m³/hr	14505						
Volumetric Flow Rate (REF)	¹	m³/hr	12897						

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

¹ Reference Conditions (REF) are: 273K, 101.3kPa, without correction for water vapour content.

Executive Summary
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MONITORING DATE(S) & TIMES

VIP Polymers Ltd, Huntingdon
Stack No.10
24th - 25th September 2013

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.73	g/hr	9.4	25/09/2013	08:20 - 08:50, 08:52 - 09:22	60
Total VOCs (as Carbon)	R1	mg/m³	5.2	g/hr	67.6	24/09/2013	17:50 - 18:50	60
Velocity & Volumetric Flow Rate	R1					25/09/2013	08:02 - 08:08	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP Polymers Ltd, Huntingdon

Stack No.10

24th - 25th September 2013

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Various
Continuous or Batch Process	Batch
Feedstock (if applicable)	Under cured Parts, Viton Seals
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

(Page 5 of 7)

MONITORING & ANALYTICAL METHODS

VIP Polymers Ltd, Huntingdon
 Stack No.10
 24th - 25th September 2013

	Monitoring				Analysis					
Parameter	Standard	Technical Procedure	UKAS Testing	Testing Lab	Analytical Procedure	Analytical Technique	UKAS Analysis	Analysis Lab	MCERTS Testing	LOD (Average)
Total Particulate Matter	BS EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.13 mg/m³
Water Vapour	BS EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.10 % v/v
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.13 mg/m³
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04	Yes	CAT	Pitot Tube and Thermocouple				Yes	N/A

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Catalyst Environmental Ltd (CAT)	UKAS Accreditation Number: 4279
----------------------------------	---------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All Parameters	All Runs	Negative flow was measured during the preliminary traverse, at the centre point of the duct.
Total Particulate Matter	1	The angle of swirl was > 15° across the entire sampling plane. As there is no other reasonable sampling location available, testing was carried out at all required sample points across the duct.
Total Particulate Matter	1	Ratio highest to lowest velocities > 5 : 1.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.75
IEDth	m	-
Area	m ²	0.44
Port Depth	cm	5
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	On Roof
Inside / Outside	Outside

Platform Details

EA Technical Guidance Note M1 / BS EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	No

Sampling Location / Platform Improvement Recommendations

The sampling location does not meet all of the Flow Criteria requirements in the Environment Agency's Technical Guidance Note M1 and BS EN 15259 (see Validation Criteria Table below).

BS EN 15259 Homogeneity Test Requirements

There is no requirement to perform a BS EN 15259 Homogeneity Test on this Stack.

Sampling Plane Validation Criteria (from EA Technical Guidance Document (Monitoring) M1)

Criteria in M1	Units	Traverse 1		Required	Compliant
Lowest Differential Pressure	Pa	-24.0		> 5 Pa	No
Mean Velocity	m/s	9.12		-	-
Lowest Gas Velocity	m/s	1.12		-	-
Highest Gas Velocity	m/s	13.63		-	-
Ratio of Above	: 1	12.17		< 3 : 1	No
Maximum Angle of Swirl	°	50		< 15°	No
No Local Negative Flow	-	No		-	No

Executive Summary

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PLANT PHOTOS

Photo 1



Photo 2



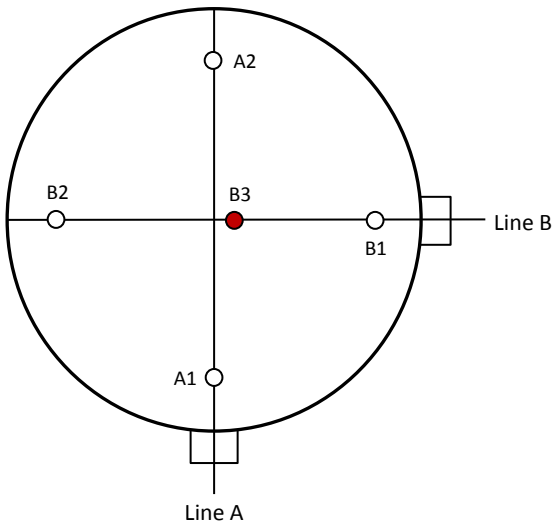
Photo 3



Photo 4



SAMPLE POINTS



where

○ = isokinetic point sampled at

● = isokinetic point not sampled at

● = combustion gases sample point

○ = non-isokinetic sample point

APPENDICES

APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 1

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Adam Dixon	MCERTS Level 2	MM 10 1079	TE1 TE2 TE3 TE4
Trainee	James Birks	MCERTS Trainee	MM 13 1239	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM	CAT 7.5	Horiba PG-250 SRM	-	Digital Manometer (1)	CAT 3.47
Box Thermocouples	CAT 3.12	Servomex 4900	-	Digital Manometer (2)	-
Umbilical	CAT 3.12	Eco Physics CLD 822Mh	-	Digital Temperature Meter	CAT 3.47
Oven Box	-	Testo 350 XL	-	Stopwatch	CAT 14.18
Probe	CAT 5.18	Servomex 5200MP	-	Barometer	CAT 13.6
S-Pitot (1)	CAT 21S.15	JCT JCC P1 Cooler	-	Stack Thermocouple (1)	CAT 4.464
S-Pitot (2)	CAT 21P.40	FT-IR	-	Stack Thermocouple (2)	-
L-Pitot	-	FT-IR Sampling System	-	1m Heated Line (1)	-
500g Check Weight	CAT 17.20	Bernath 3006 FID	CAT 8.5	1m Heated Line (2)	-
1Kg Check Weight	CAT 17.20	Heated Head Filter	CAT 12.91	1m Heated Line (3)	-
Last Impinger Arm	-	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	CAT 20.19
Callipers	CAT 23.7	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	-
Tubes Kit Thermocouple	-	Mass View (1)	-	15m Heated Line (2)	-
Laboratory Balance	CAT 1.18 / 1.18a	Mass View (2)	-	20m Heated Line (1)	-
Tape Measure	CAT 16.91	Easylogger EN-EL-12 Bit	CAT 11.13	Dual Channel Heater Controller	-

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	BS EN 13284-1	CAT-TP-01
Water Vapour	BS EN 14790	CAT-TP-05
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.75
Stack IEDth, W	m	-
Stack Area, A	m ²	0.44
Average Stack Gas Temperature, T _a	°C	33.1
Average Stack Gas Pressure	Pa	55.1
Average Stack Static Pressure, P _{static}	kPa	-0.02
Average Barometric Pressure, P _b	kPa	101.0
Average Pitot Tube Calibration Coefficient, C _p	-	0.85

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.0012
O ₂ (Estimated)	-	20.80	20.67	0.2080	32.00	1.4277	0.2970
N ₂	-	79.14	78.63	0.7914	28.01	1.2498	0.9891
Moisture (H ₂ O)	-	-	0.65	0.0065	18.02	0.8037	0.0052

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.287
Wet Density (STP), P _{STW}	kg/m ³	1.284
Dry Density (Actual), P _{Actual}	kg/m ³	1.144
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.142

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

$P_{ActualW}$ (at each sampling point) = P_{STW} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	33.1	0.00
Total Pressure	kPa	101.0	101.3
Moisture	%	0.65	0.65

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	14505
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	12897
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	12813
Gas Volumetric Flowrate REF ¹	m ³ /hr	12897

APPENDIX 2

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE

(1 of 1)

Parameter	Units	Value
Date of Survey	-	25/09/2013
Time of Survey	-	08:02 - 08:08
Atmospheric Pressure	kPa	101.0
Stack Static Pressure	Pa	-15
Type of Pitot Used	-	S-Type Pitot
Are Water Droplets Present?	-	No

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.85
Number of Lines Available	-	2
Number of Lines Used	-	2

Swirl Point (taken at the sampling points used during testing)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Angle of Swirl (°)	45	50	42	48																

Sampling Line A						Sampling Line B			
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s
1	0.04	130.0	33.1	1.142	12.77	58.0	33.1	1.142	8.53
2	0.11	148.0	33.1	1.142	13.63	80.0	33.1	1.142	10.02
3	0.19	65.0	33.1	1.142	9.03	87.0	33.1	1.142	10.45
4	0.26	23.0	33.1	1.142	5.37	107.0	33.1	1.142	11.59
5	0.34	-14.0	33.1	1.142	-IVE	61.0	33.1	1.142	8.75
6	0.41	-7.0	33.1	1.142	-IVE	-24.0	33.1	1.142	-IVE
7	0.49	1.0	33.1	1.142	1.12	-18.0	33.1	1.142	-IVE
8	0.56	53.0	33.1	1.142	8.15	49.0	33.1	1.142	7.84
9	0.64	45.0	33.1	1.142	7.51	94.0	33.1	1.142	10.86
10	0.71	82.0	33.1	1.142	10.14	82.0	33.1	1.142	10.14
Mean		52.6	33.1	1.142	8.47	57.6	33.1	1.142	9.77

APPENDIX 2

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack No.10

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.73		0.73
Uncertainty	±mg/m ³	1.3		1.3
Mass Emission	g/hr	9.4		9.4
Uncertainty	±g/hr	16.1		16.1

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.65		0.65
Uncertainty	±% v/v	0.08		0.08

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.24		0.24

General Sampling Information

Parameter	Value	
Standard	BS EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	2 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2, B1, B2	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

APPENDIX 2

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	757.5	
Stack static pressure, P_{static}	mmH ₂ O	-1.5	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	757.4	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	0.2	
Total mass collected in impingers (silica trap)	g	4.7	
Total mass of liquid collected, V_{lc}	g	4.9	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0061	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.0814	
Gas meter correction factor, Y_d	-	0.9350	
Average dry gas meter temperature, T_m	°C	21.2	
Average pressure drop across orifice, ΔH	mmH ₂ O	31.3	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	0.9380	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0065	
B_{wo} as a percentage	% v/v	0.65	
Reported Water Vapour, checked with Tables in BS EN 14790, R_{wv}	% v/v	0.65	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	0.9441	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.77	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.84	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	5.31	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	2.30	
Average stack gas temperature, T_s	°C	29.6	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	7.98	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	0.44	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	211.5	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	190.2	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	188.9	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)(O_{2REFw})$	m ³ /min	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)(O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	6.83	
Nozzle area, A_n	mm ²	36.64	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	99.8	

APPENDIX 2

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	08:20 - 08:50, 08:52 - 09:22	
Sampling Dates	-	25/09/2013	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	0.9441	
Filter I.D. Number	-	47-15647	
Start Filter Mass	g	0.14147	
End Filter Mass	g	0.14194	
Total Mass on Filter	g	0.00047	
Probe Rinse I.D. Number	-	PR-47-15647	
Start Probe Rinse Mass	g	2.97364	
End Probe Rinse Mass	g	2.97386	
Total Mass in Probe Rinse	g	0.00022	
Total Mass Collected	mg	0.69	
Calculated Concentration	mg/m ³	0.73	
Balance Uncertainty / LOD	mg/m ³	0.13	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	25/09/2013	
Average Volume Sampled (REF)	m ³	0.9441	
Filter I.D. Number	-	47-15142	
Start Filter Mass	g	0.14235	
End Filter Mass	g	0.14242	
Total Mass on Filter	g	0.00007	
Probe Rinse I.D. Number	-	PR-47-15142	
Start Probe Rinse Mass	g	3.04316	
End Probe Rinse Mass	g	3.04332	
Total Mass in Probe Rinse	g	0.00016	
Total Mass Collected	mg	0.23	
Calculated Concentration	mg/m ³	0.24	
Balance Uncertainty / LOD	mg/m ³	0.13	

APPENDIX 2

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	16.9	
Pre-Sampling Leak Rate	l/min	0.15	
Post-Sampling Leak Rate	l/min	0.12	
Allowable Leak Rate	l/min	0.34	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	12.1	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	99.8	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.25	
ELV [Daily ELV for IED]	mg/m ³	10.00	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	30	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE
(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20.0	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.40	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
Blank Acceptable	-	Yes	

Acetone / Water Rinse Blank	Units	Blank
Acetone / Water Rinse Value	mg/l	2.7
Allowable Blank	mg/l	10
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation	Run Number	
	1	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)		
Negative flow was measured during the preliminary traverse, at the centre point of the duct.	wx	
The angle of swirl was > 15° across the entire sampling plane. As there is no other reasonable sampling location available, testing was carried out at all required sample points across the duct.	x	
Ratio highest to lowest velocities > 5 : 1.	x	

APPENDIX 2

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V_m	1.08		uV_m	m^3	0.02	
Sampled Gas Temperature	T_m	294.2		uT_m	K	2.00	
Sampled Gas Pressure	p_m	101.0		up_m	kPa	0.50	
Sampled Gas Humidity	H_m	0.00		uH_m	% v/v	1.00	
Leak	L	0.71		uL	%	-	
Mass of Particulate	m	0.69		um	mg	0.12	
Oxygen Content	$O_{2,m}$	N/A		$uO_{2,m}$	% v/v	N/A	
Uncollected Mass	UCM	0.23		$uUCM$	mg	-	

Uncertainty as a Percentage				
Measured Quantities	Units	Run 1		Requirement of Standard
Sampled Volume (Actual)	%	2.00		$\leq 2\%$
Sampled Gas Temperature	%	0.68		$\leq 1\%$
Sampled Gas Pressure	%	0.50		$\leq 1\%$
Sampled Gas Humidity	%	1.00		$\leq 1\%$
Leak	%	0.71		$\leq 2\%$
Mass of Particulate	%	1.27		<5% of ELV
Oxygen Content	%	N/A		$\leq 5\%$
Uncollected Mass	%	-		-

Uncertainty in Measurement Units					Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V_m	m^3	0.94		0.78	
Leak	L	mg/m^3	0.00		1.00	
Mass of Particulate	L_r	mg	0.69		1.06	
Factor for O_2 Correction	$O_{2,m}$	% v/v	N/A		N/A	
Uncollected Mass	UCM	mg	0.13		1.06	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m^3	0.02	
Leak	mg/m^3	0.00	
Mass of Particulate	mg/m^3	0.13	
Factor for O_2 Correction	mg/m^3	N/A	
Uncollected Mass	mg/m^3	0.14	

Parameter	Units	Run 1	
Combined uncertainty	mg/m^3	0.19	
Expanded uncertainty (95% confidence)	mg/m^3	0.37	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	1.3	
Reported Uncertainty	mg/m^3	1.3	
Expanded uncertainty (95% confidence)	%	50.7	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	171	
Reported Uncertainty	%	171	

APPENDIX 2

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP Polymers Ltd, Huntingdon
Stack No.10

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	5.2		5.2
Uncertainty	±mg/m ³	0.46		0.46
Mass Emission	g/hr	67.6		67.6
Uncertainty	±g/hr	5.9		5.9

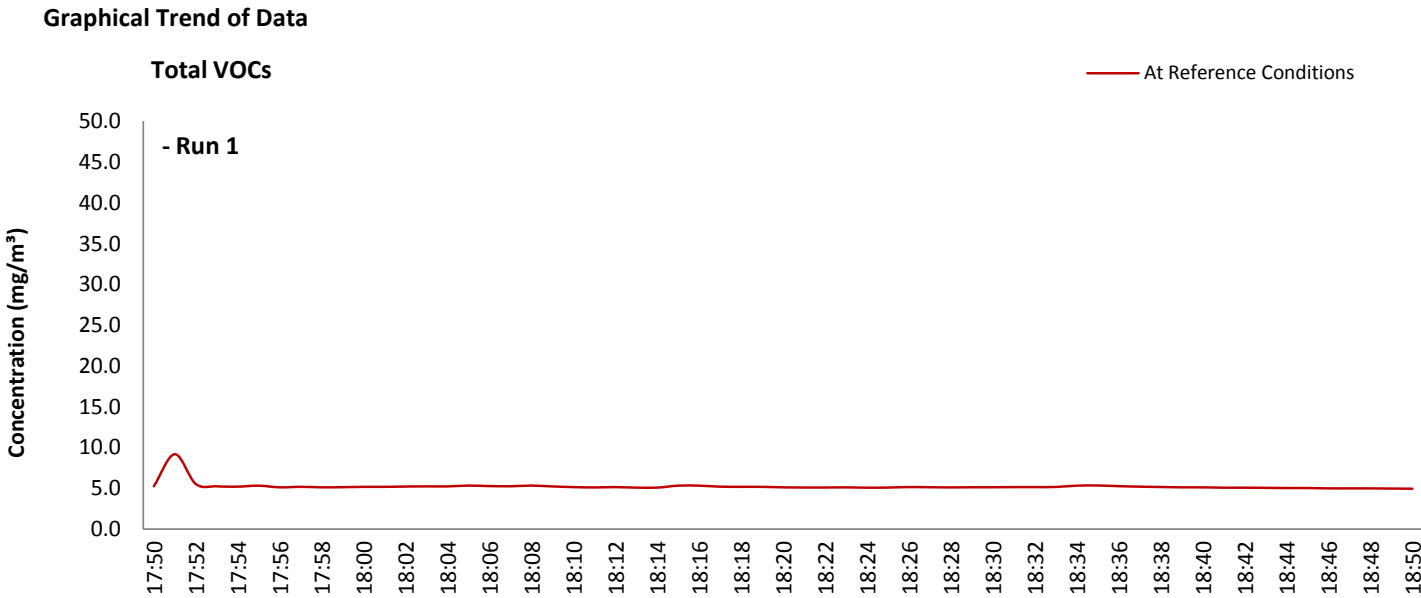
General Sampling Information

Parameter	Value	
Standard	BS EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Reference Number	CYL 1.0035	
Span Gas Expiry Date	05/12/2013	
Span Gas Start Pressure (bar)	80	
Gas Cylinder Concentration (ppm)	80.3	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Synthetic Air (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B3	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

TOTAL VOCs (as CARBON): DATA TREND



TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	17:50 - 18:50	
Sampling Dates	-	24/09/2013	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.3	

Quality Assurance

Zero Drift		Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.30	
	Zero Down Sampling Line (Post)	ppm	0.90	
	Zero Drift	ppm	0.60	
	Allowable Zero Drift	± ppm	4.02	
	Zero Drift Acceptable	-	Yes	
Span Drift		Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	80.1	
	Span Down Sampling Line (Post)	ppm	78.9	
	Span Drift	ppm	-1.20	
	Allowable Span Drift	± ppm	4.02	
	Span Drift Acceptable	-	Yes	
Test Conditions		Units	Run 1	
Run Ambient Temperature Range		°C	13 - 15	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	1	
Negative flow was measured during the preliminary traverse.	x	

APPENDIX 2

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			
	Units	Run 1	Run 2	Run 3
MCERTS Certified Range of Analyser	ppm	9.3		
Operational Range of Analyser	ppm	100		
Measured Reading	ppm	3.3		

Measured Quantities	Individual Errors as Standard Uncertainties			
	Units	Run 1	Run 2	Run 3
Nonlinearity	ppm	0.04		
Temperature Dependent Zero Drift	ppm	0.03		
Temperature Dependent Span Drift	ppm	0.03		
Cross-Sensitivity	ppm	0.08		
Leak	ppm	0.00		
Calibration Gas Uncertainty	ppm	0.02		
Mass Flow Controllers (dilution) Uncertainty	ppm	0.03		

Parameter	Units	Run 1	Run 2	Run 3
Combined uncertainty	ppm	0.10		
Expanded uncertainty (95% confidence)	ppm	0.19		
Expanded uncertainty (95% confidence), estimated with Method Deviations	ppm	0.29		
Reported Uncertainty	ppm	0.29		
Expanded uncertainty (95% confidence)	%	5.8		
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	8.8		
Reported Uncertainty	%	8.8		



Air Tech Environmental Consultancy Services

Unit C6, Emery Court, The Embankment Business Park, Heaton Mersey, Stockport, SK4 3GL

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Your Catalyst Contact: Toby Campbell (07825 130 074)

Stack Emissions Testing Report Commissioned by

Air Tech Environmental Consultancy Services

Installation Name & Address

VIP-Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7DA

PPC Permit: 11/94

Stack Reference

Stack No.35D

Dates of the Monitoring Campaign

24th September 2013

Job Reference Number

CAT-1636

Report Written by
Adam Dixon Team Leader MCERTS Level 2 MM 10 1079 TE1 TE2 TE3 TE4

Report Approved by
Matthew Pendlebury Team Leader MCERTS Level 2 MM 04 535 TE1 TE2 TE3 TE4

Report Date
30th September 2013

Version
Version 1

Signature of Report Approver


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APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

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MONITORING OBJECTIVES

VIP-Polymers Ltd, Huntingdon

Stack No.35D

24th September 2013

Overall Aim of the Monitoring Campaign

Catalyst Environmental Ltd, in partnership with Air Tech Environmental Consultancy Services, were commissioned to carry out stack emissions testing on the Stack No.35D by VIP-Polymers Ltd at Huntingdon.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Total VOCs (as Carbon)

Executive Summary

(Page 2 of 7)

MONITORING RESULTS

VIP-Polymers Ltd, Huntingdon

Stack No.35D

24th September 2013

where MU = Measurement Uncertainty associated with the Result

Concentration					Mass Emission			
Parameter	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	¹ mg/m ³	1.1	0.23	10	g/hr	10.3	2.1	-
Total VOCs (as Carbon)	¹ mg/m ³	0.96	0.17	50	g/hr	9.1	1.6	-
Water Vapour	% v/v	1.0	0.06					
Stack Gas Temperature	°C	67.6						
Stack Gas Velocity	m/s	8.7						
Volumetric Flow Rate (ACTUAL)	m ³ /hr	11760						
Volumetric Flow Rate (REF)	¹ m ³ /hr	9416						

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

¹ Reference Conditions (REF) are: 273K, 101.3kPa, without correction for water vapour content.

Executive Summary
(Page 3 of 7)

MONITORING DATE(S) & TIMES

VIP-Polymers Ltd, Huntingdon
Stack No.35D
24th September 2013

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	1.1	g/hr	10.3	24/09/2013	15:28 - 15:58, 16:00 - 16:30	60
Total VOCs (as Carbon)	R1	mg/m³	1.0	g/hr	9.1	24/09/2013	15:15 - 16:15	60
Velocity & Volumetric Flow Rate	R1					24/09/2013	14:46 - 14:59	

All results are expressed at the respective reference conditions.

Executive Summary
(Page 4 of 7)

PROCESS DETAILS

VIP-Polymers Ltd, Huntingdon
Stack No.35D
24th September 2013

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Full Production
Continuous or Batch Process	Continuous
Feedstock (if applicable)	Rubber
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

(Page 5 of 7)

MONITORING & ANALYTICAL METHODS

VIP-Polymers Ltd, Huntingdon
 Stack No.35D
 24th September 2013

	Monitoring				Analysis					
Parameter	Standard	Technical Procedure	UKAS Testing	Testing Lab	Analytical Procedure	Analytical Technique	UKAS Analysis	Analysis Lab	MCERTS Testing	LOD (Average)
Total Particulate Matter	BS EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.10 mg/m³
Water Vapour	BS EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.10 % v/v
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.13 mg/m³
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04	Yes	CAT	Pitot Tube and Thermocouple				Yes	N/A

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Catalyst Environmental Ltd (CAT)	UKAS Accreditation Number: 4279
----------------------------------	---------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All Parameters	All Runs	There are no deviations associated with the sampling employed.

Executive Summary

(Page 6 of 7)

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.69
IEDth	m	-
Area	m ²	0.37
Port Depth	cm	5
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	On Roof
Inside / Outside	Outside

Platform Details

EA Technical Guidance Note M1 / BS EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location meets all the requirements specified in EA Guidance Note M1 and BS EN 15259, and therefore there are no improvement recommendations.

BS EN 15259 Homogeneity Test Requirements

There is no requirement to perform a BS EN 15259 Homogeneity Test on this Stack.

Sampling Plane Validation Criteria (from EA Technical Guidance Document (Monitoring) M1)

Criteria in M1	Units	Traverse 1	Required	Compliant
Lowest Differential Pressure	Pa	43.0	> 5 Pa	Yes
Mean Velocity	m/s	8.73	-	-
Lowest Gas Velocity	m/s	7.74	-	-
Highest Gas Velocity	m/s	10.2	-	-
Ratio of Above	: 1	1.32	< 3 : 1	Yes
Maximum Angle of Swirl	°	14	< 15°	Yes
No Local Negative Flow	-	Yes	-	Yes

Executive Summary

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PLANT PHOTOS

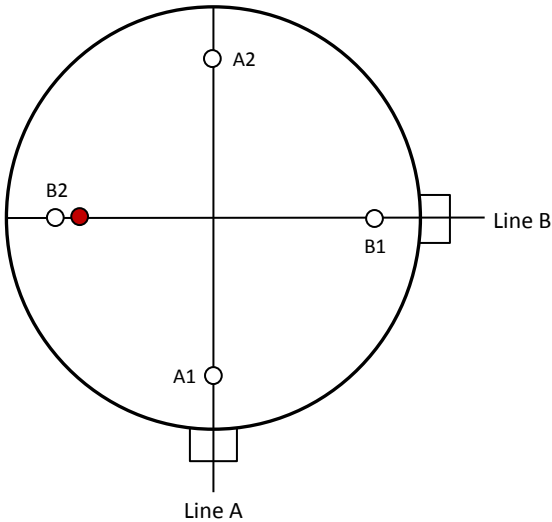
Photo 1



Photo 2



SAMPLE POINTS



where

○ = isokinetic point sampled at

● = isokinetic point not sampled at

● = combustion gases sample point

○ = non-isokinetic sample point

APPENDICES

APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 1

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Adam Dixon	MCERTS Level 2	MM 10 1079	TE1 TE2 TE3 TE4
Trainee	James Birks	MCERTS Trainee	MM 13 1239	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM	CAT 7.5	Horiba PG-250 SRM	-	Digital Manometer (1)	CAT 3.47
Box Thermocouples	CAT 3.12	Servomex 4900	-	Digital Manometer (2)	-
Umbilical	CAT 3.12	Eco Physics CLD 822Mh	-	Digital Temperature Meter	CAT 3.47
Oven Box	-	Testo 350 XL	-	Stopwatch	CAT 14.18
Probe	CAT 5.18	Servomex 5200MP	-	Barometer	CAT 13.6
S-Pitot (1)	CAT 21S.15	JCT JCC P1 Cooler	-	Stack Thermocouple (1)	CAT 4.464
S-Pitot (2)	CAT 21P.40	FT-IR	-	Stack Thermocouple (2)	-
L-Pitot	-	FT-IR Sampling System	-	1m Heated Line (1)	-
500g Check Weight	CAT 17.20	Bernath 3006 FID	CAT 8.5	1m Heated Line (2)	-
1Kg Check Weight	CAT 17.20	Heated Head Filter	CAT 12.91	1m Heated Line (3)	-
Last Impinger Arm	-	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	CAT 20.19
Callipers	CAT 23.7	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	-
Tubes Kit Thermocouple	-	Mass View (1)	-	15m Heated Line (2)	-
Laboratory Balance	CAT 1.18 / 1.18a	Mass View (2)	-	20m Heated Line (1)	-
Tape Measure	CAT 16.91	Easylogger EN-EL-12 Bit	CAT 11.13	Dual Channel Heater Controller	-

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	BS EN 13284-1	CAT-TP-01
Water Vapour	BS EN 14790	CAT-TP-05
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04

APPENDIX 2

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.69
Stack IEDth, W	m	-
Stack Area, A	m ²	0.37
Average Stack Gas Temperature, T _a	°C	67.6
Average Stack Gas Pressure	Pa	55.2
Average Stack Static Pressure, P _{static}	kPa	-0.01
Average Barometric Pressure, P _b	kPa	101.2
Average Pitot Tube Calibration Coefficient, C _p	-	0.85

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.0012
O ₂ (Estimated)	-	20.80	20.59	0.2080	32.00	1.4277	0.2970
N ₂	-	79.14	78.34	0.7914	28.01	1.2498	0.9891
Moisture (H ₂ O)	-	-	1.01	0.0101	18.02	0.8037	0.0081

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.287
Wet Density (STP), P _{STW}	kg/m ³	1.282
Dry Density (Actual), P _{Actual}	kg/m ³	1.031
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.027

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

$P_{ActualW}$ (at each sampling point) = P_{STW} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	67.6	0.00
Total Pressure	kPa	101.2	101.3
Moisture	%	1.0	1.0

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	11760
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	9416
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	9321
Gas Volumetric Flowrate REF ¹	m ³ /hr	9416

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE

(1 of 1)

Parameter	Units	Value
Date of Survey	-	24/09/2013
Time of Survey	-	14:46 - 14:59
Atmospheric Pressure	kPa	101.2
Stack Static Pressure	Pa	-13
Type of Pitot Used	-	S-Type Pitot
Are Water Droplets Present?	-	No

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.85
Number of Lines Available	-	2
Number of Lines Used	-	2

Swirl Point (taken at the sampling points used during testing)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Angle of Swirl (°)	11	14	14	14																

Sampling Line A						Sampling Line B			
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s
1	0.03	44.0	66.0	1.032	7.82	68.0	69.0	1.023	9.76
2	0.10	43.0	67.0	1.029	7.74	74.0	69.0	1.023	10.18
3	0.17	46.0	67.0	1.029	8.00	70.0	70.0	1.020	9.92
4	0.24	50.0	67.0	1.029	8.34	61.0	71.0	1.017	9.27
5	0.31	51.0	66.0	1.032	8.42	54.0	70.0	1.020	8.71
6	0.38	46.0	66.0	1.032	7.99	50.0	68.0	1.026	8.36
7	0.45	56.0	67.0	1.029	8.83	44.0	66.0	1.032	7.82
8	0.52	67.0	67.0	1.029	9.66	46.0	66.0	1.032	7.99
9	0.59	72.0	68.0	1.026	10.03	45.0	65.0	1.035	7.89
10	0.66	72.0	69.0	1.023	10.04	45.0	67.0	1.029	7.92
Mean		54.7	67.0	1.029	8.69	55.7	68.1	1.025	8.78

APPENDIX 2

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon
Stack No.35D

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	1.1		1.1
Uncertainty	±mg/m ³	0.23		0.23
Mass Emission	g/hr	10.3		10.3
Uncertainty	±g/hr	2.1		2.1

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	1.0		1.0
Uncertainty	±% v/v	0.06		0.06

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.10		0.10

NOTE: Where the Balance Uncertainty / Limit of Detection is higher than the Blank concentration, the Balance Uncertainty / Limit of Detection concentration has been reported.

General Sampling Information

Parameter	Value	
Standard	BS EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	2 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2, B1, B2	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

APPENDIX 2

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	759.0	
Stack static pressure, P_{static}	mmH ₂ O	-1.3	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	758.9	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	7.3	
Total mass collected in impingers (silica trap)	g	2.5	
Total mass of liquid collected, V_{lc}	g	9.8	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0122	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.4395	
Gas meter correction factor, Y_d	-	0.9350	
Average dry gas meter temperature, T_m	°C	35.0	
Average pressure drop across orifice, ΔH	mmH ₂ O	55.6	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	1.1976	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0101	
B_{wo} as a percentage	% v/v	1.01	
Reported Water Vapour, checked with Tables in BS EN 14790, R_{wv}	% v/v	1.01	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	1.2099	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.73	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.84	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	5.65	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	2.38	
Average stack gas temperature, T_s	°C	72.3	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	8.78	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	0.37	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	197.1	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	155.6	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	154.0	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)(O_{2REFw})$	m ³ /min	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)(O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	7.94	
Nozzle area, A_n	mm ²	49.48	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	97.9	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	15:28 - 15:58, 16:00 - 16:30	
Sampling Dates	-	24/09/2013	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	1.2099	
Filter I.D. Number	-	47-15143	
Start Filter Mass	g	0.14172	
End Filter Mass	g	0.14235	
Total Mass on Filter	g	0.00063	
Probe Rinse I.D. Number	-	PR-47-15143	
Start Probe Rinse Mass	g	3.18012	
End Probe Rinse Mass	g	3.18082	
Total Mass in Probe Rinse	g	0.00070	
Total Mass Collected	mg	1.33	
Calculated Concentration	mg/m ³	1.10	
Balance Uncertainty / LOD	mg/m ³	0.10	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	24/09/2013	
Average Volume Sampled (REF)	m ³	1.2099	
Filter I.D. Number	-	47-15615	
Start Filter Mass	g	0.13973	
End Filter Mass	g	0.13977	
Total Mass on Filter	g	0.00004	
Probe Rinse I.D. Number	-	PR-47-15615	
Start Probe Rinse Mass	g	3.13628	
End Probe Rinse Mass	g	3.13635	
Total Mass in Probe Rinse	g	0.00007	
Total Mass Collected	mg	0.11	
Calculated Concentration	mg/m ³	0.09	
Balance Uncertainty / LOD	mg/m ³	0.10	

APPENDIX 2

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	22.4	
Pre-Sampling Leak Rate	l/min	0.22	
Post-Sampling Leak Rate	l/min	0.20	
Allowable Leak Rate	l/min	0.45	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	6.3	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	97.9	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.20	
ELV [Daily ELV for IED]	mg/m ³	10.0	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	72	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE
(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20.0	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.40	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
Blank Acceptable	-	Yes	

Acetone / Water Rinse Blank	Units	Blank
Acetone / Water Rinse Value	mg/l	2.7
Allowable Blank	mg/l	10
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1	
There are no deviations associated with the sampling employed.	wx	

APPENDIX 2

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V_m	1.44		uV_m	m^3	0.03	
Sampled Gas Temperature	T_m	308.0		uT_m	K	2.00	
Sampled Gas Pressure	p_m	101.2		up_m	kPa	0.50	
Sampled Gas Humidity	H_m	0.00		uH_m	% v/v	1.00	
Leak	L	0.89		uL	%	-	
Mass of Particulate	m	1.33		um	mg	0.12	
Oxygen Content	$O_{2,m}$	N/A		$uO_{2,m}$	% v/v	N/A	
Uncollected Mass	UCM	0.11		$uUCM$	mg	-	

Uncertainty as a Percentage				
Measured Quantities	Units	Run 1		Requirement of Standard
Sampled Volume (Actual)	%	2.00		$\leq 2\%$
Sampled Gas Temperature	%	0.65		$\leq 1\%$
Sampled Gas Pressure	%	0.49		$\leq 1\%$
Sampled Gas Humidity	%	1.00		$\leq 1\%$
Leak	%	0.89		$\leq 2\%$
Mass of Particulate	%	0.99		$< 5\%$ of ELV
Oxygen Content	%	N/A		$\leq 5\%$
Uncollected Mass	%	-		-

Uncertainty in Measurement Units					Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V_m	m^3	1.20		0.92	
Leak	L	mg/m^3	0.01		1.00	
Mass of Particulate	L_r	mg	1.33		0.83	
Factor for O_2 Correction	$O_{2,m}$	% v/v	N/A		N/A	
Uncollected Mass	UCM	mg	0.06		0.83	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m^3	0.03	
Leak	mg/m^3	0.01	
Mass of Particulate	mg/m^3	0.10	
Factor for O_2 Correction	mg/m^3	N/A	
Uncollected Mass	mg/m^3	0.05	

Parameter	Units	Run 1	
Combined uncertainty	mg/m^3	0.12	
Expanded uncertainty (95% confidence)	mg/m^3	0.23	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	0.23	
Reported Uncertainty	mg/m^3	0.23	
Expanded uncertainty (95% confidence)	%	20.7	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	20.7	
Reported Uncertainty	%	20.7	

APPENDIX 2

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon
Stack No.35D

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.96		0.96
Uncertainty	±mg/m ³	0.17		0.17
Mass Emission	g/hr	9.1		9.1
Uncertainty	±g/hr	1.6		1.6

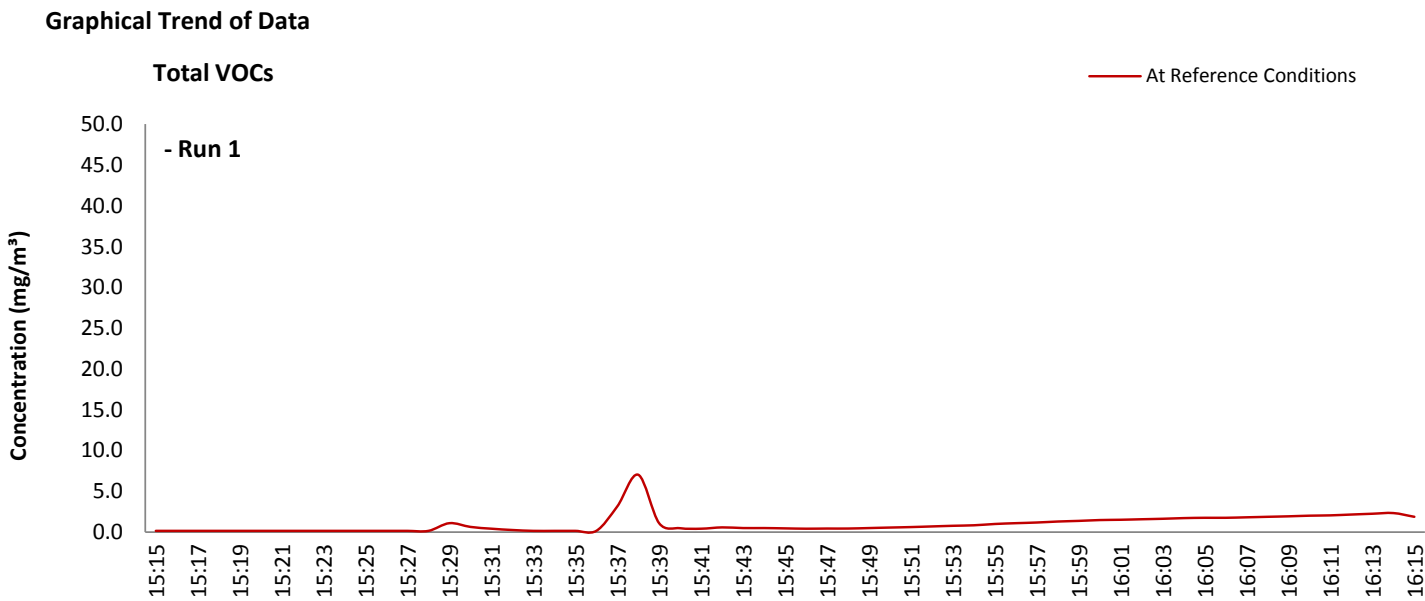
General Sampling Information

Parameter	Value	
Standard	BS EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Reference Number	CYL 1.0035	
Span Gas Expiry Date	05/12/2013	
Span Gas Start Pressure (bar)	80	
Gas Cylinder Concentration (ppm)	80.3	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Synthetic Air (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

TOTAL VOCs (as CARBON): DATA TREND



TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	15:15 - 16:15	
Sampling Dates	-	24/09/2013	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.3	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.40	
	Zero Down Sampling Line (Post)	ppm	0.40	
	Zero Drift	ppm	0.00	
	Allowable Zero Drift	± ppm	4.02	
	Zero Drift Acceptable	-	Yes	
	Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	80.1	
	Span Down Sampling Line (Post)	ppm	80.2	
	Span Drift	ppm	0.10	
	Allowable Span Drift	± ppm	4.02	
	Span Drift Acceptable	-	Yes	
	Test Conditions	Units	Run 1	
	Run Ambient Temperature Range	°C	13 - 14	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	1	
There are no deviations associated with the sampling employed.	x	

APPENDIX 2

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			
	Units	Run 1	Run 2	Run 3
MCERTS Certified Range of Analyser	ppm	9.3		
Operational Range of Analyser	ppm	100		
Measured Reading	ppm	0.60		

Measured Quantities	Individual Errors as Standard Uncertainties			
	Units	Run 1	Run 2	Run 3
Nonlinearity	ppm	0.04		
Temperature Dependent Zero Drift	ppm	0.03		
Temperature Dependent Span Drift	ppm	0.03		
Cross-Sensitivity	ppm	0.01		
Leak	ppm	0.00		
Calibration Gas Uncertainty	ppm	0.00		
Mass Flow Controllers (dilution) Uncertainty	ppm	0.00		

Parameter	Units	Run 1	Run 2	Run 3
Combined uncertainty	ppm	0.05		
Expanded uncertainty (95% confidence)	ppm	0.11		
Expanded uncertainty (95% confidence), estimated with Method Deviations	ppm	0.11		
Reported Uncertainty	ppm	0.11		
Expanded uncertainty (95% confidence)	%	17.6		
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	17.6		
Reported Uncertainty	%	17.6		



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Stack Emissions Testing Report Commissioned by

Air Tech Environmental Consultancy Services

Installation Name & Address

VIP-Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7DA

PPC Permit: 11/94

Stack Reference

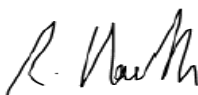
Stack No.14

Dates of the Monitoring Campaign

24th September 2013

Job Reference Number

CAT-1636

Report Written by
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Report Date
30th September 2013
Version
Version 1
Signature of Report Approver


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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

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MONITORING OBJECTIVES

VIP-Polymers Ltd, Huntingdon

Stack No.14

24th September 2013

Overall Aim of the Monitoring Campaign

Catalyst Environmental Ltd, in partnership with Air Tech Environmental Consultancy Services, were commissioned to carry out stack emissions testing on the Stack No.14 by VIP-Polymers Ltd at Huntingdon.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Total VOCs (as Carbon)

Executive Summary

(Page 2 of 7)

MONITORING RESULTS

VIP-Polymers Ltd, Huntingdon
 Stack No.14
 24th September 2013

where MU = Measurement Uncertainty associated with the Result

		Concentration				Mass Emission			
Parameter		Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	¹	mg/m³	0.35	0.39	10	g/hr	3.0	3.3	-
Total VOCs (as Carbon)	¹	mg/m³	0.61	0.22	50	g/hr	5.2	1.9	-
Water Vapour		% v/v	0.64	0.06					
Stack Gas Temperature		°C	33.8						
Stack Gas Velocity		m/s	11.1						
Volumetric Flow Rate (ACTUAL)		m³/hr	9681						
Volumetric Flow Rate (REF)	¹	m³/hr	8598						

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

¹ Reference Conditions (REF) are: 273K, 101.3kPa, without correction for water vapour content.

Executive Summary
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MONITORING DATE(S) & TIMES

VIP-Polymers Ltd, Huntingdon
Stack No.14
24th September 2013

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.35	g/hr	3.0	24/09/2012	14:04 - 14:34, 14:36 - 15:06	60
Total VOCs (as Carbon)	R1	mg/m³	0.61	g/hr	5.2	24/09/2013	13:30 - 14:30	60
Velocity & Volumetric Flow Rate	R1					24/09/2013	12:59 - 13:11	

All results are expressed at the respective reference conditions.

Executive Summary
(Page 4 of 7)

PROCESS DETAILS

VIP-Polymers Ltd, Huntingdon
Stack No.14
24th September 2013

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Varied
Continuous or Batch Process	Batch
Feedstock (if applicable)	Under cured Parts, Viton Seals
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

(Page 5 of 7)

MONITORING & ANALYTICAL METHODS

VIP-Polymers Ltd, Huntingdon

Stack No.14

24th September 2013

	Monitoring				Analysis					
Parameter	Standard	Technical Procedure	UKAS Testing	Testing Lab	Analytical Procedure	Analytical Technique	UKAS Analysis	Analysis Lab	MCERTS Testing	LOD (Average)
Total Particulate Matter	BS EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.09 mg/m³
Water Vapour	BS EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.10 % v/v
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.13 mg/m³
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04	Yes	CAT	Pitot Tube and Thermocouple				Yes	N/A

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Catalyst Environmental Ltd (CAT)	UKAS Accreditation Number: 4279
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SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	All Runs	The angle of swirl was > 15° across the entire sampling plane. As there is no other reasonable sampling location available, testing was carried out at all required sample points across the duct.
All Parameters	All Runs	Ratio highest to lowest velocities between 3 and 5 : 1.

Executive Summary

(Page 6 of 7)

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.56
IEDth	m	-
Area	m ²	0.24
Port Depth	cm	5
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	On Roof
Inside / Outside	Outside

Platform Details

EA Technical Guidance Note M1 / BS EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location meets all the requirements specified in EA Guidance Note M1 and BS EN 15259, and therefore there are no improvement recommendations.

BS EN 15259 Homogeneity Test Requirements

There is no requirement to perform a BS EN 15259 Homogeneity Test on this Stack.

Sampling Plane Validation Criteria (from EA Technical Guidance Document (Monitoring) M1)

Criteria in M1	Units	Traverse 1		Required	Compliant
Lowest Differential Pressure	Pa	20.0		> 5 Pa	Yes
Mean Velocity	m/s	11.1		-	-
Lowest Gas Velocity	m/s	5.01		-	-
Highest Gas Velocity	m/s	16.4		-	-
Ratio of Above	: 1	3.29		< 3 : 1	No
Maximum Angle of Swirl	°	70		< 15°	No
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

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PLANT PHOTOS

Photo 1



Photo 2



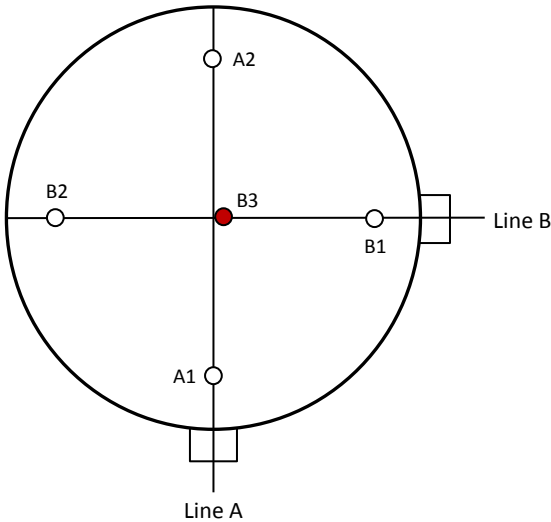
Photo 3



Photo 4



SAMPLE POINTS



where

○ = isokinetic point sampled at

● = isokinetic point not sampled at

● = combustion gases sample point

○ = non-isokinetic sample point

APPENDICES

APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 1

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Adam Dixon	MCERTS Level 2	MM 10 1079	TE1 TE2 TE3 TE4
Trainee	James Birks	MCERTS Trainee	MM 13 1239	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM	CAT 7.5	Horiba PG-250 SRM	-	Digital Manometer (1)	CAT 3.47
Box Thermocouples	CAT 3.12	Servomex 4900	-	Digital Manometer (2)	-
Umbilical	CAT 3.12	Eco Physics CLD 822Mh	-	Digital Temperature Meter	CAT 3.47
Oven Box	-	Testo 350 XL	-	Stopwatch	CAT 14.18
Probe	CAT 5.18	Servomex 5200MP	-	Barometer	CAT 13.6
S-Pitot (1)	CAT 21S.15	JCT JCC P1 Cooler	-	Stack Thermocouple (1)	CAT 4.464
S-Pitot (2)	CAT 21P.40	FT-IR	-	Stack Thermocouple (2)	-
L-Pitot	-	FT-IR Sampling System	-	1m Heated Line (1)	-
500g Check Weight	CAT 17.20	Bernath 3006 FID	CAT 8.5	1m Heated Line (2)	-
1Kg Check Weight	CAT 17.20	Heated Head Filter	CAT 12.91	1m Heated Line (3)	-
Last Impinger Arm	-	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	CAT 20.19
Callipers	CAT 23.7	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	-
Tubes Kit Thermocouple	-	Mass View (1)	-	15m Heated Line (2)	-
Laboratory Balance	CAT 1.18 / 1.18a	Mass View (2)	-	20m Heated Line (1)	-
Tape Measure	CAT 16.91	Easylogger EN-EL-12 Bit	CAT 11.13	Dual Channel Heater Controller	-

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	BS EN 13284-1	CAT-TP-01
Water Vapour	BS EN 14790	CAT-TP-05
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04

APPENDIX 2

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.56
Stack IEDth, W	m	-
Stack Area, A	m ²	0.24
Average Stack Gas Temperature, T _a	°C	33.8
Average Stack Gas Pressure	Pa	105
Average Stack Static Pressure, P _{static}	kPa	-0.10
Average Barometric Pressure, P _b	kPa	101.2
Average Pitot Tube Calibration Coefficient, C _p	-	0.85

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.0012
O ₂ (Estimated)	-	20.80	20.67	0.2080	32.00	1.4277	0.2970
N ₂	-	79.14	78.63	0.7914	28.01	1.2498	0.9891
Moisture (H ₂ O)	-	-	0.64	0.0064	18.02	0.8037	0.0051

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.287
Wet Density (STP), P _{STW}	kg/m ³	1.284
Dry Density (Actual), P _{Actual}	kg/m ³	1.143
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.141

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

$P_{ActualW}$ (at each sampling point) = P_{STW} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	33.8	0.00
Total Pressure	kPa	101.1	101.3
Moisture	%	0.64	0.64

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	9681
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	8598
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	8544
Gas Volumetric Flowrate REF ¹	m ³ /hr	8598

APPENDIX 2

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE
(1 of 1)

Parameter	Units	Value
Date of Survey	-	24/09/2013
Time of Survey	-	12:59 - 13:11
Atmospheric Pressure	kPa	101.2
Stack Static Pressure	Pa	-100
Type of Pitot Used	-	S-Type Pitot
Are Water Droplets Present?	-	No

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.85
Number of Lines Available	-	2
Number of Lines Used	-	2

Swirl Point (taken at the sampling points used during testing)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Angle of Swirl (°)	50	70	65	65																

Sampling Line A						Sampling Line B			
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m³	Velocity m/s	ΔP Pa	Temp °C	Wet Density kg/m³	Velocity m/s
1	0.03	150.0	33.0	1.143	13.71	111.0	34.0	1.140	11.81
2	0.08	216.0	33.0	1.143	16.45	134.0	34.0	1.140	12.98
3	0.14	114.0	33.0	1.143	11.95	156.0	35.0	1.136	14.03
4	0.19	41.0	32.0	1.147	7.16	109.0	35.0	1.136	11.72
5	0.25	198.0	32.0	1.147	15.72	98.0	35.0	1.136	11.12
6	0.31	29.0	32.0	1.147	6.02	96.0	35.0	1.136	11.00
7	0.36	20.0	33.0	1.143	5.01	80.0	35.0	1.136	10.04
8	0.42	62.0	34.0	1.140	8.83	82.0	34.0	1.140	10.15
9	0.47	107.0	34.0	1.140	11.60	87.0	34.0	1.140	10.46
10	0.53	116.0	34.0	1.140	12.07	87.0	34.0	1.140	10.46
Mean		105.3	33.0	1.143	10.85	104.0	34.5	1.138	11.38

APPENDIX 2

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon
Stack No.14

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.35		0.35
Uncertainty	±mg/m ³	0.39		0.39
Mass Emission	g/hr	3.0		3.0
Uncertainty	±g/hr	3.3		3.3

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.64		0.64
Uncertainty	±% v/v	0.06		0.06

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.09		0.09

NOTE: Where the Balance Uncertainty / Limit of Detection is higher than the Blank concentration, the Balance Uncertainty / Limit of Detection concentration has been reported.

General Sampling Information

Parameter	Value	
Standard	BS EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	2 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2, B1, B2	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

APPENDIX 2

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	759.0	
Stack static pressure, P_{static}	mmH ₂ O	-10.2	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	758.3	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	6.2	
Total mass collected in impingers (silica trap)	g	0.4	
Total mass of liquid collected, V_{lc}	g	6.6	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0082	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.5375	
Gas meter correction factor, Y_d	-	0.9350	
Average dry gas meter temperature, T_m	°C	34.9	
Average pressure drop across orifice, ΔH	mmH ₂ O	53.9	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	1.2795	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0064	
B_{wo} as a percentage	% v/v	0.64	
Reported Water Vapour, checked with Tables in BS EN 14790, R_{wv}	% v/v	0.64	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	1.2877	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.77	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.84	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	8.50	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	2.92	
Average stack gas temperature, T_s	°C	34.9	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	10.18	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	0.24	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	147.7	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	130.7	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	129.8	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)(O_{2REFw})$	m ³ /min	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)(O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	6.91	
Nozzle area, A_n	mm ²	37.47	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	106.0	

APPENDIX 2

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	14:04 - 14:34, 14:36 - 15:06	
Sampling Dates	-	24/09/2012	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	1.2877	
Filter I.D. Number	-	47-15141	
Start Filter Mass	g	0.14148	
End Filter Mass	g	0.14161	
Total Mass on Filter	g	0.00013	
Probe Rinse I.D. Number	-	PR-47-15141	
Start Probe Rinse Mass	g	3.08839	
End Probe Rinse Mass	g	3.08871	
Total Mass in Probe Rinse	g	0.00032	
Total Mass Collected	mg	0.45	
Calculated Concentration	mg/m ³	0.35	
Balance Uncertainty / LOD	mg/m ³	0.09	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	24/09/2013	
Average Volume Sampled (REF)	m ³	1.2877	
Filter I.D. Number	-	47-15613	
Start Filter Mass	g	0.13967	
End Filter Mass	g	0.13971	
Total Mass on Filter	g	0.00004	
Probe Rinse I.D. Number	-	PR-47-15613	
Start Probe Rinse Mass	g	0.13967	
End Probe Rinse Mass	g	0.13971	
Total Mass in Probe Rinse	g	0.00004	
Total Mass Collected	mg	0.09	
Calculated Concentration	mg/m ³	0.07	
Balance Uncertainty / LOD	mg/m ³	0.09	

APPENDIX 2

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	24.0	
Pre-Sampling Leak Rate	l/min	0.10	
Post-Sampling Leak Rate	l/min	0.20	
Allowable Leak Rate	l/min	0.48	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	9.2	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	106.0	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.19	
ELV [Daily ELV for IED]	mg/m ³	10.0	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	35	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE
(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20.0	
Pre-Sampling Leak Rate	l/min	0.22	
Post-Sampling Leak Rate	l/min	0.20	
Allowable Leak Rate	l/min	0.40	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
Blank Acceptable	-	Yes	

Acetone / Water Rinse Blank	Units	Blank
Acetone / Water Rinse Value	mg/l	2.7
Allowable Blank	mg/l	10
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1	
The angle of swirl was > 15° across the entire sampling plane. As there is no other reasonable sampling location available, testing was carried out at all required sample points across the duct.	x	
Ratio highest to lowest velocities between 3 and 5 : 1.	wx	

APPENDIX 2

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V_m	1.54		uV_m	m^3	0.03	
Sampled Gas Temperature	T_m	307.9		uT_m	K	2.00	
Sampled Gas Pressure	p_m	101.1		up_m	kPa	0.50	
Sampled Gas Humidity	H_m	0.00		uH_m	% v/v	1.00	
Leak	L	0.83		uL	%	-	
Mass of Particulate	m	0.45		um	mg	0.12	
Oxygen Content	$O_{2,m}$	N/A		$uO_{2,m}$	% v/v	N/A	
Uncollected Mass	UCM	0.09		$uUCM$	mg	-	

Uncertainty as a Percentage				
Measured Quantities	Units	Run 1		Requirement of Standard
Sampled Volume (Actual)	%	2.00		$\leq 2\%$
Sampled Gas Temperature	%	0.65		$\leq 1\%$
Sampled Gas Pressure	%	0.49		$\leq 1\%$
Sampled Gas Humidity	%	1.00		$\leq 1\%$
Leak	%	0.83		$\leq 2\%$
Mass of Particulate	%	0.93		$< 5\%$ of ELV
Oxygen Content	%	N/A		$\leq 5\%$
Uncollected Mass	%	-		-

Uncertainty in Measurement Units					Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V_m	m^3	1.28		0.28	
Leak	L	mg/m^3	0.002		1.00	
Mass of Particulate	L_r	mg	0.453		0.78	
Factor for O_2 Correction	$O_{2,m}$	% v/v	N/A		N/A	
Uncollected Mass	UCM	mg	0.05		0.78	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m^3	0.01	
Leak	mg/m^3	0.00	
Mass of Particulate	mg/m^3	0.09	
Factor for O_2 Correction	mg/m^3	N/A	
Uncollected Mass	mg/m^3	0.04	

Parameter	Units	Run 1	
Combined uncertainty	mg/m^3	0.10	
Expanded uncertainty (95% confidence)	mg/m^3	0.20	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	0.39	
Reported Uncertainty	mg/m^3	0.39	
Expanded uncertainty (95% confidence)	%	56.5	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	110.1	
Reported Uncertainty	%	110.1	

APPENDIX 2

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon
Stack No.14

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.61		0.61
Uncertainty	±mg/m ³	0.22		0.22
Mass Emission	g/hr	5.2		5.2
Uncertainty	±g/hr	1.9		1.9

General Sampling Information

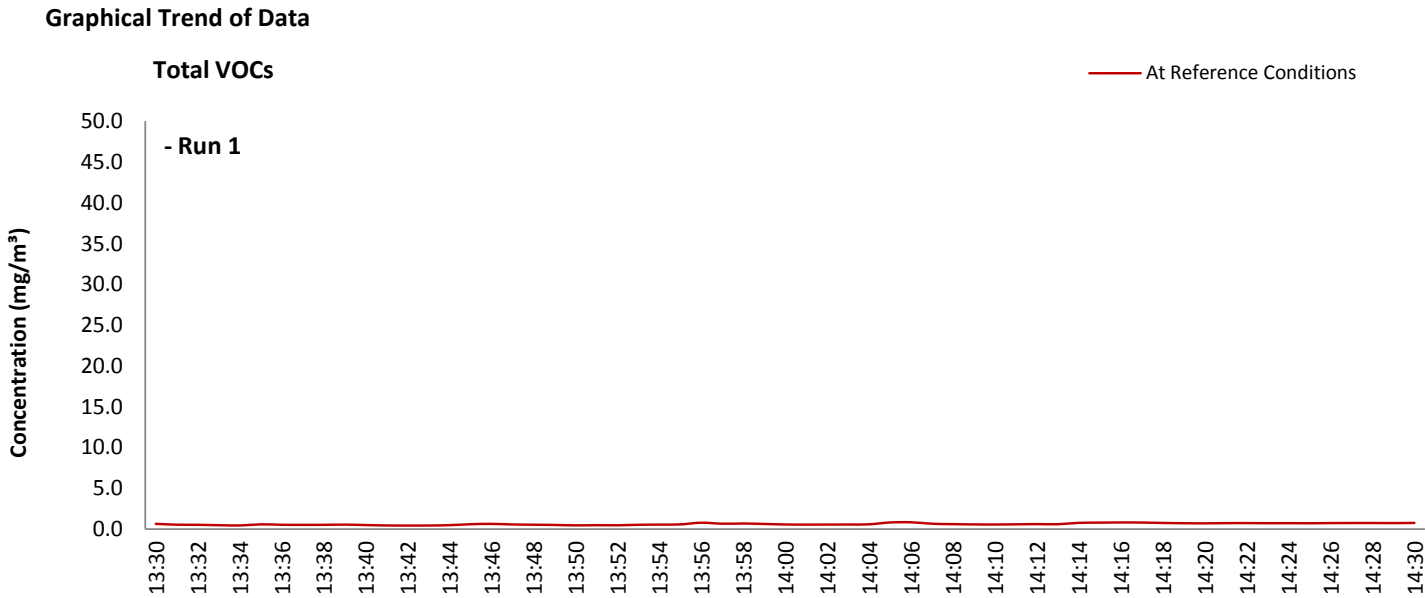
Parameter	Value	
Standard	BS EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Reference Number	CYL 1.0035	
Span Gas Expiry Date	05/12/2013	
Span Gas Start Pressure (bar)	80	
Gas Cylinder Concentration (ppm)	80.3	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Synthetic Air (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B3	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

APPENDIX 2

TOTAL VOCs (as CARBON): DATA TREND



TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	13:30 - 14:30	
Sampling Dates	-	24/09/2013	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.3	

Quality Assurance

Zero Drift		Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.90	
	Zero Down Sampling Line (Post)	ppm	0.30	
	Zero Drift	ppm	-0.60	
	Allowable Zero Drift	± ppm	4.02	
	Zero Drift Acceptable	-	Yes	
Span Drift		Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	79.8	
	Span Down Sampling Line (Post)	ppm	78.9	
	Span Drift	ppm	-0.90	
	Allowable Span Drift	± ppm	4.02	
	Span Drift Acceptable	-	Yes	
Test Conditions		Units	Run 1	
Run Ambient Temperature Range		°C	12 - 15	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	1	
Ratio highest to lowest velocities between 3 and 5 : 1.	x	

APPENDIX 2

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			
	Units	Run 1	Run 2	Run 3
MCERTS Certified Range of Analyser	ppm	9.3		
Operational Range of Analyser	ppm	100		
Measured Reading	ppm	0.38		

Measured Quantities	Individual Errors as Standard Uncertainties			
	Units	Run 1	Run 2	Run 3
Nonlinearity	ppm	0.04		
Temperature Dependent Zero Drift	ppm	0.03		
Temperature Dependent Span Drift	ppm	0.03		
Cross-Sensitivity	ppm	0.01		
Leak	ppm	0.00		
Calibration Gas Uncertainty	ppm	0.00		
Mass Flow Controllers (dilution) Uncertainty	ppm	0.00		

Parameter	Units	Run 1	Run 2	Run 3
Combined uncertainty	ppm	0.05		
Expanded uncertainty (95% confidence)	ppm	0.10		
Expanded uncertainty (95% confidence), estimated with Method Deviations	ppm	0.13		
Reported Uncertainty	ppm	0.13		
Expanded uncertainty (95% confidence)	%	27.3		
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	35.4		
Reported Uncertainty	%	35.4		



Air Tech Environmental Consultancy Services

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Your Catalyst Contact: Toby Campbell (07825 130 074)

Stack Emissions Testing Report Commissioned by

Air Tech Environmental Consultancy Services

Installation Name & Address

VIP-Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7DA

PPC Permit: PPC 11/94

Stack Reference

40A

Dates of the Monitoring Campaign

24th September 2013

Job Reference Number

CAT-1636

Report Written by
Adam Dixon Team Leader MCERTS Level 2 MM 10 1079 TE1 TE2 TE3 TE4

Report Approved by
Matthew Pendlebury Team Leader MCERTS Level 2 MM 04 535 TE1 TE2 TE3 TE4

Report Date
30th September 2013

Version
Version 1

Signature of Report Approver


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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

Opinions and interpretations expressed herein are outside the scope of Catalyst Environmental Ltd's UKAS accreditation.

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Executive Summary

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MONITORING OBJECTIVES

VIP-Polymers Ltd, Huntingdon

40A

24th September 2013

Overall Aim of the Monitoring Campaign

Catalyst Environmental Ltd, in partnership with Air Tech Environmental Consultancy Services, were commissioned to carry out stack emissions testing on the 40A by VIP-Polymers Ltd at Huntingdon.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP-Polymers Ltd, Huntingdon
 40A
 24th September 2013

where MU = Measurement Uncertainty associated with the Result

		Concentration				Mass Emission			
Parameter		Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	¹	mg/m³	0.51	0.38	10	g/hr	2.3	1.7	-
Total VOCs (as Carbon)	¹	mg/m³	2.5	0.21	50	g/hr	11.1	0.91	-
Water Vapour		% v/v	1.8	0.10					
Stack Gas Temperature		°C	39.8						
Stack Gas Velocity		m/s	7.4						
Volumetric Flow Rate (ACTUAL)		m³/hr	5095						
Volumetric Flow Rate (REF)	¹	m³/hr	4438						

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM AN AVERAGE OF ALL OF THE ISOKINETIC RUNS.

¹ Reference Conditions (REF) are: 273K, 101.3kPa, without correction for water vapour content.

Executive Summary
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MONITORING DATE(S) & TIMES

VIP-Polymers Ltd, Huntingdon
40A
24th September 2013

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.51	g/hr	2.3	24/09/2013	12:30 - 13:00, 13:02 - 13:32	60
Total VOCs (as Carbon)	R1	mg/m³	2.5	g/hr	11.1	24/09/2013	12:16 - 13:16	60
Velocity & Volumetric Flow Rate	R1					24/09/2013	11:42 - 11:49	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP-Polymers Ltd, Huntingdon
40A
24th September 2013

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Various
Continuous or Batch Process	Batch
Feedstock (if applicable)	Under cured Parts, Viton Seals
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

(Page 5 of 7)

MONITORING & ANALYTICAL METHODS

VIP-Polymers Ltd, Huntingdon
 40A
 24th September 2013

	Monitoring				Analysis					
Parameter	Standard	Technical Procedure	UKAS Testing	Testing Lab	Analytical Procedure	Analytical Technique	UKAS Analysis	Analysis Lab	MCERTS Testing	LOD (Average)
Total Particulate Matter	BS EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.11 mg/m³
Water Vapour	BS EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.10 % v/v
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.13 mg/m³
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04	Yes	CAT	Pitot Tube and Thermocouple				Yes	N/A

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Catalyst Environmental Ltd (CAT)	UKAS Accreditation Number: 4279
----------------------------------	---------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	1	The angle of swirl was > 15° across the entire sampling plane. As there is no other reasonable sampling location available, testing was carried out at all required sample points across the duct.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.50
IEDth	m	-
Area	m ²	0.19
Port Depth	cm	5
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	On Roof
Inside / Outside	Outside

Platform Details

EA Technical Guidance Note M1 / BS EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location does not meet all of the Flow Criteria requirements in the Environment Agency's Technical Guidance Note M1 and BS EN 15259 (see Validation Criteria Table below).

BS EN 15259 Homogeneity Test Requirements

There is no requirement to perform a BS EN 15259 Homogeneity Test on this Stack.

Sampling Plane Validation Criteria (from EA Technical Guidance Document (Monitoring) M1)

Criteria in M1	Units	Traverse 1	Required	Compliant
Lowest Differential Pressure	Pa	-14.0	> 5 Pa	No
Mean Velocity	m/s	6.75	-	-
Lowest Gas Velocity	m/s	2.24	-	-
Highest Gas Velocity	m/s	9.02	-	-
Ratio of Above	: 1	4.03	< 3 : 1	No
Maximum Angle of Swirl	°	70	< 15°	No
No Local Negative Flow	-	No	-	No

Executive Summary

(Page 7 of 7)

PLANT PHOTOS

Photo 1



Photo 2



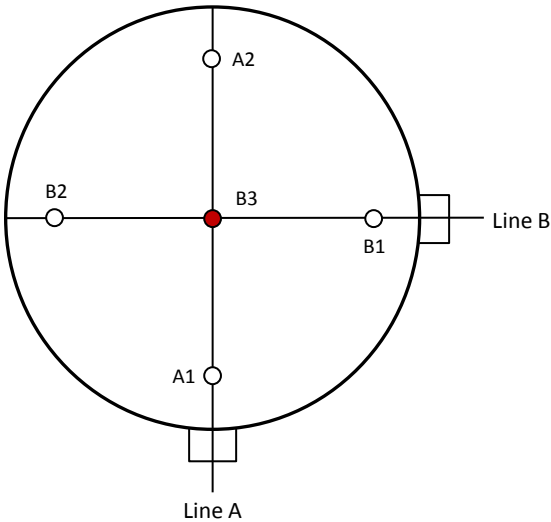
Photo 3



Photo 4



SAMPLE POINTS



where

○ = isokinetic point sampled at

● = isokinetic point not sampled at

● = combustion gases sample point

○ = non-isokinetic sample point

APPENDICES

APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 1

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Adam Dixon	MCERTS Level 2	MM 10 1079	TE1 TE2 TE3 TE4
Trainee	James Birks	MCERTS Trainee	MM 13 1239	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM	CAT 7.5	Horiba PG-250 SRM	-	Digital Manometer (1)	CAT 3.47
Box Thermocouples	CAT 3.12	Servomex 4900	-	Digital Manometer (2)	-
Umbilical	CAT 3.12	Eco Physics CLD 822Mh	-	Digital Temperature Meter	CAT 3.47
Oven Box	-	Testo 350 XL	-	Stopwatch	CAT 14.18
Probe	CAT 5.18	Servomex 5200MP	-	Barometer	CAT 13.6
S-Pitot (1)	CAT 21S.15	JCT JCC P1 Cooler	-	Stack Thermocouple (1)	CAT 4.464
S-Pitot (2)	CAT 21P.40	FT-IR	-	Stack Thermocouple (2)	-
L-Pitot	-	FT-IR Sampling System	-	1m Heated Line (1)	-
500g Check Weight	CAT 17.20	Bernath 3006 FID	CAT 8.5	1m Heated Line (2)	-
1Kg Check Weight	CAT 17.20	Heated Head Filter	CAT 12.91	1m Heated Line (3)	-
Last Impinger Arm	-	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	CAT 20.19
Callipers	CAT 23.7	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	-
Tubes Kit Thermocouple	-	Mass View (1)	-	15m Heated Line (2)	-
Laboratory Balance	CAT 1.18 / 1.18a	Mass View (2)	-	20m Heated Line (1)	-
Tape Measure	CAT 16.91	Easylogger EN-EL-12 Bit	CAT 11.13	Dual Channel Heater Controller	-

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	BS EN 13284-1	CAT-TP-01
Water Vapour	BS EN 14790	CAT-TP-05
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04

APPENDIX 2

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.50
Stack IEDth, W	m	-
Stack Area, A	m ²	0.19
Average Stack Gas Temperature, T _a	°C	31.7
Average Stack Gas Pressure	Pa	27.7
Average Stack Static Pressure, P _{static}	kPa	-0.05
Average Barometric Pressure, P _b	kPa	101.2
Average Pitot Tube Calibration Coefficient, C _p	-	0.85

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.0012
O ₂ (Estimated)	-	20.80	20.43	0.2080	32.00	1.4277	0.2970
N ₂	-	79.14	77.75	0.7914	28.01	1.2498	0.9891
Moisture (H ₂ O)	-	-	1.76	0.0176	18.02	0.8037	0.0141

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.287
Wet Density (STP), P _{STW}	kg/m ³	1.279
Dry Density (Actual), P _{Actual}	kg/m ³	1.152
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.144

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

$P_{ActualW}$ (at each sampling point) = P_{STW} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	31.7	0.00
Total Pressure	kPa	101.1	101.3
Moisture	%	1.76	1.76

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	4678
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	4185
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	4112
Gas Volumetric Flowrate REF ¹	m ³ /hr	4185

APPENDIX 2

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE

(1 of 1)

Parameter	Units	Value
Date of Survey	-	24/09/2013
Time of Survey	-	11:42 - 11:49
Atmospheric Pressure	kPa	101.2
Stack Static Pressure	Pa	-54
Type of Pitot Used	-	S-Type Pitot
Are Water Droplets Present?	-	No

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.85
Number of Lines Available	-	2
Number of Lines Used	-	2

Swirl Point (taken at the sampling points used during testing)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Angle of Swirl (°)	65	70	55	60																

Sampling Line A						Sampling Line B			
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s
1	0.02	58.0	31.2	1.146	8.52	48.0	32.0	1.143	7.76
2	0.07	34.0	31.2	1.146	6.52	31.0	32.0	1.143	6.23
3	0.12	21.0	31.3	1.145	5.12	20.0	32.0	1.143	5.01
4	0.17	4.0	31.3	1.145	2.24	-7.0	32.0	1.143	-IVE
5	0.22	-6.0	31.3	1.145	-IVE	-3.0	32.1	1.142	-IVE
6	0.27	-14.0	31.3	1.145	-IVE	-6.0	32.1	1.142	-IVE
7	0.32	32.0	31.3	1.145	6.33	15.0	32.1	1.142	4.34
8	0.37	55.0	31.3	1.145	8.29	34.0	32.1	1.142	6.53
9	0.42	65.0	31.3	1.145	9.02	52.0	32.1	1.142	8.07
10	0.47	62.0	31.3	1.145	8.81	59.0	32.1	1.142	8.60
Mean		31.1	31.3	1.146	6.85	24.3	32.1	1.143	6.65

APPENDIX 2

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon
40A

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.51		0.51
Uncertainty	±mg/m ³	0.38		0.38
Mass Emission	g/hr	2.3		2.3
Uncertainty	±g/hr	1.7		1.7

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	1.8		1.8
Uncertainty	±% v/v	0.10		0.10

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.12		0.12

General Sampling Information

Parameter	Value	
Standard	BS EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	2 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2, B1, B2	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

APPENDIX 2

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	759.0	
Stack static pressure, P_{static}	mmH ₂ O	-5.5	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	758.6	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	14.4	
Total mass collected in impingers (silica trap)	g	1.3	
Total mass of liquid collected, V_{lc}	g	15.7	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0196	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.3095	
Gas meter correction factor, Y_d	-	0.9350	
Average dry gas meter temperature, T_m	°C	33.4	
Average pressure drop across orifice, ΔH	mmH ₂ O	45.8	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	1.0944	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0176	
B_{wo} as a percentage	% v/v	1.76	
Reported Water Vapour, checked with Tables in BS EN 14790, R_{wv}	% v/v	1.76	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	1.1139	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.65	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.84	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	4.35	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	2.09	
Average stack gas temperature, T_s	°C	39.8	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	7.35	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	0.19	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	84.9	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	74.0	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	72.7	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)(O_{2REFw})$	m ³ /min	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)(O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	7.88	
Nozzle area, A_n	mm ²	48.73	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	99.1	

APPENDIX 2

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	12:30 - 13:00, 13:02 - 13:32	
Sampling Dates	-	24/09/2013	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	1.1139	
Filter I.D. Number	-	47-15549	
Start Filter Mass	g	0.14037	
End Filter Mass	g	0.14064	
Total Mass on Filter	g	0.00027	
Probe Rinse I.D. Number	-	PR-47-15549	
Start Probe Rinse Mass	g	3.03931	
End Probe Rinse Mass	g	3.03961	
Total Mass in Probe Rinse	g	0.00030	
Total Mass Collected	mg	0.57	
Calculated Concentration	mg/m ³	0.51	
Balance Uncertainty / LOD	mg/m ³	0.11	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	24/09/2013	
Average Volume Sampled (REF)	m ³	1.1139	
Filter I.D. Number	-	47-15646	
Start Filter Mass	g	0.13931	
End Filter Mass	g	0.13934	
Total Mass on Filter	g	0.00003	
Probe Rinse I.D. Number	-	PR-47-15646	
Start Probe Rinse Mass	g	2.96487	
End Probe Rinse Mass	g	2.96497	
Total Mass in Probe Rinse	g	0.00010	
Total Mass Collected	mg	0.13	
Calculated Concentration	mg/m ³	0.12	
Balance Uncertainty / LOD	mg/m ³	0.11	

APPENDIX 2

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	20.4	
Pre-Sampling Leak Rate	l/min	0.23	
Post-Sampling Leak Rate	l/min	0.20	
Allowable Leak Rate	l/min	0.41	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.8	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	99.1	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.22	
ELV [Daily ELV for IED]	mg/m ³	10.0	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	40	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE
(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20.0	
Pre-Sampling Leak Rate	l/min	0.12	
Post-Sampling Leak Rate	l/min	0.12	
Allowable Leak Rate	l/min	0.40	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
Blank Acceptable	-	Yes	

Acetone / Water Rinse Blank	Units	Blank
Acetone / Water Rinse Value	mg/l	2.7
Allowable Blank	mg/l	10
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1	
The angle of swirl was > 15° across the entire sampling plane. As there is no other reasonable sampling location available, testing was carried out at all required sample points across the duct.	x	

APPENDIX 2

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V _m	1.31		uV _m	m ³	0.03	
Sampled Gas Temperature	T _m	306.4		uT _m	K	2.00	
Sampled Gas Pressure	p _m	101.2		up _m	kPa	0.50	
Sampled Gas Humidity	H _m	0.00		uH _m	% v/v	1.00	
Leak	L	0.98		uL	%	-	
Mass of Particulate	m	0.57		um	mg	0.12	
Oxygen Content	O _{2,m}	N/A		uO _{2,m}	% v/v	N/A	
Uncollected Mass	UCM	0.13		uUCM	mg	-	

Uncertainty as a Percentage				
Measured Quantities	Units	Run 1		Requirement of Standard
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.65		≤1%
Sampled Gas Pressure	%	0.49		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.98		≤2%
Mass of Particulate	%	1.08		<5% of ELV
Oxygen Content	%	N/A		≤5%
Uncollected Mass	%	-		-

Uncertainty in Measurement Units					Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V _m	m ³	1.09		0.47	
Leak	L	mg/m ³	0.00		1.00	
Mass of Particulate	L _r	mg	0.57		0.90	
Factor for O ₂ Correction	O _{2,m}	% v/v	N/A		N/A	
Uncollected Mass	UCM	mg	0.08		0.90	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m ³	0.01	
Leak	mg/m ³	0.00	
Mass of Particulate	mg/m ³	0.11	
Factor for O ₂ Correction	mg/m ³	N/A	
Uncollected Mass	mg/m ³	0.07	

Parameter	Units	Run 1	
Combined uncertainty	mg/m ³	0.13	
Expanded uncertainty (95% confidence)	mg/m ³	0.25	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	0.38	
Reported Uncertainty	mg/m ³	0.38	
Expanded uncertainty (95% confidence)	%	49.3	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	74.0	
Reported Uncertainty	%	74.0	

APPENDIX 2

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon
40A

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	2.5		2.5
Uncertainty	±mg/m ³	0.21		0.21
Mass Emission	g/hr	11.1		11.1
Uncertainty	±g/hr	0.91		0.91

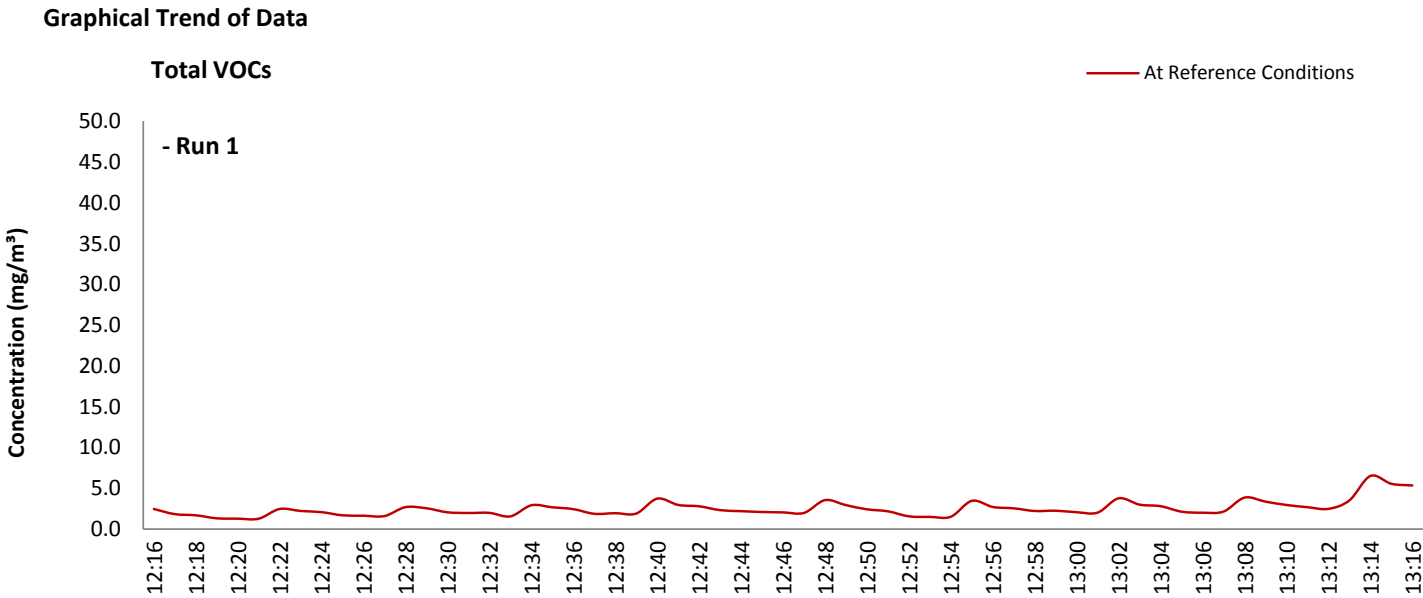
General Sampling Information

Parameter	Value	
Standard	BS EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Reference Number	CYL 1.0035	
Span Gas Expiry Date	05/12/2013	
Span Gas Start Pressure (bar)	80	
Gas Cylinder Concentration (ppm)	80.3	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Synthetic Air (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B3	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

TOTAL VOCs (as CARBON): DATA TREND



TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	12:16 - 13:16	
Sampling Dates	-	24/09/2013	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.3	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.20	
	Zero Down Sampling Line (Post)	ppm	0.60	
	Zero Drift	ppm	0.40	
	Allowable Zero Drift	± ppm	4.02	
	Zero Drift Acceptable	-	Yes	

	Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	79.5	
	Span Down Sampling Line (Post)	ppm	78.0	
	Span Drift	ppm	-1.50	
	Allowable Span Drift	± ppm	4.02	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	14 - 16	

Method Deviations

Nature of Deviation	Run Number
(x = deviation applies to the associated run)	1

APPENDIX 2

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			
	Units	Run 1	Run 2	Run 3
MCERTS Certified Range of Analyser	ppm	9.3		
Operational Range of Analyser	ppm	100		
Measured Reading	ppm	1.6		

Measured Quantities	Individual Errors as Standard Uncertainties			
	Units	Run 1	Run 2	Run 3
Nonlinearity	ppm	0.04		
Temperature Dependent Zero Drift	ppm	0.03		
Temperature Dependent Span Drift	ppm	0.03		
Cross-Sensitivity	ppm	0.04		
Leak	ppm	0.01		
Calibration Gas Uncertainty	ppm	0.01		
Mass Flow Controllers (dilution) Uncertainty	ppm	0.01		

Parameter	Units	Run 1	Run 2	Run 3
Combined uncertainty	ppm	0.07		
Expanded uncertainty (95% confidence)	ppm	0.13		
Expanded uncertainty (95% confidence), estimated with Method Deviations	ppm	0.13		
Reported Uncertainty	ppm	0.13		
Expanded uncertainty (95% confidence)	%	8.2		
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	8.2		
Reported Uncertainty	%	8.2		



Air Tech Environmental Consultancy Services

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Your Catalyst Contact: Toby Campbell (07825 130 074)

Stack Emissions Testing Report Commissioned by

Air Tech Environmental Consultancy Services

Installation Name & Address

VIP-Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7DA

PPC Permit: PPC 11/94

Stack Reference

46

Dates of the Monitoring Campaign

25th September 2013

Job Reference Number

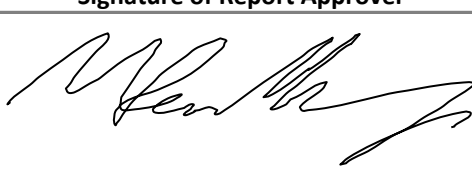
CAT-1636

Report Written by
Adam Dixon Team Leader MCERTS Level 2 MM 10 1079 TE1 TE2 TE3 TE4

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Matthew Pendlebury Team Leader MCERTS Level 2 MM 04 535 TE1 TE2 TE3 TE4

Report Date
30th September 2013

Version
Version 1

Signature of Report Approver


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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

(Page 1 of 7)

MONITORING OBJECTIVES

VIP-Polymers Ltd, Huntingdon

46

25th September 2013

Overall Aim of the Monitoring Campaign

Catalyst Environmental Ltd, in partnership with Air Tech Environmental Consultancy Services, were commissioned to carry out stack emissions testing on the 46 by VIP-Polymers Ltd at Huntingdon.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Total VOCs (as Carbon)

Executive Summary

(Page 2 of 7)

MONITORING RESULTS

VIP-Polymers Ltd, Huntingdon

46

25th September 2013

where MU = Measurement Uncertainty associated with the Result

Parameter	Concentration				Mass Emission			
	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	¹ mg/m ³	0.68	0.35	10	g/hr	6.3	3.2	-
Total VOCs (as Carbon)	¹ mg/m ³	15.7	0.82	50	g/hr	144	7.5	-
Water Vapour	% v/v	2.1	0.12					
Stack Gas Temperature	°C	21.2						
Stack Gas Velocity	m/s	7.2						
Volumetric Flow Rate (ACTUAL)	m ³ /hr	9911						
Volumetric Flow Rate (REF)	¹ m ³ /hr	9166						

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

¹ Reference Conditions (REF) are: 273K, 101.3kPa, without correction for water vapour content.

Executive Summary
(Page 3 of 7)

MONITORING DATE(S) & TIMES

VIP-Polymers Ltd, Huntingdon
46
25th September 2013

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.68	g/hr	6.3	25/09/2013	16:02 - 17:02	60
Total VOCs (as Carbon)	R1	mg/m³	15.7	g/hr	144	25/09/2013	16:05 -17:05	60
Velocity & Volumetric Flow Rate	R1					25/09/2013	15:42 - 15:49	

All results are expressed at the respective reference conditions.

Executive Summary
(Page 4 of 7)

PROCESS DETAILS

VIP-Polymers Ltd, Huntingdon
46
25th September 2013

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	10 Jigs Over The Hour
Continuous or Batch Process	Batch
Feedstock (if applicable)	Sprayed Seals
Abatement System	Wet Back Scrubber
Abatement System Running Status	On
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

(Page 5 of 7)

MONITORING & ANALYTICAL METHODS

VIP-Polymers Ltd, Huntingdon
46
25th September 2013

	Monitoring				Analysis					
Parameter	Standard	Technical Procedure	UKAS Testing	Testing Lab	Analytical Procedure	Analytical Technique	UKAS Analysis	Analysis Lab	MCERTS Testing	LOD (Average)
Total Particulate Matter	BS EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.12 mg/m³
Water Vapour	BS EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.10 % v/v
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.13 mg/m³
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04	Yes	CAT	Pitot Tube and Thermocouple				Yes	N/A

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Catalyst Environmental Ltd (CAT)	UKAS Accreditation Number: 4279
----------------------------------	---------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	All Runs	Due to the use of a MEWP only one sampling point was used.
Total VOCs (as Carbon)	All Runs	There are no deviations associated with the sampling employed.

Executive Summary

(Page 6 of 7)

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.70
IEDth	m	-
Area	m ²	0.38
Port Depth	cm	5
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	MEWP
Inside / Outside	Outside

Platform Details

EA Technical Guidance Note M1 / BS EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

All platforms should be designed in accordance with the requirements in the Environment Agency's Technical Guidance Note M1 and BS EN 15259.

BS EN 15259 Homogeneity Test Requirements

There is no requirement to perform a BS EN 15259 Homogeneity Test on this Stack.

Sampling Plane Validation Criteria (from EA Technical Guidance Document (Monitoring) M1)

Criteria in M1	Units	Traverse 1		Required	Compliant
Lowest Differential Pressure	Pa	22.0		> 5 Pa	Yes
Mean Velocity	m/s	7.15		-	-
Lowest Gas Velocity	m/s	5.17		-	-
Highest Gas Velocity	m/s	10.90		-	-
Ratio of Above	: 1	2.11		< 3 : 1	Yes
Maximum Angle of Swirl	°	5		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

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PLANT PHOTOS

Photo 1



Photo 2



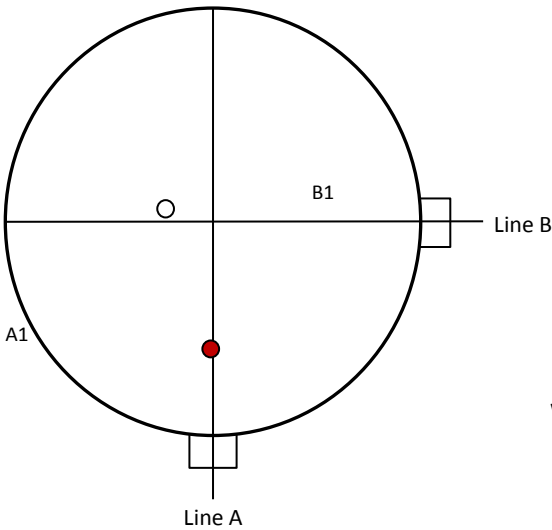
Photo 3



Photo 4



SAMPLE POINTS



- where

○ = isokinetic point sampled at

● = isokinetic point not sampled at

● = combustion gases sample point

○ = non-isokinetic sample point

APPENDICES

APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 1

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Adam Dixon	MCERTS Level 2	MM 10 1079	TE1 TE2 TE3 TE4
Trainee	James Birks	MCERTS Trainee	MM 13 1239	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM	CAT 7.5	Horiba PG-250 SRM	-	Digital Manometer (1)	CAT 3.47
Box Thermocouples	CAT 3.12	Servomex 4900	-	Digital Manometer (2)	-
Umbilical	CAT 3.12	Eco Physics CLD 822Mh	-	Digital Temperature Meter	CAT 3.47
Oven Box	-	Testo 350 XL	-	Stopwatch	CAT 14.18
Probe	CAT 5.18	Servomex 5200MP	-	Barometer	CAT 13.6
S-Pitot (1)	CAT 21S.15	JCT JCC P1 Cooler	-	Stack Thermocouple (1)	CAT 4.464
S-Pitot (2)	CAT 21P.40	FT-IR	-	Stack Thermocouple (2)	-
L-Pitot	-	FT-IR Sampling System	-	1m Heated Line (1)	-
500g Check Weight	CAT 17.20	Bernath 3006 FID	CAT 8.5	1m Heated Line (2)	-
1Kg Check Weight	CAT 17.20	Heated Head Filter	CAT 12.91	1m Heated Line (3)	-
Last Impinger Arm	-	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	CAT 20.19
Callipers	CAT 23.7	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	-
Tubes Kit Thermocouple	-	Mass View (1)	-	15m Heated Line (2)	-
Laboratory Balance	CAT 1.18 / 1.18a	Mass View (2)	-	20m Heated Line (1)	-
Tape Measure	CAT 16.91	Easylogger EN-EL-12 Bit	CAT 11.13	Dual Channel Heater Controller	-

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	BS EN 13284-1	CAT-TP-01
Water Vapour	BS EN 14790	CAT-TP-05
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04

APPENDIX 2

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.70
Stack IEDth, W	m	-
Stack Area, A	m ²	0.38
Average Stack Gas Temperature, T _a	°C	21.2
Average Stack Gas Pressure	Pa	44.5
Average Stack Static Pressure, P _{static}	kPa	-0.04
Average Barometric Pressure, P _b	kPa	101.0
Average Pitot Tube Calibration Coefficient, C _p	-	0.85

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.0012
O ₂ (Estimated)	-	20.80	20.35	0.2080	32.00	1.4277	0.2970
N ₂	-	79.14	77.44	0.7914	28.01	1.2498	0.9891
Moisture (H ₂ O)	-	-	2.14	0.0214	18.02	0.8037	0.0172

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.287
Wet Density (STP), P _{STW}	kg/m ³	1.277
Dry Density (Actual), P _{Actual}	kg/m ³	1.191
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.181

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

$P_{ActualW}$ (at each sampling point) = $P_{STW} \times (T_s / P_s) \times (P_a / T_a)$

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	21.2	0.00
Total Pressure	kPa	101.0	101.3
Moisture	%	2.14	2.14

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	9911
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	9166
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	8970
Gas Volumetric Flowrate REF ¹	m ³ /hr	9166

APPENDIX 2

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE

(1 of 1)

Parameter	Units	Value
Date of Survey	-	25/09/2013
Time of Survey	-	15:42 - 15:49
Atmospheric Pressure	kPa	101.0
Stack Static Pressure	Pa	-39
Type of Pitot Used	-	S-Type Pitot
Are Water Droplets Present?	-	No

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.85
Number of Lines Available	-	2
Number of Lines Used	-	2

Swirl Point (taken at the sampling points used during testing)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Angle of Swirl (°)	4	2	5	2																

Sampling Line A						Sampling Line B			
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s
1	0.04	25.0	21.2	1.181	5.51	98.0	21.2	1.181	10.90
2	0.11	36.0	21.2	1.181	6.61	75.0	21.2	1.181	9.54
3	0.18	28.0	21.2	1.181	5.83	83.0	21.2	1.181	10.03
4	0.25	27.0	21.2	1.181	5.72	51.0	21.2	1.181	7.87
5	0.32	29.0	21.2	1.181	5.93	41.0	21.2	1.181	7.05
6	0.39	30.0	21.2	1.181	6.03	38.0	21.2	1.181	6.79
7	0.46	31.0	21.2	1.181	6.13	31.0	21.2	1.181	6.13
8	0.53	45.0	21.2	1.181	7.39	36.0	21.2	1.181	6.61
9	0.60	67.0	21.2	1.181	9.02	24.0	21.2	1.181	5.40
10	0.67	73.0	21.2	1.181	9.41	22.0	21.2	1.181	5.17
Mean		39.1	21.2	1.181	6.76	49.9	21.2	1.181	7.55

APPENDIX 2

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon

46

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.68		0.68
Uncertainty	±mg/m ³	0.35		0.35
Mass Emission	g/hr	6.3		6.3
Uncertainty	±g/hr	3.2		3.2

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	2.1		2.1
Uncertainty	±% v/v	0.12		0.12

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.14		0.14

General Sampling Information

Parameter	Value	
Standard	BS EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	1 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	B1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

APPENDIX 2

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	757.5	
Stack static pressure, P_{static}	mmH ₂ O	-4.0	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	757.2	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	14.6	
Total mass collected in impingers (silica trap)	g	2.8	
Total mass of liquid collected, V_{lc}	g	17.4	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0217	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.1705	
Gas meter correction factor, Y_d	-	0.9350	
Average dry gas meter temperature, T_m	°C	28.8	
Average pressure drop across orifice, ΔH	mmH ₂ O	34.9	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	0.9901	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0214	
B_{wo} as a percentage	% v/v	2.14	
Reported Water Vapour, checked with Tables in BS EN 14790, R_{wv}	% v/v	2.14	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	1.0118	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.61	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.84	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	3.10	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	1.76	
Average stack gas temperature, T_s	°C	27.8	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	6.09	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	0.38	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	140.8	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	127.3	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	124.5	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)(O_{2REFw})$	m ³ /min	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)(O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	8.00	
Nozzle area, A_n	mm ²	50.27	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	101.4	

APPENDIX 2

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	16:02 - 17:02	
Sampling Dates	-	25/09/2013	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	1.0118	
Filter I.D. Number	-	47-15504	
Start Filter Mass	g	0.14221	
End Filter Mass	g	0.14231	
Total Mass on Filter	g	0.00010	
Probe Rinse I.D. Number	-	PR-47-15504	
Start Probe Rinse Mass	g	3.02322	
End Probe Rinse Mass	g	3.02381	
Total Mass in Probe Rinse	g	0.00059	
Total Mass Collected	mg	0.69	
Calculated Concentration	mg/m ³	0.68	
Balance Uncertainty / LOD	mg/m ³	0.12	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	25/09/2013	
Average Volume Sampled (REF)	m ³	1.0118	
Filter I.D. Number	-	47-15378	
Start Filter Mass	g	0.14333	
End Filter Mass	g	0.14338	
Total Mass on Filter	g	0.00005	
Probe Rinse I.D. Number	-	PR-47-15378	
Start Probe Rinse Mass	g	3.16849	
End Probe Rinse Mass	g	3.16858	
Total Mass in Probe Rinse	g	0.00009	
Total Mass Collected	mg	0.14	
Calculated Concentration	mg/m ³	0.14	
Balance Uncertainty / LOD	mg/m ³	0.12	

APPENDIX 2

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	18.2	
Pre-Sampling Leak Rate	l/min	0.05	
Post-Sampling Leak Rate	l/min	0.10	
Allowable Leak Rate	l/min	0.36	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.7	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	101.4	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.24	
ELV [Daily ELV for IED]	mg/m ³	10.0	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	28	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE
(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20.0	
Pre-Sampling Leak Rate	l/min	0.14	
Post-Sampling Leak Rate	l/min	0.15	
Allowable Leak Rate	l/min	0.40	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m³	1.0	
Blank Acceptable	-	Yes	

Acetone / Water Rinse Blank	Units	Blank
Acetone / Water Rinse Value	mg/l	2.7
Allowable Blank	mg/l	10
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1	
Due to the use of a MEWP only one sampling point was used.	x	

APPENDIX 2

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V _m	1.17		uV _m	m ³	0.02	
Sampled Gas Temperature	T _m	301.8		uT _m	K	2.00	
Sampled Gas Pressure	p _m	101.0		up _m	kPa	0.50	
Sampled Gas Humidity	H _m	0.00		uH _m	% v/v	1.00	
Leak	L	0.55		uL	%	-	
Mass of Particulate	m	0.69		um	mg	0.12	
Oxygen Content	O _{2,m}	N/A		uO _{2,m}	% v/v	N/A	
Uncollected Mass	UCM	0.14		uUCM	mg	-	

Uncertainty as a Percentage				
Measured Quantities	Units	Run 1		Requirement of Standard
Sampled Volume (Actual)	%	2.00		≤2%
Sampled Gas Temperature	%	0.66		≤1%
Sampled Gas Pressure	%	0.50		≤1%
Sampled Gas Humidity	%	1.00		≤1%
Leak	%	0.55		≤2%
Mass of Particulate	%	1.19		<5% of ELV
Oxygen Content	%	N/A		≤5%
Uncollected Mass	%	-		-

Uncertainty in Measurement Units					Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V _m	m ³	0.99		0.69	
Leak	L	mg/m ³	0.00		1.00	
Mass of Particulate	L _r	mg	0.69		0.99	
Factor for O ₂ Correction	O _{2,m}	% v/v	N/A		N/A	
Uncollected Mass	UCM	mg	0.08		0.99	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m ³	0.02	
Leak	mg/m ³	0.00	
Mass of Particulate	mg/m ³	0.12	
Factor for O ₂ Correction	mg/m ³	N/A	
Uncollected Mass	mg/m ³	0.08	

Parameter	Units	Run 1	
Combined uncertainty	mg/m ³	0.14	
Expanded uncertainty (95% confidence)	mg/m ³	0.28	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m ³	0.35	
Reported Uncertainty	mg/m ³	0.35	
Expanded uncertainty (95% confidence)	%	41.1	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	51.4	
Reported Uncertainty	%	51.4	

APPENDIX 2

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon

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Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	15.7		15.7
Uncertainty	±mg/m ³	0.82		0.82
Mass Emission	g/hr	144		144
Uncertainty	±g/hr	7.5		7.5

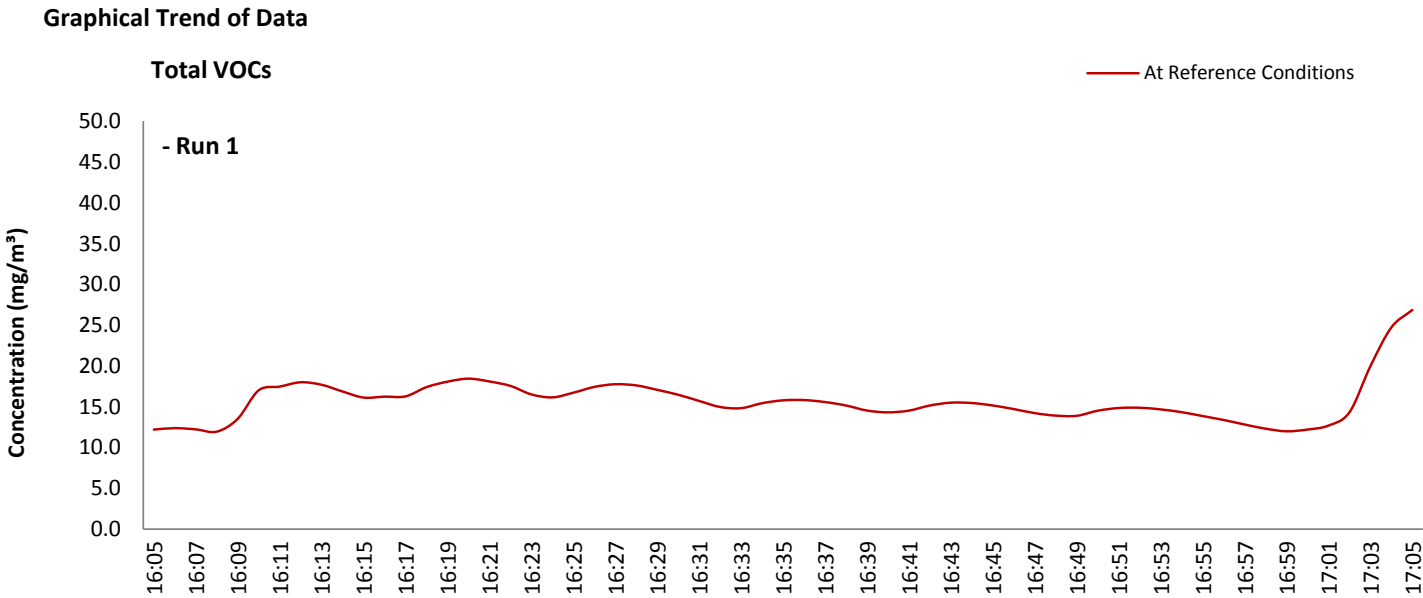
General Sampling Information

Parameter	Value	
Standard	BS EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Reference Number	CYL 1.0035	
Span Gas Expiry Date	05/12/2013	
Span Gas Start Pressure (bar)	80	
Gas Cylinder Concentration (ppm)	80.1	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Synthetic Air (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

TOTAL VOCs (as CARBON): DATA TREND



APPENDIX 2

TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	16:05 -17:05	
Sampling Dates	-	25/09/2013	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.1	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.30	
	Zero Down Sampling Line (Post)	ppm	0.30	
	Zero Drift	ppm	0.00	
	Allowable Zero Drift	± ppm	4.01	
	Zero Drift Acceptable	-	Yes	

	Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	79.1	
	Span Down Sampling Line (Post)	ppm	82.0	
	Span Drift	ppm	2.90	
	Allowable Span Drift	± ppm	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	15 - 17	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	1	
There are no deviations associated with the sampling employed.	x	

APPENDIX 2

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			
	Units	Run 1	Run 2	Run 3
MCERTS Certified Range of Analyser	ppm	9.3		
Operational Range of Analyser	ppm	100		
Measured Reading	ppm	9.8		

Measured Quantities	Individual Errors as Standard Uncertainties			
	Units	Run 1	Run 2	Run 3
Nonlinearity	ppm	0.04		
Temperature Dependent Zero Drift	ppm	0.03		
Temperature Dependent Span Drift	ppm	0.03		
Cross-Sensitivity	ppm	0.23		
Leak	ppm	0.06		
Calibration Gas Uncertainty	ppm	0.06		
Mass Flow Controllers (dilution) Uncertainty	ppm	0.08		

Parameter	Units	Run 1	Run 2	Run 3
Combined uncertainty	ppm	0.26		
Expanded uncertainty (95% confidence)	ppm	0.51		
Expanded uncertainty (95% confidence), estimated with Method Deviations	ppm	0.51		
Reported Uncertainty	ppm	0.51		
Expanded uncertainty (95% confidence)	%	5.2		
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	5.2		
Reported Uncertainty	%	5.2		

Although measured concentrations greater than the MCERTS Certified range of the analyser (15 mg/m³) were recorded, Catalyst's Internal Annual Systems Checks cover the use of the analyser up to 16061 mg/m³.



Air Tech Environmental Consultancy Services

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Your Catalyst Contact: Toby Campbell (07825 130 074)

Stack Emissions Testing Report Commissioned by

Air Tech Environmental Consultancy Services

Installation Name & Address

VIP-Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7DA

PPC Permit: PPC 11/94

Stack Reference

41

Dates of the Monitoring Campaign

25th September 2013

Job Reference Number

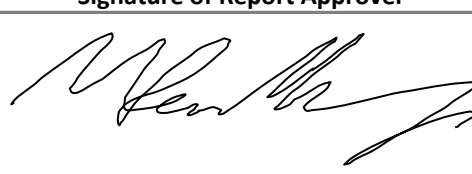
CAT-1636

Report Written by
Adam Dixon Team Leader MCERTS Level 2 MM 10 1079 TE1 TE2 TE3 TE4

Report Approved by
Matthew Pendlebury Team Leader MCERTS Level 2 MM 04 535 TE1 TE2 TE3 TE4

Report Date
30th September 2013

Version
Version 1

Signature of Report Approver


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APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

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MONITORING OBJECTIVES

VIP-Polymers Ltd, Huntingdon

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25th September 2013

Overall Aim of the Monitoring Campaign

Catalyst Environmental Ltd, in partnership with Air Tech Environmental Consultancy Services, were commissioned to carry out stack emissions testing on the 41 by VIP-Polymers Ltd at Huntingdon.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP-Polymers Ltd, Huntingdon

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25th September 2013

where MU = Measurement Uncertainty associated with the Result

		Concentration				Mass Emission			
Parameter		Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	¹	mg/m³	0.37	0.20	10	g/hr	5.0	2.7	-
Total VOCs (as Carbon)	¹	mg/m³	2.0	0.16	50	g/hr	27.2	2.1	-
Water Vapour		% v/v	1.1	0.07					
Stack Gas Temperature		°C	29.5						
Stack Gas Velocity		m/s	8.0						
Volumetric Flow Rate (ACTUAL)		m³/hr	14846						
Volumetric Flow Rate (REF)	¹	m³/hr	13347						

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM AN AVERAGE OF ALL OF THE ISOKINETIC RUNS.

¹ Reference Conditions (REF) are: 273K, 101.3kPa, without correction for water vapour content.

Executive Summary
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MONITORING DATE(S) & TIMES

VIP-Polymers Ltd, Huntingdon
41
25th September 2013

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.37	g/hr	5.0	25/09/2013	10:52 - 11:22, 11:25 - 11:55	60
Total VOCs (as Carbon)	R1	mg/m³	2.0	g/hr	27.2	25/09/2013	11:15 - 12:15	60
Velocity & Volumetric Flow Rate	R1					25/09/2013	10:28 - 10:36	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP-Polymers Ltd, Huntingdon
41
25th September 2013

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Varied
Continuous or Batch Process	Batch
Feedstock (if applicable)	Under cured Parts, Viton Seals
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

(Page 5 of 7)

MONITORING & ANALYTICAL METHODS

VIP-Polymers Ltd, Huntingdon
41
25th September 2013

	Monitoring				Analysis					
Parameter	Standard	Technical Procedure	UKAS Testing	Testing Lab	Analytical Procedure	Analytical Technique	UKAS Analysis	Analysis Lab	MCERTS Testing	LOD (Average)
Total Particulate Matter	BS EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.09 mg/m³
Water Vapour	BS EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.10 % v/v
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.16 mg/m³
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04	Yes	CAT	Pitot Tube and Thermocouple				Yes	N/A

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Catalyst Environmental Ltd (CAT)	UKAS Accreditation Number: 4279
----------------------------------	---------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All Parameters	All Runs	There are no deviations associated with the sampling employed.

Executive Summary

(Page 6 of 7)

SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.81
Width	m	-
Area	m ²	0.52
Port Depth	cm	4
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	On Roof
Inside / Outside	Outside

Platform Details

EA Technical Guidance Note M1 / BS EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location meets all the requirements specified in EA Guidance Note M1 and BS EN 15259, and therefore there are no improvement recommendations.

BS EN 15259 Homogeneity Test Requirements

There is no requirement to perform a BS EN 15259 Homogeneity Test on this Stack.

Sampling Plane Validation Criteria (from EA Technical Guidance Document (Monitoring) M1)

Criteria in M1	Units	Traverse 1		Required	Compliant
Lowest Differential Pressure	Pa	29.0		> 5 Pa	Yes
Mean Velocity	m/s	7.81		-	-
Lowest Gas Velocity	m/s	5.96		-	-
Highest Gas Velocity	m/s	9.39		-	-
Ratio of Above	: 1	1.58		< 3 : 1	Yes
Maximum Angle of Swirl	°	2		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

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PLANT PHOTOS

Photo 1



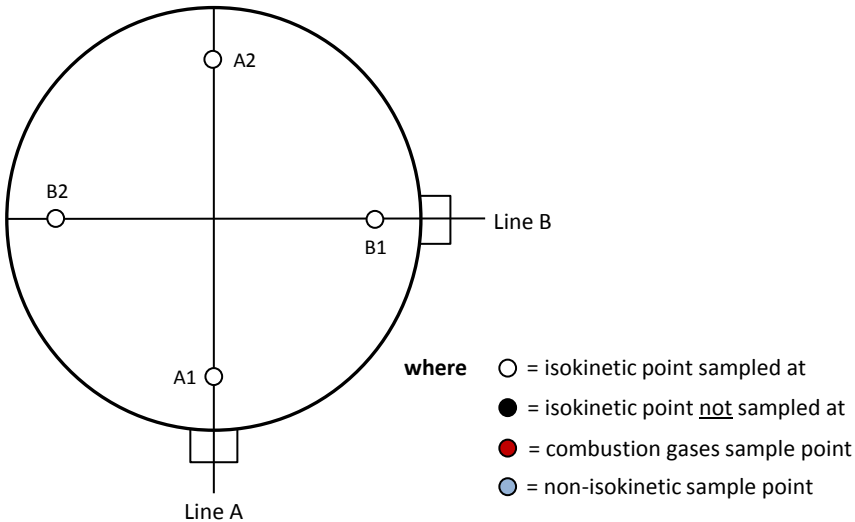
Photo 2



Photo 3



SAMPLE POINTS



APPENDICES

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APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 1

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Adam Dixon	MCERTS Level 2	MM 10 1079	TE1 TE2 TE3 TE4
Trainee	James Birks	MCERTS Trainee	MM 13 1239	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM	CAT 7.5	Horiba PG-250 SRM	-	Digital Manometer (1)	CAT 3.47
Box Thermocouples	CAT 3.12	Servomex 4900	-	Digital Manometer (2)	-
Umbilical	CAT 3.12	Eco Physics CLD 822Mh	-	Digital Temperature Meter	CAT 3.47
Oven Box	-	Testo 350 XL	-	Stopwatch	CAT 14.18
Probe	CAT 5.18	Servomex 5200MP	-	Barometer	CAT 13.6
S-Pitot (1)	CAT 21S.15	JCT JCC P1 Cooler	-	Stack Thermocouple (1)	CAT 4.464
S-Pitot (2)	CAT 21P.40	FT-IR	-	Stack Thermocouple (2)	-
L-Pitot	-	FT-IR Sampling System	-	1m Heated Line (1)	-
500g Check Weight	CAT 17.20	Bernath 3006 FID	CAT 8.5	1m Heated Line (2)	-
1Kg Check Weight	CAT 17.20	Heated Head Filter	CAT 12.91	1m Heated Line (3)	-
Last Impinger Arm	-	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	CAT 20.19
Callipers	CAT 23.7	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	-
Tubes Kit Thermocouple	-	Mass View (1)	-	15m Heated Line (2)	-
Laboratory Balance	CAT 1.18 / 1.18a	Mass View (2)	-	20m Heated Line (1)	-
Tape Measure	CAT 16.91	Easylogger EN-EL-12 Bit	CAT 11.13	Dual Channel Heater Controller	-

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	BS EN 13284-1	CAT-TP-01
Water Vapour	BS EN 14790	CAT-TP-05
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04

APPENDIX 2

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.81
Stack IEDth, W	m	-
Stack Area, A	m ²	0.52
Average Stack Gas Temperature, T _a	°C	25.0
Average Stack Gas Pressure	Pa	50.5
Average Stack Static Pressure, P _{static}	kPa	-0.04
Average Barometric Pressure, P _b	kPa	101.0
Average Pitot Tube Calibration Coefficient, C _p	-	0.85

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.0012
O ₂ (Estimated)	-	20.80	20.56	0.2080	32.00	1.4277	0.2970
N ₂	-	79.14	78.23	0.7914	28.01	1.2498	0.9891
Moisture (H ₂ O)	-	-	1.15	0.0115	18.02	0.8037	0.0092

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.287
Wet Density (STP), P _{STW}	kg/m ³	1.282
Dry Density (Actual), P _{Actual}	kg/m ³	1.175
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.170

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

$P_{ActualW}$ (at each sampling point) = $P_{STW} \times (T_s / P_s) \times (P_a / T_a)$

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	25.0	0.00
Total Pressure	kPa	101.0	101.3
Moisture	%	1.15	1.15

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	14488
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	13228
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	13076
Gas Volumetric Flowrate REF ¹	m ³ /hr	13228

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE

(1 of 1)

Parameter	Units	Value
Date of Survey	-	25/09/2013
Time of Survey	-	10:28 - 10:36
Atmospheric Pressure	kPa	101.0
Stack Static Pressure	Pa	-39
Type of Pitot Used	-	S-Type Pitot
Are Water Droplets Present?	-	No

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.85
Number of Lines Available	-	2
Number of Lines Used	-	2

Swirl Point (taken at the sampling points used during testing)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Angle of Swirl (°)	2	2	2	2																

Sampling Line A						Sampling Line B			
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s
1	0.04	41.0	25.0	1.170	7.08	49.0	25.0	1.170	7.74
2	0.12	55.0	25.0	1.170	8.21	72.0	25.0	1.170	9.39
3	0.20	52.0	25.0	1.170	7.98	68.0	25.0	1.170	9.12
4	0.28	54.0	25.0	1.170	8.13	65.0	25.0	1.170	8.92
5	0.36	51.0	25.0	1.170	7.90	67.0	25.0	1.170	9.06
6	0.45	56.0	25.0	1.170	8.28	58.0	25.0	1.170	8.43
7	0.53	43.0	25.0	1.170	7.25	50.0	25.0	1.170	7.82
8	0.61	35.0	25.0	1.170	6.55	44.0	25.0	1.170	7.34
9	0.69	35.0	25.0	1.170	6.55	49.0	25.0	1.170	7.74
10	0.77	29.0	25.0	1.170	5.96	37.0	25.0	1.170	6.73
Mean		45.1	25.0	1.170	7.39	55.9	25.0	1.170	8.23

APPENDIX 2

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon

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Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.37		0.37
Uncertainty	±mg/m ³	0.20		0.20
Mass Emission	g/hr	5.0		5.0
Uncertainty	±g/hr	2.7		2.7

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	1.1		1.1
Uncertainty	±% v/v	0.07		0.07

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.09		0.09

General Sampling Information

Parameter	Value	
Standard	BS EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	2 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2, B1, B2	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

APPENDIX 2

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	757.5	
Stack static pressure, P_{static}	mmH ₂ O	-5.4	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	757.1	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	11.1	
Total mass collected in impingers (silica trap)	g	1.4	
Total mass of liquid collected, V_{lc}	g	12.5	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0156	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.5755	
Gas meter correction factor, Y_d	-	0.9350	
Average dry gas meter temperature, T_m	°C	27.0	
Average pressure drop across orifice, ΔH	mmH ₂ O	57.4	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	1.3437	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0115	
B_{wo} as a percentage	% v/v	1.15	
Reported Water Vapour, checked with Tables in BS EN 14790, R_{wv}	% v/v	1.15	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	1.3593	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.72	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.84	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	5.33	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	2.31	
Average stack gas temperature, T_s	°C	29.5	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(\sqrt{T_s + 273})) / (\sqrt{M_s}(P_s))$	m/s	8.00	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	0.52	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	247.4	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	222.4	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	219.9	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)(O_{2REFw})$	m ³ /min	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)(O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	7.90	
Nozzle area, A_n	mm ²	49.02	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	107.1	

APPENDIX 2

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	10:52 - 11:22, 11:25 - 11:55	
Sampling Dates	-	25/09/2013	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	1.3593	
Filter I.D. Number	-	47-15540	
Start Filter Mass	g	0.14149	
End Filter Mass	g	0.14196	
Total Mass on Filter	g	0.00047	
Probe Rinse I.D. Number	-	PR-47-15540	
Start Probe Rinse Mass	g	3.15478	
End Probe Rinse Mass	g	3.15482	
Total Mass in Probe Rinse	g	0.00004	
Total Mass Collected	mg	0.51	
Calculated Concentration	mg/m ³	0.37	
Balance Uncertainty / LOD	mg/m ³	0.09	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	25/09/2013	
Average Volume Sampled (REF)	m ³	1.3593	
Filter I.D. Number	-	47-15500	
Start Filter Mass	g	0.14102	
End Filter Mass	g	0.14107	
Total Mass on Filter	g	0.00005	
Probe Rinse I.D. Number	-	PR-47-15500	
Start Probe Rinse Mass	g	2.98888	
End Probe Rinse Mass	g	2.98895	
Total Mass in Probe Rinse	g	0.00007	
Total Mass Collected	mg	0.12	
Calculated Concentration	mg/m ³	0.09	
Balance Uncertainty / LOD	mg/m ³	0.09	

APPENDIX 2

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	24.6	
Pre-Sampling Leak Rate	l/min	0.15	
Post-Sampling Leak Rate	l/min	0.20	
Allowable Leak Rate	l/min	0.49	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	5.9	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	107.1	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m³	0.18	
ELV [Daily ELV for IED]	mg/m³	10.0	
Allowable Weighing Uncertainty	mg/m³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	30	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE
(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	20.0	
Pre-Sampling Leak Rate	l/min	0.14	
Post-Sampling Leak Rate	l/min	0.15	
Allowable Leak Rate	l/min	0.40	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
Blank Acceptable	-	Yes	

Acetone / Water Rinse Blank	Units	Blank
Acetone / Water Rinse Value	mg/l	2.7
Allowable Blank	mg/l	10
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1	
There are no deviations associated with the sampling employed.	wx	

APPENDIX 2

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V_m	1.58		uV_m	m^3	0.03	
Sampled Gas Temperature	T_m	300.0		uT_m	K	2.00	
Sampled Gas Pressure	p_m	101.0		up_m	kPa	0.50	
Sampled Gas Humidity	H_m	0.00		uH_m	% v/v	1.00	
Leak	L	0.81		uL	%	-	
Mass of Particulate	m	0.51		um	mg	0.12	
Oxygen Content	$O_{2,m}$	N/A		$uO_{2,m}$	% v/v	N/A	
Uncollected Mass	UCM	0.12		$uUCM$	mg	-	

Uncertainty as a Percentage				
Measured Quantities	Units	Run 1		Requirement of Standard
Sampled Volume (Actual)	%	2.00		$\leq 2\%$
Sampled Gas Temperature	%	0.67		$\leq 1\%$
Sampled Gas Pressure	%	0.50		$\leq 1\%$
Sampled Gas Humidity	%	1.00		$\leq 1\%$
Leak	%	0.81		$\leq 2\%$
Mass of Particulate	%	0.88		<5% of ELV
Oxygen Content	%	N/A		$\leq 5\%$
Uncollected Mass	%	-		-

Uncertainty in Measurement Units					Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V_m	m^3	1.34		0.28	
Leak	L	mg/m^3	0.00		1.00	
Mass of Particulate	L_r	mg	0.51		0.74	
Factor for O_2 Correction	$O_{2,m}$	% v/v	N/A		N/A	
Uncollected Mass	UCM	mg	0.07		0.74	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m^3	0.01	
Leak	mg/m^3	0.00	
Mass of Particulate	mg/m^3	0.09	
Factor for O_2 Correction	mg/m^3	N/A	
Uncollected Mass	mg/m^3	0.05	

Parameter	Units	Run 1	
Combined uncertainty	mg/m^3	0.10	
Expanded uncertainty (95% confidence)	mg/m^3	0.20	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	0.20	
Reported Uncertainty	mg/m^3	0.20	
Expanded uncertainty (95% confidence)	%	53.9	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	53.9	
Reported Uncertainty	%	53.9	

APPENDIX 2

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon

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Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	2.0		2.0
Uncertainty	±mg/m ³	0.16		0.16
Mass Emission	g/hr	27.2		27.2
Uncertainty	±g/hr	2.1		2.1

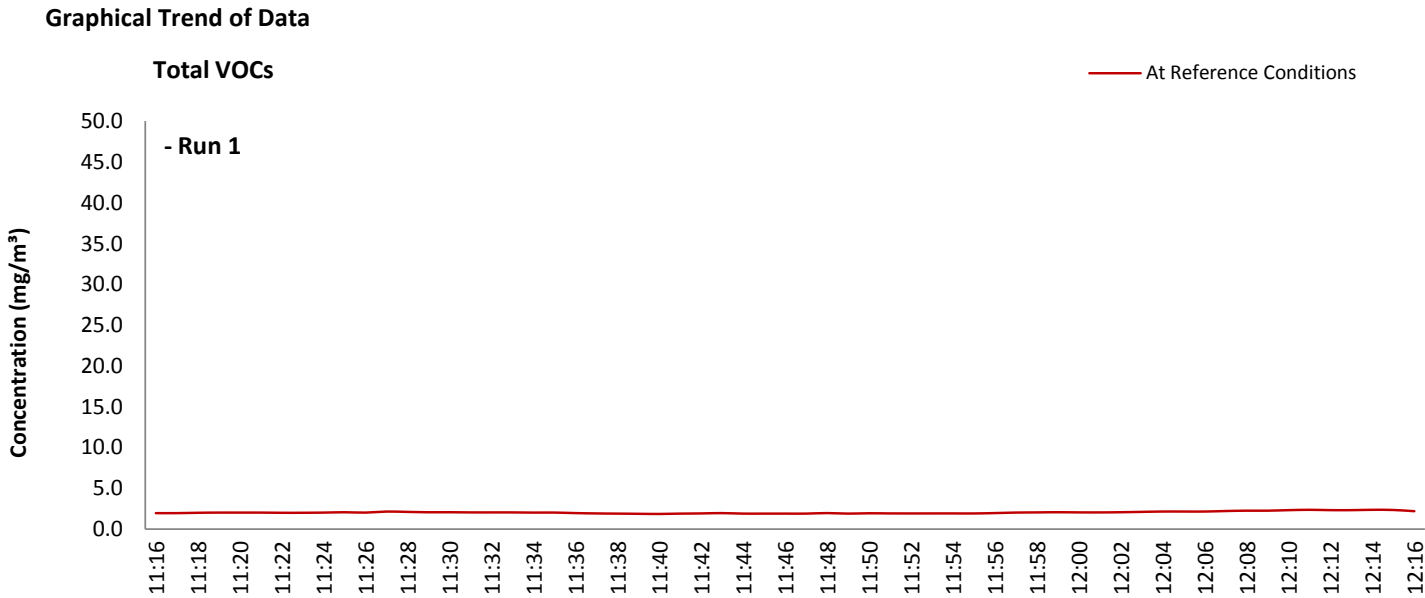
General Sampling Information

Parameter	Value	
Standard	BS EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Reference Number	CYL1.0082	
Span Gas Expiry Date	16/08/2018	
Span Gas Start Pressure (bar)	2	
Gas Cylinder Concentration (ppm)	80.1	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Synthetic Air (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

TOTAL VOCs (as CARBON): DATA TREND



APPENDIX 2

TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	11:15 - 12:15	
Sampling Dates	-	25/09/2013	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.1	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.70	
	Zero Down Sampling Line (Post)	ppm	-0.10	
	Zero Drift	ppm	-0.80	
	Allowable Zero Drift	± ppm	4.01	
	Zero Drift Acceptable	-	Yes	

	Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	79.9	
	Span Down Sampling Line (Post)	ppm	78.0	
	Span Drift	ppm	-1.90	
	Allowable Span Drift	± ppm	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	16 - 18	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	1	
There are no deviations associated with the sampling employed.	x	

APPENDIX 2

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			
	Units	Run 1	Run 2	Run 3
MCERTS Certified Range of Analyser	ppm	9.3		
Operational Range of Analyser	ppm	100.0		
Measured Reading	ppm	1.3		

Measured Quantities	Individual Errors as Standard Uncertainties			
	Units	Run 1	Run 2	Run 3
Nonlinearity	ppm	0.00		
Temperature Dependent Zero Drift	ppm	0.03		
Temperature Dependent Span Drift	ppm	0.03		
Cross-Sensitivity	ppm	0.03		
Leak	ppm	0.00		
Calibration Gas Uncertainty	ppm	0.01		
Mass Flow Controllers (dilution) Uncertainty	ppm	0.01		

Parameter	Units	Run 1	Run 2	Run 3
Combined uncertainty	ppm	0.05		
Expanded uncertainty (95% confidence)	ppm	0.10		
Expanded uncertainty (95% confidence), estimated with Method Deviations	ppm	0.10		
Reported Uncertainty	ppm	0.10		
Expanded uncertainty (95% confidence)	%	7.7		
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	7.7		
Reported Uncertainty	%	7.7		



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Stack Emissions Testing Report Commissioned by

Air Tech Environmental Consultancy Services

Installation Name & Address

VIP-Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7DA

PPC Permit: PPC 11/94

Stack Reference

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Dates of the Monitoring Campaign

24th September 2013

Job Reference Number

CAT-1636

Report Written by
Adam Dixon Team Leader MCERTS Level 2 MM 10 1079 TE1 TE2 TE3 TE4

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Report Date
30th September 2013

Version
Version 1

Signature of Report Approver


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APPENDIX 1 - Monitoring Personnel & List of Equipment

APPENDIX 2 - Raw Data, Sampling Equations & Charts

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Executive Summary

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MONITORING OBJECTIVES

VIP-Polymers Ltd, Huntingdon

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24th September 2013

Overall Aim of the Monitoring Campaign

Catalyst Environmental Ltd, in partnership with Air Tech Environmental Consultancy Services, were commissioned to carry out stack emissions testing on the 55 by VIP-Polymers Ltd at Huntingdon.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Total VOCs (as Carbon)

Executive Summary

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MONITORING RESULTS

VIP-Polymers Ltd, Huntingdon
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24th September 2013

where MU = Measurement Uncertainty associated with the Result

		Concentration				Mass Emission			
Parameter		Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	¹	mg/m³	0.58	0.23	10	g/hr	6.0	2.4	-
Total VOCs (as Carbon)	¹	mg/m³	2.1	0.19	50	g/hr	21.6	2.0	-
Water Vapour		% v/v	1.4	0.08					
Stack Gas Temperature		°C	31.5						
Stack Gas Velocity		m/s	10.3						
Volumetric Flow Rate (ACTUAL)		m³/hr	11692						
Volumetric Flow Rate (REF)	¹	m³/hr	10461						

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM AN AVERAGE OF ALL OF THE ISOKINETIC RUNS.

¹ Reference Conditions (REF) are: 273K, 101.3kPa, without correction for water vapour content.

Executive Summary

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MONITORING DATE(S) & TIMES

VIP-Polymers Ltd, Huntingdon

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24th September 2013

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	0.58	g/hr	6.0	24/09/2013	10:54 - 11:24, 11:26 - 11:56	60
Total VOCs (as Carbon)	R1	mg/m³	2.1	g/hr	21.6	24/09/2013	10:50 - 11:50	60
Velocity & Volumetric Flow Rate	R1					24/09/2013	10:38 - 10:43	

All results are expressed at the respective reference conditions.

Executive Summary

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PROCESS DETAILS

VIP-Polymers Ltd, Huntingdon

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24th September 2013

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Various
Continuous or Batch Process	Batch
Feedstock (if applicable)	Under cured Parts, Viton Seals
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

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MONITORING & ANALYTICAL METHODS

VIP-Polymers Ltd, Huntingdon

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24th September 2013

Parameter	Monitoring				Analysis				MCERTS Testing	LOD (Average)
	Standard	Technical Procedure	UKAS Testing	Testing Lab	Analytical Procedure	Analytical Technique	UKAS Analysis	Analysis Lab		
Total Particulate Matter	BS EN 13284-1	CAT-TP-01	SELECT	CAT	CAT-TP-03	Gravimetric	SELECT	CAT	No	0.10 mg/m ³
Water Vapour	BS EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.10 % v/v
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.13 mg/m ³
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04	Yes	CAT	Pitot Tube and Thermocouple				Yes	N/A

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Catalyst Environmental Ltd (CAT)	UKAS Accreditation Number: 4279
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SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
All Parameters	All Runs	There are no deviations associated with the sampling employed.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.64
IEDth	m	-
Area	m ²	0.32
Port Depth	cm	4
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	On Roof
Inside / Outside	Outside

Platform Details

EA Technical Guidance Note M1 / BS EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location meets all the requirements specified in EA Guidance Note M1 and BS EN 15259, and therefore there are no improvement recommendations.

BS EN 15259 Homogeneity Test Requirements

There is no requirement to perform a BS EN 15259 Homogeneity Test on this Stack.

Sampling Plane Validation Criteria (from EA Technical Guidance Document (Monitoring) M1)

Criteria in M1	Units	Traverse 1		Required	Compliant
Lowest Differential Pressure	Pa	12.0		> 5 Pa	Yes
Mean Velocity	m/s	9.18		-	-
Lowest Gas Velocity	m/s	3.84		-	-
Highest Gas Velocity	m/s	13.12		-	-
Ratio of Above	: 1	3.42		< 3 : 1	No
Maximum Angle of Swirl	°	8		< 15°	Yes
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

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PLANT PHOTOS

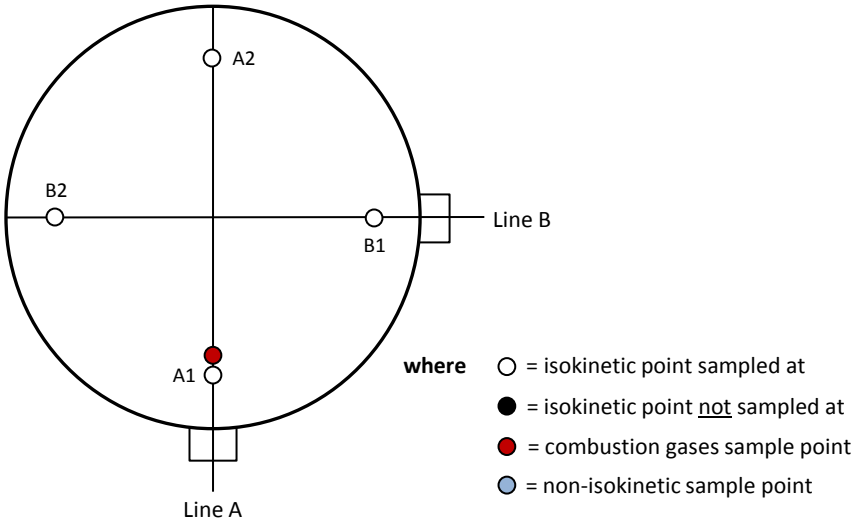
Photo 1



Photo 2



SAMPLE POINTS



APPENDICES

APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 1

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Adam Dixon	MCERTS Level 2	MM 10 1079	TE1 TE2 TE3 TE4
Trainee	James Birks	MCERTS Trainee	MM 13 1239	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM	CAT 7.5	Horiba PG-250 SRM	-	Digital Manometer (1)	CAT 3.47
Box Thermocouples	CAT 3.12	Servomex 4900	-	Digital Manometer (2)	-
Umbilical	CAT 3.12	Eco Physics CLD 822Mh	-	Digital Temperature Meter	CAT 3.47
Oven Box	-	Testo 350 XL	-	Stopwatch	CAT 14.18
Probe	CAT 5.18	Servomex 5200MP	-	Barometer	CAT 13.6
S-Pitot (1)	CAT 21S.15	JCT JCC P1 Cooler	-	Stack Thermocouple (1)	CAT 4.464
S-Pitot (2)	CAT 21P.40	FT-IR	-	Stack Thermocouple (2)	-
L-Pitot	-	FT-IR Sampling System	-	1m Heated Line (1)	-
500g Check Weight	CAT 17.20	Bernath 3006 FID	CAT 8.5	1m Heated Line (2)	-
1Kg Check Weight	CAT 17.20	Heated Head Filter	CAT 12.91	1m Heated Line (3)	-
Last Impinger Arm	-	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	CAT 20.19
Callipers	CAT 23.7	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	-
Tubes Kit Thermocouple	-	Mass View (1)	-	15m Heated Line (2)	-
Laboratory Balance	CAT 1.18 / 1.18a	Mass View (2)	-	20m Heated Line (1)	-
Tape Measure	CAT 16.91	Easylogger EN-EL-12 Bit	CAT 11.13	Dual Channel Heater Controller	-

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	BS EN 13284-1	CAT-TP-01
Water Vapour	BS EN 14790	CAT-TP-05
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.64
Stack IEDth, W	m	-
Stack Area, A	m ²	0.32
Average Stack Gas Temperature, T _a	°C	26.3
Average Stack Gas Pressure	Pa	74.7
Average Stack Static Pressure, P _{static}	kPa	-0.07
Average Barometric Pressure, P _b	kPa	101.2
Average Pitot Tube Calibration Coefficient, C _p	-	0.85

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.0012
O ₂ (Estimated)	-	20.80	20.51	0.2080	32.00	1.4277	0.2970
N ₂	-	79.14	78.04	0.7914	28.01	1.2498	0.9891
Moisture (H ₂ O)	-	-	1.39	0.0139	18.02	0.8037	0.0112

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.287
Wet Density (STP), P _{STW}	kg/m ³	1.281
Dry Density (Actual), P _{Actual}	kg/m ³	1.172
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.166

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

$P_{ActualW}$ (at each sampling point) = P_{STW} x (T_s / P_s) x (P_a / T_a)

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	26.3	0.00
Total Pressure	kPa	101.1	101.3
Moisture	%	1.39	1.39

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	10465
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	9531
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	9399
Gas Volumetric Flowrate REF ¹	m ³ /hr	9531

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE

(1 of 1)

Parameter	Units	Value
Date of Survey	-	24/09/2013
Time of Survey	-	10:38 - 10:43
Atmospheric Pressure	kPa	101.2
Stack Static Pressure	Pa	-66
Type of Pitot Used	-	S-Type Pitot
Are Water Droplets Present?	-	No

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.85
Number of Lines Available	-	2
Number of Lines Used	-	2

Swirl Point (taken at the sampling points used during testing)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Angle of Swirl (°)	8	5	3	8																

Sampling Line A						Sampling Line B			
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s
1	0.03	49.0	26.1	1.167	7.76	46.0	26.2	1.166	7.52
2	0.10	63.0	26.1	1.167	8.79	26.0	26.2	1.166	5.65
3	0.16	21.0	26.1	1.167	5.08	37.0	26.3	1.166	6.74
4	0.22	12.0	26.1	1.167	3.84	43.0	26.3	1.166	7.27
5	0.29	38.0	26.2	1.166	6.83	76.0	26.3	1.166	9.66
6	0.35	58.0	26.2	1.166	8.44	88.0	26.4	1.166	10.40
7	0.41	77.0	26.2	1.166	9.72	106.0	26.4	1.166	11.41
8	0.48	103.0	26.3	1.166	11.25	136.0	26.4	1.166	12.93
9	0.54	127.0	26.3	1.166	12.49	133.0	26.4	1.166	12.78
10	0.60	115.0	26.3	1.166	11.89	140.0	26.5	1.165	13.12
Mean		66.3	26.2	1.167	8.61	83.1	26.3	1.166	9.75

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon

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Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	0.58		0.58
Uncertainty	±mg/m ³	0.23		0.23
Mass Emission	g/hr	6.0		6.0
Uncertainty	±g/hr	2.4		2.4

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	1.4		1.4
Uncertainty	±% v/v	0.08		0.08

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.11		0.11

General Sampling Information

Parameter	Value	
Standard	BS EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	2 / 2	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2, B1, B2	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	759.0	
Stack static pressure, P_{static}	mmH ₂ O	-6.7	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	758.5	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	-29.8	
Total mass collected in impingers (silica trap)	g	43.5	
Total mass of liquid collected, V_{lc}	g	13.7	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0171	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.4230	
Gas meter correction factor, Y_d	-	0.9350	
Average dry gas meter temperature, T_m	°C	28.6	
Average pressure drop across orifice, ΔH	mmH ₂ O	50.0	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	1.2085	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0139	
B_{wo} as a percentage	% v/v	1.39	
Reported Water Vapour, checked with Tables in BS EN 14790, R_{wv}	% v/v	1.39	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	1.2255	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.69	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.84	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	8.71	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	2.95	
Average stack gas temperature, T_s	°C	31.5	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	10.25	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	0.32	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	194.9	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	174.4	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	171.9	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)(O_{2REFw})$	m ³ /min	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)(O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	6.76	
Nozzle area, A_n	mm ²	35.86	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	103.5	

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	10:54 - 11:24, 11:26 - 11:56	
Sampling Dates	-	24/09/2013	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	1.2255	
Filter I.D. Number	-	47-15645	
Start Filter Mass	g	0.14022	
End Filter Mass	g	0.13961	
Total Mass on Filter	g	-0.00061	
Probe Rinse I.D. Number	-	PR-47-15645	
Start Probe Rinse Mass	g	2.99063	
End Probe Rinse Mass	g	2.99195	
Total Mass in Probe Rinse	g	0.00132	
Total Mass Collected	mg	0.71	
Calculated Concentration	mg/m ³	0.58	
Balance Uncertainty / LOD	mg/m ³	0.10	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	24/09/2013	
Average Volume Sampled (REF)	m ³	1.2255	
Filter I.D. Number	-	47-15644	
Start Filter Mass	g	0.13959	
End Filter Mass	g	0.13961	
Total Mass on Filter	g	0.00002	
Probe Rinse I.D. Number	-	PR-47-15644	
Start Probe Rinse Mass	g	3.02890	
End Probe Rinse Mass	g	3.02901	
Total Mass in Probe Rinse	g	0.00011	
Total Mass Collected	mg	0.13	
Calculated Concentration	mg/m ³	0.11	
Balance Uncertainty / LOD	mg/m ³	0.10	

APPENDIX 2

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	22.2	
Pre-Sampling Leak Rate	l/min	0.30	
Post-Sampling Leak Rate	l/min	0.32	
Allowable Leak Rate	l/min	0.44	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	6.0	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	103.5	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.20	
ELV [Daily ELV for IED]	mg/m ³	10.0	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	32	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.0	
Pre-Sampling Leak Rate	l/min	0.12	
Post-Sampling Leak Rate	l/min	0.13	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m³	1.0	
Blank Acceptable	-	Yes	

Acetone / Water Rinse Blank	Units	Blank
Acetone / Water Rinse Value	mg/l	2.7
Allowable Blank	mg/l	10
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1	
There are no deviations associated with the sampling employed.	wx	

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V_m	1.42		uV_m	m^3	0.03	
Sampled Gas Temperature	T_m	301.6		uT_m	K	2.00	
Sampled Gas Pressure	p_m	101.1		up_m	kPa	0.50	
Sampled Gas Humidity	H_m	0.00		uH_m	% v/v	1.00	
Leak	L	1.44		uL	%	-	
Mass of Particulate	m	0.71		um	mg	0.12	
Oxygen Content	$O_{2,m}$	N/A		$uO_{2,m}$	% v/v	N/A	
Uncollected Mass	UCM	0.13		$uUCM$	mg	-	

Uncertainty as a Percentage				
Measured Quantities	Units	Run 1		Requirement of Standard
Sampled Volume (Actual)	%	2.00		$\leq 2\%$
Sampled Gas Temperature	%	0.66		$\leq 1\%$
Sampled Gas Pressure	%	0.49		$\leq 1\%$
Sampled Gas Humidity	%	1.00		$\leq 1\%$
Leak	%	1.44		$\leq 2\%$
Mass of Particulate	%	0.98		$< 5\%$ of ELV
Oxygen Content	%	N/A		$\leq 5\%$
Uncollected Mass	%	-		-

Uncertainty in Measurement Units					Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V_m	m^3	1.21		0.48	
Leak	L	mg/m^3	0.00		1.00	
Mass of Particulate	L_r	mg	0.71		0.82	
Factor for O_2 Correction	$O_{2,m}$	% v/v	N/A		N/A	
Uncollected Mass	UCM	mg	0.08		0.82	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m^3	0.02	
Leak	mg/m^3	0.00	
Mass of Particulate	mg/m^3	0.10	
Factor for O_2 Correction	mg/m^3	N/A	
Uncollected Mass	mg/m^3	0.06	

Parameter	Units	Run 1	
Combined uncertainty	mg/m^3	0.12	
Expanded uncertainty (95% confidence)	mg/m^3	0.23	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	0.23	
Reported Uncertainty	mg/m^3	0.23	
Expanded uncertainty (95% confidence)	%	39.6	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	39.6	
Reported Uncertainty	%	39.6	

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon

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Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	2.1		2.1
Uncertainty	±mg/m ³	0.19		0.19
Mass Emission	g/hr	21.6		21.6
Uncertainty	±g/hr	2.0		2.0

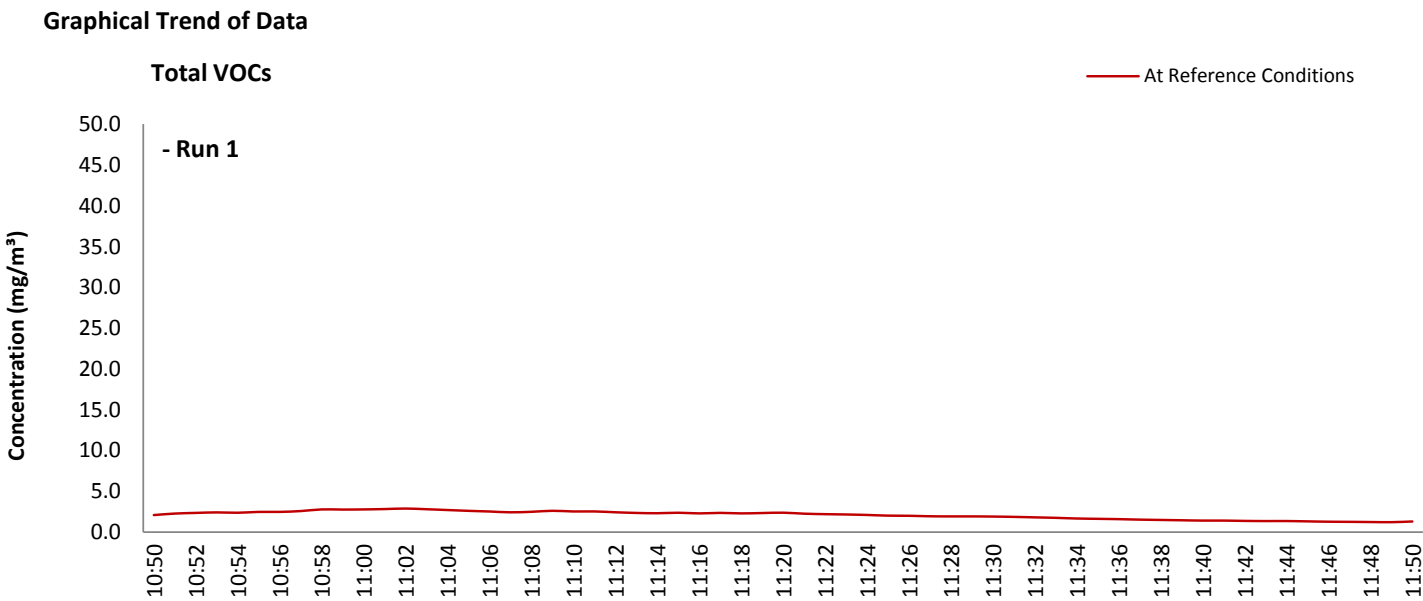
General Sampling Information

Parameter	Value	
Standard	BS EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Reference Number	CYL 1.0035	
Span Gas Expiry Date	05/12/2013	
Span Gas Start Pressure (bar)	80	
Gas Cylinder Concentration (ppm)	80.1	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Synthetic Air (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

TOTAL VOCs (as CARBON): DATA TREND



TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	10:50 - 11:50	
Sampling Dates	-	24/09/2013	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.1	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.20	
	Zero Down Sampling Line (Post)	ppm	0.10	
	Zero Drift	ppm	-0.10	
	Allowable Zero Drift	± ppm	4.01	
	Zero Drift Acceptable	-	Yes	

	Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	79.0	
	Span Down Sampling Line (Post)	ppm	79.0	
	Span Drift	ppm	0.00	
	Allowable Span Drift	± ppm	4.01	
	Span Drift Acceptable	-	Yes	

Test Conditions	Units	Run 1	
Run Ambient Temperature Range	°C	17 - 19	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	1	
There are no deviations associated with the sampling employed.	x	

APPENDIX 2

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			
	Units	Run 1	Run 2	Run 3
MCERTS Certified Range of Analyser	ppm	9.3		
Operational Range of Analyser	ppm	100		
Measured Reading	ppm	1.3		

Measured Quantities	Individual Errors as Standard Uncertainties			
	Units	Run 1	Run 2	Run 3
Nonlinearity	ppm	0.04		
Temperature Dependent Zero Drift	ppm	0.03		
Temperature Dependent Span Drift	ppm	0.03		
Cross-Sensitivity	ppm	0.03		
Leak	ppm	0.01		
Calibration Gas Uncertainty	ppm	0.01		
Mass Flow Controllers (dilution) Uncertainty	ppm	0.01		

Parameter	Units	Run 1	Run 2	Run 3
Combined uncertainty	ppm	0.06		
Expanded uncertainty (95% confidence)	ppm	0.12		
Expanded uncertainty (95% confidence), estimated with Method Deviations	ppm	0.12		
Reported Uncertainty	ppm	0.12		
Expanded uncertainty (95% confidence)	%	9.5		
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	9.5		
Reported Uncertainty	%	9.5		



Air Tech Environmental Consultancy Services

Unit C6, Emery Court, The Embankment Business Park, Heaton Mersey, Stockport, SK4 3GL

T: 0800 328 1821

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Your Catalyst Contact: Toby Campbell (07825 130 074)

Stack Emissions Testing Report Commissioned by

Air Tech Environmental Consultancy Services

Installation Name & Address

VIP-Polymers Ltd
15 Windover Road
Huntingdon
Cambridgeshire
PE29 7DA

PPC Permit: PPC 11/94

Stack Reference

44

Dates of the Monitoring Campaign

25th September 2013

Job Reference Number

CAT-1636

Report Written by
Adam Dixon Team Leader MCERTS Level 2 MM 10 1079 TE1 TE2 TE3 TE4

Report Approved by
Matthew Pendlebury Team Leader MCERTS Level 2 MM 04 535 TE1 TE2 TE3 TE4

Report Date
30th September 2013

Version
Version 1

Signature of Report Approver


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Opinions and interpretations expressed herein are outside the scope of Catalyst Environmental Ltd's UKAS accreditation.

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Executive Summary

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MONITORING OBJECTIVES

VIP-Polymers Ltd, Huntingdon

44

25th September 2013

Overall Aim of the Monitoring Campaign

Catalyst Environmental Ltd, in partnership with Air Tech Environmental Consultancy Services, were commissioned to carry out stack emissions testing on the 44 by VIP-Polymers Ltd at Huntingdon.

The aim of the monitoring campaign was to demonstrate compliance with a set of emission limit values (ELVs) as specified in the Site's Permit.

Special Requirements

There were no special requirements.

Target Parameters

Total Particulate Matter, Total VOCs (as Carbon)

Executive Summary

(Page 2 of 7)

MONITORING RESULTS

VIP-Polymers Ltd, Huntingdon
 44
 25th September 2013

where MU = Measurement Uncertainty associated with the Result

Parameter	Concentration				Mass Emission			
	Units	Result	MU +/-	Limit	Units	Result	MU +/-	Limit
Total Particulate Matter	¹ mg/m ³	1.7	0.37	10	g/hr	14.3	3.1	-
Total VOCs (as Carbon)	¹ mg/m ³	4.6	0.28	50	g/hr	38.5	2.3	-
Water Vapour	% v/v	0.67	0.05					
Stack Gas Temperature	°C	38.4						
Stack Gas Velocity	m/s	16.2						
Volumetric Flow Rate (ACTUAL)	m ³ /hr	9266						
Volumetric Flow Rate (REF)	¹ m ³ /hr	8411						

NOTE: VOLUMETRIC FLOW RATE DATA TAKEN FROM THE PRELIMINARY VELOCITY TRAVERSE.

¹ Reference Conditions (REF) are: 273K, 101.3kPa, without correction for water vapour content.

Executive Summary
(Page 3 of 7)

MONITORING DATE(S) & TIMES

VIP-Polymers Ltd, Huntingdon
44
25th September 2013

Parameter		Units	Concentration	Units	Mass Emission	Sampling Date(s)	Sampling Times	Duration mins
Total Particulate Matter	R1	mg/m³	1.7	g/hr	14.3	25/09/2013	12:45 - 13:45	60
Total VOCs (as Carbon)	R1	mg/m³	4.6	g/hr	38.5	25/09/2013	12:45 - 13:45	60
Velocity & Volumetric Flow Rate	R1					25/09/2013	12:31 - 13:35	

All results are expressed at the respective reference conditions.

Executive Summary
(Page 4 of 7)

PROCESS DETAILS

VIP-Polymers Ltd, Huntingdon
44
25th September 2013

Standard Operating Conditions

Parameter	Value
Process Status	Normal Operation
Capacity (of 100%) and Tonnes / Hour	Varied
Continuous or Batch Process	Batch
Feedstock (if applicable)	Under cured Parts, Viton Seals
Abatement System	None
Abatement System Running Status	N/A
Fuel	N/A
Plume Appearance	None Visible

Executive Summary

(Page 5 of 7)

MONITORING & ANALYTICAL METHODS

VIP-Polymers Ltd, Huntingdon
 44
 25th September 2013

	Monitoring				Analysis					
Parameter	Standard	Technical Procedure	UKAS Testing	Testing Lab	Analytical Procedure	Analytical Technique	UKAS Analysis	Analysis Lab	MCERTS Testing	LOD (Average)
Total Particulate Matter	BS EN 13284-1	CAT-TP-01	Yes	CAT	CAT-TP-03	Gravimetric	Yes	CAT	Yes	0.09 mg/m³
Water Vapour	BS EN 14790	CAT-TP-05	Yes	CAT	CAT-TP-05	Gravimetric	Yes	CAT	Yes	0.10 % v/v
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20	Yes	CAT	Flame Ionisation Detection by Sick 3006 FID				Yes	0.13 mg/m³
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04	Yes	CAT	Pitot Tube and Thermocouple				Yes	N/A

ANALYSIS LABORATORIES

(with short name reference as appears in the table above)

Catalyst Environmental Ltd (CAT)	UKAS Accreditation Number: 4279
----------------------------------	---------------------------------

SUMMARY OF SAMPLING DEVIATIONS

Parameter	Run	Deviation
Total Particulate Matter	All Runs	The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.
Total Particulate Matter	All Runs	Only one sampling line was installed on the stack, however the number of sample points used on the available line were increased to meet the requirements of the Standard.
Total VOCs (as Carbon)	All Runs	There are no deviations associated with the sampling employed.

Executive Summary

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SUITABILITY OF SAMPLING LOCATION

Duct Characteristics

Parameter	Units	Value
Type	-	Circular
Depth	m	0.45
IEDth	m	-
Area	m ²	0.16
Port Depth	cm	5
Orientation of Duct	-	Vertical
Sample Port Size	-	4" BSP

Location of Sampling Platform

General Platform Information	Value
Permanent / Temporary Platform	On Roof
Inside / Outside	Outside

Platform Details

EA Technical Guidance Note M1 / BS EN 15259 Platform Requirements	Value
Sufficient working area to manipulate probe and operate the measuring instruments	Yes
Platform has 2 levels of handrails (approx. 0.5m & 1.0m high)	N/A
Platform has vertical base boards (approx. 0.25m high)	N/A
Platform has chains / self closing gates at top of ladders	N/A
There are no obstructions present which hamper insertion of sampling equipment	Yes
Safe Access Available	Yes
Easy Access Available	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location does not meet all of the Flow Criteria requirements in the Environment Agency's Technical Guidance Note M1 and BS EN 15259 (see Validation Criteria Table below).

BS EN 15259 Homogeneity Test Requirements

There is no requirement to perform a BS EN 15259 Homogeneity Test on this Stack.

Sampling Plane Validation Criteria (from EA Technical Guidance Document (Monitoring) M1)

Criteria in M1	Units	Traverse 1		Required	Compliant
Lowest Differential Pressure	Pa	170.0		> 5 Pa	Yes
Mean Velocity	m/s	16.18		-	-
Lowest Gas Velocity	m/s	14.45		-	-
Highest Gas Velocity	m/s	17.39		-	-
Ratio of Above	: 1	1.20		< 3 : 1	Yes
Maximum Angle of Swirl	°	21		< 15°	No
No Local Negative Flow	-	Yes		-	Yes

Executive Summary

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PLANT PHOTOS

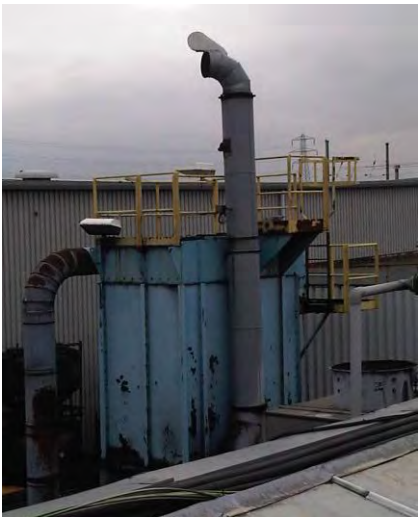
Photo 1



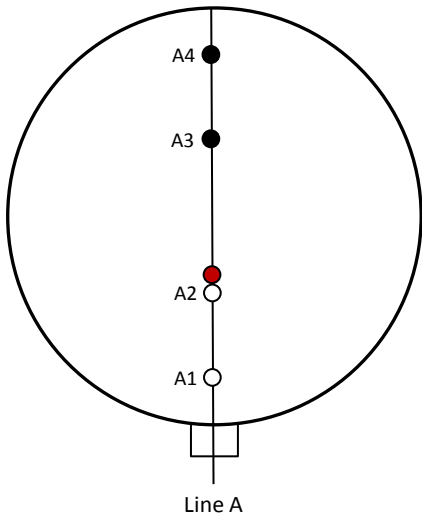
Photo 2



Photo 3



SAMPLE POINTS



where

○ = isokinetic point sampled at

● = isokinetic point not sampled at

● = combustion gases sample point

● = non-isokinetic sample point

APPENDICES

APPENDIX CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Personnel, List of Equipment & Methods and Technical Procedures Used

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

APPENDIX 1

STACK EMISSIONS MONITORING PERSONNEL

Position	Name	MCERTS Accreditation	MCERTS Number	Technical Endorsements
Team Leader	Adam Dixon	MCERTS Level 2	MM 10 1079	TE1 TE2 TE3 TE4
Trainee	James Birks	MCERTS Trainee	MM 13 1239	None

LIST OF EQUIPMENT

Extractive Sampling		Instrumental Analysers		Miscellaneous Items	
Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.	Equipment Type	Equipment I.D.
Control Box DGM	CAT 7.5	Horiba PG-250 SRM	-	Digital Manometer (1)	CAT 3.47
Box Thermocouples	CAT 3.12	Servomex 4900	-	Digital Manometer (2)	-
Umbilical	CAT 3.12	Eco Physics CLD 822Mh	-	Digital Temperature Meter	CAT 3.47
Oven Box	-	Testo 350 XL	-	Stopwatch	CAT 7.5
Probe	CAT 5.18	Servomex 5200MP	-	Barometer	CAT 13.6
S-Pitot (1)	CAT 21S.15	JCT JCC P1 Cooler	-	Stack Thermocouple (1)	CAT 4.223
S-Pitot (2)	CAT 21S.40	FT-IR	-	Stack Thermocouple (2)	-
L-Pitot	-	FT-IR Sampling System	-	1m Heated Line (1)	-
500g Check Weight	CAT 17.20	Bernath 3006 FID	CAT 3.6	1m Heated Line (2)	-
1Kg Check Weight	CAT 17.20	Heated Head Filter	CAT 12.91	1m Heated Line (3)	-
Last Impinger Arm	-	Mass Flow Controller (1)	CAT 6.19	5m Heated Line (1)	-
Callipers	CAT 23.7	Mass Flow Controller (2)	CAT 6.20	15m Heated Line (1)	-
Tubes Kit Thermocouple	-	Mass View (1)	-	15m Heated Line (2)	-
Laboratory Balance	CAT 1.18 / 1.18a	Mass View (2)	-	20m Heated Line (1)	CAT 20.17
Tape Measure	CAT 16.91	Easylogger EN-EL-12 Bit	CAT 11.13	Dual Channel Heater Controller	-

METHODS & TECHNICAL PROCEDURES USED

Parameter	Standard	Technical Procedure
Total Particulate Matter	BS EN 13284-1	CAT-TP-01
Water Vapour	BS EN 14790	CAT-TP-05
Total VOCs (as Carbon)	BS EN 12619:2013	CAT-TP-20
Velocity & Vol. Flow Rate	BS EN 13284-1	CAT-TP-04

APPENDIX 2

PRELIMINARY STACK SURVEY: CALCULATIONS

General Stack Details

Stack Details (from Traverse)	Units	Value
Stack Diameter / Depth, D	m	0.45
Stack IEDth, W	m	-
Stack Area, A	m ²	0.16
Average Stack Gas Temperature, T _a	°C	27.1
Average Stack Gas Pressure	Pa	214
Average Stack Static Pressure, P _{static}	kPa	0.08
Average Barometric Pressure, P _b	kPa	101.0
Average Pitot Tube Calibration Coefficient, C _p	-	0.85

Stack Gas Composition & Molecular Weights

Component	Conc ppm	Conc Dry % v/v	Conc Wet % v/v	Volume Fraction r	Molar Mass M	Density kg/m ³ p	Conc kg/m ³ p _i
CO ₂ (Estimated)	-	0.06	0.06	0.0006	44.01	1.9635	0.0012
O ₂ (Estimated)	-	20.80	20.66	0.2080	32.00	1.4277	0.2970
N ₂	-	79.14	78.61	0.7914	28.01	1.2498	0.9891
Moisture (H ₂ O)	-	-	0.67	0.0067	18.02	0.8037	0.0054

Where: $p = M / 22.41$

$p_i = r \times p$

Calculation of Stack Gas Densities

Determinand	Units	Result
Dry Density (STP), P _{STD}	kg/m ³	1.287
Wet Density (STP), P _{STW}	kg/m ³	1.284
Dry Density (Actual), P _{Actual}	kg/m ³	1.168
Average Wet Density (Actual), P _{ActualW}	kg/m ³	1.166

Where: P_{STD} = sum of component concentrations, kg/m³ (not including water vapour)

P_{STW} = sum of all wet concentrations / 100 x density, kg/m³ (including water vapour)

$P_{Actual} = P_{STD} \times (T_{STP} / (P_{STP})) \times ((P_{static} + P_b) / T_a)$

$P_{ActualW}$ (at each sampling point) = $P_{STW} \times (T_s / P_s) \times (P_a / T_a)$

Calculation of Stack Gas Volumetric Flowrate, Q

Duct gas flow conditions	Units	Actual	REF ¹
Temperature	°C	27.1	0.00
Total Pressure	kPa	101.1	101.3
Moisture	%	0.67	0.67

Gas Volumetric Flowrate (from Traverse)	Units	Result
Gas Volumetric Flowrate (Actual)	m ³ /hr	9266
Gas Volumetric Flowrate (STP, Wet)	m ³ /hr	8411
Gas Volumetric Flowrate (STP, Dry)	m ³ /hr	8355
Gas Volumetric Flowrate REF ¹	m ³ /hr	8411

APPENDIX 2

PRELIMINARY STACK SURVEY: VELOCITY TRAVERSE

(1 of 1)

Parameter	Units	Value
Date of Survey	-	25/09/2013
Time of Survey	-	12:31 - 13:35
Atmospheric Pressure	kPa	101.0
Stack Static Pressure	Pa	77
Type of Pitot Used	-	S-Type Pitot
Are Water Droplets Present?	-	No

Parameter	Units	Value
Initial Pitot Leak Check	-	Pass
Final Pitot Leak Check	-	Pass
Orientation of Duct	-	Vertical
Pitot Tube, C _p	-	0.85
Number of Lines Available	-	1
Number of Lines Used	-	1

Swirl Point (taken at the sampling points used during testing)																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Angle of Swirl (°)	3	4	18	21																

Sampling Line A					
Traverse Point	Depth m	ΔP Pa	Temp °C	Wet Density kg/m ³	Velocity m/s
1	0.02	246.0	27.1	1.166	17.39
2	0.07	216.0	27.1	1.166	16.29
3	0.11	220.0	27.1	1.166	16.44
4	0.16	210.0	27.1	1.166	16.07
5	0.20	221.0	27.1	1.166	16.48
6	0.25	170.0	27.1	1.166	14.45
7	0.29	196.0	27.1	1.166	15.52
8	0.34	214.0	27.1	1.166	16.22
9	0.38	212.0	27.1	1.166	16.14
10	0.43	230.0	27.1	1.166	16.81
Mean		213.5	27.1	1.166	16.18

APPENDIX 2

TOTAL PARTICULATE MATTER: RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon

44

Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	1.7		1.7
Uncertainty	±mg/m ³	0.37		0.37
Mass Emission	g/hr	14.3		14.3
Uncertainty	±g/hr	3.1		3.1

Parameter	Units	Run 1		Mean
Water Vapour	% v/v	0.67		0.67
Uncertainty	±% v/v	0.05		0.05

Blank Runs

Parameter	Units	Blank 1		Maximum
Concentration	mg/m ³	0.13		0.13

General Sampling Information

Parameter	Value	
Standard	BS EN 13284-1	
Technical Procedure	CAT-TP-01	
Probe Material	Titanium	
Filter Housing Material	Titanium	
Positioning of Filter	In Stack	
Filter Size and Material	47mm Glass Fibre	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	4 / 4	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A1, A2, A3 & A4	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

APPENDIX 2

TOTAL PARTICULATE MATTER: ISOKINETIC SAMPLING CALCULATIONS

Test	Units	Run 1	
Absolute pressure of stack gas, P_s			
Barometric pressure, P_b	mmHg	757.5	
Stack static pressure, P_{static}	mmH ₂ O	7.9	
$P_s = (P_b + (P_{static} / 13.6))$	mmHg	758.1	
Volume of water vapour collected, V_{wstd}			
Total mass collected in impingers (liquid trap)	g	1.8	
Total mass collected in impingers (silica trap)	g	5.3	
Total mass of liquid collected, V_{lc}	g	7.1	
$V_{wstd} = (0.001246)(V_{lc})$	m ³	0.0088	
Volume of gas metered dry, V_{mstd}			
Volume of gas sample through gas meter, V_m	m ³	1.5537	
Gas meter correction factor, Y_d	-	0.9350	
Average dry gas meter temperature, T_m	°C	30.1	
Average pressure drop across orifice, ΔH	mmH ₂ O	63.9	
$V_{mstd} = ((0.3592)(V_m)(P_b + (\Delta H/13.6))(Y_d)) / (T_m + 273)$	m ³	1.3123	
Moisture content, B_{wo} & R_{wv}			
$B_{wo} = V_{wstd} / (V_{mstd} + V_{wstd})$	m ³	0.0067	
B_{wo} as a percentage	% v/v	0.67	
Reported Water Vapour, checked with Tables in BS EN 14790, R_{wv}	% v/v	0.67	
Volume of gas metered wet, V_{mstw}			
$V_{mstw} = (V_{mstd})(100/(100 - R_{wv}))$	m ³	1.3211	
Volume of gas metered at Oxygen Reference Conditions, $V_{mstd@X\%O_2}$ & $V_{mstw@X\%O_2}$			
IED & Incinerates Hazardous Material? (Yes = no positive O ₂ correction)	-	No	
% wet oxygen measured in gas stream, ACT%O _{2w}	% v/v	N/A	
% dry oxygen measured in gas stream, ACT%O _{2d}	% v/v	N/A	
% oxygen reference condition, REF%O ₂	% v/v	N/A	
O ₂ Reference Factor wet ($O_{2REFw} = (21 - REF\%O_2) / (21 - ACT\%O_{2w})$)	-	N/A	
O ₂ Reference Factor dry ($O_{2REFd} = (21 - REF\%O_2) / (21 - ACT\%O_{2d})$)	-	N/A	
$V_{mstw@X\%oxygen} = (V_{mstw}) / (O_{2REFw})$	m ³	N/A	
$V_{mstd@X\%oxygen} = (V_{mstd}) / (O_{2REFd})$	m ³	N/A	
Molecular weight of dry gas stream, M_d			
CO ₂ (Estimated)	% v/v	0.06	
O ₂ (Estimated)	% v/v	20.80	
Total	% v/v	20.86	
N ₂	% v/v	79.14	
$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%N_2)$	g/gmol	28.84	
Molecular weight of stack gas (wet), M_s			
$M_s = M_d(1 - (R_{wv}/100)) + 18(R_{wv}/100)$	g/gmol	28.77	
Velocity of stack gas, V_s			
Pitot tube velocity constant, K_p	-	34.97	
Velocity pressure coefficient, C_p	-	0.84	
Average of velocity heads, ΔP_{avg}	mmH ₂ O	20.81	
Average square root of velocity heads, $\sqrt{\Delta P}$	√mmH ₂ O	4.56	
Average stack gas temperature, T_s	°C	38.4	
$V_s = ((K_p)(C_p)(\sqrt{\Delta P})(T_s + 273)) / (V(M_s)(P_s))$	m/s	16.01	
Total flow of stack gas: Actual (Q_a), Wet (Q_{stw}), Dry (Q_{std}), Wet@O_{2REF} (Q_{stwO_2}), Dry@O_{2REF} (Q_{stdO_2})			
Area of stack, A_s	m ²	0.16	
$Q_a = (60)(A_s)(V_s)$	m ³ /min	152.8	
Conversion factor (K/mm.Hg), C_f	-	0.3592	
$Q_{stw} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)$	m ³ /min	133.6	
$Q_{std} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)$	m ³ /min	132.7	
$Q_{stwO_2} = ((Q_a)(P_s)(C_f)) / ((T_s) + 273)(O_{2REFw})$	m ³ /min	N/A	
$Q_{stdO_2} = ((Q_a)(P_s)(C_f)(1 - (R_{wv}/100))) / ((T_s) + 273)(O_{2REFd})$	m ³ /min	N/A	
Percent isokinetic, %I			
Nozzle diameter, D_n	mm	5.80	
Nozzle area, A_n	mm ²	26.42	
Total sampling time, q	min	60	
$\%I = (4.6398E^6)(T_s + 273)(V_{mstd}) / (P_s)(V_s)(A_n)(q)(1 - (R_{wv}/100))$	%	99.2	

APPENDIX 2

TOTAL PARTICULATE MATTER: SAMPLING DETAILS

Sample Runs

Parameter	Units	Run 1	
Sampling Times	-	12:45 - 13:45	
Sampling Dates	-	25/09/2013	
Sampling Device	-	ISO	
Volume Sampled (REF)	m ³	1.3211	
Filter I.D. Number	-	47-15379	
Start Filter Mass	g	0.14113	
End Filter Mass	g	0.14284	
Total Mass on Filter	g	0.00171	
Probe Rinse I.D. Number	-	PR-47-15379	
Start Probe Rinse Mass	g	2.89619	
End Probe Rinse Mass	g	2.89672	
Total Mass in Probe Rinse	g	0.00053	
Total Mass Collected	mg	2.24	
Calculated Concentration	mg/m ³	1.70	
Balance Uncertainty / LOD	mg/m ³	0.09	

Where: ISO stands for Manual Isokinetic Sampling Train

Blank Runs

Parameter	Units	Blank 1	
Blank Dates	-	25/09/2013	
Average Volume Sampled (REF)	m ³	1.3211	
Filter I.D. Number	-	47-15501	
Start Filter Mass	g	0.14032	
End Filter Mass	g	0.14038	
Total Mass on Filter	g	0.00006	
Probe Rinse I.D. Number	-	PR-47-15501	
Start Probe Rinse Mass	g	3.00992	
End Probe Rinse Mass	g	3.01003	
Total Mass in Probe Rinse	g	0.00011	
Total Mass Collected	mg	0.17	
Calculated Concentration	mg/m ³	0.13	
Balance Uncertainty / LOD	mg/m ³	0.09	

APPENDIX 2

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE

(PAGE 1 OF 2)

Sample Runs

Leak Test Results	Units	Run 1	
Mean Sampling Rate	l/min	24.2	
Pre-Sampling Leak Rate	l/min	0.30	
Post-Sampling Leak Rate	l/min	0.31	
Allowable Leak Rate	l/min	0.48	
Leak Test Acceptable	-	Yes	
Water Droplets	Units	Run 1	
Are Water Droplets Present	-	No	
MU (Concurrent Water Vapour)	Units	Run 1	
Measurement Uncertainty (MU)	%	6.9	
Allowable MU	%	20	
MU Acceptable	%	Yes	
Silica Gel (Concurrent Water Vapour)	Units	Run 1	
Less than 50% Faded	%	Yes	
Isokinetic Criterion Compliance	Units	Run 1	
Isokinetic Variation	%	99.2	
Allowable Isokinetic Range	%	95 - 115	
Isokineticity Acceptable	-	Yes	
Weighing Uncertainty Criteria	Units	Run 1	
Overall Weighing Uncertainty	± mg	0.24	
Overall Weighing Uncertainty	± mg/m ³	0.18	
ELV [Daily ELV for IED]	mg/m ³	10.0	
Allowable Weighing Uncertainty	mg/m ³	0.50	
Weighing Uncertainty Acceptable	-	Yes	
Filter Temperatures	Units	Run 1	
Pre-Conditioning Temperature	°C	180	
Post-Conditioning Temperature	°C	160	
Maximum Filter Temperature	°C	38	
Test Conditions	Units	Run 1	
Ambient Temperature Recorded?	-	Yes	

TOTAL PARTICULATE MATTER: QUALITY ASSURANCE
(PAGE 2 OF 2)

Blank Runs

Leak Test Results	Units	Blank 1	
Expected Sampling Rate	l/min	15.0	
Pre-Sampling Leak Rate	l/min	0.26	
Post-Sampling Leak Rate	l/min	0.28	
Allowable Leak Rate	l/min	0.30	
Leak Test Acceptable	-	Yes	

Validity of Blank vs ELV	Units	Blank 1	
Allowable Blank	mg/m ³	1.0	
Blank Acceptable	-	Yes	

Acetone / Water Rinse Blank	Units	Blank
Acetone / Water Rinse Value	mg/l	2.7
Allowable Blank	mg/l	10
Blank Acceptable	-	Yes

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run, wx = deviation also applies to the concurrent water vapour run)	1	
The sample points where the angle of swirl was > 15° were omitted from the sampling exercise. The effective number of points was doubled and any non-compliant swirl points after this increase were omitted.	x	
Only one sampling line was installed on the stack, however the number of sample points used on the available line were increased to meet the requirements of the Standard.	x	

APPENDIX 2

TOTAL PARTICULATE MATTER: MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			Standard uncertainty			
	Symbol	Run 1		Symbol	Units	Run 1	
Sampled Volume (Actual)	V_m	1.55		uV_m	m^3	0.03	
Sampled Gas Temperature	T_m	303.1		uT_m	K	2.00	
Sampled Gas Pressure	p_m	101.1		up_m	kPa	0.50	
Sampled Gas Humidity	H_m	0.0		uH_m	% v/v	1.00	
Leak	L	1.28		uL	%	-	
Mass of Particulate	m	2.24		um	mg	0.12	
Oxygen Content	$O_{2,m}$	N/A		$uO_{2,m}$	% v/v	N/A	
Uncollected Mass	UCM	0.17		uUCM	mg	-	

Uncertainty as a Percentage				
Measured Quantities	Units	Run 1		Requirement of Standard
Sampled Volume (Actual)	%	2.00		$\leq 2\%$
Sampled Gas Temperature	%	0.66		$\leq 1\%$
Sampled Gas Pressure	%	0.49		$\leq 1\%$
Sampled Gas Humidity	%	1.00		$\leq 1\%$
Leak	%	1.28		$\leq 2\%$
Mass of Particulate	%	0.91		$< 5\%$ of ELV
Oxygen Content	%	N/A		$\leq 5\%$
Uncollected Mass	%	-		-

Uncertainty in Measurement Units					Sensitivity Coefficient	
Measured Quantities	Symbol	Units	Run 1		Run 1	
Sampled Volume (STP)	V_m	m^3	1.31		1.29	
Leak	L	mg/m^3	0.01		1.00	
Mass of Particulate	L_r	mg	2.24		0.76	
Factor for O_2 Correction	$O_{2,m}$	% v/v	N/A		N/A	
Uncollected Mass	UCM	mg	0.10		0.76	

Uncertainty in Result			
Measured Quantities	Units	Run 1	
Sampled Volume (STP)	mg/m^3	0.05	
Leak	mg/m^3	0.01	
Mass of Particulate	mg/m^3	0.09	
Factor for O_2 Correction	mg/m^3	N/A	
Uncollected Mass	mg/m^3	0.07	

Parameter	Units	Run 1	
Combined uncertainty	mg/m^3	0.13	
Expanded uncertainty (95% confidence)	mg/m^3	0.25	
Expanded uncertainty (95% confidence), estimated with Method Deviations	mg/m^3	0.37	
Reported Uncertainty	mg/m^3	0.37	
Expanded uncertainty (95% confidence)	%	14.6	
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	21.9	
Reported Uncertainty	%	21.9	

APPENDIX 2

TOTAL VOCs (as CARBON): RESULTS SUMMARY

VIP-Polymers Ltd, Huntingdon

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Sample Runs

Parameter	Units	Run 1		Mean
Concentration	mg/m ³	4.6		4.6
Uncertainty	±mg/m ³	0.28		0.28
Mass Emission	g/hr	38.5		38.5
Uncertainty	±g/hr	2.3		2.3

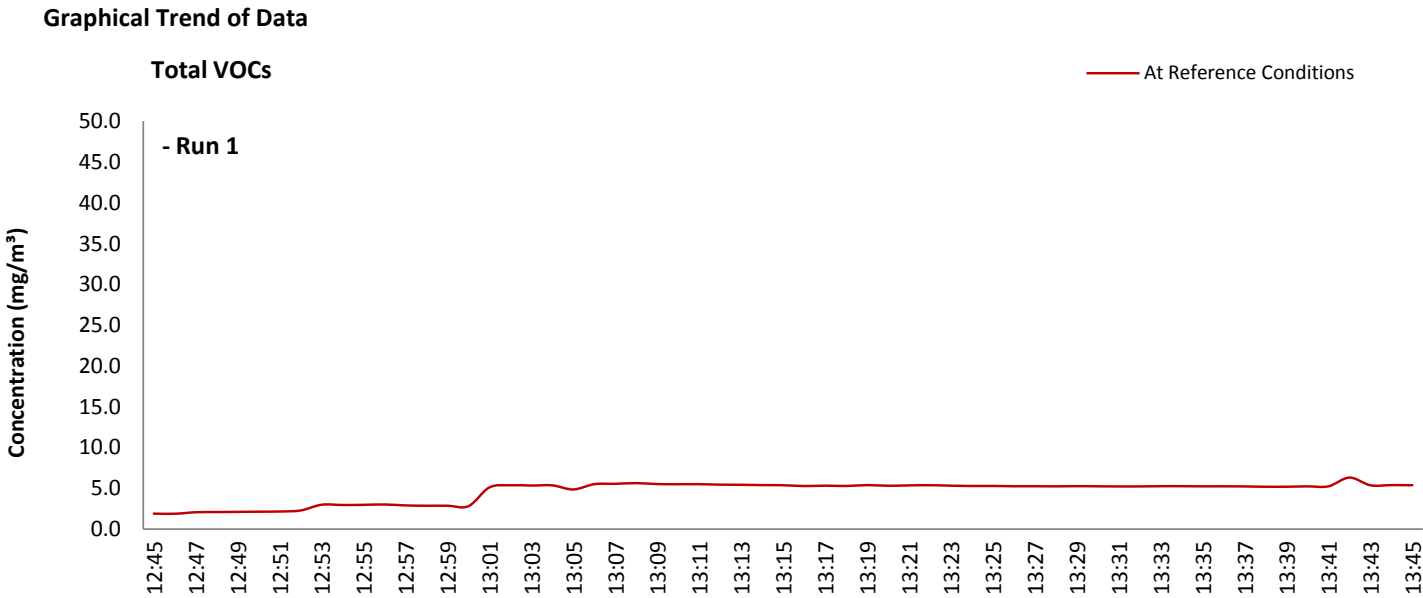
General Sampling Information

Parameter	Value	
Standard	BS EN 12619:2013	
Technical Procedure	CAT-TP-20	
Probe Material	Stainless Steel	
Filtration Type / Size	0.1µm Glass Fibre	
Heated Head Filter Used	Yes	
Heated Line Temperature	180°C	
Span Gas Reference Number	CYL 1.0035	
Span Gas Expiry Date	05/12/2013	
Span Gas Start Pressure (bar)	80	
Gas Cylinder Concentration (ppm)	80.3	
Span Gas Uncertainty (%)	2	
Zero Gas Type	Synthetic Air (5 Grade)	
Number of Sampling Lines Used	1 / 1	FORMAT: Number Used / Number Required
Number of Sampling Points Used	1 / 1	FORMAT: Number Used / Number Required
Sample Point I.D.'s	A2	

Reference Conditions

Reference Conditions are: 273K, 101.3kPa, without correction for water vapour content.

TOTAL VOCs (as CARBON): DATA TREND



TOTAL VOCs (as CARBON): SAMPLING DETAILS & QUALITY ASSURANCE

Sampling Details

Parameter	Units	Run 1	
Sampling Times	-	12:45 - 13:45	
Sampling Dates	-	25/09/2013	
Instrument Range	ppm	100	
Span Gas Value	ppm	80.3	

Quality Assurance

	Zero Drift	Units	Run 1	
CAL 1	Zero Down Sampling Line (Pre)	ppm	0.50	
	Zero Down Sampling Line (Post)	ppm	0.20	
	Zero Drift	ppm	-0.30	
	Allowable Zero Drift	± ppm	4.02	
	Zero Drift Acceptable	-	Yes	
	Span Drift	Units	Run 1	
CAL 1	Span Down Sampling Line (Pre)	ppm	80.3	
	Span Down Sampling Line (Post)	ppm	79.2	
	Span Drift	ppm	-1.10	
	Allowable Span Drift	± ppm	4.02	
	Span Drift Acceptable	-	Yes	
	Test Conditions	Units	Run 1	
	Run Ambient Temperature Range	°C	15 - 17	

Method Deviations

Nature of Deviation	Run Number	
(x = deviation applies to the associated run)	1	
There are no deviations associated with the sampling employed.	x	

APPENDIX 2

TOTAL VOCs (as CARBON): MEASUREMENT UNCERTAINTY CALCULATIONS

Measured Quantities	Value			
	Units	Run 1	Run 2	Run 3
MCERTS Certified Range of Analyser	ppm	9.3		
Operational Range of Analyser	ppm	100		
Measured Reading	ppm	2.9		

Measured Quantities	Individual Errors as Standard Uncertainties			
	Units	Run 1	Run 2	Run 3
Nonlinearity	ppm	0.04		
Temperature Dependent Zero Drift	ppm	0.03		
Temperature Dependent Span Drift	ppm	0.03		
Cross-Sensitivity	ppm	0.07		
Leak	ppm	0.00		
Calibration Gas Uncertainty	ppm	0.02		
Mass Flow Controllers (dilution) Uncertainty	ppm	0.02		

Parameter	Units	Run 1	Run 2	Run 3
Combined uncertainty	ppm	0.09		
Expanded uncertainty (95% confidence)	ppm	0.17		
Expanded uncertainty (95% confidence), estimated with Method Deviations	ppm	0.17		
Reported Uncertainty	ppm	0.17		
Expanded uncertainty (95% confidence)	%	6.1		
Expanded uncertainty (95% confidence), estimated with Method Deviations	%	6.1		
Reported Uncertainty	%	6.1		