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AIR & EMISSIONS TESTING GROUP

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Stack Emissions Testing Report

Total Particulate Matter
Volatile Organic Compounds

Air Tech Environmental Consultancy Services

VIP Polymers Ltd

Huntingdon

16 Sacomat

Sampling Date **26th September 2006**

Report by Paul Adamczyk

Job Number LAB 06679

Contents

Introduction

VIP Polymers Ltd operates a rubber products manufacturing process process at Huntingdon which is subject to Local Air Pollution Control by Huntingdon District Council under the Pollution Prevention and Control Regulations 2000.

Scientifics Limited, working in partnership with Air Tech ECS, were commissioned by VIP Polymers Ltd to carry out stack emissions testing to determine the release of total particulate matter and volatile organic compounds from the following Plant under normal operating conditions.

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	16 Sacomat
Sampling Date	26th September 2006
Time Test Started	18:27
Time Test Ended	19:14
Operating Conditions	Normal
Materials Processed	Rubber
Plume Appearance	None Visible

Throughout sampling, the operating conditions were maintained as above. Any deviations from BS 3405 : 1983 are noted in the conclusion.

Emissions Summary

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	16 Sacomat
Sampling Date	26th September 2006

Parameter	Units	Result	Limit	Outcome
Total Particulate Matter	mg/m^3	0.04	10	Passed
Particulate Emission Rate	g/hr	0.0001	-	-
Volatile Organic Compounds	mg/m^3	0.91	50	Passed
VOC Emission Rate	g/hr	3.3	-	-
Stack Gas Temperature	^{o}C	33	-	-
Stack Gas Volumetric Flow Rate (Actual)	m^3/hr	4139	-	-
Stack Gas Volumetric Flow Rate (STP)	m^3/hr	3640	-	-
Stack Gas Velocity	m/s	11.9	-	-

All results are mean values, with particulate concentrations expressed at reference conditions.

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

Written Summary

Total Particulate Matter	Passed

Two particulate tests were performed during continuous operating conditions. The mean sampling time was 20 minutes. The mean particulate concentration was 0.04 mg/m^3 at reference conditions. This value is below the specified emission limit of 10 mg/m^3. This is below the specified emission limit.

The tests were performed following the main procedural requirements of BS 3405 : 1983 using a Ströhlein STE 4 isokinetic particulate sampling train.

Volatile Organic Compounds	Passed

VOC (as Carbon) concentrations were measured continuously over a 30 minute period, with average values being recorded at 1 minute intervals. The mean VOC (as Carbon) concentration was 0.91 mg/m^3.

The sampling was performed in accordance with the main procedural requirements of BS 12619 : 1999 using a heated sampling line and a Signal 3010 MINIFID portable VOC analyser, with detection by FID calibrated against 74.6 ppm propane certified span gas.

Total Particulate Matter Summary

Sample	Sampling Times	Concentration	Limit
Run 1	18:27 - 18:47	0.02 mg/m^3	10 mg/m^3
Run 2	12:35 - 12:55	0.05 mg/m^3	10 mg/m^3
Mean Particulate Concentration		0.04 mg/m^3	10 mg/m^3

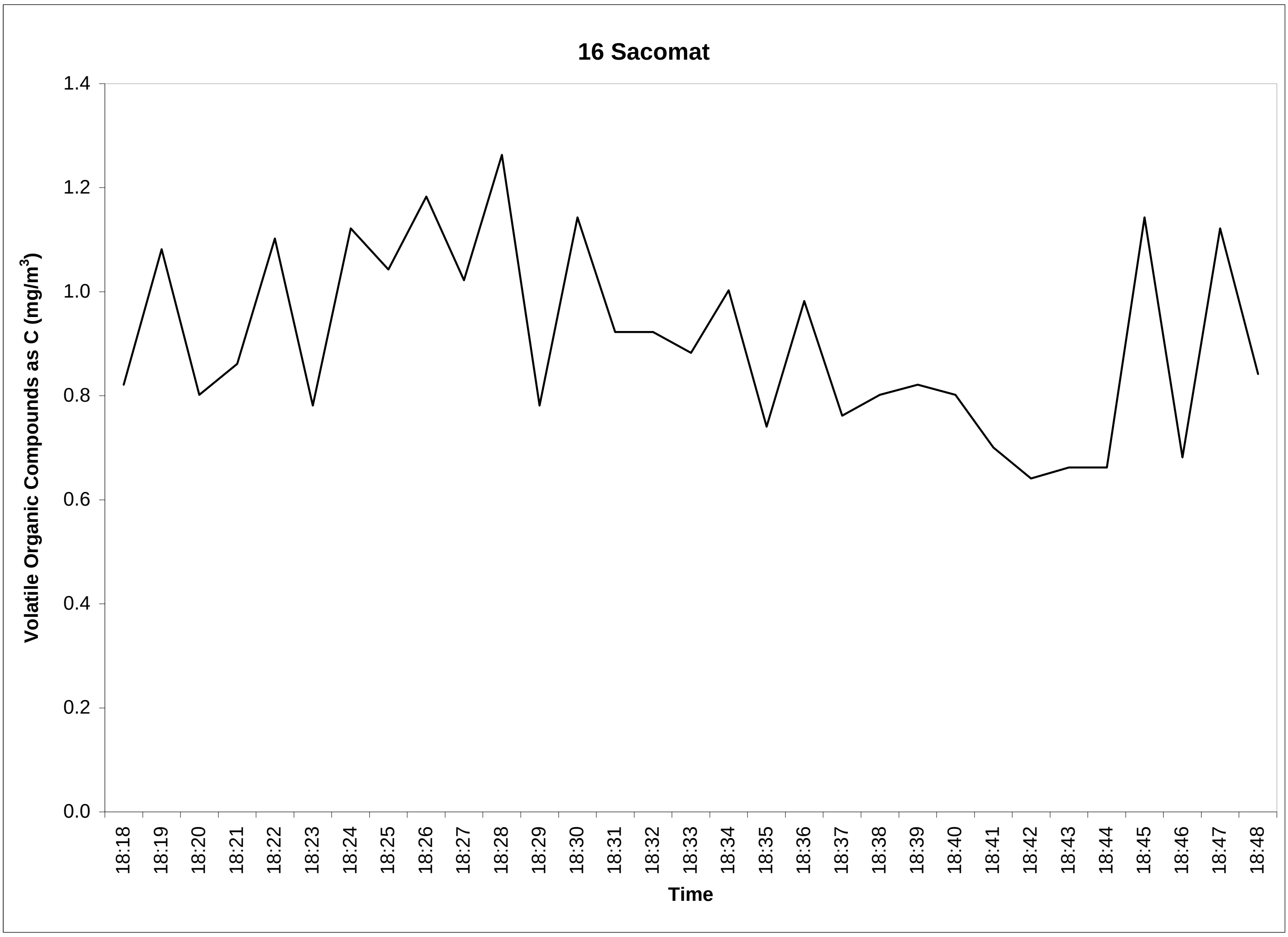
Sample	Sampling Times	Particulate Emission Rate	Ratio of Particulate Emission Rates
Run 1	18:27 - 18:47	0.00002 g/s	-
Run 2	12:35 - 12:55	0.00005 g/s	-
Mean Particulate Emission Rate		0.00003 g/s	3.0 : 1

Volatile Organic Compounds Summary

Sampling Times	Concentration (mg/m^3)	Limit (mg/m^3)	Emission Rate (g/hr)	Limit (g/hr)
18:18 - 18:48	0.91	50	3.3	-

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

Volatile Organic Compounds Emissions Profile



Volatile Organic Compounds Emissions Data

Time	VOC ppm	VOC mg/m^3
18:18	0.51	0.82
18:19	0.67	1.08
18:20	0.50	0.80
18:21	0.54	0.86
18:22	0.69	1.10
18:23	0.49	0.78
18:24	0.70	1.12
18:25	0.65	1.04
18:26	0.74	1.18
18:27	0.64	1.02
18:28	0.79	1.26
18:29	0.49	0.78
18:30	0.71	1.14
18:31	0.57	0.92
18:32	0.57	0.92
18:33	0.55	0.88

Time	VOC ppm	VOC mg/m^3
18:34	0.62	1.00
18:35	0.46	0.74
18:36	0.61	0.98
18:37	0.47	0.76
18:38	0.50	0.80
18:39	0.51	0.82
18:40	0.50	0.80
18:41	0.44	0.70
18:42	0.40	0.64
18:43	0.41	0.66
18:44	0.41	0.66
18:45	0.71	1.14
18:46	0.42	0.68
18:47	0.70	1.12
18:48	0.52	0.84
Mean	0.56	0.91

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

Volatile Organic Compounds Sampling Methodology

The Signal 3010 MINIFID Portable Heated Total Hydrocarbon Analyser uses Flame Ionisation to detect total organic carbon in a gas stream.

Checks Carried Out before Arrival On Site

The FID analyser is set up and is tested. The following are checked; the furnace and sample line temperatures, the zero and span gas calibration and the operation of the data logger.

On Site Sampling Procedure

The FID and sample line are switched on and allowed to reach operational temperature. The analyser will take 20 minutes to reach its operational temperature of 180^{o}C. The sample line is heated to approximately 180^{o}C to avoid VOCs condensing in the line. When the components have reached the correct operating temperature the fuel and span gas valves are opened and the FID is ignited.

The FID will take about 20 minutes before it stabilises and gives a zero ppm reading. The zero gas is fed into the FID and the zero set. The span gas is fed into the FID and the instrument adjusted to read the certified span gas value. The zero gas is fed into the FID once more to check that the reading returns to zero, if it does not, then these steps are repeated.

The probe, with a particulate filter, is then inserted into the stack, and the data logger activated.

The data logger can be programmed to log results over a 1, 5, 10 etc minute period. The results displayed and logged are the volume concentration of propane in ppm, which are converted to mg/m³ by the following calculations:

$$C_m = C_v \frac{36}{22.4}$$

where C_m is the TOC concentration in mg/m^3 (273 K; 101300 Pa)

C_v is the volume concentration of propane in ppm (by volume)

Calculations - Run 1

1. Stack Gas Velocity (V)

V = $0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$
V = Velocity (m/s)
Cp = Pitot Tube Calibration Coefficient
ΔP = Mean Differential Pressure (Pa)
T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	11.84	m/s
Stack Diameter (D)	0.35	m
Stack Area (A)	0.10	m^2
Stack Temperature (T)	306.00	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.06	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A$ $Q_{(actual)} = V \times A$

$Q_{(STP)}$ = 1.00 m^3/s   **$Q_{(actual)}$ = 1.14 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.00001	g
Stack Area (A)	0.10	m^2

$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6$ = 1.6E-05 g/s

M = 0.0000 g/s

4. Particulate Concentration (C) at 273K, 101.3kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 0.02 mg/m^3

Calculations - Run 2

1. Stack Gas Velocity (V)

$V = 0.075 \text{ x } Cp \text{ x } \sqrt{\Delta P} \text{ x } \sqrt{T}$

V = Velocity (m/s)

Cp = Pitot Tube Calibration Coefficient

ΔP = Mean Differential Pressure (Pa)

T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	12.05	m/s
Stack Diameter (D)	0.35	m
Stack Area (A)	0.10	m^2
Stack Temperature (T)	306.00	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.06	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$$Q_{(STP)} = \frac{273}{T} \text{ x } \frac{(P_A + P_{St}) \text{ x } V \text{ x } A}{P_B} \qquad Q_{(actual)} = V \text{ x } A$$

$Q_{(STP)}$ = 1.02 m^3/s **$Q_{(actual)}$ = 1.16 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.0000	g
Stack Area (A)	0.10	m^2

$$M = \frac{(A \text{ x } m) \text{ x } 10^6}{(n \text{ x } a \text{ x } s)} = 4.8\text{E-}05 \text{ g/s}$$

M = 0.000 g/s

4. Particulate Concentration (C) at 273K, 101.3 kPa

$C = (M / Q_{(STP)}) \text{ x } 1000$

C = 0.05 mg/m^3

Total Particulate Matter Sampling Methodology

Job Preparation

A pre-site survey must first be undertaken to obtain the following information. Client details (full address & contact names), description of stack (name & location), sampling platform / access (Permanent - platform of adequate size & load capability, kick boards, hand & middle rails, free from debris, good drainage, fixed ladders with hoops and chain. Temporary - adequate size & load capability, stabilising legs, valid inspection tag, kick boards, hand & middle rails. Both types of platform must have a secure anchorage point to fix pulley system) hazards (dust, noise, temperature, gases/vapours, vibration, light, moving machinery, electricity etc) power supply and location, additional PPE required (high temperature gloves/overalls, PPE).

The Strohlein STE 4, isokinetic particulate measurement equipment, is fully inspected prior to use and its calibration status observed. This includes:

Pitot Tube - All pitot tubes are physically checked for damage, paying particular attention to the inlet holes. All dirt and blockages are removed.

Micromanometer - Digital differential pressure meters are used capable of measuring pressure in the range 0 Pa to 2250 Pa with a sensitivity of ±1 Pa. These instruments are checked for obvious physical damage, battery life tested and calibrated status observed.

Thermocouple - Temperature is measured using k type thermocouples. Each thermocouple is inspected for obvious damage and its calibration status observed. Digital temperature meters are used in conjunction with K type thermocouples. These are also checked for obvious physical damage and their battery life tested.

Nozzles - All nozzles used have been constructed in accordance BS 3405 : 1983, section 5.3.2. Each nozzle is physically checked for damage and removed if necessary. The nozzle calibration status is observed.

Flowmeter - The flowmeter is checked for blockages and obvious physical damage. Its calibration status is also observed.

Balance - A Mettler Toledo balance is used to weigh filters. The balance is positioned on a solid base located in a specially built weighing room. The balance is serviced and calibrated routinely each year by the manufacturer and also checked daily with in-house check weights.

Rope Kit - All lifting tackle i.e. rope, pulleys, karabiners, brakes and slings are physically checked for cuts and contamination.

Should the calibration certainty of any of the above equipment be in question, that item of equipment must be recalibrated and replaced if necessary.

Filter Selection and Preparation

Stack conditions can vary greatly for temperature, moisture, acidity, low and heavy particulate loading. Following the pre-site survey, the stack gas condition should be known and the appropriate filter can be selected and prepared as described below.

Filter mediums - glass wool, quartz wool, Gelman Sciences A/C Glass Fibre filter papers, Gelman Sciences Low Ash PVC membrane filter papers, Schleicher & Schuell Glass Fibre Thimbles or Schleicher & Schuell Quartz Thimbles.

Filters are prepared by drying in an oven at 160^{o}C for a period of one hour and then placed to cool in a dessicator. The filters are weighed accurately on a 4-figure balance and then placed in clean individual petri dishes and transported to site in a filter storage box. Spare filters are also prepared to allow for accidents and to obtain blank values.

Sampling Procedure

Suitability of Sampling Location

Before sampling can commence, a preliminary velocity and temperature survey must be undertaken along the two sampling lines at ten equally spaced points excluding the region within 5% of the effective flue diameter from the wall. The stack diameter is measured using a steel rod. If the ratio of the highest to lowest dynamic pressures exceeds 9:1 or if the ratio of the highest to lowest gas velocities exceeds 3:1, another sampling plane should be used. Sampling is undertaken from either four or eight sampling points.

Total Particulate Matter Sampling Methodology

Four sampling points are used when the ratio of the highest to lowest dynamic pressures is less than 4:1 and eight sampling points when the ratio of highest to lowest dynamic pressures exceeds 4:1 but less than 9:1 or the stack area exceeds 2.5 m^2. Temperature is also measured at ten equally spaced points along the sampling lines and an average temperature calculated. Should the temperature at any of the sampling points differ by more than + 10% from that of the average temperature, then that point must not be used.

The required number of sampling points can now be calculated using the following:
4 point sampling, circular stacks: 0.15 x D and 0.85 x D.
4 point sampling, square stacks: 0.25 x D and 0.75 x D.
8 point sampling, circular stacks: 0.065 x D, 0.25 x D, 0.75 x D and 0.935 x D.
8 point sampling, square stacks: 0.125 x D, 0.375 x D, 0.625 x D and 0.875 x D.

Leak Checks

A leak check should be undertaken before and after the iso-kinetic sampling is carried out. This is to make sure that all suction is taken at the sampling nozzle.

Sampling

Once the iso-kinetic sampling flow rates have been calculated, the probe is inserted into the stack at 90^o to the stack gas flow, as not to impinge any particulate matter on to the filter media prior to sampling. Allow the filter head and probe to attain the stack gas temperature. Start the suction device, and set the flowmeter to the correct suction rate for isokinetic sampling. At the same time turn the nozzle into flow and start the timing device.

Duration of Sampling Time

Duration of sampling time depends on :

(a) ensuring adequate quantities of particulate matter on the filter for weighing (> 0.3 % of the filter weight).
(b) whether cumulative or incremental sampling is undertaken.
(c) the number of sampling points i.e. either 4 or 8 point sampling.
(d) the continuity of plant operation.

Cumulative Sampling

After the first sample is taken from the first sampling position the control valve is closed simultaneously turning the sampling probe 90^o tc the stack gas flow, moving the probe to the next sample position. This process should be repeated until all the sample points have been used once.

Repeat Velocity and Temperature Readings

At each of the sampling points repeat the readings for the stack gas flow rate and stack gas temperatures. Calculate the new iso-kinetic sampling flow rates. If the stack gas velocity is more than $\underline{+}$ 5% from the initial readings the test result shall not be regarded as having the required accuracy. The new temperature reading should not exceed the permitted range calculated in the preliminary survey. i.e. it should be within $\underline{+}$ 10% of the original mean temperature.

N.B. The filter head should be cleaned and the particulate matter added to the particulate matter on the filter.
The Sampling procedure should be repeated to obtain a duplicate sample, the ratio of the two particulate emission rates should not exceed 1.5 : 1.

Weighing of Sample

The used filter should be placed in an oven at 180^{o}C and dried thoroughly, cooled and equilibrated in a desiccator and weighed as quickly as possible so as to avoid any errors due to moisture absorption onto the filter. The gross weight of the filter should be measured to within $\underline{+}$ 0.1 mg. The filter weight and any residual particulate matter from the filter head can then be used in the final report to calculate the particulate concentration.

On Site Isokinetic Data Sheet

Preliminary Stack Survey		Sampling Line A		Sampling Line B	
Traverse Point	Distance in Stack (m)	Dynamic Pressure (Pa)	Temperature (°C)	Dynamic Pressure (Pa)	Temperature (°C)
1	0.02	95	33	-	-
2	0.05	118	33	-	-
3	0.09	115	33	-	-
4	0.12	122	33	-	-
5	0.16	127	33	-	-
6	0.19	128	33	-	-
7	0.23	159	33	-	-
8	0.26	121	33	-	-
9	0.30	144	33	-	-
10	0.33	123	33	-	-
Mean	-	125	33	-	-

Lowest Dynamic Pressure (any line)	95	Ratio of Above	1.67 : 1	
Highest Dynamic Pressure (any line)	159	(Highest permitted ratio 9:1)		
Temperature Range permitted for any point is between		2	and	64

Run 1		**Sampling Time (mins)**		**20**	**Nozzle size used (mm)**		**8.0**
Sampling Point	**Dynamic Pressure (Pa)**		**Temperature (°C)**		**Velocity (m/s)**		**Flowmeter set at (m^3/hr)**
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	
1	95	110	33	33	10.74	11.56	1.88
2	115	112	33	33	11.82	11.66	2.07
3	121	118	33	33	12.12	11.97	2.12
4	123	132	33	33	12.22	12.66	2.14
Mean	114	118	33	33	11.73	11.96	2.05

Difference between Initial Velocity and Final Velocity = 1.98 % (Limit permitted is ± 5%)

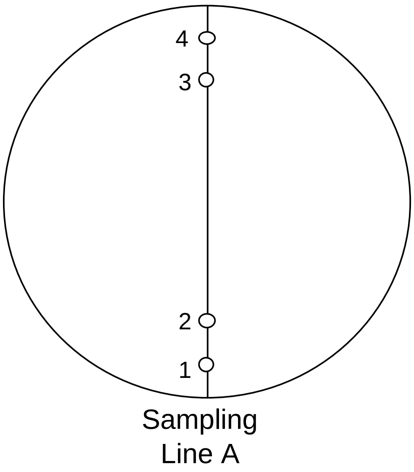
Start Filter Weight =	0.1199 g	Sample Weight =	0.00001 g
End Filter Weight =	0.1199 g	Sample as % of Filter Weight =	0.01 %

Run 2		**Sampling Time (mins)**		**20**	**Nozzle size used (mm)**		**8.0**
Sampling Point	**Dynamic Pressure (Pa)**		**Temperature (°C)**		**Velocity (m/s)**		**Flowmeter set at (m^3/hr)**
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	
1	110	120	33	33	11.56	12.07	2.03
2	112	110	33	33	11.66	11.56	2.04
3	118	126	33	33	11.97	12.37	2.10
4	132	130	33	33	12.66	12.57	2.22
Mean	118	122	33	33	11.96	12.14	2.10

Difference between Initial Velocity and Final Velocity = 1.47 % (Limit permitted is ± 5%)

Start Filter Weight =	0.1192 g	Sample Weight =	0.00003 g
End Filter Weight =	0.1192 g	Sample as % of Filter Weight =	0.03 %

Stack Diagram

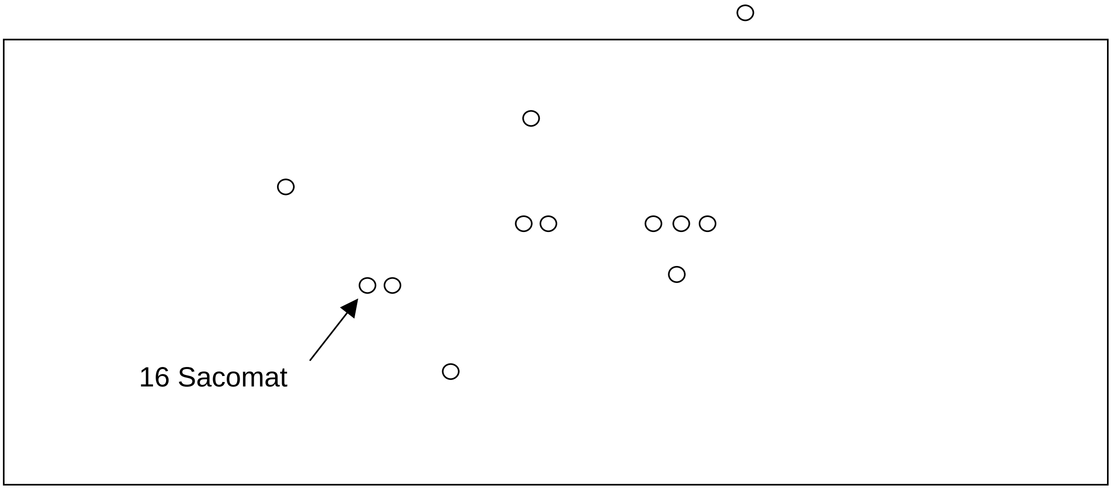


Stack Diameter (D) = 0.35 m

Stack Area (A) = 0.10 m^2

Sampling Point	Distance as a % of (D)	Distance in m
1	6.5	0.02
2	25.0	0.09
3	75.0	0.26
4	93.5	0.33

Plant Layout



Quality Assurance Checklist

Velocity Measurements:

Were water droplets present ?	No
Direction of gas flow within ± 20° of stack axis.	Yes
Dynamic pressures > 5 Pa at all sampling points.	Yes
Ratio of highest to lowest dynamic pressures < 9 : 1.	Yes

Sampling:

Sampling plane was correctly positioned.	Yes
Area of sampling apparatus was < 10% of stack area.	Yes
Sampling was from centres of equal areas.	Yes
Sampling at each point not less than 3 minutes.	Yes
Nozzle was facing directly upstream to within ± 10°.	Yes
Leak check performed before and after each run and passed.	Yes

Sample Handling:

Minimum weight of samples collected > 0.3% of filter weights.	No
Samples achieved stable weights.	Yes
Particulate samples stored for 3 months.	Yes

QA Procedures:

Isokinetic data sheet completed and signed off by Team Leader.	Yes
Report saved electronically onto Scientifics server.	Yes
Raw data and hard copy of report filed together.	Yes

Environmental Monitoring Team

Environmental Team Leader	Paul Adamczyk BSc (Hons) Fuel and Combustion Science MSc Environmental Pollution Control MCERTS Level 2, Technical Endorsement 1 & 4 - MM 04 547
Environmental Technician	Robert Adamczyk BSc Environmental Science MCERTS Trainee - MM06 721
Report by	Paul Adamczyk Level 2 Team Leader

Checked and Authorised By

Mark Allison Print Name

7th November 2006 Dated

Team Leader Business Title

Conclusion

The results of this test demonstrate that under normal operating conditions, this Plant is being operated in compliance with the total particulate matter and volatile organic compounds emission limits specified in PG 6/28 (04).

Good housekeeping and maintenance of the ducting and associated Plant should be continued in order to maintain this level of Plant performance.

A regular programme of stack emissions testing in accordance with the Plant's Local Air Pollution Control Authorisation will be required to demonstrate continued compliance.

Deviations from BS 3405 : 1983

Less than 0.3% of the filter weight was collected during both sample runs. This was due to the very low level of particulate emissions from the Plant.

AIR & EMISSIONS TESTING GROUP

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Stack Emissions Testing Report

Total Particulate Matter
Volatile Organic Compounds

Air Tech Environmental Consultancy Services

VIP Polymers Ltd

Huntingdon

24 Desma 10 Booth

Sampling Date **26th September 2006**

Report by Paul Adamczyk

Job Number LAB 06679

Contents

Introduction

VIP Polymers Ltd operates a rubber products manufacturing process process at Huntingdon which is subject to Local Air Pollution Control by Huntingdon District Council under the Pollution Prevention and Control Regulations 2000.

Scientifics Limited, working in partnership with Air Tech ECS, were commissioned by VIP Polymers Ltd to carry out stack emissions testing to determine the release of total particulate matter and volatile organic compounds from the following Plant under normal operating conditions.

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	24 Desma 10 Booth
Sampling Date	26th September 2006
Time Test Started	12:38
Time Test Ended	13:23
Operating Conditions	Normal
Materials Processed	Rubber
Plume Appearance	None Visible

Throughout sampling, the operating conditions were maintained as above. Any deviations from BS 3405 : 1983 are noted in the conclusion.

Emissions Summary

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	24 Desma 10 Booth
Sampling Date	26th September 2006

Parameter	Units	Result	Limit	Outcome
Total Particulate Matter	mg/m^3	0.06	10	Passed
Particulate Emission Rate	g/s	0.11	-	-
Volatile Organic Compounds	mg/m^3	0.98	50	Passed
VOC Emission Rate	g/hr	1.9	-	-
Stack Gas Temperature	^{o}C	23	-	-
Stack Gas Volumetric Flow Rate (Actual)	m^3/hr	2081	-	-
Stack Gas Volumetric Flow Rate (STP)	m^3/hr	1891	-	-
Stack Gas Velocity	m/s	8.2	-	-

All results are mean values, with particulate concentrations expressed at reference conditions.

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

Written Summary

Total Particulate Matter	Passed

Two particulate tests were performed during continuous operating conditions. The mean sampling time was 20 minutes. The mean particulate concentration was 0.06 mg/m^3 at reference conditions. This value is below the specified emission limit of 10 mg/m^3. This is below the specified emission limit.

The tests were performed following the main procedural requirements of BS 3405 : 1983 using a Ströhlein STE 4 isokinetic particulate sampling train.

Volatile Organic Compounds	Passed

VOC (as Carbon) concentrations were measured continuously over a 30 minute period, with average values being recorded at 1 minute intervals. The mean VOC (as Carbon) concentration was 0.98 mg/m^3.

The sampling was performed in accordance with the main procedural requirements of BS 12619 : 1999 using a heated sampling line and a Signal 3010 MINIFID portable VOC analyser, with detection by FID calibrated against 74.6 ppm propane certified span gas.

Total Particulate Matter Summary

Sample	Sampling Times	Concentration	Limit
Run 1	12:38 - 12:58	0.04 mg/m^3	10 mg/m^3
Run 2	13:03 - 13:23	0.07 mg/m^3	10 mg/m^3
Mean Particulate Concentration		0.06 mg/m^3	10 mg/m^3

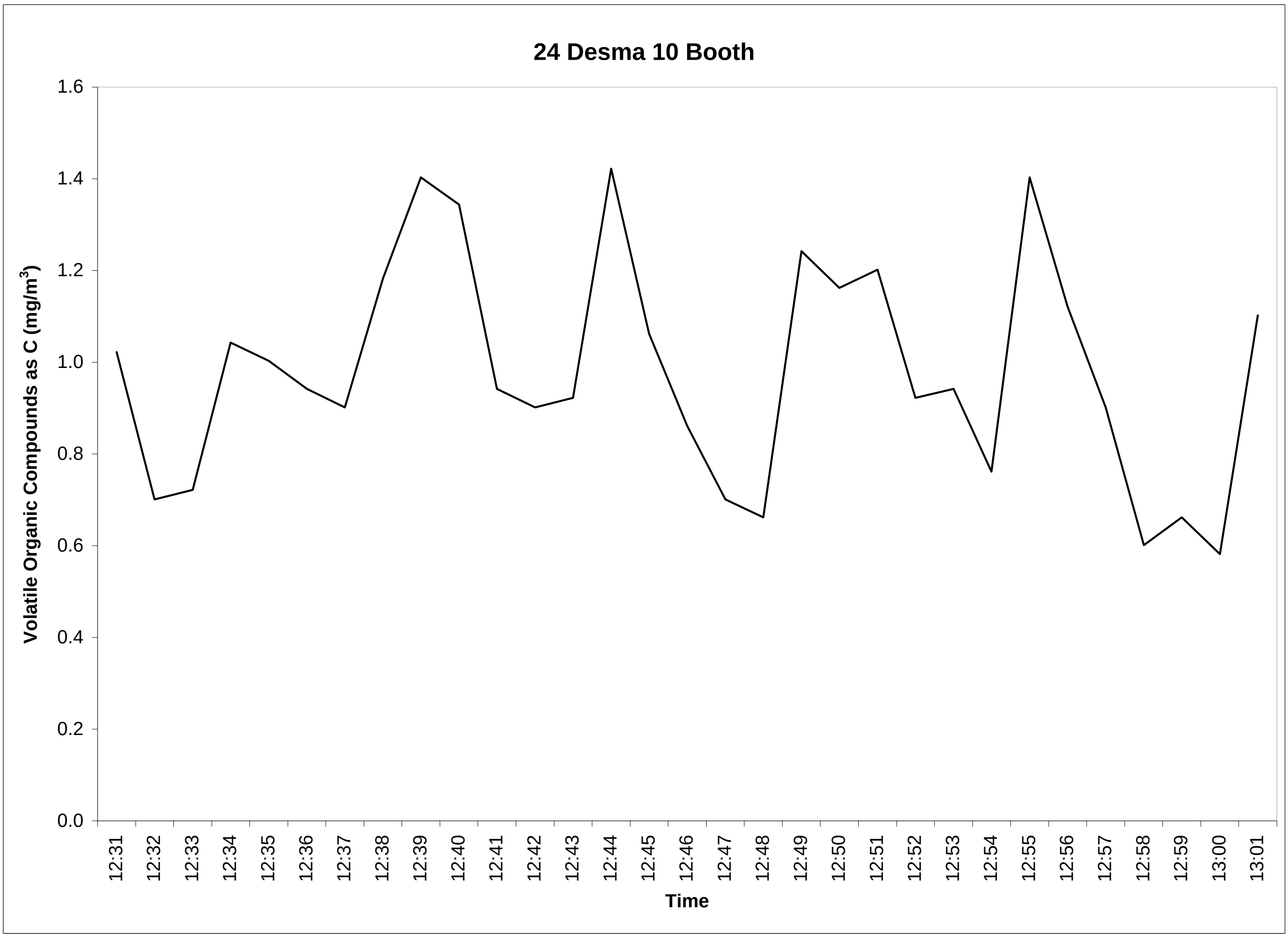
Sample	Sampling Times	Particulate Emission Rate	Ratio of Particulate Emission Rates
Run 1	12:38 - 12:58	0.00002 g/s	-
Run 2	13:03 - 13:23	0.00004 g/s	-
Mean Particulate Emission Rate		0.00003 g/s	1.5 : 1

Volatile Organic Compounds Summary

Sampling Times	Concentration (mg/m^3)	Limit (mg/m^3)	Emission Rate (g/hr)	Limit (g/hr)
12:31 - 13:01	0.98	50	1.9	-

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

Volatile Organic Compounds Emissions Profile



Volatile Organic Compounds Emissions Data

Time	VOC ppm	VOC mg/m^3
12:31	0.64	1.02
12:32	0.44	0.70
12:33	0.45	0.72
12:34	0.65	1.04
12:35	0.62	1.00
12:36	0.59	0.94
12:37	0.56	0.90
12:38	0.74	1.18
12:39	0.87	1.40
12:40	0.84	1.34
12:41	0.59	0.94
12:42	0.56	0.90
12:43	0.57	0.92
12:44	0.89	1.42
12:45	0.66	1.06
12:46	0.54	0.86

Time	VOC ppm	VOC mg/m^3
12:47	0.44	0.70
12:48	0.41	0.66
12:49	0.77	1.24
12:50	0.72	1.16
12:51	0.75	1.20
12:52	0.57	0.92
12:53	0.59	0.94
12:54	0.47	0.76
12:55	0.87	1.40
12:56	0.70	1.12
12:57	0.56	0.90
12:58	0.37	0.60
12:59	0.41	0.66
13:00	0.36	0.58
13:01	0.69	1.10
Mean	0.61	0.98

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

Volatile Organic Compounds Sampling Methodology

The Signal 3010 MINIFID Portable Heated Total Hydrocarbon Analyser uses Flame Ionisation to detect total organic carbon in a gas stream.

Checks Carried Out before Arrival On Site

The FID analyser is set up and is tested. The following are checked; the furnace and sample line temperatures, the zero and span gas calibration and the operation of the data logger.

On Site Sampling Procedure

The FID and sample line are switched on and allowed to reach operational temperature. The analyser will take 20 minutes to reach its operational temperature of 180^{o}C. The sample line is heated to approximately 180^{o}C to avoid VOCs condensing in the line. When the components have reached the correct operating temperature the fuel and span gas valves are opened and the FID is ignited.

The FID will take about 20 minutes before it stabilises and gives a zero ppm reading. The zero gas is fed into the FID and the zero set. The span gas is fed into the FID and the instrument adjusted to read the certified span gas value. The zero gas is fed into the FID once more to check that the reading returns to zero, if it does not, then these steps are repeated.

The probe, with a particulate filter, is then inserted into the stack, and the data logger activated.

The data logger can be programmed to log results over a 1, 5, 10 etc minute period. The results displayed and logged are the volume concentration of propane in ppm, which are converted to mg/m^3 by the following calculations:

$$C_m = C_v \frac{36}{22.4}$$

where C_m is the TOC concentration in mg/m^3 (273 K; 101300 Pa)

C_v is the volume concentration of propane in ppm (by volume)

Calculations - Run 1

1. Stack Gas Velocity (V)

$V = 0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$
V = Velocity (m/s)
Cp = Pitot Tube Calibration Coefficient
ΔP = Mean Differential Pressure (Pa)
T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	8.21	m/s
Stack Diameter (D)	0.30	m
Stack Area (A)	0.07	m^2
Stack Temperature (T)	296.00	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.03	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A \qquad Q_{(actual)} = V \times A$$

$Q_{(STP)} =$ 0.53 m^3/s **$Q_{(actual)} =$ 0.58 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.00002	g
Stack Area (A)	0.07	m^2

$$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6 = 2.3E\text{-}05 \text{ g/s}$$

M = 0.0000 g/s

4. Particulate Concentration (C) at 273K, 101.3kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 0.04 mg/m^3

Calculations - Run 2

1. Stack Gas Velocity (V)

V = 0.075 x Cp x $\sqrt{\Delta P}$ x $\sqrt{T}$
V = Velocity (m/s)
Cp = Pitot Tube Calibration Coefficient
ΔP = Mean Differential Pressure (Pa)
T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	8.14	m/s
Stack Diameter (D)	0.30	m
Stack Area (A)	0.07	m^2
Stack Temperature (T)	296.00	K
Atmospheric Pressure (P_A)	99.80	kPa
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Standard Barometric Pressure (P_B)	101.30	kPa

$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A$ $Q_{(actual)} =$ V x A

$Q_{(STP)}$ = 0.52 m^3/s **$Q_{(actual)}$ = 0.58 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.0000	g
Stack Area (A)	0.07	m^2

$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6$ = 3.5E-05 g/s

M = 0.000 g/s

4. Particulate Concentration (C) at 273K, 101.3 kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 0.07 mg/m^3

Total Particulate Matter Sampling Methodology

Job Preparation

A pre-site survey must first be undertaken to obtain the following information. Client details (full address & contact names), description of stack (name & location), sampling platform / access (Permanent - platform of adequate size & load capability, kick boards, hand & middle rails, free from debris, good drainage, fixed ladders with hoops and chain. Temporary - adequate size & load capability, stabilising legs, valid inspection tag, kick boards, hand & middle rails. Both types of platform must have a secure anchorage point to fix pulley system) hazards (dust, noise, temperature, gases/vapours, vibration, light, moving machinery, electricity etc) power supply and location, additional PPE required (high temperature gloves/overalls, PPE).

The Strohlein STE 4, isokinetic particulate measurement equipment, is fully inspected prior to use and its calibration status observed. This includes:

Pitot Tube - All pitot tubes are physically checked for damage, paying particular attention to the inlet holes. All dirt and blockages are removed.

Micromanometer - Digital differential pressure meters are used capable of measuring pressure in the range 0 Pa to 2250 Pa with a sensitivity of ±1 Pa. These instruments are checked for obvious physical damage, battery life tested and calibrated status observed.

Thermocouple - Temperature is measured using k type thermocouples. Each thermocouple is inspected for obvious damage and its calibration status observed. Digital temperature meters are used in conjunction with K type thermocouples. These are also checked for obvious physical damage and their battery life tested.

Nozzles - All nozzles used have been constructed in accordance BS 3405 : 1983, section 5.3.2. Each nozzle is physically checked for damage and removed if necessary. The nozzle calibration status is observed.

Flowmeter - The flowmeter is checked for blockages and obvious physical damage. Its calibration status is also observed.

Balance - A Mettler Toledo balance is used to weigh filters. The balance is positioned on a solid base located in a specially built weighing room. The balance is serviced and calibrated routinely each year by the manufacturer and also checked daily with in-house check weights.

Rope Kit - All lifting tackle i.e. rope, pulleys, karabiners, brakes and slings are physically checked for cuts and contamination.

Should the calibration certainty of any of the above equipment be in question, that item of equipment must be recalibrated and replaced if necessary.

Filter Selection and Preparation

Stack conditions can vary greatly for temperature, moisture, acidity, low and heavy particulate loading. Following the pre-site survey, the stack gas condition should be known and the appropriate filter can be selected and prepared as described below.

Filter mediums - glass wool, quartz wool, Gelman Sciences A/C Glass Fibre filter papers, Gelman Sciences Low Ash PVC membrane filter papers, Schleicher & Schuell Glass Fibre Thimbles or Schleicher & Schuell Quartz Thimbles.

Filters are prepared by drying in an oven at 160°C for a period of one hour and then placed to cool in a dessicator. The filters are weighed accurately on a 4-figure balance and then placed in clean individual petri dishes and transported to site in a filter storage box. Spare filters are also prepared to allow for accidents and to obtain blank values.

Sampling Procedure

Suitability of Sampling Location

Before sampling can commence, a preliminary velocity and temperature survey must be undertaken along the two sampling lines at ten equally spaced points excluding the region within 5% of the effective flue diameter from the wall. The stack diameter is measured using a steel rod. If the ratio of the highest to lowest dynamic pressures exceeds 9:1 or if the ratio of the highest to lowest gas velocities exceeds 3:1, another sampling plane should be used. Sampling is undertaken from either four or eight sampling points.

Total Particulate Matter Sampling Methodology

Four sampling points are used when the ratio of the highest to lowest dynamic pressures is less than 4:1 and eight sampling points when the ratio of highest to lowest dynamic pressures exceeds 4:1 but less than 9:1 or the stack area exceeds 2.5 m^2. Temperature is also measured at ten equally spaced points along the sampling lines and an average temperature calculated. Should the temperature at any of the sampling points differ by more than + 10% from that of the average temperature, then that point must not be used.

The required number of sampling points can now be calculated using the following:
4 point sampling, circular stacks: 0.15 x D and 0.85 x D.
4 point sampling, square stacks: 0.25 x D and 0.75 x D.
8 point sampling, circular stacks: 0.065 x D, 0.25 x D, 0.75 x D and 0.935 x D.
8 point sampling, square stacks: 0.125 x D, 0.375 x D, 0.625 x D and 0.875 x D.

Leak Checks

A leak check should be undertaken before and after the iso-kinetic sampling is carried out. This is to make sure that all suction is taken at the sampling nozzle.

Sampling

Once the iso-kinetic sampling flow rates have been calculated, the probe is inserted into the stack at 90^o to the stack gas flow, as not to impinge any particulate matter on to the filter media prior to sampling. Allow the filter head and probe to attain the stack gas temperature. Start the suction device, and set the flowmeter to the correct suction rate for isokinetic sampling. At the same time turn the nozzle into flow and start the timing device.

Duration of Sampling Time

Duration of sampling time depends on :
(a) ensuring adequate quantities of particulate matter on the filter for weighing (> 0.3 % of the filter weight).
(b) whether cumulative or incremental sampling is undertaken.
(c) the number of sampling points i.e. either 4 or 8 point sampling.
(d) the continuity of plant operation.

Cumulative Sampling

After the first sample is taken from the first sampling position the control valve is closed simultaneously turning the sampling probe 90^o tc the stack gas flow, moving the probe to the next sample position. This process should be repeated until all the sample points have been used once.

Repeat Velocity and Temperature Readings

At each of the sampling points repeat the readings for the stack gas flow rate and stack gas temperatures. Calculate the new iso-kinetic sampling flow rates. If the stack gas velocity is more than ± 5% from the initial readings the test result shall not be regarded as having the required accuracy. The new temperature reading should not exceed the permitted range calculated in the preliminary survey. i.e. it should be within ± 10% of the original mean temperature.

N.B. The filter head should be cleaned and the particulate matter added to the particulate matter on the filter.
The Sampling procedure should be repeated to obtain a duplicate sample, the ratio of the two particulate emission rates should not exceed 1.5 : 1.

Weighing of Sample

The used filter should be placed in an oven at 180^{o}C and dried thoroughly, cooled and equilibrated in a desiccator and weighed as quickly as possible so as to avoid any errors due to moisture absorption onto the filter. The gross weight of the filter should be measured to within ± 0.1 mg. The filter weight and any residual particulate matter from the filter head can then be used in the final report to calculate the particulate concentration.

On Site Isokinetic Data Sheet

Preliminary Stack Survey		Sampling Line A		Sampling Line B	
Traverse Point	Distance in Stack (m)	Dynamic Pressure (Pa)	Temperature (^{o}C)	Dynamic Pressure (Pa)	Temperature (^{o}C)
1	0.02	-	-	54	23
2	0.05	-	-	58	23
3	0.08	-	-	52	23
4	0.11	-	-	60	23
5	0.14	-	-	61	23
6	0.17	-	-	64	23
7	0.20	-	-	65	23
8	0.23	-	-	68	23
9	0.26	-	-	55	23
10	0.29	-	-	52	23
Mean	-	-	-	59	23

Lowest Dynamic Pressure (any line) 52 Ratio of Above 1.31 : 1
Highest Dynamic Pressure (any line) 68 (Highest permitted ratio 9:1)
Temperature Range permitted for any point is between -7 and 53

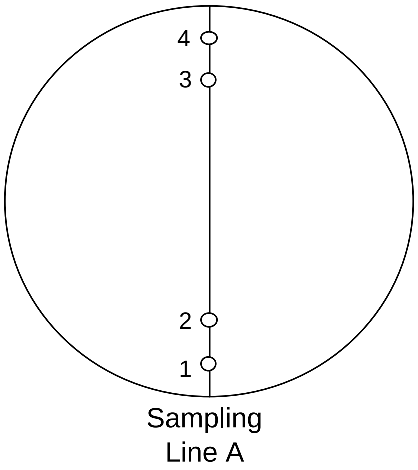
Run 1		**Sampling Time (mins)**		**20**	**Nozzle size used (mm)**		**8.0**
Sampling Point	**Dynamic Pressure (Pa)**		**Temperature (^{o}C)**		**Velocity (m/s)**		**Flowmeter set at (m^3/hr)**
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	
1	54	64	23	23	7.96	8.67	1.44
2	52	53	23	23	7.82	7.89	1.42
3	68	57	23	23	8.94	8.18	1.62
4	52	60	23	23	7.82	8.40	1.42
Mean	57	59	23	23	8.13	8.29	1.47

Difference between Initial Velocity and Final Velocity = 1.83 % (Limit permitted is ± 5%)
Start Filter Weight = 0.1244 g Sample Weight = 0.00002 g
End Filter Weight = 0.1244 g Sample as % of Filter Weight = 0.02 %

Run 2		**Sampling Time (mins)**		**20**	**Nozzle size used (mm)**		**8.0**
Sampling Point	**Dynamic Pressure (Pa)**		**Temperature (^{o}C)**		**Velocity (m/s)**		**Flowmeter set at (m^3/hr)**
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	
1	64	60	23	23	8.67	8.40	1.57
2	53	51	23	23	7.89	7.74	1.43
3	57	50	23	23	8.18	7.66	1.48
4	60	57	23	23	8.40	8.18	1.52
Mean	59	55	23	23	8.29	8.00	1.50

Difference between Initial Velocity and Final Velocity = -3.62 % (Limit permitted is ± 5%)
Start Filter Weight = 0.1192 g Sample Weight = 0.00003 g
End Filter Weight = 0.1192 g Sample as % of Filter Weight = 0.03 %

Stack Diagram

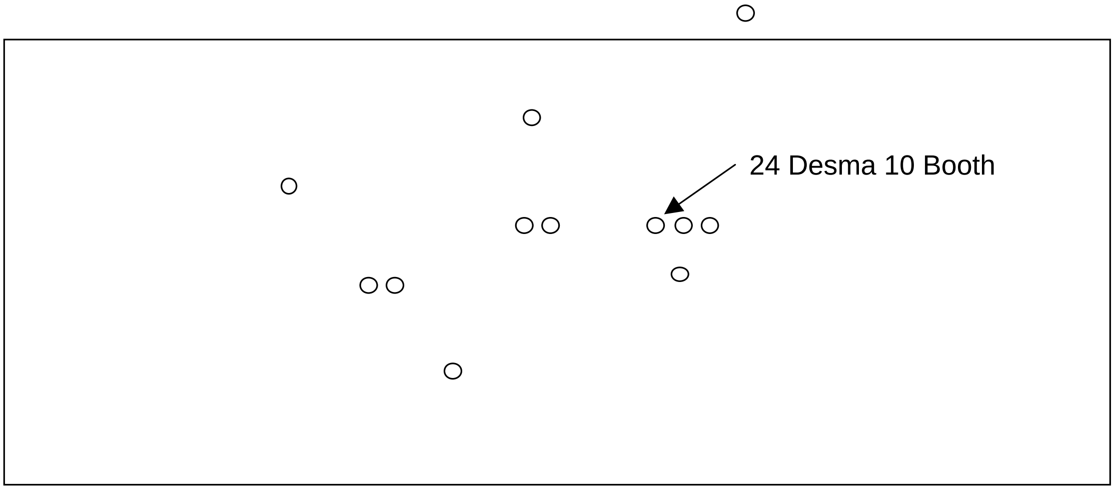


Stack Diagram (D) = 0.30 m

Stack Area (A) = 0.07 m^2

Sampling Point	**Distance as a % of (D)**	**Distance in m**
1	6.5	0.02
2	25.0	0.08
3	75.0	0.23
4	93.5	0.28

Plant Layout



Quality Assurance Checklist

Velocity Measurements:

Were water droplets present ?	No
Direction of gas flow within ± 20^{o} of stack axis.	Yes
Dynamic pressures > 5 Pa at all sampling points.	Yes
Ratio of highest to lowest dynamic pressures < 9 : 1.	Yes

Sampling:

Sampling plane was correctly positioned.	Yes
Area of sampling apparatus was < 10% of stack area.	Yes
Sampling was from centres of equal areas.	Yes
Sampling at each point not less than 3 minutes.	Yes
Nozzle was facing directly upstream to within ± 10^{o}.	Yes
Leak check performed before and after each run and passed.	Yes

Sample Handling:

Minimum weight of samples collected > 0.3% of filter weights.	No
Samples achieved stable weights.	Yes
Particulate samples stored for 3 months.	Yes

QA Procedures:

Isokinetic data sheet completed and signed off by Team Leader.	Yes
Report saved electronically onto Scientifics server.	Yes
Raw data and hard copy of report filed together.	Yes

Environmental Monitoring Team

Environmental Team Leader	Paul Adamczyk BSc (Hons) Fuel and Combustion Science MSc Environmental Pollution Control MCERTS Level 2, Technical Endorsement 1 & 4 - MM 04 547
Environmental Technician	Robert Adamczyk BSc Environmental Science MCERTS Trainee - MM06 721
Report by	Paul Adamczyk Level 2 Team Leader

Checked and Authorised By

Mark Allison Print Name

8th November 2006 Dated

Team Leader Business Title

Conclusion

The results of this test demonstrate that under normal operating conditions, this Plant is being operated in compliance with the total particulate matter and volatile organic compounds emission limits specified in PG 6/28 (04).

Good housekeeping and maintenance of the ducting and associated Plant should be continued in order to maintain this level of Plant performance.

A regular programme of stack emissions testing in accordance with the Plant's Local Air Pollution Control Authorisation will be required to demonstrate continued compliance.

Deviations from BS 3405 : 1983

Less than 0.3% of the filter weight was collected during both sample runs. This was due to the very low level of particulate emissions from the Plant.

AIR & EMISSIONS TESTING GROUP

52 Offerton Industrial Estate, Hempshaw Lane, Stockport, SK2 5TJ.
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Mobile: 07973 319576 (24 Hours)
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Stack Emissions Testing Report

Total Particulate Matter
Volatile Organic Compounds

Air Tech Environmental Consultancy Services

VIP Polymers Ltd

Huntingdon

2 Booth MIR 7

Sampling Date **26th September 2006**

Report by Paul Adamczyk

Job Number LAB 06679

Contents

Introduction

VIP Polymers Ltd operates a rubber products manufacturing process process at Huntingdon which is subject to Local Air Pollution Control by Huntingdon District Council under the Pollution Prevention and Control Regulations 2000.

Scientifics Limited, working in partnership with Air Tech ECS, were commissioned by VIP Polymers Ltd to carry out stack emissions testing to determine the release of total particulate matter and volatile organic compounds from the following Plant under normal operating conditions.

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	2 Booth MIR 7
Sampling Date	26th September 2006
Time Test Started	17:26
Time Test Ended	18:10
Operating Conditions	Normal
Materials Processed	Rubber
Plume Appearance	None Visible

Throughout sampling, the operating conditions were maintained as above. Any deviations from BS 3405 : 1983 are noted in the conclusion.

Emissions Summary

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	2 Booth MIR 7
Sampling Date	26th September 2006

Parameter	Units	Result	Limit	Outcome
Total Particulate Matter	mg/m^3	0.04	10	Passed
Particulate Emission Rate	g/hr	0.0001	-	-
Volatile Organic Compounds	mg/m^3	1.2	50	Passed
VOC Emission Rate	g/hr	3.8	-	-
Stack Gas Temperature	^oC	26	-	-
Stack Gas Volumetric Flow Rate (Actual)	m^3/hr	3631	-	-
Stack Gas Volumetric Flow Rate (STP)	m^3/hr	3267	-	-
Stack Gas Velocity	m/s	11.1	-	-

All results are mean values, with particulate concentrations expressed at reference conditions.

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

Written Summary

Total Particulate Matter	Passed

Two particulate tests were performed during continuous operating conditions. The mean sampling time was 20 minutes. The mean particulate concentration was 0.04 mg/m^3 at reference conditions. This value is below the specified emission limit of 10 mg/m^3. This is below the specified emission limit.

The tests were performed following the main procedural requirements of BS 3405 : 1983 using a Ströhlein STE 4 isokinetic particulate sampling train.

Volatile Organic Compounds	Passed

VOC (as Carbon) concentrations were measured continuously over a 30 minute period, with average values being recorded at 1 minute intervals. The mean VOC (as Carbon) concentration was 1.2 mg/m^3.

The sampling was performed in accordance with the main procedural requirements of BS 12619 : 1999 using a heated sampling line and a Signal 3010 MINIFID portable VOC analyser, with detection by FID calibrated against 74.6 ppm propane certified span gas.

Total Particulate Matter Summary

Sample	Sampling Times	Concentration	Limit
Run 1	17:26 - 17:46	0.02 mg/m^3	10 mg/m^3
Run 2	17:50 - 18:10	0.05 mg/m^3	10 mg/m^3
Mean Particulate Concentration		0.04 mg/m^3	10 mg/m^3

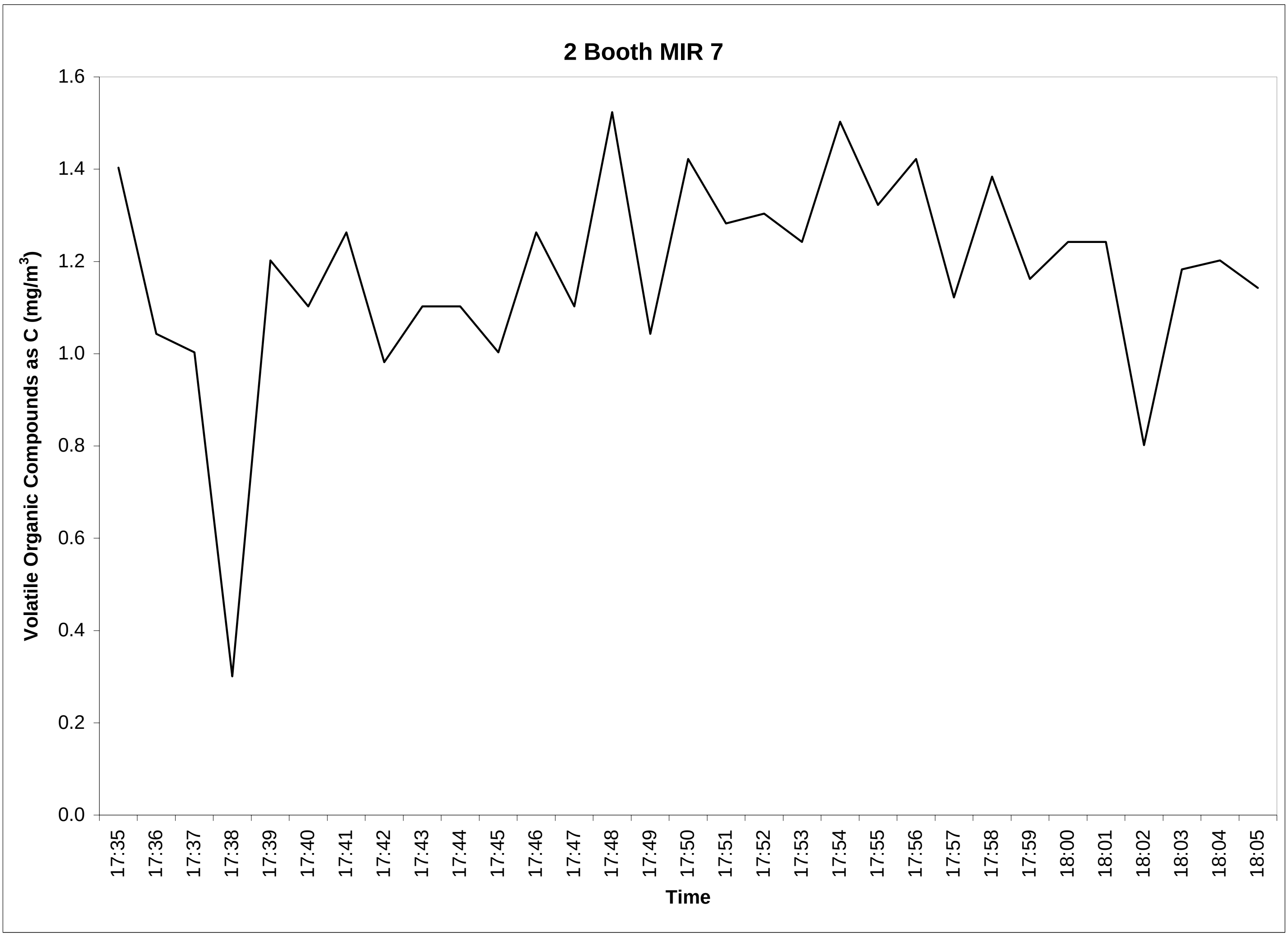
Sample	Sampling Times	Particulate Emission Rate	Ratio of Particulate Emission Rates
Run 1	17:26 - 17:46	0.00002 g/s	-
Run 2	17:50 - 18:10	0.00005 g/s	-
Mean Particulate Emission Rate		0.00003 g/s	3.0 : 1

Volatile Organic Compounds Summary

Sampling Times	Concentration (mg/m^3)	Limit (mg/m^3)	Emission Rate (g/hr)	Limit (g/hr)
17:35 - 18:05	1.2	50	3.8	-

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

Volatile Organic Compounds Emissions Profile



Volatile Organic Compounds Emissions Data

Time	VOC ppm	VOC mg/m^3
17:35	0.87	1.4
17:36	0.65	1.0
17:37	0.62	1.0
17:38	0.19	0.3
17:39	0.75	1.2
17:40	0.69	1.1
17:41	0.79	1.3
17:42	0.61	1.0
17:43	0.69	1.1
17:44	0.69	1.1
17:45	0.62	1.0
17:46	0.79	1.3
17:47	0.69	1.1
17:48	0.95	1.5
17:49	0.65	1.0
17:50	0.89	1.4

Time	VOC ppm	VOC mg/m^3
17:51	0.80	1.3
17:52	0.81	1.3
17:53	0.77	1.2
17:54	0.94	1.5
17:55	0.82	1.3
17:56	0.89	1.4
17:57	0.70	1.1
17:58	0.86	1.4
17:59	0.72	1.2
18:00	0.77	1.2
18:01	0.77	1.2
18:02	0.50	0.8
18:03	0.74	1.2
18:04	0.75	1.2
18:05	0.71	1.1
Mean	0.73	1.2

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

Volatile Organic Compounds Sampling Methodology

The Signal 3010 MINIFID Portable Heated Total Hydrocarbon Analyser uses Flame Ionisation to detect total organic carbon in a gas stream.

Checks Carried Out before Arrival On Site

The FID analyser is set up and is tested. The following are checked; the furnace and sample line temperatures, the zero and span gas calibration and the operation of the data logger.

On Site Sampling Procedure

The FID and sample line are switched on and allowed to reach operational temperature. The analyser will take 20 minutes to reach its operational temperature of 180^{o}C. The sample line is heated to approximately 180^{o}C to avoid VOCs condensing in the line. When the components have reached the correct operating temperature the fuel and span gas valves are opened and the FID is ignited.

The FID will take about 20 minutes before it stabilises and gives a zero ppm reading. The zero gas is fed into the FID and the zero set. The span gas is fed into the FID and the instrument adjusted to read the certified span gas value. The zero gas is fed into the FID once more to check that the reading returns to zero, if it does not, then these steps are repeated.

The probe, with a particulate filter, is then inserted into the stack, and the data logger activated.

The data logger can be programmed to log results over a 1, 5, 10 etc minute period. The results displayed and logged are the volume concentration of propane in ppm, which are converted to mg/m³ by the following calculations:

$$C_m = C_v \frac{36}{22.4}$$

where C_m is the TOC concentration in mg/m^3 (273 K; 101300 Pa)

C_v is the volume concentration of propane in ppm (by volume)

Calculations - Run 1

1. Stack Gas Velocity (V)

V = $0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$
V = Velocity (m/s)
Cp = Pitot Tube Calibration Coefficient
ΔP = Mean Differential Pressure (Pa)
T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	11.09	m/s
Stack Diameter (D)	0.34	m
Stack Area (A)	0.09	m^2
Stack Temperature (T)	299.00	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.03	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A \qquad Q_{(actual)} = V \times A$$

$Q_{(STP)}$ = 0.91 m^3/s **$Q_{(actual)}$ = 1.01 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.00001	g
Stack Area (A)	0.09	m^2

$$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6 = 1.5E-05 \text{ g/s}$$

M = 0.0000 g/s

4. Particulate Concentration (C) at 273K, 101.3kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 0.02 mg/m^3

Calculations - Run 2

1. Stack Gas Velocity (V)

$V = 0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$
V = Velocity (m/s)
Cp = Pitot Tube Calibration Coefficient
ΔP = Mean Differential Pressure (Pa)
T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	11.13	m/s
Stack Diameter (D)	0.34	m
Stack Area (A)	0.09	m^2
Stack Temperature (T)	299.00	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.03	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A \qquad Q_{(actual)} = V \times A$$

$Q_{(STP)}$ = 0.91 m^3/s **$Q_{(actual)}$ = 1.01 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.0000	g
Stack Area (A)	0.09	m^2

$$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6 = 4.5E-05 \text{ g/s}$$

M = 0.000 g/s

4. Particulate Concentration (C) at 273K, 101.3 kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 0.05 mg/m^3

Total Particulate Matter Sampling Methodology

Job Preparation

A pre-site survey must first be undertaken to obtain the following information. Client details (full address & contact names), description of stack (name & location), sampling platform / access (Permanent - platform of adequate size & load capability, kick boards, hand & middle rails, free from debris, good drainage, fixed ladders with hoops and chain. Temporary - adequate size & load capability, stabilising legs, valid inspection tag, kick boards, hand & middle rails. Both types of platform must have a secure anchorage point to fix pulley system) hazards (dust, noise, temperature, gases/vapours, vibration, light, moving machinery, electricity etc) power supply and location, additional PPE required (high temperature gloves/overalls, PPE).

The Strohlein STE 4, isokinetic particulate measurement equipment, is fully inspected prior to use and its calibration status observed. This includes:
Pitot Tube - All pitot tubes are physically checked for damage, paying particular attention to the inlet holes. All dirt and blockages are removed.
Micromanometer - Digital differential pressure meters are used capable of measuring pressure in the range 0 Pa to 2250 Pa with a sensitivity of ±1 Pa. These instruments are checked for obvious physical damage, battery life tested and calibrated status observed.

Thermocouple - Temperature is measured using k type thermocouples. Each thermocouple is inspected for obvious damage and its calibration status observed. Digital temperature meters are used in conjunction with K type thermocouples. These are also checked for obvious physical damage and their battery life tested.
Nozzles - All nozzles used have been constructed in accordance BS 3405 : 1983, section 5.3.2. Each nozzle is physically checked for damage and removed if necessary. The nozzle calibration status is observed.
Flowmeter - The flowmeter is checked for blockages and obvious physical damage. Its calibration status is also observed.

Balance - A Mettler Toledo balance is used to weigh filters. The balance is positioned on a solid base located in a specially built weighing room. The balance is serviced and calibrated routinely each year by the manufacturer and also checked daily with in-house check weights.
Rope Kit - All lifting tackle i.e. rope, pulleys, karabiners, brakes and slings are physically checked for cuts and contamination.

Should the calibration certainty of any of the above equipment be in question, that item of equipment must be recalibrated and replaced if necessary.

Filter Selection and Preparation

Stack conditions can vary greatly for temperature, moisture, acidity, low and heavy particulate loading. Following the pre-site survey, the stack gas condition should be known and the appropriate filter can be selected and prepared as described below.

Filter mediums - glass wool, quartz wool, Gelman Sciences A/C Glass Fibre filter papers, Gelman Sciences Low Ash PVC membrane filter papers, Schleicher & Schuell Glass Fibre Thimbles or Schleicher & Schuell Quartz Thimbles.

Filters are prepared by drying in an oven at 160^{o}C for a period of one hour and then placed to cool in a dessicator. The filters are weighed accurately on a 4-figure balance and then placed in clean individual petri dishes and transported to site in a filter storage box. Spare filters are also prepared to allow for accidents and to obtain blank values.

Sampling Procedure

Suitability of Sampling Location

Before sampling can commence, a preliminary velocity and temperature survey must be undertaken along the two sampling lines at ten equally spaced points excluding the region within 5% of the effective flue diameter from the wall. The stack diameter is measured using a steel rod. If the ratio of the highest to lowest dynamic pressures exceeds 9:1 or if the ratio of the highest to lowest gas velocities exceeds 3:1, another sampling plane should be used. Sampling is undertaken from either four or eight sampling points.

Total Particulate Matter Sampling Methodology

Four sampling points are used when the ratio of the highest to lowest dynamic pressures is less than 4:1 and eight sampling points when the ratio of highest to lowest dynamic pressures exceeds 4:1 but less than 9:1 or the stack area exceeds 2.5 m^2. Temperature is also measured at ten equally spaced points along the sampling lines and an average temperature calculated. Should the temperature at any of the sampling points differ by more than + 10% from that of the average temperature, then that point must not be used.

The required number of sampling points can now be calculated using the following:
4 point sampling, circular stacks: 0.15 x D and 0.85 x D.
4 point sampling, square stacks: 0.25 x D and 0.75 x D.
8 point sampling, circular stacks: 0.065 x D, 0.25 x D, 0.75 x D and 0.935 x D.
8 point sampling, square stacks: 0.125 x D, 0.375 x D, 0.625 x D and 0.875 x D.

Leak Checks

A leak check should be undertaken before and after the iso-kinetic sampling is carried out. This is to make sure that all suction is taken at the sampling nozzle.

Sampling

Once the iso-kinetic sampling flow rates have been calculated, the probe is inserted into the stack at 90^o to the stack gas flow, as not to impinge any particulate matter on to the filter media prior to sampling. Allow the filter head and probe to attain the stack gas temperature. Start the suction device, and set the flowmeter to the correct suction rate for isokinetic sampling. At the same time turn the nozzle into flow and start the timing device.

Duration of Sampling Time

Duration of sampling time depends on :
(a) ensuring adequate quantities of particulate matter on the filter for weighing (> 0.3 % of the filter weight).
(b) whether cumulative or incremental sampling is undertaken.
(c) the number of sampling points i.e. either 4 or 8 point sampling.
(d) the continuity of plant operation.

Cumulative Sampling

After the first sample is taken from the first sampling position the control valve is closed simultaneously turning the sampling probe 90^o tc the stack gas flow, moving the probe to the next sample position. This process should be repeated until all the sample points have been used once.

Repeat Velocity and Temperature Readings

At each of the sampling points repeat the readings for the stack gas flow rate and stack gas temperatures. Calculate the new iso-kinetic sampling flow rates. If the stack gas velocity is more than ± 5% from the initial readings the test result shall not be regarded as having the required accuracy. The new temperature reading should not exceed the permitted range calculated in the preliminary survey. i.e. it should be within ± 10% of the original mean temperature.

N.B. The filter head should be cleaned and the particulate matter added to the particulate matter on the filter.
The Sampling procedure should be repeated to obtain a duplicate sample, the ratio of the two particulate emission rates should not exceed 1.5 : 1.

Weighing of Sample

The used filter should be placed in an oven at 180^oC and dried thoroughly, cooled and equilibrated in a desiccator and weighed as quickly as possible so as to avoid any errors due to moisture absorption onto the filter. The gross weight of the filter should be measured to within ± 0.1 mg. The filter weight and any residual particulate matter from the filter head can then be used in the final report to calculate the particulate concentration.

On Site Isokinetic Data Sheet

Preliminary Stack Survey		Sampling Line A		Sampling Line B	
Traverse Point	Distance in Stack (m)	Dynamic Pressure (Pa)	Temperature (°C)	Dynamic Pressure (Pa)	Temperature (°C)
1	0.02	-	-	85	26
2	0.05	-	-	92	26
3	0.09	-	-	118	26
4	0.12	-	-	116	26
5	0.15	-	-	108	26
6	0.19	-	-	117	26
7	0.22	-	-	111	26
8	0.26	-	-	116	26
9	0.29	-	-	91	26
10	0.32	-	-	83	26
Mean	-	-	-	104	26

Lowest Dynamic Pressure (any line) 83 Ratio of Above 1.42 : 1
Highest Dynamic Pressure (any line) 118 (Highest permitted ratio 9:1)
Temperature Range permitted for any point is between -4 and 56

Run 1		**Sampling Time (mins)**		**20**	**Nozzle size used (mm)**		**8.0**
Sampling Point	**Dynamic Pressure (Pa)**		**Temperature (°C)**		**Velocity (m/s)**		**Flowmeter set at (m^3/hr)**
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	
1	85	114	26	26	10.04	11.63	1.80
2	118	108	26	26	11.83	11.32	2.12
3	116	113	26	26	11.73	11.58	2.10
4	83	95	26	26	9.92	10.62	1.78
Mean	101	108	26	26	10.88	11.29	1.95

Difference between Initial Velocity and Final Velocity = 3.58 % (Limit permitted is ± 5%)

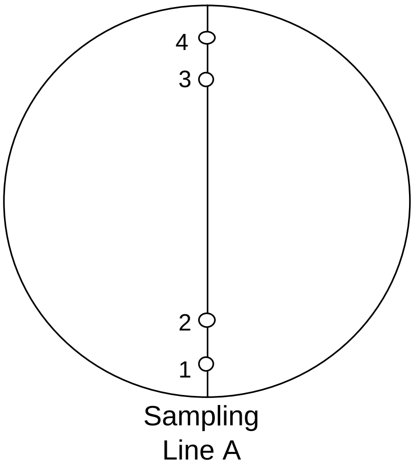
Start Filter Weight = 0.1196 g Sample Weight = 0.00001 g
End Filter Weight = 0.1196 g Sample as % of Filter Weight = 0.01 %

Run 2		**Sampling Time (mins)**		**20**	**Nozzle size used (mm)**		**8.0**
Sampling Point	**Dynamic Pressure (Pa)**		**Temperature (°C)**		**Velocity (m/s)**		**Flowmeter set at (m^3/hr)**
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	
1	114	118	26	26	11.63	11.83	2.09
2	108	100	26	26	11.32	10.89	2.03
3	113	99	26	26	11.58	10.84	2.08
4	95	90	26	26	10.62	10.33	1.90
Mean	108	102	26	26	11.29	10.98	2.02

Difference between Initial Velocity and Final Velocity = -2.85 % (Limit permitted is ± 5%)

Start Filter Weight = 0.1192 g Sample Weight = 0.00003 g
End Filter Weight = 0.1192 g Sample as % of Filter Weight = 0.03 %

Stack Diagram

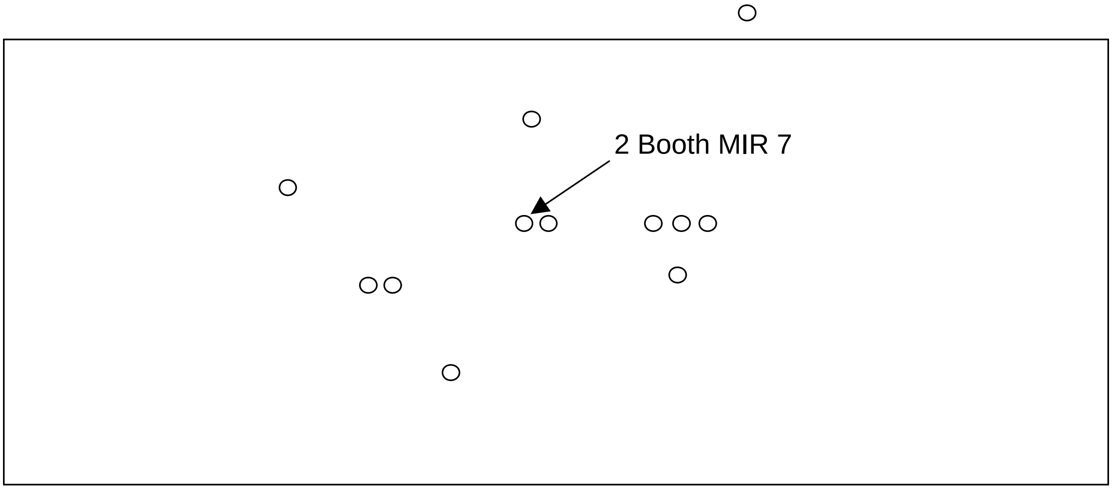


Stack Diameter (D) = 0.34 m

Stack Area (A) = 0.09 m^2

Sampling Point	Distance as a % of (D)	Distance in m
1	6.5	0.02
2	25.0	0.09
3	75.0	0.26
4	93.5	0.32

Plant Layout



Quality Assurance Checklist

Velocity Measurements:

Were water droplets present ?	No
Direction of gas flow within ± 20° of stack axis.	Yes
Dynamic pressures > 5 Pa at all sampling points.	Yes
Ratio of highest to lowest dynamic pressures < 9 : 1.	Yes

Sampling:

Sampling plane was correctly positioned.	Yes
Area of sampling apparatus was < 10% of stack area.	Yes
Sampling was from centres of equal areas.	Yes
Sampling at each point not less than 3 minutes.	Yes
Nozzle was facing directly upstream to within ± 10°.	Yes
Leak check performed before and after each run and passed.	Yes

Sample Handling:

Minimum weight of samples collected > 0.3% of filter weights.	No
Samples achieved stable weights.	Yes
Particulate samples stored for 3 months.	Yes

QA Procedures:

Isokinetic data sheet completed and signed off by Team Leader.	Yes
Report saved electronically onto Scientifics server.	Yes
Raw data and hard copy of report filed together.	Yes

Environmental Monitoring Team

Environmental Team Leader	Paul Adamczyk BSc (Hons) Fuel and Combustion Science MSc Environmental Pollution Control MCERTS Level 2, Technical Endorsement 1 & 4 - MM 04 547
Environmental Technician	Robert Adamczyk BSc Environmental Science MCERTS Trainee - MM06 721
Report by	Paul Adamczyk Level 2 Team Leader

Checked and Authorised By

Mark Allison Print Name

7th November 2006 Dated

Team Leader Business Title

Conclusion

The results of this test demonstrate that under normal operating conditions, this Plant is being operated in compliance with the total particulate matter and volatile organic compounds emission limits specified in PG 6/28 (04).

Good housekeeping and maintenance of the ducting and associated Plant should be continued in order to maintain this level of Plant performance.

A regular programme of stack emissions testing in accordance with the Plant's Local Air Pollution Control Authorisation will be required to demonstrate continued compliance.

Deviations from BS 3405 : 1983

Less than 0.3% of the filter weight was collected during both sample runs. This was due to the very low level of particulate emissions from the Plant.

scientifics®

AIR & EMISSIONS TESTING GROUP

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Stack Emissions Testing Report

Total Particulate Matter
Volatile Organic Compounds

Air Tech Environmental Consultancy Services

VIP Polymers Limited

Huntingdon

14 MIR 7

Sampling Date **26th September 2006**

Report by Paul Adamczyk

Job Number LAB 06679

Contents

Introduction

VIP Polymers Limited operates a rubber products manufacturing process process at Huntingdon which is subject to Local Air Pollution Control by Huntingdon District Council under the Pollution Prevention and Control Regulations 2000.

Scientifics Limited, working in partnership with Air Tech ECS, were commissioned by VIP Polymers Limited to carry out stack emissions testing to determine the release of total particulate matter and volatile organic compounds from the following Plant under normal operating conditions.

Company	VIP Polymers Limited
Site	Huntingdon
Stack	14 MIR 7
Sampling Date	26th September 2006
Time Test Started	20:08
Time Test Ended	20:52
Operating Conditions	Normal
Materials Processed	Rubber
Plume Appearance	Light Fume Visible

Throughout sampling, the operating conditions were maintained as above. Any deviations from BS 3405 : 1983 are noted in the conclusion.

Emissions Summary

Company	VIP Polymers Limited
Site	Huntingdon
Stack	14 MIR 7
Sampling Date	26th September 2006

Parameter	Units	Result	Limit	Outcome
Total Particulate Matter	mg/m^3	23	10	Failed
Particulate Emission Rate	g/hr	275	-	-
Volatile Organic Compounds	mg/m^3	4.3	50	Passed
VOC Emission Rate	g/hr	52	-	-
Stack Gas Temperature	^{o}C	25	-	-
Stack Gas Volumetric Flow Rate (Actual)	m^3/hr	13317	-	-
Stack Gas Volumetric Flow Rate (STP)	m^3/hr	12023	-	-
Stack Gas Velocity	m/s	18.8	-	-

All results are mean values, with particulate concentrations expressed at reference conditions.

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

Written Summary

Total Particulate Matter	Failed

Two particulate tests were performed during continuous operating conditions. The mean sampling time was 20 minutes. The mean particulate concentration was 23 mg/m^3 at reference conditions. This value is above the specified emission limit of 10 mg/m^3. This is below the specified emission limit.

The tests were performed following the main procedural requirements of BS 3405 : 1983 using a Ströhlein STE 4 isokinetic particulate sampling train.

Volatile Organic Compounds	Passed

VOC (as Carbon) concentrations were measured continuously over a 30 minute period, with average values being recorded at 1 minute intervals. The mean VOC (as Carbon) concentration was 4.3 mg/m^3.

The sampling was performed in accordance with the main procedural requirements of BS 12619 : 1999 using a heated sampling line and a Signal 3010 MINIFID portable VOC analyser, with detection by FID calibrated against 74.6 ppm propane certified span gas.

Total Particulate Matter Summary

Sample	Sampling Times	Concentration	Limit
Run 1	20:08 - 20:28	35.0 mg/m^3	10 mg/m^3
Run 2	20:32 - 20:52	10.3 mg/m^3	10 mg/m^3
Mean Particulate Concentration		23.0 mg/m^3	10 mg/m^3

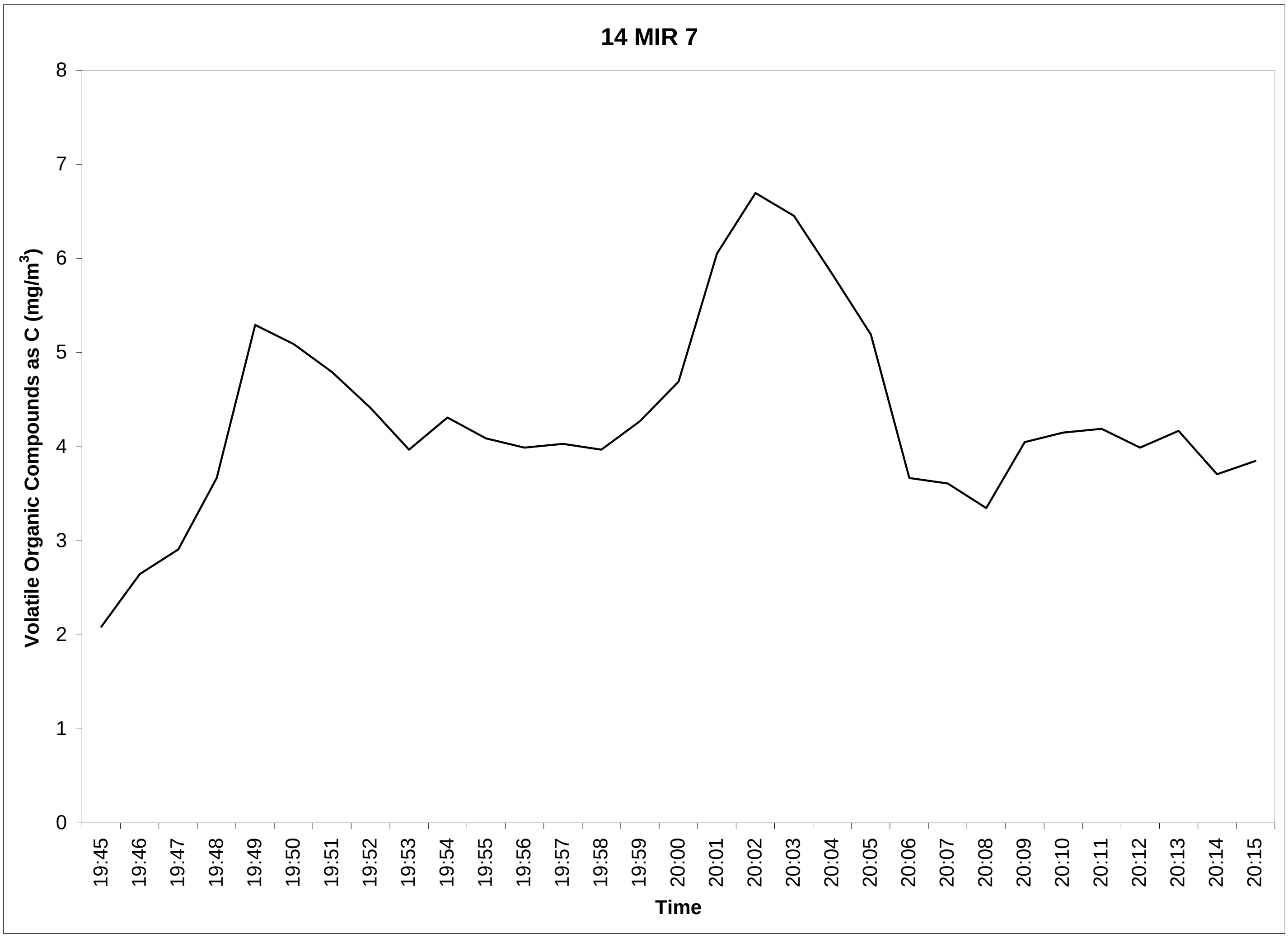
Sample	Sampling Times	Particulate Emission Rate	Ratio of Particulate Emission Rates
Run 1	20:08 - 20:28	0.118 g/s	-
Run 2	20:32 - 20:52	0.035 g/s	-
Mean Particulate Emission Rate		0.076 g/s	3.4 : 1

Volatile Organic Compounds Summary

Sampling Times	Concentration (mg/m^3)	Limit (mg/m^3)	Emission Rate (g/hr)	Limit (g/hr)
19:45 - 20:15	4.3	50	52	-

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

Volatile Organic Compounds Emissions Profile



Volatile Organic Compounds Emissions Data

Time	VOC ppm	VOC mg/m^3
19:45	1.3	2.1
19:46	1.6	2.6
19:47	1.8	2.9
19:48	2.3	3.7
19:49	3.3	5.3
19:50	3.2	5.1
19:51	3.0	4.8
19:52	2.7	4.4
19:53	2.5	4.0
19:54	2.7	4.3
19:55	2.5	4.1
19:56	2.5	4.0
19:57	2.5	4.0
19:58	2.5	4.0
19:59	2.7	4.3
20:00	2.9	4.7

Time	VOC ppm	VOC mg/m^3
20:01	3.8	6.1
20:02	4.2	6.7
20:03	4.0	6.5
20:04	3.6	5.8
20:05	3.2	5.2
20:06	2.3	3.7
20:07	2.2	3.6
20:08	2.1	3.3
20:09	2.5	4.0
20:10	2.6	4.1
20:11	2.6	4.2
20:12	2.5	4.0
20:13	2.6	4.2
20:14	2.3	3.7
20:15	2.4	3.8
Mean	2.7	4.3

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

Volatile Organic Compounds Sampling Methodology

The Signal 3010 MINIFID Portable Heated Total Hydrocarbon Analyser uses Flame Ionisation to detect total organic carbon in a gas stream.

Checks Carried Out before Arrival On Site

The FID analyser is set up and is tested. The following are checked; the furnace and sample line temperatures, the zero and span gas calibration and the operation of the data logger.

On Site Sampling Procedure

The FID and sample line are switched on and allowed to reach operational temperature. The analyser will take 20 minutes to reach its operational temperature of 180°C. The sample line is heated to approximately 180°C to avoid VOCs condensing in the line. When the components have reached the correct operating temperature the fuel and span gas valves are opened and the FID is ignited.

The FID will take about 20 minutes before it stabilises and gives a zero ppm reading. The zero gas is fed into the FID and the zero set. The span gas is fed into the FID and the instrument adjusted to read the certified span gas value. The zero gas is fed into the FID once more to check that the reading returns to zero, if it does not, then these steps are repeated.

The probe, with a particulate filter, is then inserted into the stack, and the data logger activated.

The data logger can be programmed to log results over a 1, 5, 10 etc minute period. The results displayed and logged are the volume concentration of propane in ppm, which are converted to mg/m³ by the following calculations:

$$C_m = C_v \frac{36}{22.4}$$

where C_m is the TOC concentration in mg/m^3 (273 K; 101300 Pa)
C_v is the volume concentration of propane in ppm (by volume)

Calculations - Run 1

1. Stack Gas Velocity (V)

V = $0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$

V = Velocity (m/s)

Cp = Pitot Tube Calibration Coefficient

ΔP = Mean Differential Pressure (Pa)

T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	18.84	m/s
Stack Diameter (D)	0.50	m
Stack Area (A)	0.20	m^2
Stack Temperature (T)	298.00	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.03	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A$ $\qquad$ $Q_{(actual)} = V \times A$

$Q_{(STP)}$ = 3.34 m^3/s $\qquad$ **$Q_{(actual)}$ = 3.70 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.03635	g
Stack Area (A)	0.20	m^2

$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6$ = 1.2E-01 g/s

M = 0.1183 g/s

4. Particulate Concentration (C) at 273K, 101.3kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 35.43 mg/m^3

Calculations - Run 2

1. Stack Gas Velocity (V)

$V = 0.075 \times C_p \times \sqrt{\Delta P} \times \sqrt{T}$

V = Velocity (m/s)

C_p = Pitot Tube Calibration Coefficient

ΔP = Mean Differential Pressure (Pa)

T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	18.84	m/s
Stack Diameter (D)	0.50	m
Stack Area (A)	0.20	m^2
Stack Temperature (T)	298.00	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.03	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St}) \times V \times A}{P_B}$ $\qquad Q_{(actual)} = V \times A$

$Q_{(STP)}$ = 3.34 m^3/s $\qquad$ **$Q_{(actual)}$ = 3.70 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.0106	g
Stack Area (A)	0.20	m^2

$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6$ = 3.5E-02 g/s

M = 0.035 g/s

4. Particulate Concentration (C) at 273K, 101.3 kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 10.33 mg/m^3

Total Particulate Matter Sampling Methodology

Job Preparation

A pre-site survey must first be undertaken to obtain the following information. Client details (full address & contact names), description of stack (name & location), sampling platform / access (Permanent - platform of adequate size & load capability, kick boards, hand & middle rails, free from debris, good drainage, fixed ladders with hoops and chain. Temporary - adequate size & load capability, stabilising legs, valid inspection tag, kick boards, hand & middle rails. Both types of platform must have a secure anchorage point to fix pulley system) hazards (dust, noise, temperature, gases/vapours, vibration, light, moving machinery, electricity etc) power supply and location, additional PPE required (high temperature gloves/overalls, PPE).

The Strohlein STE 4, isokinetic particulate measurement equipment, is fully inspected prior to use and its calibration status observed. This includes:

Pitot Tube - All pitot tubes are physically checked for damage, paying particular attention to the inlet holes. All dirt and blockages are removed.

Micromanometer - Digital differential pressure meters are used capable of measuring pressure in the range 0 Pa to 2250 Pa with a sensitivity of ±1 Pa. These instruments are checked for obvious physical damage, battery life tested and calibrated status observed.

Thermocouple - Temperature is measured using k type thermocouples. Each thermocouple is inspected for obvious damage and its calibration status observed. Digital temperature meters are used in conjunction with K type thermocouples. These are also checked for obvious physical damage and their battery life tested.

Nozzles - All nozzles used have been constructed in accordance BS 3405 : 1983, section 5.3.2. Each nozzle is physically checked for damage and removed if necessary. The nozzle calibration status is observed.

Flowmeter - The flowmeter is checked for blockages and obvious physical damage. Its calibration status is also observed.

Balance - A Mettler Toledo balance is used to weigh filters. The balance is positioned on a solid base located in a specially built weighing room. The balance is serviced and calibrated routinely each year by the manufacturer and also checked daily with in-house check weights.

Rope Kit - All lifting tackle i.e. rope, pulleys, karabiners, brakes and slings are physically checked for cuts and contamination.

Should the calibration certainty of any of the above equipment be in question, that item of equipment must be recalibrated and replaced if necessary.

Filter Selection and Preparation

Stack conditions can vary greatly for temperature, moisture, acidity, low and heavy particulate loading. Following the pre-site survey, the stack gas condition should be known and the appropriate filter can be selected and prepared as described below.

Filter mediums - glass wool, quartz wool, Gelman Sciences A/C Glass Fibre filter papers, Gelman Sciences Low Ash PVC membrane filter papers, Schleicher & Schuell Glass Fibre Thimbles or Schleicher & Schuell Quartz Thimbles.

Filters are prepared by drying in an oven at 160^{o}C for a period of one hour and then placed to cool in a dessicator. The filters are weighed accurately on a 4-figure balance and then placed in clean individual petri dishes and transported to site in a filter storage box. Spare filters are also prepared to allow for accidents and to obtain blank values.

Sampling Procedure

Suitability of Sampling Location

Before sampling can commence, a preliminary velocity and temperature survey must be undertaken along the two sampling lines at ten equally spaced points excluding the region within 5% of the effective flue diameter from the wall. The stack diameter is measured using a steel rod. If the ratio of the highest to lowest dynamic pressures exceeds 9:1 or if the ratio of the highest to lowest gas velocities exceeds 3:1, another sampling plane should be used. Sampling is undertaken from either four or eight sampling points.

Total Particulate Matter Sampling Methodology

Four sampling points are used when the ratio of the highest to lowest dynamic pressures is less than 4:1 and eight sampling points when the ratio of highest to lowest dynamic pressures exceeds 4:1 but less than 9:1 or the stack area exceeds 2.5 m^2. Temperature is also measured at ten equally spaced points along the sampling lines and an average temperature calculated. Should the temperature at any of the sampling points differ by more than + 10% from that of the average temperature, then that point must not be used.

The required number of sampling points can now be calculated using the following:
4 point sampling, circular stacks: 0.15 x D and 0.85 x D.
4 point sampling, square stacks: 0.25 x D and 0.75 x D.
8 point sampling, circular stacks: 0.065 x D, 0.25 x D, 0.75 x D and 0.935 x D.
8 point sampling, square stacks: 0.125 x D, 0.375 x D, 0.625 x D and 0.875 x D.

Leak Checks

A leak check should be undertaken before and after the iso-kinetic sampling is carried out. This is to make sure that all suction is taken at the sampling nozzle.

Sampling

Once the iso-kinetic sampling flow rates have been calculated, the probe is inserted into the stack at 90° to the stack gas flow, as not to impinge any particulate matter on to the filter media prior to sampling. Allow the filter head and probe to attain the stack gas temperature. Start the suction device, and set the flowmeter to the correct suction rate for isokinetic sampling. At the same time turn the nozzle into flow and start the timing device.

Duration of Sampling Time

Duration of sampling time depends on :
(a) ensuring adequate quantities of particulate matter on the filter for weighing (> 0.3 % of the filter weight).
(b) whether cumulative or incremental sampling is undertaken.
(c) the number of sampling points i.e. either 4 or 8 point sampling.
(d) the continuity of plant operation.

Cumulative Sampling

After the first sample is taken from the first sampling position the control valve is closed simultaneously turning the sampling probe 90° tc the stack gas flow, moving the probe to the next sample position. This process should be repeated until all the sample points have been used once.

Repeat Velocity and Temperature Readings

At each of the sampling points repeat the readings for the stack gas flow rate and stack gas temperatures. Calculate the new iso-kinetic sampling flow rates. If the stack gas velocity is more than ± 5% from the initial readings the test result shall not be regarded as having the required accuracy. The new temperature reading should not exceed the permitted range calculated in the preliminary survey. i.e. it should be within ± 10% of the original mean temperature.

N.B. The filter head should be cleaned and the particulate matter added to the particulate matter on the filter.

The Sampling procedure should be repeated to obtain a duplicate sample, the ratio of the two particulate emission rates should not exceed 1.5 : 1.

Weighing of Sample

The used filter should be placed in an oven at 180°C and dried thoroughly, cooled and equilibrated in a desiccator and weighed as quickly as possible so as to avoid any errors due to moisture absorption onto the filter. The gross weight of the filter should be measured to within ± 0.1 mg. The filter weight and any residual particulate matter from the filter head can then be used in the final report to calculate the particulate concentration.

On Site Isokinetic Data Sheet

Preliminary Stack Survey		**Sampling Line A**		**Sampling Line B**	
Traverse Point	**Distance in Stack (m)**	**Dynamic Pressure (Pa)**	**Temperature (^oC)**	**Dynamic Pressure (Pa)**	**Temperature (^oC)**
1	0.03	-	-	-	-
2	0.08	-	-	-	-
3	0.13	300	25	-	-
4	0.18	-	-	-	-
5	0.23	-	-	-	-
6	0.28	-	-	-	-
7	0.33	-	-	-	-
8	0.38	300	25	-	-
9	0.43	-	-	-	-
10	0.48	-	-	-	-
Mean	-	300	25	-	-

Lowest Dynamic Pressure (any line)	300	Ratio of Above	1.00 : 1
Highest Dynamic Pressure (any line)	300	(Highest permitted ratio 9:1)	

Temperature Range permitted for any point is between -5 and 55

Run 1		**Sampling Time (mins)**	**20**		**Nozzle size used (mm)**		**8.0**
Sampling Point	**Dynamic Pressure (Pa)**		**Temperature (^oC)**		**Velocity (m/s)**		**Flowmeter set at (m^3/hr)**
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	
1	300	300	25	25	18.84	18.84	3.39
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
Mean	300	300	25	25	18.84	18.84	3.39

Difference between Initial Velocity and Final Velocity = 0.00 % (Limit permitted is ± 5%)

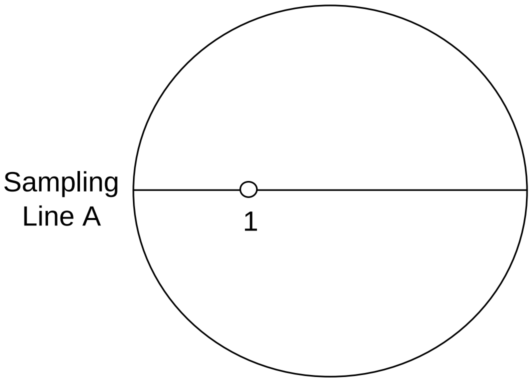
Start Filter Weight =	0.1201 g	Sample Weight =	0.03635 g
End Filter Weight =	0.1565 g	Sample as % of Filter Weight =	30.26 %

Run 2		**Sampling Time (mins)**	**20**		**Nozzle size used (mm)**		**8.0**
Sampling Point	**Dynamic Pressure (Pa)**		**Temperature (^oC)**		**Velocity (m/s)**		**Flowmeter set at (m^3/hr)**
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	
1	300	300	25	25	18.84	18.84	3.39
2	-	-	-	-	-	-	-
3	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-
Mean	300	300	25	25	18.84	18.84	3.39

Difference between Initial Velocity and Final Velocity = 0.00 % (Limit permitted is ± 5%)

Start Filter Weight =	0.1182 g	Sample Weight =	0.01060 g
End Filter Weight =	0.1288 g	Sample as % of Filter Weight =	8.97 %

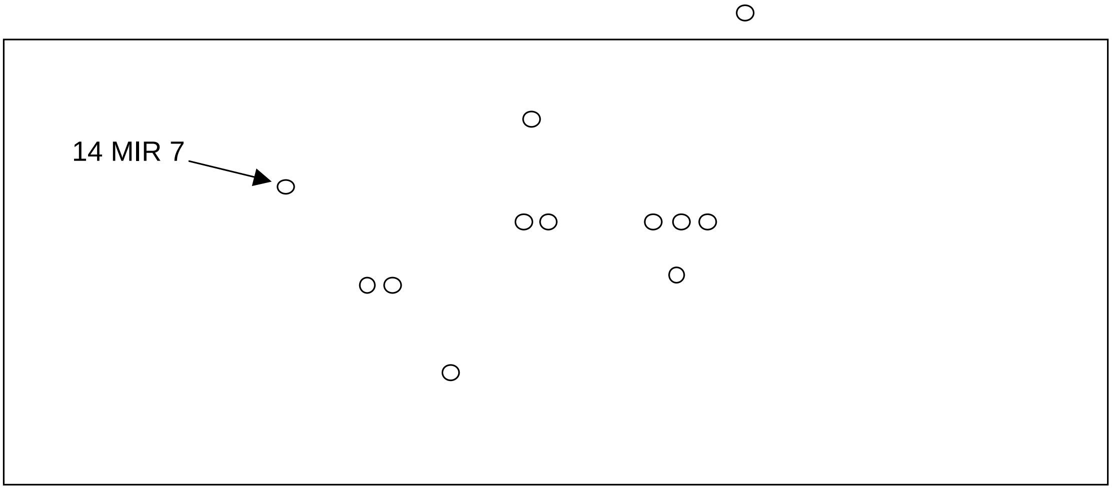
Stack Diagram



Stack Diameter (D) = 0.50 m
Stack Area (A) = 0.20 m^2

Sampling Point	Distance as a % of (D)	Distance in m
1	30	0.15

Plant Layout



Quality Assurance Checklist

Velocity Measurements:

Were water droplets present ? No

Direction of gas flow within ± 20° of stack axis. Yes

Dynamic pressures > 5 Pa at all sampling points. Yes

Ratio of highest to lowest dynamic pressures < 9 : 1. Yes

Sampling:

Sampling plane was correctly positioned. Yes

Area of sampling apparatus was < 10% of stack area. Yes

Sampling was from centres of equal areas. Yes

Sampling at each point not less than 3 minutes. Yes

Nozzle was facing directly upstream to within ± 10°. Yes

Leak check performed before and after each run and passed. Yes

Sample Handling:

Minimum weight of samples collected > 0.3% of filter weights. Yes

Samples achieved stable weights. Yes

Particulate samples stored for 3 months. Yes

QA Procedures:

Isokinetic data sheet completed and signed off by Team Leader. Yes

Report saved electronically onto Scientifics server. Yes

Raw data and hard copy of report filed together. Yes

Environmental Monitoring Team

Environmental Team Leader	Paul Adamczyk BSc (Hons) Fuel and Combustion Science MSc Environmental Pollution Control MCERTS Level 2, Technical Endorsement 1 & 4 - MM 04 547
Environmental Technician	Robert Adamczyk BSc Environmental Science MCERTS Trainee - MM 06 721
Report by	Paul Adamczyk Level 2 Team Leader

Checked and Authorised By	Mark Allison	Print Name
	7th November 2006	Dated
	Team Leader	Business Title

Conclusion

The results of this test demonstrate that under normal operating conditions, this Plant is being operated with emissions of total particulate matter in excess of the emission limit specified in PG 6/28 (04).

The performance of the Plant should be immediately investigated and steps taken to reduce emissions of total particulate matter to a level below the current emission limit of 10 mg/m³.

A regular programme of stack emissions testing in accordance with the Plant's Local Air Pollution Control Authorisation will be required to demonstrate future compliance.

Deviations from BS 3405 : 1983

AIR & EMISSIONS TESTING GROUP

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Business Manager
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Stack Emissions Testing Report

Total Particulate Matter

Report Date / Version:	2nd February 2007 / Version 1
Report By: MCERTS Number: MCERTS Level: Technical Endorsements:	Huw Williams MM 05 619 MCERTS Level 1 TE 1
Report Approved By: MCERTS Number: Business Title: Technical Endorsements: Signature:	Laurence Sharrock MM 05 572 Level 2 - Team Leader TE1 & TE2

VIP Polymers Limited

Huntingdon

MIR 7 Exhaust

Sampling Date:
30th January 2007

Job Number:
LSW 01659

CONTENTS

EXECUTIVE SUMMARY (Page 1 of 9)

Stack Emissions Monitoring Objectives

VIP Polymers Limited operates a rubber moulding process at Huntingdon which is subject to a PPC Permit, under the Pollution Prevention & Control Regulations 2000.

Scientifics Limited were commissioned by VIP Polymers Limited to carry out stack emissions monitoring to determine the release of total particulate matter from the following Plant under Normal operating conditions.

The results of this test shall be used to demonstrate compliance with an emission limit value for total particulate matter as specified in the Plant's PPC Permit, PPC 11/94.

Plant

MIR 7 Exhaust

Operator

PPC Permit: PPC 11/94

VIP Polymers Limited
St Peters Road
Huntingdon
Cambridgeshire
PE29 7DA

Stack Emissions Monitoring

Scientifics Limited - Swindon Laboratory
Great Western One
Bristol Street
Swindon
SN1 5ET
UKAS and MCERTS Number: 1015

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

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EXECUTIVE SUMMARY (Page 2 of 9)

Emissions Summary

VIP Polymers Limited, Huntingdon
MIR 7 Exhaust
30th January 2007

Parameter	**Units**	**Result**	**Uncertainty +/-**	**Limit**	**Outcome**
Total Particulate Matter	mg/m³	2.7	0.9	50	Passed
Particulate Emission Rate	g/hr	24.1	8.5	-	-
Moisture	%	1.1	0.11	-	-
Stack Gas Temperature	°C	28	-	-	-
Stack Gas Velocity	m/s	10.6	-	-	-
Gas Volumetric Flow Rate (Actual)	m³/hr	9734	-	-	-
Gas Volumetric Flow Rate (STP, Wet)	m³/hr	8809	-	-	-
Gas Volumetric Flow Rate (STP, Dry)	m³/hr	8709	-	-	-

All results are mean values, with pollutant concentrations expressed at reference conditions.

Particulate Matter: Reference conditions are 273K, 101.3kPa, without correction for water vapour content.

EXECUTIVE SUMMARY (Page 3 of 9)

Monitoring Times

Parameter	Sampling Date	Sampling Times	Sampling Duration
Total Particulate Matter	30th January 2007	14:18 - 14:48 / 14:52 - 15:22	60 minutes

Process Details

Parameter	Process Details
Process Status	Normal
Capacity and / or Production Rate	18.46 charges / hour
Continuous or Batch Process	Batch
Feedstock (if applicable)	Pipe Seals
Abatement System	None
Abatement System Running Status	N/A
Fuel (if applicable)	N/A
Plume Appearance	None visible from the sampling location

EXECUTIVE SUMMARY (Page 4 of 9)

Monitoring Methods

The selection of standard methods employed by Scientifics is determined, wherever possible by the hierarchy of method selection outlined in Environment Agency Technical Guidance Document (Monitoring) M2. i.e. CEN, ISO, BS, US EPA etc.

The table below summarises the monitoring methods, techniques and technical procedures employed, and details any deviations from the aforementioned hierarchy:

Sampling Methods with Subsequent Analysis

Species	Standard Method	Scientifics Technical Procedure	UKAS Lab Number	MCERTS Accredited Method	Limit of Detection (LOD)	MU of Method +/- %	MU +/- %
TPM	BS EN 13284-1	AE 006	1015	Yes	~ 0.1 mg/m³	30%	35% (E)
H_2O	US EPA Method 4	AE 004	1015	Yes	0.1%	10%	-

where C = Calculated Measurement Uncertainty, E = Estimated Measurement Uncertainty

EXECUTIVE SUMMARY (Page 5 of 9)

Analytical Methods

The following tables list the analytical methods employed together with the custody and archiving details:

Sampling Methods with Subsequent Analysis

Species	Analytical Technique	Analytical Procedure	UKAS Lab Number	UKAS Accredited Analysis	Laboratory	Sample Archive Location	Archive Period
TPM	Gravimetric	AE 006	1015	Yes	Swindon	Swindon	3 months
H_2O	Gravimetric	AE 004	1015	Yes	Swindon	-	-

EXECUTIVE SUMMARY (Page 6 of 9)

Measurement Uncertainty (MU)

Total Particulate Matter

There are 4 ways in which to report measurement uncertainty for total particulate matter. These are listed in the hierarchical table below. The table also indicates which method has been taken to work out the MU for the parameters listed in this report.

MU Reported	**Yes / No**
a) Report a calculated MU	-
b) Report an estimated MU if there are any deviations from the sampling plane validation criteria	Yes
c) Report an estimated MU if there are any deviations from the specified method	Yes
d) Report the MU specified in the method	-

NOTE: The estimated uncertainty is based upon a calculated MU, coupled with the experience of the Stack Emissions Test house.

EXECUTIVE SUMMARY (Page 7 of 9)

Sampling Location

Sampling Plane Validation Criteria (BS EN 13284-1)	Value	Units	Requirement	Compliance	Method
Lowest Differential Pressure	5	Pa	> 5 Pa	No	All
Lowest Gas Velocity	2.38	m/s	-	-	-
Highest Gas Velocity	15.92	m/s	-	-	-
Ratio of Above	6.68	: 1	< 3 : 1	No	All
Mean Velocity	6.99	m/s	-	-	-
Angle of flow with regard to duct axis	0	^{o}	< 15^{o}	Yes	All
No local negative flow	-	-	-	Yes	All
Highly homogeneous flow stream / gas velocity	-	-	-	Yes	ISO 10396

Duct Characteristics

	Value	Units
Type	Circular	-
Depth	0.57	m
Width	-	m
Area	0.26	m^2
Port Depth	40	mm

Sampling Lines & Sample Points

	TPM
Sample Port Size	4 inch BSP
Number Used	2
Orientation	Horizontal
Number Points / Line	2
In Stack / Out Stack Filtration	Out Stack

Sampling Platform

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

Annex A (BS EN 13284-1) Normative requirements	
Minimum Platform Area 5 m^2	Yes
Platform has 2 levels of handrails (approximately 0.5 m & 1.0 m high)	N/A
Platform has vertical base boards (approximately 0.25 m high)	N/A
Platform has removable chains / self closing gates at the top of ladders	N/A
Handrail / obstructions do not hamper insertion of sampling equipment	Yes
Depth of Platform = Minimum of 2m or Probe Length + 1m	Yes

Sampling Location / Platform Improvement Recommendations

The sampling location meets all the requirements as specified in BS EN 13284-1.

EXECUTIVE SUMMARY (Page 8 of 9)

Sampling & Analytical Method Deviations

Nozzle Size

The nozzle size used is less than the minimum required for the testing standard (6.0 mm), this is due to this being the correct nozzle size required for sampling isokinectically.

Gas Velocity Ratio

The velocities within the stack are greater than the ratio of 3:1, as outlined in the testing standard. This is due to the sampling location not being fully compliant with the requirements of BS EN 13284-1.

EXECUTIVE SUMMARY (Page 9 of 9)

Conclusion & Discussion

The results of these tests demonstrate that under normal operating conditions, this Plant is being operated in full compliance with the emission limits specified in its PPC Permit, PPC 11/94.

A regular programme of stack emissions testing in accordance with the Plant's PPC Permit, PPC 11/94, will be required to demonstrate continued compliance.

APPENDICES

CONTENTS

APPENDIX 1 - Stack Emissions Monitoring Team

STACK EMISSIONS MONITORING TEAM

Environmental Team Leader	Brenton Wells MCERTS Level 2, Technical Endorsements 1, 2 & 4 MM 03 196 BSc (Hons) Environmental Risk Management
Environmental Technician	Huw Williams MCERTS Level 1, Technical Endorsement 1 MM 05 619 BSc (Hons) Environmental Science

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

TOTAL PARTICULATE MATTER SUMMARY

VIP Polymers Limited, Huntingdon
MIR 7 Exhaust
30th January 2007

Test	**Sampling Times**	**Duration min**	**Concentration mg/m^3**	**Emission Rate g/hr**
Particulate Matter	14:18 - 14:48 / 14:52 - 15:22	60	2.7	24.1

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

Overall Blank Value mg/m^3	**Daily Emission Limit Value mg/m^3**	**Weighing Uncertainty ± mg**
0.46	50	0.37

Acetone Blank Value mg/l	**Acceptable Value mg/l**
1.0	10

ISOKINETIC SAMPLING EQUATIONS 1

Total Particulate Matter

Test	1	Units
Absolute pressure of stack gas, P_s		
Barometric pressure, P_b	758.3	mm Hg
Stack static pressure, P_{static}	6.8	mm H_2O
$P_s = P_b + \frac{(P_{static})}{13.6}$	758.8	mm Hg
Volume of water vapour collected, V_{wstd}		
Impinger volume collected	1	ml
Silica gel weight increase	7	g
Total volume of liquid collected, V_{lc}	8	ml
$V_{wstd} = (0.001246)(V_{lc})$	0.0099	m³
Volume of gas metered dry, V_{mstd}		
Volume of gas sample through gas meter, V_m	0.8345	m³
Gas meter correction factor, Y_d	1.0809	-
Average dry gas meter temperature, T_m	11.5	°C
Average pressure drop across orifice, ΔH	23.4	mm H_2O
$V_{mstd} = \frac{(0.3592)(V_m)(P_b+(\Delta H/13.6))(Y_d)}{T_m + 273}$	0.8656	m³
Volume of gas metered wet, V_{mstw}		
$V_{mstw} = V_{mstd} + V_{wstd}$	0.8755	m³
Moisture content, B_{wo}		
$B_{wo} = \frac{V_{wstd}}{V_{mstd} + V_{wstd}}$	0.011	m³
	1.13	%
Molecular weight of dry gas stream, M_d		
CO_2	0.03	%
O_2	20.8	%
Total	20.8	%
N_2 (100 -Total)	79.2	%
$M_d = 0.44(\%CO_2)+0.32(\%O_2)+0.28(\%N_2)$	28.84	g/gmol
Molecular weight of stack gas (wet), M_s		
$M_s = M_d(1 - B_{wo}) + 18(B_{wo})$	28.71	g/gmol

ISOKINETIC SAMPLING EQUATIONS 2

Total Particulate Matter

Test	1	Units
Velocity of stack gas, V_s		
Pitot tube velocity constant, K_p	34.97	-
Velocity pressure coefficient, C_p	0.82	-
Average of velocity heads, ΔP_{avg}	9.88	mm H_2O
Average square root of velocity heads, $\surd\Delta P$	3.14	$\surd$mm H_2O
Average stack gas temperature, T_s	28	^oC
$V_s = \frac{(K_p)(C_p)(\surd\Delta P)(\surd T_s + 273)}{\surd(M_s)(P_s)}$	10.59	m/s
Actual flow of stack gas, Q_a		
Area of stack, A_s	0.26	m^3
$Q_a = (60)(A_s)(V_s)$	162.2	m^3/min
Dry total flow of stack gas, Q_{std}		
Conversion factor (K/mm.Hg)	0.3592	-
$Q_{std} = \frac{(Q_a)P_s(0.3592)(1\text{-}B_{wo})}{(T_s) + 273}$	145.1	m^3/min
Wet total flow of stack gas, Q_{stw}		
Conversion factor (K/mm.Hg)	0.3592	-
$Q_{stw} = \frac{(Q_a)P_s(0.3592)}{(T_s) + 273}$	146.8	m^3/min
Percent isokinetic, %I		
Nozzle diameter, D_n	5.81	mm
Nozzle area, A_n	26.52	mm^2
Total sampling time, θ	60	min
$\%I = \frac{(4.6398E6)(T_s+273)(V_{mstd})}{(P_s)(V_s)(A_n)(\theta)(1\text{-}B_{wo})}$	95.7	%
Acceptable isokinetic range 95% to 115%	Yes	-

ISOKINETIC SAMPLING EQUATIONS 3

Total Particulate Matter

Test	1	Units
Particulate Concentration, C		
Mass of particulate collected on filter, M_f	0.0003	g
Mass of particulate collected in probe, M_p	0.0021	g
Mass of total particulate collected, M_n	0.0024	g
$C_{wet} = \frac{M_n}{V_{mstw}}$	2.74	mg/m³
$C_{dry} = \frac{M_n}{V_{mstd}}$	2.77	mg/m³
Particulate Emission Rates, E		
$E = [(C_{wet})(Q_{stw})(60)] / 1000$	24.1	g/hr
Weighing, Conditioning & Filtration Temperatures		
Pre-conditioning temperature	180	°C
Maximum filtration temperature	171	°C
Post-conditioning temperature	160	°C

TOTAL PARTICULATE MATTER QUALITY ASSURANCE CHECKLIST

Leak Test Results	**Value**	**Units**
Mean Sampling Rate	15.0	litre/min
Pre-sampling Leak Rate	0.06	litre/min
Post-sampling Leak Rate	0.08	litre/min
Acceptable Leak Rate	0.30	litre/min
Leak Tests Acceptable	Yes	-

Overall Blank Value	**Value**	**Units**
Overall Blank Value	0.46	mg/m³
Daily Emission Limit Value	50	mg/m³
Acceptable Blank Value	5	mg/m³
Overall Blank Acceptable	Yes	-

Isokinetic Criterion Compliance	**Value**	**Units**
Isokinetic Variation	95.7	%
Acceptable Isokineticity	Yes	-

Acceptable isokinetic range 95% to 115%

Total Particulate Matter Filters	**Value**	**Units**
Filter Material	GF	-
Filter Size	47	mm

GF = Glass Fibre
QF = Quartz Fibre

APPENDIX 2 - Summaries, Calculations, Raw Data and Charts

PRELIMINARY STACK SURVEY

VIP Polymers Limited, Huntingdon
MIR 7 Exhaust
30th January 2007

Time of Survey	13:45 - 13:55
Velocity Measurement Device:	S-Type Pitot

Sampling Line A

Traverse Point	Distance into duct (m)	ΔPpt mmH$_2$O	ΔPpt Pa	Temp °C	Velocity m/s	O$_2$ % Vol	Angle of Swirl °
1	0.03	9.1	89	28	10.17	-	0
2	0.09	3.8	37	28	6.57	-	
3	0.14	1.0	10	28	3.37	-	
4	0.20	0.8	8	28	3.01	-	
5	0.26	0.5	5	28	2.38	-	
6	0.31	1.1	11	28	3.54	-	
7	0.37	2.0	20	28	4.77	-	
8	0.43	8.6	84	28	9.88	-	
9	0.48	10.8	106	28	11.08	-	
10	0.54	16.5	162	28	13.69	-	0
Mean	-	5.4	53	28	6.85	-	

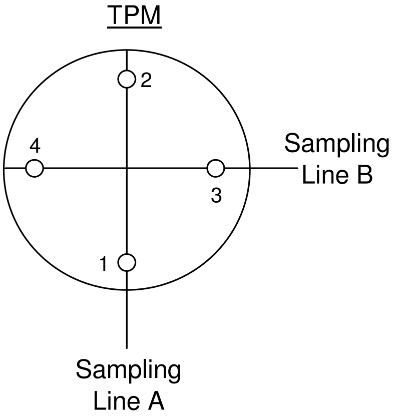
Sampling Line B

Traverse Point	Distance into duct (m)	ΔPpt mmH$_2$O	ΔPpt Pa	Temp °C	Velocity m/s	O$_2$ % Vol	Angle of Swirl °
1	0.03	4.6	45	28	7.23	-	0
2	0.09	1.5	15	28	4.13	-	
3	0.14	7.0	69	28	8.92	-	
4	0.20	0.5	5	28	2.38	-	
5	0.26	0.5	5	28	2.38	-	
6	0.31	1.2	12	28	3.69	-	
7	0.37	0.7	7	28	2.82	-	
8	0.43	7.2	71	28	9.04	-	
9	0.48	19.4	190	28	14.85	-	
10	0.54	22.3	219	28	15.92	-	0
Mean	-	6.5	64	28	7.14	-	

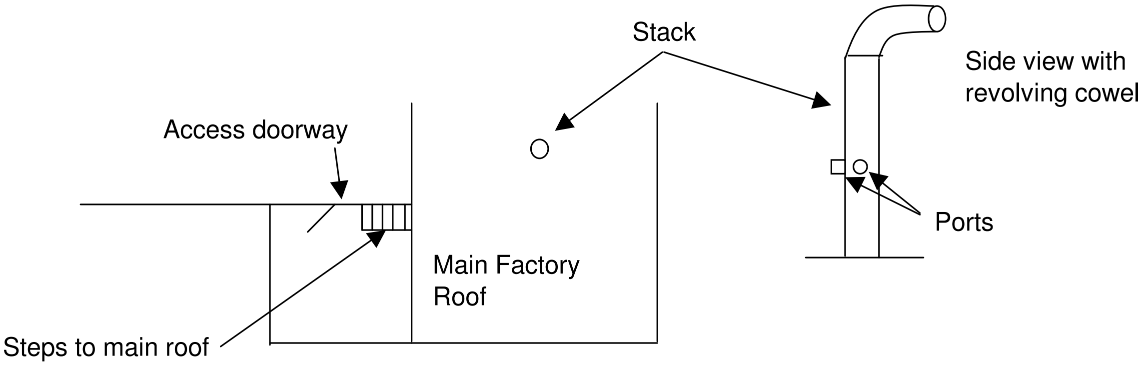
STACK DIAGRAM

	Value	Units
Stack Depth	0.57	m
Stack Width	-	m
Area	0.26	m^2

Sampling Point	Distance (% of Depth)	Distance into Stack	Units
1	15	0.09	m
2	85	0.48	m
3	15	0.09	m
4	85	0.48	m



PLANT LAYOUT



APPENDIX 3 - Calibrateable Equipment Checklist

CALIBRATEABLE EQUIPMENT CHECKLIST

Extractive Sampling		Instrumental Analyser/s		Miscellaneous	
Equipment	**Equipment I.D.**	**Equipment**	**Equipment I.D.**	**Equipment**	**Equipment I.D.**
Control Box DGM	13-03	Horiba PG-250 Analyser	-	Laboratory Balance	50-10
Box Thermocouples	03-09	Horiba PG-200 Cooler	-	Tape Measure	24-06
Meter In Thermocouple	10-26	JCT JCC P-1 Cooler	-	Stopwatch	17-01
Meter Out Thermocouple	10-27	Testo 350 Analyser	-	Protractor	-
Control Box Timer	17-08	Testo 339 Cooler	-	Barometer	08-03
Umbilical	03-11	FT-IR	-	Digital Micromanometer	01-01
Oven Box	03-08	FT-IR Oven Box	-	Digital Temperature Meter	03-02
Probe	11-03	Bernath 3006 FID	-	Stack Thermocouple	10-42
S-Pitot	06-08	Signal 3010 MINIFID	-	Drycal	-
L-Pitot	-	Signal 3030 FID	-	Mass Flow Controller	-
Site Balance	-	Servomex 570A	-	Mass Flow Control Box	-
Last Impinger Arm	-	JCT Heated Head Filter	-	1m Heated Line	-
Callipers	30-02			5m Heated Line (1)	-
Small DGM	-			5m Heated Line (2)	-
				10m Heated Line (1)	-
				10m Heated Line (2)	-
				15m Heated Line (1)	-
				15m Heated Line (2)	-

NOTE: If the equipment I.D is represented by a dash (-), then this piece of equipment has not been used for this test.

MEASUREMENT UNCERTAINTY BUDGET - TOTAL PARTICULATE MATTER

	Value	Units
Limit value	50	mg/m³
Measured concentration	2.7	mg/m³
Reference oxygen	N/A	% by volume

Measured Quantities	Symbol	Value	Units
Sampled Volume	V_m	0.8656	m³
Sampled Gas Temperature	T_m	284	K
Sampled Gas Pressure	ρ_m	101.1	KPa
Sampled Gas Humidity	H_m	0.0	% by volume
Oxygen Content	$O_{2,m}$	N/A	% by volume
Mass of Particulate	m	2.4	mg
Leak	L	0.53	%
Uncollected Mass	UCM	0.40	mg

NOTE: Sampled Gas Temperature, Pressure and Humidity are at the Dry Gas Meter.

Standard Uncertainty	Symbol	Value	Units	Uncertainty as a %	Uncertainty Required	Uncertainty Met?
Sampled Volume	uV_m	0.0173	m³	2.0	≤ 2%	Yes
Sampled Gas Temperature	uT_m	3	K	1.0	≤ 1%	Yes
Sampled Gas Pressure	$u\rho_m$	1.0110	KPa	1.0	≤ 1%	Yes
Sampled Gas Humidity	uH_m	0.0000	% by volume	0.0	≤ 1%	Yes
Oxygen Content	$uO_{2,m}$	N/A	% by volume	N/A	≤ 5%	N/A
Mass of Particulate	um	0.3700	mg	0.8	≤ 5% of ELV	Yes
Leak	-	-	-	0.5	≤ 2%	Yes
Uncollected Mass	-	-	-	0.9	≤ 10% of ELV	Yes

Parameter	Symbol	Value	Units	Uncertainty in Result	Units	Uncertainty as a %	Units
Volume (STP)	V	0.8291	m³	0.07	mg/m³	2.52	%
Mass of Particulate	m	2.4	mg	0.42	mg/m³	15.42	%
Factor for O2 Correction	fc	N/A	-	0.00	mg/m³	0.00	%
Leak	L	0.01	mg/m³	0.01	mg/m³	0.31	%
Uncollected mass	UCM	0.23	mg	0.26	mg/m³	9.62	%
Combined uncertainty				0.50	mg/m³	18.35	%

Uncertainty expressed at a 95% confidence level (where k = 2)	**0.99**	**mg/m³**	**36.70**	**%**

(k is a coverage factor which gives a 95% confidence in the quoted figures)

NOTE: Because there are one or more method deviations from BS EN 13284-1, a calculated MU can not be quoted for the concentration or mass emission of total particulate matter. Instead, this figure may be used to make a best estimate of what the MU might be.

AIR & EMISSIONS TESTING GROUP

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Stack Emissions Testing Report

Total Particulate Matter
Volatile Organic Compounds

Air Tech Environmental Consultancy Services

VIP Polymers Ltd

Huntingdon

15 Sacomat

Sampling Date **26th September 2006**

Report by Paul Adamczyk

Job Number LAB 06679

Contents

Introduction

VIP Polymers Ltd operates a rubber products manufacturing process process at Huntingdon which is subject to Local Air Pollution Control by Huntingdon District Council under the Pollution Prevention

Scientifics Limited, working in partnership with Air Tech ECS, were commissioned by VIP Polymers Ltd to carry out stack emissions testing to determine the release of total particulate matter and volatile organic compounds from the following Plant under normal operating conditions.

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	15 Sacomat
Sampling Date	26th September 2006
Time Test Started	19:23
Time Test Ended	20:08
Operating Conditions	Normal
Materials Processed	Rubber
Plume Appearance	None Visible

Throughout sampling, the operating conditions were maintained as above. Any deviations from BS 3405 : 1983 are noted in the conclusion.

Emissions Summary

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	15 Sacomat
Sampling Date	26th September 2006

Parameter	Units	Result	Limit	Outcome
Total Particulate Matter	mg/m^3	0.02	10	Passed
Particulate Emission Rate	g/s	0.06	-	-
Volatile Organic Compounds	mg/m^3	1.8	50	Passed
VOC Emission Rate	g/hr	6.1	-	-
Stack Gas Temperature	^{o}C	30	-	-
Stack Gas Volumetric Flow Rate (Actual)	m^3/hr	3814	-	-
Stack Gas Volumetric Flow Rate (STP)	m^3/hr	3394	-	-
Stack Gas Velocity	m/s	11.0	-	-

All results are mean values, with particulate concentrations expressed at reference conditions.

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

Written Summary

Total Particulate Matter	Passed

Two particulate tests were performed during continuous operating conditions. The mean sampling time was 20 minutes. The mean particulate concentration was 0.02 mg/m^3 at reference conditions. This value is below the specified emission limit of 10 mg/m^3. This is below the specified emission limit.

The tests were performed following the main procedural requirements of BS 3405 : 1983 using a Ströhlein STE 4 isokinetic particulate sampling train.

Volatile Organic Compounds	Passed

VOC (as Carbon) concentrations were measured continuously over a 30 minute period, with average values being recorded at 1 minute intervals. The mean VOC (as Carbon) concentration was 1.8 mg/m^3.

The sampling was performed in accordance with the main procedural requirements of BS 12619 : 1999 using a heated sampling line and a Signal 3010 MINIFID portable VOC analyser, with detection by FID calibrated against 74.6 ppm propane certified span gas.

Total Particulate Matter Summary

Sample	Sampling Times	Concentration	Limit
Run 1	19:23 - 19:43	0.02 mg/m^3	10 mg/m^3
Run 2	19:48 - 20:08	0.02 mg/m^3	10 mg/m^3
Mean Particulate Concentration		0.02 mg/m^3	10 mg/m^3

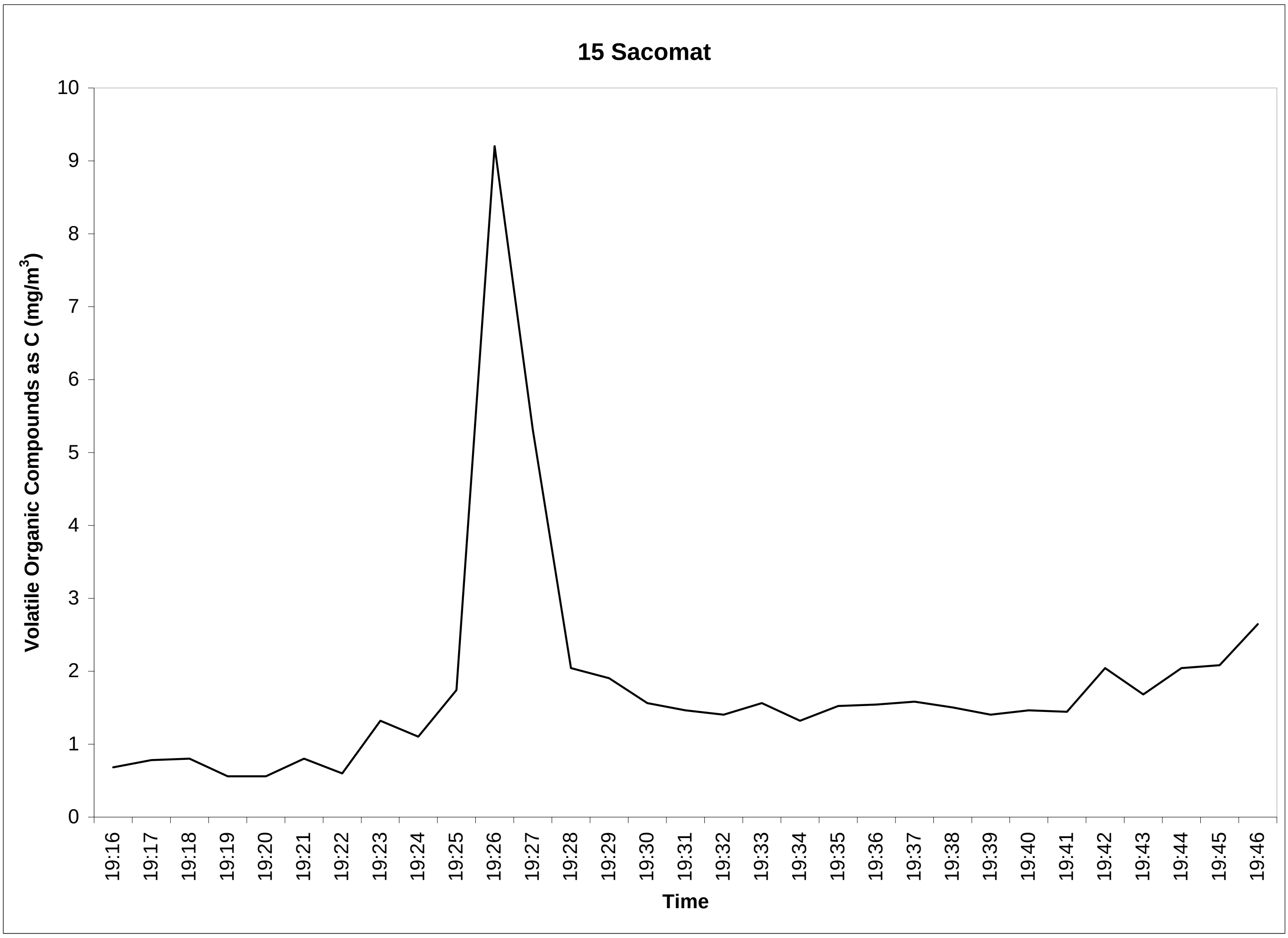
Sample	Sampling Times	Particulate Emission Rate	Ratio of Particulate Emission Rates
Run 1	19:23 - 19:43	0.00002 g/s	-
Run 2	19:48 - 20:08	0.00002 g/s	-
Mean Particulate Emission Rate		0.00002 g/s	1.0 : 1

Volatile Organic Compounds Summary

Sampling Times	Concentration (mg/m^3)	Limit (mg/m^3)	Emission Rate (g/hr)	Limit (g/hr)
19:16 - 19:46	1.8	50	6.1	-

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

Volatile Organic Compounds Emissions Profile



Volatile Organic Compounds Emissions Data

Time	VOC ppm	VOC mg/m^3
19:16	0.4	0.7
19:17	0.5	0.8
19:18	0.5	0.8
19:19	0.3	0.6
19:20	0.3	0.6
19:21	0.5	0.8
19:22	0.4	0.6
19:23	0.8	1.3
19:24	0.7	1.1
19:25	1.1	1.7
19:26	5.7	9.2
19:27	3.3	5.3
19:28	1.3	2.0
19:29	1.2	1.9
19:30	1.0	1.6
19:31	0.9	1.5
19:32	0.9	1.4
19:33	1.0	1.6
19:34	0.8	1.3
19:35	0.9	1.5
19:36	1.0	1.5
19:37	1.0	1.6
19:38	0.9	1.5
19:39	0.9	1.4
19:40	0.9	1.5
19:41	0.9	1.4
19:42	1.3	2.0
19:43	1.0	1.7
19:44	1.3	2.0
19:45	1.3	2.1
19:46	1.6	2.6
Mean	1.1	1.8

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

Volatile Organic Compounds Sampling Methodology

The Signal 3010 MINIFID Portable Heated Total Hydrocarbon Analyser uses Flame Ionisation to detect total organic carbon in a gas stream.

Checks Carried Out before Arrival On Site

The FID analyser is set up and is tested. The following are checked; the furnace and sample line temperatures, the zero and span gas calibration and the operation of the data logger.

On Site Sampling Procedure

The FID and sample line are switched on and allowed to reach operational temperature. The analyser will take 20 minutes to reach its operational temperature of 180°C. The sample line is heated to approximately 180°C to avoid VOCs condensing in the line. When the components have reached the correct operating temperature the fuel and span gas valves are opened and the FID is ignited.

The FID will take about 20 minutes before it stabilises and gives a zero ppm reading. The zero gas is fed into the FID and the zero set. The span gas is fed into the FID and the instrument adjusted to read the certified span gas value. The zero gas is fed into the FID once more to check that the reading returns to zero, if it does not, then these steps are repeated.

The probe, with a particulate filter, is then inserted into the stack, and the data logger activated.

The data logger can be programmed to log results over a 1, 5, 10 etc minute period. The results displayed and logged are the volume concentration of propane in ppm, which are converted to mg/m³ by the following calculations:

$$C_m = C_v \frac{36}{22.4}$$

where C_m is the TOC concentration in mg/m^3 (273 K; 101300 Pa)

C_v is the volume concentration of propane in ppm (by volume)

Calculations - Run 1

1. Stack Gas Velocity (V)

V = $0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$

V = Velocity (m/s)

Cp = Pitot Tube Calibration Coefficient

ΔP = Mean Differential Pressure (Pa)

T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	10.99	m/s
Stack Diameter (D)	0.35	m
Stack Area (A)	0.10	m^2
Stack Temperature (T)	302.50	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.07	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A$ $Q_{(actual)} = V \times A$

$Q_{(STP)}$ = 0.94 m^3/s **$Q_{(actual)}$ = 1.06 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.00001	g
Stack Area (A)	0.10	m^2

$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6$ = 1.6E-05 g/s

M = 0.0000 g/s

4. Particulate Concentration (C) at 273K, 101.3kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 0.02 mg/m^3

Calculations - Run 2

1. Stack Gas Velocity (V)

V = 0.075 x Cp x $\sqrt{\Delta P}$ x $\sqrt{T}$
V = Velocity (m/s)
Cp = Pitot Tube Calibration Coefficient
ΔP = Mean Differential Pressure (Pa)
T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	11.04	m/s
Stack Diameter (D)	0.35	m
Stack Area (A)	0.10	m^2
Stack Temperature (T)	302.50	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.07	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St}) \times V \times A}{P_B}$ $Q_{(actual)} = V \times A$

$Q_{(STP)}$ = 0.94 m^3/s **$Q_{(actual)}$ = 1.06 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.0000	g
Stack Area (A)	0.10	m^2

$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6$ = 1.6E-05 g/s

M = 0.000 g/s

4. Particulate Concentration (C) at 273K, 101.3 kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 0.02 mg/m^3

Total Particulate Matter Sampling Methodology

Job Preparation

A pre-site survey must first be undertaken to obtain the following information. Client details (full address & contact names), description of stack (name & location), sampling platform / access (Permanent - platform of adequate size & load capability, kick boards, hand & middle rails, free from debris, good drainage, fixed ladders with hoops and chain. Temporary - adequate size & load capability, stabilising legs, valid inspection tag, kick boards, hand & middle rails. Both types of platform must have a secure anchorage point to fix pulley system) hazards (dust, noise, temperature, gases/vapours, vibration, light, moving machinery, electricity etc) power supply and location, additional PPE required (high temperature gloves/overalls, PPE).

The Strohlein STE 4, isokinetic particulate measurement equipment, is fully inspected prior to use and its calibration status observed. This includes:
Pitot Tube - All pitot tubes are physically checked for damage, paying particular attention to the inlet holes. All dirt and blockages are removed.
Micromanometer - Digital differential pressure meters are used capable of measuring pressure in the range 0 Pa to 2250 Pa with a sensitivity of ±1 Pa. These instruments are checked for obvious physical damage, battery life tested and calibrated status observed.

Thermocouple - Temperature is measured using k type thermocouples. Each thermocouple is inspected for obvious damage and its calibration status observed. Digital temperature meters are used in conjunction with K type thermocouples. These are also checked for obvious physical damage and their battery life tested.
Nozzles - All nozzles used have been constructed in accordance BS 3405 : 1983, section 5.3.2. Each nozzle is physically checked for damage and removed if necessary. The nozzle calibration status is observed.
Flowmeter - The flowmeter is checked for blockages and obvious physical damage. Its calibration status is also observed.

Balance - A Mettler Toledo balance is used to weigh filters. The balance is positioned on a solid base located in a specially built weighing room. The balance is serviced and calibrated routinely each year by the manufacturer and also checked daily with in-house check weights.
Rope Kit - All lifting tackle i.e. rope, pulleys, karabiners, brakes and slings are physically checked for cuts and contamination.

Should the calibration certainty of any of the above equipment be in question, that item of equipment must be recalibrated and replaced if necessary.

Filter Selection and Preparation

Stack conditions can vary greatly for temperature, moisture, acidity, low and heavy particulate loading. Following the pre-site survey, the stack gas condition should be known and the appropriate filter can be selected and prepared as described below.

Filter mediums - glass wool, quartz wool, Gelman Sciences A/C Glass Fibre filter papers, Gelman Sciences Low Ash PVC membrane filter papers, Schleicher & Schuell Glass Fibre Thimbles or Schleicher & Schuell Quartz Thimbles.

Filters are prepared by drying in an oven at 160^{o}C for a period of one hour and then placed to cool in a dessicator. The filters are weighed accurately on a 4-figure balance and then placed in clean individual petri dishes and transported to site in a filter storage box. Spare filters are also prepared to allow for accidents and to obtain blank values.

Sampling Procedure

Suitability of Sampling Location

Before sampling can commence, a preliminary velocity and temperature survey must be undertaken along the two sampling lines at ten equally spaced points excluding the region within 5% of the effective flue diameter from the wall. The stack diameter is measured using a steel rod. If the ratio of the highest to lowest dynamic pressures exceeds 9:1 or if the ratio of the highest to lowest gas velocities exceeds 3:1, another sampling plane should be used. Sampling is undertaken from either four or eight sampling points.

Total Particulate Matter Sampling Methodology

Four sampling points are used when the ratio of the highest to lowest dynamic pressures is less than 4:1 and eight sampling points when the ratio of highest to lowest dynamic pressures exceeds 4:1 but less than 9:1 or the stack area exceeds 2.5 m^2. Temperature is also measured at ten equally spaced points along the sampling lines and an average temperature calculated. Should the temperature at any of the sampling points differ by more than + 10% from that of the average temperature, then that point must not be used.

The required number of sampling points can now be calculated using the following:
4 point sampling, circular stacks: 0.15 x D and 0.85 x D.
4 point sampling, square stacks: 0.25 x D and 0.75 x D.
8 point sampling, circular stacks: 0.065 x D, 0.25 x D, 0.75 x D and 0.935 x D.
8 point sampling, square stacks: 0.125 x D, 0.375 x D, 0.625 x D and 0.875 x D.

Leak Checks

A leak check should be undertaken before and after the iso-kinetic sampling is carried out. This is to make sure that all suction is taken at the sampling nozzle.

Sampling

Once the iso-kinetic sampling flow rates have been calculated, the probe is inserted into the stack at 90^o to the stack gas flow, as not to impinge any particulate matter on to the filter media prior to sampling. Allow the filter head and probe to attain the stack gas temperature. Start the suction device, and set the flowmeter to the correct suction rate for isokinetic sampling. At the same time turn the nozzle into flow and start the timing device.

Duration of Sampling Time

Duration of sampling time depends on :
(a) ensuring adequate quantities of particulate matter on the filter for weighing (> 0.3 % of the filter weight).
(b) whether cumulative or incremental sampling is undertaken.
(c) the number of sampling points i.e. either 4 or 8 point sampling.
(d) the continuity of plant operation.

Cumulative Sampling

After the first sample is taken from the first sampling position the control valve is closed simultaneously turning the sampling probe 90^o tc the stack gas flow, moving the probe to the next sample position. This process should be repeated until all the sample points have been used once.

Repeat Velocity and Temperature Readings

At each of the sampling points repeat the readings for the stack gas flow rate and stack gas temperatures. Calculate the new iso-kinetic sampling flow rates. If the stack gas velocity is more than ± 5% from the initial readings the test result shall not be regarded as having the required accuracy. The new temperature reading should not exceed the permitted range calculated in the preliminary survey. i.e. it should be within ± 10% of the original mean temperature.

N.B. The filter head should be cleaned and the particulate matter added to the particulate matter on the filter.
The Sampling procedure should be repeated to obtain a duplicate sample, the ratio of the two particulate emission rates should not exceed 1.5 : 1.

Weighing of Sample

The used filter should be placed in an oven at 180^oC and dried thoroughly, cooled and equilibrated in a desiccator and weighed as quickly as possible so as to avoid any errors due to moisture absorption onto the filter. The gross weight of the filter should be measured to within ± 0.1 mg. The filter weight and any residual particulate matter from the filter head can then be used in the final report to calculate the particulate concentration.

On Site Isokinetic Data Sheet

Preliminary Stack Survey		Sampling Line A		Sampling Line B	
Traverse Point	Distance in Stack (m)	Dynamic Pressure (Pa)	Temperature (^{o}C)	Dynamic Pressure (Pa)	Temperature (^{o}C)
1	0.02	106	30	-	-
2	0.05	99	30	-	-
3	0.09	114	30	-	-
4	0.12	117	30	-	-
5	0.16	124	30	-	-
6	0.19	81	30	-	-
7	0.23	79	30	-	-
8	0.26	88	30	-	-
9	0.30	87	30	-	-
10	0.33	82	30	-	-
Mean	-	98	30	-	-

Lowest Dynamic Pressure (any line) 79 Ratio of Above 1.57 : 1
Highest Dynamic Pressure (any line) 124 (Highest permitted ratio 9:1)
Temperature Range permitted for any point is between 0 and 60

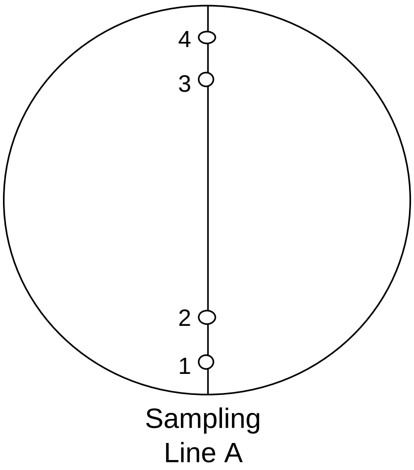
Run 1		Sampling Time (mins)		20	Nozzle size used (mm)		8.0
Sampling Point	Dynamic Pressure (Pa)		Temperature (^{o}C)		Velocity (m/s)		Flowmeter set at (m^3/hr)
	Initial	Final	Initial	Final	Initial	Final	
1	106	136	30	29	11.29	12.77	2.00
2	114	110	30	29	11.71	11.48	2.07
3	88	90	30	29	10.29	10.39	1.82
4	82	84	30	29	9.93	10.03	1.76
Mean	98	105	30	29	10.80	11.17	1.91

Difference between Initial Velocity and Final Velocity = 3.25 % (Limit permitted is ± 5%)
Start Filter Weight = 0.1160 g Sample Weight = 0.00001 g
End Filter Weight = 0.1160 g Sample as % of Filter Weight = 0.01 %

Run 2		Sampling Time (mins)		20	Nozzle size used (mm)		8.0
Sampling Point	Dynamic Pressure (Pa)		Temperature (^{o}C)		Velocity (m/s)		Flowmeter set at (m^3/hr)
	Initial	Final	Initial	Final	Initial	Final	
1	136	100	29	30	12.77	10.97	2.27
2	110	108	29	30	11.48	11.40	2.04
3	90	98	29	30	10.39	10.86	1.84
4	84	90	29	30	10.03	10.40	1.78
Mean	105	99	29	30	11.17	10.91	1.98

Difference between Initial Velocity and Final Velocity = -2.40 % (Limit permitted is ± 5%)
Start Filter Weight = 0.1181 g Sample Weight = 0.00001 g
End Filter Weight = 0.1181 g Sample as % of Filter Weight = 0.01 %

Stack Diagram

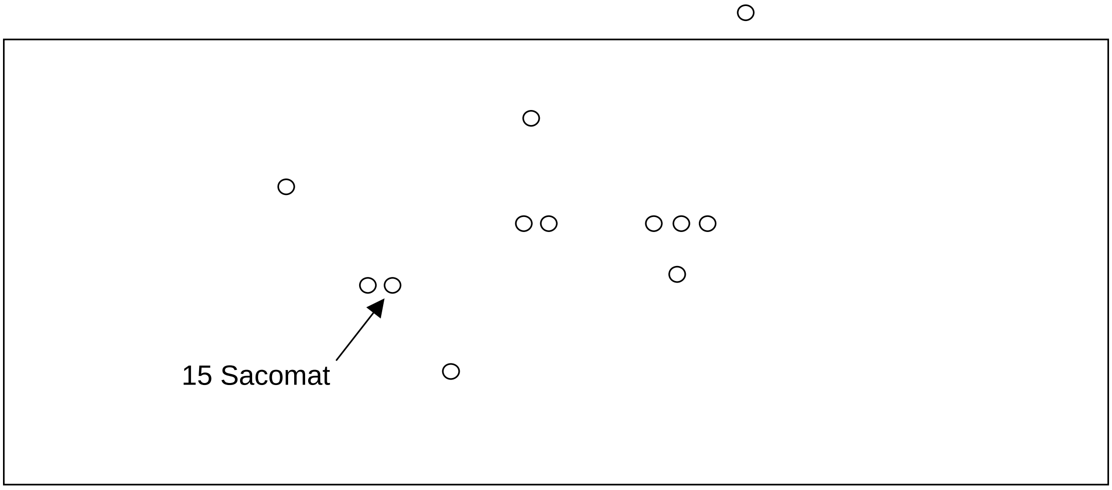


Stack Diameter (D) = 0.35 m

Stack Area (A) = 0.10 m^2

Sampling Point	Distance as a % of (D)	Distance in m
1	6.5	0.02
2	25.0	0.09
3	75.0	0.26
4	93.5	0.33

Plant Layout



Quality Assurance Checklist

Velocity Measurements:

Were water droplets present ? No

Direction of gas flow within ± 20° of stack axis. Yes

Dynamic pressures > 5 Pa at all sampling points. Yes

Ratio of highest to lowest dynamic pressures < 9 : 1. Yes

Sampling:

Sampling plane was correctly positioned. Yes

Area of sampling apparatus was < 10% of stack area. Yes

Sampling was from centres of equal areas. Yes

Sampling at each point not less than 3 minutes. Yes

Nozzle was facing directly upstream to within ± 10°. Yes

Leak check performed before and after each run and passed. Yes

Sample Handling:

Minimum weight of samples collected > 0.3% of filter weights. No

Samples achieved stable weights. Yes

Particulate samples stored for 3 months. Yes

QA Procedures:

Isokinetic data sheet completed and signed off by Team Leader. Yes

Report saved electronically onto Scientifics server. Yes

Raw data and hard copy of report filed together. Yes

Environmental Monitoring Team

Environmental Team Leader	Paul Adamczyk BSc (Hons) Fuel and Combustion Science MSc Environmental Pollution Control MCERTS Level 2, Technical Endorsement 1 & 4 - MM 04 547
Environmental Technician	Robert Adamczyk BSc Environmental Science MCERTS Trainee - MM06 721
Report by	Paul Adamczyk Level 2 Team Leader

Checked and Authorised By

Mark Allison Print Name

7th November 2006 Dated

Team Leader Business Title

Conclusion

The results of this test demonstrate that under normal operating conditions, this Plant is being operated in compliance with the total particulate matter and volatile organic compounds emission limits specified in PG 6/28 (04).

Good housekeeping and maintenance of the ducting and associated Plant should be continued in order to maintain this level of Plant performance.

A regular programme of stack emissions testing in accordance with the Plant's Local Air Pollution Control Authorisation will be required to demonstrate continued compliance.

Deviations from BS 3405 : 1983

Less than 0.3% of the filter weight was collected during both sample runs. This was due to the very low level of particulate emissions from the Plant.

AIR & EMISSIONS TESTING GROUP

52 Offerton Industrial Estate, Hempshaw Lane, Stockport, SK2 5TJ.
Tel: 0161 477 3004 Fax: 0161 480 4642
Mobile: 07973 319576 (24 Hours)
Email: james.bealing@scientifics.com

Stack Emissions Testing Report

Total Particulate Matter
Volatile Organic Compounds

Air Tech Environmental Consultancy Services

VIP Polymers Ltd

Huntingdon

24 Desma 10 Booth

Sampling Date	**26th September 2006**
Report by	Paul Adamczyk
Job Number	LAB 06679

Contents

Introduction

VIP Polymers Ltd operates a rubber products manufacturing process process at Huntingdon which is subject to Local Air Pollution Control by Huntingdon District Council under the Pollution Prevention and Control Regulations 2000.

Scientifics Limited, working in partnership with Air Tech ECS, were commissioned by VIP Polymers Ltd to carry out stack emissions testing to determine the release of total particulate matter and volatile organic compounds from the following Plant under normal operating conditions.

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	24 Desma 10 Booth
Sampling Date	26th September 2006
Time Test Started	12:38
Time Test Ended	13:23
Operating Conditions	Normal
Materials Processed	Rubber
Plume Appearance	None Visible

Throughout sampling, the operating conditions were maintained as above. Any deviations from BS 3405 : 1983 are noted in the conclusion.

Emissions Summary

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	24 Desma 10 Booth
Sampling Date	26th September 2006

Parameter	Units	Result	Limit	Outcome
Total Particulate Matter	mg/m^3	0.06	10	Passed
Particulate Emission Rate	g/s	0.11	-	-
Volatile Organic Compounds	mg/m^3	0.98	50	Passed
VOC Emission Rate	g/hr	1.9	-	-
Stack Gas Temperature	^{o}C	23	-	-
Stack Gas Volumetric Flow Rate (Actual)	m^3/hr	2081	-	-
Stack Gas Volumetric Flow Rate (STP)	m^3/hr	1891	-	-
Stack Gas Velocity	m/s	8.2	-	-

All results are mean values, with particulate concentrations expressed at reference conditions.

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

Written Summary

Total Particulate Matter	Passed

Two particulate tests were performed during continuous operating conditions. The mean sampling time was 20 minutes. The mean particulate concentration was 0.06 mg/m^3 at reference conditions. This value is below the specified emission limit of 10 mg/m^3. This is below the specified emission limit.

The tests were performed following the main procedural requirements of BS 3405 : 1983 using a Ströhlein STE 4 isokinetic particulate sampling train.

Volatile Organic Compounds	Passed

VOC (as Carbon) concentrations were measured continuously over a 30 minute period, with average values being recorded at 1 minute intervals. The mean VOC (as Carbon) concentration was 0.98 mg/m^3.

The sampling was performed in accordance with the main procedural requirements of BS 12619 : 1999 using a heated sampling line and a Signal 3010 MINIFID portable VOC analyser, with detection by FID calibrated against 74.6 ppm propane certified span gas.

Total Particulate Matter Summary

Sample	Sampling Times	Concentration	Limit
Run 1	12:38 - 12:58	0.04 mg/m^3	10 mg/m^3
Run 2	13:03 - 13:23	0.07 mg/m^3	10 mg/m^3
Mean Particulate Concentration		0.06 mg/m^3	10 mg/m^3

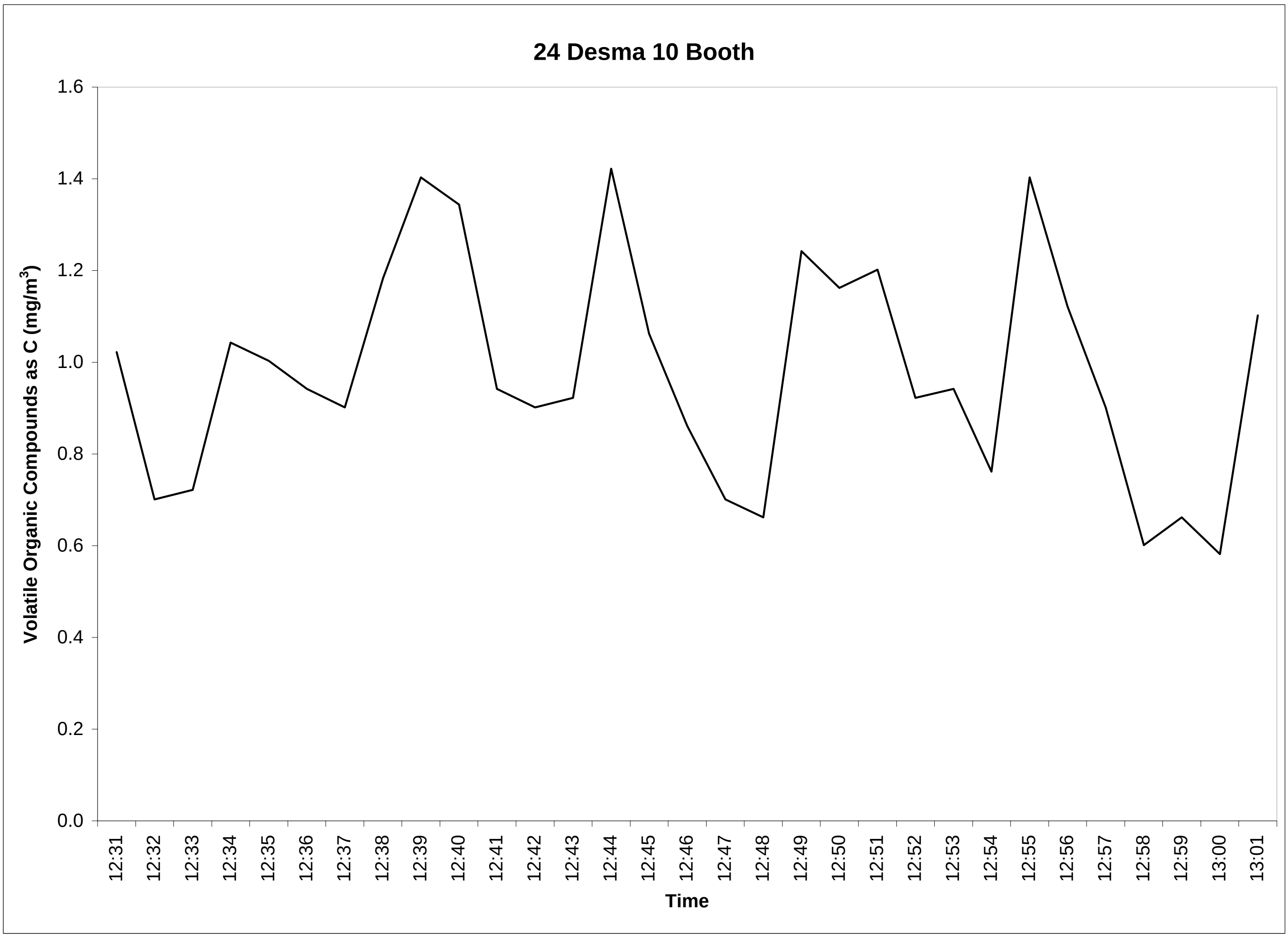
Sample	Sampling Times	Particulate Emission Rate	Ratio of Particulate Emission Rates
Run 1	12:38 - 12:58	0.00002 g/s	-
Run 2	13:03 - 13:23	0.00004 g/s	-
Mean Particulate Emission Rate		0.00003 g/s	1.5 : 1

Volatile Organic Compounds Summary

Sampling Times	Concentration (mg/m^3)	Limit (mg/m^3)	Emission Rate (g/hr)	Limit (g/hr)
12:31 - 13:01	0.98	50	1.9	-

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

Volatile Organic Compounds Emissions Profile



Volatile Organic Compounds Emissions Data

Time	VOC ppm	VOC mg/m^3
12:31	0.64	1.02
12:32	0.44	0.70
12:33	0.45	0.72
12:34	0.65	1.04
12:35	0.62	1.00
12:36	0.59	0.94
12:37	0.56	0.90
12:38	0.74	1.18
12:39	0.87	1.40
12:40	0.84	1.34
12:41	0.59	0.94
12:42	0.56	0.90
12:43	0.57	0.92
12:44	0.89	1.42
12:45	0.66	1.06
12:46	0.54	0.86

Time	VOC ppm	VOC mg/m^3
12:47	0.44	0.70
12:48	0.41	0.66
12:49	0.77	1.24
12:50	0.72	1.16
12:51	0.75	1.20
12:52	0.57	0.92
12:53	0.59	0.94
12:54	0.47	0.76
12:55	0.87	1.40
12:56	0.70	1.12
12:57	0.56	0.90
12:58	0.37	0.60
12:59	0.41	0.66
13:00	0.36	0.58
13:01	0.69	1.10
Mean	0.61	0.98

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

Volatile Organic Compounds Sampling Methodology

The Signal 3010 MINIFID Portable Heated Total Hydrocarbon Analyser uses Flame Ionisation to detect total organic carbon in a gas stream.

Checks Carried Out before Arrival On Site

The FID analyser is set up and is tested. The following are checked; the furnace and sample line temperatures, the zero and span gas calibration and the operation of the data logger.

On Site Sampling Procedure

The FID and sample line are switched on and allowed to reach operational temperature. The analyser will take 20 minutes to reach its operational temperature of 180^{o}C. The sample line is heated to approximately 180^{o}C to avoid VOCs condensing in the line. When the components have reached the correct operating temperature the fuel and span gas valves are opened and the FID is ignited.

The FID will take about 20 minutes before it stabilises and gives a zero ppm reading. The zero gas is fed into the FID and the zero set. The span gas is fed into the FID and the instrument adjusted to read the certified span gas value. The zero gas is fed into the FID once more to check that the reading returns to zero, if it does not, then these steps are repeated.

The probe, with a particulate filter, is then inserted into the stack, and the data logger activated.

The data logger can be programmed to log results over a 1, 5, 10 etc minute period. The results displayed and logged are the volume concentration of propane in ppm, which are converted to mg/m³ by the following calculations:

$$C_m = C_v \frac{36}{22.4}$$

where C_m is the TOC concentration in mg/m^3 (273 K; 101300 Pa)

C_v is the volume concentration of propane in ppm (by volume)

Calculations - Run 1

1. Stack Gas Velocity (V)

V = $0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$
V = Velocity (m/s)
Cp = Pitot Tube Calibration Coefficient
ΔP = Mean Differential Pressure (Pa)
T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	8.21	m/s
Stack Diameter (D)	0.30	m
Stack Area (A)	0.07	m^2
Stack Temperature (T)	296.00	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.03	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A \qquad Q_{(actual)} = V \times A$$

$Q_{(STP)}$ = 0.53 m^3/s **$Q_{(actual)}$ = 0.58 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.00002	g
Stack Area (A)	0.07	m^2

$$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6 = 2.3E-05 \text{ g/s}$$

M = 0.0000 g/s

4. Particulate Concentration (C) at 273K, 101.3kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 0.04 mg/m^3

Calculations - Run 2

1. Stack Gas Velocity (V)

$V = 0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$

V = Velocity (m/s)

Cp = Pitot Tube Calibration Coefficient

ΔP = Mean Differential Pressure (Pa)

T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	8.14	m/s
Stack Diameter (D)	0.30	m
Stack Area (A)	0.07	m^2
Stack Temperature (T)	296.00	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.03	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A \qquad Q_{(actual)} = V \times A$$

$Q_{(STP)}$ = 0.52 m^3/s **$Q_{(actual)}$ = 0.58 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.0000	g
Stack Area (A)	0.07	m^2

$$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6 = 3.5\text{E-}05 \text{ g/s}$$

M = 0.000 g/s

4. Particulate Concentration (C) at 273K, 101.3 kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 0.07 mg/m^3

Total Particulate Matter Sampling Methodology

Job Preparation

A pre-site survey must first be undertaken to obtain the following information. Client details (full address & contact names), description of stack (name & location), sampling platform / access (Permanent - platform of adequate size & load capability, kick boards, hand & middle rails, free from debris, good drainage, fixed ladders with hoops and chain. Temporary - adequate size & load capability, stabilising legs, valid inspection tag, kick boards, hand & middle rails. Both types of platform must have a secure anchorage point to fix pulley system) hazards (dust, noise, temperature, gases/vapours, vibration, light, moving machinery, electricity etc) power supply and location, additional PPE required (high temperature gloves/overalls, PPE).

The Strohlein STE 4, isokinetic particulate measurement equipment, is fully inspected prior to use and its calibration status observed. This includes:

Pitot Tube - All pitot tubes are physically checked for damage, paying particular attention to the inlet holes. All dirt and blockages are removed.

Micromanometer - Digital differential pressure meters are used capable of measuring pressure in the range 0 Pa to 2250 Pa with a sensitivity of ±1 Pa. These instruments are checked for obvious physical damage, battery life tested and calibrated status observed.

Thermocouple - Temperature is measured using k type thermocouples. Each thermocouple is inspected for obvious damage and its calibration status observed. Digital temperature meters are used in conjunction with K type thermocouples. These are also checked for obvious physical damage and their battery life tested.

Nozzles - All nozzles used have been constructed in accordance BS 3405 : 1983, section 5.3.2. Each nozzle is physically checked for damage and removed if necessary. The nozzle calibration status is observed.

Flowmeter - The flowmeter is checked for blockages and obvious physical damage. Its calibration status is also observed.

Balance - A Mettler Toledo balance is used to weigh filters. The balance is positioned on a solid base located in a specially built weighing room. The balance is serviced and calibrated routinely each year by the manufacturer and also checked daily with in-house check weights.

Rope Kit - All lifting tackle i.e. rope, pulleys, karabiners, brakes and slings are physically checked for cuts and contamination.

Should the calibration certainty of any of the above equipment be in question, that item of equipment must be recalibrated and replaced if necessary.

Filter Selection and Preparation

Stack conditions can vary greatly for temperature, moisture, acidity, low and heavy particulate loading. Following the pre-site survey, the stack gas condition should be known and the appropriate filter can be selected and prepared as described below.

Filter mediums - glass wool, quartz wool, Gelman Sciences A/C Glass Fibre filter papers, Gelman Sciences Low Ash PVC membrane filter papers, Schleicher & Schuell Glass Fibre Thimbles or Schleicher & Schuell Quartz Thimbles.

Filters are prepared by drying in an oven at 160^{o}C for a period of one hour and then placed to cool in a dessicator. The filters are weighed accurately on a 4-figure balance and then placed in clean individual petri dishes and transported to site in a filter storage box. Spare filters are also prepared to allow for accidents and to obtain blank values.

Sampling Procedure

Suitability of Sampling Location

Before sampling can commence, a preliminary velocity and temperature survey must be undertaken along the two sampling lines at ten equally spaced points excluding the region within 5% of the effective flue diameter from the wall. The stack diameter is measured using a steel rod. If the ratio of the highest to lowest dynamic pressures exceeds 9:1 or if the ratio of the highest to lowest gas velocities exceeds 3:1, another sampling plane should be used. Sampling is undertaken from either four or eight sampling points.

Total Particulate Matter Sampling Methodology

Four sampling points are used when the ratio of the highest to lowest dynamic pressures is less than 4:1 and eight sampling points when the ratio of highest to lowest dynamic pressures exceeds 4:1 but less than 9:1 or the stack area exceeds 2.5 m^2. Temperature is also measured at ten equally spaced points along the sampling lines and an average temperature calculated. Should the temperature at any of the sampling points differ by more than + 10% from that of the average temperature, then that point must not be used.

The required number of sampling points can now be calculated using the following:
4 point sampling, circular stacks: 0.15 x D and 0.85 x D.
4 point sampling, square stacks: 0.25 x D and 0.75 x D.
8 point sampling, circular stacks: 0.065 x D, 0.25 x D, 0.75 x D and 0.935 x D.
8 point sampling, square stacks: 0.125 x D, 0.375 x D, 0.625 x D and 0.875 x D.

Leak Checks

A leak check should be undertaken before and after the iso-kinetic sampling is carried out. This is to make sure that all suction is taken at the sampling nozzle.

Sampling

Once the iso-kinetic sampling flow rates have been calculated, the probe is inserted into the stack at 90° to the stack gas flow, as not to impinge any particulate matter on to the filter media prior to sampling. Allow the filter head and probe to attain the stack gas temperature. Start the suction device, and set the flowmeter to the correct suction rate for isokinetic sampling. At the same time turn the nozzle into flow and start the timing device.

Duration of Sampling Time

Duration of sampling time depends on :
(a) ensuring adequate quantities of particulate matter on the filter for weighing (> 0.3 % of the filter weight).
(b) whether cumulative or incremental sampling is undertaken.
(c) the number of sampling points i.e. either 4 or 8 point sampling.
(d) the continuity of plant operation.

Cumulative Sampling

After the first sample is taken from the first sampling position the control valve is closed simultaneously turning the sampling probe 90° tc the stack gas flow, moving the probe to the next sample position. This process should be repeated until all the sample points have been used once.

Repeat Velocity and Temperature Readings

At each of the sampling points repeat the readings for the stack gas flow rate and stack gas temperatures. Calculate the new iso-kinetic sampling flow rates. If the stack gas velocity is more than ± 5% from the initial readings the test result shall not be regarded as having the required accuracy. The new temperature reading should not exceed the permitted range calculated in the preliminary survey. i.e. it should be within ± 10% of the original mean temperature.

N.B. The filter head should be cleaned and the particulate matter added to the particulate matter on the filter.
The Sampling procedure should be repeated to obtain a duplicate sample, the ratio of the two particulate emission rates should not exceed 1.5 : 1.

Weighing of Sample

The used filter should be placed in an oven at 180°C and dried thoroughly, cooled and equilibrated in a desiccator and weighed as quickly as possible so as to avoid any errors due to moisture absorption onto the filter. The gross weight of the filter should be measured to within ± 0.1 mg. The filter weight and any residual particulate matter from the filter head can then be used in the final report to calculate the particulate concentration.

On Site Isokinetic Data Sheet

Preliminary Stack Survey		Sampling Line A		Sampling Line B	
Traverse Point	Distance in Stack (m)	Dynamic Pressure (Pa)	Temperature (^{o}C)	Dynamic Pressure (Pa)	Temperature (^{o}C)
1	0.02	-	-	54	23
2	0.05	-	-	58	23
3	0.08	-	-	52	23
4	0.11	-	-	60	23
5	0.14	-	-	61	23
6	0.17	-	-	64	23
7	0.20	-	-	65	23
8	0.23	-	-	68	23
9	0.26	-	-	55	23
10	0.29	-	-	52	23
Mean	-	-	-	59	23

Lowest Dynamic Pressure (any line) 52 Ratio of Above 1.31 : 1
Highest Dynamic Pressure (any line) 68 (Highest permitted ratio 9:1)
Temperature Range permitted for any point is between -7 and 53

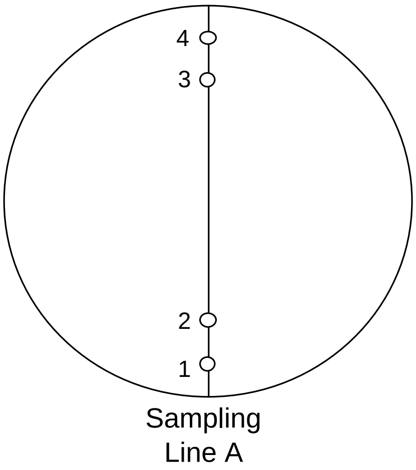
Run 1		Sampling Time (mins)		20	Nozzle size used (mm)		8.0
Sampling Point	Dynamic Pressure (Pa)		Temperature (^{o}C)		Velocity (m/s)		Flowmeter set at (m^3/hr)
	Initial	Final	Initial	Final	Initial	Final	
1	54	64	23	23	7.96	8.67	1.44
2	52	53	23	23	7.82	7.89	1.42
3	68	57	23	23	8.94	8.18	1.62
4	52	60	23	23	7.82	8.40	1.42
Mean	57	59	23	23	8.13	8.29	1.47

Difference between Initial Velocity and Final Velocity = 1.83 % (Limit permitted is ± 5%)
Start Filter Weight = 0.1244 g Sample Weight = 0.00002 g
End Filter Weight = 0.1244 g Sample as % of Filter Weight = 0.02 %

Run 2		Sampling Time (mins)		20	Nozzle size used (mm)		8.0
Sampling Point	Dynamic Pressure (Pa)		Temperature (^{o}C)		Velocity (m/s)		Flowmeter set at (m^3/hr)
	Initial	Final	Initial	Final	Initial	Final	
1	64	60	23	23	8.67	8.40	1.57
2	53	51	23	23	7.89	7.74	1.43
3	57	50	23	23	8.18	7.66	1.48
4	60	57	23	23	8.40	8.18	1.52
Mean	59	55	23	23	8.29	8.00	1.50

Difference between Initial Velocity and Final Velocity = -3.62 % (Limit permitted is ± 5%)
Start Filter Weight = 0.1192 g Sample Weight = 0.00003 g
End Filter Weight = 0.1192 g Sample as % of Filter Weight = 0.03 %

Stack Diagram

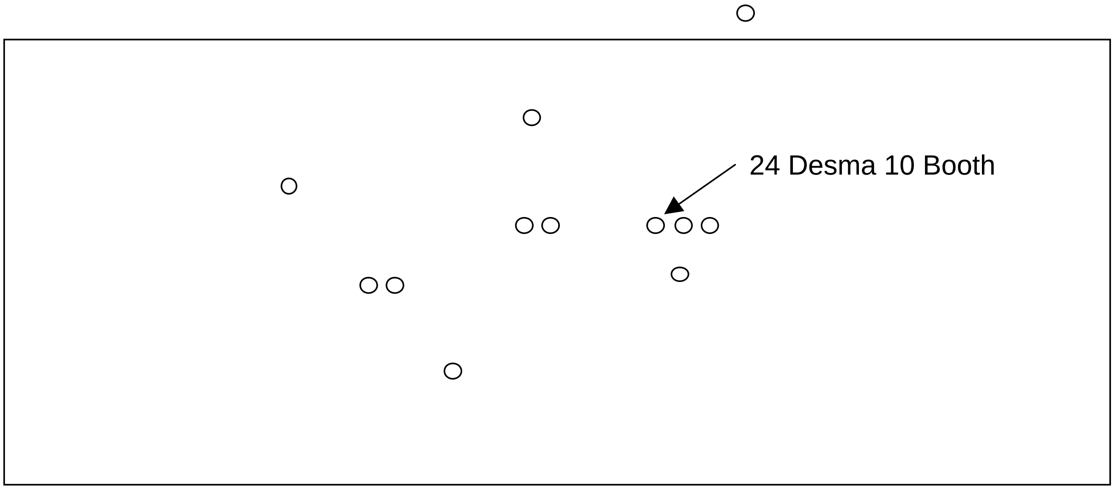


Stack Diameter (D) = 0.30 m

Stack Area (A) = 0.07 m^2

Sampling Point	**Distance as a % of (D)**	**Distance in m**
1	6.5	0.02
2	25.0	0.08
3	75.0	0.23
4	93.5	0.28

Plant Layout



Quality Assurance Checklist

Velocity Measurements:

Were water droplets present ?	No
Direction of gas flow within ± 20° of stack axis.	Yes
Dynamic pressures > 5 Pa at all sampling points.	Yes
Ratio of highest to lowest dynamic pressures < 9 : 1.	Yes

Sampling:

Sampling plane was correctly positioned.	Yes
Area of sampling apparatus was < 10% of stack area.	Yes
Sampling was from centres of equal areas.	Yes
Sampling at each point not less than 3 minutes.	Yes
Nozzle was facing directly upstream to within ± 10°.	Yes
Leak check performed before and after each run and passed.	Yes

Sample Handling:

Minimum weight of samples collected > 0.3% of filter weights.	No
Samples achieved stable weights.	Yes
Particulate samples stored for 3 months.	Yes

QA Procedures:

Isokinetic data sheet completed and signed off by Team Leader.	Yes
Report saved electronically onto Scientifics server.	Yes
Raw data and hard copy of report filed together.	Yes

Environmental Monitoring Team

Environmental Team Leader	Paul Adamczyk BSc (Hons) Fuel and Combustion Science MSc Environmental Pollution Control MCERTS Level 2, Technical Endorsement 1 & 4 - MM 04 547
Environmental Technician	Robert Adamczyk BSc Environmental Science MCERTS Trainee - MM06 721
Report by	Paul Adamczyk Level 2 Team Leader

Checked and Authorised By

Mark Allison Print Name

8th November 2006 Dated

Team Leader Business Title

Conclusion

The results of this test demonstrate that under normal operating conditions, this Plant is being operated in compliance with the total particulate matter and volatile organic compounds emission limits specified in PG 6/28 (04).

Good housekeeping and maintenance of the ducting and associated Plant should be continued in order to maintain this level of Plant performance.

A regular programme of stack emissions testing in accordance with the Plant's Local Air Pollution Control Authorisation will be required to demonstrate continued compliance.

Deviations from BS 3405 : 1983

Less than 0.3% of the filter weight was collected during both sample runs. This was due to the very low level of particulate emissions from the Plant.

scientifics®

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Stack Emissions Testing Report

Total Particulate Matter
Volatile Organic Compounds

VIP Polymers Ltd

Huntingdon

Air Tech Environmental Consultancy Services

25 Desma 11 Booth

Sampling Date	**26th September 2006**
Report by	Paul Adamczyk
Job Number	LAB 06679

Contents

Introduction

VIP Polymers Ltd operates a rubber products manufacturing process process at Huntingdon which is subject to Local Air Pollution Control by Huntingdon District Council under the Pollution Prevention and Control Regulations 2000.

Scientifics Limited, working in partnership with Air Tech ECS, were commissioned by VIP Polymers Ltd to carry out stack emissions testing to determine the release of total particulate matter and volatile organic compounds from the following Plant under normal operating conditions.

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	25 Desma 11 Booth
Sampling Date	26th September 2006
Time Test Started	11:48
Time Test Ended	12:30
Operating Conditions	Normal
Materials Processed	Rubber
Plume Appearance	None Visible

Throughout sampling, the operating conditions were maintained as above. Any deviations from BS 3405 : 1983 are noted in the conclusion.

Emissions Summary

Company	VIP Polymers Ltd
Site	Huntingdon
Stack	25 Desma 11 Booth
Sampling Date	26th September 2006

Parameter	**Units**	**Result**	**Limit**	**Outcome**
Total Particulate Matter	mg/m^3	0.59	10	Passed
Particulate Emission Rate	g/s	1.1	-	-
Volatile Organic Compounds	mg/m^3	1.1	50	Passed
VOC Emission Rate	g/hr	2.1	-	-
Stack Gas Temperature	^{o}C	28	-	-
Stack Gas Volumetric Flow Rate (Actual)	m^3/hr	2055	-	-
Stack Gas Volumetric Flow Rate (STP)	m^3/hr	1837	-	-
Stack Gas Velocity	m/s	8.1	-	-

All results are mean values, with particulate concentrations expressed at reference conditions.

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

Written Summary

Total Particulate Matter	**Passed**

Two particulate tests were performed during continuous operating conditions. The mean sampling time was 20 minutes. The mean particulate concentration was 0.59 mg/m^3 at reference conditions. This value is below the specified emission limit of 10 mg/m^3. This is below the specified emission limit.

The tests were performed following the main procedural requirements of BS 3405 : 1983 using a Ströhlein STE 4 isokinetic particulate sampling train.

Volatile Organic Compounds	**Passed**

VOC (as Carbon) concentrations were measured continuously over a 30 minute period, with average values being recorded at 1 minute intervals. The mean VOC (as Carbon) concentration was 1.1 mg/m^3.

The sampling was performed in accordance with the main procedural requirements of BS 12619 : 1999 using a heated sampling line and a Signal 3010 MINIFID portable VOC analyser, with detection by FID calibrated against 74.6 ppm propane certified span gas.

Total Particulate Matter Summary

Sample	Sampling Times	Concentration	Limit
Run 1	11:48 - 12:08	0.63 mg/m^3	10 mg/m^3
Run 2	12:10 - 12:30	0.55 mg/m^3	10 mg/m^3
Mean Particulate Concentration		0.59 mg/m^3	10 mg/m^3

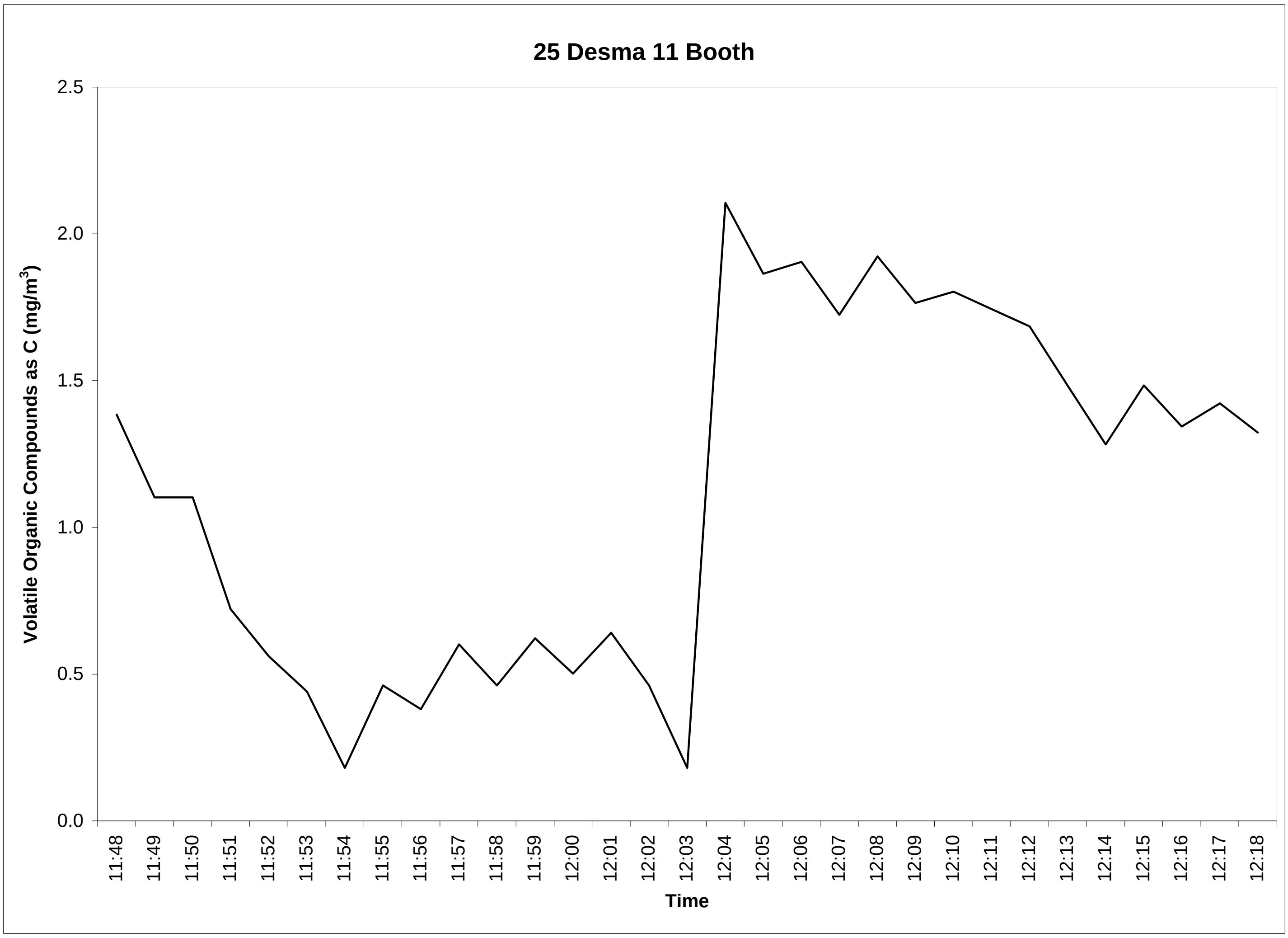
Sample	Sampling Times	Particulate Emission Rate	Ratio of Particulate Emission Rates
Run 1	11:48 - 12:08	0.00032 g/s	-
Run 2	12:10 - 12:30	0.00028 g/s	-
Mean Particulate Emission Rate		0.00030 g/s	1.1 : 1

Volatile Organic Compounds Summary

Sampling Times	Concentration (mg/m^3)	Limit (mg/m^3)	Emission Rate (g/hr)	Limit (g/hr)
11:48 - 12:18	1.1	50	2.1	-

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

Volatile Organic Compounds Emissions Profile



Volatile Organic Compounds Emissions Data

Time	VOC ppm	VOC mg/m^3
11:48	0.86	1.4
11:49	0.69	1.1
11:50	0.69	1.1
11:51	0.45	0.7
11:52	0.35	0.6
11:53	0.27	0.4
11:54	0.11	0.2
11:55	0.29	0.5
11:56	0.24	0.4
11:57	0.37	0.6
11:58	0.29	0.5
11:59	0.39	0.6
12:00	0.31	0.5
12:01	0.40	0.6
12:02	0.29	0.5
12:03	0.11	0.2

Time	VOC ppm	VOC mg/m^3
12:04	1.31	2.1
12:05	1.16	1.9
12:06	1.19	1.9
12:07	1.07	1.7
12:08	1.20	1.9
12:09	1.10	1.8
12:10	1.12	1.8
12:11	1.09	1.7
12:12	1.05	1.7
12:13	0.92	1.5
12:14	0.80	1.3
12:15	0.92	1.5
12:16	0.84	1.3
12:17	0.89	1.4
12:18	0.82	1.3
Mean	0.70	1.1

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

Volatile Organic Compounds Sampling Methodology

The Signal 3010 MINIFID Portable Heated Total Hydrocarbon Analyser uses Flame Ionisation to detect total organic carbon in a gas stream.

Checks Carried Out before Arrival On Site

The FID analyser is set up and is tested. The following are checked; the furnace and sample line temperatures, the zero and span gas calibration and the operation of the data logger.

On Site Sampling Procedure

The FID and sample line are switched on and allowed to reach operational temperature. The analyser will take 20 minutes to reach its operational temperature of 180°C. The sample line is heated to approximately 180°C to avoid VOCs condensing in the line. When the components have reached the correct operating temperature the fuel and span gas valves are opened and the FID is ignited.

The FID will take about 20 minutes before it stabilises and gives a zero ppm reading. The zero gas is fed into the FID and the zero set. The span gas is fed into the FID and the instrument adjusted to read the certified span gas value. The zero gas is fed into the FID once more to check that the reading returns to zero, if it does not, then these steps are repeated.

The probe, with a particulate filter, is then inserted into the stack, and the data logger activated.

The data logger can be programmed to log results over a 1, 5, 10 etc minute period. The results displayed and logged are the volume concentration of propane in ppm, which are converted to mg/m³ by the following calculations:

$$C_m = C_v \frac{36}{22.4}$$

where C_m is the TOC concentration in mg/m^3 (273 K; 101300 Pa)

C_v is the volume concentration of propane in ppm (by volume)

Calculations - Run 1

1. Stack Gas Velocity (V)

$V = 0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$

$V =$ Velocity (m/s)

$Cp =$ Pitot Tube Calibration Coefficient

$\Delta P =$ Mean Differential Pressure (Pa)

$T =$ Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	8.00	m/s
Stack Diameter (D)	0.30	m
Stack Area (A)	0.07	m^2
Stack Temperature (T)	301.00	K
Atmospheric Pressure (P_A)	99.80	kPa
Static Pressure (P_{St})	0.06	kPa
Standard Barometric Pressure (P_B)	101.30	kPa

$$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A \qquad Q_{(actual)} = V \times A$$

$Q_{(STP)} =$ 0.51 m^3/s **$Q_{(actual)} =$ 0.57 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.00027	g
Stack Area (A)	0.07	m^2

$$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6 = 3.2E\text{-}04 \text{ g/s}$$

M = 0.0003 g/s

4. Particulate Concentration (C) at 273K, 101.3kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 0.63 mg/m^3

Calculations - Run 2

1. Stack Gas Velocity (V)

V = $0.075 \times Cp \times \sqrt{\Delta P} \times \sqrt{T}$

V = Velocity (m/s)

Cp = Pitot Tube Calibration Coefficient

ΔP = Mean Differential Pressure (Pa)

T = Mean Temperature (K)

2. Stack Gas Volumetric Flow Rate (Q)

Stack Gas Velocity (V)	8.15	m/s
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$$Q_{(STP)} = \frac{273}{T} \times \frac{(P_A + P_{St})}{P_B} \times V \times A \qquad Q_{(actual)} = V \times A$$

$Q_{(STP)}$ = 0.51 m^3/s **$Q_{(actual)}$ = 0.58 m^3/s**

3. Particulate Mass Emission Rate (M)

No. of Sampling Points (n)	4	
Duration at each point (s)	300	s
Nozzle area (a)	50.27	mm^2
Particulate mass (m)	0.0002	g
Stack Area (A)	0.07	m^2

$$M = \frac{(A \times m)}{(n \times a \times s)} \times 10^6 = 2.8E\text{-}04 \text{ g/s}$$

M = 0.000 g/s

4. Particulate Concentration (C) at 273K, 101.3 kPa

$C = (M / Q_{(STP)}) \times 1000$

C = 0.55 mg/m^3

Total Particulate Matter Sampling Methodology

Job Preparation

A pre-site survey must first be undertaken to obtain the following information. Client details (full address & contact names), description of stack (name & location), sampling platform / access (Permanent - platform of adequate size & load capability, kick boards, hand & middle rails, free from debris, good drainage, fixed ladders with hoops and chain. Temporary - adequate size & load capability, stabilising legs, valid inspection tag, kick boards, hand & middle rails. Both types of platform must have a secure anchorage point to fix pulley system) hazards (dust, noise, temperature, gases/vapours, vibration, light, moving machinery, electricity etc) power supply and location, additional PPE required (high temperature gloves/overalls, PPE).

The Strohlein STE 4, isokinetic particulate measurement equipment, is fully inspected prior to use and its calibration status observed. This includes:

Pitot Tube - All pitot tubes are physically checked for damage, paying particular attention to the inlet holes. All dirt and blockages are removed.

Micromanometer - Digital differential pressure meters are used capable of measuring pressure in the range 0 Pa to 2250 Pa with a sensitivity of ±1 Pa. These instruments are checked for obvious physical damage, battery life tested and calibrated status observed.

Thermocouple - Temperature is measured using k type thermocouples. Each thermocouple is inspected for obvious damage and its calibration status observed. Digital temperature meters are used in conjunction with K type thermocouples. These are also checked for obvious physical damage and their battery life tested.

Nozzles - All nozzles used have been constructed in accordance BS 3405 : 1983, section 5.3.2. Each nozzle is physically checked for damage and removed if necessary. The nozzle calibration status is observed.

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Rope Kit - All lifting tackle i.e. rope, pulleys, karabiners, brakes and slings are physically checked for cuts and contamination.

Should the calibration certainty of any of the above equipment be in question, that item of equipment must be recalibrated and replaced if necessary.

Filter Selection and Preparation

Stack conditions can vary greatly for temperature, moisture, acidity, low and heavy particulate loading. Following the pre-site survey, the stack gas condition should be known and the appropriate filter can be selected and prepared as described below.

Filter mediums - glass wool, quartz wool, Gelman Sciences A/C Glass Fibre filter papers, Gelman Sciences Low Ash PVC membrane filter papers, Schleicher & Schuell Glass Fibre Thimbles or Schleicher & Schuell Quartz Thimbles.

Filters are prepared by drying in an oven at 160°C for a period of one hour and then placed to cool in a dessicator. The filters are weighed accurately on a 4-figure balance and then placed in clean individual petri dishes and transported to site in a filter storage box. Spare filters are also prepared to allow for accidents and to obtain blank values.

Sampling Procedure

Suitability of Sampling Location

Before sampling can commence, a preliminary velocity and temperature survey must be undertaken along the two sampling lines at ten equally spaced points excluding the region within 5% of the effective flue diameter from the wall. The stack diameter is measured using a steel rod. If the ratio of the highest to lowest dynamic pressures exceeds 9:1 or if the ratio of the highest to lowest gas velocities exceeds 3:1, another sampling plane should be used. Sampling is undertaken from either four or eight sampling points.

Total Particulate Matter Sampling Methodology

Four sampling points are used when the ratio of the highest to lowest dynamic pressures is less than 4:1 and eight sampling points when the ratio of highest to lowest dynamic pressures exceeds 4:1 but less than 9:1 or the stack area exceeds 2.5 m^2. Temperature is also measured at ten equally spaced points along the sampling lines and an average temperature calculated. Should the temperature at any of the sampling points differ by more than + 10% from that of the average temperature, then that point must not be used.

The required number of sampling points can now be calculated using the following:
4 point sampling, circular stacks: 0.15 x D and 0.85 x D.
4 point sampling, square stacks: 0.25 x D and 0.75 x D.
8 point sampling, circular stacks: 0.065 x D, 0.25 x D, 0.75 x D and 0.935 x D.
8 point sampling, square stacks: 0.125 x D, 0.375 x D, 0.625 x D and 0.875 x D.

Leak Checks

A leak check should be undertaken before and after the iso-kinetic sampling is carried out. This is to make sure that all suction is taken at the sampling nozzle.

Sampling

Once the iso-kinetic sampling flow rates have been calculated, the probe is inserted into the stack at 90^o to the stack gas flow, as not to impinge any particulate matter on to the filter media prior to sampling. Allow the filter head and probe to attain the stack gas temperature. Start the suction device, and set the flowmeter to the correct suction rate for isokinetic sampling. At the same time turn the nozzle into flow and start the timing device.

Duration of Sampling Time

Duration of sampling time depends on :
(a) ensuring adequate quantities of particulate matter on the filter for weighing (> 0.3 % of the filter weight).
(b) whether cumulative or incremental sampling is undertaken.
(c) the number of sampling points i.e. either 4 or 8 point sampling.
(d) the continuity of plant operation.

Cumulative Sampling

After the first sample is taken from the first sampling position the control valve is closed simultaneously turning the sampling probe 90^o tc the stack gas flow, moving the probe to the next sample position. This process should be repeated until all the sample points have been used once.

Repeat Velocity and Temperature Readings

At each of the sampling points repeat the readings for the stack gas flow rate and stack gas temperatures. Calculate the new iso-kinetic sampling flow rates. If the stack gas velocity is more than ± 5% from the initial readings the test result shall not be regarded as having the required accuracy. The new temperature reading should not exceed the permitted range calculated in the preliminary survey. i.e. it should be within ± 10% of the original mean temperature.

N.B. The filter head should be cleaned and the particulate matter added to the particulate matter on the filter.
The Sampling procedure should be repeated to obtain a duplicate sample, the ratio of the two particulate emission rates should not exceed 1.5 : 1.

Weighing of Sample

The used filter should be placed in an oven at 180^oC and dried thoroughly, cooled and equilibrated in a desiccator and weighed as quickly as possible so as to avoid any errors due to moisture absorption onto the filter. The gross weight of the filter should be measured to within ± 0.1 mg. The filter weight and any residual particulate matter from the filter head can then be used in the final report to calculate the particulate concentration.

On Site Isokinetic Data Sheet

Preliminary Stack Survey		Sampling Line A		Sampling Line B	
Traverse Point	Distance in Stack (m)	Dynamic Pressure (Pa)	Temperature (^oC)	Dynamic Pressure (Pa)	Temperature (^oC)
1	0.02	56	28	52	28
2	0.05	61	28	55	28
3	0.08	54	28	56	28
4	0.11	50	28	56	28
5	0.14	57	28	60	28
6	0.17	61	28	58	28
7	0.20	51	28	55	28
8	0.23	48	28	52	28
9	0.26	41	28	48	28
10	0.29	38	28	45	28
Mean	-	52	28	54	28

Lowest Dynamic Pressure (any line) 38 Ratio of Above 1.61 : 1

Highest Dynamic Pressure (any line) 61 (Highest permitted ratio 9:1)

Temperature Range permitted for any point is between -2 and 58

Run 1		**Sampling Time (mins)**		**20**	**Nozzle size used (mm)**		**8.0**
Sampling Point	**Dynamic Pressure (Pa)**		**Temperature (^oC)**		**Velocity (m/s)**		**Flowmeter set at (m^3/hr)**
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	
1	61	58	28	28	8.54	8.32	1.52
2	48	62	28	28	7.57	8.61	1.35
3	55	45	28	28	8.11	7.33	1.44
4	48	53	28	28	7.57	7.96	1.35
Mean	53	55	28	28	7.95	8.05	1.42

Difference between Initial Velocity and Final Velocity = 1.34 % (Limit permitted is ± 5%)

Start Filter Weight = 0.1256 g Sample Weight = 0.00027 g

End Filter Weight = 0.1259 g Sample as % of Filter Weight = 0.21 %

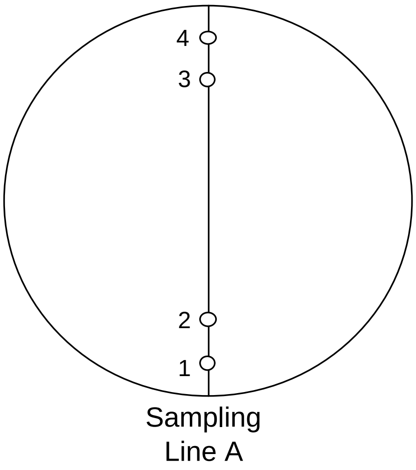
Run 2		**Sampling Time (mins)**		**20**	**Nozzle size used (mm)**		**8.0**
Sampling Point	**Dynamic Pressure (Pa)**		**Temperature (^oC)**		**Velocity (m/s)**		**Flowmeter set at (m^3/hr)**
	Initial	**Final**	**Initial**	**Final**	**Initial**	**Final**	
1	58	62	28	28	8.32	8.61	1.48
2	62	66	28	28	8.61	8.88	1.53
3	45	52	28	28	7.33	7.88	1.31
4	53	48	28	28	7.96	7.57	1.42
Mean	55	57	28	28	8.05	8.24	1.43

Difference between Initial Velocity and Final Velocity = 2.19 % (Limit permitted is ± 5%)

Start Filter Weight = 0.1258 g Sample Weight = 0.00024 g

End Filter Weight = 0.1260 g Sample as % of Filter Weight = 0.19 %

Stack Diagram

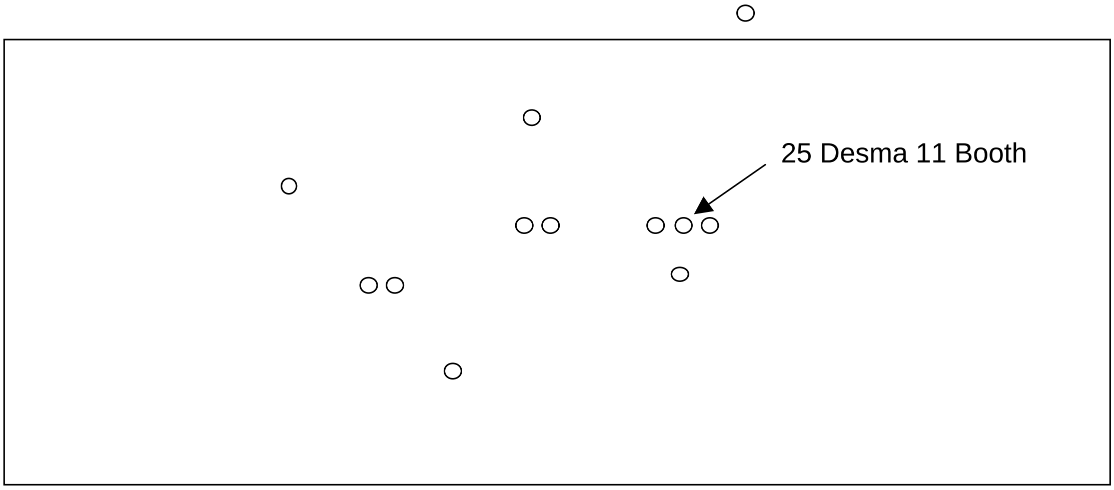


Stack Diameter (D) = 0.30 m

Stack Area (A) = 0.07 m^2

Sampling Point	**Distance as a % of (D)**	**Distance in m**
1	6.5	0.02
2	25.0	0.08
3	75.0	0.23
4	93.5	0.28

Plant Layout



Quality Assurance Checklist

Velocity Measurements:

Were water droplets present ? No

Direction of gas flow within ± 20° of stack axis. Yes

Dynamic pressures > 5 Pa at all sampling points. Yes

Ratio of highest to lowest dynamic pressures < 9 : 1. Yes

Sampling:

Sampling plane was correctly positioned. Yes

Area of sampling apparatus was < 10% of stack area. Yes

Sampling was from centres of equal areas. Yes

Sampling at each point not less than 3 minutes. Yes

Nozzle was facing directly upstream to within ± 10°. Yes

Leak check performed before and after each run and passed. Yes

Sample Handling:

Minimum weight of samples collected > 0.3% of filter weights. No

Samples achieved stable weights. Yes

Particulate samples stored for 3 months. Yes

QA Procedures:

Isokinetic data sheet completed and signed off by Team Leader. Yes

Report saved electronically onto Scientifics server. Yes

Raw data and hard copy of report filed together. Yes

Environmental Monitoring Team

Environmental Team Leader	Paul Adamczyk BSc (Hons) Fuel and Combustion Science MSc Environmental Pollution Control MCERTS Level 2, Technical Endorsement 1 & 4 - MM 04 547
Environmental Technician	Robert Adamczyk BSc Environmental Science MCERTS Trainee - MM06 721
Report by	Paul Adamczyk Level 2 Team Leader

Checked and Authorised By

Mark Allison Print Name

8th November 2006 Dated

Team Leader Business Title

Conclusion

The results of this test demonstrate that under normal operating conditions, this Plant is being operated in compliance with the total particulate matter and volatile organic compounds emission limits specified in PG 6/28 (04).

Good housekeeping and maintenance of the ducting and associated Plant should be continued in order to maintain this level of Plant performance.

A regular programme of stack emissions testing in accordance with the Plant's Local Air Pollution Control Authorisation will be required to demonstrate continued compliance.

Deviations from BS 3405 : 1983

Less than 0.3% of the filter weight was collected during both sample runs. This was due to the very low level of particulate emissions from the Plant.