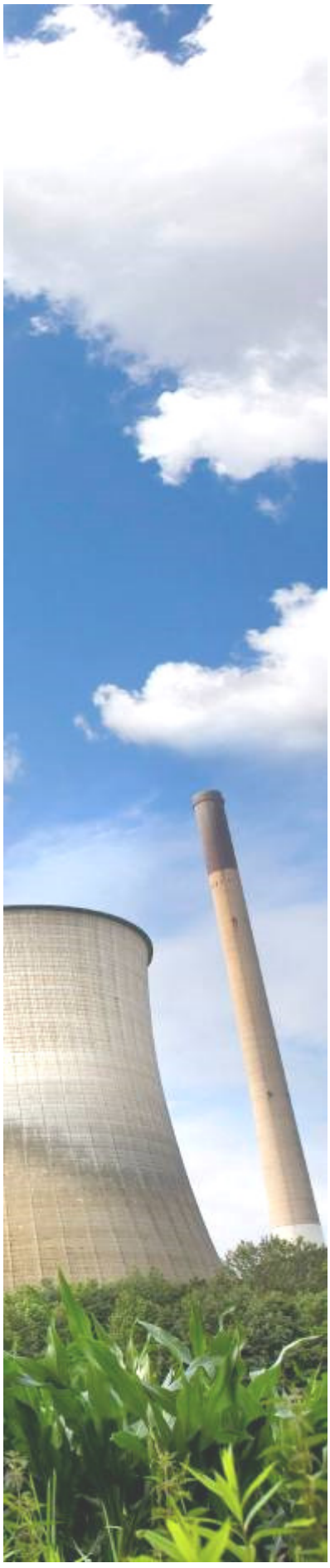
REC
Resource & Environmental Consultants Ltd

UKAS TESTING 2082



MONITORING OF EMISSIONS FROM THE POWDER COATING AND WOOD SPRAYING PROCESSES

11-12 June & 30-31July, 2013

Prepared for Alan Nuttalls Ltd

REC Report 71519p1r0

Issued: 30 August, 2013

REC Air Quality

GREEN ACHIEVER

SAFEcontractor APPROVED

Prepared for:

Alan Nuttalls Ltd
National Works
Hall Street
Dudley
DY2 7DQ

Prepared by:

REC Ltd
Unit 19 Bordesley Trading Estate
Bordesley Green Road
Birmingham
B8 1BZ
Tel : 0121 326 7007
Fax : 0121 328 1689
E-mail : sales@recltd.co.uk
Web :www.recltd.co.uk

Issued : 30 August, 2013
Reference : 71519p1r0

Prepared by : _____
Michelle Edwards, Team Leader
MM05 659, MCERTS Level 2 TE1-3

Reviewed by : _____
Ibai Castezubi, Team Leader
MM05 674, MCERTS Level 2 TE1-4

CONTENTS **Page No.**

TABLES (13 x Additional Pages)

APPENDICES (14 x Additional Pages)

EXECUTIVE SUMMARY

Resource & Environmental Consultants (REC) Ltd was commissioned by Alan Nuttalls Ltd to monitor to monitor emissions of pollutants released from various process stacks at their site in Dudley.

In accordance with the requirements of their site permit, monitoring has been undertaken for the following pollutants:-

- Combustion Gases including O_2 & CO
- Total Particulate Matter
- Hydrogen Chloride (HCl)
- Hydrogen Cyanide
- Formaldehyde
- Total Volatile Organic Compounds (VOCs) expressed as Carbon (C)

The following results were obtained from the emission monitoring survey and are compared with the current permit limit:-

Oven and Spraybooths

Species	Accreditation Status	Particulate Emission Concentration (mg/Nm^3)	Permit Limit (mg/Nm^3)
Pre-treatment Drying Oven	B	1.1	10
Refrigeration Powder Coat	B	1.2	10
Camel Back Curing Oven	B	1.0	10
Batch Line Curing Oven	B	1.6	10
Automatic Line Curing Oven	B	0.5	50
Wood Spraying Booth No.1	B	0.5	50
Wood Spraying Booth No.2	B	<0.3	50

NOTE 1: All data are expressed in mg/Nm^3 at 273K, 101.3kPa, without correction for moisture and oxygen content unless otherwise stated.
NOTE: UKAS Status:- (B) REC Ltd accredited for sampling only, UKAS accredited analysis conducted by SAL Ltd .

Wood Burning Boiler

Species	Accreditation Status	Emission Concentration (mg/Nm^3)	Permit Limit (mg/Nm^3)
Total VOCs (as C)	A	2179.9	20
Oxygen	A	15.2	n/a
Carbon Monoxide	A	599.6	250
Particulate Matter	B	63.1	200
Hydrogen Chloride	B	6.9	100
Hydrogen Cyanide	E	2.87	5
Formaldehyde	B	<0.1	5

NOTE 1: All data are expressed in mg/Nm^3 at 273K, 101.3kPa, without correction for moisture and oxygen content unless otherwise stated.
NOTE: UKAS Status:- (A) REC Ltd accredited for sampling and analysis. (B) REC Ltd accredited for sampling only, UKAS accredited analysis conducted by SAL Ltd or RPS Ltd. (E) REC Ltd not accredited for sampling, sub-contracted analysis not UKAS accredited.

1. INTRODUCTION

1.1 Background

Alan Nuttals Ltd commissioned REC Ltd to conduct an emission monitoring survey on various process stacks at their site in Dudley.

The mains processes at the site involve the manufacture and powder coating of shop furniture fittings such as shelving. The other part of their operations involves the manufacture and powder coating of refrigerated display and storage units.

1.2 Scope of the Survey

An emission monitoring survey was required to determine the release concentrations of various pollutants from the powder coat and wood spraying processes. Concentrations of the following pollutants were quantified during the survey:

- Combustion Gases including O_2 & CO
- Total Particulate Matter
- Hydrogen Chloride (HCl)
- Hydrogen Cyanide
- Formaldehyde
- Total Volatile Organic Compounds (VOCs) expressed as Carbon (C)

Ancillary measurements of stack dimensions, temperature and velocity were also made.

Sampling for combustion gases (CO & O_2) and VOCs was carried out on a continuous basis with measured concentrations being data-logged at 1 minute intervals over the sampling period.

All results were to be reported at 273K, 101.3kPa, wet gas without correction for oxygen content.

1.3 Sampling Personnel

Monitoring was conducted by the following REC Ltd permanent staff:-

11 June, 2013

- Michelle Edwards - Team Leader, MM05 659, MCERTS Level 2, TE1&2
- Rachel Powis - Assistant, MM12 1203, MCERTS Level 1

12 June, 2013

- Dave Burns - Team Leader, MM05 579, MCERTS Level 2, TE1-4
- Michelle Edwards - Assistant, MM05 659, MCERTS Level 2, TE1&2

30-31 July, 2013

- Dave Burns - Team Leader, MM05 579, MCERTS Level 2, TE1-4
- Rachel Powis - Assistant, MM12 1203, MCERTS Level 1

2. METHODOLOGY

2.1 Species & Techniques

The following table shows the reference methods used for the emission monitoring survey:

Species	UKAS Status	Method	Uncertainty (±%)	Limit of Detection
Moisture	A	In house method MM0010 based on BS EN 14790	20	0.1%vol
Particulate Matter	B	In house method MM0004 based on BS EN 13284 & BS ISO 9096	10	1 mg/m^3
Hydrogen Chloride	B	In house method MM0006 based on BS EN 1911	15	0.1 mg/m^3
Hydrogen Cyanide	E	Based on US EPA CTM33	30	0.1 mg/m^3
Formaldehyde	B	In house method MM0015 based on US EPA M316A	20	0.1 mg/m^3
Carbon Monoxide	A	In house method MM0002 based on BS EN 15058	10	1 mg/m^3
Oxygen	A	In house method MM0002 based on BS EN 14789	10	0.1%vol
Total VOCs (as C)	A	In house method MM0002 based on BS EN 12619 or BS EN 13526	10	1 mg/m^3

NOTE: UKAS Status:- (A) REC Ltd accredited for sampling and analysis. (B) REC Ltd accredited for sampling only, UKAS accredited analysis conducted by SAL Ltd or RPS Ltd. (E) REC Ltd not accredited for sampling, sub-contracted analysis by not UKAS accredited.

2.2 Sampling & Analytical Methodology

Total Particulate Matter

To determine the concentration of particulate matter in emissions, isokinetic stack sampling equipment satisfying the requirements of BS EN 13284 was utilised and in-house method MM0004 followed.

The Standard describes the methodology for measuring particulate matter under defined conditions and at discrete locations in the duct. Sampling is carried out under isokinetic sampling conditions i.e. the flowrate through the sampling nozzle is adjusted to equal the flowrate in the duct at the sampling positions. Velocity pressures were recorded throughout the monitoring period by means of an 'S' type pitot integral to the sampling probe and nozzle assembly.

A sample of the exhaust stream was removed from the stack via a titanium nozzle and titanium lined heated probe. It was then passed through a quartz fibre filter contained in a heated oven compartment. The temperature of the probe and filter box were maintained at

160ºC i.e. above the dew point of the stack gases, to ensure moisture did not condense on the filter. Each filter used complied with the requirements of Section 6.2.7 of BS EN 13284-1:2001 in that the efficiency was better than 99.5% for particles of 0.3µm diameter (or 99.9% for particles of 0.6µm diameter).

The impinger train was seated in a water bath to cool the gas stream and condense out less volatile gases and water vapour.

The first two impingers encountered by the gas stream contained deionised water. The third impinger was left empty and the fourth contained anhydrous silica gel which was used to dry the gas stream before passing it through a dry gas meter (DGM) to measure the volume of gas sampled.

All the impingers were weighed before and after the sampling run in order to determine the mass of water condensed by the impinger train (in house Method MM0010).

The sample volume collected was in excess of the minimum requirement stated in MM0004. The minimum sample volume ensures the results would be representative of normal plant operating conditions.
Upon completion of sampling, the filter was removed to a clean petri dish, labelled and sealed. The probe and filter housing were rinsed with acetone and water. The washings were collected in a container and submitted for analysis along with the filter.

This methodology allows the determination of formaldehyde to be carried out in conjunction with the particulate sampling as per US EPA Method 316A.

HCl

To determine the concentration of HCl in emissions, non-isokinetic stack sampling equipment satisfying the requirements of BS EN 1911 was utilised and in-house method MM0006 followed.

A sample of the exhaust stream was removed from the stack via a probe. It was then passed through a quartz fibre filter. On leaving the filter, the sampled exhaust gas was passed into a series of impingers.

The first three impingers encountered by the gas stream contained deionised water to capture and absorb the volatile chloride (Cl^-) ions. The fourth impinger was left empty and the fifth contained anhydrous silica gel which was used to dry the gas stream before passing it through a dry gas meter (DGM) to measure the volume of gas sampled.

Upon completion of sampling, the contents of impingers 1 & 2 were transferred to a sealed, labelled container. The contents of impinger 3 were transferred to a separate container. The absorbing solution was subsequently analysed for chloride (Cl^-) via an ion chromatographic (IC) technique.

HCN
To determine the concentration of HCN in emissions, non-isokinetic stack sampling equipment satisfying the requirements of US EPA CTM33 was utilised.

A sample of stack gas was removed via a stainless steel sampling probe. The gas then passes into a series of impingers. The first Two impingers encountered by the gas stream contained 0.1M sodium hydroxide (NaOH) to capture and absorb Cyanide ions.
The third impinger was left empty and the fourth contained anhydrous silica gel.
Sampling was conducted using a pre-calibrated, low flow sampling pump and Dry gas meter.

On completion of sampling, the impinger solution was collected and analysed for HCN by a colorimetric procedure.

Stack Temperature and Velocity

To determine the stack temperature, a calibrated thermocouple and digital indicator were employed. The exhaust gas velocity was investigated using a pitot static probe (to MM0004) and digital manometer.

2.3 Laboratory Analysis

An approved UKAS accredited sub-contractor, SAL Ltd, would undertake the sample analysis for Particulate matter, Hydrogen Cyanide and Hydrogen Chloride. RPS Ltd would undertake the sample analysis for Formaldehyde.

A copy of the Certificate of Analysis is enclosed in Appendix 1.

3. SAMPLING AND OPERATIONAL DETAILS

3.1 Process Description

The operations at Alan Nuttalls Ltd are authorised under a Part B permit issued by the Local Authority under the Environmental Permitting Regulations, 2010.

The process is therefore under Local Authority regulation and must demonstrate compliance with the emission limits stipulated in the site permit.

The main process operations involve the automatic and manual coating of shop furniture fittings, with various powdered paints, spirit stains and/or solvent based lacquers.

Once products have been spray coated, they are fed to a gas fired oven where the coatings are cured at a temperature of 180^{o}c

The Waste wood generated in the manufacturing process is used to fuel the Ranheat wood burning boiler. The heat produced is then utilised to heat the factory. During sampling the waste wood used to fire the boiler, comprised of sawdust, laminates, chipboards and fibreboard.

3.2 Sampling Positions

On stacks all stack a single 4" BSP sampling port was installed on a horizontal plane. The sampling points provided were less than 4 x hydraulic diameters from any flow disturbance both upstream and downstream from the sampling plane.
Access was via small temporary scaffolding.

Both the port size and sample planes do not fully meet the requirements stated in Environment Agency Technical Guidance Note M1. TGN M1 of 2 x 5" BSP sockets located at least 5 x hydraulic diameters from any flow disturbance both upstream and downstream of the sampling plane. However the initial temperature and velocity traverse conducted along the sample plane showed that the flow requirements of TGN M1 were however met.

Photographs detailing the sampling locations are provided in Appendix 2.

3.3 Uncertainty

Due to the absence of a second sampling port, only a single sampling plane could be utilised. However the number of sample points, were increased along this plane and therefore the standard uncertainties would still apply.

REC has calculated uncertainty budgets for all of the pollutants listed in the Method Details Table in Section 2.1 above in accordance with calculations and methodology supplied by the Source Testing Association (STA). These uncertainties are quoted in the Tables section of this report.

3.4 Emission Monitoring Survey Details

The emission monitoring survey was carried out on the powder coating and wood spraying processes over the period 11-12 June and 30-31 July, 2013. The table overleaf summarises the actual sampling periods.

SAMPLING PERIODS

Stack	Parameter	Sample Time (& Date)
Pre-treatment Drying Oven	Particulate Matter	13:02 – 13:50 (11/06/13)
Refrigeration Powder Coat	Particulate Matter	15:32 – 16:04 (11/06/13)
Camel Back Curing Oven	Particulate Matter	13:00 – 13:48 (12/06/13)
Automatic Line Curing Oven	Particulate Matter	14:44 – 15:18 (12/06/13)
Batch line Curing Oven	Particulate Matter	09:27 – 09:57 (30/07/13
Wood Spraybooth No.1	Particulate Matter	11:54 – 12:34 (30/07/13)
Wood Spraybooth No.2	Particulate Matter	13:49 – 14:29 (30/07/13)
Wood Burning Boiler	Particulate Matter & HCHO	09:36 – 10:06 (31/07/13)
	HCl	09:35 – 10:05 (31/07/13
	HCN	10:30 – 11:00 (31/07/13)
	Combustion Gas & VOC	10:01 – 11:01 (31/07/13

4. RESULTS AND DISCUSSION

4.1 Initial Velocity and Temperature Traverse

An initial pitot-static pressure and temperature traverse was carried out. From these data stack velocity, expressed in metres per second (m/s), and volumetric flowrates expressed in cubic metre per hour (m^3/hr) have been calculated.

The results are reported at actual stack conditions and the volumetric flowrate is further expressed at the standard reference conditions of 273K, 101.3kPa i.e. standard temperature and pressure (STP). The results are summarised in Table 1.

4.2 Particulate Matter

The results of the particulate sampling runs are summarised in Tables 2 to 10. From the mass of particulate matter on the filter and in the acetone/water wash residue and volume sampled an emission concentration was calculated.

The results are expressed in mg/m^3 at 273K, 101.3kPa, without correction for water vapour content.

4.3 Formaldehyde

The results of the Formaldehyde sampling runs are also summarised in Table 10.
From the mass of HCHO in the absorbing solution and measured sample volume an emission concentration was calculated.

The results are expressed in mg/m^3 at 273K, 101.3kPa, without correction for water vapour content.

4.4 Hydrogen Chloride

The results of the volatile chloride sampling runs are summarised in Table 11. From the concentration of Cl^- and the measured volume of absorbing solution a total mass of HCl in microgram (µg) was determined. From their respective molecular weights, equivalent weights of HCl were then calculated. From the measured sample volume, an emission concentration was calculated.

The results are expressed in mg/m^3 at 273K, 101.3kPa, without correction for water vapour content

4.5 HCN

The results of the Hydrogen Cyanide sampling run are summarised in Table 12. From the concentration of HCN in the absorbing solution and measured sample volume an emission concentration was calculated.

The results are expressed in mg/m^3 at 273K, 101.3kPa, without correction for water vapour content.

4.6 Combustion Gases

The results of the combustion gas monitoring tests are summarised in Table 13 and Figure 1. The table presents the average of concentrations measured throughout each of the sample period.

Concentrations are expressed in mg/m^3 at the standard reference conditions of 273K, 101.3kPa without correction for water vapour content.

Measured concentrations on a dry gas basis have been converted to a wet gas basis using moisture measurements from the Particulate /Formaldehyde sampling runs.

4.7 Total VOC Emission Data

The results of the VOC monitoring tests are summarised in Table 13 and Figure 2. The table presents the average of concentrations measured throughout each of the sample periods.

Concentrations are expressed in mg/m^3 as carbon (C) at the standard reference conditions of 273K, 101.3kPa without correction for water vapour content.

====== End of Report Text ====

FIGURES

Fig 1: Combustion Gas Emission Data, Alan Nuttalls, Wood Burning Boiler , (31/07/13)

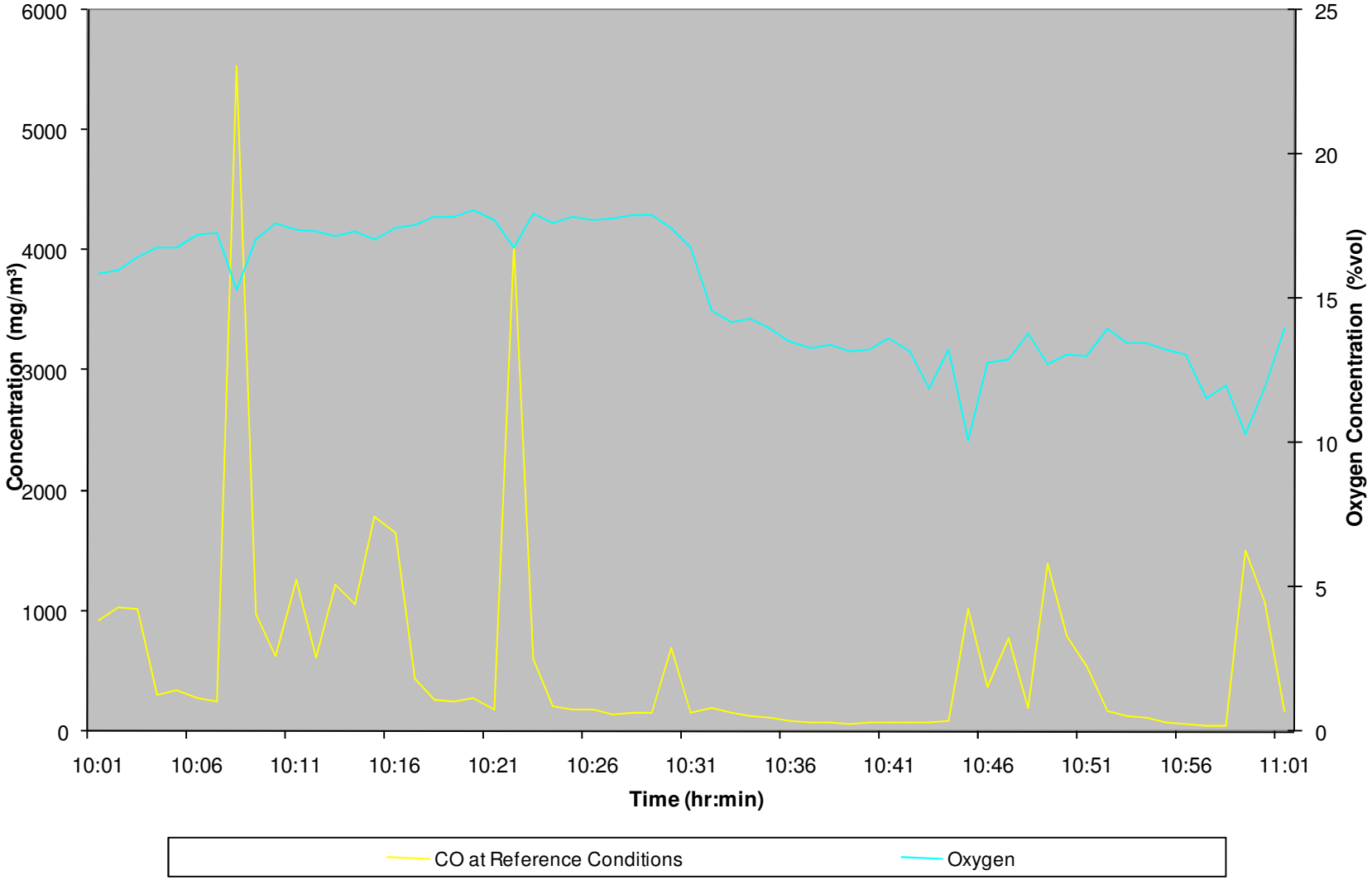
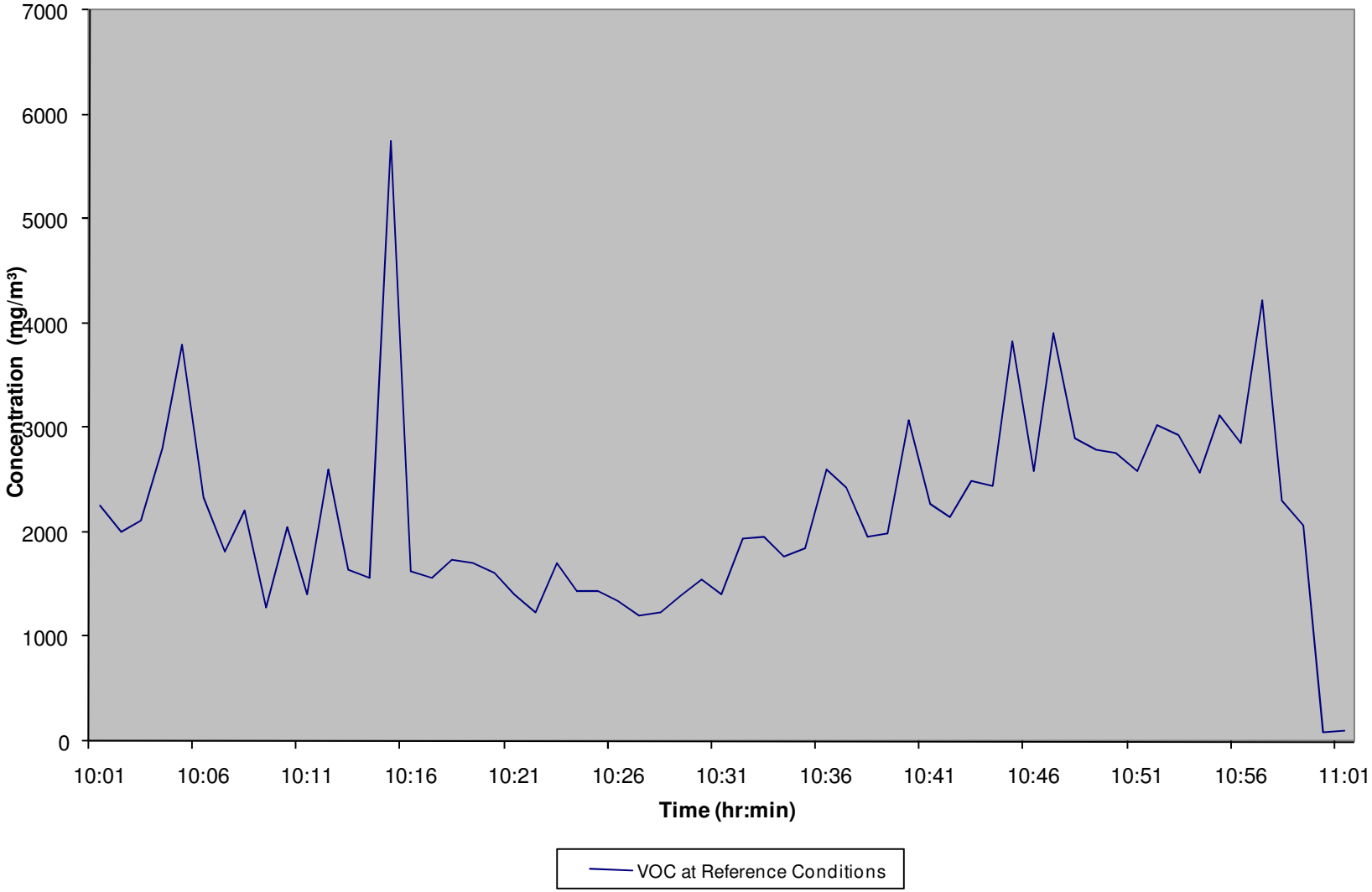


Fig 2: Total VOC Emission Data, Alan Nuttall, Wood Burning Boiler, (31/07/13)



TABLES

TABLE 1

FLOW DATA

Stack Ref.	Stack Temp	Av Pitot ΔP	Duct Diam	X-Sect. Area	Velocity (actual)	Volume Flow (m^3/hr)	
	(^{0}C)	(Pa)	(cm)	(m^2)	(m/s)	(actual)	(@ ntp)
Batch Line Curing Oven	138	119	40	0.126	16.8	7,610	5,058
Pre-treatment Drying Oven	184	10	40	0.126	5.1	2,324	1,391
Refrigeration stack	97	26	48x28	0.134	7.5	3,632	2,681
Camel Back Curing Oven	146	17	40	0.126	6.5	2,936	1,912
Automatic Line Curing Oven	190	42	39	0.119	10.7	4,612	2,721
Wet Spraybooth No.1	42	22	80	0.503	6.4	11,524	9,988
Wet Spraybooth No.2	23	28	80	0.503	6.9	12,553	11,586
Wood Burning Boiler	127	68	22	0.038	12.5	1,714	1,171

TABLE 2

PARTICULATE EMISSION DATA SUMMARY – PRE-TREATMENT DRYING OVEN

DATE: 11/06/13 **13:02 - 13:50**

Sampling Data	
Run Time (min)	**48**
Total mass H_2O collected (g)	**16.6**
Pitot tube constant, Cp	**0.84**
Dry gas meter (DGM) volume (m^3)	**0.773**
Temperature DGM (^oC)	**25**
Temperature stack (^oC)	**184**
Mean pitot tube pressure drop, delta P (mm H_2O)	**1.6**
Orifice meter pressure drop, delta H (mm H_2O)	**24.2**
Barometric Pressure (kPa)	**98.4**
X-sectional area of stack (m^2)	**0.126**
Nozzle size (mm)	**10.09**
Flow Data	
Velocity, actual (m/s)	**5.4**
Velocity, ntp (m/s)	**3.2**
Vol. Flow, actual (m^3/hr)	**2,448**
Vol. Flow, ntp (m^3/hr)	**1,440**
Volume sampled, ntp, dry gas (m^3)	**0.686**
Volume sampled, ntp, wet gas (m^3)	**0.707**
Analytical Data	
Filter Weight Gain (mg)	**<0.1**
Acetone Wash Residue Weight (mg)	**0.8**
Total Particulates (mg)	**0.8**
Partics Field Blank (mg)	**<0.9**
Blank % of ELV	**13.1**
Emission Data	
H_2O (% vol)	**2.9**
Percentage Isokinetic	**96.5**
Particulates (mg/m^3)	**1.1**
Uncertainty (± mg/m^3)	**0.7**

TABLE 3

PARTICULATE EMISSION DATA SUMMARY – REFRIGERATION POWDER COAT

DATE: 11/06/13 **15:32 - 16:04**

Sampling Data	
Run Time (min)	**32**
Total mass H_2O collected (g)	**14.5**
Pitot tube constant, Cp	**0.84**
Dry gas meter (DGM) volume (m^3)	**0.896**
Temperature DGM (^oC)	**29**
Temperature stack (^oC)	**109**
Mean pitot tube pressure drop, delta P (mm H_2O)	**3.7**
Orifice meter pressure drop, delta H (mm H_2O)	**66.0**
Barometric Pressure (kPa)	**98.4**
X-sectional area of stack (m^2)	**0.134**
Nozzle size (mm)	**10.09**
Flow Data	
Velocity, actual (m/s)	**7.6**
Velocity, ntp (m/s)	**5.3**
Vol. Flow, actual (m^3/hr)	**3,655**
Vol. Flow, ntp (m^3/hr)	**2,577**
Volume sampled, ntp, dry gas (m^3)	**0.783**
Volume sampled, ntp, wet gas (m^3)	**0.801**
Analytical Data	
Filter Weight Gain (mg)	**<0.10**
Acetone Wash Residue Weight (mg)	**1.0**
Total Particulates (mg)	**1.0**
Partics Field Blank (mg)	**<0.4**
Blank % of ELV	**5.1**
Emission Data	
H_2O (% vol)	**2.3**
Percentage Isokinetic	**97.8**
Particulates (mg/m^3)	**1.2**
Uncertainty (± mg/m^3)	**0.7**

TABLE 5

PARTICULATE EMISSION DATA SUMMARY – CAMEL BACK

DATE: 11/06/13 **13:00 - 13:48**

Sampling Data	
Run Time (min)	**48**
Total mass H_2O collected (g)	**20.2**
Pitot tube constant, Cp	**0.84**
Dry gas meter (DGM) volume (m^3)	**0.899**
Temperature DGM (^oC)	**29**
Temperature stack (^oC)	**147**
Mean pitot tube pressure drop, delta P (mm H_2O)	**1.9**
Orifice meter pressure drop, delta H (mm H_2O)	**30.1**
Barometric Pressure (kPa)	**98.2**
X-sectional area of stack (m^2)	**0.126**
Nozzle size (mm)	**10.09**
Flow Data	
Velocity, actual (m/s)	**5.8**
Velocity, ntp (m/s)	**3.7**
Vol. Flow, actual (m^3/hr)	**2,602**
Vol. Flow, ntp (m^3/hr)	**1,664**
Volume sampled, ntp, dry gas (m^3)	**0.785**
Volume sampled, ntp, wet gas (m^3)	**0.810**
Analytical Data	
Filter Weight Gain (mg)	**<0.10**
Acetone Wash Residue Weight (mg)	**0.8**
Total Particulates (mg)	**0.8**
Partics Field Blank (mg)	**<0.7**
Blank % of ELV	**1.8**
Emission Data	
H_2O (% vol)	**3.1**
Percentage Isokinetic	**95.7**
Particulates (mg/m^3)	**1.0**
Uncertainty (± mg/m^3)	**0.6**

TABLE 6

PARTICULATE EMISSION DATA SUMMARY – AUTOMATIC LINE

DATE: 12/06/13 **14:44 - 15:18**

Sampling Data	
Run Time (min)	**34**
Total mass H_2O collected (g)	**13.1**
Pitot tube constant, Cp	**0.84**
Dry gas meter (DGM) volume (m^3)	**1.055**
Temperature DGM (^oC)	**27**
Temperature stack (^oC)	**193**
Mean pitot tube pressure drop, delta P (mm H_2O)	**5.1**
Orifice meter pressure drop, delta H (mm H_2O)	**74.5**
Barometric Pressure (kPa)	**98.1**
X-sectional area of stack (m^2)	**0.119**
Nozzle size (mm)	**10.09**
Flow Data	
Velocity, actual (m/s)	**9.9**
Velocity, ntp (m/s)	**5.7**
Vol. Flow, actual (m^3/hr)	**4,270**
Vol. Flow, ntp (m^3/hr)	**2,460**
Volume sampled, ntp, dry gas (m^3)	**0.926**
Volume sampled, ntp, wet gas (m^3)	**0.942**
Analytical Data	
Filter Weight Gain (mg)	**<0.10**
Acetone Wash Residue Weight (mg)	**0.5**
Total Particulates (mg)	**0.5**
Partics Field Blank (mg)	**<0.4**
Blank % of ELV	**4.3**
Emission Data	
H_2O (% vol)	**1.7**
Percentage Isokinetic	**101.0**
Particulates (mg/m^3)	**0.5**
Uncertainty (± mg/m^3)	**0.6**

TABLE 7

PARTICULATE EMISSION DATA SUMMARY – BATCH LINE

DATE: 30/07/13 **09:27 - 09:57**

Sampling Data	
Run Time (min)	**30**
Total mass H_2O collected (g)	**12.1**
Pitot tube constant, Cp	**0.84**
Dry gas meter (DGM) volume (m^3)	**0.671**
Temperature DGM (^oC)	**22**
Temperature stack (^oC)	**133**
Mean pitot tube pressure drop, delta P (mm H_2O)	**9.7**
Orifice meter pressure drop, delta H (mm H_2O)	**40.4**
Barometric Pressure (kPa)	**98.8**
X-sectional area of stack (m^2)	**0.126**
Nozzle size (mm)	**7.01**
Flow Data	
Velocity, actual (m/s)	**12.6**
Velocity, ntp (m/s)	**8.4**
Vol. Flow, actual (m^3/hr)	**5,720**
Vol. Flow, ntp (m^3/hr)	**3,800**
Volume sampled, ntp, dry gas (m^3)	**0.604**
Volume sampled, ntp, wet gas (m^3)	**0.619**
Analytical Data	
Filter Weight Gain (mg)	**<0.10**
Acetone Wash Residue Weight (mg)	**1.0**
Total Particulates (mg)	**1.0**
Partics Field Blank (mg)	**0.4**
Blank % of ELV	**6.6**
Emission Data	
H_2O (% vol)	**2.4**
Percentage Isokinetic	**105.9**
Particulates (mg/m^3)	**1.6**
Uncertainty (± mg/m^3)	**0.8**

TABLE 8

PARTICULATE EMISSION DATA SUMMARY – WOOD SPRAY BOOTH No.1

DATE: 30/07/13 **11:54 - 12:34**

Sampling Data	
Run Time (min)	**40**
Total mass H_2O collected (g)	**7.6**
Pitot tube constant, Cp	**0.85**
Dry gas meter (DGM) volume (m^3)	**1.059**
Temperature DGM (^oC)	**22**
Temperature stack (^oC)	**31**
Mean pitot tube pressure drop, delta P (mm H_2O)	**2.4**
Orifice meter pressure drop, delta H (mm H_2O)	**54.6**
Barometric Pressure (kPa)	**99.9**
X-sectional area of stack (m^2)	**0.503**
Nozzle size (mm)	**10.09**
Flow Data	
Velocity, actual (m/s)	**5.5**
Velocity, ntp (m/s)	**4.9**
Vol. Flow, actual (m^3/hr)	**9,871**
Vol. Flow, ntp (m^3/hr)	**8,803**
Volume sampled, ntp, dry gas (m^3)	**0.963**
Volume sampled, ntp, wet gas (m^3)	**0.973**
Analytical Data	
Filter Weight Gain (mg)	**<0.10**
Acetone Wash Residue Weight (mg)	**0.5**
Total Particulates (mg)	**0.5**
Partics Field Blank (mg)	**0.5**
Blank % of ELV	**1.0**
Emission Data	
H_2O (% vol)	**1.0**
Percentage Isokinetic	**104.3**
Particulates (mg/m^3)	**0.5**
Uncertainty (± mg/m^3)	**0.5**

TABLE 9

PARTICULATE EMISSION DATA SUMMARY – WOOD SPRAY BOOTH No.2

DATE: 30/07/13 **13:49 - 14:29**

Sampling Data	
Run Time (min)	**40**
Total mass H_2O collected (g)	**11.9**
Pitot tube constant, Cp	**0.85**
Dry gas meter (DGM) volume (m^3)	**1.292**
Temperature DGM (^oC)	**26**
Temperature stack (^oC)	**24**
Mean pitot tube pressure drop, delta P (mm H_2O)	**3.6**
Orifice meter pressure drop, delta H (mm H_2O)	**92.6**
Barometric Pressure (kPa)	**99.6**
X-sectional area of stack (m^2)	**0.503**
Nozzle size (mm)	**10.09**
Flow Data	
Velocity, actual (m/s)	**6.6**
Velocity, ntp (m/s)	**6.0**
Vol. Flow, actual (m^3/hr)	**11,964**
Vol. Flow, ntp (m^3/hr)	**10,923**
Volume sampled, ntp, dry gas (m^3)	**1.154**
Volume sampled, ntp, wet gas (m^3)	**1.169**
Analytical Data	
Filter Weight Gain (mg)	**<0.1**
Acetone Wash Residue Weight (mg)	**<0.3**
Total Particulates (mg)	**<0.4**
Partics Field Blank (mg)	**<0.4**
Blank % of ELV	**0.7**
Emission Data	
H_2O (% vol)	**1.3**
Percentage Isokinetic	**100.9**
Particulates (mg/m^3)	**<0.3**
Uncertainty (± mg/m^3)	**0.4**

TABLE 10

PARTICULATE & HCHO EMISSION DATA SUMMARY – WOOD BURNING BOILER

DATE: 31/07/13 **09:36 - 10:06**

Sampling Data	
Run Time (min)	**30**
Total mass H_2O collected (g)	**17.8**
Pitot tube constant, Cp	**0.85**
Dry gas meter (DGM) volume (m^3)	**0.763**
Temperature DGM (^oC)	**20**
Temperature stack (^oC)	**135**
Mean pitot tube pressure drop, delta P (mm H_2O)	**8.0**
Orifice meter pressure drop, delta H (mm H_2O)	**57.7**
Barometric Pressure (kPa)	**98.7**
X-sectional area of stack (m^2)	**0.126**
Nozzle size (mm)	**8.06**
Flow Data	
Velocity, actual (m/s)	**11.6**
Velocity, ntp (m/s)	**7.7**
Vol. Flow, actual (m^3/hr)	**5,264**
Vol. Flow, ntp (m^3/hr)	**3,474**
Volume sampled, ntp, dry gas (m^3)	**0.691**
Volume sampled, ntp, wet gas (m^3)	**0.713**
Analytical Data	
Filter Weight Gain (mg)	**27.0**
Acetone Wash Residue Weight (mg)	**18.0**
Total Particulates (mg)	**45.0**
Partics Field Blank (mg)	**0.4**
Blank % of ELV	**0.3**
Mass of HCHO (µg)	**<42.0**
Emission Data	
H_2O (% vol)	**3.1**
Percentage Isokinetic	**101.1**
Particulates (mg/m^3)	**63.1**
Uncertainty (± mg/m^3)	**2.1**
HCHO (mg/m^3)	**<0.1**
Uncertainty (± mg/m^3)	**0.01**

TABLE 11

HCL EMISSION DATA SUMMARY

Sampling Data	Boiler Stack
Start Time/Date	09:35, 31/07/13
End Time/Date	10:05, 31/07/13
Sampling Period (min)	30
DGM start (dry m^3)	44.773
DGM end (dry m^3)	45.093
Volume Sampled (dry m^3)	0.320
Ambient Temp (^oC)	20.5
Ambient Press (kPa)	98.7
Wt of Water (g)	80.9
Volume Water (m^3)	0.101
Volume Sampled, 273K, 101.3kPa (dry m^3)	0.290
Volume Sampled, 273K, 101.3kPa (wet m^3)	0.391
Volume H_2O Impingers 1+2 (ml)	330
Volume H_2O Impinger 3 (ml)	170
Analytical Data	
HCl Blank (mg/l)	<0.05
HCl in H_2O Imps 1+2 (mg/l)	7.5
HCl in Imps 1+2 (µg)	2475
HCl in H_2O Imp 3 (mg/l)	1.30
HCl in Imp 3 (µg)	221
% HCl in Imps 1+2	92
Emission Concentration Data	
Moisture (%vol)	25.8
HCl (mg/m^3)	6.9
HCl Measurement Uncertainty (± mg/m^3)	1.1

TABLE 12

HCN EMISSION DATA SUMMARY

Sampling Data	Wood Burning Boiler
Start Time/Date	10:30, 31/07/13
End Time/Date	11:00, 31/07/13
Sampling Period (min)	30
DGM start (dry m^3)	45.101
DGM end (dry m^3)	45.375
Volume Sampled (dry m^3)	0.274
Ambient Temp (^oC)	21.5
Ambient Press (kPa)	98.7
Wt of Water (g)	13.3
Volume Water (m^3)	0.017
Volume Sampled, 273K, 101.3kPa (dry m^3)	0.247
Volume Sampled, 273K, 101.3kPa (wet m^3)	0.264
Volume NaOH Impinger 1 (ml)	330
Analytical Data	
HCl Blank (mg/l)	<0.05
HCN in NaOH Imp1 (mg/l)	2.30
total HCN (µg)	759
Emission Concentration Data	
Moisture (%vol)	6.3
HCN (mg/m^3)	2.87

TABLE 13

COMBUSTION GAS & VOC EMISSION DATA SUMMARY

Stack Ref	O_2	CO		Total VOCs	
	(%vol)	ppm	mg/m^3	ppm (as C_3H_8)	mg/m^3 as C
Wood Burning Boiler	15.2	130.4	599.6	1356.4	2179.9
Uncertainty (±)	0.4	-	14.5	-	49.7

APPENDIX 1

Certificate of Analysis

Scientific Analysis Laboratories is a
limited company registered in England and
Wales (No 2514788) whose address is at
Hadfield House, Hadfield Street, Manchester M16 9FE

Scientific Analysis Laboratories Ltd

Certificate of Analysis

Hadfield House
Hadfield Street
Cornbrook
Manchester
M16 9FE
Tel : 0161 874 2400
Fax : 0161 874 2404

Report Number: 335526-1

Date of Report: 24-Jun-2013

Customer: Resource Environmental Consultants Ltd
Unit 19
Bordesley Trading Estate
Bordesley Green Road
Birmingham
B8 1BZ

Customer Contact: Ms Michelle Edwards

Customer Job Reference: 71519
Customer Site Reference: 11&12 June, 2013
Date Job Received at SAL: 17-Jun-2013
Date Analysis Started: 19-Jun-2013
Date Analysis Completed: 24-Jun-2013

The results reported relate to samples received in the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs
All results have been reviewed in accordance with QP22

UKAS TESTING
1549

Report checked
and authorised by :
Mary Drury
Project Manager

Issued by :
Mary Drury
Project Manager

SAL Reference: 335526
Project Site: 11&12 June, 2013
Customer Reference: 71519

Wash(Acetone) Analysed as Wash(Acetone)
Miscellaneous

				SAL Reference	**335526 002**	**335526 004**	**335526 006**	**335526 008**	**335526 010**
				Customer Sample Reference	**71519/2**	**71519/4**	**71519/6**	**71519/8**	**71519/14**
				Test Sample	**AR**	**AR**	**AR**	**AR**	**AR**
Determinand	**Method**	**LOD**	**Units**	**Symbol**					
Particulates (Total)	Grav	0.3	mg	U	**0.8**	**0.8**	<0.3	**1.0**	**0.7**

SAL Reference: 335526
Project Site: 11&12 June, 2013
Customer Reference: 71519

Wash(Acetone) Analysed as Wash(Acetone)
Miscellaneous

				SAL Reference	**335526 012**	**335526 014**	**335526 016**
				Customer Sample Reference	**71519/16**	**71519/18**	**71519/20**
				Test Sample	**AR**	**AR**	**AR**
Determinand	**Method**	**LOD**	**Units**	**Symbol**			
Particulates (Total)	Grav	0.3	mg	U	**0.8**	<0.3	**0.5**

SAL Reference: 335526
Project Site: 11&12 June, 2013
Customer Reference: 71519

Filter Quartz 110mm Analysed as Filter Quartz 110mm
Miscellaneous

				SAL Reference	**335526 001**	**335526 003**	**335526 013**	**335526 015**
				Customer Sample Reference	**71519/1**	**71519/3**	**71519/17**	**71519/19**
				Test Sample	**AR**	**AR**	**AR**	**AR**
				Filter Reference	**729**	**730**	**477**	**459**
Determinand	**Method**	**LOD**	**Units**	**Symbol**				
Particulates (Total)	Grav (5 Dec)	0.10	mg	U	<0.10	<0.10	<0.10	<0.10

SAL Reference: 335526
Project Site: 11&12 June, 2013
Customer Reference: 71519

Filter Quartz 85mm Analysed as Filter Quartz 85mm
Miscellaneous

				SAL Reference	**335526 005**	**335526 007**	**335526 009**	**335526 011**
				Customer Sample Reference	**71519/5**	**71519/7**	**71519/13**	**71519/15**
				Test Sample	**AR**	**AR**	**AR**	**AR**
				Filter Reference	**858**	**865**	**818**	**868**
Determinand	**Method**	**LOD**	**Units**	**Symbol**				
Particulates (Total)	Grav (5 Dec)	0.10	mg	U	<0.10	<0.10	<0.10	<0.10

Index to symbols used in 335526-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited

RPS Laboratories

UKAS TESTING 0605

Test Certificate

Date 19/08/2013

Client	REC Ltd Unit 19 Bordesley Trading Estate Bordesley Green Rd Birmingham B8 1BZ	**Order No.**	71519
		Certificate No.	**WK13-4922**
		Issue No.	1
Contact	Michelle Edwards	**Date Received**	09/08/2013
Description	3 solutions for formaldehyde	**Technique**	Wet Chemistry

Sample No.	**755209**	**71519/22**		**Method**
Formaldehyde	<0.1 µg/ml	420 ml	M103(U)	

Sample No.	**755210**	**71519/23**		**Method**
Formaldehyde	<0.1 µg/ml	395 ml	M103(U)	

Sample No.	**755211**	**71519/24**		**Method**
Formaldehyde	<0.1 µg/ml	228 ml	M103(U)	

RPS Laboratories Ltd. Unit 12. Waters Edge Business Park. Modwen Road. Salford. M5 3EZ
Tel: (0161) 872 2443 Fax: (0161) 877 3959

UKAS TESTING 0605

Test Certificate

Date 19/08/2013

Client REC Ltd

Certificate No. WK13-4922

Issue No. 1

Tested By Ashley Lunt Date 16/08/2013

Approved By Date 19/08/2013

Joanne Dewhurst
Laboratory Manager

For and on authority of RPS Laboratories Ltd.

Method Symbols (U) Analysis is UKAS Accredited
(N) Analysis is not UKAS Accredited

Concentration values (mg/m3 and ppm) are provided to assist with interpretation only, they are not covered by the scope of UKAS accreditation.

Results stated as ml are refering to the sample volume.

RPS Laboratories terms and conditions apply - a copy is available on request.

Analysis carried out on samples 'as received'

RPS Laboratories Ltd. Unit 12. Waters Edge Business Park. Modwen Road. Salford. M5 3EZ
Tel: (0161) 872 2443 Fax: (0161) 877 3959

APPENDIX 2

Photographs of Sampling Locations

Pre-treatment Drying Oven

Refrigeration Powder Coat

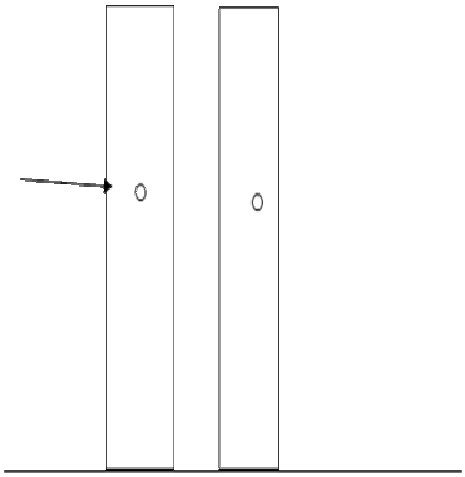
Camel Back

Automatic Line

Batch Line

Wood Burning Boiler

Wood Spraybooth's No.1& 2



APPENDIX 3

Calculations

Conversion Factors

ppm ® mg/Nm³ (at 273K, 101.3kPa: STP)

CO	x	1.25	
SO_2	x	2.86	
VOC's	x	1.61	(ppm as C_3H_8 to mg/Nm^3 as C)
NO_X	x	2.05	(ppm NO + NO_2 to mg/m^3 as NO_2)

Oxygen Correction to Reference Value

Concentration at (STP) -> Concentration at 273K, 101.3kPa, reference O_2 and Dry Gas, i.e.

Concentration X ((20.9-O_2 ref)/(20.9-O_2 measured)) = Concentration at ref Oxygen state.

Example Calculation

SO_2 concentration at STP	=	170.7 mg/Nm³
Oxygen percentage in gas stream	=	13.8%
Reference Oxygen	=	11%

SO_2 concentration at reference O_2 conditions	=	170.7 ((20.9-11)/(20.9-13.8))
	=	238 mg/Nm³ at 273K, 101.3kPa, 11% O_2 and Dry Gas

Moisture Correction (Wet to Dry)

Concentration of Gas Dry = Concentration of x 100/100-Bws Gas Wet

Concentration of Gas Wet = Concentration of x 100-Bws/100 Gas Dry

Where Bws = moisture content of gas stream in percent (Vol/Vol).

Example

VOC concentration	=	25 mg/Nm³ (Wet)
Moisture Content	=	27.1%
Concentration of VOC	=	25 (100/(100-27.1))

Carbon (C) to Trichloethylene (TCE)

ppm TCE = ppm C x 0.6715

TCE in mg/m^3 = TCE ppm x 5.864 (Mol Wt/22.4)