REC
Resource & Environmental Consultants Ltd

UKAS TESTING 2082

MONITORING OF EMISSIONS FROM THE ANIMAL FEED MANUFACTURING PROCESS

July & September, 2014

Prepared for Sundown Products Ltd

REC Report 71815p1r0

Issued: 2 October, 2014

REC Air Quality

safecontractor APPROVED

a CONCEPT LIFE SCIENCES company

Prepared for:

Sundown Products Ltd
Station Road
Tilbrook
Huntingdon
PE28 OJY

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 : 2 October, 2014
Reference : 71815p1r0

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

Reviewed by : _____
Jon Connor, Team Leader
MM04 526, MCERTS Level 2, TE1-4

CONTENTS **Page No.**

EXECUTIVE SUMMARY

Resource & Environmental Consultants (REC) Ltd was commissioned by Sundown Products Ltd to monitor emissions of pollutants released from the Animal Feed manufacturing process at their site in Huntingdon, Cambridgeshire.

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

- Total Particulate Matter
- Oxygen (O_2) for reference purposes on the Dryer stack only

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

Emission Source	Species	Emission Concentration (mg/Nm^3)	Permit Limit (mg/Nm^3)	Accreditation Status
Dryer	Particulate Matter	40.0	150	B
Cooler	Particulate Matter	9.7	150	B
BBF	Particulate Matter	4.2	20	B
Tub 1 Filter	Particulate Matter	19.9	20	B

NOTE 1: Data from all sources except Dryer are expressed in mg/Nm^3 at 273K, 101.3kPa, without correction for moisture and oxygen content unless otherwise stated. Data from Dryer expressed in mg/Nm^3 at 273K, 101.3kPa, wet gas corrected to 17% oxygen content
NOTE: UKAS Status:- (B) REC Ltd accredited for sampling only, UKAS accredited analysis conducted by SAL Ltd.

1. INTRODUCTION

1.1 Background

Sundown Products Ltd commissioned REC Ltd to conduct an emission monitoring survey on their various process emission stacks from the animal feed manufacturing process at their site in Huntingdon, Cambridgeshire.

Operations at Sundown Products Ltd, involve the use of drying and cooling processes to manufacturer a wide range of animal feed.

The Dryer process removes moisture from straw through heating in a rotational drum.

The Cooler process helps to complete the pellets chemical reactions with sodium hydroxide and also allows them to cool down.

The BBF stack acts as an outlet from a cyclone process on a conveyor belt.

The Tub 1 Filter process involves the filtration of air from various processes onsite. Once removed from the various processes the air is passed through a bag filter, before being discharged out to atmosphere. This process is classified as a batch process

1.2 Scope of the Survey

An emission monitoring survey was required to determine the release concentrations of various pollutants from the animal feed production process. Concentrations of the following pollutants were quantified during the survey:

- Total Particulate Matter
- Oxygen

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

The results from the Cooler, Tub 1 Filter and BBF stacks were to be reported at 273K, 101.3kPa, wet gas without correction for oxygen content.

The results from the Dryer were to be reported at 273K, 101.3kPa, wet gas and corrected to 17 % Oxygen content.

1.3 Sampling Personnel

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

7 & 8 July, 2014

- Aidan Wrynne - Team Leader, MM08 921, MCERTS Level 2, TE1-4
- Craig Macdonald - Assistant, MM10 1036, MCERTS Trainee

8 September, 2014

- David Burns - Team Leader, MM05 579, MCERTS Level 2, TE1-4
- Michelle Edwards - Assistant, MM05 659, MCERTS Level 2, TE1-3

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	10	1 mg/m^3
Oxygen	A	In house method MM0002 based on ISO 12039	10	0.1%vol

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

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.

Oxygen Gas

To determine the concentration of Oxygen in emissions, a Testotherm Model 350XL multigas analyser was used. The analyser incorporates a gas conditioner to enable the gas stream to be presented to the electrochemical cells on a dry gas basis. In house method MM0002 was followed.

The analyser satisfies the requirements of the following Standards:-

O_2 - ISO 12039

For each parameter the measured value (m.v.) and accuracy associated with this type of measurement using the Testo 350XL is:

O_2 ± 0.8% of full scale deflection

The analyser would be calibrated against traceable test gases prior to the survey.

The Standards describe the methodology for measuring the combustion gases listed above under defined conditions in the duct. Sampling is carried out under anisokinetic sampling conditions as it is assumed that the gas is homogenous across the sample plane.

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 total particulate matter.

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

3. SAMPLING AND OPERATIONAL DETAILS

3.1 Process Description

The operations at Sundown Products 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 B03/94.

The Dryer process involves the drying of straw pellets on a continuous basis. Once dry the excess dust is passed through a Cyclone before being discharged to atmosphere.

The Cooler process involves the completion of the chemical reactions with sodium hydroxide followed by the cooling of the Pellets. The fine dust is separated by a cyclone before being discharged to atmosphere. This is a continuous process.

The BBF stack is a continuous dust extraction process, which also has a cyclone method of abatement installed.

3.2 Sampling Positions

On the Dryer Stack a single 4" BSP sampling port was installed on a horizontal plane. The sampling point provided was less than 5 hydraulic diameters downstream and greater than 5 hydraulic diameters upstream from any potential flow disturbances.
Access was via permanent platform.

On the Cooler Stack a single 4" BSP sampling port was installed on a horizontal plane. The sampling point provided was less than 4 x hydraulic diameters from any flow disturbance both upstream and downstream from the sampling plane.
Access was via permanent platform.

On the BBF stack a single 4" BSP sampling port was installed on a horizontal plane. The sampling point provided was at least 5 x hydraulic diameters from any flow disturbance both upstream and downstream from the sampling plane. Due to access restrictions, only single point sampling could be undertaken.
Access was via small temporary scaffolding.

On the Tub 1 Filter, 2 x 4" BSP sampling ports were installed at 90° to each other on the same horizontal plane . . The sampling point provided was at least 5 x hydraulic diameters from any flow disturbance both upstream and downstream from the sampling plane. However due to the nature of the platform provided, sampling could only be carried out across one sampling plane.

Both the sample locations and sample port size do not fully comply with the positional requirements of Environment Agency Technical Guidance Note M1 (EA TGN M1). TGN M1 requires 2 x 5"BSP sockets to be fitted, at least 5 hydraulic diameters from any flow disturbances. However the initial temperature and velocity traverses conducted along the sample planes showed that the flow requirements of TGN M1 were met.

Diagrams detailing the sampling positions and taken from Site Worksheets are provided in Appendix 2.

3.3 Uncertainty

Due to access restrictions sampling from each source could only be conducted through one sampling port.

However on the Tub 1 Filter, Dryer and Cooler Stacks the number of sample points were increased along the single sampling plane. Therefore the standard uncertainties would still apply.

On the BBF Stack, only a single sampling point could be sampled. This will increase the measurement uncertainty above the standard ±10%.

The sample planes do not meet the requirements stated in Environment Agency Technical Guidance Note M1.

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 animal feed manufacturing process over the period 7-8 July and 8 September, 2014. The table below summarises the actual sampling periods.

SAMPLING PERIODS

Stack	Parameter	Sample Time (& Date)
Dryer	Particulates & Oxygen	15:52 - 16:32 (07/07/14)
Cooler	Particulates	15:20 - 16:00 (08/07/14)
BBF	Particulates	11:22 - 12:02 (08/09/14)
Tub 1 Filter	Particulates	12:24 - 13:04 (08/09/14)

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 5. 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 from the Dryer process are expressed in mg/m^3 at 273K, 101.3kPa, without correction for water vapour and referenced to 17% O_2 content.

The results from the Tub 1 Filter, Cooler and BBF process are expressed in mg/m^3 at 273K, 101.3kPa, without correction for water vapour and O_2 content.

4.3 Oxygen

The results of the oxygen gas monitoring tests on the Dryer Stack are summarised in Table 5 and Figure 1. The table presents the average of concentrations measured throughout each of the sample periods.

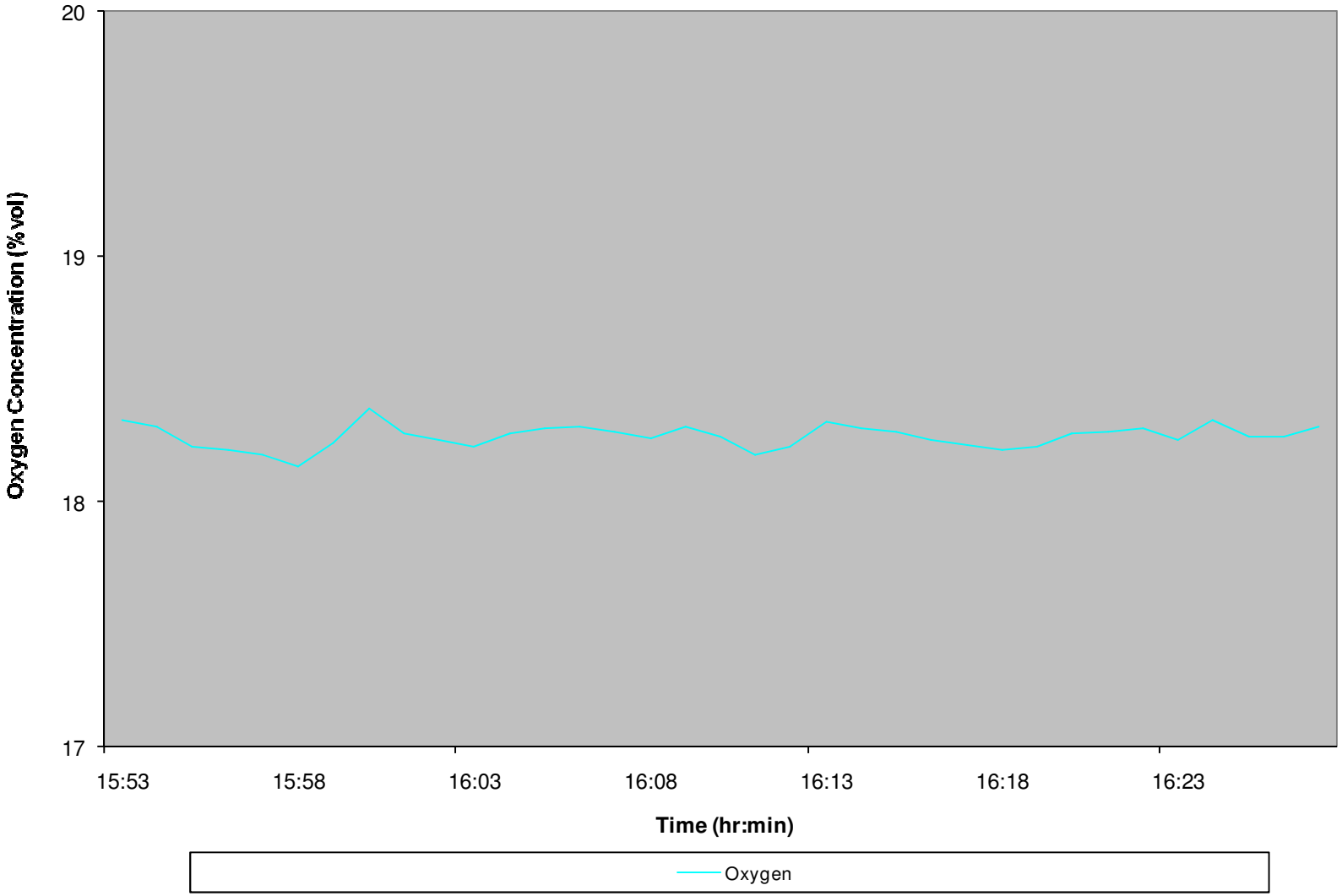
Concentrations are expressed as a percentage by volume (% vol).

Measured concentrations on a dry gas basis have been converted to a wet gas basis using moisture measurements from the Particulate Test, which was ran concurrently.

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

FIGURES

Fig 1: Oxygen Emission Data, Dryer Stack, (07/07/14)



TABLES

TABLE 1

FLOW DATA

Stack Ref.	Stack Temp	Av Pitot ΔP	Duct Diam	X-Sect. Area	Velocity (std)	Volume Flow (m^3/hr)	
	(^{0}C)	(Pa)	(cm)	(m^2)	(Nm/s)	(actual)	(@ ntp)
Cooler	26	54	100	0.785	8.8	27,151	24,791
Dryer	80	102	100	0.785	11.1	40,510	31,377
BBF	37	383	50	0.196	26.0	18,359	16,184
Tub 1 Filter	36	276	43	0.145	22.0	11,517	10,182

TABLE 2

PARTICULATE EMISSION DATA SUMMARY – DRYER

DATE: 07/07/14 **15:52-16:32**

Sampling Data	
Run Time (min)	**40**
Total mass H_2O collected (g)	**38.1**
Pitot tube constant, Cp	**0.84**
Dry gas meter (DGM) volume (m^3)	**0.738**
Temperature DGM (^oC)	**26**
Temperature stack (^oC)	**80**
Mean pitot tube pressure drop, delta P (mm H_2O)	**12.5**
Orifice meter pressure drop, delta H (mm H_2O)	**32.5**
Barometric Pressure (kPa)	**100.4**
X-sectional area of stack (m^2)	**0.785**
Nozzle size (mm)	**6.03**
Flow Data	
Velocity, actual (m/s)	**13.4**
Velocity, ntp (m/s)	**10.3**
Vol. Flow, actual (m^3/hr)	**37,830**
Vol. Flow, ntp (m^3/hr)	**29,147**
Volume sampled, ntp, dry gas (m^3)	**0.657**
Volume sampled, ntp, wet gas (m^3)	**0.704**
Analytical Data	
Filter Weight Gain (mg)	**15.0**
Acetone Wash Residue Weight (mg)	**2.5**
Total Particulates (mg)	**17.5**
Partics Field Blank (mg)	**0.4**
Blank % of ELV	**0.4**
Emission Data	
O_2 (%vol)	**18.3**
H_2O (% vol)	**6.7**
Percentage Isokinetic	**99.8**
Particulates (mg/m^3 at ref O_2)	**40.0**
Uncertainty (± mg/m^3)	**4.1**

TABLE 3

PARTICULATE EMISSION DATA SUMMARY – COOLER

DATE: 08/07/14 **15:20 -16:00**

Sampling Data	
Run Time (min)	**40**
Total mass H_2O collected (g)	**7.9**
Pitot tube constant, Cp	**0.84**
Dry gas meter (DGM) volume (m^3)	**0.600**
Temperature DGM (^oC)	**22**
Temperature stack (^oC)	**28**
Mean pitot tube pressure drop, delta P (mm H_2O)	**6.6**
Orifice meter pressure drop, delta H (mm H_2O)	**22.8**
Barometric Pressure (kPa)	**100.3**
X-sectional area of stack (m^2)	**0.785**
Nozzle size (mm)	**6.03**
Flow Data	
Velocity, actual (m/s)	**8.9**
Velocity, ntp (m/s)	**8.6**
Vol. Flow, actual (m^3/hr)	**25,151**
Vol. Flow, ntp (m^3/hr)	**24,381**
Volume sampled, ntp, dry gas (m^3)	**0.579**
Volume sampled, ntp, wet gas (m^3)	**0.589**
Analytical Data	
Filter Weight Gain (mg)	**3.8**
Acetone Wash Residue Weight (mg)	**1.9**
Total Particulates (mg)	**5.7**
Partics Field Blank (mg)	**0.4**
Blank % of ELV	**0.5**
Emission Data	
H_2O (% vol)	**1.7**
Percentage Isokinetic	**99.7**
Particulates (mg/m^3)	**9.7**
Uncertainty (± mg/m^3)	**2.0**

TABLE 4

PARTICULATE EMISSION DATA SUMMARY – BBF

DATE: 08/09/14 **11:22 -12:02**

Sampling Data	
Run Time (min)	**40**
Total mass H_2O collected (g)	**11.5**
Pitot tube constant, Cp	**0.82**
Dry gas meter (DGM) volume (m^3)	**1.436**
Temperature DGM (^oC)	**22**
Temperature stack (^oC)	**37**
Mean pitot tube pressure drop, delta P (mm H_2O)	**48.3**
Orifice meter pressure drop, delta H (mm H_2O)	**124.0**
Barometric Pressure (kPa)	**100.9**
X-sectional area of stack (m^2)	**0.196**
Nozzle size (mm)	**6.03**
Flow Data	
Velocity, actual (m/s)	**23.9**
Velocity, ntp (m/s)	**22.6**
Vol. Flow, actual (m^3/hr)	**16,888**
Vol. Flow, ntp (m^3/hr)	**15,950**
Volume sampled, ntp, dry gas (m^3)	**1.476**
Volume sampled, ntp, wet gas (m^3)	**1.490**
Analytical Data	
Filter Weight Gain (mg)	**1.9**
Acetone Wash Residue Weight (mg)	**4.4**
Total Particulates (mg)	**6.3**
Partics Field Blank (mg)	**1.5**
Blank % of ELV	**5.0**
Emission Data	
H_2O (% vol)	**1.0**
Percentage Isokinetic	**96.5**
Particulates (mg/m^3)	**4.2**
Uncertainty (± mg/m^3)	**0.8**

TABLE 5

PARTICULATE EMISSION DATA SUMMARY – TUB 1 FILTER

DATE: 08/09/14 **12:24 -13:04**

Sampling Data	
Run Time (min)	**40**
Total mass H_2O collected (g)	**19.5**
Pitot tube constant, Cp	**0.82**
Dry gas meter (DGM) volume (m^3)	**1.346**
Temperature DGM (^oC)	**26**
Temperature stack (^oC)	**35**
Mean pitot tube pressure drop, delta P (mm H_2O)	**35.1**
Orifice meter pressure drop, delta H (mm H_2O)	**94.8**
Barometric Pressure (kPa)	**100.9**
X-sectional area of stack (m^2)	**0.145**
Nozzle size (mm)	**6.03**
Flow Data	
Velocity, actual (m/s)	**20.4**
Velocity, ntp (m/s)	**19.3**
Vol. Flow, actual (m^3/hr)	**10,648**
Vol. Flow, ntp (m^3/hr)	**10,109**
Volume sampled, ntp, dry gas (m^3)	**1.369**
Volume sampled, ntp, wet gas (m^3)	**1.393**
Analytical Data	
Filter Weight Gain (mg)	**22.0**
Acetone Wash Residue Weight (mg)	**5.7**
Total Particulates (mg)	**27.7**
Partics Field Blank (mg)	**1.0**
Blank % of ELV	**3.7**
Emission Data	
H_2O (% vol)	**1.7**
Percentage Isokinetic	**105.2**
Particulates (mg/m^3)	**19.9**
Uncertainty (± mg/m^3)	**0.9**

TABLE 5

OXYGEN EMISSION DATA - DRYER STACK

Stack Ref	O_2 (%vol)
Dryer Stack	18.3
Uncertainty (±)	3.1

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: 409070-1

Date of Report: 24-Jul-2014

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

Customer Contact: Mr Aidan Wrynne

Customer Job Reference: 71815
Customer Site Reference: Date Collected: 7/7/14 - 8/7/14
Date Job Received at SAL: 16-Jul-2014
Date Analysis Started: 17-Jul-2014
Date Analysis Completed: 24-Jul-2014

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 :
James Allan
Project Manager

Issued by :
James Allan
Project Manager

Signature valid
Digitally signed by James Allan
Date: 2014.07.24 17:28:36 BST
Reason: Issue
Location: SAL

SAL Reference: 409070
Project Site: Date Collected: 7/7/14 - 8/7/14
Customer Reference: 71815

Wash(Acetone) Analysed as Wash(Acetone)
Miscellaneous

				SAL Reference	**409070 002**	**409070 004**	**409070 006**	**409070 008**	**409070 010**
				Customer Sample Reference	**71815/2**	**71815/4**	**71815/6**	**71815/8**	**71815/10**
				Test Sample	**AR**	**AR**	**AR**	**AR**	**AR**
Determinand	**Method**	**LOD**	**Units**	**Symbol**					
Particulates (Total)	Grav	0.3	mg	U	<0.3	**5.4**	<0.3	**2.5**	<0.3

SAL Reference: 409070
Project Site: Date Collected: 7/7/14 - 8/7/14
Customer Reference: 71815

Wash(Acetone) Analysed as Wash(Acetone)
Miscellaneous

				SAL Reference	**409070 012**	
				Customer Sample Reference	**71815/12**	
				Test Sample	**AR**	
Determinand	**Method**	**LOD**	**Units**	**Symbol**		
Particulates (Total)	Grav	0.3	mg	U	**1.9**	

SAL Reference: 409070
Project Site: Date Collected: 7/7/14 - 8/7/14
Customer Reference: 71815

Filter Quartz 110mm Analysed as Filter Quartz 110mm
Miscellaneous

				SAL Reference	**409070 005**	**409070 007**	**409070 009**	**409070 011**
				Customer Sample Reference	**71815/5**	**71815/7**	**71815/9**	**71815/11**
				Test Sample	**AR**	**AR**	**AR**	**AR**
				Filter Reference	**195**	**196**	**201**	**194**
Determinand	**Method**	**LOD**	**Units**	**Symbol**				
Particulates (Total)	Grav (5 Dec)	0.10	mg	U	<0.10	**15**	<0.10	**3.8**

SAL Reference: 409070
Project Site: Date Collected: 7/7/14 - 8/7/14
Customer Reference: 71815

Filter Quartz 85mm Analysed as Filter Quartz 85mm
Miscellaneous

				SAL Reference	**409070 001**	**409070 003**
				Customer Sample Reference	**71815/1**	**71815/3**
				Test Sample	**AR**	**AR**
				Filter Reference	**132**	**131**
Determinand	**Method**	**LOD**	**Units**	**Symbol**		
Particulates (Total)	Grav (5 Dec)	0.10	mg	U	<0.10	**37**

Index to symbols used in 409070-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited

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

Scientific Analysis Laboratories Ltd

Certificate of Analysis

Report Number: 421994-1

Date of Report: 18-Sep-2014

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

Customer Contact: Ms Michelle Edwards

Customer Job Reference: 71815 2P
Customer Site Reference: Date Collected: 8/9/14
Date Job Received at SAL: 12-Sep-2014
Date Analysis Started: 15-Sep-2014
Date Analysis Completed: 18-Sep-2014

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 :
James Allan
Project Manager

Issued by :
James Allan
Project Manager

Signature valid
Digitally signed by James Allan
Date: 2014.09.18 17:19:36 BST
Reason: Issue
Location: SAL

SAL Reference: 421994
Project Site: Date Collected: 8/9/14
Customer Reference: 71815 2P

Wash(Acetone) Analysed as Wash(Acetone)
Miscellaneous

				SAL Reference	**421994 002**	**421994 004**	**421994 006**	**421994 008**
				Customer Sample Reference	**71815/2**	**71815/4**	**71815/6**	**71815/8**
				Test Sample	**AR**	**AR**	**AR**	**AR**
Determinand	**Method**	**LOD**	**Units**	**Symbol**				
Particulates (Total)	Grav	0.3	mg	U	**0.9**	**4.4**	<0.3	**5.7**

SAL Reference: 421994
Project Site: Date Collected: 8/9/14
Customer Reference: 71815 2P

Filter Quartz 110mm Analysed as Filter Quartz 110mm
Miscellaneous

				SAL Reference	**421994 001**	**421994 003**
				Customer Sample Reference	**71815/1**	**71815/3**
				Test Sample	**AR**	**AR**
				Filter Reference	**120**	**151**
Determinand	**Method**	**LOD**	**Units**	**Symbol**		
Particulates (Total)	Grav (5 Dec)	0.10	mg	U	**0.59**	**1.9**

SAL Reference: 421994
Project Site: Date Collected: 8/9/14
Customer Reference: 71815 2P

Filter Quartz 85mm Analysed as Filter Quartz 85mm
Miscellaneous

				SAL Reference	**421994 005**	**421994 007**
				Customer Sample Reference	**71815/5**	**71815/7**
				Test Sample	**AR**	**AR**
				Filter Reference	**78**	**77**
Determinand	**Method**	**LOD**	**Units**	**Symbol**		
Particulates (Total)	Grav (5 Dec)	0.10	mg	U	**1.0**	**22**

Index to symbols used in 421994-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited

APPENDIX 2

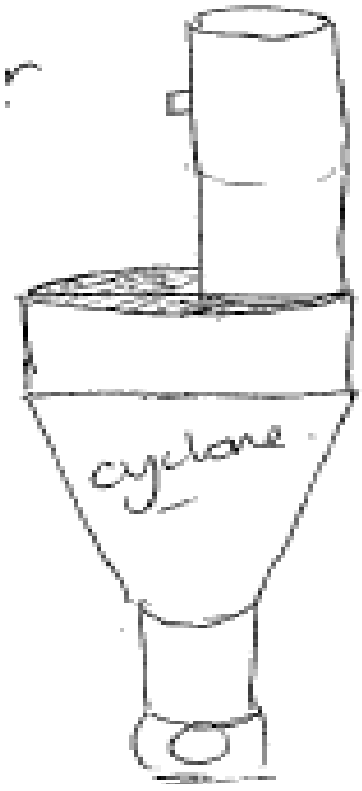
Diagrams of Sampling Points

BBF STACK

DRYER STACK

TUB 1 FILTER

COOLER STACK



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)