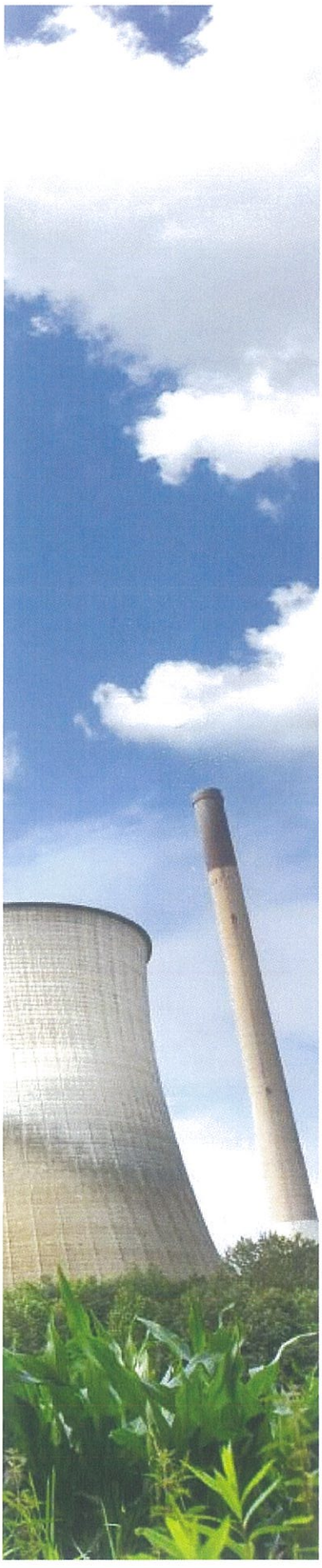
REC
Resource & Environmental Consultants Ltd

UKAS TESTING 2082



MONITORING OF EMISSIONS FROM THE DRYER & COOLER PROCESS

27 MARCH 2012

Prepared for Sundown Products Ltd

REC Report 71402p1r0

Issued: 13 April 2012

REC Air Quality

GREEN ACHIEVER

SAFEcontractor APPROVED

REC Air Quality

UKAS TESTING 2082

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 : 13 April, 2012
Reference : 71402p1r0

Prepared by : _____
A. Wrynne. Env. Technician
MM08 921, MCERTS Level 1

Reviewed by : _____
Paul Jones. Principal Consultant
MM02 021, MCERTS Level 2 TE1-4

CONTENTS

EXECUTIVE SUMMARY

Resource & Environmental Consultants (REC) Ltd was commissioned by Sundown Products Ltd to monitor emissions of pollutants released from the Dryer & Cooler processes at their site in Huntingdon.

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

- Oxygen
- Total Particulate Matter

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	38.3	150	B
Cooler	Particulate Matter	8.7	150	B

NOTE 1: The Cooler data are expressed in mg/Nm^3 at 273K, 101.3kPa, without correction for moisture and oxygen content

NOTE 2: The Dryer data are expressed in mg/Nm^3 at 273K, 101.3kPa, on a wet basis and referenced to 17% Oxygen data

NOTE: UKAS Status:- (A) REC Ltd accredited for sampling and analysis. (B) REC Ltd accredited for sampling only, UKAS accredited analysis conducted by SAL

INTRODUCTION

1.1 Background

Sundown Products Ltd commissioned REC Ltd to conduct an emission monitoring survey on the Cooler & Dryer processes at their site in Huntingdon.

The processes involve the chopping, grinding and pelletizing of Straw during the manufacturing of various Animal Feed products.

1.2 Scope of the Survey

An emission monitoring survey was required to determine the release concentrations of various pollutants from the cooler & dryer processes. Concentrations of the following pollutants were quantified during the survey:

- Oxygen.
- Total Particulate Matter

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

Sampling for Oxygen was carried out on a continuous basis with measured concentrations being data-logged at 1 minute intervals over the sampling period.

The results from the Cooler 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:-

- David Burns - Team Leader, MM05 579, MCERTS Level 2, TE1-4
- Michelle Edwards - Assistant, MM05 659, MCERTS Level 1, TE1 & 2

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 ISO 9096	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 ISO 9096 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. The temperature of the probe was maintained at 160ºC. 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 330XL 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.

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, 2007.

The process is therefore under Local Authority regulation and must demonstrate compliance with the emission limits stipulated in the site permit: B03/94

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 Dryer process involves the drying of straw pellets on a continuous basis. Dust is passed through a Cyclone before being discharged to atmosphere.

3.2 Sampling Positions

On the Cooler stack, 1 x 4" BSP sampling port was installed. The sampling points provided were less than 4 x hydraulic diameters from any flow disturbance both upstream and downstream from the sampling plane. However the flow criteria stipulated in the E.A Technical guidance note M1 was met.

Only one axis was in place so the number of sampling points along this axis was doubled.

On the Dryer stack, 1 x 4" BSP sampling port was installed. The sampling points provided were at least 4 x hydraulic diameters from any flow disturbance both upstream and downstream from the sampling plane.

Only one axis was in place so the number of sampling points along this axis was doubled. The flow requirements stipulated in the EA technical guidance note M1 were met.

Diagrams detailing the sampling positions and taken from Site Worksheets are provided in Appendix 1

3.3 Uncertainty

Sampling could only be conducted through 1 x sampling port. However the number of sampling points along this sample axis was doubled, however the standard measurement uncertainty of ±10% will not apply as this is defined over 2 axis.

The uncertainty associated with the Oxygen gas emission data from the Dryer process will not be affected by the sampling plane deviations as it is in the gaseous phase and assumed to be homogenous across the sampling plane and so the standard uncertainty applies.

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 Cooler & Dryer Processes on the 27th of March 2012. The table below summarises the actual sampling periods.

SAMPLING PERIODS

Stack	Parameter	Sample Time (& Date)
Dryer	Particulates	10:22 – 11:02 (27/03/12)
Cooler	Particulates	12:05 – 12:45 (27/03/12)

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 and 3. 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 Cooler process are expressed in mg/m^3 at 273K, 101.3kPa, without correction for water vapour and O_2 content.

The results from the Dryer process are expressed in mg/m^3 at 273K, 101.3kPa on a wet basis and referenced to 17% Oxygen content.

4.3 Oxygen

The results of the Oxygen gas monitoring tests are summarised in Table 4 and Figure 1. The table presents the average of concentrations measured throughout each of the sample periods.

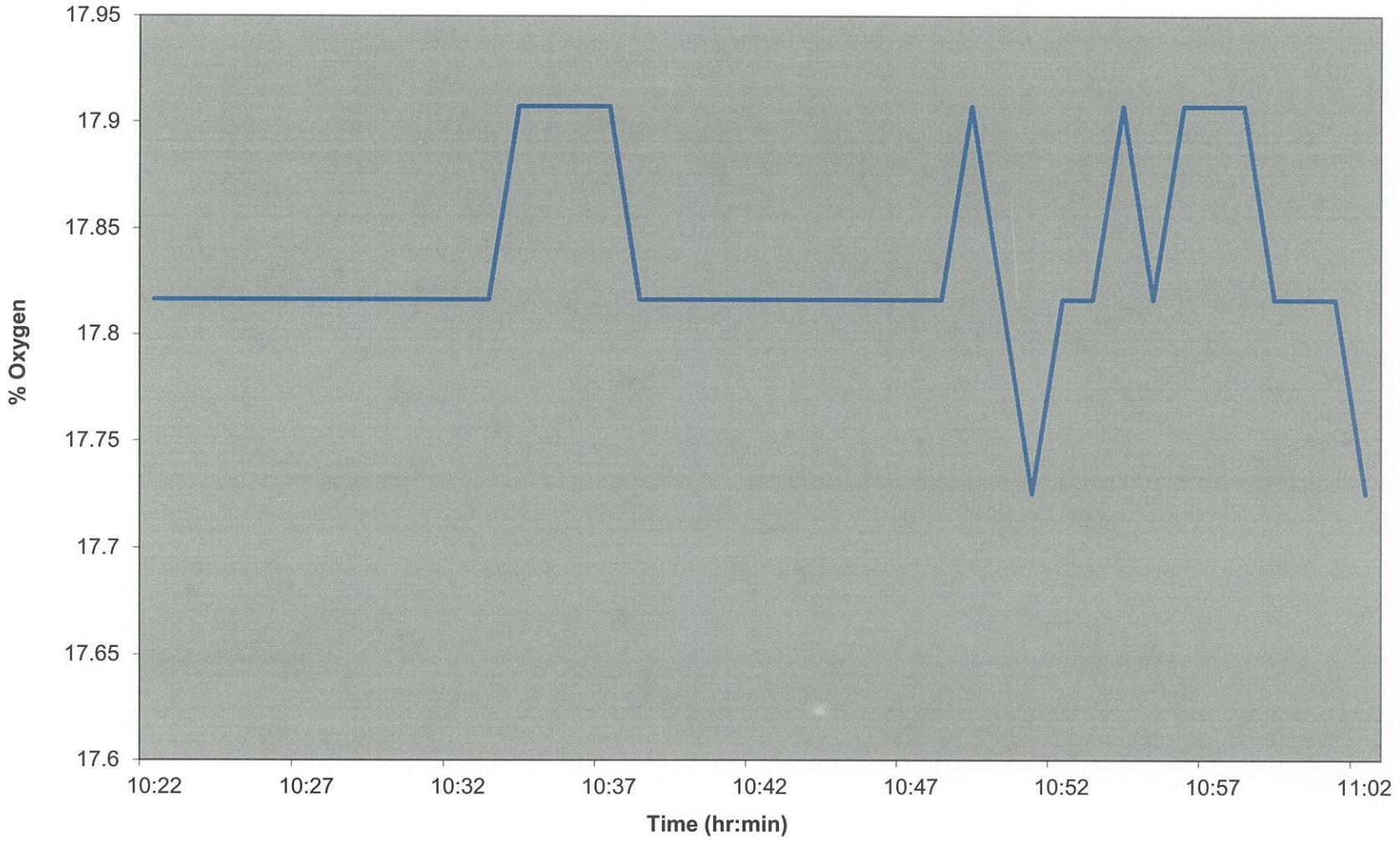
Concentrations are expressed as a percentage at the standard reference conditions of 273K, 101.3kPa on a wet basis.

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: Wet Oxygen Emission Data, Sundown Products Ltd, Huntingdon, Dryer (27/3/12)



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)
Cooler	24	122	100	0.785	14.3	40,533	37,296
Dryer	79	38	100	0.785	8.7	24,599	19,085

TABLE 2

PARTICULATE EMISSION DATA SUMMARY – COOLER – 27/03/12

DATE: 27/3/12 **12:05 - 12:45**

Sampling Data	
Run Time (min)	40
Total mass H_2O collected (g)	8.8
Pitot tube constant, Cp	0.82
Dry gas meter (DGM) volume (m^3)	0.714
Temperature DGM (°C)	22
Temperature stack (°C)	24
Mean pitot tube pressure drop, delta P (mm H_2O)	14.8
Orifice meter pressure drop, delta H (mm H_2O)	32.5
Barometric Pressure (kPa)	102.6
X-sectional area of stack (m^2)	0.785
Nozzle size (mm)	6.00
Flow Data	
Velocity, actual (m/s)	12.8
Velocity, ntp (m/s)	11.8
Vol. Flow, actual (m^3/hr)	36,196
Vol. Flow, ntp (m^3/hr)	33,456
Volume sampled, ntp, dry gas (m^3)	0.735
Volume sampled, ntp, wet gas (m^3)	0.746
Analytical Data	
Filter Weight Gain (mg)	4.4
Acetone Wash Residue Weight (mg)	2.1
Total Particulates (mg)	6.5
Partics Field Blank (mg)	1.0
Blank % of ELV	13.2
Emission Data	
H_2O (% vol)	1.5
Percentage Isokinetic	92.8
Particulates (mg/m^3)	8.7
Uncertainty (± mg/m^3)	0.7

TABLE 3

PARTICULATE EMISSON DATA SUMMARY – DRYER – 27/03/12

DATE: 27/3/12 **10:22 - 11:02**

Sampling Data	
Run Time (min)	40
Total mass H_2O collected (g)	54.4
Pitot tube constant, Cp	0.82
Dry gas meter (DGM) volume (m^3)	0.651
Temperature DGM (^oC)	19
Temperature stack (^oC)	78
Mean pitot tube pressure drop, delta P (mm H_2O)	4.4
Orifice meter pressure drop, delta H (mm H_2O)	24.6
Barometric Pressure (kPa)	102.6
X-sectional area of stack (m^2)	0.785
Nozzle size (mm)	8.16
Flow Data	
Velocity, actual (m/s)	7.7
Velocity, ntp (m/s)	6.0
Vol. Flow, actual (m^3/hr)	21,678
Vol. Flow, ntp (m^3/hr)	16,987
Volume sampled, ntp, dry gas (m^3)	0.678
Volume sampled, ntp, wet gas (m^3)	0.746
Analytical Data	
Filter Weight Gain (mg)	19.0
Acetone Wash Residue Weight (mg)	3.7
Total Particulates (mg)	22.7
Partics Field Blank (mg)	0.4
Blank % of ELV	2.9
Emission Data	
O_2 (%vol)	17.8
H_2O (% vol)	9.1
Percentage Isokinetic	98.9
Particulates (mg/m^3 at ref O_2)	38.3
Uncertainty (± mg/m^3)	3.3

TABLE 4

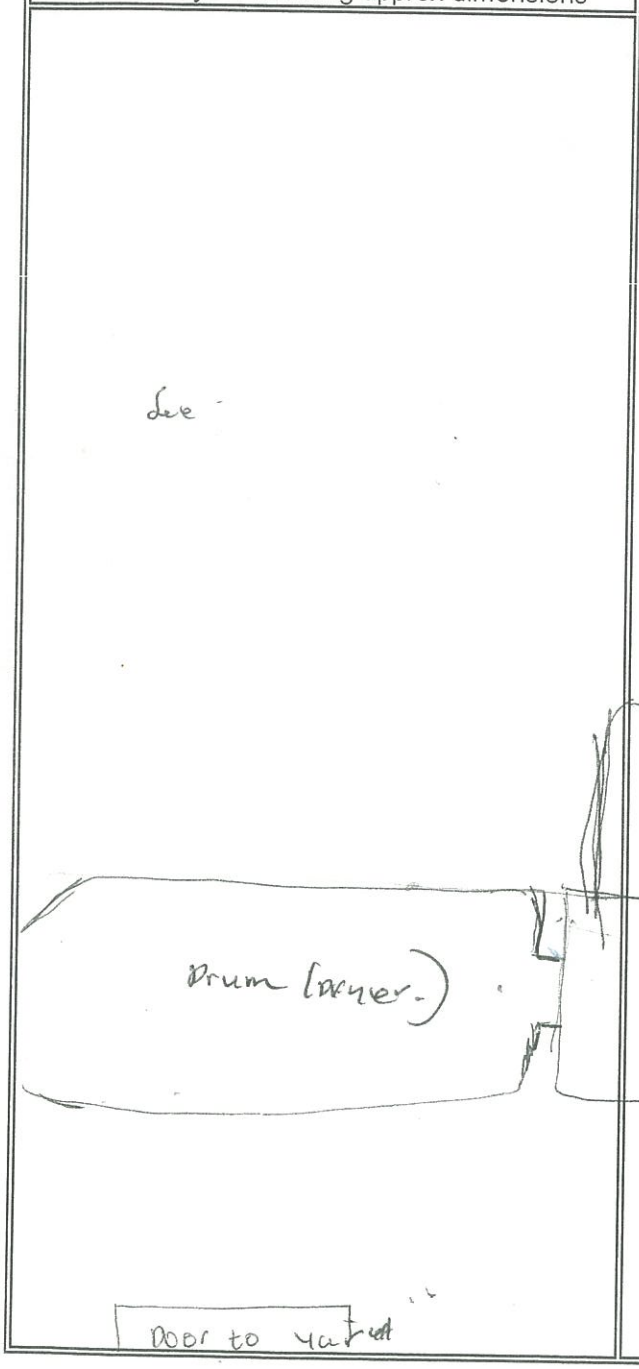
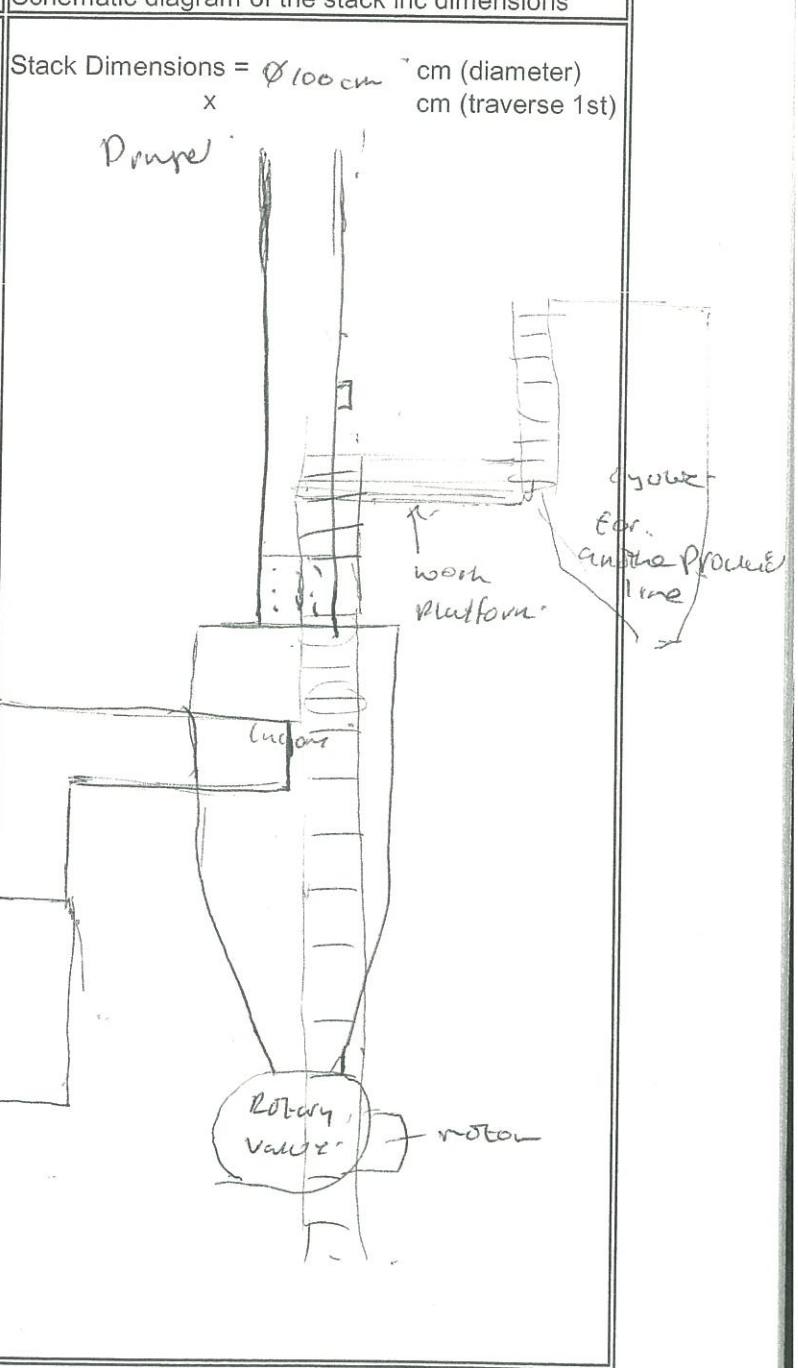
OXYGEN GAS EMISSION DATA SUMMARY – DRYER – 27/03/12

Stack Ref	O_2 (%vol)
Dryer	17.8
Uncertainty (±)	3.0

APPENDIX 1

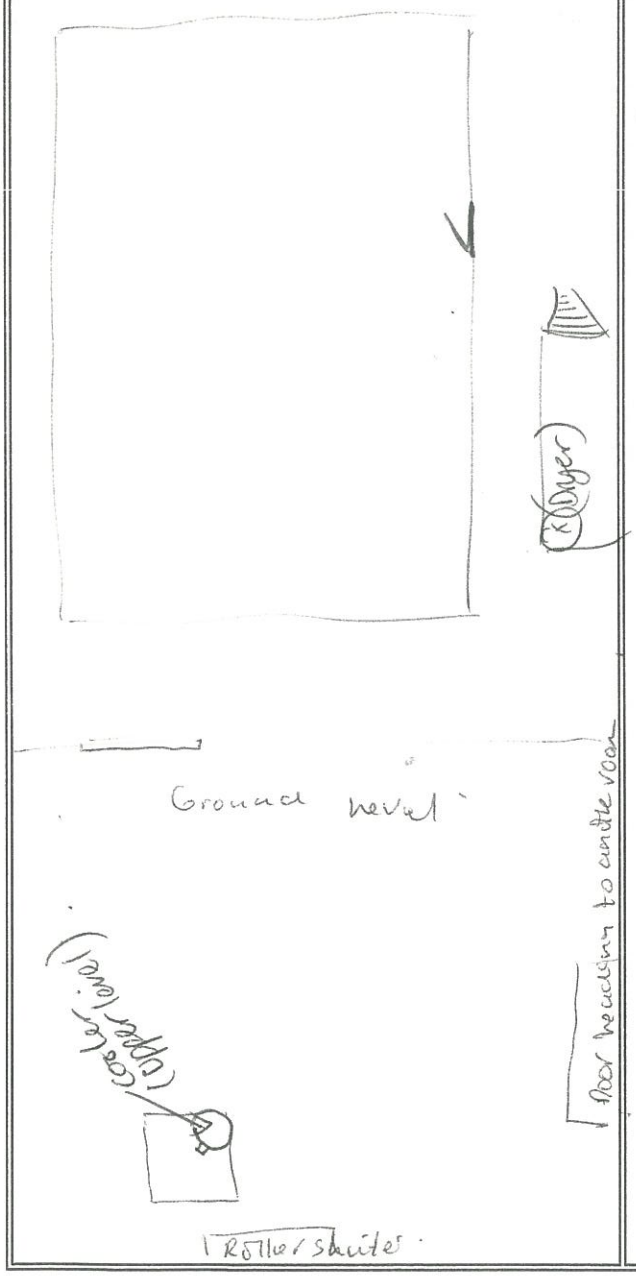
Diagrams of Sampling Points

DIAGRAMS OF STACK

Plan of site layout including approx dimensions	Schematic diagram of the stack inc dimensions
	Stack Dimensions = Ø 100 cm cm (diameter) x cm (traverse 1st) 

Other Notes

DIAGRAMS OF STACK

Plan of site layout including approx dimensions	Schematic diagram of the stack inc dimensions
	Stack Dimensions = Ø100cm · cm (diameter) x cm (traverse 1st)

Other Notes

APPENDIX 2

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)