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TECHNICAL REPORT
INDUSTRIAL EMISSIONS MONITORING
for
David Smith St Ives Ltd
St Ives
Huntingdon
October 2000

Endorsed for Particulate Measurement
Source Testing
STA
Association Member
Registration No P10027

Produced by: Mr. Nigel Stanger

Date: 13/12/00

Reviewed By: Mr.Grant Lethby

Date: 13/12/00

Report Reference: LNP/000145/NTS/021

Project Date: October 2000

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DOCUMENT INFORMATION AND CONTROL SHEET

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REPORT ISSUE RECORD

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Issue: 1 of 2 Recipient: Mr. Mike Carrington – David Smith St Ives Ltd

Issue: 2 of 2 Recipient: Casella Science & Environment Ltd - File Copy

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Issue: 1 of 2 Recipient: MIKE CARRINGTON

MANAGEMENT SUMMARY

- The primary objective of the study was to measure and assess emission levels of specified parameters from the process, according to accepted and approved methodologies, in order to assist the plant management to assess the long-term monitoring, emission control and process upgrade implications, as well as to demonstrate compliance with any operating conditions set out by the local authority.

- A summary of results obtained can be seen below:

Determinant	Wood Boiler		Authorisation Level
	Test 1	Test 2	
Temperature (^{0}C)	143		N/A
Corrected Velocity (ms^{-1})*	20.8		N/A
Uncorrected Velocity (ms^{-1})	19		N/A
Oxygen (%)	13		N/A
Carbon Monoxide ($mg\ m^{-3}$)*	484		350
Moisture	3.3	2.5	N/A
Total Particulate Matter ($mg\ m^{-3}$)*	112	139	200
Volatile Organic Compounds ($mg\ m^{-3}$)*	145		20

*Expressed at reference conditions, 273 K, 101.3 kPa, 11% O_2 and dry gas.

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1.0 INTRODUCTION

Casella Science & Environment Ltd (Casella) were commissioned by Mr. Richard Britton of David Smith St Ives Ltd, to undertake an industrial emissions monitoring programme at their site in St Ives. The fieldwork was conducted by Mr. Nigel Stanger and Mr. Grant Lethby on the 2nd October 2000 at Marley Road, St Ives, Huntingdon, PE17 6EX.

1.1 Objectives and Scope of Works

For convenience and information, Casella's proposals referenced *LNQ/000145/NTS/005* and dated September 2000 set out the scope of works and are presented below:

Process Description	Determinants
Wood Boiler	Total Particulate Matter Volatile Organic Compounds Moisture Oxygen Carbon Monoxide

2.0 SAMPLING AND ANALYTICAL METHODOLOGIES

2.1 Summary

Throughout the project all methods used are as specified in detail in the monitoring proposal, dated September 2000, Ref: *LNQ/000145/NTS/005*. The methods used are summarised in the table below:

Item	Determinant	Sampling Method
1	Total Particulate Matter	BS 3405: 1983
2	Volatile Organic Compounds	USEPA Method 25a
3	Moisture	Modified USEPA Method 4
4	Oxygen & Carbon Monoxide	Electrochemical Cell

2.2 Deviations

Due to the small diameter of the duct (175mm) it was necessary to undertake centre point sampling. To introduce the sampling probe to various points across the duct would in no doubt disturb the flow as the surface area of the sampling probe within the duct would have exceeded 10% of the flue area as stated in BS 3405: 1983.

3.0 DISCUSSION

The following results were obtained following industrial emissions testing at David Smith St Ives Ltd, Huntingdon

3.1 Wood Boiler

Wood Boiler				Average Temperature (°C)	Uncorrected Velocity (ms^{-1})	Corrected Velocity (ms^{-1})*	Volumetric Flow Rate ($m^3 s^{-1}$)
				143	19	20.8	0.5
Determinant	Date	Test No	Start Time	Test Duration (min)	Volume Sampled (m^{-3})	Concentration ($mg\ m^{-3}$)*	Authorisation Limit ($mg\ m^{-3}$)*
Total Particulate Matter	2nd Oct	1	11:15	40	0.60334	112	200
		2	14:02		0.60334	139	
Oxygen	2nd Oct	1	11:57	150	-	13.0 %	N/A
Moisture	2nd Oct	1	11:57	53	0.106	3.3 %	N/A
		2	11:57		0.106	2.5 %	
Carbon Monoxide	2nd Oct	-	11:57	150	-	484	350
Average Volatile Organic Compounds (as Carbon)	2nd Oct	-	11:57	90	-	145	20

* values expressed at Standard Conditions 273K, 101.3kPa, 11% oxygen and dry gas

It can be seen that this process exceeded its authorisation limits for volatile organic compounds and carbon monoxide. However the remainder of the determinants were below their respective limits

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APPENDIX I

Nomenclature

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NOMENCLATURE

Technical Abbreviation	
Δ Delta P	Differential pressure of stack gas
Δ Delta H	Differential pressure of orifice meter
Static P_s	Static pressure
T_s	Absolute temperature of stack gas
+/- Ve	**Positive/ negative flow**
T_m	Absolute temperature at dry gas meter
C_p	Pitot calibration coefficient
P_b	Barometric pressure
B_{ws}	**Moisture present in stack gas in percent**
DGM_{in}	Absolute temperature entering dry gas meter
DGM_{out}	Absolute temperature leaving dry gas meter
DGM_c	Dry gas meter coefficient
D_n	**Nozzle diameter**
T_p	Sampling position on probe traverse point
Stack Dims	Stack dimensions
STP	Standard temperature and pressure
Units of Measurement	
mb	Millibars
mm	Millimetres
ppm	Parts per million
$m\ s^{-1}$	Metres per second
$m^3\ s^{-1}$	Cubic metres per second
kPa	Kilopascals
Pa	Pascals
$mg\ m^{-3}$	Milligrams per cubic metre
mg	Milligrams
m	Minutes
%	Percent
°C	Degrees centigrade
K	Kelvin
$mg\ l^{-1}$	Milligrams per litre
m^2	Meters squared
$l\ min^{-1}$	Litres per minute

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APPENDIX II

Particulate: Data Sheets

Table 1. David Smith St Ives: Levels of particulate measured from the Wood Boiler 2nd October 2000

Sampling Start Time	Duration of Sampling *(mins)*	Test No.	Volume Sampled (m^3)	Filter Mass Gain *(mg)*	Concentration $mg\ m^{-3}$ *
11:53	40	One	0.597	45.21	**111.68**
14:02	40	Two	0.476	44.97	**138.76**

*** Concentrations are expressed at standard conditions, 273K, 1013KPa, 11% oxygen and dry gas.**

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Particulate Sampling Data Sheet

Date:	2-Oct-00	Stack Schematic:			Port Length (mm)		90
Company:	David Smith St Ives				Stack Dims: (mm)		175
Site:	St Ives				Stack Area: m^2		0.02
Location:	Boiler				+/-Ve:		+ve
Stack No:	DSSI 1				Probe No:		1mss
Test No:	One				Nozzle No:		7mmss
System:	Tecora	Delta P Ave:	18.9	Filter No:	11920	DGMc:	0.99
Pitot Cp:	0.84	Pe:(Pa)	895.76	Wash No:	DSSI 1-1w	CO ppm:	N/A
Ts:(C)	147	Bws:	0.03	Filter Box:	In Stack	CO_2 %:	N/A
Tm:(C)	30	Dn: (mm)	6.98	Probe:(C)	120	N_2 ppm:	N/A
Pam:(KPa)	99.58	Samp/Point	1	Min/point:	40	O_2 %:	N/A
Pa:(mb)	987	Start	Finish	Notes:			
Pitot leak test:		✓	✓	*Avg DGM Temp =*	29.8184		
System leak test:		✓	✓	*Vol Sampled =*	0.59731		
DGM: (m^3)		0	0.60334				

Tp Dist	Tp No	Time	DGM in	Silica Gel/ Condensate	Ts	Delta P	Delta H
mm		hr:min	°C	°C	°C	m/s	l/min
116	A1	11:53	30	-	147	18.9	22.8

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Particulate Sampling Data Sheet

Date:	2-Oct-00	Stack Schematic:			Port Length (mm)		90
Company:	David Smith St Ives				Stack Dims: (mm)		175
Site:	St Ives				Stack Area: m^2		0.02
Location:	Boiler				+/-Ve:		+ve
Stack No:	DSSI 1				Probe No:		1mss
Test No:	Two				Nozzle No:		7mmss
System:	Tecora	Delta P Ave:	18.4	Filter No:	11937	DGMc:	0.99
Pitot Cp:	0.84	Pe:(Pa)	1116.23	Wash No:	DSSI 1-2w	CO ppm:	N/A
Ts:(C)	150	Bws:	0.03	Filter Box:	In Stack	CO_2 %:	N/A
Tm:(C)	31	Dn: (mm)	7.96	Probe:(C)		N_2 ppm:	N/A
Pam:(KPa)	99.58	Samp/Point	1	Min/point:	40	O_2 %:	N/A
Pa:(mb)	985	Start	Finish	Notes:			
Pitot leak test:		✓	✓	*Avg DGM Temp =*	30.5196		
System leak test:		✓	✓	*Vol Sampled =*	0.47644		
DGM: (m^3)		0	0.48125				

Tp Dist	Tp No	Time	DGM in	Silica Gel/ Condensate	Ts	Delta P	Delta H
mm		hr:min	°C	°C	°C	m/s	l/min
116	A1	14:02	31	-	150	18.4	16.0

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APPENDIX III

Moisture : Data Sheets

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Stack Moisture Determination Sheet - Test One

Operatives	NTS & GL	Filter No(*if applicable*):	N/A
Date:	02/10/00	Barom Press:(kPa)	99.6
Company:	David Smith St Ives Ltd	Stack Temp:(C)	160
Job No:	LNP/000145/NTS	DGM Temp Start:(C)	19.9
Site Stack ID:	DSSI 1	DGM Temp Finish:(C)	19.9
Process:	Furnace	Sample Rate:(l/pm)	2

Start		Finish	
Time:	11:57	Time:	12:50
DGM Reading:(m^3)	0	DGM Reading:(m^3)	0.106
Impinger 1: (g)	268.7	Impinger 1 (g)	270
Impinger 2: (g)	191.6	Impinger 2: (g)	192
Impinger 3: (g)	255.5	Impinger 3: (g)	256.4
Impinger 4: (g)	0	Impinger 4: (g)	0
Impinger 5 : (g)	0	Impinger 5: (g)	0
Total Weight:(g)	715.8	Total Weight:(g)	718.4
Weight Gain:(g)	2.6	Volume Sampled:	0.106

Calculation

Gas Volume Corrected to STP (V_{STP}):

$$= \text{Vol Sampled} \times \frac{273}{\text{Mean DGM Temp} + 273} \times \frac{\text{Barom P}}{101.3} = 0.094$$

Conversion to Molar Volume of Dry Gas at STP (M_D):

$$= \frac{V_{STP}}{0.0224} = 4.194$$

Moles of H_2O Collected at STP (M_W):

$$= \frac{H_2O \text{ Collected}}{18} = 0.144$$

% H_2O

$$= 100 \times \frac{M_W}{M_W + M_D} = 3.3$$

Comments

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Stack Moisture Determination Sheet - Test Two

Operatives	NTS & GL	Filter No(*if applicable*):	N/A
Date:	02/10/00	Barom Press:(kPa)	99.6
Company:	David Smith St Ives Ltd	Stack Temp:(C)	160
Job No:	LNP/000145/NTS	DGM Temp Start:(C)	19.9
Site Stack ID:	DSSI 1	DGM Temp Finish:(C	19.9
Process:	Furnace	Sample Rate:(l/pm)	2

Start		Finish	
Time:	**11:57**	Time:	**12:50**
DGM Reading:(m^3)	**0**	DGM Reading:(m^3)	**0.106**
Impinger 1: (g)	**268.0**	Impinger 1 (g)	**268.9**
Impinger 2: (g)	**182.4**	Impinger 2: (g)	**182.8**
Impinger 3: (g)	**258.7**	*Impinger 3: (g)*	**259.3**
Impinger 4: (g)	**0**	Impinger 4: (g)	**0**
Total Weight:(g)	709.1	Total Weight:(g)	711.0
Weight Gain:(g)	1.9	Volume Sampled:	0.106

Calculation

***Gas Volume** Corrected to STP (V_{STP}):*

$$= \text{Vol Sampled} \times \frac{273}{\text{Mean DGM Temp} + 273} \times \frac{\text{Barom P}}{101.3} \qquad 0.094$$

Conversion to Molar Volume of Dry Gas at STP (M_D):

$$= \frac{V_{STP}}{0.0224} \qquad 4.194$$

Moles of H_2O Collected at STP (M_W):

$$= \frac{H_2O \text{ Collected}}{18} \qquad 0.106$$

% H_2O

$$= 100 \times \frac{M_W}{M_W + M_D} \qquad 2.5$$

Comments

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APPENDIX IV

Oxygen: Data Sheets

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Table 1. David Smith St Ives; Oxygen Half Hourly Averages		
from	*to*	%
8:00	8:30	13.0
Average		13.0

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APPENDIX V

Carbon Monoxide: Data Sheets

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Table 1. David Smith St Ives;
Carbon Monoxide Half Hourly Averages

from	*to*	PPM	mg m^{-3} *
8:00	**8:30**	309	484
Average		309	484

* ***Results*** *expressed at STP, 273 K, 101.3 kPa, 11% O_2 and dry gas.*

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APPENDIX VI

Volatile Organic Compounds : Data Sheets

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Table 1. David Smith St Ives;
Volatile Organic Compound half Hourly Averages

from	*to*	PPM	mg m^{-3} *
12:45	**13:15**	306.6	212.1
13:15	**13:45**	178.8	123.7
13:45	**14:15**	142.0	98.2
Average		209.1	144.7

** Results expressed at STP, 273 K, 101.3 kPa, 11% O_2 and dry gas.*

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Figure 1. David Smith St Ives Ltd
Volatile Organic Compound Data Taken From The Wood Boiler On 2nd October 2000
(mg m^{-3} expressed at 273K, 101.3kPa, 11% O_2 and dry gas)