APPENDIX ONE

[x6 pages in total]

Scientific Analysis Laboratories

Certificate of Analysis

Report Number: 178067

Date of Report: 06-Oct-09

Client:
Alderley Consulting Group
Middlewood Lodge
Middlewood Lane
Shore
Littleborough
Lancashire, OL15 8EZ

Client Contact: Dr. Bernard Acton
Client Job Reference:

Date Job Received at SAL: 28-Sep-09
Date Analysis Started: 01-Oct-09

The results reported relate to samples received at 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

Key to symbols used in this report:

W:	Analysis was performed at another SAL laboratory
S:	Analysis was subcontracted
N:	Analysis is not UKAS accredited
U:	Analysis is UKAS accredited

Result Summary

SAL Ref	Your Ref	I-TEQ (ng/kg)	Analysis
178067E001	1.Bottom Ash	<0.5	U
178067E002	2.ESP	25	U
178067E003	3.Bag Filter	550	
178067E004	4.Filter Press	5.2	
178067EBL		<0.5	U

Note: Results are reported based upon analysis of the samples 'as received'.

Report written by: L.F.Collins
Dioxin Analyst

Report checked and authorised by: Paul Harrington
Quality Manager

UKAS TESTING

DIOXINS AND FURANS

SAL Job Reference:178067
Your Job Reference:

SAL Sample Reference: 178067E001
Your Sample Reference: 1.Bottom Ash

Job Number : 178067E Sample Number : 178067E001 Client Id :
Date Acquired : 06-Oct-09 Acquired File : A:D0510
Operator : L.F.Collins Instrument : EID74 Column :DB-5MS
PC File : R:\DIOXINV\D0510\sample.011\D0510.DAT
File Text : 1.Bottom Ash
Sample Employed : 10.0 g

Compound Name	Quantity ng/kg	Toxic Equivalents BGA	USEPA	EC
Dioxins				
2,3,7,8-TCDD	N.D.			
1,2,3,7,8-PeCDD	N.D.			
1,2,3,6,7,8-HxCDD	0.64	0.064	0.064	0.064
1,2,3,4,7,8-HxCDD	0.42	0.042	0.042	0.042
1,2,3,7,8,9-HxCDD	0.41	0.041	0.041	0.041
1,2,3,4,6,7,8-HpCDD	4.2	0.042	0.042	0.042
OCDD	4.0	0.0040	0.0004	0.0040
Total non-targeted isomers				
TCDD	N.D.			
PeCDD	N.D.			
HxCDD	0.27	0.0027	0.0	0.0
HpCDD	2.2	0.0022	0.0	0.0
Total Dioxins TEQ		0.20	0.19	0.19
Furans				
2,3,7,8-TCDF	N.D.			
1,2,3,7,8-PeCDF	N.D.			
2,3,4,7,8-PeCDF	N.D.			
1,2,3,4,7,8-HxCDF	0.70	0.070	0.070	0.070
1,2,3,6,7,8-HxCDF	0.61	0.061	0.061	0.061
2,3,4,6,7,8-HxCDF	0.47	0.047	0.047	0.047
1,2,3,7,8,9-HxCDF	N.D.			
1,2,3,4,6,7,8-HpCDF	4.5	0.045	0.045	0.045
1,2,3,4,7,8,9-HpCDF	0.66	0.0066	0.0066	0.0066
OCDF	7.5	0.0075	0.0008	0.0075
Total non-targeted isomers				
TCDF	N.D.			
PeCDF	N.D.			
HxCDF	2.9	0.029	0.0	0.0
HpCDF	N.D.			
Total Furans TEQ		0.27	0.23	0.24
Grand Total TEQ		0.46	0.42	0.43

DIOXINS AND FURANS

SAL Job Reference:178067
Your Job Reference:

SAL Sample Reference: 178067E002
Your Sample Reference: 2.ESP

Job Number : 178067E Sample Number : 178067E002 Client id :
Date Acquired : 06-Oct-09 Acquired File : A:D0510
Operator : L.F.Collins Instrument : EID74 Column :DB-5MS
PC File : R:\DIOXINV\D0510\sample.012\D0510.DAT
File Text : 2.ESP
Sample Employed : 10.0 g

Compound Name	Quantity ng/kg	Toxic Equivalents BGA	USEPA	EC
Dioxins				
2,3,7,8-TCDD	0.81	0.81	0.81	0.81
1,2,3,7,8-PeCDD	3.0	0.30	3.0	1.5
1,2,3,6,7,8-HxCDD	5.0	0.50	0.50	0.50
1,2,3,4,7,8-HxCDD	8.6	0.86	0.86	0.86
1,2,3,7,8,9-HxCDD	9.2	0.92	0.92	0.92
1,2,3,4,6,7,8-HpCDD	160	1.6	1.6	1.6
OCDD	900	0.90	0.090	0.90
Total non-targeted isomers				
TCDD	2.6	0.026	0.0	0.0
PeCDD	14	0.14	0.0	0.0
HxCDD	52	0.52	0.0	0.0
HpCDD	140	0.14	0.0	0.0
Total Dioxins TEQ		6.8	7.8	7.1
Furans				
2,3,7,8-TCDF	1.3	0.13	0.13	0.13
1,2,3,7,8-PeCDF	2.9	0.29	0.15	0.15
2,3,4,7,8-PeCDF	10	1.0	5.2	5.2
1,2,3,4,7,8-HxCDF	15	1.5	1.5	1.5
1,2,3,6,7,8-HxCDF	17	1.7	1.7	1.7
2,3,4,6,7,8-HxCDF	48	4.8	4.8	4.8
1,2,3,7,8,9-HxCDF	12	1.2	1.2	1.2
1,2,3,4,6,7,8-HpCDF	230	2.3	2.3	2.3
1,2,3,4,7,8,9-HpCDF	58	0.58	0.58	0.58
OCDF	450	0.45	0.045	0.45
Total non-targeted isomers				
TCDF	34	0.34	0.0	0.0
PeCDF	110	1.1	0.0	0.0
HxCDF	130	1.3	0.0	0.0
HpCDF	160	0.16	0.0	0.0
Total Furans TEQ		17	18	18
Grand Total TEQ		24	25	25

DIOXINS AND FURANS

SAL Job Reference:178067
Your Job Reference:

SAL Sample Reference: 178067E003
Your Sample Reference: 3.Bag Filter

Job Number : 178067E Sample Number : 178067E003 Client Id :
Date Acquired : 06-Oct-09 Acquired File : A:D0510
Operator : L.F.Collins Instrument : EID74 Column :DB-5MS
PC File : R:\DIOXINV\D0510\sample.013\D0510.DAT
File Text : 3.Bag Filter
Sample Employed : 10.0 g

Compound Name	Quantity ng/kg	Toxic Equivalents BGA	USEPA	EC
Dioxins				
2,3,7,8-TCDD	13	13	13	13
1,2,3,7,8-PeCDD	58	5.8	58	29
1,2,3,6,7,8-HxCDD	73	7.3	7.3	7.3
1,2,3,4,7,8-HxCDD	110	11	11	11
1,2,3,7,8,9-HxCDD	68	6.8	6.8	6.8
1,2,3,4,6,7,8-HpCDD	540	5.4	5.4	5.4
OCDD	460	0.46	0.046	0.46
Total non-targeted isomers				
TCDD	150	1.5	0.0	0.0
PeCDD	690	6.9	0.0	0.0
HxCDD	1200	12	0.0	0.0
HpCDD	610	0.61	0.0	0.0
Total Dioxins TEQ		71	100	73
Furans				
2,3,7,8-TCDF	77	7.7	7.7	7.7
1,2,3,7,8-PeCDF	180	18	9.0	9.0
2,3,4,7,8-PeCDF	490	49	250	250
1,2,3,4,7,8-HxCDF	410	41	41	41
1,2,3,6,7,8-HxCDF	400	40	40	40
2,3,4,6,7,8-HxCDF	850	85	85	85
1,2,3,7,8,9-HxCDF	210	21	21	21
1,2,3,4,6,7,8-HpCDF	1800	18	18	18
1,2,3,4,7,8,9-HpCDF	620	6.2	6.2	6.2
OCDF	850	0.85	0.085	0.85
Total non-targeted isomers				
TCDF	3000	30	0.0	0.0
PeCDF	5300	53	0.0	0.0
HxCDF	4300	43	0.0	0.0
HpCDF	2300	2.3	0.0	0.0
Total Furans TEQ		410	470	470
Grand Total TEQ		490	580	550

DIOXINS AND FURANS

SAL Job Reference:178067
Your Job Reference:

SAL Sample Reference: 178067E004
Your Sample Reference: 4.Filter Press

Job Number : 178067E Sample Number : 178067E004 Client Id :
Date Acquired : 06-Oct-09 Acquired File : A:D0510
Operator : L.F.Collins Instrument : EID74 Column :DB-5MS
PC File : R:\DIOXINV\D0510\sample.014\D0510.DAT
File Text : 4.Filter Press
Sample Employed : 10.0 g

Compound Name	Quantity ng/kg	Toxic Equivalents BGA	USEPA	EC
Dioxins				
2,3,7,8-TCDD	N.D.			
1,2,3,7,8-PeCDD	N.D.			
1,2,3,6,7,8-HxCDD	0.60	0.060	0.060	0.060
1,2,3,4,7,8-HxCDD	2.0	0.20	0.20	0.20
1,2,3,7,8,9-HxCDD	1.4	0.14	0.14	0.14
1,2,3,4,6,7,8-HpCDD	29	0.29	0.29	0.29
OCDD	120	0.12	0.012	0.12
Total non-targeted isomers				
TCDD	N.D.			
PeCDD	N.D.			
HxCDD	15	0.15	0.0	0.0
HpCDD	23	0.023	0.0	0.0
Total Dioxins TEQ		0.98	0.70	0.81
Furans				
2,3,7,8-TCDF	0.38	0.038	0.038	0.038
1,2,3,7,8-PeCDF	0.88	0.088	0.044	0.044
2,3,4,7,8-PeCDF	3.4	0.34	1.7	1.7
1,2,3,4,7,8-HxCDF	3.2	0.32	0.32	0.32
1,2,3,6,7,8-HxCDF	3.0	0.30	0.30	0.30
2,3,4,6,7,8-HxCDF	11	1.1	1.1	1.1
1,2,3,7,8,9-HxCDF	2.4	0.24	0.24	0.24
1,2,3,4,6,7,8-HpCDF	35	0.35	0.35	0.35
1,2,3,4,7,8,9-HpCDF	15	0.15	0.15	0.15
OCDF	130	0.13	0.013	0.13
Total non-targeted isomers				
TCDF	3.1	0.031	0.0	0.0
PeCDF	10	0.10	0.0	0.0
HxCDF	13	0.13	0.0	0.0
HpCDF	35	0.035	0.0	0.0
Total Furans TEQ		3.4	4.3	4.4
Grand Total TEQ		4.4	5.0	5.2

DIOXINS AND FURANS

SAL Job Reference:178067
Your Job Reference:

SAL Sample Reference: 178067EBL
Your Sample Reference: Method Blank

Job Number : 178067E Sample Number : 178067EBL Client Id :-
Date Acquired : 06-Oct-09 Acquired File : A:D0510
Operator : L.F.Collins Instrument : EID74 Column :DB-5MS
PC File : R:\DIOXINV\D0510\sample.008\D0510.DAT
File Text : Method Blank
Sample Employed : 10.0 g

Compound Name	Quantity ng/kg	Toxic Equivalents BGA	USEPA	EC
Dioxins				
2,3,7,8-TCDD	N.D.			
1,2,3,7,8-PeCDD	N.D.			
1,2,3,6,7,8-HxCDD	N.D.			
1,2,3,4,7,8-HxCDD	N.D.			
1,2,3,7,8,9-HxCDD	N.D.			
1,2,3,4,6,7,8-HpCDD	N.D.			
OCDD	0.27	0.0003	0.0000	0.0003
Total non-targeted isomers				
TCDD	1.3	0.013	0.0	0.0
PeCDD	N.D.			
HxCDD	N.D.			
HpCDD	0.19	0.0002	0.0	0.0
Total Dioxins TEQ		0.013	0.0000	0.0003
Furans				
2,3,7,8-TCDF	N.D.			
1,2,3,7,8-PeCDF	N.D.			
2,3,4,7,8-PeCDF	N.D.			
1,2,3,4,7,8-HxCDF	0.20	0.020	0.020	0.020
1,2,3,6,7,8-HxCDF	N.D.			
2,3,4,6,7,8-HxCDF	N.D.			
1,2,3,7,8,9-HxCDF	N.D.			
1,2,3,4,6,7,8-HpCDF	0.46	0.0046	0.0046	0.0046
1,2,3,4,7,8,9-HpCDF	N.D.			
OCDF	4.4	0.0044	0.0004	0.0044
Total non-targeted isomers				
TCDF	4.4	0.044	0.0	0.0
PeCDF	2.7	0.027	0.0	0.0
HxCDF	N.D.			
HpCDF	N.D.			
Total Furans TEQ		0.100	0.025	0.029
Grand Total TEQ		0.11	0.025	0.029

COMPANY: Environmental Pollution Control, Health & Safety and Occupational Hygiene Limited
Director: Dr Bernard C Acton, PhD, MSc, LBIOH, FIOSH (RSP), MIIRSM, DpPH-MCIEH, FRSH
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SAMPLE ANALYSES

INCINERATION COMPONENT

OF

WASTE TO ENEGRY INSTALLATION

PREPARED FOR: **Mr William Spence**
Waste Management Services
Infrastructure Services Department
c/o Waste to Energy Plant
Greenhead
LERWICK
Shetland
ZE1 0PY

PREPARED BY: **Dr Bernard C Acton**
PhD, MSc, LBIOH, FIOSH (RSP), MIIRSM, DpPH-MCIEH, FRSH
Technical Director - ACG

Project No. 29200
December 2009-January 2010

1.0 INTRODUCTION

The SHETLAND Islands Council operates a purpose designed waste to energy installation located at Greenhead, Lerwick. The plant is a traditional grate system for the incineration of mixed waste-types including domestic, industrial, trade & office and combustible waste from the oil industry. The plant has a nominal waste destruction capacity of 3,300 kg $hour^{-1}$ from which energy in the form of low pressure hot water is generated using a traditional boiler unit.

Flue gases from the primary incineration stage are treated prior to discharge to atmosphere by controlled secondary combustion, dry electrostatic precipitation and wet chemical dosing followed by drying with reheat-air derived from a cross-heat exchanger before final treatment in a bag filtration system.

The SHETLANDS Islands Council has engaged the services of the *Alderley Consulting Group* (ACG) to assist with various aspects of sampling and analysis of some gaseous, solid and liquid waste streams generated as a result of operation of the process.

Four solid waste samples [Bag House Fines, Electrostatic Precipitator Ash, Bottom Ash and Filter Press Cake] plus one Final Effluent liquid sample relating to a period of routine utilisation of the incineration facility during September 2009 have been procured for analysis to permit consideration of disposal options; the samples were received at the Laboratory on Tuesday 21st December 2009.

2.0 SAMPLE ANALYSES & RESULTS

The four solid samples have each been analysed for a suit of 'metals and their compounds'.

The Bag House Fines, Electrostatic Precipitator Ash and Bottom Ash samples have also been analysed for 'total organic carbon content' and for 'loss on ignition' determination.

The Bag House Fines and Electrostatic Precipitator Ash samples have additionally been analysed for 'free lime' and 'moisture' content.

Finally, the liquid Final Effluent sample has been analysed for polychlorinated dioxins+furans.

3.0 RESULTS

Result TABLE ONE overleaf details analysis results for the four solid samples with respect to 'metals and their compounds' together with 'loss on ignition' determinations and also the 'free lime' content plus moisture content with respect to the Bag House Fines, Electrostatic Precipitator Ash and Bottom Ash samples. The 'total organic carbon' with respect to the Bottom Ash is additionally reported.

The dioxin/furan analysis result for the Final Effluent sample was <0.01 ng $L^{-1}{}_{I\text{-}TEQ}$.
APPENDIX ONE provides the Analytical Laboratory's synopsis result data for the dioxin/furan analyses.

TABLE ONE

Report Number:	186966							
	SIC WtoEPlant							
	29200.2							
	21/12/2009			LAB Ref	186966 001	186966 002	186966 003	186966 004
				Client Ref:	Bottom Ash	ESP	Bag House Fines	Filter Cake
Determinand	**Method**	**Units**	**LOD**					
Antimony	ICP/OES	mg/kg	10		<10	750	<10	<10
Cadmium	ICP/OES	mg/kg	1		<1	6	10	5
Chromium	ICP/OES	mg/kg	1		1	2	5	22
Cobalt	ICP/OES	mg/kg	10		<10	<10	<10	<10
Copper	ICP/OES	mg/kg	1		2600	970	20	8
Lead	ICP/OES	mg/kg	1		900	4100	83	46
Manganese	ICP/OES	mg/kg	1		780	880	110	77
Mercury	ICP/OES	mg/kg	1		<1	<1	15	41
Nickel	ICP/OES	mg/kg	1		3	1	9	11
Thallium	ICP/OES	mg/kg	10		<10	<10	<10	<10
Ca(OH)2 (lime)	Titration	%	0.1		NT	40	71	NT
Moisture	Grav	%	0.1		NT	0.2	0.2	NT
Loss on ignition	Grav	%	0.1		2	<0.1	<0.1	NT
Total organic carbon	OX/IR	%	0.1		0.8	0.7	15	NT

NT = no test required

APPENDIX ONE

[x3 pages in total]

Scientific Analysis Laboratories

Certificate of Analysis

Report Number:	187034
Date of Report:	08-Jan-10
Client:	Alderley Consulting Group Middlewood Lodge Middlewood Lane Shore Littleborough Lancashire, OL15 8EZ
Client Contact:	Dr. Bernard Acton
Client Job Reference:	
Date Job Received at SAL:	23-Dec-09
Date Analysis Started:	07-Jan-10

The results reported relate to samples received at the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
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Tests covered by this certificate were conducted in accordance with SAL SOPs

Key to symbols used in this report:

W:	Analysis was performed at another SAL laboratory
S:	Analysis was subcontracted
N:	Analysis is not UKAS accredited
U:	Analysis is UKAS accredited

Result Summary

SAL Ref	Your Ref	I-TEQ (ng/L)	Analysis
187034E001	Final Effluent	<0.01*	U
187034EBL		<0.005	U

Note: Results are reported based upon analysis of the samples 'as received'.

*LOD based on volume of sample extracted

Report written by:	Hayley Jackson Dioxin Analyst
Report checked and authorised by:	Paul Harrington Quality Manager

DIOXINS AND FURANS

SAL Job Reference:187034
Your Job Reference:

SAL Sample Reference: 187034E001
Your Sample Reference: Final Effluent

Job Number : 187034E Sample Number : 187034E001 Client Id :
Date Acquired : 11-Jan-10 Acquired File : A:D0701B
Operator : H Jackson Instrument : EID74 ' Column :
PC File : R:\DIOXINV\D0701B\sample.007\D0701B.DAT
File Text : Final Effluent
Sample Employed : 250 ml

Compound Name	Quantity ng/L	Toxic Equivalents BGA	USEPA	EC
Dioxins				
2,3,7,8-TCDD	N.D.			
1,2,3,7,8-PeCDD	N.D.			
1,2,3,6,7,8-HxCDD	N.D.			
1,2,3,4,7,8-HxCDD	N.D.			
1,2,3,7,8,9-HxCDD	N.D.			
1,2,3,4,6,7,8-HpCDD	N.D.			
OCDD	0.0061	0.0000	0.0000	0.0000
Total non-targeted isomers				
TCDD	0.0057	0.0001	0.0	0.0
PeCDD	N.D.			
HxCDD	N.D.			
HpCDD	N.D.			
Total Dioxins TEQ		0.0001	0.0000	0.0000
Furans				
2,3,7,8-TCDF	N.D.			
1,2,3,7,8-PeCDF	N.D.			
2,3,4,7,8-PeCDF	N.D.			
1,2,3,4,7,8-HxCDF	N.D.			
1,2,3,6,7,8-HxCDF	N.D.			
2,3,4,6,7,8-HxCDF	N.D.			
1,2,3,7,8,9-HxCDF	N.D.			
1,2,3,4,6,7,8-HpCDF	N.D.			
1,2,3,4,7,8,9-HpCDF	N.D.			
OCDF	N.D.			
Total non-targeted isomers				
TCDF	N.D.			
PeCDF	N.D.			
HxCDF	N.D.			
HpCDF	N.D.			
Total Furans TEQ		0.0	0.0	0.0
Grand Total TEQ		0.0001	0.0000	0.0000

DIOXINS AND FURANS

SAL Job Reference:187034
Your Job Reference:

SAL Sample Reference: 187034EBL
Your Sample Reference: Method Blank

Job Number : 187034E Sample Number : 187034EBL Client Id :
Date Acquired : 07-Jan-10 Acquired File : A:D0701A
Operator : L.F.Collins Instrument : EID74 Column :DB5-Ms
PC File : R:\DIOXINV\D0701A\sample.019\D0701A.DAT
File Text : Method Blank
Sample Employed : 500 ml

Compound Name	Quantity ng/L	Toxic Equivalents BGA	USEPA	EC
Dioxins				
2,3,7,8-TCDD	N.D.			
1,2,3,7,8-PeCDD	N.D.			
1,2,3,6,7,8-HxCDD	N.D.			
1,2,3,4,7,8-HxCDD	N.D.			
1,2,3,7,8,9-HxCDD	N.D.			
1,2,3,4,6,7,8-HpCDD	N.D.			
OCDD	N.D.			
Total non-targeted isomers				
TCDD	N.D.			
PeCDD	N.D.			
HxCDD	N.D.			
HpCDD	N.D.			
Total Dioxins TEQ		0.0	0.0	0.0
Furans				
2,3,7,8-TCDF	N.D.			
1,2,3,7,8-PeCDF	N.D.			
2,3,4,7,8-PeCDF	N.D.			
1,2,3,4,7,8-HxCDF	N.D.			
1,2,3,6,7,8-HxCDF	N.D.			
2,3,4,6,7,8-HxCDF	N.D.			
1,2,3,7,8,9-HxCDF	N.D.			
1,2,3,4,6,7,8-HpCDF	N.D.			
1,2,3,4,7,8,9-HpCDF	N.D.			
OCDF	N.D.			
Total non-targeted isomers				
TCDF	N.D.			
PeCDF	N.D.			
HxCDF	N.D.			
HpCDF	N.D.			
Total Furans TEQ		0.0	0.0	0.0
Grand Total TEQ		0.0	0.0	0.0