GMR endurvinnslan

VERKÍS
VERKFRÆÐISTOFA

GMR Endurvinnslan ehf.
Útblástursmælingar

GMR ENDURVINNSLAN EHF.-ÚTBLÁSTURSMÆLINGAR

GREINARGERÐ

VERKNÚMER:	14004-001	DAGS:	2016-05-12
VERKÞÁTTUR:	01	NR.:	05
UNNIÐ FYRIR:	GMR Endurvinnsluna ehf.		
VERKEFNISSTJÓRI:	Birgir Tómas Arnar		
HÖFUNDUR:	Birgir Tómas Arnar	YFIRFARIÐ:	GÞJ
DREIFING:	Daði Jóhannesson, GMR Endurvinnslan ehf., Guðjón Jónsson, VSÓ Ráðgjöf.		

Mælingar í útblæstri frá báðum reykháfum í verksmiðju GMR Endurvinnslunnar ehf. á Grundartanga voru framkvæmdar dagana 30. og 31. mars af starfsmönnum Verkís hf. Síur og díoxín var efnagreint á rannsóknarstofu Scientific Analysis Labortories Ltd. (SAL) í Bretlandi.

Verkís hf. | Ofanleiti 2, 103 Reykjavík | 422 8000 | verkis.is | verkis@verkis.is

Efnisyfirlit

Yfirlit yfir töflur

1 Inngangur

Verkís hf. í samstarfi við Rannsóknarþjónustuna Sýni ehf. tók að sér mælingar í útblæstri frá báðum reykháfum verksmiðju GMR Endurvinnslu ehf. á Grundartanga. Út um reykháfana streymir útsog frá ofni verksmiðjunnar annars vegar og útsog frá loftræsikerfi verksmiðjunnar hinsvegar. Í reykháfnum var mældur hraði og hitastig útblásturslofts, rykmagn, styrkur brennisteinsoxíðs (SO_x), vetnisklóríðs (HCl), vetnisflúoríðs (HF), klórs (Cl_2) og á díoxín/fúrönum. Þungmálmar voru einnig efnagreindir í útblæstrinum.

Síur og díoxín var efnagreint á rannsóknarstofu Scientific Analysis Laboratories (SAL) í Bretlandi. Niðurstöður mælinga sjást hér í töflunni að neðan.

Allir útreikningar í töflum 1.1 og 1.2 og losunarmörk sem eru skilgreind þar miðast við staðalaðstæður (STP), 273K (0°C) og 101,3 kPa, þurrt loft.

1 N/m³ svarar til eins rúmmetra af lofti við staðalaðstæður.

Tafla 1.1 Niðurstöður mælinga í útblæstri frá loftræsireykháfi

Mælingar í útblæstri				
Mæliþáttur	***Mæligildi (meðaltöl)***	***Losunarmörk***	***Útstreymis-magn***	***Tímasvið***
Rykmagn í útblæstri	0,45 mg/Nm³	5,0 mg/Nm³	0,0 kg/klst	2x30 mín
Brennisteinsoxíð (SO_x)	0,7 mg/Nm³	50 mg/Nm³	0,0 kg/klst	2x30 mín
Vetnisklóríð (HCl)	0,1 mg/Nm³	10 mg/Nm³	0,0 kg/klst	2x30 mín
Vetnisflúroíð (HF)	0,04 mg/Nm³	1 mg/Nm³	0,0 kg/klst	2x30 mín
Klór (Cl_2)	0,0 mg/Nm³	3 mg/Nm³	0,0 kg/klst	2x30 mín
Díoxín /Fúrön (I-TEQ) (Sía /XAD-2)	0,012 ng/Nm³	0,1 ng/Nm³	0,0 µg/klst	4x60mín
Hg	0,0 mg/Nm³	0,050 mg/Nm³	-	1x30 mín
∑Sb+Pb+Cr+CN+F+Cu+Mn+V+Se+Te+Ni+Co+Sn	0,18 mg/Nm³	0,25 mg/Nm³	-	1x30 mín
CO_2	0%	-	-	2x30 mín
Hitastig mælibúnaðar	3°C	-	-	-
Hitastig útblásturslofts	6°C	-	-	-
Rakainnihald útblásturslofts	0%	-	-	-
Loftþrýstingur á mælistað	751,9 mmHg			
Lofthraði útblásturslofts	10,5 m/s	-	-	-
Loftmagn	66.275 Nm³/klst	-	-	-

Tafla 1.2 Niðurstöður mælinga í útblæstri frá ofnreykháfi

Mælingar í útblæstri				
Mæliþáttur	***Mæligildi (meðaltöl)***	***Losunarmörk***	***Útstreymis-magn***	***Tímasvið***
Rykmagn í útblæstri	2,2 mg/Nm³	5,0 mg/Nm³	0,0 kg/klst	2x30 mín
Brennisteinsoxíð (SO_x)	15,0 mg/Nm³	50 mg/Nm³	0,3 kg/klst	2x30 mín
Vetnisklóríð (HCl)	0,2 mg/Nm³	10 mg/Nm³	0,0 kg/klst	2x30 mín
Vetnisflúroíð (HF)	0,1 mg/Nm³	1 mg/Nm³	0,0 kg/klst	2x30 mín
Klór (Cl_2)	0,0 mg/Nm³	3 mg/Nm³	0,0 kg/klst	2x30 mín
Díoxín /Fúrön (I-TEQ) (Sía /XAD-2)	0,007 ng/Nm³	0,1 ng/Nm³	0,0 µg/klst	4x60mín
Hg	0,0 mg/Nm³	0,050 mg/Nm³	-	1x30 mín
∑Sb+Pb+Cr+CN+F+Cu+Mn+V+Se+ Te+Ni+Co+Sn	0,16 mg/Nm³	0,25 mg/Nm³	-	1x30 mín
CO_2	0,1%	-	-	3x30 mín
Hitastig mælibúnaðar	0°C	-	-	-
Hitastig útblásturslofts	26°C	-	-	-
Rakainnihald útblásturslofts	1%	-	-	-
Loftþrýstingur á mælistað	757,3 mmHg			
Lofthraði útblásturslofts	12,6 m/s	-	-	-
Loftmagn	17.616 Nm³/klst	-	-	-

2 Mælingar

2.1 Mælingar í útblæstri frá loftræsireykháfi

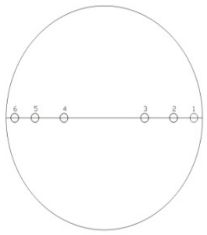
2.1.1 Hraðamælingar

Lofthraði var mældur í þversniði reykháfs í 6 punktum, sbr. mynd hér að neðan[1].

Tafla 2.1 Helstu kennistærðir reykháfs á mælistað

	Stærðir	*Eining*
Innra þvermál reykháfs	1,57	m
Flatarmál reykháfs	1,94	m²

Tafla 2.2 Niðurstöður hraðamælingar



Pkt. nr.	*Staða í rás (cm)*	*Mældur hraði*
1	7,0	9,2
2	23,0	10,7
3	46,3	11,7
4	110,7	10,7
5	133,9	10,7
6	150,0	10,2

Meðalhraði v_m=10,5 m/sek
Raunloftflæði= 73.178 m³/klst

[1] Frávik frá ISO 9096 staðlinum sem gerir ráð fyrir að mælt sé í 6 punktum á tveimur línum sem eru hornréttar hvor á aðra í mæliplaninu. Þetta orsakast að því að einungis eitt gat er aðgengilegt til mælinga á reykháfi.

2.1.2 Heildarryk

Tvö ryksýni voru tekin með ryksafnara með glertrefja síu. Ryksafnaranum er stungið inn í reykháfinn og loftstraumur sogaður út í gegnum hann með jafnhraðasýnatöku (isokinetic sampling). Niðurstöður mælinga eru gefnar í eftirfarandi töflu.

Tafla 2.3 Niðurstöður rykmælinga

Ryk í útblæstri				
Mæliröð nr.	Mælt rykmagn	Ryk í síu	Tími	Rykmagn (þurrt)
1 (sía #14)	0,6 mg/Nm³	0,3 mg	9:00-9:30	0,6 mg/Nm³
2 (sía #15)	1,1 mg/Nm³	0,6 mg	9:40-10:10	1,1 mg/Nm³

2.2 Mælingar í útblæstri frá ofnreykháfi

2.2.1 Hraðamælingar

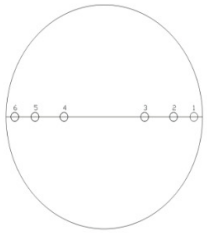
Lofthraði var mældur í þversniði reykháfs í 6 punktum, sbr. mynd hér að neðan[2].

Tafla 2.4 Helstu kennistærðir reykháfs á mælistað

	Stærðir	***Eining***
Innra þvermál reykháfs	0,74	m
Flatarmál reykháfs	0,43	m²

[2] Frávik frá ISO 9096 staðlinum sem gerir ráð fyrir að mælt sé í 6 punktum á tveimur línum sem eru hornréttar hvor á aðra í mæliplaninu. Þetta orsakast að því að einungis eitt gat er aðgengilegt til mælinga á reykháfi.

Tafla 2.5 Niðurstöður hraðamælingar

		
Pkt. nr.	***Staða í rás (cm)***	***Mældur hraði***
1	3,3	12,5
2	10,9	13,7
3	21,8	13,7
4	52,2	12,1
5	63,1	12,1
6	70,7	11,2

Meðalhraði v_m=12,6 m/sek
Raunloftflæði= 19.509 m³/klst

2.2.2 Heildarryk

Tvö ryksýni voru tekin með ryksafnara með glertrefja síu. Ryksafnaranum er stungið inn í reykháfinn og loftstraumur sogaður út í gegnum hann með jafnhraðasýnatöku (isokinetic sampling). Niðurstöður mælinga eru gefnar í eftirfarandi töflu.

Tafla 2.6 Niðurstöður rykmælinga

Ryk í útblæstri				
Mæliröð nr.	Mælt rykmagn	Ryk í síu	Tími	Rykmagn (þurrt)
1 (sía #17)	2,6 mg/Nm³	1,7 mg	9:11-9:41	2,6 mg/Nm³
2 (sía #18)	1,8 mg/Nm³	1,2 mg	9:51-10:21	1,8 mg/Nm³

2.2.3 Brennisteinsoxíð (SO_x)

Brennisteinoxíð (SO_x) var mælt með Madur GA-12 Plus gasmælitæki.

2.2.4 Vetnisklóríð (HCl)

Vetnisklóríð (HCl) var mælt samhliða rykmælingu og dregið í gegnum glerflösku með vökvalausn (afjónað vatn).

2.2.5 Vetnisflúoríð (HF)

Vetnisflúoríð var mælt samhliða rykmælingu og dregið í gegnum glerflösku með vökvalausn (0.1 M NaOH) og greint sem ryk í síum.

2.2.6 Klór (Cl_2)

Klór var mælt samhliða rykmælingu og dregið í gegnum glerflösku með vökvalausn (H_2SO_4).

2.2.7 Díoxín/fúrön

Díoxín og fúrön voru mæld í útblæstrinum með jafnhraðasýnatöku. Notuð var s.k. „Filter/condenser" aðferð skv. ÍST EN 1948.

2.2.8 Þungmálmar

Eftirfarandi þungmálmar voru efnagreindir í síu og styrkur þeirra reiknaður í rúmmáli útblásturslofts. Málmar voru mældir með ICP-OES eftir upplausn í saltpéturssýru og peroxíði skv. EPA aðerð nr. 3051. Styrkur þungmálma í útblæstri sést í töflu 1.2

- Kvikasilfur (Hg)
- Summa: Antímon (Sb), Blý (Pb), Króm (Cr), Sýaníð (CN), Járn (Fe), Kopar (Cu), Mangan (Mn), Vanadíum (V), Selenium (Se), Tellerium (Te), Nikkel (Ni), Kóbolt (Co) og Tin (Sn)

3 Mælinákvæmni

3.1.1 Mælinákvæmni

Taflan hér að neðan sýnir nákvæmni, gefna upp í %, sem búast má við í mælingunum ef notaðar eru þær aðferðir sem vísað er í eða frá framleiðanda tækjabúnaðar.

Tafla 3.1 Nákvæmni í mældum gildum

Mælinákvæmni		
Mæliþáttur	% nákvæmni	Mæliaðferð
Ryk	±15%	ISO 9096
TOC	±15%	-
HCl	±30%	EN 1911
HF	±20%	ISO 15713
CO	±5%	Skv. framleiðanda gasmælis
NO_x	±5%	Skv. framleiðanda gasmælis
SO_2	±5%	Skv. framleiðanda gasmælis
NH_3	±20%	-
O_2	±5%	Skv. framleiðanda gasmælis
Þungmálmar	±15%	EPA 3051
Díoxín og fúrön	±30%	EN 1948
Hraði	±3%	ISO 10780
Hitastig	±5%	EN 14790
Raki	±20%	EN 14790

Viðauki 1 – Niðurstöður efnagreininga

Verkís
B.t. Birgis Tómasar Arnars
Ofanleiti 2
103 Reykjavík

SÝNI

NIÐURSTÖÐUR EFNA- OG ÖRVERUGREININGA

Sýni nr.: E-2819-2820, 2822-2823-16

Gerð sýnis: Síur
Sendandi: Verkís
Sýnataka: Verkís

Móttekið: 11.04.2016
Rannsakað: 11.04.2016
Verkkaupi: Verkís v/ GMR endurvinnsla

Nr. sýnis	Merking sýnis	Þyngd fyrir notkun (g)	Þyngd eftir notkun (g)	Ryk (mg)
E-2819	Sía nr. 14	1.3394	1.3397	0.3
E-2820	Sía nr. 15	1.4353	1.4359	0.6
E-2822	Sía nr. 17	1.5487	1.5504	1.7
E-2823	Sía nr. 18	1.4401	1.4413	1.2

Athugasemdir: Síurnar voru þurrkaðar við 103°C í 2 klst.

Reykjavík, 4. maí 2016

Þorvaldur Snæbjörnsson
Efnafræðingur

Niðurstöður eiga einungis við um það sýni sem mælt var.
Upplýsingar um aðferðafræði, nákvæmni og næmni aðferða má fá hjá Rannsóknarþjónustunni Sýni hf.
Óheimilt er að afrita prófunarskýrslur nema í heilu lagi ef ekki liggur fyrir skriflegt samþykki frá Rannsóknarþjónustunni Sýni ehf.

RANNSÓKNARÞJÓNUSTAN SÝNI EHF. • LYNGHÁLSI 3 • 110 REYKJAVÍK • KT. 410493-2689 • SÍMI 512 3380 • FAX 512 3399

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: 563230-2

Date of Report: 28-Apr-2016

Customer: Verkis
Ofanleiti 2
103 Reykjavik
Iceland

Customer Contact: . Birgir Arnar

Customer Job Reference:
Date Job Received at SAL: 12-Apr-2016
Date Analysis Started: 20-Apr-2016
Date Analysis Completed: 28-Apr-2016

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.
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
All results have been reviewed in accordance with Section 25 of the SAL Quality Manual

UKAS TESTING
1549

Report checked and authorised by :
Mary Hughes
Customer Service Manager

Issued by :
Mary Hughes
Customer Service Manager

SAL Reference: 563230
Customer Reference:

Impinger (0.1N Sulphuric Acid) Analysed as Impinger (0.1N Sulphuric Acid)
Miscellaneous

				SAL Reference	**563230 005**	**563230 008**
				Customer Sample Reference	**CL2 1**	**CL2 2**
				Test Sample	**AR**	**AR**
Determinand	**Method**	**LOD**	**Units**	**Symbol**		
Chloride	IC	0.5	mg/l	N	(176) <5000	(176) <50
Volume	Vol	1	ml	N	**30**	**18**

SAL Reference: 563230
Customer Reference:

Filter Analysed as Filter
Miscellaneous

				SAL Reference	**563230 001**	**563230 002**
				Customer Sample Reference	**FILTER #14**	**FILTER #15**
				Test Sample	**AR**	**AR**
Determinand	**Method**	**LOD**	**Units**	**Symbol**		
Cyanide (Total)	Colorimetry	1	µg	N	(248) <1	-
Hydrogen Fluoride	IC (acetate separation method)	0.5	µg	N	**(248) 8.6**	**19**

SAL Reference: 563230
Customer Reference:

Impinger(DI water) Analysed as Impinger(DI water)
Miscellaneous

				SAL Reference	**563230 003**	**563230 006**
				Customer Sample Reference	**HCL 1**	**HCL 2**
				Test Sample	**AR**	**AR**
Determinand	**Method**	**LOD**	**Units**	**Symbol**		
Hydrogen Chloride	IC	0.05	mg/l	U	**(13) 0.10**	**(13) 0.13**
Volume	Vol	1	ml	U	**35**	**35**

SAL Reference: 563230
Customer Reference:

Impinger (sodium hydroxide) Analysed as Impinger (sodium hydroxide)
Miscellaneous

				SAL Reference	**563230 004**	**563230 007**
				Customer Sample Reference	**HF 1**	**HF 2**
				Test Sample	**AR**	**AR**
Determinand	**Method**	**LOD**	**Units**	**Symbol**		
Hydrogen Fluoride	IC (acetate separation method)	0.05	mg/l	U	**(13) 0.05**	<0.05
Volume	Vol	1	ml	U	**39**	**38**

SAL Reference: 563230
Customer Reference:

Filter Analysed as Filter
Filter Suite

SAL Reference	**563230 001**
Customer Sample Reference	**FILTER #14**
Test Sample	**AR**

Determinand	Method	LOD	Units	Symbol	
Antimony	ICP/OES	1	µg	U	(248) <1
Chromium	ICP/OES	1	µg	U	**(248) 1**
Cobalt	ICP/OES	1	µg	U	(248) <1
Copper	ICP/OES	1	µg	U	(248) <1
Iron	ICP/OES	1	µg	U	**(248) 24**
Lead	ICP/OES	1	µg	U	**(248) 1**
Manganese	ICP/OES	1	µg	U	**(248) 2**
Mercury	ICP/OES	1	µg	U	(248) <1
Nickel	ICP/OES	1	µg	U	(248) <1
Selenium	ICP/OES	1	µg	U	(248) <1
Tellurium	ICP/OES	1	µg	N	(248) <1
Tin	ICP/OES	1	µg	U	(248) <1
Vanadium	ICP/OES	1	µg	U	(248) <1

Index to symbols used in 563230-2

Value	Description
AR	As Received
13	Results have been blank corrected.
176	LOD raised due to interference from high levels of other anions present.
248	Analysis was performed on one third of the sample, therefore result/LOD should be multiplied by three to calculate result per whole sample.
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

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Scientific Analysis Laboratories Ltd

Certificate of Analysis

Report Number: 563289-1

Date of Report: 11-May-2016

Customer: Verkis
Ofanleiti 2
103 Reykjavik
Iceland

Customer Contact: . Birgir Arnar

Customer Job Reference:
Date Job Received at SAL: 12-Apr-2016
Date Analysis Started: 20-Apr-2016
Date Analysis Completed: 06-May-2016

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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 Section 25 of the SAL Quality Manual

1549

Report checked and authorised by :
Michael Goodman
Project Manager

Issued by :
Lauren Clarke
Trainee Project Manager

Summary Of Results

Composite (Filt, Trap, Wash)

Dioxins and Dioxin-like PCBs

				ITEQ Toxic Equivalents ng	
SAL Reference	**Customer Sample Reference**	**Analysis**	**Symbol**	**Lower Bound**	**Upper Bound**
563289 003	Combined XAD TRAP 1 + FILTER #16	Dioxins and Furans (BS EN 1948:06)	U	0.071	**0.084**
563289 006	Combined METHOD BLANK	Dioxins and Furans (BS EN 1948:06)	U	0.0	**0.0061**

Sampling Recoveries

SAL Reference	Customer Sample Reference	Determinand	Sampling Recovery %
563289 003	Combined XAD TRAP 1 + FILTER #16	1,2,3,7,8-PeCDF	124
		1,2,3,7,8,9-HxCDF	125
		1,2,3,4,7,8,9-HpCDF	99

Composite (Filt, Trap, Wash)

Customer Sample Reference : Combined XAD TRAP 1 + FILTER #16
SAL Sample Reference : 563289 003

Dioxins and Furans (BS EN 1948:06)

Technique : GC/MS (HR)

					ITEQ Toxic Equivalents ng	
Determinand	**Symbol**	**LOD ng**	**Result ng**	**Internal Recovery %**	**Lower Bound**	**Upper Bound**
2,3,7,8-TCDD	U	0.0040	<0.0040	63	0.0	**0.0040**
1,2,3,7,8-PeCDD	U	0.0022	**0.018**	79	0.0090	**0.0090**
1,2,3,4,7,8-HxCDD	U	0.0027	**0.023**	86	0.0023	**0.0023**
1,2,3,6,7,8-HxCDD	U	0.0023	**0.059**	94	0.0059	**0.0059**
1,2,3,7,8,9-HxCDD	U	0.0023	**0.029**		0.0029	**0.0029**
1,2,3,4,6,7,8-HpCDD	U	0.0045	**0.45**	76	0.0045	**0.0045**
OCDD	U	0.0068	**0.70**	69	0.00070	**0.00070**
				Dioxins Totals :	0.025	**0.029**
2,3,7,8-TCDF	U	0.012	<0.012	78	0.0	**0.0012**
1,2,3,7,8-PeCDF	U	0.030	<0.030		0.0	**0.0015**
2,3,4,7,8-PeCDF	U	0.0017	**0.047**	78	0.024	**0.024**
1,2,3,4,7,8-HxCDF	U	0.0023	**0.056**	85	0.0056	**0.0056**
1,2,3,6,7,8-HxCDF	U	0.0023	**0.064**	86	0.0064	**0.0064**
2,3,4,6,7,8-HxCDF	U	0.0023	**0.080**	69	0.0080	**0.0080**
1,2,3,7,8,9-HxCDF	U	0.050	<0.050		0.0	**0.0050**
1,2,3,4,6,7,8-HpCDF	U	0.0043	**0.25**	93	0.0025	**0.0025**
1,2,3,4,7,8,9-HpCDF	U	0.050	<0.050		0.0	**0.00050**
OCDF	U	0.0057	**0.11**	78	0.00011	**0.00011**
				Furans Totals :	0.046	**0.054**
				Totals :	**0.071**	**0.084**

Composite (Filt, Trap, Wash)

Customer Sample Reference : Combined METHOD BLANK
SAL Sample Reference : 563289 006

Dioxins and Furans (BS EN 1948:06)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng	Result ng	Internal Recovery %	ITEQ Toxic Equivalents ng	
					Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.0020	<0.0020	79	0.0	**0.0020**
1,2,3,7,8-PeCDD	U	0.0020	<0.0020	94	0.0	**0.0010**
1,2,3,4,7,8-HxCDD	U	0.0020	<0.0020	96	0.0	**0.00020**
1,2,3,6,7,8-HxCDD	U	0.0020	<0.0020	103	0.0	**0.00020**
1,2,3,7,8,9-HxCDD	U	0.0020	<0.0020		0.0	**0.00020**
1,2,3,4,6,7,8-HpCDD	U	0.010	<0.010	82	0.0	**0.00010**
OCDD	U	0.030	<0.030	77	0.0	**0.00003**
				Dioxins Totals :	0.0	**0.0037**
2,3,7,8-TCDF	U	0.0020	<0.0020	84	0.0	**0.00020**
1,2,3,7,8-PeCDF	U	0.0020	<0.0020		0.0	**0.00010**
2,3,4,7,8-PeCDF	U	0.0020	<0.0020	96	0.0	**0.0010**
1,2,3,4,7,8-HxCDF	U	0.0020	<0.0020	89	0.0	**0.00020**
1,2,3,6,7,8-HxCDF	U	0.0020	<0.0020	89	0.0	**0.00020**
2,3,4,6,7,8-HxCDF	U	0.0020	<0.0020	82	0.0	**0.00020**
1,2,3,7,8,9-HxCDF	U	0.0020	<0.0020		0.0	**0.00020**
1,2,3,4,6,7,8-HpCDF	U	0.010	<0.010	89	0.0	**0.00010**
1,2,3,4,7,8,9-HpCDF	U	0.010	<0.010		0.0	**0.00010**
OCDF	U	0.020	<0.020	75	0.0	**0.00002**
				Furans Totals :	0.0	**0.0023**
				Totals :	**0.0**	**0.0061**

Index to symbols used in 563289-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited

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

Scientific Analysis Laboratories Ltd

Certificate of Analysis

Report Number: 563235-1

Date of Report: 28-Apr-2016

Customer: Verkis
Ofanleiti 2
103 Reykjavik
Iceland

Customer Contact: . Birgir Arnar

Customer Job Reference:
Date Job Received at SAL: 12-Apr-2016
Date Analysis Started: 22-Apr-2016
Date Analysis Completed: 28-Apr-2016

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.
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 Section 25 of the SAL Quality Manual

1549

Report checked
and authorised by :
Mary Hughes
Customer Service Manager

Issued by :
Mary Hughes
Customer Service Manager

SAL Reference: 563235
Customer Reference:

Impinger (0.1N Sulphuric Acid) Analysed as Impinger (0.1N Sulphuric Acid)
Miscellaneous

					SAL Reference	563235 005	563235 008
					Customer Sample Reference	CL2 3	CL2 4
					Test Sample	AR	AR
Determinand	**Method**	**LOD**	**Units**	**Symbol**			
Chloride	IC	0.5	mg/l	N		(176) <50	(176) <50
Volume	Vol	1	ml	N		**15**	**18**

SAL Reference: 563235
Customer Reference:

Filter Analysed as Filter
Miscellaneous

					SAL Reference	563235 001	563235 002
					Customer Sample Reference	FILTER #17	FILTER #18
					Test Sample	AR	AR
Determinand	**Method**	**LOD**	**Units**	**Symbol**			
Cyanide (Total)	Colorimetry	1	µg	N		(248) <1	-
Hydrogen Fluoride	IC (acetate separation method)	0.5	µg	N		**(248) 35**	**56**

SAL Reference: 563235
Customer Reference:

Impinger(DI water) Analysed as Impinger(DI water)
Miscellaneous

					SAL Reference	563235 003	563235 006
					Customer Sample Reference	HCL 3	HCL 4
					Test Sample	AR	AR
Determinand	**Method**	**LOD**	**Units**	**Symbol**			
Hydrogen Chloride	IC	0.05	mg/l	U		**(13) 0.12**	**(13) 0.15**
Volume	Vol	1	ml	U		**35**	**39**

SAL Reference: 563235
Customer Reference:

Impinger (sodium hydroxide) Analysed as Impinger (sodium hydroxide)
Miscellaneous

					SAL Reference	563235 004	563235 007
					Customer Sample Reference	HF 3	HF 4
					Test Sample	AR	AR
Determinand	**Method**	**LOD**	**Units**	**Symbol**			
Hydrogen Fluoride	IC (acetate separation method)	0.05	mg/l	U		**(13) 0.05**	**(13) 0.05**
Volume	Vol	1	ml	U		**37**	**42**

SAL Reference: 563235
Customer Reference:

Filter Analysed as Filter
Filter Suite

SAL Reference	**563235 001**
Customer Sample Reference	**FILTER #17**
Test Sample	**AR**

Determinand	Method	LOD	Units	Symbol	
Antimony	ICP/OES	1	µg	U	(248) <1
Chromium	ICP/OES	1	µg	U	**(248) 2**
Cobalt	ICP/OES	1	µg	U	(248) <1
Copper	ICP/OES	1	µg	U	(248) <1
Iron	ICP/OES	1	µg	U	**(248) 24**
Lead	ICP/OES	1	µg	U	(248) <1
Manganese	ICP/OES	1	µg	U	(248) <1
Mercury	ICP/OES	1	µg	U	(248) <1
Nickel	ICP/OES	1	µg	U	(248) <1
Selenium	ICP/OES	1	µg	U	(248) <1
Tellurium	ICP/OES	1	µg	N	(248) <1
Tin	ICP/OES	1	µg	U	(248) <1
Vanadium	ICP/OES	1	µg	U	(248) <1

Index to symbols used in 563235-1

Value	Description
AR	As Received
248	Analysis was performed on one third of the sample, therefore result/LOD should be multiplied by three to calculate result per whole sample.
13	Results have been blank corrected.
176	LOD raised due to interference from high levels of other anions present.
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

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Scientific Analysis Laboratories Ltd

Certificate of Analysis

Report Number: 563306-1

Date of Report: 11-May-2016

Customer: Verkis
Ofanleiti 2
103 Reykjavik
Iceland

Customer Contact: . Birgir Arnar

Customer Job Reference:
Date Job Received at SAL: 12-Apr-2016
Date Analysis Started: 20-Apr-2016
Date Analysis Completed: 05-May-2016

The results reported relate to samples received in the laboratory and may not be representative of a whole batch.
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 Section 25 of the SAL Quality Manual

1549

Report checked and authorised by :
Michael Goodman
Project Manager

Issued by :
Lauren Clarke
Trainee Project Manager

Summary Of Results

Composite (Filt, Trap, Wash)

Dioxins and Dioxin-like PCBs

				ITEQ Toxic Equivalents ng	
SAL Reference	**Customer Sample Reference**	**Analysis**	**Symbol**	**Lower Bound**	**Upper Bound**
563306 003	Combined XAD TRAP 2 + FILTER #19	Dioxins and Furans (BS EN 1948:06)	U	0.029	**0.037**
563306 006	Combined METHOD BLANK	Dioxins and Furans (BS EN 1948:06)	U	0.0	**0.0061**

Sampling Recoveries

SAL Reference	Customer Sample Reference	Determinand	Sampling Recovery %
563306 003	Combined XAD TRAP 2 + FILTER #19	1,2,3,7,8-PeCDF	123
		1,2,3,7,8,9-HxCDF	115
		1,2,3,4,7,8,9-HpCDF	76

Composite (Filt, Trap, Wash)

Customer Sample Reference : Combined XAD TRAP 2 + FILTER #19
SAL Sample Reference : 563306 003

Dioxins and Furans (BS EN 1948:06)

Technique : GC/MS (HR)

					ITEQ Toxic Equivalents ng	
Determinand	**Symbol**	**LOD ng**	**Result ng**	**Internal Recovery %**	**Lower Bound**	**Upper Bound**
2,3,7,8-TCDD	U	0.0020	<0.0020	88	0.0	**0.0020**
1,2,3,7,8-PeCDD	U	0.0070	<0.0070	60	0.0	**0.0035**
1,2,3,4,7,8-HxCDD	U	0.0090	<0.0090	78	0.0	**0.00090**
1,2,3,6,7,8-HxCDD	U	0.0090	**0.013**	95	0.0013	**0.0013**
1,2,3,7,8,9-HxCDD	U	0.0090	<0.0090		0.0	**0.00090**
1,2,3,4,6,7,8-HpCDD	U	0.0052	**0.11**	77	0.0011	**0.0011**
OCDD	U	0.0063	**0.20**	79	0.00020	**0.00020**
				Dioxins Totals :	0.0026	**0.0099**
2,3,7,8-TCDF	U	0.0034	**0.019**	74	0.0019	**0.0019**
1,2,3,7,8-PeCDF	U	0.0028	**0.016**		0.00080	**0.00080**
2,3,4,7,8-PeCDF	U	0.0028	**0.031**	88	0.016	**0.016**
1,2,3,4,7,8-HxCDF	U	0.0080	**0.027**	124	0.0027	**0.0027**
1,2,3,6,7,8-HxCDF	U	0.0080	**0.019**	106	0.0019	**0.0019**
2,3,4,6,7,8-HxCDF	U	0.0080	**0.026**	69	0.0026	**0.0026**
1,2,3,7,8,9-HxCDF	U	0.0080	<0.0080		0.0	**0.00080**
1,2,3,4,6,7,8-HpCDF	U	0.0044	**0.088**	113	0.00088	**0.00088**
1,2,3,4,7,8,9-HpCDF	U	0.0044	**0.012**		0.00012	**0.00012**
OCDF	U	0.0067	**0.063**	74	0.00006	**0.00006**
				Furans Totals :	0.026	**0.027**
				Totals :	**0.029**	**0.037**

Composite (Filt, Trap, Wash)

Customer Sample Reference : Combined METHOD BLANK
SAL Sample Reference : 563306 006

Dioxins and Furans (BS EN 1948:06)

Technique : GC/MS (HR)

Determinand	Symbol	LOD ng	Result ng	Internal Recovery %	ITEQ Toxic Equivalents ng	
					Lower Bound	Upper Bound
2,3,7,8-TCDD	U	0.0020	<0.0020	79	0.0	**0.0020**
1,2,3,7,8-PeCDD	U	0.0020	<0.0020	94	0.0	**0.0010**
1,2,3,4,7,8-HxCDD	U	0.0020	<0.0020	96	0.0	**0.00020**
1,2,3,6,7,8-HxCDD	U	0.0020	<0.0020	103	0.0	**0.00020**
1,2,3,7,8,9-HxCDD	U	0.0020	<0.0020		0.0	**0.00020**
1,2,3,4,6,7,8-HpCDD	U	0.010	<0.010	82	0.0	**0.00010**
OCDD	U	0.030	<0.030	77	0.0	**0.00003**
				Dioxins Totals :	0.0	**0.0037**
2,3,7,8-TCDF	U	0.0020	<0.0020	84	0.0	**0.00020**
1,2,3,7,8-PeCDF	U	0.0020	<0.0020		0.0	**0.00010**
2,3,4,7,8-PeCDF	U	0.0020	<0.0020	96	0.0	**0.0010**
1,2,3,4,7,8-HxCDF	U	0.0020	<0.0020	89	0.0	**0.00020**
1,2,3,6,7,8-HxCDF	U	0.0020	<0.0020	89	0.0	**0.00020**
2,3,4,6,7,8-HxCDF	U	0.0020	<0.0020	82	0.0	**0.00020**
1,2,3,7,8,9-HxCDF	U	0.0020	<0.0020		0.0	**0.00020**
1,2,3,4,6,7,8-HpCDF	U	0.010	<0.010	89	0.0	**0.00010**
1,2,3,4,7,8,9-HpCDF	U	0.010	<0.010		0.0	**0.00010**
OCDF	U	0.020	<0.020	75	0.0	**0.00002**
				Furans Totals :	0.0	**0.0023**
				Totals :	**0.0**	**0.0061**

Index to symbols used in 563306-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited