

## Kratus ehf. Útblástursmælingar



## KRATUS EHF.-ÚTBLÁSTURSMÆLINGAR

### GREINARGERÐ

VERKNÚMER:	13330-001	DAGS:	2016-06-15
VERKÞÁTTUR:	01	NR.:	02
UNNIÐ FYRIR:	Kratus ehf.		
VERKEFNISSTJÓRI:	Birgir Tómas Arnar		
HÖFUNDUR:	Birgir Tómas Arnar	YFIRFARIÐ:	GþJ
DREIFING:	Haraldur Thorlacius, Kratus ehf., Guðjón Jónsson, VSÓ Ráðgjöf.		

Mælingar í útblæstri frá reykháfií verksmiðju Kratus ehf. á Grundartanga voru framkvæmdar þann 18. maí af starfsmönnum Verkís hf. Síur og díoxín var efnagreint á rannsóknarstofu Scientific Analysis Laboratories Ltd. (SAL) í Bretlandi.



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## 1 Inngangur

Verkís hf. í samstarfi við Rannsóknarþjónustuna Sýni ehf. tók að sér mælingar í útblæstri frá reykháfi verksmiðju Kratus ehf. á Grundartanga. Í reykháfnum var mældur hraði og hitastig útblásturslofts, rykmagn, og styrkur eftirfarandi efna: vetnisklóriðs (HCl), vetnisflúoríðs (HF), klórs (Cl<sub>2</sub>) og díoxín/fúrön.

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/m<sup>3</sup> svarar til eins rúmmetra af lofti við staðalaðstæður.

**Tafla 1.1 Niðurstöður mælinga í útblæstri frá loftræsireykháfi**

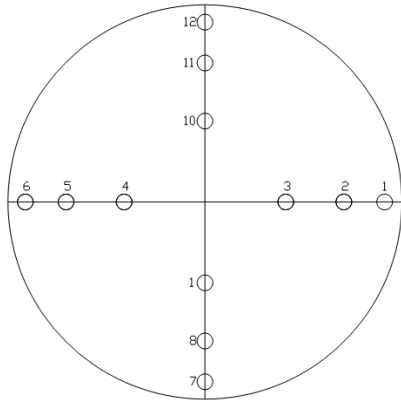
<b>Mælingar í útblæstri</b>				
<b>Mælipáttur</b>	<b>Mæligildi (meðaltöl)</b>	<b>Losunarmörk</b>	<b>Útstreymismagn</b>	<b>Tímasvið</b>
Rykmagn í útblæstri	17,7 mg/Nm <sup>3</sup>	20,0 mg/Nm <sup>3</sup>	0,4 kg/klst	2x30 mín
Vetnisklórið (HCl)	0,8 mg/Nm <sup>3</sup>	10,0 mg/Nm <sup>3</sup>	0,0 kg/klst	2x30 mín
Vetnisflúoríð (HF)	20,5 mg/Nm <sup>3</sup>	2,5 mg/Nm <sup>3</sup>	0,5 kg/klst	2x30 mín
Klór (Cl <sub>2</sub> )	114,4 mg/Nm <sup>3</sup>	1,0 mg/Nm <sup>3</sup>	2,8 kg/klst	2x30 mín
Díoxín /Fúrön (I-TEQ) (Sía #10 /XAD-2)	0,03 ng/Nm <sup>3</sup>	0,1 ng/Nm <sup>3</sup>	0,0 µg/klst	4x60mín
Hitastig mælibúnaðar	32°C	-	-	-
Hitastig útblásturslofts	51°C	-	-	-
Rakainnihald útblásturslofts	2,5%	-	-	-
Loftþrýstingur á mælistað	735,3 mmHg	-	-	-
Lofthraði útblásturslofts	9,8 m/s	-	-	-
Loftmagn	24.713 Nm <sup>3</sup> /klst	-	-	-

## 2 Mælingar

### 2.1 Mælingar í útblæstri frá reykháfi

#### 2.1.1 Hraðamælingar

Lofthraði var mældur í þversniði reykháfs í 12 punktum, sbr. mynd hér að neðan.



Tafla 2.1 Helstu kennistærðir reykháfs á mælistað

	<i>Stærðir</i>	<i>Eining</i>
Innra þvermál reykháfs	~1,05	m
Flatarmál reykháfs	0,87	m <sup>2</sup>

Tafla 2.2 Niðurstöður hraðamælingar

Pkt. nr.	Staða í rás (cm)	Staða í rás (% af þvermáli)	Hraðamæling [m/sek]
1	4,6	4,4	14,3
2	15,4	14,7	14,3
3	31,0	29,5	14,3
4	74,0	70,5	14,7
5	89,6	85,3	14,7
6	100,4	95,6	14,7
7	4,6	4,4	4,8
8	15,4	14,7	4,8
9	31,0	29,5	4,8
10	74,3	70,5	5,6
11	89,6	85,3	5,6
12	100,4	95,6	4,8
Meðalhraði:			<b>9,8</b>

**Raunloftflæði = 30.549 m<sup>3</sup>/klst**



### 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**

<i>Ryk í útblæstri</i>				
Mæliröð nr.	Mælt rykmagn	Ryk í síu	Tími	Rykmagn (þurrt)
1 (sía #20)	10,8 mg/Nm <sup>3</sup>	4,2 mg	12:00-12:30	11,1 mg/Nm <sup>3</sup>
2 (sía #21)	23,4 mg/Nm <sup>3</sup>	8,8 mg	13:00-13:30	24,2 mg/Nm <sup>3</sup>

### 2.1.3 Vetnisklóríð (HCl)

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

### 2.1.4 Vetnisflúoríð (HF)

Vetnisflúoríð var mælt samhliða rykmælingu og dregið í gegnum glerflösku með vökvalausn (0.1 M NaOH) og greint sem ryk í síum #20 og #21.

### 2.1.5 Klór (Cl<sub>2</sub>)

Klór var mælt samhliða rykmælingu og dregið í gegnum glerflösku með vökvalausn (H<sub>2</sub>SO<sub>4</sub>).

### 2.1.6 Díoxín/fúrön

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

### 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		
Mælipáttur	% nákvæmni	Mæliaðferð
Ryk	±15%	ISO 9096
TOC	±15%	-
HCl	±30%	EN 1911
HF	±20%	ISO 15713
CO	±5%	Skv. framleiðanda gasmælis
NO <sub>x</sub>	±5%	Skv. framleiðanda gasmælis
SO <sub>2</sub>	±5%	Skv. framleiðanda gasmælis
NH <sub>3</sub>	±20%	-
O <sub>2</sub>	±5%	Skv. framleiðanda gasmælis
Pungmálmur	±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

## NIÐURSTÖÐUR EFNA- OG ÖRVERUGREININGA

Sýni nr.: E-3746-16

**Gerð sýnis:** Síur  
**Sendandi:** Verkís  
**Sýnataka:** Verkís

**Móttakið:** 19.05.2016  
**Rannsað:** 19.05.2016  
**Verkkaupi:** Verkís v/ **Kratus**

Nr. sýnis	Merking sýnis	Þyngd fyrir notkun (g)	Þyngd eftir notkun (g)	Ryk (mg)
E-3746	Sía # 20	1.3869	1.3911	4,2
	Sía # 21	1.4441	1.4529	8,8

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

Reykjavík 23. maí 2016

*Erna Jónsdóttir*

Erna Jónsdóttir  
Líffræðingur

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.

Síða 1 af 1



# Scientific Analysis Laboratories Ltd

## Certificate of Analysis

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

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

**Report Number:** 572947-1

**Date of Report:** 06-Jun-2016

**Customer:** Verkis  
Ofanleiti 2  
103 Reykjavik  
Iceland

**Customer Contact:** . Birgir Arnar

**Customer Job Reference:**

**Date Job Received at SAL:** 25-May-2016

**Date Analysis Started:** 31-May-2016

**Date Analysis Completed:** 06-Jun-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



Report checked  
and authorised by :  
Mary Hughes  
Customer Service Manager

Issued by :  
Lauren Clarke  
Trainee Project Manager

SAL Reference: 572947						
Customer Reference:						
Filter Analysed as Filter						
Miscellaneous						
SAL Reference			572947 001	572947 002		
Customer Sample Reference			FILTER #20	FILTER #21		
Test Sample			AR	AR		
Determinand	Method	LOD	Units	Symbol		
Hydrogen Fluoride	IC (acetate separation method)	0.5	µg	N	(195) 5900	(195) 8600

SAL Reference: 572947						
Customer Reference:						
Impinger(DI water) Analysed as Impinger(DI water)						
Miscellaneous						
SAL Reference			572947 003	572947 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) 0.61	(13) 0.44
Volume	Vol	1	ml	U	40	41

SAL Reference: 572947						
Customer Reference:						
Impinger (sodium hydroxide) Analysed as Impinger (sodium hydroxide)						
Miscellaneous						
SAL Reference			572947 004	572947 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	0.17	0.70
Volume	Vol	1	ml	U	36	41

SAL Reference: 572947						
Customer Reference:						
Impinger (0.1N Sulphuric Acid) Analysed as Impinger (0.1N Sulphuric Acid)						
Miscellaneous						
SAL Reference			572947 005	572947 008		
Customer Sample Reference			CL2 1	CL2 2		
Test Sample			AR	AR		
Determinand	Method	LOD	Units	Symbol		
Chloride	IC	0.5	mg/l	N	(13,195) 93	(13,195) 62
Volume	Vol	1	ml	N	36	39

## Index to symbols used in 572947-1

Value	Description
AR	As Received
13	Results have been blank corrected.
195	Due to levels found in the sample that are outside of the normal calibration range of the instrument, analysis was conducted on a diluted sample
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited



# Scientific Analysis Laboratories Ltd

## Certificate of Analysis

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

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

**Report Number:** 572682-1

**Date of Report:** 10-Jun-2016

**Customer:** Verkis  
Ofanleiti 2  
103 Reykjavik  
Iceland

**Customer Contact:** . Birgir Arnar

**Customer Job Reference:**  
**Date Job Received at SAL:** 25-May-2016  
**Date Analysis Started:** 26-May-2016  
**Date Analysis Completed:** 10-Jun-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



Report checked  
and authorised by :  
Mary Hughes  
Customer Service Manager

Issued by :  
Lauren Clarke  
Trainee Project Manager

# Summary Of Results

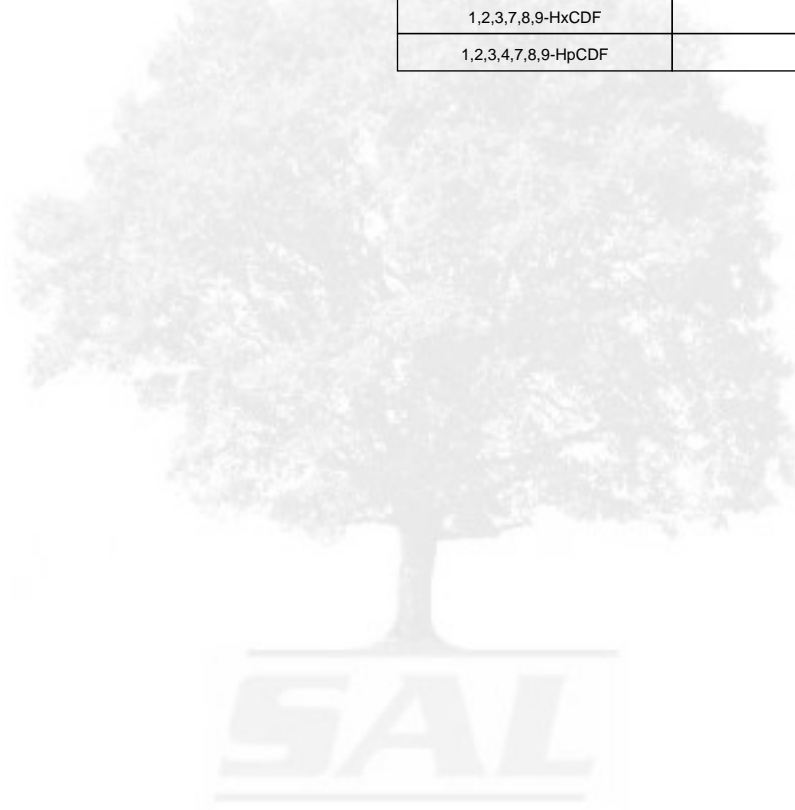
Composite (Filt, Trap, Wash)

Dioxins and Dioxin-like PCBs

SAL Reference	Customer Sample Reference	Analysis	Symbol	ITEQ Toxic Equivalents ng	
				Lower Bound	Upper Bound
572682 003	Combined FILTER #10 + XAD TRAP	Dioxins and Furans (BS EN 1948:06)	U	0.20	<b>0.20</b>
572682 006	Combined METHOD BLANK	Dioxins and Furans (BS EN 1948:06)	U	0.0	<b>0.0070</b>

## Sampling Recoveries

SAL Reference	Customer Sample Reference	Determinand	Sampling Recovery %
572682 003	Combined FILTER #10 + XAD TRAP	1,2,3,7,8-PeCDF	88
		1,2,3,7,8,9-HxCDF	101
		1,2,3,4,7,8,9-HpCDF	105



# Composite (Filt, Trap, Wash)

Customer Sample Reference : Combined FILTER #10 + XAD TRAP

SAL Sample Reference : 572682 003

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	0.0021	0.012	96	0.012	0.012
1,2,3,7,8-PeCDD	U	0.0019	0.086	103	0.043	0.043
1,2,3,4,7,8-HxCDD	U	0.0020	0.060	100	0.0060	0.0060
1,2,3,6,7,8-HxCDD	U	0.0022	0.11	91	0.011	0.011
1,2,3,7,8,9-HxCDD	U	0.0022	0.079		0.0079	0.0079
1,2,3,4,6,7,8-HpCDD	U	0.0041	0.43	78	0.0043	0.0043
OCDD	U	0.0058	0.44	69	0.00044	0.00044
<b>Dioxins Totals :</b>					0.085	0.085
2,3,7,8-TCDF	U	0.0020	0.098	100	0.0098	0.0098
1,2,3,7,8-PeCDF	U	0.0016	0.066		0.0033	0.0033
2,3,4,7,8-PeCDF	U	0.0016	0.12	125	0.060	0.060
1,2,3,4,7,8-HxCDF	U	0.0018	0.093	110	0.0093	0.0093
1,2,3,6,7,8-HxCDF	U	0.0022	0.098	92	0.0098	0.0098
2,3,4,6,7,8-HxCDF	U	0.0021	0.13	93	0.013	0.013
1,2,3,7,8,9-HxCDF	U	0.0021	0.038		0.0038	0.0038
1,2,3,4,6,7,8-HpCDF	U	0.0046	0.23	87	0.0023	0.0023
1,2,3,4,7,8,9-HpCDF	U	0.0046	0.029		0.00029	0.00029
OCDF	U	0.0049	0.053	81	0.00005	0.00005
<b>Furans Totals :</b>					0.11	0.11
<b>Totals :</b>					0.20	0.20

# Composite (Filt, Trap, Wash)

Customer Sample Reference : Combined METHOD BLANK

SAL Sample Reference : 572682 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	97	0.0	0.0020
1,2,3,7,8-PeCDD	U	0.0024	<0.0024	97	0.0	0.0012
1,2,3,4,7,8-HxCDD	U	0.0030	<0.0030	99	0.0	0.00030
1,2,3,6,7,8-HxCDD	U	0.0030	<0.0030	90	0.0	0.00030
1,2,3,7,8,9-HxCDD	U	0.0030	<0.0030		0.0	0.00030
1,2,3,4,6,7,8-HpCDD	U	0.010	<0.010	60	0.0	0.00010
OCDD	U	0.055	<0.055	60	0.0	0.00006
<b>Dioxins Totals :</b>					0.0	0.0043
2,3,7,8-TCDF	U	0.0020	<0.0020	101	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	105	0.0	0.0010
1,2,3,4,7,8-HxCDF	U	0.0030	<0.0030	82	0.0	0.00030
1,2,3,6,7,8-HxCDF	U	0.0030	<0.0030	84	0.0	0.00030
2,3,4,6,7,8-HxCDF	U	0.0030	<0.0030	81	0.0	0.00030
1,2,3,7,8,9-HxCDF	U	0.0030	<0.0030		0.0	0.00030
1,2,3,4,6,7,8-HpCDF	U	0.010	<0.010	60	0.0	0.00010
1,2,3,4,7,8,9-HpCDF	U	0.010	<0.010		0.0	0.00010
OCDF	U	0.010	<0.010	56	0.0	0.00001
<b>Furans Totals :</b>					0.0	0.0027
<b>Totals :</b>					0.0	0.0070



## Index to symbols used in 572682-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited

### Notes

Please Note: Due to volume sampled confirmation column analysis was not required.

