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Report

on

the performance of

**emission measurements
in the clean gas of an
electric arc furnace**

Facilities: **Electric arc furnace III**

Components: **PCDD/F**
PAH

Date of measurement: 24.06.2011

at

**Elkem Iceland
Grundartangi
Akranes
Iceland**

Client:	Elkem Iceland Grundartangi Akranes Iceland
Date of purchase order:	07.09.2011 by e-mail
Purchase order number:	not avaliable
ANECO - Project- / Report-No.:	11 0258/5 E
Project manager:	Mr. Dipl.-Ing. Jöckel
Adress of the measurement institute:	Wehnerstraße 1 - 7 41068 Mönchengladbach, Germany
Report contents:	15 + 1 pages annex
Date of report:	14.02.2013

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SUMMARY OF THE RESULTS:

Component	Dimension	value
Dioxins and Furans I-TEQ** according to NATO/CCMS	I-TEQ [ng/m³]*	0,00102
Polycyclic aromatic hydrocarbon according to EPA 610	[µg/m³]*	93,80

Component	Dimension	Value minus extended measurement uncertainty	Value plus extended measurement uncertainty
Dioxins and Furans I-TEQ** according to NATO/CCMS	[ng/m³]*	0,00051	0,00153
Polycyclic aromatic hydrocarbons according to EPA 610	µg/m³]*	46,90	140,70

Legend:

*) Values are stated at 273 K; 101.3 kPa, dry gas

**) I-TEQ: Toxic equivalency

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1. Specification of the measurement objective

1.1 Client:

Name:	Elkem
Street:	Grundartangi
City:	Akranes

1.2 Operator:

Name:	See point 1.1
Street:	See point 1.1
City:	See point 1.1
Coordinator:	Thorsteinn Hannesson

1.3 Location:

Plant:	Iron Smelter
Site:	Electric arc furnace

1.4 Date of the measurement:

This measurement:	24.06.2011
Previous measurement:	Not applicable
Following measurement:	void

1.5 Measurement components:

Components	***Number of measurements***
➢ ***Waste gas conditions***	
Moisture	1
➢ ***Continuous captured components***	
Temperature, air flow	Recorded for 6 hours
➢ ***Discontinuous captured, highly toxic, organic components***	
Polycyclic aromatic hydrocarbons (PAH according to EPA 610)	1 for 6 hours
Polychlorinated dibenzodioxins (PCDD) and Polychlorinated dibenzofurans (PCDF)	1 for 6 hours

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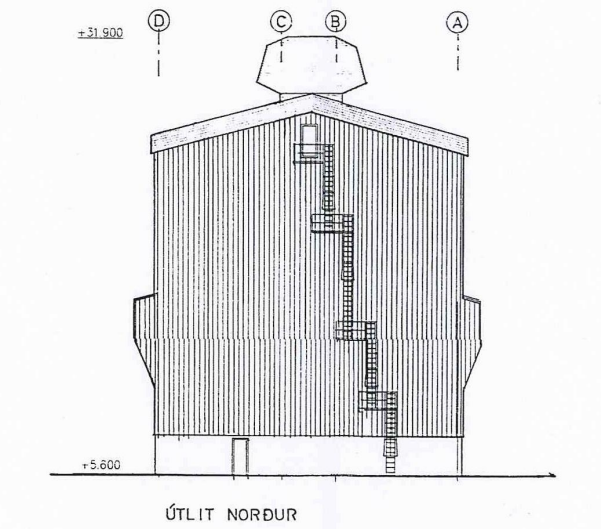
1.6 Deviations from EN-15259 and furter applicable guidelines:

The sample was taken directly on the outlet of the bag house filter at a height of 31,9 meters. Therefore it was not possible to determinate an reliable air flow which is necessary for an isocinetic sampling method according to EN-15259 respecticvely EN-1948.



In addition it was either not possible to perform an required grid measurement, on the one hand because of the extremely large cross section area of the outlet (approx. 116 m²) on the other hand for reasons of the workplace safety and health.

The measurement was performed on an aerial work platform as an one point measurement for 6 hours. So the results are not representative for the whole measurement area.

1.7 Measurement plan coordination:

The measurement program was coordinated with the operator.

1.8 Personnel involved in the measurements:

- Mr. Dipl.-Ing. Jöckel
- Mr. Peters

- Auxiliary workers: none

1.9 Participation of further institutes:

Analysis of PCDD/F samples mas GmbH, Münster. In addition, the mas GmbH also determined from these samples polycyclic aromatic hydrocarbons. This procedure was inter alia examined by comparative analysis (according to DIN EN 1948 and VDI 3874) at sampling-extracts.

1.10 Technical supervisor:

Mr. Dipl.-Chem. Robert

1.10.1 Telephone number of the institute:

+49 21 61 / 301 69-0

1.10.2 E-Mail:

robert@aneco.de

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2. Description of the plant and the materials handled

2.1 Type of plant:

Iron smelting plant

2.2 Description of the plant:

Elkem is located in the area of Grundatangi, Iceland, and operates three electric arc furnaces.

2.3 Description of the emission source:

2.3.1 Location:

See point 1.3

2.3.2 Emission source:

The main sources of the emission are the reactions taking place in the submerged electrical arc furnaces of the plant. The main reaction is a carbothermic reduction of silica and iron oxide.

The main axis of the outlet is 45° east of north

Height above ground:	[m]	31,9
Cross-sectional area of outlet:	[m^2]	116,2
Building design:		steel

2.4 Statement of raw materials possible according to the perm

The main raw materials are:

High volatile metallurgical coal
Reactive coke
Wood chips
Iron ore pellets
Quartz

2.5 Operating times:

2.5.1 Total operating time:

The total emission from each furnace for a given period of time is directly proportion to the energy used in the furnace for that period. The reference period, i.e. the period for the measurements was 6 hours and the average load for the furnace for that period was 45.85 MW. The energy used for the period was thus of 275,1 MWh. Accordingly one needs not take into consideration the operating time only the total energy used (in MWh)

2.5.2 Time of emission according to the operator:

Time of emission according to the operator:	Time of emission is equal to the total operating time

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2.6 Device for collecting and reducing the emissions:

2.6.1 Device for collecting the emissions:

2.6.1.1 Installations for collecting the emissions:

Closed system. There are no significant fugitive emissions.

2.6.1.2 Collection elements:

Ducts, fans, stack

2.6.1.3 Fan data:

There are two fans, each with the following specifications.

Manufacturer:		Flebu AS
Year:		1998
Typ:		BF L81/140
Nominal power:	[m³/h]	125.000
Pressure:	[kPa]	6,5
rotational speed:	[min^{-1}]	991
engine power:	[kW]	710

2.6.1.4 Suction area:

not applicable

2.6.2 Device reducing the emissions

2.6.2.1 Dry scrubber:

Manufacturer:		Elkem ASA (Elkem Materials)
Year:		1998
Typ:		Double line, pressure type
Number of filter chambers:		10
Number of tubes per chamber:		120
Filter Material:		Gore-tex / Glass fiber
filter area	[m^2]	10.240
Type of cleaning:		Pneumatic
cleaning cycle:	[sec.]	50

2.6.2.2 Zyklon:

Manufacturer:		Elkem ASA (Elkem Materials)
Year:		1998
Typ:		Radiclone, RCA 16000
Construction:		Single
Number of zyklons:		2 at each fan
Arrangment of zyklons:		Parallel
Diameter of zyklons:	[m]	4,35

2.6.3 Device cooling the waste gas: Not applicable

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3. Description of the sampling point:

3.1 Position of the measurement plane:

Installation:		Bag House Filter III
Height above ground:	[m]	31,9
Free inlet / outlet zone:	[m / m]	no analogous information possible
Geometric arrangment of the duct:		Vertical
Position reffered to fan:		behind fans

3.1.1 Accordance of the measurement plane with the technical regulations:

Requirement		**Source of emission**
Free waste gas inlet	≥ 5 x $d_{hydr.}$	not suffused
Free waste gas outlet	≥ 2 x $d_{hydr.}$	not suffused
Distance to the outlet-area	≥ 5 x $d_{hydr.}$	not suffused
Local negative flow		not determinable
Velocity profile		not determinable
Flow direction		not determinable
Minimumspeed		not suffused

3.2 Dimensions of the duct at the height of the measurement plane:

Dimensions:	[m]	Wide: 8,3 Length: 14,0
Cross-sectional area of the measurement plane	[m^2]	116,200

3.3 Number of measurement lines and position of the measurement points in the measurement plane

On encountered measurement cross-section the sampling could not performed in accordance with the requirements of EN-15259, clause 8.2.

It was not possible to perform an required grid measurement, on the one hand because of the extremely large cross section area of the outlet (approx. 116 m²) on the other hand for reasons of the workplace safety and health.

The measurement was performed on an aerial work platform as an one point measurement for 6 hours.
So the results are not representative for the whole measurement area.

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4. Measurement methods

4.1 Measurement methods for waste gas conditions

4.1.1 Flow velocity

Continous recorded measurement
Prandtl´s pitot tube featuring an electric micromanometer

Manufacturer:	SI - Special Instruments, Nördlingen
Model:	DIGIMA FP 19“
Measuring range:	Dynamic pressure: 0 - 1.000 Pa Static pressure: 0 - 1.000 Pa
Detection limit:	Dynamic pressure: 0,1 Pa Static pressure: 1 Pa
Signal outlet:	4 - 20 mA
Calibration:	Pressurecalibrator, Airflow; Model Kal 84 pressure calibrator
Last calibration:	03/2011
Recorded with:	Analog-Digitaltransformer
Model:	TRENDbus-Modul EA8-V/A
Recording and evaluation:	Trendows XP and Microsoft Excel

4.1.2 Static pressure in the duct

See point 4.1.1

4.1.3 Air pressure at the height of the sampling location

Barometer

Manufacturer:	Greisinger Electronic, Regenstauf
Model:	GPB 1300 / GPB 2300
Measuring range:	900 - 1.300 mbar
Detection limit:	900 mbar
Calibration:	Precisionbarometer, Ströhlein
Last calibration:	03/2011

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4.1.4 Waste gas temperature

Continous recorded measurement

Manufacturer:	TC Direct, Mönchengladbach
Model:	Mantelthermoelement Typ K
Geometry:	∅ 3 mm x 1.000mm
Measuring range:	0 - 1.100 °C
Signal outlet:	4 - 20 mA
Last calibration:	03/2011
Recorded with:	Analog-Digitaltransformer
Model:	TRENDbus-Modul EA8-V/A
Recording and evaluation:	Auswerte- und Erfassungsprogramm TRENDOWS Version XP in Verbindung mit Tabellenkalkulationsprogramm EXCEL.

4.1.5 Water vapour content in the waste gas (waste gas moisture)

Psychrometric determination according to the two-thermometer-method via NiCr/Ni-thermocouple

4.1.6 Waste gas density

Calculated under consideration of the following waste gas parameters:

➢ Oxygen (O_2) ➢ Carbon dioxide (CO_2) ➢ Air nitrogen calculated as residual gas (with 0,933 % Ar) ➢ Waste gas moisture ➢ Waste gas temperature ➢ Air pressure and static pressure in the duct

4.1.7 Waste gas cooling

not applicable

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4.2 Discontinous measurement methods:

4.2.1 Special highly toxic exhaust constituents:

4.2.1.1 Polychlorinated dibenzodioxins (PCDD) and polychlorinated dibenzofurans (PCDF) as well as polycyclic aromatic hydrocarbon (PAH according to EPA 610)

4.2.1.1.1 Measurement procedure / technical standards

Enhancing sampling based on EN 1948 -1 to -3 following the instructions of the „cooled suction pipe method“ under consideration of the VDI-guideline 2066, part 1 and 2.

4.2.1.1.2 Sampling devices:

Sampling probe and exhaust manifold	
Manufacturer / material:	Sonmet / Titanium
Particle filter	
Manufacturer	without
Extraction duct	
Building / length	Titanium in a water cooled, stainless steel duct / ca. 1,5 m plus 2 m adapion
Ab/Adsorption facilities:	
Condensat bottle:	Duran glass, 1.000 ml
Moisture eleiminator:	Impinger, Duran glass, 250 ml
2-ary adsorber section	
Step 1:	Glass cartridge with slotted supportplate, quartz filter, 50 mm diameter, (GF-10HY, Schleicher & Schüll) tamped with quartz wool
Step 2:	XAD-2 filled glass cartridge

Extraction device for component current
Modular system consisting extraction hoses, a stainless steel condensate separator (depending on the moisture content in the flue gas), drying tower containing spheric silica gel to precipitate residual moisture, rotameter (0 - 4 m³/h), pump (manufactured by Rietschle, model VTE 6) with bypass control, thermocouple (0 - 70 °C) for the determination of Teilgas temperature and a gas meter (manufactured by Pipersberg, model BK 2,5; reading accuracy 0,2 l). The assessment of suction rates for the individual extraction points in the measurement cross-section takes place on a laptop using the ANECO programme "Volumenstrom".

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The quartz wool was interlarded with the following PCDD/F sampling standards before the sampling:

Sampling standards:	
$^{13}C_{12}$-1,2,3,7,8,-PentaCDF:	400 pg
$^{13}C_{12}$-1,2,3,7,8,9-HexaCDF:	400 pg
$^{13}C_{12}$-1,2,3,4,7,8,9,-HeptaCDF:	800 pg

The adsorber was prepared and provided by the foreign laboratory **mas | münster analytical solutions gmbh**. The reconditioning and analysis was also carried out by **mas gmbh**, Münster.

4.2.1.1.3 Analytical determination:

4.2.1.1.3.1 Processing of the samples and extraction

Sampling probe
Rinse with acetone und toluene in the condensate tank following the individual measurement.With apparent scaling: also comminute and transfer for analysis, extraction in soxhlet together with XAD-2 resin, respectiveley content of dust
Condensate/scavenger:
Liquid/Liquid-extraction with toluene (at least 3 times), desiccate over sodium sulphate, filtration and separate soxhlet extraction of the desiccated residue with toluene/acetone when particulate material is present.
Quartz wool filter
Conveyence of the quartz-wool and the quartz filter in the XAD-cartridge and allowance of the following extraction standards:

PCDD:		PCDF:	
$^{13}C_{12}$-2,3,7,8-TetraCDD	400 pg	$^{13}C_{12}$-2,3,7,8-TetraCDF	400 pg
$^{13}C_{12}$-1,2,3,7,8-PentaCDD	400 pg	$^{13}C_{12}$-2,3,4,7,8-PentaCDF	400 pg
$^{13}C_{12}$-1,2,3,4,7,8-HexaCDD	400 pg	$^{13}C_{12}$-1,2,3,4,7,8-HexaCDF	400 pg
$^{13}C_{12}$-1,2,3,6,7,8-HexaCDD	400 pg	$^{13}C_{12}$-1,2,3,6,7,8-HexaCDF	400 pg
$^{13}C_{12}$-1,2,3,4,6,7,8-HeptaCDD	800 pg	$^{13}C_{12}$-2,3,4,6,7,8-HexaCDF	400 pg
$^{13}C_{12}$-1,2,3,4,6,7,8,9-OctaCDD	800 pg	$^{13}C_{12}$-1,2,3,4,6,7,8-HeptaCDF	800 pg
		$^{13}C_{12}$-1,2,3,4,6,7,8,9-OctaCDF	800 pg

XAD-2 cartridge
Collective extraction with the quatz wool and the quartz filter in the soxhlet with toluene acetone (for at least 20 h).The partial extracts were combined, confined and regulated with toluene to a predefined volume.

4.2.1.1.3.2 Processing and analysis of PCDD/F:

A fraction of normally 50 % of the complete extract was cleaned via column chomatogram at different adsorbent materials and respectively mixed with 400 pg $^{13}C_{12}$-1,2,3,4-TetraCDD and $^{13}C_{12}$-1,2,3,7,8,9-HexaCDD (peak standard) before the GC/HRMS-analysis in order to be able to determine the recovery rates of the previously inserted $^{13}C_{12}$-marked PCDD/F standards. The remaining fractions were deferred for potential secondary analysis or additional analysis of further organic flue gas contents.

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HRGC/MS-Analyse:	
Gas – chromatogram:	Trace GC Ultra
HRMS:	MAT 95 XP, Thermo Finnigan
HRGS/HRMS-conditions:	
Injection character:	PTV in the cold fed mode
Solvent:	n-nonane
GC-columns:	RTX-2330, 60 m, 0,25 mm ID, 0,1 µm Film; DB-5 MS, 60 m x 0,25 mm ID, 0,25 µm Film
Carrier gas:	Helium, 0,9 ml/min
Temperature program:	RTX-2330: 120°C, 4 min isotherm / with 30 °C/min to 210 °C, with 2°C/ min to 240°C, with 30 °C/min with 260 °C, 25 min isotherm DB-5 MS: 120°C 3,2 min isotherm, with 40 °C/min to 210 °C, 0,5 min isotherm, with 2,5°C / min to 270°C, with 20 °C/min to 320 °C, 8 min isotherm
Temperature of the transfer line:	250 °C
Source´s temperature:	250 °C
Dissolution:	ca. 10.000, EI (40 eV)
Reference substance:	PFTBA, FC 43
Detection mode:	MID mode, up to 3 masses per homologous groups, setting of time-slots

The 1,2,3,7,8- and 1,2,3,4,8- PentaCDF aswell as the 1,2,3,4,7,8- and 1,2,3,4,7,9-HexaCDF at RTX 2330 column as GC phase cannot be separated, as described in the literature. Therefore the corresponding cumulative values are stated, which are regarded as maximum values of the congeners with 2,3,7,8-Cl-substitution patterns.

4.2.1.1.3.3 Processing and GC/MS-analysis of the PAH:

After inserting the following deuterated standards - if applicable after previous purification via liquid/liquid extraction with N,N-dimethyl formamide / water compound - a fraction of 10 % of the toluene extract was cleaned via column chromatography and subsequently fed to the GC for the MS analysis:

D_{10}-acenaphthene
D_8-acenaphthylene
D_{10}-anthracene
D_{12}-benz(a)anthracene
D_{12}-benzo(b)fluoranthene
D_{12}-benzo(k)fluoranthene
D_{12}-benzo(ghi)perylene
D_{12}-benzo(a)pyrene
D_{12}-chrysene
D_{14}-dibenz(a,h)anthracene
D_{10}-fluoranthene
D_{10}-fluorene
D_{12}-indeno(1,2,3-cd)pyrene
D_8-naphthaline
D_{10}-phenanthrene
D_{10}-Pyrene

A GC/MS-System Trace GC Ultra / DSQ MS (manufactured byThermo Electron GmbH) was used for the analysis of the PAH.

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4.2.1.1.4 Method performance data:

Interferences:	The analysis via GC/MS is specific and permitted after a successful processing of the samples and exclusion of interferences.
Limit of quantitation:	The limits of quantification are stated together with the results.
Rate of uncertainty:	An inspection is carried out by - participation in intercomparison programmes - multiple determinations - application of secondary samples for the sake of precision - certified reference material - certified standards - increasements Additionally with PCDD/F: - longterm-reproducibility tests on a flue ash extract - self-determination of the method performance data in the method performance data through dual-determinations in the range of concentration 0,3 – 1,5 ng I-TEQ/m³ go to 6.3

4.2.1.1.5 Measures for quality assurance:

Leak test

Before starting measurement: gas flow by locked sampling apparature and maximal low pressure: < 0,05 m³/h

After completing measurement: gas flow by locked sampling apparature and maximal low pressure: < 0,05 m³/h

Gas meter:

Regular review of gas meters by means of recirculated gas meter
BK 2,5 (allowed deviation: < 2%)

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5. Operating state of the plant during the measurements

5.1 Production plant:

During the sampling period the furnace was on full, normal and stable operation, with the average load of 45.85 MW. The furnace produced 75% Ferro Silicon.
Raw material feeding was a normal small batch feeding and tapping of metal was normal, i.e. batch tapping every hour.

5.2 Waste gas purification units:

The bag house filter and the cyclones were in full and normal operation. The gas pressure into the filters was stable and normal, on the average 220 mmWG.
The temperature into the filters was also stable at 200 – 203°C.
Cleaning cycle was on auto, approximately 50 seconds.

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6. Summary of the results and discussion

6.1 Assessment of the operating conditions during the measurements

The iron smelter worked under normal conditions during the measurements.

6.2 Measurements results:

Plant Operator			**Elkem**			
Sampling Site			**Bag House Filter III**			
Flue gas component			**Polychlorinated dibenzodioxins (PCDD) and -furans (PCDF**			
Measuring No.			**1**			
Date			**24.06.2011**			
Measuring Time			**06:15-12:15**			
Sampling conditions						
Sampling volume (Reference condition	[m³/sample]		10,720	pressure, atmospheric [hPa]		1023
Sampling pressure	[hPa]		0			
Sampling temperature	[°C]		21			
Sampling volume (Standart conditions)	[m³*/sample]		10,053			
PCDF		**Analysis**		**Detection limits**		**Value**
		[ng/sample]		**[ng/sample]**	**[ng/m³*]**	**[ng/m³*]**
Sum of TetraCDF			0,28			0,0275
Sum of PentaCDF			0,09			0,0085
Sum of HexaCDF			0,03			0,0029
Sum of HeptaCDF			0,03			0,0027
OctaCDF			0,07			0,0072
Summe Tetra- bis OctaCDF			0,49	0,045	0,0045	0,0487
-2,3,7,8 -	TetraCDF		0,008	0,001	0,0001	0,0008
-1,2,3,7,8 (+ 1,2,3,4,8)-	PentaCDF		0,009	0,002	0,0002	0,0009
-2,3,4,7,8 -	PentaCDF		0,006	0,002	0,0002	0,0006
-1,2,3,4,7,8 (+ 1,2,3,4,7,9)-	HexaCDF		0,007	0,003	0,0003	0,0007
-1,2,3,6,7,8 -	HexaCDF		0,004	0,003	0,0003	0,0004
-1,2,3,7,8,9 -	HexaCDF	<	0,003	0,003	0,0003	< 0,0003
-2,3,4,6,7,8-	HexaCDF		0,005	0,003	0,0003	0,0005
-1,2,3,4,6,7,8 -	HeptaCDF		0,027	0,015	0,0015	0,0027
-1,2,3,4,7,8,9 -	HeptaCDF	<	0,015			< 0,0015
PCDD		**Analysis**		**Detection limits**		**Value**
		[ng/sample]		**[ng/sample]**	**[ng/m³*]**	**[ng/m³*]**
Sum of TetraCDD			0,296			0,0295
Sum of PentaCDD			0,150			0,0150
Sum of HexaCDD			0,060			0,0060
Sum of HeptaCDD		<	0,045			< 0,0045
OctaCDD		<	0,045			< 0,0045
Sum of Tetra- bis OctaCDD			0,507	0,045	0,0045	0,0504
-2,3,7,8-	TetraCDD		0,001	0,001	0,0001	0,0001
-1,2,3,7,8 -	PentaCDD		0,003	0,002	0,0002	0,0003
-1,2,3,4,7,8 -	HexaCDD	<	0,003	0,003	0,0003	< 0,0003
-1,2,3,6,7,8 -	HexaCDD	<	0,003	0,003	0,0003	< 0,0003
-1,2,3,7,8,9 -	HexaCDD	<	0,003	0,003	0,0003	< 0,0003
-1,2,3,4,6,7,8 -	HeptaCDD	<	0,015	0,015	0,0015	< 0,0015
I-Teq (TE after NATO / CCMS) incl. LDI			**0,0102**			**0,0010**
I-Teq (TE after NATO / CCMS) excl. LDI			**0,0087**			**0,0009**
Determination of the recovery rates of						
^{13}C -1,2,3,7,8-PentaCDF / ^{13}C -1,2,3,7,8,9-HexaCDF / ^{13}C -1,2,3,4,7,8,9-HeptaCDF [%]						109 / 113 / 107

undetectable congeners are not included in total summation

* = 273 K, 1013 hPa, dry flue gas

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Plant Operator		**Elkem**			
Sampling Site		**Bag House Filter III**			
Flue gas component		**PAH according to EPA 610**			
Measuring No.		**1**			
Date		**24.06.2011**			
Measuring Time		**06:15-12:15**			
Sampling conditions					
Sampling volume (Reference condition	[m³/sample]	10,720	Luftdruck	[hPa]	1023
Sampling pressure	[hPa]	0			
Sampling temperature	[°C]	21			
Sampling volume (Standart conditions)	[m³*/sample]	10,053			

PAH-Measurement 1:	**Analysis**	**Detection limits**		**value**
	[µg/Probe]	**[µg/Probe]**	**[µg/m³*]**	**[µg/m³*]**
Naphthalin	393,20	0,03	0,003	39,114
Acenaphthylen	147,84	0,01	0,001	14,707
Acenaphthen	0,64	0,01	0,001	0,064
Fluoren	19,47	0,01	0,001	1,936
Phenanthren	149,82	0,02	0,002	14,904
Anthracen	10,82	0,01	0,001	1,076
Fluoranthen	114,96	0,01	0,001	11,436
Pyren	81,51	0,01	0,001	8,108
Benz(a)anthracen	4,15	0,01	0,001	0,413
Chrysen	8,33	0,01	0,001	0,829
Benzo(b/j)fluoranthen	8,10	0,01	0,001	0,806
Benzo(k/j)fluoranthen	2,35	0,01	0,001	0,234
Benzo(a)pyren	0,23	0,01	0,001	0,022
Dibenz(a,h)anthracen	0,01	0,01	0,001	0,001
Benzo(ghi)perylen	0,78	0,01	0,001	0,078
Indeno(1,2,3-cd)pyren	0,74	0,01	0,001	0,074
Sum after EPA excl. Detection limits	**942,95**			**93,802**
Sum after EPA incl. Detection limits	**942,95**			**93,802**

* = 273 K, 1013 hPa, dry flue gas

6.3 Measurement uncertainty:

extendend measuremnet uncertainty according to VDI 4219

Component	relativ measurement uncertainty	way of determination	value Y_{max}	measurement uncertainty U_p	Value $^{+}/_{-} U_p$ $Y_{max}+U_p$	$Y_{max}-U_p$	
Dioxins and Furans I-TEQ according to NATO/CCMS	50 %	A	0,00102	0,00051	0,00153	0,00051	[ng/m³]*
Polycyclic aromatic hydrocarbon according to EPA 610	50 %	A	93,80	46,90	140,70	46,90	µg/m³]*

* = 273 K, 1013 hPa, dry flue gas
Values < detection limit are calculated in this table
[A] Determination according to VDI 4219 (indirect approach)
[A] Determination according to VDI 4219 (direct approach)

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Mönchengladbach, 14.02.2013 Jö/PS

Technical supervisor

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Project manager:

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ANNEX

WASTE GAS CONDITIONS

For further calculations, the flow was considered by the two fans per 125.000 m³/h = 250.000 m³/h.