Emission measurements at cremation installation Geleen

DFW

October 9, 2019

Responsibility

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Project number	1271511
Number of pages	48
Date	October 9, 2019

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Summary

In assignment of DFW Europe B.V. as part of the completion of the electric cremator with abatement system (DFW Electric), Tauw conducted an emission study at cremation installation Geleen.
The measurements were performed on 20 and 21 June 2019.

The aim of the research is to test the measured values against emission limit values.
A distinction is thereby made to the limit values according to Dutch Regulations. These limit values have been drawn up for gas-fired cremation installations, where the emissions are based on 11% O_2.
In Germany, the 27 BImSchV sets requirements for electric cremation installations. The emission limit values from this directive are based on 15% O_2. In the UK the PG5 sets requirements for electric cremation installations based on 15% O_2.

This report tests against the general requirements from the Dutch emission regulations and the requirements from 27 BImSch and PG5.

The following components are involved in the emission study:

- Dust
- Mercury (Hg)
- Dioxins
- CO
- HCl
- SO_2
- NO_x

The tables below show the result of the investigation with a check against the requirements of the German BImSchV , PG5 from the UK and the Dutch emission Regulations.

Table 0.1 *Testing against the emission limit values 27 BIschV*

Component	Unit	Average concentration	Value to be Reviewed corrected for uncertainty	Emission Limit value 27 BImSchV	Review
dust	[mg/m$^3_{o\ 15\ vol.-\%}$]	0,6	< 0,5	10	Satisfies
dioxins	[ng/m$^3_{o\ 15\ vol.-\%}$]	< 0,01	n.a.[1]	0,1	Satisfies
Hg	[mg/m$^3_{o\ 15\ vol.-\%}$]	< 0,002	n.a.[1]	n.a.	Satisfies
CO	[mg/m$^3_{o\ 15\ vol.-\%}$]	18	16	50	Satisfies

Table 0.2 *Testing against the emission limit values PG5*

Component	Unit	Average concentration	Value to be Reviewed corrected for uncertainty	Emission Limit value PG5	Review
dust	[mg/m$^3_{o\ 15\ vol.-\%}$]	0,6	< 0,5	20	Satisfies
dioxins	[ng/m$^3_{o\ 15\ vol.-\%}$]	< 0,01	n.a.[1]	0,1	Satisfies
Hg	[ug/m$^3_{o\ 15\ vol.-\%}$]	< 0,002	n.a.[1]	50	Satisfies
CO	[mg/m$^3_{o\ 15\ vol.-\%}$]	18	16	100	Satisfies
CO	[g/h]	18	18	150*/300**	Satisfies
HCl	[mg/m$^3_{o\ 15\ vol.-\%}$]	3,5	2,6	30	Satisfies

**For the first hour of cremation for 95 % of the cremations*

***For the first hour of cremation for 100 % of the cremations*

Table 0.3 *Dutch emission regulations: massflow emission*

Component	unit	Maximal average massflow	Value to be reviewed corrected for uncertainty	Emission Limit value Dutch regulations (massflow limit MFL)	Review
dust	g/h	< 0,6	< 0,5	200	< MFL
dioxins	mg TEQ /year	< 1 E^{-5}	< 1 E^{-5}	20	< MFL
Hg	g/h	0,002	0,002	0,25	< MFL
HCl	g/h	2,5	2,5	15	< MFL
SO_2	g/h	4,5	4,5	2000	< MFL
NO_x als NO_2	g/h	168	168	2000	< MFL

If there is an exceedance of the mass flow limit, a concentration requirement is applicable.
A concentration requirement always applies for dust.

[1] Not applicable because average is lower than reporting limit

Table 0.3 *Activity Decree concentration review at limit value at 15 % O_2 and 11 % O_2*

Component	Unit	Average concentration	Value to be reviewed	Emission Limit value Dutch regulations	Review
dust	[$mg/m^3_{o\ 15\ vol.\ -\%}$]	0,6	< 0,5	20	Satisfies

Component	Unit	Average concentration	Value to be reviewed	Emission Limit value Dutch regulations	Review
Dust	[$mg/m^3_{o\ 11\ vol.\ -\%}$]	1,1	< 0,5	20	Satisfies

The investigation shows that on the measurement days there is no exceeding of the limit values from the German 27 BImSchV, the PG5 from the UK and the Dutch emission regulations.

1 Introduction

In assignment of DFW Europe B.V. as part of the completion of the electric crematior with abatement system (DFW Electric), Tauw conducted an emission study at cremation installation Geleen.
The measurements were performed on 20 and 21 June 2019.

1.1 Client details

Company Name: DFW Europe B.V.
Address: Dulleweg 43
1721 PM Broek op Langedijk
Contact person: Desiree van den Haak

1.2 Purpose of the investigation

The aim of the research is to test the measured values against emission limit values.
A distinction is thereby made to the limit values from the Dutch emission regulations. These limit values have been drawn up for gas-fired cremators, where the emissions are based on 11% O_2.

In Germany, the 27 BImSchV sets requirements for electric cremation installations. The emission limit values from this directive are based on 15% O_2.
In the UK the PG5 sets requirements for electric cremation installations based on 15% O_2.

This report tests against the general requirements from the Dutch emission regulations and the requirements from the German 27 BImSch and the PG5 from the UK.

The following components are involved in the emission study:

Dust
Mercury (Hg)
Dioxins
CO
HCl
SO_2
NO_x

The abbreviations and terms used are explained in Appendix 1

1.3 Changes compared to the previous version

This is not applicable as this is a first version.

2 Design and implementation of the research

This chapter describes the design of the study and describes the performance of the measurements.

2.1 Implementation

Table 2.1 indicates which components are involved in the study. The measurements were taken over 3 cremation. At each cremation two half hour measurements are done.

Table 2.1 *Measuring programme*

Component	Measurement method	RvA	Analysis method	RvA
Flow	NEN-EN-ISO 16911-1	Q	-	-
Sample gasconditioning	NEN-ISO 10396	Q	-	-
Review plane	NEN-EN 15259	Q	-	-
Temperature	ISO 8756	Q	-	-
Moisture	NEN-EN 14790	Q	-	-
O_2	NEN-EN 14789	Q	-	-
HCl	NEN-EN 1911	Q	EN-ISO 10304-1	Q
Dioxins and furans (PCDD / PCDF)	NEN-EN 1948-1	Q	EN 1948-2/3	Q
CO	NEN-EN 15058	Q	-	-
Hg	NEN-EN 13211	Q	destruction: own method Analysis:EN 13211	Q Q
NO_X as NO_2	NEN-EN 14792	Q	-	-
Dust	NEN-EN 13284-1	Q	-	-
SO_2	NEN-ISO 7935	Q	-	-

The implementation of the measurements is described in detail in Appendix 2.

2.2 Outsourcing

Analysis of the samples are outsourced to AL-West B.V. in Deventer. AL-West is accreditated for analysis of air samples by the Dutch Accreditation Council (RvA) in accordance with NEN-EN-ISO / IEC 17025. Table 2.1 indicates with a Q which laboratory operations are covered by the accreditation.

3 Quality

Tauw is accredited by the Accreditation Council (RvA) for performing air measurements in accordance with NEN-EN-ISO / IEC 17025. All equipment used by Tauw is calibrated and traceable to (inter) national standards. Table 2.1 indicates with a Q which transactions are covered by the accreditation. For a copy of the accreditation certificate, reference is made to Appendix 6**.**

3.1 Deviations from the standard

In this section deviations from the standard are given, indicating what the influence of this can be on the measured value. There are no deviations from the standard.

3.2 Blank criteria

For mercury and HCl, a field blank was taken prior to the measurement. If the results of the measurements taken are below the reporting limit of the relevant component, the analysis of the blank has no added value and this analysis will not take place. For the field blank, the concentration in the field blank may not exceed 10% of the standard emission limit value (as stated in the Activities Decree Article 5.19). If this value is exceeded, the measurement must be rejected. In the case of dust, a field blank is taken at every measurement series, per measurement location, prior to the measurements. A leakage test is also carried out during the blanking test, so that any dust present in the measuring equipment on the filter is collected. The blank filter undergoes the same treatments as the sample filters taken. The blank is not corrected. The criterion for the blank is a maximum of 10% of the emission limit value. If the emission limit value is ≤ 5 mg / Nm^3 (or no emission limit value applies), the blank criterion is 0.5 mg / Nm3.This method is based on the specific accreditation protocol (SAP L001) as drawn up by the Dutch Accreditation Council (RvA) for the implementation of air emission measurements. This specific accreditation protocol (SAP L001) is published on the website of the RvA (www.rva.nl).

3.3 Breakdown criteria

For mercury a decisive step has been taken per partial measurement. If the measured concentration in the first impinger (s) is lower than the reporting limit, it is not necessary to analyze the breakdown and this analysis will not take place. If the analysis result is ten times higher than the detection limit, a criterion is used for breakdown (capture efficiency). The applied criterion is stated in table 3.1.

Table 3.1 *Breakdown criteria*

Component	Maximal breakdown [%]	breakdown [µg/Nm^3]
Hg[2]	5	2
other components	5	-

[2] For mercury a percentage of 5% applies with a minimum of 2 [µg/Nm^3]

In the event of breakdown, the concentration found is reported as greater than or rejected. This method is based on the specific accreditation protocol (SAP L001) as drawn up by the Dutch Accreditation Council (RvA) for the implementation of air emission measurements. This specific accreditation protocol (SAP L001) is published on the website of the RvA (www.rva.nl).

3.4 Leak testing

To check whether the measuring set-up is leak-tight, Tauw carries out a check for each measuring set-up prior to the measurement. Tauw uses a 2% criterion for this check, in accordance with NEN-EN 13284. No leak was found during the checks carried out prior to the measurement. The difference between the gas meter reading before and after the leak test was 0 litres.

Prior to the measurement, the sampling probe is supplied with 100 [vol .-%] nitrogen under atmospheric conditions in order to test the entire measuring system for leak-tightness. For the oxygen monitor, a maximum level of 0.2 [vol.%] Oxygen to be measured applies. The measured difference may not exceed 2%. No leak was found during the tests carried out.

4 Process conditions

Specific process conditions, which could have influenced the results of the investigation, are mentioned in this section.

The measurements were made during representative operating conditions for the electric cremator (Source: DFW).It should be noted that for the purpose of the experiment an Hg dosage has taken place by placing an ampoule containing a fixed amount of Hg.

The process times and temperature set points are as follows.

Geleen *Setpoints*

process	1		2		3		setpoints temperature °C	
date	start	end	start	end	start	end	Main chamber	Secundary chamber
20-6-2019	12:20	14:18	17:08	18:41			650	750
21-6-2019					10:57	12:43	650	800

5 Results

The results are calculated under normalized conditions (0 [° C], 101.3 [kPa], dry waste gas, with current oxygen and an oxygen content of 15 and 11 [% by volume], respectively). It is noted that Tauw uses reporting limits, in connection with the measurement uncertainty of the measurement (see appendix 4). Lower concentrations (or detection limits) may be specified in the appendix (s).

5.1 Results measurement plane assessment

For the complete measuring surface assessment, reference is made to Appendix 3.

5.2 Results blank and breakdown

Appendix 9 shows the results of the blanks and breakdowns taken.• In none of the cases did the result of the blank give rise to rejection of the measurement• In none of the cases did the result of the breakdown lead to a report of the result as "greater than".

5.3 Results

The measurement results are given in the tables below. The off-gas characteristics are listed in Appendix 7. Appendix 8 shows the underlying measurement data. The analysis certificates are included in Appendix 9.

Table 5.1 *Results emission concentration measurements during 3 cremation processes at 15% O_2*

Component Oven Temperature	Unit [oC]	cremation 1 750	cremation 2 750	cremation 3 800
Date	[dd-mm-jjjj]	20-6-2019	20-6-2019	21-6-2019
Time start	[hr:mm]	12:20	17:08	10:57
Time end	[hr:mm]	14:18	18:41	12:43
O_2	[vol.-%]	14,2	15,7	15,7
Dust	[mg/Nm^3]	0,7	< 0,5	0,5
	[mg/m$^3_{o\ 15\ vol.-\%}$]	0,6	< 0,5	0,6
Dioxins	[ng TEQ /Nm^3]	< 0,01	< 0,01	< 0,01
	[ng TEQ/m$^3_{o\ 15\ vol.-\%}$]	< 0,01	< 0,01	< 0,01
HCl	[mg/Nm3]	< 0,3	3,1	1,4
	[mg/m$^3_{o\ 15\ vol.-\%}$]	< 0,3	3,5	1,6
Hg	[mg/Nm^3]	< 0,002	0,003	< 0,002
	[mg/m$^3_{o\ 15\ vol.-\%}$]	< 0,002	0,003	< 0,002
CO	[mg/Nm^3]	0,4	11,9	16,0
	[mg/m$^3_{o\ 15\ vol.-\%}$]	0,3	13,5	18,1
SO_2	[mg/Nm^3]	4,6	4,2	4,0
	[mg/m$^3_{o\ 15\ vol.-\%}$]	4,1	4,7	4,5
NO_x als NO_2	[mg/Nm^3]	139	93	147
	[mg/m$^3_{o\ 15\ vol.-\%}$]	123	106	167

Table 5.2 *Results emission concentration measurements during 3 cremation processes at 11 % O_2*

Component Oven Temperature	Unit [oC]	measurement 1 750	measurement 2 750	measurement 3 800
Date	[dd-mm-jjjj]	20-6-2019	20-6-2019	21-6-2019
Time start	[hr:mm]	12:20	17:08	10:57
Time end	[hr:mm]	14:18	18:41	12:43
O_2	[vol.-%]	14,2	15,7	15,7
Dust	[mg/Nm^3]	0,6	< 0,5	0,6
	[mg/m$^3_{o\ 11\ vol.-\%}$]	0,9	< 0,5	1,1
Dioxins	[ng TEQ /Nm^3]	< 0,01	< 0,01	< 0,01
	[ng TEQ/m$^3_{o\ 11\ vol.-\%}$]	< 0,01	< 0,01	< 0,01
HCl	[mg/Nm3]	< 0,3	3,1	1,4
	[mg/m$^3_{o\ 11\ vol.-\%}$]	< 0,3	5,9	2,7
Hg	[mg/Nm^3]	< 0,002	0,003	< 0,002
	[mg/m$^3_{o\ 11\ vol.-\%}$]	< 0,002	0,006	< 0,002
CO	[mg/Nm^3]	0,4	11,9	16,0
	[mg/m$^3_{o\ 11\ vol.-\%}$]	0,6	22,6	30,3
SO_2	[mg/Nm^3]	4,6	4,2	4,0
	[mg/m$^3_{o\ 11\ vol.-\%}$]	6,8	7,9	7,5
NO_x als NO_2	[mg/Nm^3]	139	93	147
	[mg/m$^3_{o\ 11\ vol.-\%}$]	205	176	279

According to the Dutch emission regulations, emissions must be presented as half-hourly averages. Reports R001-1271511V01 and R002-1271511V01 show these half-hourly resources for the components that are applicable within the activity decree (dust and Hg) with measured values based on 11% and 15% respectively.

Table 5.1 *Emission massflow*

Component	Unit	measurement 1	measurement 2	measurement 3
Oven Temperature	[oC]	750	750	800
Date	[dd-mm-jjjj]	20-6-2019	20-6-2019	21-6-2019
Time start	[hr:mm]	12:20	17:08	10:57
Time end	[hr:mm]	14:18	18:41	12:43
Dust	[g/h]	0,6	< 0,6	0,6
Dioxins	[mg(TEQ/h]	< 1^{E}-05	< 1^{E}-05	< 1^{E}-05
HCl	[g/h]	0,32	2,5	1,6
Hg	[g/h]	< 0,002	0,002	< 0,002
CO	[g/h]	0,4	9,8	18,2
SO_2	[g/h]	4,4	3,4	4,5
NO_x als NO_2	[g/h]	132	76	168

The residence time of gases in the oven is 2.4 seconds at a flue gas flow rate of 4044 m^3 / h at 750 ^oC and an oven volume of 2.65 m^3.

In accordance with the Dutch emission regulations, the following applies to a gas-fired cremator: for a good and complete combustion, the waste gases in the post-combustion chamber must have a residence time of at least 1.5 seconds.
The temperature of the flue gases must always be higher than 800 °C. For this the burner must be equipped with an automatic control. The cremation installation must continuously monitor the oxygen content and temperature because these parameters indicate whether the cremation oven is functioning properly. The oxygen content in the after-burning room must be at least 6%.

A short-term exceedance is permitted, but may not be lower than 3% and not longer than 1 minute.
Six months after commissioning and annually the proper functioning of the installation must be checked by an expert, for example an installer.
This is the cremator including the abatement installation.
This electric cremator meets the O_2 requirement (O_2 => 13.7%) and the residence time requirement (2.4 seconds).The oven can be set at a lower temperature than a gas-fired cremator because the emissions of dioxins, dust, Hg, HCl, CO, NO_x meet the Dutch, UK and German limit values.

6 Review

In this chapter the measurement results presented in chapter 5 are tested against the emission limit values for the relevant components from the German BImschV, the UK PG5 and the Dutch emission regulations.

The 95% confidence interval is calculated for the average measured emission concentration per emission component. The lower value of the 95% confidence interval (value to be tested) has been compared with the emission limit values. Appendix 4 provides an explanation of the measurement inaccuracies used by Tauw.

Table 6.1 *Testing against the emission limit values 27 BIschV*

Component	Unit	Average concentration	Value to be reviewed	Emission Limt value 27 BImSchV	Review
Dust	[mg/m$^3_{o\ 15\ vol.\ -\%}$]	0,6	< 0,5	10	Satisfies
Dioxins	[ng/m$^3_{o\ 15\ vol.\ -\%}$]	< 0,01	na.[3]	0,1	Satisfies
Hg	[mg/m$^3_{o\ 15\ vol.\ -\%}$]	< 0,002	na.[3]	na	Satisfies
CO	[mg/m$^3_{o\ 15\ vol.\ -\%}$]	18	16	50	Satisfies

Table 6.2 *Testing against the emission limit values PG5*

Component	Unit	Average concentration	Value to be Reviewed Corrected for uncertainty	Emission Limt value PG5	Review
Dust	[mg/m$^3_{o\ 15\ vol.\ -\%}$]	0,6	< 0,5	20	Satisfies
Dioxins	[ng/m$^3_{o\ 15\ vol.\ -\%}$]	< 0,01	n.a.[3]	0,1	Satisfies
Hg	[ug/m$^3_{o\ 15\ vol.\ -\%}$]	< 0,002	n.a.[3]	50	Satisfies
CO	[mg/m$^3_{o\ 15\ vol.\ -\%}$]	18	16	100	Satisfies
CO	[g/h]	18	18	150*/300**	Satisfies
HCl	[mg/m$^3_{o\ 15\ vol.\ -\%}$]	3,5	2,6	30	Satisfies

**For the first hour of cremation for 95 % of the cremations*

***For the first hour of cremation for 100 % of the cremations*

[3] Not applicable because average is lower than reporting limit

Table 6.3 *Dutch emission regulations: massflow*

Component	unit	Maximal average massflow	Value to be reviewed	Emission Limit value Dutch emission regulations (massflow limit MFL)	Review
Dust	g/h	< 0,6	< 0,5	200	< MFL
Dioxins	mg TEQ /year	< 1 E^{-5}	< 1 E^{-5}	20	< MFL
Hg	g/h	0,002	0,002	0,25	< MFL
HCl	g/h	2,5	2,5	15	< MFL
SO_2	g/h	4,5	4,5	2000	< MFL
NO_x als NO_2	g/h	168	168	2000	< MFL

If there is an exceedance of the mass flow limit, a concentration requirement is applicable.
A concentration requirement always applies for dust.

Table 6.4 *Dutch emission regulation: concentration review at limit value at 15 % O_2 and 11 % O_2*

Component	Unit	Average concentration	Value to be reviewed	Emission Limit value Activitity Decree	Review
Dust	[$mg/m^3_{o\ 15\ vol.-\%}$]	0,6	< 0,5	20	Satisfies

Component	Unit	Average concentration	Value to be reviewed	Emission Limit value Activitity Decree	Review
Dust	[$mg/m^3_{o\ 11\ vol.-\%}$]	1,1	< 0,5	20	Satisfies

The investigation shows that on the measurement days there is no exceeding of the limit values from the 27 BImSchV, the PG5 and the Dutch emission regulations.

Appendix 1 Explanation of abbreviations and terms used

abbreviation	Explanation
BI	Confidence interval
°C	Degrees Celsius
dd	Day
Dh	Hydraulic diameter (4 x surface measuring surface / circumference measuring surface)
EGW	Emission limit value
jjjj	Year
K	Kelvin
m^3	Cubic meter (operating conditions)
m^3_o	Cubic meter, based on standard conditions; 0 [° C], 101.3 [kPa] with dry waste gas corrected for plant specific oxygen content
mg	Milligram
mm	Minute / month
n.a.	Not applicable
Nm^3	Cubic meter, based on standard conditions; 0 [° C], 101.3 [kPa] with dry waste gas (actual oxygen)
O_2	Oxygen
Pa	Pascal
Q	Operation falls under RvA accreditation
RvA	Dutch Accreditation Council
hr / h	Hour
VKL	Association of Air Measurement Quality
vol.-%	Volume percent

Appendix 2 Overview of the measurement and analysis methods used

Sample conditioning

Determination method	NEN-ISO-10396, heated lance (titanium) with heated take-off filter and heated measuring gas pipe (inner pipe: PTFE). The system is set to a temperature of 180 ° C. The measuring gas line is connected to a cooler (approximately 4 ° C)
Connection to stack	Standard flange
Tauw.Leak testing	Prior to the measurements, a leak test was performed in accordance with standard Tauw working instructions.

Nitrogen oxides (NOx)

Determination method	NEN-EN 14792
Principle	Chemoluminescence
Interferents:	CO_2 (> 30 [vol%]), this is not applicable here H_2O (no influence on measured value due to the use of cooler) NH_3 0.1% of the range at 20 mg / Nm^3 NH_3
Analyzer type	42C HL
Manufacturer	Thermo Electron
Converter efficiency	> 95%
Response time	<200 [s]
Datalog	frequency 60 [s]
Calibration	The monitors are calibrated with an (inter) nationally traceable gas.
Check with control gas	Prior to the measurements, the monitor was checked with control gases (zero and span). The gases used by Tauw can be traced to (inter) national standards.
Drift	After the measurement, the monitor was checked with control gases (zero and span). The drift over the specified zero and span points is determined and these should be ≤ 5% of the set span value.

Oxygen (O2)

Determination method	NEN-EN 14789
Principle	paramagnetism
Type of analyzer	Servomex MiniMP 5200 / 410i / Xentra 4900
Manufacturer	Servomex / Thermo Electron
Measuring range	0 - 25 [vol.%]
Response time	<200 [s]
Datalog frequency	60 [s]
Calibration	The monitors are calibrated and adjusted with (for zero) nitrogen (5.0) used and (for the clamping point) dried outside air (20.95 [vol.%]).
Check with control gas	Prior to the measurements, the monitor was checked with a control gas. The deviation may amount to a maximum of 0.20 [vol.%].
Drift	After the measurement, the monitor was checked with zero and span gas. The drift over the specified zero and span points is determined, and these should be ≤ 5 [%] of the set span value.

Carbon monoxide (CO)

Determination method	NEN-EN 15058
Principle	gas filter correlation
Analyzer type	48C HL
Manufacturer	Thermo Electron
Response time	<200 [s]
Datalog frequency	60 [s]
Calibration	The monitors are calibrated with an (inter) nationally traceable gas.
Control with control gas	Prior to the measurements, the monitor was checked with control gases (zero and span). The gases used by Tauw are traceable to (inter) national standards.
Drift	After the measurement, the monitor was checked with control gases (zero and span). The drift over the specified zero and span points is determined and these should be ≤ 5% of the set span value.

Sulfur dioxide (SO2)

Determination method	NEN-ISO 7935
Basically	pulsed fluorescence
Analyzer type	43C
Manufacturer	Thermo Electron
Response time	<200 [s]
Datalog frequency	60 [s]

Calibration	The monitors are calibrated with an (inter) nationally traceable gas.
Check with control gas	Prior to the measurements, the monitor was checked with control gases (zero and span). The gases used by Tauw can be traced to (inter) national standards.
Drift	After the measurement, the monitor was checked with control gases (zero and span). The drift over the specified zero and span points is determined and these should be ≤ 5% of the set span value.

Discontinuous measurements:

General:	For all components, the sampling takes place at the traverse points (NEN-EN 15259). The sampling parts are made of titanium, PTFE or glass. The following provisions can be combined.
Flow rate	Determination method NEN-EN-ISO 16911-1
Principle	pressure difference
Measurement	S-pitot analyzer type
Measuring range	0 - 2,500 [Pa]
Measuring plane assessment	
Determination method	NEN-EN 15259
Execution	Criteria are checked with a thermocouple, a pitot and a precision pressure gauge.
Dust	
Determination method	NEN-EN 13284-1
Execution	A partial flow of the waste gas is isokinetically extracted and passed over a dust filter (quartz).
Analysis method	NEN-EN 13284-1
Temperature	
determination method	ISO 8756
Principle	thermocouple
analyzer type	Type K
Measuring range	-200 - 1,370 [° C]
Water (H2O)	
Determination method	NEN-EN 14790
Execution	Here, a partial flow of the off-gas is suctioned isokinetically heated and passed over a dust filter. After the filter, the gas is

	cooled in impingers placed in a water bath (where the temperature is lower than 20 [° C]).
Analysis method	NEN-EN 14790

Water (H2O) – psychrometric

Determination method	NEN-EN 14790
Execution	The moisture content is determined from the so-called wet and dry bulb method.
Analysis method	NEN-EN 14790

Mercury

Determination method	NEN-EN 13211
Execution	A partial flow of the waste gas is isokinetically aspirated and passed over a dust filter. After the filter, a partial flow was extracted from this and the gas was cooled in impingers (placed in a water bath (where the temperature is lower than 20 [° C]). The impingers are filled with a known amount of 20% HNO_3 with $K_2 Cr_2 O_7$
Analysis method for filter	destruction: own method analysis: NEN-EN 13211

Hydrochloric acid (HCl)

Determination method	NEN-EN 1911
Execution	Here, a partial flow of the off-gas is suctioned isokinetically heated and passed over a dust filter. After the filter, the gas is cooled in impingers placed in a water bath (where the temperature is lower than 20 [° C]). The impingers are filled with a known amount of demi water
Analysis method	NEN-EN-ISO 10304-1 (ion chromatography)

PCDD / F

Determination method	NEN-EN 1948-1
Implementation	The samples of dibenzodioxins and dibenzofurans (PCDD / F) have been carried out according to the cooled lance method (in accordance with NEN-EN 1948-1) and will take place by isokinetic extraction and cooling of a partial flow of the flue gas by means of a water-cooled probe . The condensate, together with the extracted off-gas, was collected in impingers placed in a water bath (with a temperature lower than 20 [° C]) and then passed over a layer of fiberglass and XAD-2 (cartouche). The dust-like PCDD / Fs are trapped both in the liquid and on the

	glass fiber layer. The gaseous PCDD / Fs are adsorbed at the XAD-2
Analysis method	In accordance with NEN-EN 1948-2 / 3 (GC / HRMS)

Appendix 3 Summary measuring plane description and evaluation

Description of measuring plane

parameter	unit	value
Number of measurement ports	[-]	4
corner of measurement ports	[degree]	90
Position stack	[-]	vertical
Diameter stack	[cm]	25
Distance of disturbance before measuring plane	[m]	6
Distance of disturbance before measuring plane	[m]	0,5
Type of disturbance before measuring plane	[-]	bend
Type of disturbance after measuring plane	[-]	outlet

parameter	assessment
Number of measurement ports	meets criteria
location measurement ports	meets criteria
Corner between measurement ports	meets criteria
No negative gas velocities	meets criteria
Pressure difference > 5 Pa	meets criteria
Ratio between highest and lowest gas velocity < 3:1	meets criteria
Result of measuring place assessment	meets criteria

Appendix 4 Measurement uncertainties

Measurement uncertainties

The measurement uncertainty indicates the uncertainty of a measured value of a certain quantity. Every measurement taken has a certain degree of uncertainty. Every measurement is attempted to determine the "true" value. However, the measured value is always an approximation of this true value. Thus, the result of each measurement consists of the measured value and the uncertainty of this measured value.

This appendix lists the measurement uncertainties of the measurements performed by Tauw.

Tabel B5.2 Specification CO measurement: gasfilter correlation, range 250 ppm

Performance characteristic	Criteria EN 15058	Tauw
Response time	≤ 200 s	50 s
Detection limit	≤ 2 % of range	0,05 ppm (0,02 % of range)
Linearity	≤ 2 % of range	5 ppm (2 % of range)
Zero drift	≤ 2 % of range/24h	0,1 ppm (0,04 % of range / 24h)
Span drift	≤ 2 % of range/24h	2,5 ppm (1 % of range / 24h)
Flow sensitivity	≤ 1 % of range	0,5 ppm (0,2 % of range)
Pressure sensitivity	≤ 3 % of range	0,2 ppm (0,08 % of range)
Temperature sensitivity	≤ 3 % of range / 10 K	0,25 ppm (0,01 % of range / 10 K)
Voltage sensitivity	≤ 2 % of range / 10 V	0,3 ppm (0,1 % of range / 10 V)
Interference CO_2	≤ 4 % of range	2 ppm (0,8 % of range)
Interference CH_4		3,6 ppm (1,4 % of range)
Interference H_2O		0,14 ppm (0,06 % of range)
Repeatability span [including loss in lines]	≤ 2 % of range	0,9 ppm (0,4 % of range)
Measuring uncentainty	6 % of ELV	5,8 % of ELV

Tabel B4.2 Specification NO_X measurement: chemoluminescence, range 250 ppm

Performance characteristic	Criteria EN 14792	Tauw
Response time	≤ 200 s	80 s
Detection limit	≤ 2 % of range	0,5 ppm (0,2 % van de range)
Linearity	≤ 2 % of range	5 ppm (2 % of range)
Zero drift	≤ 2 % of range/24h	0,4 ppb (0,0002 % of range / 24h)
Span drift	≤ 2 % of range/24h	2,5 ppm (1 % of range / 24h)
Flow sensitivity	≤ 1 % of range	0,5 ppm (0,2 % of range)
Pressure sensitivity	≤ 3 % of range 2 kPa	4 ppm (1,6 % of range)
Temperature sensitivity	≤ 3 % of range /10 K	0,25 ppm (0,1 % of range / 10 K)
Voltage sensitivity	≤ 2 % of range / 10 V	0,3 ppm (0,12 % of range / 10 V)
Interference CO_2	≤ 4 % of range	7,5 ppm (3 % of range at 93 % CO_2)
Interference CH_4		0,25 ppm (0,1 % of range at 20 mg/Nm^3 NH_3)
Interference H_2O		0,25 ppm (0,1 % of range at 20 vol.% H_2O)
Convertor efficiency	≥ 95 %	>95 %
Repeatability span [including loss in lines]	≤ 2 % of range	1,7 ppm (0,68 % of range)
Measuring uncentainty	10 % of ELV	9 % of ELV

Tabel B4.3 Specifications O_2 measurement: paramagnetism, range 25 vol. %

Performance characteristic	Criteria EN 14789	Tauw
Response time	≤ 200 s	30 s
Detection limit	≤ 2 % of range	0,05 vol.% (0,2 % of range)
Linearity	≤ 0,3 vol.%	0,3 vol.%
Zero drift	≤ 0,2 vol.%/24h	0,05 vol.% / 24h
Span drift	≤ 0,2 vol.%/24h	0,15 vol. % / 24h
Flow sensitivity	≤ 1 % of range	0,2 vol.% / (0,8 % of range)
Pressure sensitivity	≤ 3 % of range	0,25 vol.% / (1 % of range)
Temperature sensitivity	≤ 0,3 % of range/10 K	0,0006 vol.%/10°C / 0,003 %/10 K
Voltage sensitivity	≤ 0,1 vol % / 10 V	≤ 0,1 vol % / 10 V
Interference CO_2	≤ 0,2 vol%	0,03 vol.% (0,1 % of range)
Interference CH_4		0,03 vol.% (0,1 % of range)
Interference H_2O		0,01 vol.% (0,04 % of range)
Repeatability span [including loss in lines]	≤ 0,4 % of range	0,1 vol.% (0,4 % of range)
Measuring uncentainty	6 % of measured value	6 % of measured value

Tabel B4.4 Specifications SO_2 measurement, wet chemical sampling

Performance characteristic	Criterium NEN-EN 14791	Tauw
Determination absorption volume	≤ 1 % of volume	≤ 1 % van volume
Gasmeter		
Volume	≤ 2 % of volume	≤ 2 % of volume
Temperature	≤ 2,5 K	≤ 2,5 K
Pressure	≤ 1 % of absolute pressure	≤ 1 % of absolute pressure
Absorption-efficiency	> 95 %	> 99 %
Leak	≤ 2 % of flow	≤ 2 % of flow
Field blanc	≤ 10 % of ELV	≤ 10 % of ELV
Measurement uncertainty	≤ 20 % of ELV	11 % of ELV

Tabel B4.5 Specifications moisture measurement, gravimetric sampling

Performance characteristic	Criterium NEN-EN 14790	Tauw
Gasmeter		
Volume	≤ 2 % of volume	≤ 2 % of volume
Temperature	≤ 2,5 °C	≤ 2,5 °C
Pressure	≤ 1 % of absolute pressure	≤ 1 % of absolute pressure
Leak	≤ 2 % of flow	≤ 2 % of flow
Measurement uncertainty	20 % of measured value	11 % of measured value

Tabel B4.6 Specifications HCl measurement wet chemical sampling

Performance characteristic	Criterium, NEN-EN 1911	Tauw
Determination absorption volume	≤ 1 % of volume	≤ 1 % of volume
Gasmeter		
Volume	≤ 2 % of volume	≤ 2 % of volume
Temperature	≤ 2,5 K	≤ 2,5 K
Pressure	≤ 1 kPa	≤ 10 mbar (1 % of absolute pressure)
Absorption-efficiency	> 95 %	> 98 %
Leak	≤ 2 % of flow	≤ 2 % of flow
Field blanc	≤ 10 % of ELV	≤ 10 % of ELV
Measurement uncertainty	30 % of measured value	25 % of measured value

Tauw measurement uncertainties established by Tauw

Tauw has determined the measurement uncertainties for the parameters below based on validation research or the uncertainties have been taken from the measurement standard. The measurement uncertainties for these parameters are shown in Table B4.1.

Tabel B4.7 Uncentainty

Parameter	Guideline	Principe	Values of guideline	Tauw
Adsorption Measurement	-	Adsorption	-	40 %
Flow	EN-ISO 16911-1	Pressure measurement	3 – 5 %	20 %
Hg	EN 13211	CVAAS	4 – 10 µg/Nm3: 46 % 40 – 100 µg/Nm3: 27 %	46 %
PCDD/F	EN 1948	GC/HRMS	0,041 ± 0,011 0,13 ± 0,02 0,035 ± 0,05	45 %
SO_2	EN-ISO 7935	Pulsfluorescence	-	20 %
Dust	EN 13284-1	Gravimetry	20 – 39 %	30 %

Application of measurement uncertainties and testing against the emission limit value

A separate measurement consists of three partial measurements of half an hour, unless a longer sampling time results from the measurement method or the representative method of sampling. The result of the individual emission measurement is the average of the partial measurements, reduced by the reported measurement uncertainty or by a standard value for the measurement uncertainty.

The competent authority determines the measurement uncertainty based on the 95% confidence interval of individual observations. When determining the measurement uncertainty, the average of the partial measurements is corrected for the number of partial measurements. The measurement uncertainty is calculated as a percentage of the limit value.

Appendix 5 Reporting limits

Determination of reporting limits

The reporting limits used by Tauw are mentioned in the tables below.

The determination of the reporting limits is based on the reporting as used by the laboratory (in case of analysis).

Table B5.1 reporting limits

Component	Reporting limit	Assumption
HCl	< 0,2 [mg/Nm^3]	Sampled volume: 0,2 Nm^3 volume absorption fluid: 200 ml
Hg	< 0,002 [mg/Nm^3]	Sampled volume: 0,2 Nm^3 volume absorption fluid: 200 ml
Dust	< 0,5 [mg/Nm^3]	Sampled volume: 1 Nm^3
NO_x as NO_2	< 2 [mg/Nm^3]	1 ppm lowest reading
CO	< 2 [mg/Nm^3]	1 ppm lowest reading
SO_2	< 3 [mg/Nm^3]	1 ppm lowest reading

Table B5.2 reporting limits dioxins and furans

Component	Reporting limit	Assumption
Dioxins and furans	< 0,01 [ng TEQ/Nm^3]	Sampled volume: 6 Nm^3

Appendix 6 Copy of the Accreditation Certificate

RAAD VOOR ACCREDITATIE

Dutch Accreditation Council RvA
PO Box 2768 NL-3500 GT Utrecht

De Stichting Raad voor Accreditatie,
bij wet aangewezen als de nationale accreditatie-instantie voor Nederland,
verklaart hierbij accreditatie te hebben verleend aan:

Tauw B.V.
Business Unit Meten, Inspecties en Advies
Metingen en Monsterneming
Deventer

De instelling heeft aangetoond in staat te zijn op technisch bekwame wijze valide resultaten te leveren en te werken volgens een managementsysteem.

Deze accreditatie is gebaseerd op een beoordeling tegen de vereisten zoals vastgelegd in NEN-EN-ISO/IEC 17025:2005.

De accreditatie is van toepassing op de activiteiten zoals gespecificeerd in de gewaarmerkte bijlage die is voorzien van het registratienummer.

De accreditatie is van kracht, onder voorwaarde dat de instelling blijft voldoen aan de vereisten.

De accreditatie voor registratienummer:

L 429

is verleend op 29 september 2016

Deze verklaring is geldig tot
1 november 2020

De accreditatie is voor het eerst verleend op
27 oktober 2004

[redacted]
Ir. J.C. van der Poel

De Stichting Raad voor Accreditatie is ondertekenaar van de European co-operation for Accreditation (EA) Multilateral Agreement voor accreditatie in dit werkgebied.

Bijlage bij accreditatieverklaring (scope van accreditatie)
Normatief document: EN ISO/IEC 17025:2005
Registratienummer: L 429

van **Tauw B.V.**
Business Unit Meten, Inspecties en Advies, Metingen en Monsternemingen

Deze bijlage is geldig van: **12-09-2018** tot **01-11-2020** Vervangt bijlage d.d.: **27-09-2017**

Locatie(s) waar activiteiten onder accreditatie worden uitgevoerd

Hoofdkantoor

Kamperstraat 21
7418 CA
Deventer
Nederland

Locatie	Afkorting
Kamperstraat 21 7418 CA Deventer Nederland	D
Rhijnspoor 209 2901 LB Capelle aan den IJssel Nederland	C

Nr.	Materiaal of product	Verrichting / Onderzoeksmethode [1]	Intern referentienummer	Locatie
Monsterneming lucht (CEN/TS 15675 kwaliteitsborging volgens NEN-EN 14181)				
a.	Geëmitteerde lucht- en procesgassen	Het bemonsteren van gasvormige componenten voor het bepalen van de gehalten aan HCl, HF, NH_3, SO_x; absorptiemethode	WV2.6.3.11 en WV2.6.3.9 conform: - NEN-EN 1911 (HCl) - NEN-ISO 15713 (HF) - NEN 2826 (NH_3) - NEN-ISO 11632 (SOx) - NEN-EN 14791 (SO_2)	D, C

Deze bijlage is goedgekeurd door het bestuur van de Raad voor Accreditatie, namens deze,

mr. J.A.W.M. de Haas
Operationeel Directeur

[1] Indien wordt verwezen naar een codering beginnende met NAW, NAP, EA of IAF dan betreft het een schema opgenomen in de RvA-BR010 lijst (https://www.rva.nl/document/download/BR010-i(pt).
Indien geen datum of versienummer is vermeld betreft de accreditatie de actuele versie van het document of schema.

Bijlage bij accreditatieverklaring (scope van accreditatie)
Normatief document: EN ISO/IEC 17025:2005
Registratienummer: L 429

van **Tauw B.V.**
Business Unit Meten, Inspecties en Advies, Metingen en Monsternemingen

Deze bijlage is geldig van: **12-09-2018** tot **01-11-2020** Vervangt bijlage d.d.: **27-09-2017**

Nr.	Materiaal of product	Verrichting / Onderzoeksmethode [1]	Intern referentienummer	Locatie
b.	Geëmitteerde lucht- en procesgassen	Het bemonsteren van totaal stofgebonden en gasvormige componenten voor het bepalen van het gehalte aan zware metalen en PAK's	WV2.6.3.11 en WV2.6.3.9 conform: - NEN-EN 13284-1 (stof) - NEN-ISO 9096 (stof) - NEN-EN 13211 (kwik) - NVN 2817 (1996) (zware metalen) - NEN-ISO 11338-1 (PAK) - NEN-EN 14385 (zware metalen)	D, C
c.	Geëmitteerde lucht- en procesgassen	Het bemonsteren voor het bepalen van het gehalte aan stofgebonden en gasvormige PCDD/PCDF's	WV2.6.3.13 conform: - NEN-EN 1948-1	D, C
	Monsternemingen lucht (CEN/TS 15675 kwaliteitsborging volgens NEN-EN 14181) en in het kader van NTA 9065			
d.	Lucht en (proces)gassen	Monsterneming ten behoeve van de bepaling van de emissie uit gekanaliseerde bronnen voor de component geur (concentratie en/of vracht). (De bijbehorende testen worden uitbesteed)	WV2.6.3.15 conform CEN/TS 15675 conform NEN-EN 15259 conform ISO 10780	D, C
	Luchtmetingen (CEN/TS 15675 kwaliteitsborging volgens NEN-EN 14181)			
1.	Geëmitteerde lucht- en procesgassen	Het bepalen van de afgaskarakteristieken debiet, temperatuur en vochtgehalte; drukmeting, thermokoppel, gravimetrisch en psychrometrisch	WV2.6.3.3 conform: - ISO 10780 en NEN-EN-ISO 16911-1 (debiet) - ISO 8756 (temperatuur) - EPA methode 4 (vocht) - NEN-EN 14790 (vocht) - NEN-ISO 9096 (1994) (debiet)	D, C
2.	Geëmitteerde lucht- en procesgassen	Het bepalen van de geschiktheid van het meetvlak (t.b.v. het bepalen van het gehalte aan de gasvormige componenten)	WV 2.6.3.3 conform: - NEN-EN 15259	D, C
3.	Geëmitteerde lucht- en procesgassen	Het bepalen van het gehalte aan de gasvormige componenten SO_2, NO_x, CO en CO_2 (continue meting); pulsfluorescentie, chemoluminescentie, gasfiltercorrelatie en infrarood	WV2.6.3.5 conform: - NEN-ISO 10396 - NEN-ISO 7935 (SO_2) - NEN-ISO 10849 (NO_x) - NEN-EN 14792 (NO_x) - NEN-ISO 12039 (O_2, CO_2) - NEN-EN 15058 (CO)	D, C
4.	Geëmitteerde lucht- en procesgassen	Het bepalen van het gehalte aan zuurstof (continue meting); paramagnetisme	WV2.6.3.6 conform: - NEN-ISO 12039 - NEN-EN 14789	D, C

Bijlage bij accreditatieverklaring (scope van accreditatie)
Normatief document: EN ISO/IEC 17025:2005
Registratienummer: L 429

van **Tauw B.V.**
Business Unit Meten, Inspecties en Advies, Metingen en Monsternemingen

Deze bijlage is geldig van: **12-09-2018** tot **01-11-2020** Vervangt bijlage d.d.: **27-09-2017**

Nr.	Materiaal of product	Verrichting / Onderzoeksmethode [1]	Intern referentienummer	Locatie
5.	Geëmitteerde lucht- en procesgassen	Het bepalen van het gehalte aan totaal stof; gravimetrie (inclusief bijbehorende monstername)	WV2.6.3.11 conform: - NEN-EN 13284-1 - NEN-ISO 9096	D, C gehalte-bepaling wordt alleen in Deventer uitgevoerd
6.	Geëmitteerde lucht- en procesgassen	Het bepalen van het totale gehalte aan koolwaterstoffen (C_xH_y) (continue meting); FID	WV 2.6.3.7 conform: - NEN-EN 12619 - VDI 3481/1 (1975) - VDI 3481/3	D, C

** Naast de in deze scope opgenomen geur activiteiten, welke onder accreditatie uitgevoerd kunnen worden, kunnen een aantal specifieke werkzaamheden **niet** onder de accreditatie uitgevoerd worden. Deze zijn:*

- ***Geuremissie door natuurlijke ventilatie;***
- ***Loef-lijzijdemethode;***
- ***Verspreiding van geur;***
- ***Monsterneming ten behoeve van de bepaling van de emissie uit actieve oppervlakte bronnen.***

Appendix 7 Overview of waste gas characteristics

Flow measurement	Unit			
Date	dd-mm-yy	20-6-19	20-6-19	21-6-19
Atmospheric pressure	[hPa]	1006	1006	1006
Static pressure	[Pa]	50	50	50
Moisture content	[vol %]	10	10	9
Temperature	[^{o}C]	82,9	94,5	88,1
Velocity	[m/s]	7,8	7,0	9,4
Flow (actual)	[m^3/h]	1387	1236	1664
Flow (normalised)	[Nm^3/h]	950	821	1137

Appendix 8 Underlying measurement data

general data					
In assigment of		DFW			
projectnumber		1271511			
projectcode		D19-146			
date		20-06-2019			
technician		rhj			
reporting		Zijderveld, Paul			
check		pzx			
location		Schoorsteen DFW Electric			
general sampling information		**Stof**		**Stof**	
sample code	[-]	D19-146/Stof/201		D19-146/Stof/202	
date	[dd:mm:yy]	20-06-2019		20-06-2019	
start	[hh:min]	14:27		14:59	
eind	[hh:min]	14:57		15:33	
delay	[hh:min]	00:00		00:00	
measuring time	[hh:min]	00:30		00:34	
nozzle diameter	[mm]	8		8	
average velocity	[m/s]	9,1		9,0	
static pressure	[Pa]	49		49	
moisture content	[vol.-%]	9,8		9,8	
atmospheric pressure	[hPa]	999		999	
temperature	[°C]	83,0		87,0	
O2	[vol.-%]	14,7		14,5	
master					
sampling information	**measurement**	**A**	**B**	**A**	**B**
filtercode	[-]	DA10271		DA10221	
mass of filter before measurements	[g]	33,9611		34,1944	
mass of filter after measurements	[g]	33,9613		34,1948	
value gasmeter start	[m³]	6,430		6,939	
values gasmeter end	[m³]	6,940		7,502	
temperature gasmeter	[°C]	25		25	
slave 1		**HCL**		**HCL**	
sampling info	**measurement**	**A**	**B**	**A**	**B**
sample code	[-]	D19-146/HCL/201/A			
volume sample	[ml]	226	96	216	95
value gasmeter start	[m³]	1,561		1,643	
values gasmeter end	[m³]	1,643		1,748	
temperature gasmeter	[°C]	25		25	
sample volume	[Nm³]	0,0741		0,0949	
slave 2		**HG**		**HG**	
sampling info	**measurement**	**A**	**B**	**A**	**B**
sample code	[-]	D19-146/HG/201/A		D19-146/HG/202/A	
volume monster	[ml]	226	104	211	107
value gasmeter start	[m³]	9,343		9,427	
values gasmeter end	[m³]	9,427		9,532	
temperature gasmeter	[°C]	25		25	
sample volume	[Nm³]	0,0759		0,0949	
calculated parameters					
sampled volume master	[Nm³]	0,4608		0,5092	
sampled volume slave 1	[Nm³]	0,0741		0,0949	
sampled volume slave 1	[Nm³]	0,0759		0,0949	
total sampled volume	[Nm³]	0,6108		0,6990	
volume theroretical	[Nm³]	0,5618		0,6227	
isokinetic	[%]	9		12	

general data					
In assigment of		DFW			
projectnumber		1271511			
projectcode		D19-146			
date		20-06-2019			
technician		rhj			
reporting		Zijderveld, Paul			
check		0			
location		**Stack cremator Geleen**			
general sampling information		**Stof**		**Stof**	
sample code	[-]	D19-146/Stof/301		D19-146/Stof/302	
date	[dd:mm:yy]	20-06-2019		20-06-2019	
start	[hh:min]	17:09		17:42	
eind	[hh:min]	17:39		18:22	
delay	[hh:min]	00:00		00:00	
measuring time	[hh:min]	00:30		00:40	
nozzle diameter	[mm]	8		8	
average velocity	[m/s]	11,2		7,7	
static pressure	[Pa]	49		49	
moisture content	[vol.-%]	9,8		9,8	
atmospheric pressure	[hPa]	999		999	
temperature	[°C]	94,0		97,0	
O2	[vol.-%]	15,2		14,9	
master					
sampling information	**measurement**	**A**	**B**	**A**	**B**
filtercode	[-]	DA10248		DA10249	
mass of filter before measurements	[g]	35,4213		33,0981	
mass of filter after measurements	[g]	35,4216		33,0983	
value gasmeter start	[m³]	7,502		8,080	
values gasmeter end	[m³]	8,080		8,618	
temperature gasmeter	[°C]	25		25	
slave 1		**HCL**		**HCL**	
sampling info	**measurement**	**A**	**B**	**A**	**B**
sample code	[-]	D19-146/HCL/301/A			
volume sample	[ml]	200	97	215	110
value gasmeter start	[m³]	1,748		1,842	
values gasmeter end	[m³]	1,842		1,934	
temperature gasmeter	[°C]	25		25	
sample volume	[Nm³]	0,0849		0,0831	
slave 2		**HG**		**HG**	
sampling info	**measurement**	**A**	**B**	**A**	**B**
sample code	[-]	D19-146/HG/301/A			
volume monster	[ml]	189	110	228	115
value gasmeter start	[m³]	9,532		9,628	
values gasmeter end	[m³]	9,628		9,719	
temperature gasmeter	[°C]	25		25	
sample volume	[Nm³]	0,0867		0,0822	
calculated parameters					
sampled volume master	[Nm³]	0,5222		0,4861	
sampled volume slave 1	[Nm³]	0,0849		0,0831	
sampled volume slave 1	[Nm³]	0,0867		0,0822	
total sampled volume	[Nm³]	0,6939		0,6514	
volume theroretical	[Nm³]	0,6707		0,6098	
isokinetic rating	[%]	3		7	

general data					
In assigment of		DFW			
projectnumber		1271511			
projectcode		D19-146			
date		21-06-2019			
technician		rhj			
reporting		Zijderveld, Paul			
check		0			
location		Stack cremator Geleen			
general sampling information		**Dust**		**Dust**	
sample code	[-]	D19-146/Stof/401		D19-146/Stof/402	
date	[dd:mm:yy]	21-06-2019		21-06-2019	
start	[hh:min]	10:54		11:29	
eind	[hh:min]	11:24		11:59	
delay	[hh:min]	00:00		00:00	
measuring time	[hh:min]	00:30		00:30	
nozzle diameter	[mm]	8		8	
average velocity	[m/s]	10,7		9,2	
static pressure	[Pa]	49		49	
moisture content	[vol.-%]	9,2		8,7	
atmospheric pressure	[hPa]	1.006		1.006	
temperature	[°C]	67,0		82,0	
O2	[vol.-%]	16,3		14,3	
master					
sampling information	**measurement**	**A**	**B**	**A**	**B**
filtercode	[-]	DA10127		DA10129	
mass of filter before measurements	[g]	0,1692		0,1688	
mass of filter after measurements	[g]	0,1695		0,1689	
value gasmeter start	[m³]	8,618		9,205	
values gasmeter end	[m³]	9,205		9,758	
temperature gasmeter	[°C]	28		28	
slave 1		**HCL**		**HCL**	
sampling information	**measurement**	**A**	**B**	**A**	**B**
sample code	[-]				
volume sample	[ml]	212	112	233	112
value gasmeter start	[m³]	1,934		2,031	
values gasmeter end	[m³]	2,031		2,120	
temperature gasmeter	[°C]	30		30	
sample volume	[Nm³]	0,0868		0,0796	
slave 2		**HG**		**HG**	
sampling info	**measurement**	**A**	**B**	**A**	**B**
sample code	[-]				
volume monster	[ml]	194	107	215	123
value gasmeter start	[m³]	9,719		9,818	
values gasmeter end	[m³]	9,818		9,908	
temperature gasmeter	[°C]	30		30	
sample volume	[Nm³]	0,0886		0,0805	
calculated parameters					
sampled volume master	[Nm³]	0,5287		0,4981	
sampled volume slave 1	[Nm³]	0,0868		0,0796	
sampled volume slave 1	[Nm³]	0,0886		0,0805	
total sampled volume	[Nm³]	0,7041		0,6583	
volume theroretical	[Nm³]	0,7009		0,5808	
isokinetic rating	[%]	0		13	

Sampling of dioxins and furans according to EN 1948:2006				Tauw
general data				
In assigment of	:	**DFW**		
projectnumber	:	**1271511**		
projectcode	:	**D19-146**		
date	:	**20-06-2019**		
technician	:	**rhj**		
reporting	:	**Zijderveld, Paul**		
check	:			
location	:	**Stack cremator Geleen**		
sampling information				
sample code	:	D19-146/PCDD/F/101	D19-146/PCDD/F/102	
number cartouch	:	d1040	d1089	
date	[dd:mm:yy] :	20-06-2019	20-06-2019	
start	[hh:min] :	12:19	13:03	
eind	[hh:min] :	13:00	13:33	
delay	[hh:min] :			
measuring time	[hh:min] :	00:41	00:30	
nozzle diameter	[mm] :	7	7	
average velocity	[m/s] :	9,0	7,7	
static pressure	[Pa] :	49	49	
moisture content	[vol.-%] :	9,8	9,8	
atmospheric pressure	[hPa] :	1.006	1.006	
temperature	[°C] :	60,0	73,0	
O2	[vol.-%] :	14,5	14,0	
value gasmeter start	[m³] :	2,879	3,587	
values gasmeter end	[m³] :	3,582	4,060	
temperature gasmeter	[°C] :	20,0	25,0	
calculated parameters				
sampled volume	[Nm³] :	0,650	0,430	
volume theroretical	[Nm³] :	0,626	0,377	
isokinetic rating	[%] :	4	14	

Sampling of dioxins and furans according to EN 1948:2006			Tauw
general data			
In assigment of		: DFW	
projectnumber		: 1271511	
projectcode		: D19-146	
date		: 43636	
technician		: rhj	
reporting		: Zijderveld, Paul	
check		: PZX	
location		: Stack cremator Geleen	
sampling information			
sample code		: D19-146/PCDD/F/401	
number cartouch		: d1094	
date	[dd:mm:yy]	: 21-06-2019	
start	[hh:min]	: 10:54	
eind	[hh:min]	: 11:57	
delay	[hh:min]	:	
measuring time	[hh:min]	: 01:03	
nozzle diameter	[mm]	: 7	
average velocity	[m/s]	: 10,5	
static pressure	[Pa]	: 49	
moisture content	[vol.-%]	: 9,2	
atmospheric pressure	[hPa]	: 1.006	
temperature	[°C]	: 75,0	
O2	[vol.-%]	: 15,1	
value gasmeter start	[m³]	: 6,284	
values gasmeter end	[m³]	: 7,552	
temperature gasmeter	[°C]	: 25,0	
calculated parameters			
sampled volume	[Nm³]	: 1,154	
volume theroretical	[Nm³]	: 1,080	
isokinetic rating	[%]	: 7	

Appendix 9 Results blancs and doorslag

Breaktrough Geleen				
general sampling data				
Date	[dd-mm=yy]	20-06-2019		
start	[hr-min]	14:27		
eind	[hr-min]	14:57		
component	**breaktrough**	**concentration [mg/Nm3]**	**concentration**	**result**
kwik	no	0,004	n.a	n.a
waterstofchloride	no	0,3	n.a	n.a

Breaktrough Geleen				
general sampling data				
Date	[dd-mm=yy]	20-06-2019		
start	[hr-min]	14:59		
eind	[hr-min]	15:33		
component	**breaktrough**	**concentration [mg/Nm3]**	**concentration**	**result**
kwik	no	< 0,003	n.a	n.a
waterstofchloride	no	0,7	n.a	n.a

Breaktrough Geleen				
general sampling data				
Date	[dd-mm=yy]	20-06-2019		
start	[hr-min]	17:09		
eind	[hr-min]	17:39		
component	**breaktrough**	**concentration [mg/Nm3]**	**concentration**	**result**
kwik	no	0,005	n.a.	n.v.t.
waterstofchloride	yes	4,4		no breaktrough

Breaktrough Geleen				
general sampling data				
Date	[dd-mm=yy]	20-06-2019		
start	[hr-min]	17:42		
eind	[hr-min]	18:22		
component	**breaktrough**	**concentration [mg/Nm3]**	**concentration**	**result**
kwik	no	< 0,003	n.a.	n.v.t.
waterstofchloride	yes	2,9		no breaktrough

Breaktrough Geleen				
general sampling data				
Date	[dd-mm=yy]	21-06-2019		
start	[hr-min]	10:54		
eind	[hr-min]	11:24		
component	**breaktrough**	**concentration [mg/Nm3]**	**concentration**	**result**
kwik	no	< 0,003	n.a	n.a
waterstofchloride	no	2,0	n.a	n.a

Breaktrough Geleen				
general sampling data				
Date	[dd-mm=yy]	21-06-2019		
start	[hr-min]	11:29		
eind	[hr-min]	11:59		
component	**breaktrough**	**concentration [mg/Nm3]**	**concentration**	**result**
kwik	no	< 0,003	n.a	n.a
waterstofchloride	no	0,9	n.a	n.a

Appendix 10 Certificates of analysis

Tauw Nederland B.V.
Paul Zijderveld
POSTBUS 133
7400 AC DEVENTER

Datum	27.06.2019
Relatienr	35003840
Opdrachtnr.	863618

ANALYSERAPPORT

Opdracht 863618 Gas/Lucht

Opdrachtgever	35003840 Tauw Nederland B.V.
Uw referentie	1271511 DFW, crematorium Geleen 411093
Opdrachtacceptatie	24.06.19
Monsternemer	Opdrachtgever

Geachte heer, mevrouw,

Hierbij zenden wij u de resultaten van het door u aangevraagde laboratoriumonderzoek.
De analyses zijn, tenzij anders vermeld, geaccrediteerd volgens NEN-EN-ISO/IEC 17025 en uitgevoerd overeenkomstig de onderzoeksmethoden die worden genoemd in de meest actuele versie van onze verrichtingenlijst van de Raad voor Accreditatie, accreditatienummer L005.

Indien u gegevens wenst over de meetonzekerheden van een methode, kunnen wij u deze op verzoek verstrekken.

Dit rapport mag alleen in zijn geheel worden gereproduceerd. Eventuele bijlagen zijn onderdeel van het rapport.

Indien u nog vragen heeft of aanvullende informatie wenst, verzoeken wij u om contact op te nemen met Klantenservice.

Wij vertrouwen erop u met de toegezonden informatie van dienst te zijn.

Met vriendelijke groet,

AL-West B.V. Dhr. Jan Godlieb, Tel. 31/570788113
Klantenservice

De in dit rapport vermelde analyses zijn geaccrediteerd volgens ISO/IEC 17025:2005, tenzij bij de analyse het symbool " * " staat vermeld.

Kamer van Koophandel Nr. 08110898 VAT/BTW-ID-Nr.: NL 811132559 B01
Directeur ppa. Marc van Gelder Dr. Paul Wimmer

RvA TESTING RvA L 005

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Opdracht **863618 Gas/Lucht**

Monsternr.	*Monsteromschrijving*	*Monstername*	*Monsternamepunt*
278855	D19-146/HCL/201/A	20.06.2019	
278856	D19-146/HCL/001/A	20.06.2019	
278857	D19-146/HCL/002/A	20.06.2019	
278859	D19-146/HCL/202/A	20.06.2019	
278860	D19-146/HCL/301/A	20.06.2019	

	Eenheid	278855 D19-146/HCL/201/A	278856 D19-146/HCL/001/A	278857 D19-146/HCL/002/A	278859 D19-146/HCL/202/A	278860 D19-146/HCL/301/A
Klassiek Chemische Analyses						
Chloride (impinger)	mg/l	**0,1**	**<0,1**	**<0,1**	**0,3**	**1,8**
Metalen						
Kwik (Hg) (impinger)	µg/l	--	--	--	--	--

" * " staat vermeld.

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Opdracht **863618 Gas/Lucht**

Monsternr.	*Monsteromschrijving*	*Monstername*	*Monsternamepunt*
278861	D19-146/HCL/302/A	20.06.2019	
278862	D19-146/HCL/401/A	21.06.2019	
278863	D19-146/HCL/402/A	21.06.2019	
278864	D19-146/HCL/501/A	21.06.2019	
278865	D19-146/HCL/502/A	21.06.2019	

	Eenheid	278861 D19-146/HCL/302/A	278862 D19-146/HCL/401/A	278863 D19-146/HCL/402/A	278864 D19-146/HCL/501/A	278865 D19-146/HCL/502/A
Klassiek Chemische Analyses						
Chloride (impinger)	mg/l	**1,1**	**0,8**	**0,3**	**0,5**	**1,7**
Metalen						
Kwik (Hg) (impinger)	µg/l	--	--	--	--	--

staat vermeld.

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Opdracht **863618 Gas/Lucht**

Monsternr.	*Monsteromschrijving*	*Monstername*	*Monsternamepunt*
278866	D19-146/HCL/601/A	21.06.2019	
278867	D19-146/HCL/602/A	21.06.2019	
278868	D19-146/HG/001/A	06.04.7793	
278869	D19-146/HG/002/A	20.06.2019	
278870	D19-146/HG/201/A	20.06.2019	

staat vermeld.

	Eenheid	278866 D19-146/HCL/601/A	278867 D19-146/HCL/602/A	278868 D19-146/HG/001/A	278869 D19-146/HG/002/A	278870 D19-146/HG/201/A
Klassiek Chemische Analyses						
Chloride (impinger)	mg/l	**5,9**	**7,3**	--	--	--
Metalen						
Kwik (Hg) (impinger)	µg/l	--	--	**0,8**	**<0,5**	**1,6**

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Monsternr.	*Monsteromschrijving*	*Monstername*	*Monsternamepunt*
278871	D19-146/HG/202/A	07.04.7857	
278872	D19-146/HG/301/A	20.06.2019	
278873	D19-146/HG/302/A	20.06.2019	
278874	D19-146/HG/401/A	21.06.2019	
278875	D19-146/HG/402/A	21.06.2019	

	Eenheid	278871 D19-146/HG/202/A	278872 D19-146/HG/301/A	278873 D19-146/HG/302/A	278874 D19-146/HG/401/A	278875 D19-146/HG/402/A
Klassiek Chemische Analyses						
Chloride (impinger)	mg/l	--	--	--	--	--
Metalen						
Kwik (Hg) (impinger)	µg/l	<0,5	2,4	<0,5	1,2	<0,5

' staat vermeld.

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Monsternr.	*Monsteromschrijving*	*Monstername*	*Monsternamepunt*
278876	D19-146/HG/501/A	21.06.2019	
278877	D19-146/HG/502/A	21.06.2019	
278878	D19-146/HG/601/A	21.06.2019	
278879	D19-146/HG/602/A	21.06.2019	

	Eenheid	278876 D19-146/HG/501/A	278877 D19-146/HG/502/A	278878 D19-146/HG/601/A	278879 D19-146/HG/602/A
Klassiek Chemische Analyses					
Chloride (impinger)	mg/l	--	--	--	--
Metalen					
Kwik (Hg) (impinger)	µg/l	0,9	<0,5	<0,5	0,6

' staat vermeld.

Verklaring:"<" of n.a. betekent dat het gehalte van de component lager is dan de rapportagegrens

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Opdracht **863653 Gas/Lucht**

Monsternr.	*Monsteromschrijving*	*Monstername*	*Monsternamepunt*
278990	D19-146/stof/101	20.06.2019	
278991	D19-146/stof/102	20.06.2019	
278992	D19-146/stof/201	20.06.2019	
278993	D19-146/stof/202	20.06.2019	
278994	D19-146/stof/301	20.06.2019	

	Eenheid	278990 D19-146/stof/101	278991 D19-146/stof/102	278992 D19-146/stof/201	278993 D19-146/stof/202	278994 D19-146/stof/301
Voorbehandeling metalen analyse						
Waterstoffluoride-ontsluiting (Hg)		++	++	++	++	++
Metalen						
Kwik (Hg) (HF) (filter)	µg/filter	<0,010	<0,010	<0,010	<0,010	<0,010

ool "*" staat vermeld.

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Opdracht **863653 Gas/Lucht**

Monsternr.	*Monsteromschrijving*	*Monstername*	*Monsternamepunt*
278995	D19-146/stof/302	20.06.2019	
278996	D19-146/stof/401	20.06.2019	
278997	D19-146/stof/402	20.06.2019	
278998	D19-146/stof/501	20.06.2019	
278999	D19-146/stof/502	20.06.2019	

	Eenheid	278995 D19-146/stof/302	278996 D19-146/stof/401	278997 D19-146/stof/402	278998 D19-146/stof/501	278999 D19-146/stof/502
Voorbehandeling metalen analyse						
Waterstoffluoride-ontsluiting (Hg)		++	++	++	++	++
Metalen						
Kwik (Hg) (HF) (filter)	µg/filter	<0,010	0,010	<0,010	<0,010	<0,010

ool "*" staat vermeld.

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Opdracht **863653 Gas/Lucht**

Monsternr.	*Monsteromschrijving*	*Monstername*	*Monsternamepunt*
279000	D19-146/stof/601	20.06.2019	
279001	D19-146/stof/602	20.06.2019	

	Eenheid	279000 D19-146/stof/601	279001 D19-146/stof/602
Voorbehandeling metalen analyse			
Waterstoffluoride-ontsluiting (Hg)		++	++
Metalen			
Kwik (Hg) (HF) (filter)	µg/filter	<0,010	<0,010

" staat vermeld.

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Opdracht **863630 Gas/Lucht**

Monsternr.	*Monsteromschrijving*	*Monstername*	*Monsternamepunt*
278891	D19-146/PCDD/F/101	20.06.2019	
278892	D19-146/PCDD/F/102	20.06.2019	
278893	D19-146/PCDD/F/201/SPOE	20.06.2019	
278894	D19-146/PCDD/F/301/SPOE	20.06.2019	
278895	D19-146/PCDD/F/401	20.06.2019	

	Eenheid	278891 D19-146/PCDD/F/101	278892 D19-146/PCDD/F/102 1	278895 D19-146/PCDD/F/401
Dioxinen en Dibenzofuranen				
2,3,7,8 Tetra CDD (filter)	ng/filter	<0,0030	<0,0030	<0,0030
1,2,3,7,8 Penta CDD (Filter)	ng/filter	<0,0060	<0,0060	<0,0060
1,2,3,4,7,8 Hexa CDD (Filter)	ng/filter	<0,010	<0,010	<0,010
1,2,3,6,7,8 HexaCDD (filter)	ng/filter	<0,010	<0,010	<0,010
1,2,3,7,8,9 Hexa CDD (Filter)	ng/filter	<0,010	<0,010	<0,010
1,2,3,4,6,7,8-Hepta CDD (filter)	ng/filter	<0,050	<0,050	<0,050
Octa CDD (filter)	ng/filter	<0,10	<0,10	<0,10
2,3,7,8-Tetrachloordibenzofuraan (filter)	ng/filter	<0,010	<0,010	<0,010
1,2,3,7,8 Penta CDF (Filter)	ng/filter	<0,010	<0,010	<0,010
2,3,4,7,8-Penta CDF (filter)	ng/filter	<0,0060	<0,0060	<0,0060
1,2,3,4,7,8 Hexa CDF (Filter)	ng/filter	<0,010	<0,010	<0,010
1,2,3,6,7,8 Hexa CDF (Filter)	ng/filter	<0,010	<0,010	<0,010
1,2,3,7,8,9 Hexa CDF (Filter)	ng/filter	<0,010	<0,010	<0,010
2,3,4,6,7,8 - Hexa CDF (filter)	ng/filter	<0,010	<0,010	<0,010
1,2,3,4,7,8,9 -Hepta CDF (filter)	ng/filter	<0,050	<0,050	<0,050
1,2,3,4,6,7,8 Hepta CDF (Filter)	ng/filter	<0,050	<0,050	<0,050
Octa CDF (Filter)	ng/filter	<0,10	<0,10	<0,10
TEQ volgens NATO/CCMS Upper bound (filter)	ng/filter	0,0192 **	0,0192 **	0,0192 **
TEQ volgens NATO/CCMS (filter)	ng/filter	n.a.	n.a.	n.a.
Bemonsteringsstandaard				
13C12-1,2,3,7,8-PeCDF	%	100 *	89 *	110 *
13C12-1,2,3,7,8,9-HxCDF	%	90 *	83 *	98 *
13C12-1,2,3,4,7,8,9-HpCDF	%	120 *	110 *	96 *
Extractiestandaard				
13C12-2,3,7,8-TeCDD	%	78 *	85 *	74 *
13C12-1,2,3,7,8-PeCDD	%	84 *	89 *	76 *
13C12-1,2,3,4,7,8-HxCDD	%	82 *	89 *	91 *
13C12-1,2,3,6,7,8-HxCDD	%	81 *	86 *	78 *
13C12-1,2,3,4,6,7,8-HpCDD	%	73 *	77 *	73 *
13C12-OCDD	%	81 *	77 *	73 *
13C12-2,3,7,8-TeCDF	%	82 *	98 *	74 *
13C12-2,3,4,7,8-PeCDF	%	79 *	94 *	68 *

aanmelden die in dit document worden vermeld, zijn geaccrediteerd volgens ISO / IEC 17025: 2005. Alleen niet geaccrediteerde parameters / resultaten zijn gemarkeerd met het symbool **