Long-Term Monitoring of Dioxin Emissions of a Hazardous Waste Incinerator during Lowered Incineration Temperature

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Introduction

For incineration of hazardous waste a European guideline provides uniform regulations in view of (beside others) waste to be burnt, incineration conditions and emission limits.
As far as hazardous waste with a total content of organic chlorine of more than 1 % by weight is to be burnt the European guideline 94/67 EG [1] stipulates an incineration temperature of 1,100 °C towards 850 °C when incinerating waste with lower content of organic chlorine.
But operation of the incinerator at the higher temperature level of 1,100 °C - or even 1,200 °C as it was demanded in Germany by the 17. BImSchV [2] until March 1999 - causes higher operating expenses due to higher corrosion, higher energy demand and lower throughput. Lowering of the incineration temperature from 1,200 °C to 1,000 °C may economize the operating expenses by 10 to 15 %.
Minimum incineration temperatures are fixed by law to minimize the formation of polychlorinated Dibenzofurans and Dibenzo(p)dioxins (PCDF/Ds). Although the PCDF/D emission behavior of an incineration plant at higher and lower temperatures can be examined by single measurements lasting 6 to 8 hours (according to EN 1948), it cannot be proved by such measurements, that the emission limit of 0.1 ng I-TEQ/m^3 is observed at all times, and particularly during unfavorable incineration states. Underestimation of PCDF/D emissions is possible when supervision is restricted to a few 6 or 8 hour measurements [3].
Long term monitoring using AMESA enables monitoring of PCDF/D emissions of an incine-ration plant without gaps ensuring that emissions do not exceed the limit by average within a period of up to 4 weeks [4].

This work describes the long term samplings for PCDF/Ds in the stack gas of a hazardous waste incinerator of Infraserv GmbH & Co. Höchst KG in Frankfurt, Germany, during a period of high and lowered incineration temperatures and presents the first results. The long term sampling of PCDF/Ds was one of the requirements of the authority for permission of operation of the incineration at lowered temperatures of 1,000 °C instead of 1,200 °C as required before this test.

Material and Methods

The plant investigated is a hazardous waste incinerator with two incineration lines consisting each of rotary kiln, re-burn chamber, steam boiler, electric precipitator, fan, two stage wet scrubber, reheater, coke adsorber and SCR reactor. The PCDF/D samplings were carried out in the common stack gas of both incineration lines by use of the long-term sampling system AMESA which was developed by the companies GfA and bm becker meßtechnik and certified by TÜV Rheinland

[5,6] in the years 1996 and 1997. The sampling method used in AMESA is based on the adsorption method which is described elsewhere [7,8].

Start and termination of each long-term sampling was carried out manually by GfA staff. All other functions of isokinetic sampling such as monitoring of flue gas velocity, flue gas temperature, oxygen content etc. were controlled by AMESA. Sampling was interrupted automatically if waste feeding was locked by the control console for both lines at the same time.

From May 1998 until March 1999 a total of 11 long term samples – each lasting 3 to 4 weeks - were taken and analyzed. Five of the samples were taken during higher (1,200 °C) and six of them during lower (1,000 °C) incineration temperatures. Nine of the 11 samples were analyzed by GfA. For quality control reasons due to authorities requirements two samples were analyzed by an other independent laboratory (TÜV Ecoplan Umwelt GmbH; samples S7 and S11).
All analyses of PCDF/Ds in the long term samples were carried out according to VDI guideline 3499, part 3, or EN 1948 by use of high resolution GC/MS.

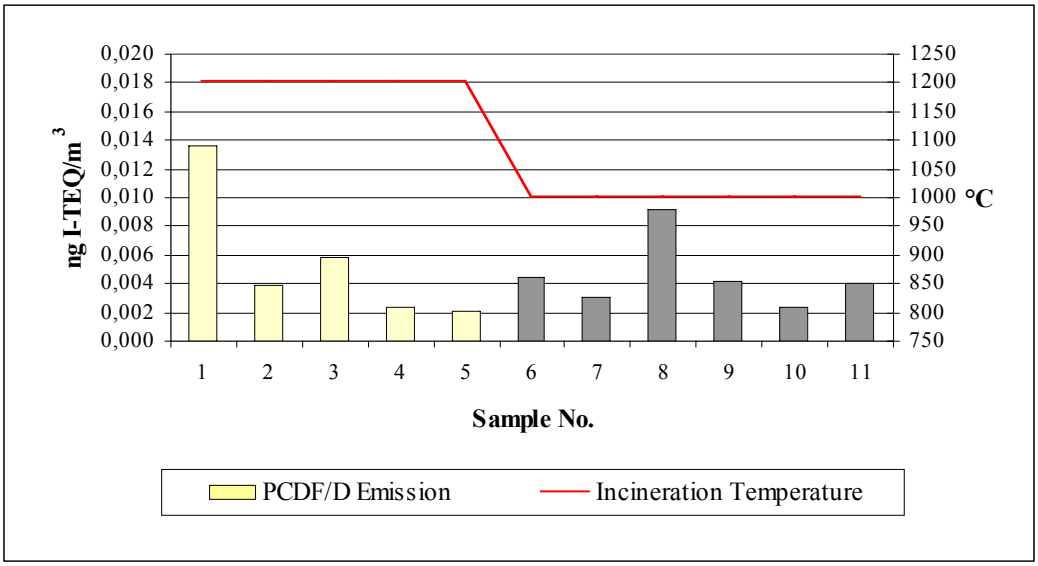
Results and Discussion
The results of the PCDF/D analyses of all long-term samples are shown in Table 1 and Figure 1. The emission values range from 0.002 to 0.014 ng I-TEQ/m^3 and are all below the European emission limit of 0.1 ng I-TEQ/m^3 at least by the factor of 7. The average of the samples S 1 to S 5, which represents the incineration temperature of 1,200 °C, is 0.006 ng I-TEQ/m^3 while the average of the samples S 6 to S 11 is 0.005 ng I-TEQ/m^3, representing the incineration temperature of 1,000 °C. This indicates no influence by lowering the incineration temperature of this plant from 1,200 to 1,000 °C.

Tab. 1: PCDF/D concentrations in the stack gas of the hazardous waste incinerator; ng I-TEQ/m^3 refers to 0 °C, 101.3 kPa, dry, related to 11 % O_2

Sample No.	S 1	S 2	S 3	S 4	S 5
Sampling Period	06.05. – 26.05.98	26.05. – 15.06.98	26.06. – 13.07.98	16.07. – 12.08.98	12.08. – 31.08.98
Incineration Temp. [°C]	1,200	1,200	1,200	1,200	1,200
PCDF/D conc. [ng I-TEQ/m^3]	0.014	0.004	0.006	0.002	0.002
Average [ng I-TEQ/m^3]	0,006				
Standard deviation [ng I-TEQ/m^3]	0,005				

Sample No.	S 6	S 7	S 8	S 9	S 10	S 11
Sampling Period	31.08. – 30.09.98	30.09. – 30.10.98	30.10. – 30.11.98	30.11. – 30.12.98	30.12.98- 30.01.99	30.01. – 01.03.99
Incineration Temp. [°C]	1,000	1,000	1,000	1,000	1,000	1,000
PCDF/D conc. [ng I-TEQ/m^3]	0.004	0.003	0.009	0.004	0.002	0.004
Average [ng I-TEQ/m^3]	0.005					
Standard deviation [ng I-TEQ/m^3]	0.002					

Fig. 1: PCDF/D concentrations in the stack gas of the hazardous waste incinerator as well as incineration temperature; ng I-TEQ/m^3 refers to 0 °C, 101.3 kPa, dry, related to 11 % O_2



Standard deviations of PCDF/D emissions within the two temperature levels are 0.005 and 0.002 ng I-TEQ/m^3 which is rather high considering the average values but reflects the varying operating conditions of the plant within the single sampling periods.

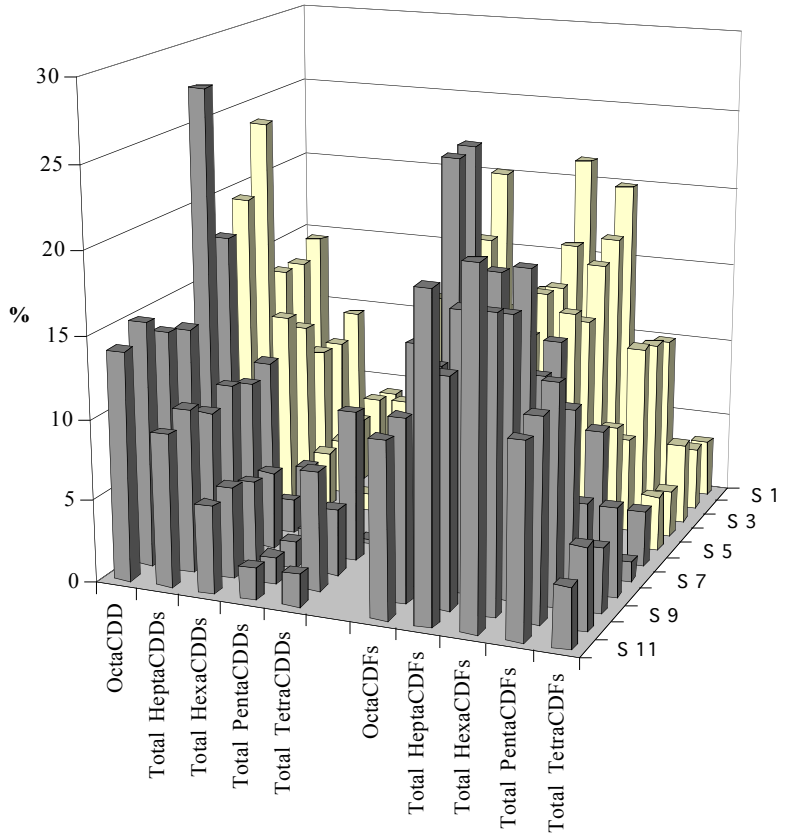
Figure 2 shows the proportional parts of Tetra- through OctaCDF/Ds in the flue gas samples. The profiles shown are very typical for flue gas samples from incineration processes. No significant difference is detectable between the two incineration temperatures which are indicated by light (1,200 °C) and dark (1,000 °C) columns.

Conclusions

Within this work it was found that the incineration temperature of a hazardous waste incineration plant may be lowered from 1,200 to 1,000 °C without any effect on the PCDF/D emission behavior. Long-term monitoring by use of AMESA showed that the emission limit of 0.1 ng I-TEQ/m^3 is kept securely without gaps by the plant investigated here even at the lowered temperature of 1,000 °C.

Because of the obligation by European law to incinerate hazardous waste with high contents of organic chlorine (> 1 % by weight) at minimum 1,100 °C the authorities may hesitate to permit lower incineration temperatures. Continuous sampling of PCDF/D provides a suitable possibility to supervise PCDF/D emissions of incineration plants and guarantee that a possible increase of PCDF/D emission will not remain unnoticed.

Fig. 2: Proportional parts of Tetra- through OctaCDF/Ds in the flue gas samples taken during higher (1,200 °C, light columns) and lower (1,000 °C, dark columns) incineration temperatures



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