

PERFORMANCE CHARACTERISTICS OF THE ADSORPTION METHOD FOR SAMPLING POLYCHLORINATED DIBENZOFURANS (PCDFs) AND DIBENZO(P)DIOXINS (PCDDs) IN EMISSIONS OF COMBUSTION FACILITIES

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Introduction

Recently the GfA published a new method for the sampling of PCDF/Ds in flue gas of combustion facilities¹. Meanwhile the sampling equipment was frequently tested in emission measurements. The main goal was to receive reliable and comprehensive data to verify the method's applicability for the determination of low PCDF/D flue gas concentrations ($< 0.1 \text{ ng TE/m}^3$). This is obtained by involving another laboratory in sampling, work-up and analyses. In the scope of the comparison measurements performed in cooperation with the Landesanstalt für Immissionsschutz (LIS), Essen, not only two sampling equipments of the adsorption method were operated by two different measurement teams, but also parallel samples were taken by using the filter-condensation method².

Experimental

The sampling equipment used was described recently¹. The samplings were performed at a combustion facility with comparably low PCDF/D emissions ($< 0.1 \text{ ng TE/m}^3$). Work-up and analyses in both laboratories were performed as described in VDI guideline 3499, part 2².

Results and Discussion

The results from 6 parallel samplings performed by GfA and LIS (both laboratories using the adsorption method) are shown in table 1.

Table 1: Mean values (\bar{x}) as well as absolute and relative standard deviations (s) of the complete method (sampling by using the adsorption method, work-up and analyses, performed by GfA and LIS) from 6 parallel samplings

Parameter	\bar{x}	s	s _{rel}	n
PCDF/PCDD	ng/m ³	ng/m ³	%	
Total TetracDFs	1.47	0.15	10	6
Total PentaCDFs	1.10	0.31	28	6
Total HexaCDFs	0.45	0.13	29	6
Total HeptaCDFs	0.09	0.02	22	6
OctaCDF	0.01	< 0.01	< 100	5
Total Tetra- bis OctaCDFs	3.12	0.51	16	6
2378-TetraCDF	0.044	0.005	11	6
12378-/12348-PentaCDF ^a	0.090	0.030	33	6
23478-PentaCDF	0.047	0.010	21	6
123478-/123479-HexaCDF ^a	0.056	0.020	36	6
123678-HexaCDF	0.059	0.020	34	6
123789-HexaCDF	0.005	0.004	80	6
234678-HexaCDF	0.021	0.002	10	6
1234678-HeptaCDF	0.069	0.012	17	6
1234789-HeptaCDF	0.005	0.006	120	6
Total TetracDDs	0.25	0.07	28	6
Total PentaCDDs	0.27	0.04	15	6
Total HexaCDDs	0.38	0.11	29	6
Total HeptaCDDs	0.19	0.07	37	6
OctaCDD	0.13	0.05	38	6
Total Tetra- bis OctaCDDs	1.22	0.23	19	6
2378-TetraCDD	0.004	0.001	25	6
12378-PentaCDD	0.016	0.003	19	6
123478-HexaCDD	0.008	0.002	25	6
123678-HexaCDD	0.017	0.004	24	6
123789-HexaCDD	0.013	0.004	31	6
1234678-HeptaCDD	0.096	0.033	34	6
Total Tetra- bis OctaCDF/Ds	4.34	0.72	17	6
TE (BGA 1984)	0.079	0.015	19	6
TE (NATO/CCMS 1988)	0.064	0.014	22	6

Not detected congeners or homolog groups are not included in the calculation of totals and TE-values

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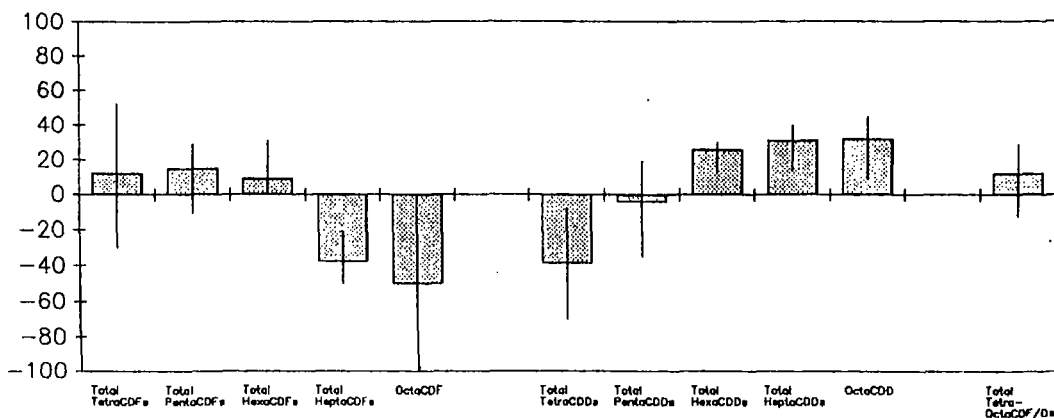
As can be seen in Table 1, the relative standard deviation (s_{rel}), including the whole method from sampling to GC/MS analysis, is 22 % for the TE value (NATO/CCMS).

This is in the range of standard deviations accomplished with other methods described in the VDI guideline series 3499³, for comparably higher PCDF/D concentrations ($> 1 \text{ ng TE/m}^3$).

Figure 1 shows graphically the results from parallel samplings performed by GfA and LIS comparing the adsorption method (sampling by GfA) to the filter-condensation method (sampling by LIS). The deviations are in the range of standard deviations from parallel samplings for both methods (compare Table 1). It has to be taken into account that local and temporary non-homogeneities in the stack gas cannot be excluded.

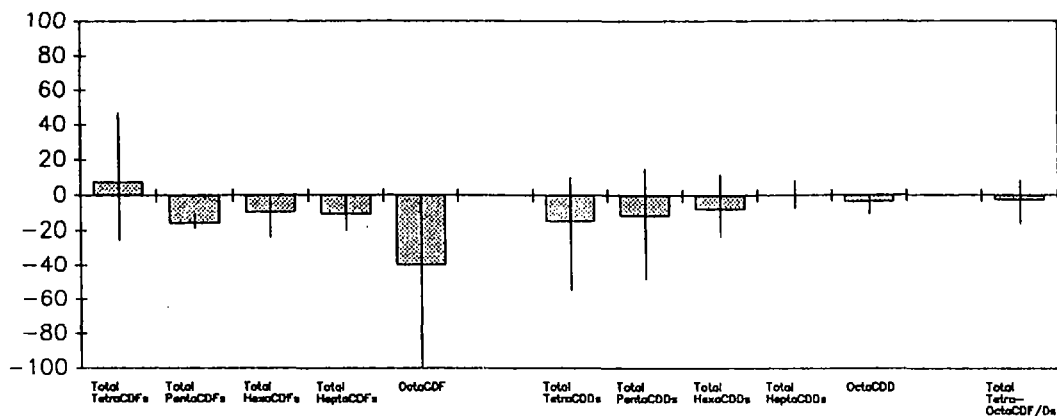
Figure 2 shows comparable results for measurements performed solely by the LIS comparing the two methods.

Figure 1: Percentage differences in PCDF/D concentrations determined with the adsorption method (set to 100 %) and the filter-condensation method at a combustion facility with PCDF/D emissions of approx. 0.1 ng TE/m^3 ; mean values and ranges from 3 parallel samplings (samplings performed by GfA and LIS, respectively)



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Figure 2: Percentage differences in PCDF/D concentrations determined with the adsorption method (set to 100 %) and the filter-condensation method at a combustion facility with PCDF/D emissions of approx. 0.1 ng TE/m^3 ; mean values and ranges from 3 parallel samplings (samplings performed by LIS)



The results presented here complete the data that verify the applicability of the new sampling method for the determination of low PCDF/D concentrations in flue gas of combustion facilities. This method assures that the stack discharge limit of 0.1 ng TE/m^3 according to the 17. BImSchV⁴ can be verified with high reliability.

References

- 1 Funcke, W., Linnemann, H. *Chemosphere* 1992; 24: 1563-72.
- 2 VDI guideline 3499, part 2, Düsseldorf 1993 (draft).
- 3 VDI guideline 3499, part 1, Düsseldorf 1990 (draft); VDI guideline 3499, part 3, Düsseldorf 1990 (preliminary draft); VDI guideline 3499, part 4, Düsseldorf 1988 (preliminary draft).
- 4 17. Verordnung zur Durchführung des Bundes-Immissionsschutzgesetzes (Verordnung über Verbrennungsanlagen für Abfälle und ähnliche brennbare Stoffe - 17. BImSchV), *Bundesgesetzblatt*, 1990: 2545.