Change of PCDD/PCDF Profiles in the Wet Scrubber System of a Fluidized-Bed Incinerator used for Municipal Solid Waste

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Abstract

During the starting up of a fluidized-bed incinerator (FBI) used for burning municipal solid waste a not optimized operation lead to a contamination of the wet srubber system with PCDD/PCDF. The comparison of the PCDD/F profiles showed significant differences before and behind the scrubber presumably due to desorption/adsorption at the scrubber walls.

Introduction

A fluidized-bed incinerator (FBI) for burning municipal waste has been put into operation in 1997. In order to optimize the operational conditions examinations took place in 1998 e.g. to verify the adherence to the limit value of the PCDD/F emissions of 0.1 ng ITEQ/m³.

In course of the starting up of the FBI, the waste charging procedure as well as the fluid-bed combustion itself have been optimized.

In the middle of 1998, serious contamination of the flue gas cleaning system downstream of the fabric filter occurred due to disruptions and troubles of the fluidized-bed process and due to defective single bags of the fabric filter itself. With the repair of the fabric filter defects in combination with its optimized operation, the clean gas remained under the PCDD/F limit value. Gas samples taken at the same time downstream of the fabric filter and behind the 2-step wet scrubber system showed a significant increase of the ITEQ-values. Similar observations on a much lower level have been published in the last years [1,2,3].

With the examination results around the wet scrubber system presented here we will discuss in how far adsorption/desorption effects could be a reason for the increased PCDD/F contents of the clean gas [4,5].

Plant description

The FBI has one combustion line equipped with a fluidized-bed oven designed for burning 10 tons of waste per hour. The flue gas cleaning installation unit consists of a post-combustion chamber, a boiler with the super heater section and the economizer, a spray dryer with the injection of scrubber water coming from a precipitation container, a fly stream reactor with the addition of lime containing 5 up to 15 % activated carbon, a fabric filter, a venturi scrubber, an alcaline scrubber and a steam reheating. Typical daily average emission data are shown in tab. 1:

| Volstr. | O ₂ | СО | NO _x | SO ₂ | HCl | TOC | Dust |
|--------------------|----------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| Nm ³ /h | Vol-% | mg/m ³ |
| 50.000 | 12,5 | 4,5 | 165 | 2,0 | 1,0 | 2,0 | 0,3 |

Sampling, sample treatment and analysis

ORGANOHALOGEN COMPOUNDS Vol. 41 (1999) In Fig. 1 the PCDD/F sampling points A, B and C in the flue gas of the FBI are represented schematically.



PCDD/F sampling and analysis of the emission samples were performed by MPU according to DIN EN 1948 part 1,2,3 using filter cooler method (B3), in combination with XAD-2 adsorber and HRGC/HRMS. A part of the emission measurements (#1 to 4, 7) were done by independent experts according to german guideline VDI 3499 part 1. The results have been normalized to standardized conditions and the operational oxygen content.

Results and Discussion

Not optimized combustion conditions combined with leaks in the fabric filter lead to serious contamination of the wet scrubber sytem during the first half of 1998. The evaluation of PAH data received at the same time with measurement No. 5 showed an increase of PAH emissions of a factor of 6 in sampling point C compared to sampling point A.This leads to the conclusion that there have been leaks within many of the single bags of the fabric filter. Directly before measurement No. 6 the fabric filter has been upgraded and for the first time it could be shown that the limit value for the PCDD/F could be achieved at sampling point B though the ITEQ-values increased again by a factor of 26 downstream of the wet scrubber system. A cleaning of the scrubber by means of emptying and flushing with clear water, lead, as shown at measurement No.7, to a decreased PCDD/F content in the clean gas of about a factor of 2.

| PCDD/F at the sampling points A, B and C [ng ITEQ/m ³] | | | | | | | | |
|--|----------|------|-------|------|-----------------------------|--|--|--|
| No | Date | Α | В | С | Remarks | | | |
| 1 | 19.01.98 | 9,7 | - | 0,29 | Lime, 5 % activated carbon | | | |
| 2 | 20.01.98 | 3,5 | - | 0,27 | Lime, 5 % activated carbon | | | |
| 3 | 13.08.98 | 34 | - | 6,9 | Lime, 5 % activated carbon | | | |
| 4 | 19.08.98 | 134 | - | 5,3 | Lime, 5 % activated carbon | | | |
| 5 | 22.10.98 | 4,02 | - | 1,99 | Lime, 15 % activated carbon | | | |
| 6 | 05.11.98 | - | 0,052 | 1,37 | Lime, 15 % activated carbon | | | |
| 7 | 20.11.98 | 2,7 | 0,08 | 0,62 | Lime, 15 % activated carbon | | | |

Table 2 PCDD/F results at the sampling points A, B and C

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A comparison of the PCDD/F congener sums of sampling point B and C shows a significant shift of the PCDD/F-profiles towards the lower chlorinated PCDD/F which have the higher vapor pressure. Whereas the OCDD and OCDF have approximately the same concentration, the lower chlorinated congeners are 20 to 80 times higher behind the wet scrubber system (see figure 2 and 3).



Figure 2 to 3: PCDD/F contents at sampling point B and C



Figure 4 to 5: PCDD/F distribution at sampling point B and C

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As a consequence of the PCDD/F values found, the complete wet scrubber system has been opened and has intensively been cleaned. The results of the PCDD/F analysis of the cleaning sludge showed the sizeable content of PCDD/F of 57600 ng ITEQ/kg dry matter (sum of PCDD and PCDF 4.05 mg/kg dm., see table 3) in the sludge.

| | PCDD | | PCDF |
|-------------|--------------------|-----------------|--------------------|
| | [ng/kg dry matter] | | [ng/kg dry matter] |
| Sum TCDD | 13100 | Sum TCDF | 263000 |
| Sum PCDD | 49000 | Sum PCDF | 546000 |
| Sum HxCDD | 143000 | Sum HxCDF | 834000 |
| Sum HpCDD | 234000 | Sum HpCDF | 1030000 |
| OCDD | 125000 | OCDF | 809000 |
| Sum T4-OCDD | 564100 | Sum T4-OCDF | 3482000 |
| | | Sum PCDD + PCDF | 4046100 |

Table 3: PCDD/F contents of the sludge sample from the scrubber cleaning

In our opinion, the reasons for the significant increase of the PCDD/F concentration in the gas which passed the wet scrubber system, could be found in a desorption from the polymer coated fibreglass-reinforced plastic of the scrubber walls which acted as a storage for organic compounds and perhaps on the other hand in a PCDD/F-discharge from deposits of sludge, soot and particles on the scrubber walls.

To determine the influence of the scrubber wall material on the increased PCDD/F concentration, material samples have been drawn from the scrubber walls directly before the cleaning procedure. The PCDD/F results of these samples will be presented at the 19th dioxin symposium in Venice.

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