Organic Components Reduction (PCDD/PCDF/PCB) in Flue-Gases and Residual Materials from Waste Incinerators by Use of Carbonaceous Adsorbents

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1. Introduction

Enforcement of and compliance with the limits imposed by the 17th Federal Pollution Control Directive, in particular for organic pollutants (PCDD/PCDF 0.1 ng/Nm³) and heavy metals (Hg 0.05 mg/Nm³) for purification of exhaust gases in municipal waste incinerators [1], led to the rapid development and introduction of suitable processes. One of these processes is the so-called entrained-flow process using carbonaceous adsorbents, an extensive range of which is available on the market under the trade name of Sorbalit® (mixtures of "lime and carbon").
While introduction of this process was important primarily for compliance with limits, the question of disposal or utilization of filter residues in the entrained-flow process is coming more and more to the fore with relation to the residue-minimizing requirement.

2. Dry Sorption Process

Especially in the purification of exhaust gases in municipal waste incinerators with high exhaust gas temperatures of 180 - 200 °C dry sorption is a safe and economical approach to control the limits for PCDD/PCDF.
The main part of the dry sorption process is the injection of a carbonaceous adsorbent in the flue gas and the collection on a fabric filter . [2]

3. Results of Flue Gas Purification

The measurement results obtained from various municipal waste incineration plants show emission values in purified gas that are considerably lower than 0,1 ng TEQ/Nm³ for PCDD/PCDF.
Very low values are also obtained for other organic pollutants, such as chlorobenzenes, PCB and PAH. The following Table 1 which is representative for a total number of 30 plants in continuous operation gives the emission values of organic pollutants as evidenced in the waste incineration plant of Geiselbullach (Germany) from November 1990. [3]

Table 1: Concentration of organic pollutants in gaseous emissions of the municipal waste incinerator of Geiselbullach (Germany) in two measurements.

Parameter	Untreated Gas	Purified Gas
PCDD/PCDF	2.17 ng TEQ/Nm³	0.069 ng TEQ/Nm³
	2.10 ng TEQ/Nm³	0.035 ng TEQ/Nm³
Chlorobenzenes	2630 ng/Nm³	10.8 ng/Nm³
	882 ng/Nm³	0.4 ng/Nm³
PCBs	119.4 ng/Nm³	24.2 ng/Nm³
	59.1 ng/Nm³	2.8 ng/Nm³
PAHs	2.21 µg/Nm³	0.25 µg/Nm³
	2.42 µg/Nm³	0.22 µg/Nm³

4. Constituents in Residual Material

The comparison of constituents in reaction products between the use of normal pure hydrated lime and a mixture of lime and activated carbon shows significantly higher values when using mixtures.

Table 2: Comparison of constituents in reaction products

Parameter	Hydrated Lime	Sorbalit®
PCDD/PCDF (dioxins/furans)	320 ng/kg	970 ng/kg
PCBs (polychlorinated benzenes)	0.0414 mg/kg	0.1267 mg/kg
PCPh (polychlorinated phenols)	0.088 mg/kg	0.099 mg/kg
PCN (polychlorinated naphtalenes)	0.001 mg/kg	0.014 mg/kg
PAH (polycyclic aromatic hydrocarbons)	0.11 mg/kg	3.29 mg/kg
HCH (hexachlorocyclohexane)	0.003 mg/kg	0.008 mg/kg

Measurement results of the concentration of dioxins and furans in the residual material are now available from a wide range of plants among which may be mentioned: [4]

- the hazardous waste incineration plant Schöneiche with 238 ng TEQ/kg residual material
- the spray sorption system at the hazardous waste incineration plant Schweinfurt with only 131 ng TEQ/kg residual material
- the filter dusts from the municipal waste incineration plant Würzburg with averages ranging from 71 - 202 ng TEQ/kg.

It is remarkable that all results obtained so far are below 1000 ng TEQ/Nm³ which is a limit value for the disposal in many landfills.

5. Residue in Emission-Control Filters

If using carbonanceous adsorbents in the entrained-flow process as the final cleaning stage after wet scrubber (emission-control filters), a residue of about 2 to 3 kg/t of waste may be expected. This small quantity, which is only slightly contaminated with mercury, since the latter is very largely removed in the scrubber, may be disposed of in various ways:

- Return to combustion chamber
- Thermal treatment
- Use as neutralizing agent in scrubbers
- Smelting

Return to the combustion chamber has been practiced at the Zirndorf municipal waste combustor (Germany) since 1991. This plant is the first one for which this process was officially approved.

Part of the used adsorbent material ($Ca(OH)_2$ 80 % OHC 20 %) is steadily drawn from the recirculation hopper of the bag filter and fed through a rotary valve to a weighing device. From there the material is transported directly to the combustion chamber by means of pneumatic conveyors. The used adsorbent material is injected into the hottest part of the flame. There the flame serves to dispose of the adsorbed organic pollutants. Any mercury and other metals driven out again are taken out by the scrubber, so that no undue buildup takes place. [5]

Table 3: Emission Values of the Municipal Waste Incinerator of Zirndorf (Germany), measured over a period of 3 years

Parameter		**1991**	**1992**	**1993**
PCDD/PCDF	ng TEQ/Nm³	0.0059	0.001	0.001
Mercury	mg/Nm³	0.01	0.006	0.001

6. Conclusion

Minimization of dioxin thus proceeds free of residue, since the contaminated activated carbon and the dioxin are reliably destroyed thermally. For all plants which use emission control filters, this process variant is the simplest, most reliable and cheapest way to handle residue problems, also meeting the residue-minimizing requirement.

7. References

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