PCDD/F- and PAH-Emission from House Heating Systems

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1. Introduction

German municipal waste incinerators emit PCDD/F-concentrations of 313 g I-TE/year[1] by a waste gas concentration of 6 ng I-TE/m^3. House heating emissions were calculated for Germany to 4 - 20 g I-TE/year[2]. Newer dates gave for Baden-Württemberg[3] (a country from germany) about 10 g I-TE/year for house burning with wood. This means for Germany a total emission by house burning of 100 - 150 g I-TE/year. At the introduction of the 17. BImSchV the emissions of municipal waste incinerators for Germany will reduce to 5 g I-TE/year[1] and also the emissions of the metall regeneration. To investigate the calculated data about house burning emission experiments on burning of natural wood, paper, cartons and plastics were carried out at the fire test stand of the institute of Landtechnik in Weihenstephan.
Beside the PCDD/F-concentrations also PAH-concentrations were detected.

2. Experimental

2.1 Incineration experiments
Different fuels were burned in tiled stoves and boilers (see table 1 and 2). The sampling was done by the filter-cooler method according to the VDI guide line 3499 page 2[4] and the VDI guide line 2066 page 1 and 2[5,6].

2.2 Clean up and GC/MS analysis
The clean up of the exhaust gases and the chimney soot samples and also the GC/MS analysis were done by the method of Hagenmaier et al[7]. For the detection of PAH a aliquot of the extract was spiked with 4 PAH-standards and after concetration analyzed by GC/MS.

3. Results

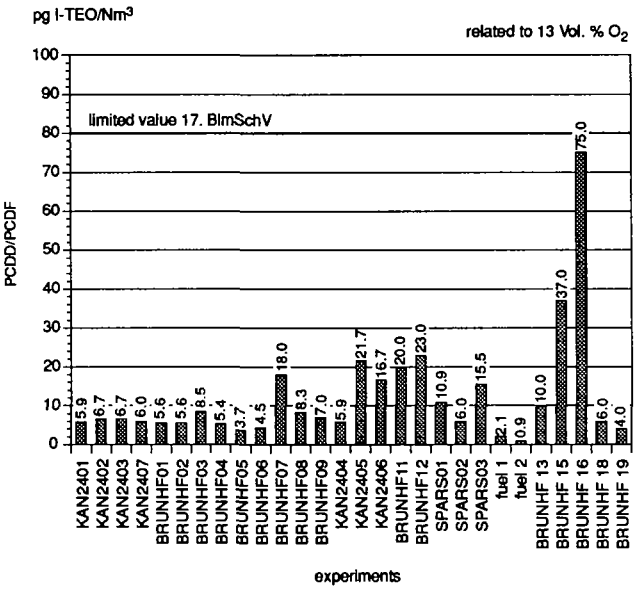

Fig. 1: Emissions of PCDD/F during the incineration of natural untreated wood, fuel mixtures and light fuel in domestic plants

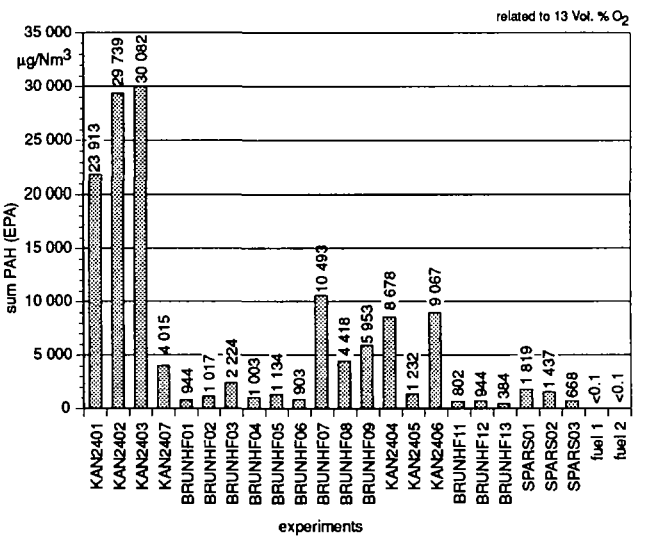

Fig. 2: PAH emissions during the incineration of fuel in domestic plants

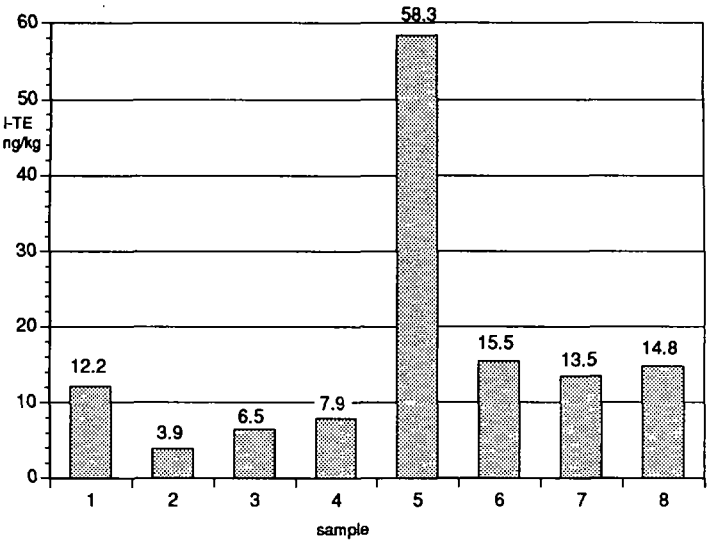

Fig. 3: PCDD/F-concentrations in chimney soot

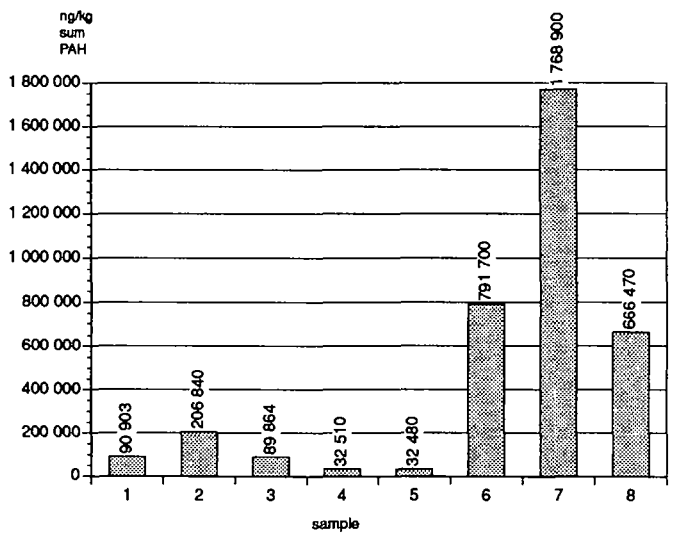

Fig. 4: PAH-concentrations in chimney soot

fuel	water content %	PCDD/F-concentration pg I-TE/Nm³	system
pieces of conifers (KAN 2401-2407)	15-20	7	tiled stove old
pieces of conifers (BRUNHF 01-03)	15-20	6	tiled stove new
pieces of beech (BRUNHF 04-06)	15-20	5	tiled stove new
pieces of conifers (BRUNHF 07-09)	> 30	11	tiled stove new
pieces of beech (KAN 2404-2406)	15-20	14	tiled stove old
pieces of conifers (SPARS 01-03)	15-20	11	tiled stove air margin
briquettes of conifers (BRUNHF 11-13)	< 10	18	tiled stove new
beech and mixture from newspaper, cartons, enomalled.prospects. (30%) (BRUNHF 15, 16)		56	tiled stove new
beech and 20% plastics (mixture from PP, PE, PS (BRUNHF 18)		6	tiled stove new
beech and 2% plastics (mixture from PP, PE, PS (BRUNHF 19)		4	tiled stove new
oil		2	boiler

Table 1: Average-PCDD/F concentrations in emissions

fuel	water content %	PAH µg/Nm³	system
pieces of conifers (KAN 2401-2407)	15-20	21 937	tiled stove old
pieces of conifers (BRUNHF 01-03)	15-20	1 395	tiled stove old
pieces of beech (BRUNHF 04-06)	15-20	1 013	tiled stove new
pieces of conifers (BRUNHF 07-09)	> 30	6 954	tiled stove new
pieces of beech (KAN 2404-2406)	15-20	6 326	tiled stove old
pieces of conifers (SPARS 01-03)	15-20	1 308	tiled stove air margin
briquettes of conifers (BRUNHF 11-13)	> 10	710	tiled stove new

Table 2: Average-PAH concentrations in emissions (related to 13 Vol% O_2

4. Discussion

In relation to the exhaust investigations the following first statements can be made:

- in general the PCDD/F-concentrations with natural untreated wood are in the range of 4 to 18 pg I-TE/Nm^3 (related to 13 Vol% O_2)
- the highest concentrations were found using briquettes of conifers as fuel
- the incineration of wood and plastic (without chlorine) gave the same con centrations like the incineration of beech
- the highest concentrations were found by burning beech, newspaper etc. Here we get PCDD/F on the average of 56.0 pg/Nm^3 I-TE (limit value 80 pg/Nm^3 I-TE)
- the average concentrations of PAH are in the range of 710 to 21 937 µg/Nm^3
- in all experiments we see, that the emissions were reduced by a factor 6 to 16 changing an old tiled stove against a new one
- also the increasing water content to > 30 % gave a increasing of the PAH concentration by a factor 6
- the lowest emission concentration gave the burning of pine

5. Literature

1) **Umweltbundesamt** - Koordination, Erfassung und Auswertung von Dioxinmessungen an Abfallverbrennungsanlagen - Abschlußbericht, Berlin (April 1991)

2) **Dioxine und Furane, StMLU**, RB.-NR. 14/93/14, ISBN 3-910088-08-2, 1. Auflage Oktober 1993

3) **Hagenmeier, H., Krauß, P. , Vatter, I., Walczok, M.**: Organohalogen Compounds 22, 49 (1995)

4) **VDI 3499 Blatt 2** Messen von Emissionen: Messen von polychlorierten Dibenzo-p-dioxinen (PCDD) und Dibenzofuranen (PCDF); Filter/Kühlermethode; VDI-Handbuch Reinhaltung der Luft, Band 5 (1993)

5) **VDI 2066 Blatt 1** Messen von Partikeln: Staubmessungen in strömenden Gasen; Gravimetrische Bestimmung der Staubbeladung; Übersicht, Oktober 1975, Düsseldorf

6) **VDI 2066 Blatt 2** Messen von Partikeln: Manuelle Staubmessung in strö menden Gasen; Gravimetrische Bestimmung der Staubbeladung; Filterkopfgeräte (4 m3/H, 12 m3/h), Oktober 1975, Düsseldorf

7) **H. Hagenmeier, H. Brunner, R. Haag, H.-J. Kunzendorf, M. Kraft, K. Tichaczek, U. Weberruß;** VDI-Bericht 634, S. 61 (1987)