Influences of Various Fuel Fractions on the Concentration of Chlorinated Aromatic Compounds in Waste Incineration Raw Gas

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1. Introduction

Chlorinated aromatic compounds and their dependency of different waste fractions are still a topic of concern in waste incineration. In view of the widely accepted de-novo reaction for the formation of PCDD/F [1] especially the influence of Cl, Br and Cu containing waste fractions is of major interest.

2. Experimental

During two experimental campaigns at the TAMARA test facility for waste incineration [2] various fuel mixtures have been combusted over a period of 24h each and their influence on the raw gas concentrations of chlorinated aromatic compounds has been investigated. The parameters of the incinerator (primary air supply and its distribution) were always kept constant. Differences in the heating values of the fuel mixtures were compensated by variation of the mass flow in order to keep the temperature and the oxygen concentration at the outlet of the combustion chamber constant. Sampling of the chlorinated aromatic compounds was performed in the raw gas as shown in Fig.1. Sampling started always 16h after changing the fuel. All sampling was carried out several times over a period of about 8h.

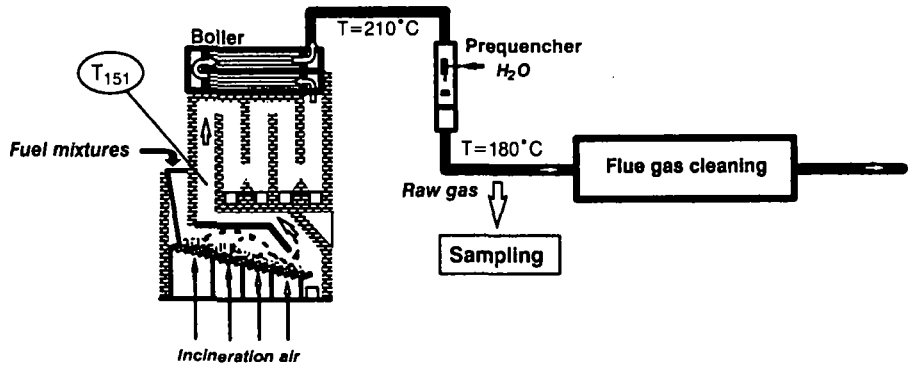

Fig.1: Flow chart of TAMARA and sampling position

3. Results and discussion

All experiments were characterized by an excellent burnout of the flue gas and the fly ashes. The CO levels were always in the range of the detection limit (<2 mg/Nm^3). The concentrations of the most important gaseous constituents are shown in Tab.1 and the related fly ash data are compiled in Tab.2. The different fuel mixtures influence the raw gas composition and the fly ash data significantly.

Tab.1: Flue gas data

fuel	Exp. No.	Flue gas concentrations					
		O_2	CO_2	H_2O *)	HCl	HBr	T_{151}
		Vol.%	g/Nm^3	g/Nm^3	mg/Nm^3	mg/Nm^3	°C
wood chips	1.1	11.5	175	122	24	0.5	895
straw pellets	1.2	12.1	152	75	171	1.1	925
MSW/RDF	1.3	11.1	155	109	630	1.1	918
MSW/RDF	1.4	10.8	159	110	596	1.2	960
MSW/RDF/ASR	1.5	11.3	140	75	789	3.2	947
MSW/RDF/E&E	1.6	11.7	135	68	816	146.6	943
MSW/RDF	2.1	10.8	175	144	881	13.3	949
MSW/RDF/PVC	2.4	10.2	158	183	3496	4.8	971
MSW/RDF/E&E	2.5	10.9	149	128	1265	85.8	993
MSW/RDF	2.6	10.1	162	157	940	17.9	981

MSW=municipal solid waste, RDF=refuse derived fuel, ASR=automotive shredder residue, E&E=electrical and electronic waste

*) = H_2O concentration in front of the prequencher

Tab.2: Fly ash data

fuel	Exp. No.	Fly ash conc.	Fly ash composition			
			C	Cu	Cl	Br
		mg/Nm^3	%	ppm	%	%
wood chips	1.1	54	0.632	737	4.74	0.069
straw pellets	1.2	480	0.036	997	5.26	0.175
MSW/RDF	1.3	553	0.047	3382	6.71	0.073
MSW/RDF	1.4	583	0.032	3060	6.74	0.087
MSW/RDF/ASR	1.5	881	0.015	13498	8.76	0.194
MSW/RDF/E&E	1.6	841	0.025	3688	6.99	2.646
MSW/RDF	2.1	406	0.030	2810	5.81	0.066
MSW/RDF/PVC	2.4	827	0.023	6603	8.16	0.037
MSW/RDF/E&E	2.5	646	0.025	5121	7.65	2.898
MSW/RDF	2.6	428	0.021	3592	7.89	0.474

Tab.1 points out that the raw gas concentration of HCl varied in a wide range. The lowest values were detected when burning natural wood chips (exp. 1.1, HCl=24mg/Nm^3) the highest when burning MSW/RDF/PVC (exp. 2.4, HCl=3500 mg/Nm^3). The concentration of chlorine in the fly ash was not influenced significantly.

The co-feeding of E&E waste increased the bromine inventory of the fuel substantially. This resulted in high values of HBr in the gas phase and in high concentrations of bromine in the fly ashes (exp 1.6 and 2.5).

High concentrations of copper were found in the fly ashes when burning MSW/RDF/ASR (exp.1.5).

The concentrations of the chlorinated aromatic compounds detected in the raw gas of all experiments are compared in fig.2 and 3.

In spite of the almost constant temperature level, oxygen concentration and fly ash load different concentrations of chlorinated aromatic compounds were obtained in the two campaigns even when burning the same fuel mixture. The concentrations in campaign 2 were rather low and document that very low concentrations of chlorinated aromatic compounds can be achieved already in the raw gas. For the time being there is no explanation for the differences and more detailed investigations are needed to guarantee a permanent operation at such low levels.

In general the very high differences in the fuel concentrations of Cl, Cu and Br show no significant variations in the concentration levels and homologue profiles of the different investigated chlorinated aromatic compounds.

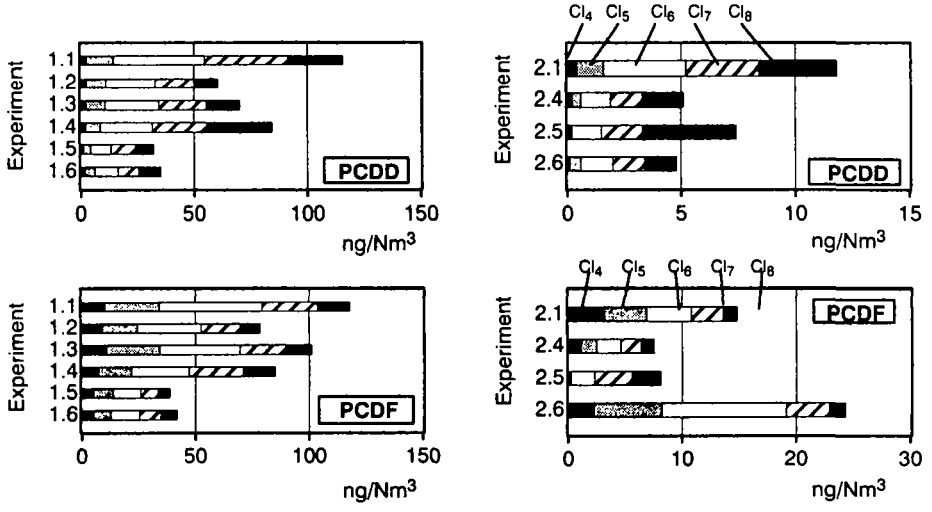

Fig.2: Concentrations of PCDD/F in the raw gas

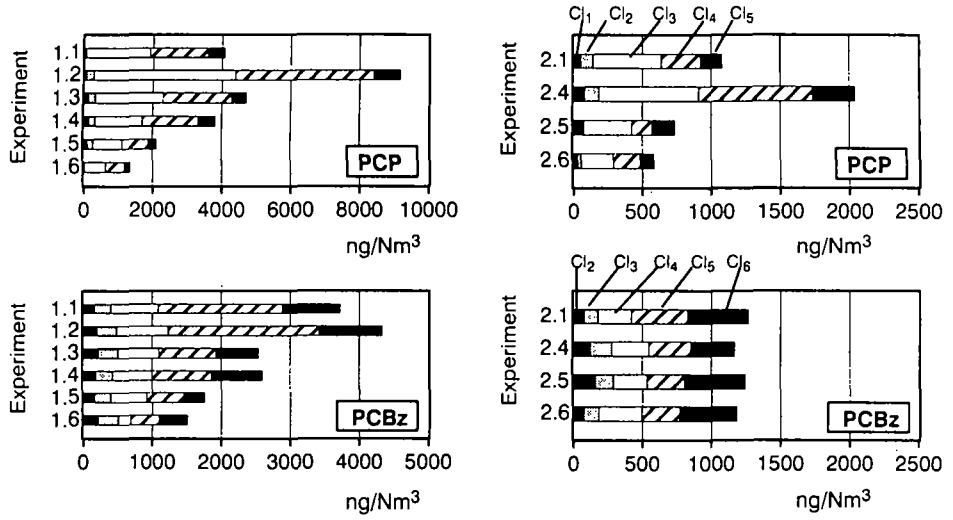

Fig.3: Concentrations of chlorophenols (PCP) and chlorobenzenes (PCBz) in the raw gas

These findings support the results of a study upon the effects of PVC in the case of Cl [3] and verify former experiments on the co-combustion of various plastic fractions in the case of Cl, Br and Cu [4,5].

4. References

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