Coplanar PCBs and PCDDs/PCDFs in Municipal Waste Incineration

S.Sakai*, M.Hiraoka**, N.Takeda**, K.Shiozaki***
*Environment Preservation Center, **Department of Environmental & Sanitary Engineering, Kyoto University, Sakyo-ku, Kyoto 606, Japan
*** Kaneka Techno Research Co., Ltd., Yoshida-cho, Kobe 602, Japan

Coplanar PCBs, having a planar structure involving 4 or more chlorine substitutions at the "meta" and "para" positions, but no chlorine substitution at the "ortho" position, are known to be similar in nature to PCDDs and PCDFs. In view of some reports of high Co-PCB concentrations in human adipose tissue and fish, and of the greater toxic contribution of Co-PCBs than PCDDs and PCDFs, and since municipal waste incineration produces significant amounts of PCDDs and PCDFs, which are structurally similar to Co-PCBs, it is urgently necessary to confirm the level of production of Co-PCBs in the incineration of municipal waste. A slight modification of the alumina column fractionation method (Figure 1), in accordance with the present analytical manual of PCDDs/PCDFs was investigated for potential use by recovery tests using standard mixtures and by analyses of actual flyash samples and exhaust gas.

The recovery tests using standard substances confirmed the applicability of the alumina column three-fraction method following silica gel cleanup. The percent contribution of Co-PCBs to the total PCB concentration in flyash and exhaust gas from municipal waste incineration was about 5 to 10%, higher than that in Yusho oil and PCB oil, which has about 1% (Table 1). Also, the toxicity of Co-PCBs accounted for about several percents of the 2,3,7,8-TCDD toxic equivalent concentration (Table 2) ; Co-PCBs do not appear to be detected at concentrations as high as in fish and human tissue. However, further investigation should be continued, since the number of samples analyzed was too small to fully assess the status of Co-PCBs involved in the incineration of municipal waste.

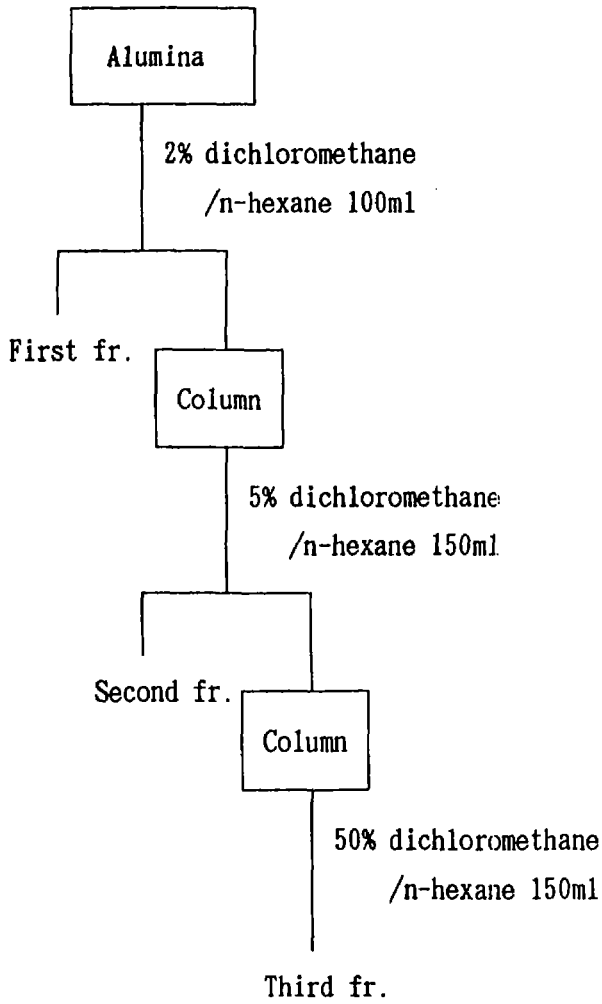

Figure 1 Alumina column fractionation

Table 1 Concentrations of PCBs in exhaust gas from MSW incineration

(ng/Nm³)

	Exhaust gas	
	Alumina	Activated charcoal on silica gel
Coplanar PCBs		
3,3',4,4'-T_4CB	12	14
3,3',4,4',5-P_5CB	7.9	7.1
3,3',4,4',5,5'-H_6CB	1.8	2.0
Total Coplanar PCBs	22	23
other PCBs		
D_2CBs	53	86
T_3CBs	102	120
T_4CBs	142	180
P_5CBs	59	71
H_6CBs	30	28
H_7CBs	29	19
O_8CBs	16	22
N_9CBs	13	16
Total other PCBs	440	540
Total Coplanar PCBs + Total other PCBs	460	560

Table 2 2,3,7,8-T_4CDD TEQ concentration of exhaust gas including Co-PCBs

		2,3,7,8-T_4CDD TEQ conc. (ng/Nm^3 as 2,3,7,8-T_4CDD)	
	TEQ factor*1	Alumina method	Dioxin manual
2,3,7,8-T_4CDD	1	1.2	0.79
1,2,3,7,8-P_5CDD	0.5	3.8	3.8
2,3,7,8-substituted H_6CDD	0.1	1.3	2.4
1,2,3,4,6,7,8-H_7CDD	0.01	0.90	1.1
O_8CDD	0.001	0.13	0.13
Total PCDDs		7.3	8.2
2,3,7,8-T_4CDF	0.1	0.65	0.68
1,2,3,7,8-P_5CDF	0.05	0.85	1.4
2,3,4,7,8-P_5CDF	0.5	8.5	10
2,3,7,8-subsituted H_6CDF	0.1	5.5	9.0
2,3,7,8-subsituted H_7CDF	0.01	0.87	1.2
O_8CDF	0.001	0.038	0.081
Total PCDFs		16	22
Total (PCDDs+PCDFs)		23	30
Coplanar PCBs *2			
3,3',4,4'-T_4CB	0.01	0.12	———
3,3',4,4',5-P_5CB	0.1	0.79	———
3,3',4,4',5,5'-H_6CB	0.05	0.09	———
Total Coplanar PCBs		1.0	

1) 2,3,7,8-T_4CDD toxic equivalent factors : International-TEF
2) Toxic equivalent factors of Co-PCBs is the proposal by Safe[2)]