Emission Level of Co-PCBs from MSW Incinerators

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Abstract

Under various conditions and simultaneously with measurements for dioxin and other related substances, the authors made many measurements of coplanar PCBs (Co-PCBs) in the flue gas of municipal solid waste (MSW) incinerators. We found that the toxic contribution of Co-PCBs to dioxin toxicity was low at about 5 percent, far less than that encounteredin food-stuffs.

Introduction

MSW incineration facilities are gaining acceptance among neighboring residents as progress is made in reducing dioxin emission level. Co-PCBs, which are structurally similar to dioxin, may be also the source of public concern ; and proper operation of such incineration facilities requires that Co-PCBs emission also be fully investigated. [1] Here, we surveyed three MSW incineration plants and obtained some understanding of th relation between Co-PCBs, dioxin and related substances. We report our findings below.

Experiments

outline of surveys and experiments is presented in Table 1.

Table 1. Outline of Investigation

Test	Subject	Facility	Capacity/Type/Gas cool	Dust collector
1	Each time Emission from an intermittent operation plant designed before GUIDLINE	A	10t/8h/line Stoker/ water spray	Electrostatic precipitator
2	Each time Emission from an intermittent operation plant designed after GUIDLINE Change along process flow	B	12.5t/8h/line Stoker/ water spray	Bag house
3	Change along process flow	C	65t/24h/line Stoker/ water spray	Electrostatic precipitator

FORM

Results

Survey results are shown in Tables 2. ~ 5. and Figures 1. ~ 6. A wide range analysis data of Co-PCBs were obtained, because we selected an existing facility without consideration for dioxin and new one with a lot of dioxin countermeasures, and also special efforts were made to measure concentration fluctuations as related to measurement position and non-normal operation.

Table 2. Test-1 Analysis Data (Facility-A)

	Unit	RUN 1 Start-up	RUN 2 Steady state		RUN 3* Shut-dn1	RUN 4* Shut-dn2	RUN 5* Night	RUN 6 Start-up	RUN 7 Steady state		RUN 8** Shut-dn1	RUN 9** Shut-dn2	RUN 10** Night
		EP-out	EP-in	EP-out	EP-out	EP-out	EP-out	EP-out	EP-in	EP-out	EP-out	EP-out	EP-out
Comb-Temp.	℃	100-800	600-980		480-760	400-480	100-360	120-360	560-880		160-460	200-240	80-180
EP-Temp.	℃	80-280	260-300		300-330	300-320	100-300	90-280	220-280		140-240	140-150	80-150
O_2 av.	%	14.8	14.2	14.7	16.0	18.8	20.5	14.2	15.0	15.5	20.0	20.6	20.9
CO av.	PPM	359		219	696	1588	424	573		246	455	327	22
THC	PPM	10		9	21	345	250	68		16	98	102	18
CBs	μg/m3N	60		43	170	620	110	87		25	59	57	10
CPs	μg/m3N	300		440	1000	3800	230	220		100	170	25	3.7
PCDDs	ng/m3N	740	970	2000	10000	40000	1200	2100	870	950	1400	1500	49
PCDFs	ng/m3N	1700	2100	2500	13000	15000	710	2400	940	860	670	1700	40
I-TEQ	ng/m3N	40.3	48.3	66.4	336.1	646.5	18.3	55.6	35.8	23.1	22.2	54.2	1.0
PCBs	ng/m3N	200	290	360	3000	3400	950	1300	150	130	550	310	16
Co-Cl4Bi	ng/m3N	19	13	25	160	390	30	73	7.0	10	11	4.8	0.2
Co-Cl5Bi	ng/m3N	13	9.3	24	100	220	16	28	4.3	7.5	5.3	2.5	0.1
Co-Cl6Bi	ng/m3N	1.5	1.3	5.1	50	67	6.2	3.4	0.64	1.4	0.8	0.6	0.3
Co-PCBsTE Hamberg[2]	ng/m3N	2.0	1.4	3.7	15.5	33.4	2.5	4.3	0.66	1.2	0.8	0.4	0.025
Co-PCBsTE Safe[3]	ng/m3N	1.6	1.1	2.7	14.1	29.3	2.1	3.7	0.53	0.9	0.7	0.3	0.027

*Stock fire operation **Burn-out operation

Table 3. Test-2 Analysis Data (Facility-B)

	Unit	RUN 1 Steady state				RUN 2** Shut-dn1	RUN 3** Shut-dn2	RUN 4** Night	RUN 6 Startup2	RUN 7 Steady state	
		Furnace	GC-out	BF-in	BF-out	BF-out	BF-out	BF-out	BF-out	BF-in	BF-out
Comb-Temp.	℃	780-890				600-930	324-460	170-306	810-960	805-925	
BF-Temp.	℃	170-180				160-180	130-160	120-155	165-180	170-180	
O_2 av.	%	10.3	10.5	10.3	11.4	15.1	20.7	20.9	7.8	11.2	11.6
CO av.	PPM			-	1.0	382	368	21	9		1.0
THC	PPM				0.1	44	157	14.6	1.7		0.4
CBs	μg/m3N	0.94	7.1	11	7.2	28	59	22	14	12	9.1
CPs	μg/m3N	0.46	4.2	9.5	12	340	55	26	36	16	20
PCDDs	ng/m3N	30	140	83	130	71	190	190	270	240	160
PCDFs	ng/m3N	70	630	130	540	140	280	160	540	310	240
I-TEQ	ng/m3N	2.02	20.9	3.18	14.25	2.86	6.48	5.09	8.46	8.90	6.55
PCBs	ng/m3N	64	206	240	190	120	350	68	360	130	110
Co-Cl4Bi	ng/m3N	0.33	3.1	2.4	4.1	4.3	7.5	1.3	13	5.6	5.4
Co-Cl5Bi	ng/m3N	0.39	4.8	1.3	3.3	1.4	2.9	1.1	6.0	2.7	2.2
Co-Cl6Bi	ng/m3N	0.46	7.23	0.62	4.1	0.55	1.5	1.1	2.9	1.4	0.95
Co-PCBsTE Hamberg[2]	ng/m3N	0.06	0.76	0.20	0.52	0.21	0.46	0.18	0.93	0.43	0.35
Co-PCBsTE Safe[3]	ng/m3N	0.06	0.87	0.18	0.58	0.21	0.45	0.18	0.88	0.40	0.32

GC=Gas cooler BF=Bag filter **Burn-out operation

Table 4. Test-3 Analysis Data (Facility-C)

	Unit	GC out	EP-in	EP-out
Gas-Temp.	°C	300	260	245
O_2 av.	%	7.7	7.7	11.8
CO av.	PPM			33
THC	PPM			2.8
CBs	μg/m3N	13	10	21
CPs	μg/m3N	38	46	67
PCDDs	ng/m3N	340	370	110
PCDFs	ng/m3N	1060	800	110
I-TEQ	ng/m3N	29.6	23.5	3.6
Co-Cl4Bi	ng/m3N	4.0		2.8
Co-Cl5Bi	ng/m3N	11.1		2.8
Co-Cl6Bi	ng/m3N	9.9		0.89
Co-PCBsTE Hamberg[2]	ng/m3N	1.73		0.42
Co-PCBsTE Safe[3]	ng/m3N	1.64		0.35

Table 5. Analysis Data of dust and slag Unit:ng/g

	Test-1 (Facility A)				Test-2	Test-3
	RUN 2		RUN 5*	Run 7	(Facility B)	(Facility C)
	Steady state		Night	Steady	Steady state	Steady state
	EP-dust	Slag	EP-dust	EP-dust	BF-dust	EP-dust
PCDDs	2900	0.89	4200	1700	230	210
PCDFs	810	1.7	1900	300	110	80
I-TEQ	36.7	0.02	74.7	16.7	4.41	4.3
PCBs	19	1.5	100	15	16	
Co-Cl4Bi	0.97	0.005	3.8	0.35	0.84	1.6
Co-Cl5Bi	1.3	0.001	4.7	0.45	0.65	1.6
Co-Cl6Bi	0.25	0.001	1.7	0.095	0.44	0.52
Co-PCBsTE Hamberg[2]	0.20	0.00016	0.72	0.068	0.10	0.24
Co-PCBsTE Safe[3]	0.15	0.00020	0.59	0.053	0.10	0.21

*Stock fire operation

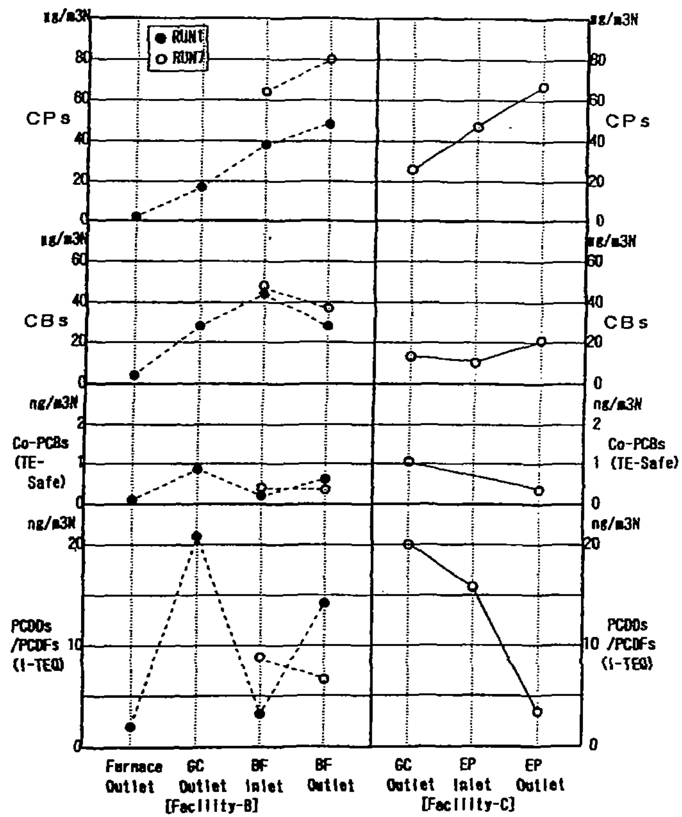

Figure 1. Concentration Change along Process Flow

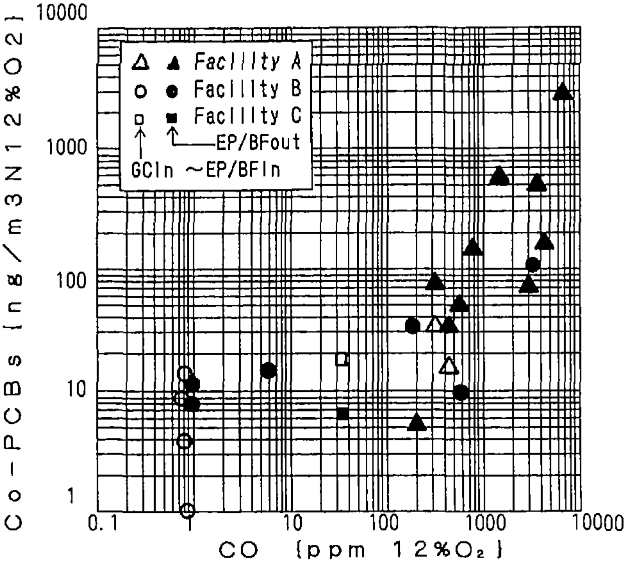

Figure 2 Relation between CO and Co-PCBs

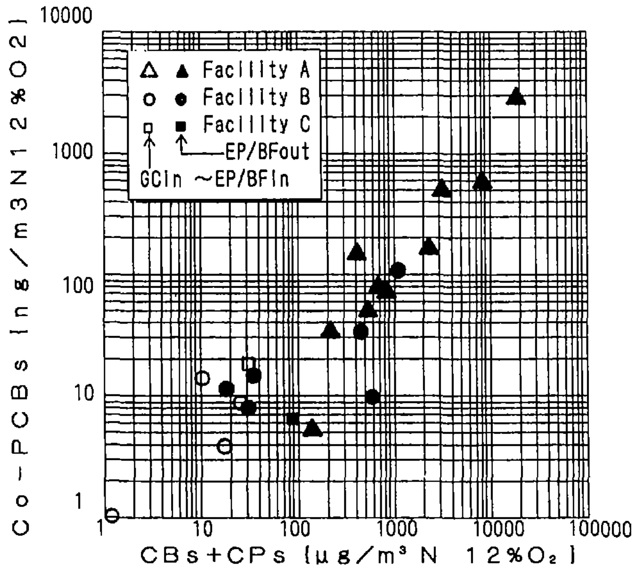

Figure 3. Relation between CBs+CPs and Co-PCBs

Discussion

Figures 1., arranged in processing flow, suggests that Co-PCBs are produced by a principle similar to that for PCDDs and PCDFs. Figures 2.~6. show strong correlations. In Figure 5. the toxicity contribution of Co-PCBs to dioxin toxicity was low at about 5 percent (In contrast, that for foodstuffs was reported to be 260 percent[4] to1000 percent[5]). From the above, we believe that emissions of Co-PCBs can be suppressed simultaneously in conjunction with measuresfor reducingdioxin emission.

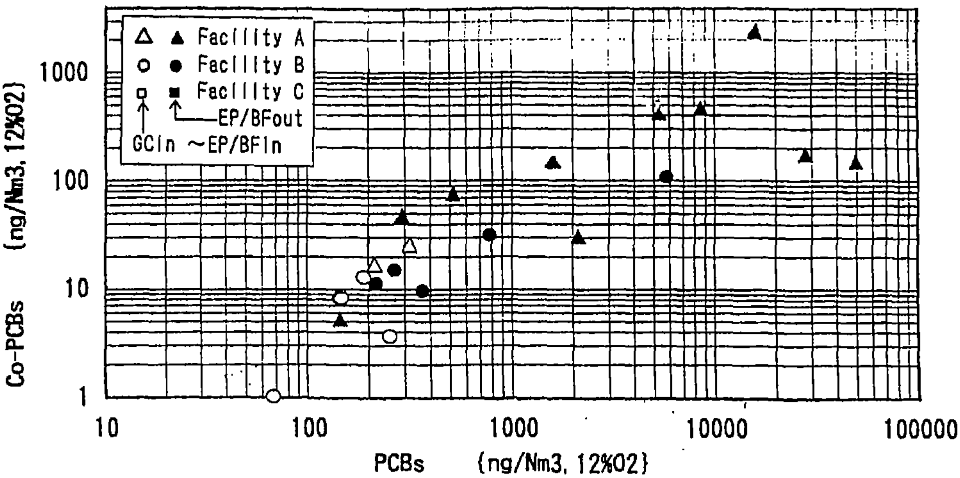

Figure 4. Relation between PCBs and Co-PCBs in Flue Gas (Black:EP/BF outlet, White:Furnace~EP/BF inlet)

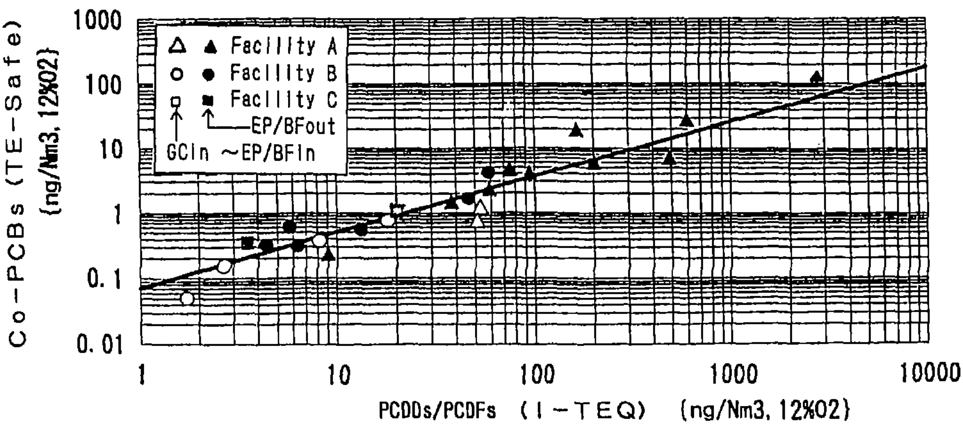

Figure 5. Relation between PCDDs/PCDFs and Co-PCBs in Flue Gas (Black:EP/BF outlet, White:Furnace~EP/BF inlet)

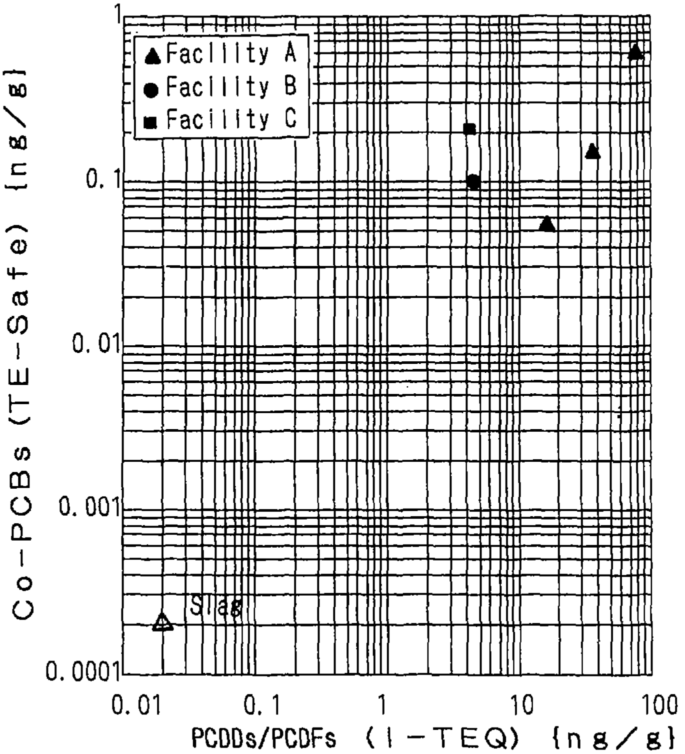

Figure 6. Relation between PCDDs/PCDFs and Co-PCBs in dast

Reference

1 S.Sakai et al.: Coplanar PCBs and PCDDs/PCDFs in Municipal Waste Incineration, DIOXIN'92 Vol.9 Tampere Finland, 1992
2 Hamberg et al.: Chemospher, 20, 1161-1164, 1990
3 Safe et al.: Short paper of DIOXIN'90, Vol.2, Bayrueth Germany, 1990
4 Masuda, Y : Dioxin Regulation and Research Action in Japan, DIOXIN'90, Vol.2, Bayrueth Germany, 1990
5 Kashimoto, T et al.: PCDDs/PCDFs and Coplanar PCBs in Japanese coastal and commercially marketed fish. EISEIKSGAKU, Vol.37, No.2, Japan, 1991