Concentrations of PCDDs, PCDFs and PCBs in Sera from Workers with Past and Present Exposure

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INTRODUCTION

The production and use of PCBs has been prohibited in Finland since early 1980s, but the products containing PCBs may still cause exposure until they have been properly destroyed. Finnish Institute of Occupational Health has done biological monitoring of serum PCBs since 1983 among workers with different occupational exposures. In the present study we analyzed the levels of PCDDs, PCDFs and PCBs from workers whose earlier results in routine biological monitoring had indicated occupational exposure. Part of the study, concerning biological monitoring results and non-*ortho*-chlorobiphenyls, was reported in DIOXIN'92 (1).

MATERIALS AND METHODS

Blood specimens for the determination of PCDDs, PCDFs and PCBs (non-, mono- and di-*ortho*-chlorinated PCBs were collected from workers in capacitor manufacture (past exposure until 1980's), capacitor paper manufacture (past exposure until 1980's), hazardous waste disposal (continuous exposure) and from referents.
The PCDDs, PCDFs and non-*ortho*-chlorobiphenyls were analyzed using semiautomated sample clean up procedure and isotope-dilution HRGC/HRMS for quantification (2,3).

We report here the results as wet weight basis (fg/g), the lipid adjusted results and the TEQs of PCDDs, PCDFs and all PCBs will be reported at the symposium.

RESULTS AND DISCUSSION

PCDDs

The congeners 2,3,7,8-TCDD (2378D), 1,2,3,7,8-pentaCDD (12378D), 1,2,3,4,7,8-(123478D), 1,2,3,6,7,8- (123678D), 1,2,3,7,8,9-hexaCDD (123789D), 1,2,3,4,6,7,8-(1234678D), 1,2,3,4,6,7,9-heptaCDD (1234679D) and octaCDD (OCDD) were determined. The serum dioxin levels of the referents were similar to those reported from other countries (4,5). The concentrations in capacitor paper manufacture were analyzed from one worker and were similar to the referents. In capacitor manufacture (past exposure) clearly higher concentrations compared to referents were found for 2378D, 12378D, 123478D, 123678D and 123789D (Table 1), while concentrations of the other three dioxin congeners were not different from the referents (Table 1). The exposure had ended about ten years before the samples were taken for this study. In the hazardous waste disposal plant (continuous exposure) the mean value of the isomer 123678D was 549 fg/g, i.e. two times higher than in the referents (274 fg/g) and a mean value for 123789D of 43.1 fg/g (16.9 fg/g in referents). All other isomers showed higher concentrations in some hazardous waste disposal workers: maximum concentrations of 2378D, 12378D, 123678D, 123789D, 1234678D and OCDD were about two times higher than in referents (Table 1). The elevated mean levels in waste disposal workers were caused by high values observed in some workers, while the majority were not different from the referents. This was to be expected since the workers came from different parts of the plant, such as waste reception, automated burning section and service functions, laboratory and inorganic waste section, and the exposure has probably been quite different in different jobs.

PCDFs

The congeners 2,3,7,8-TCDF (2378F), 1,2,3,7,8- (12378F), 2,3,4,7,8-pentaCDF (23478F), 1,2,3,4,7,8- (123478F9, 1,2,3,6,7,8- (123678F), 1,2,3,7,8,9- (123789F), 2,3,4,6,7,8-hexaCDF, 1,2,3,4,6,7,8- (1234678F), 1,2,3,4,7,8,9-heptaCDF (1234789F) and octaCDF (OCDF) were determined. The serum furan levels of the referents in this study were similar to results from other countries (4,5). The concentrations of seven furan congeners were similar in capacitor manufacture (past exposure) workers (Table 1). The mean concentrations of three furan congeners in capacitor manufacture (past exposure) workers were higher compared to referents: 23478F, 123478F and 123678F. In hazardous waste disposal plant workers three congeners 234678F, 1234789F and OCDF mean concentrations were similar

Table 1. Dioxins, furans and coplanar PCBs in different exposure groups (wet weight results (fg/g).

fg/g wet weight	REFERENTS (N=5)			CAPACITOR MANUFACTURE (N=4) (past exposure)			HAZARDOUS WASTE (N=12) (continuous exposure)		
	Mean	Med	Range	Mean	Med	Range	Mean	Med	Range
Dioxins									
2378D	10.6	11.1	4.55 -13.7	19.3	18.7	13.4 - 26.4	10.9	9.35	4.75 - 27.8
12378D	38.8	40.8	28.8 - 50.9	66.1	66.2	58.7 - 73.3	50.1	43.8	19.2 - 92.6
123478D	8.4	7.1	5.0 - 12.1	17.8	19.1	9.95 - 23.3	11.5	11.1	7.65 - 15.8
123678D	274	269	186 - 351	534	524	511 - 576	549	528	293 - 728
123789D	16.9	12.5	6.05 - 44.8	29.8	29.1	12.6 - 48.6	43.1	36.9	5.35 - 134
1234678D	467	470	270 - 598	437	435	407 - 470	574	498	210 - 1280
1234679D	20.8	20.1	12.1 - 30.8	22.0	22.3	15.5 - 28.3	20.4	16.8	12.2 - 45.8
OCDD	3380	3400	2920 - 3830	2450	2470	2070 - 2820	3920	3660	2000 - 6400
Σdioxins	4210	4200	3900 - 4740	3810	3720	3270 - 4520	4980	4630	2570 - 8550
Furans									
2378F	13.2	11.7	5.05 - 21.6	12.7	12.6	10.6 - 15.1	20.6	14.0	5.0 - 81.9
12378F	5.33	4.80	3.85 - 8.20	5.1	5.58	3.0 - 6.25	8.75	5.83	2.60 - 42.2
23478F	125.3	100	87.0 - 206	353	348	274 - 443	130	89.6	47.7 - 326
123478F	28.6	25.5	4.8 - 47.2	70.6	61.0	54.4 - 106	63.6	52.1	13.3 - 140
123678F	24.6	22.5	5.0 - 44.1	57.6	55.8	46.9 - 72.3	50.2	44.0	5.05 - 94.4
123789F	6.0	5.3	3.95 - 8.1	8.65	8.53	8.05 - 9.5	7.98	7.8	3.25 - 20.2
234678F	21.3	23.0	7.3 - 32.0	-			27.6	26.6	7.35 - 53.3
1234678F	192	165	130 - 310	180	224	107 - 261	457	400	156 - 949
1234789F	18.6	17.3	11.2 - 28.7	23.0	21.9	18.0 - 30.4	18.3	18.2	13.1 - 24.6
OCDF	23.0	20.6	11.9 - 36.7	44.1	-	-	17.4	17.4	6.75 - 30 .1
Σfurans	458	426	352 - 683	760	739	577 - 984	755	706	342 - 1380
Coplanars									
IUPAC77	17.2	9.9	7.2 - 31.9	249	270	39 - 417	488	40.1	11.9 - 4950
IUPAC81	ND (7.4)	ND (7.2)	ND (7.0 - 8.5)	286	303	87.1 - 450	591	38.4	7.25 - 5160
IUPAC126	343	352	201 - 487	1560	1220	786 - 3030	373	201	64.1 - 1760
IUPAC169	219	202	126 - 395	545	552	427 - 649	266	231	124 - 494
Σcoplanars	587	518	386 - 858	2640	2380	1390 - 4410	1720	518	223 - 12400

results below D.L. have been denoted as 0.5 x D.L.
missing values in calculating Σdioxins, Σfurans and Σcoplanars were denoted to the corresponding mean value of the congener in referents.

to referents. Although the mean values of the other congeners were close to the referents, the maximum concentrations were 3.7 (2378F), 5.1 (12378F), 1.6 (23478F), 3.0 (123478F), 2.1 (123678F), 2.5 (123789F), and 3.1 (1234678F) times higher compared to the maximum concentrations of the referents.

COPLANAR PCBs

The concentrations of the coplanar PCBs [3,3',4,4'-tetraCB (IUPAC 77), 3,4,4'5-tetraCB (IUPAC 81), 3,3',4,4',5-pentaCB (IUPAC 126) and 3,3',4,4',5,5'-hexaCB (IUPAC 169)], are given in Table 1, and the results were reported in DIOXIN'92 (1).

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