

Environmental Levels of Dioxins in Japan: Results of Nationwide Survey of Dioxins.

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Introduction

Atmospheric monitoring for dioxins has been conducted in Japan since 1988, providing us its levels and general tendency of distribution. Furthermore, several studies such as comprehensive pilot survey of dioxins were done in 1997, however, still limited knowledge of dioxins was obtained. In 1999, a large-scale program which covered all areas of the country (nationwide survey of dioxins) was initiated to understand the current status of dioxins throughout the whole country to cope with an elevated public concern in recent years.

The study was designed to investigate various levels of dioxins (PCDDs, PCDFs, and Co-PCBs) contained in air, water, soil, sediment, and aquatic organisms. Data analyzed in this study were collected from 387 sites, whose levels of dioxins were explored intensively. Presented here is the result of the survey.

Materials and Methods

Study regions consist of all 47 prefectures and 12 government ordinance-designated cities. In each region, at least two different sites were chosen to represent the character of area such as the vicinity of dioxin source and population. Our samples were also taken from three sites along roads as well as three areas fairly far away from roadside. In addition, twenty sites were selected as priority points and seven rural regions as background; thus the total number of sites came up to 387.

The investigation covered a broad range of areas, which was the most extensive dioxin-study in Japan. Air samples were measured four times a year (spring, summer, autumn, and winter), twice for atmospheric deposition (summer and winter), once for water (most water samples were measured in winter except for sites adjacent to incinerators where data was collected twice, in summer and winter), once for aquatic organisms (autumn), and once for other samples (summer).

Sample analyses were conducted using isotope dilution/high resolution mass spectrometry technique which is supported by the official analytical method by JEA.

Results and Discussion

A wide range of data was collected and analyzed for dioxin concentrations, congener patterns accumulation data, geographical patterns, and bioconcentration rates. Dioxin levels in different environmental compartments are summarized in Table 1.

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Table 1 Concentrations of PCDFs, PCDDs, and Co-planar PCBs in different environmental compartments.

	N	Units	Mean values	Median values	Range detected
Air	387	pg-TEQ/m ³	0.22	0.15	0-1.8
	100	pg-TEQ/m ³	0.23	0.17	0.0017-0.70
Atmospheric depositions	205	pg-TEQ/m ² /day	21	17	0.20-170
	103	pg-TEQ/m ² /day	21	18	0.34-66
Public waters	204	pg-TEQ/L	0.36	0.089	0-12
	204	pg-TEQ/L	0.40	0.11	0.0014-13
Underground water	243	pg-TEQ/L	0.086	0.0073	0-5.3
	188	pg-TEQ/L	0.081	0.011	0-5.4
Sediment	205	pg-TEQ/g dry weight	6.8	0.23	0-230
	205	pg-TEQ/g dry weight	7.7	0.41	0-260
Soil	344	pg-TEQ/g	6.2	2.3	0.00067-110
	286	pg-TEQ/g	6.5	2.7	0.0015-61
Aquatic organisms	368	pg-TEQ/g wet weight	0.64	0.32	0-11
	368	pg-TEQ/g wet weight	2.1	1.1	0.0022-30

The upper figures represent the amount of PCDFs and PCDDs.

The lower figures represent the amount of PCDFs, PCDDs, Co-planar and mono-ortho PCBs.

Comparisons of mean dioxin levels (PCDFs, PCDDs, and Co-planar PCBs) from different sources revealed that atmospheric levels decreased in the following order: the vicinity of incinerators (0.25 pg-TEQ/m³), large cities (0.21 pg-TEQ/m³), medium/small cities (0.18 pg-TEQ/m³), and background (0.25 pg-TEQ/m³). Details of data were summarized in Table 2. Samples gathered from underground water showed little difference in the dioxin levels among various categories. Although there was some degree of relationship between atmospheric and soot/dust levels, it was unable to find relationship among other media.

Co-planar and mono-ortho PCBs, contained in other than aquatic organisms, accounted for no more than 10 to 30 % of the total TEQ values at more than 80 % of all sites. Those data from aquatic organisms represented 50 % or more of total TEQ values at more than 70 % of sites.

In this study, dioxin levels seem lower than the values of previous studies, but we can not simply compare these results because of different research protocols. The present survey is based on a severe analytical quality control and, it seems essentially important to monitor dioxin levels periodically and keep abreast of the most recent dioxin concentrations.

Reference

The Government of Japan, Basic Guideline of Japan for the Promotion of Measures against Dioxins. September 30, 1999.

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Table 2 Dioxin levels from various sources.

	Categories	N	Mean values	Median values	Range detected	
Air (pg-TEQ/m ³)	Vicinity of incinerator	13	0.25	0.17	0.00030-1.8	
		8				
			64	0.25	0.19	0.015-0.70
	Large cities	11	0.22	0.15	0.00050-1.1	
		8				
			26	0.21	0.18	0.0050-0.53
	Small/medium cities	11	0.18	0.13	0-0.86	
		8				
			6	0.20	0.15	0.0017-0.66
	Background		7	0.013	0.0062	0-0.067
		4	0.021	0.0058	0.0018-0.071	
	Vicinity of roads	3	0.44	0.60	0.00093-0.72	
	Sites away from roads	3	0.44	0.61	0.014-0.70	
Soot and dust (pg-TEQ/m ² /day)	Vicinity of incinerator	79	25	21	0.40-170	
		48	23	21	1.9-54	
	Large cities	59	19	16	0.22-50	
		28	23	23	0.82-53	
	Small/medium cities	59	18	14	0.29-62	
		20	19	11	0.92-66	
	Background	7	4.1	3.8	0.20-8.6	
		7	4.4	3.8	0.34-8.6	
		Vicinity of roads	1	23	23	23
	Public waters (pg-TEQ/L)	Vicinity of incinerator	79	0.47	0.11	0.00038-12
79			0.54	0.13	0.0052-13	
Large cities		59	0.35	0.11	0-3.7	
		59	0.38	0.14	0.0044-3.8	
Small/medium cities		59	0.25	0.065	0.00015-3.5	
		59	0.29	0.080	0.0061-3.5	
Background		7	0.041	0.011	0.000065-0.13	
		7	0.047	0.014	0.0014-0.14	
Underground water (pg-TEQ/L)		Vicinity of incinerator	11	0.088	0.0068	0-4.0
			8			
			64	0.056	0.0092	0.00015-0.59
	Large cities	59	0.036	0.0082	0-0.45	
		59	0.048	0.013	0.00031-0.47	
	Small/medium cities	59	0.14	0.0088	0-5.3	
		59	0.14	0.012	0-5.4	
	Background	7	0.032	0.00015	0-0.12	
		6	0.041	0.015	0.00092-0.13	

The upper figures represent the amount of PCDFs and PCDDs.

The lower figures represent the amount of PCDFs, PCDDs, Co-planar and mono-ortho PCBs.

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Table 2 (continued) Dioxin levels from various sources.

	Categories	N	Mean values	Median values	Range detected
Sediment (pg-TEQ/g dry weight)	Vicinity of incinerator	79	7.4	0.21	0.00037-230
		79	8.5	0.38	0.00087-260
	Large cities	60	8.5	0.79	0.00035-190
		60	9.6	0.90	0.0014-200
	Small/medium cities	59	5.0	0.19	0-150
		59	5.5	0.39	0.0013-160
	Background	7	0.75	0.028	0-4.9
		7	0.75	0.033	0-4.9
Soil (pg-TEQ/g)	Vicinity of incinerator	34	6.8	2.6	0.00067-110
		4			
		28	7.1	2.9	0.0015-49
	Large cities	6			
		21	5.4	2.7	0.057-33
		9			
	Small/medium cities	16	6.1	3.5	0.063-35
		1			
		59	5.6	1.5	0.022-61
	Background	59	6.0	1.7	0.024-61
		59	1.7	1.3	0.13-5.6
		59	1.8	1.8	0.26-5.6
Aquatic organisms (pg-TEQ/g wet weight)	Vicinity of incinerator	11	0.82	0.39	0-8.4
		8			
		11	2.3	1.3	0.065-12
	Large cities	8			
		11	0.60	0.33	0-11
		8			
	Small/medium cities	11	2.5	1.4	0.032-30
		8			
		11	0.51	0.33	0-4.5
	Background	8			
		11	1.7	1.0	0.0061-12
		8			
	Background	14	0.43	0.14	0-3.4
		14	0.73	0.44	0.0022-4.1

The upper figures represent the amount of PCDFs and PCDDs.

The lower figures represent the amount of PCDFs, PCDDs, Co-planar and mono-ortho PCBs.