

PCDDs/PCDFs level of soil accumulation on the edges of major highway, Seoul

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Introduction

2,3,7,8-Tetrachlorinated dibenzo-p-dioxins (TCDD) and its related compounds have been known as extremely toxic, persistent in the environment and bio-accumulative. The most important sources of them are combustion processes. However, we must not neglect the other sources such as chemical, industrial and traffic ones. There are five major highways in Seoul. The highways have been polluted by smoke and soot, including hydrophobic compounds such as dioxins that come from automobile exhaust gas. The contaminants have been absorbed in particle such as soil and have been accumulated on the edges of highways. In case of scattering, the polluted soil accumulation can be inhaled by humans. In this study, a research has been conducted on the PCDDs/Fs level of soil accumulation on the edges of highway, and relative abundance of PCDDs/Fs isomers has also been investigated. We also compared dioxin isomer profiles in soil accumulation on the edges of highway with the dioxin isomer profiles in soil around municipal waster incinerator.

Method and Material

Sampling ; The 25 samples were collected from soil accumulation on the edges of five major highways in Seoul ; 25 different sampling sites along the highways. The sampling was done from January to March in 2002

Analytical Procedure ; The samples were dried in a stainless box for a few days. The dried samples were crushed with a steel blender and sieved, only the fraction <88 μm was analyzed¹. Each sieved sample(10g) was spiked with fifteen 2,3,7,8-substitued ¹³C₁₂-labeled PCDDs/Fs as internal standard (100pg/ μl \times 20 μl), and then extracted with 350ml of toluene by soxhlet extractor. The extract was treated with conc. sulfuric acid, and cleaned up by passage through a multi-layer silica column and alumina column. and then spiked with ¹³C₁₂-labelled 1,2,3,4- and 1,2,3,7,8,9-substitued PCDDs as recovery standard. Chromatograms were collected from Gas chromatography electron impact mass spectrometry (GC-EIMS, a Micromass Autospec Ultima) at a resolution of 15,000(10% valley) in SIM. Verification of the resolution in the working mass range was obtained by measuring perfluorokerosene(PFK) reference peaks. The current trap was 500uA, the ionization energy was 39eV and the acceleration voltage was 8000 V. Ion source temperature was 250 . The two most abundant ions in the [M-Cl]⁺ cluster were monitored at 60ms dwell time and a delay time

of 20 ms. Chromatographic separation was achieved with a DB5-5ms(J&W Scientific, CA,USA) fused silica capillary column (60m DB-5ms 0.32mm i.d., 0.25um film thickness) with helium as carrier gas at a linear velocity of 35cm/s in the splitless injection mode of 1 . The temperature program was: 150 for 1min; 10 /min to 210 hold for 8min, 3 /min to 235 hold for 10min, 5 /min to 265 hold for 3min.

Result and Discussion

The five highways on which we have conducted the research have the highest traffic density in Seoul. The color of soil accumulation on the edges of five highways are blackish, supposedly because they are polluted by dust, soot and smoke that come from automobile tire abrasion and exhaust gas.

The total concentration of PCDDs/Fs in the entire samples range from 652 to 1345 pg/g dry weight. The concentration of OCDD in total concentration was the highest of the other isomers and the value of OCDF, 1,2,3,4,6,7,8-HpCDF and 1,2,3,4,6,7,8-HpCDF was high comparatively. The higher chlorinated dioxin and furan, the higher concentration.(Figure 1.)

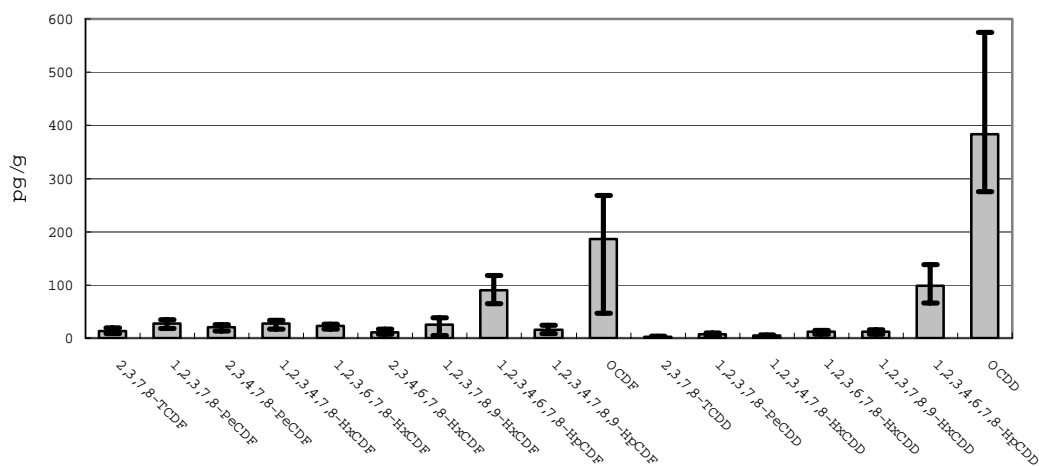


Figure 1. The total concentration of PCDDs/Fs

Table 1 shows the summary of the TEQ values obtained from analysis of 25 samples. TEQ values of them range from 23.37 to 39.22 pg-TEQ/g. 2,3,4,7,8-PeCDF has the most influence on TEQ value in entire sample. The occupation percentage of the isomer in TEQ value was 30%. The low chlorinated dioxin and furan such as TCDF, TCDD, PeCDD and PeCDF occupied 30% in TEQ value. PCDFs level in TEQ values is about 2~3 times as much as PCDDs level.

Table 1. The TEQ value of PCDDs/Fs in soil accumulation

	Isomers	Olympic Exp.way	Gangbyon Exp.way	Dongbu Exp.way	Seobu Exp.way	Naebu Exp.way
Furan	2,3,7,8-TCDF	1.21	0.85	1.88	1.47	1.01
	1,2,3,7,8-PeCDF	1.75	0.92	1.04	1.77	1.40
	2,3,4,7,8-PeCDF	12.29	6.52	7.96	12.87	10.93
	1,2,3,4,7,8-HxCDF	3.34	1.68	2.21	3.38	3.16
	1,2,3,6,7,8-HxCDF	2.67	1.71	1.71	2.61	2.44
	2,3,4,6,7,8-HxCDF	1.21	1.66	0.71	0.68	0.97
	1,2,3,7,8,9-HxCDF	3.83	0.54	1.98	3.75	2.74
	1,2,3,4,6,7,8-HpCDF	1.18	0.65	0.66	1.13	0.86
	1,2,3,4,7,8,9-HpCDF	0.24	0.09	0.12	0.18	0.13
	OCDF	0.26	0.05	0.27	0.22	0.13
Dioxin	2,3,7,8-TCDD	2.04	4.02	1.74	2.46	1.69
	1,2,3,7,8-PeCDD	3.56	1.61	4.70	4.17	3.00
	1,2,3,4,7,8-HxCDD	0.52	0.65	0.40	0.47	0.41
	1,2,3,6,7,8-HxCDD	1.49	0.68	1.27	1.40	1.09
	1,2,3,7,8,9-HxCDD	1.58	0.76	1.17	1.18	1.13
	1,2,3,4,6,7,8-HpCDD	1.38	0.66	0.85	1.08	0.94
		OCDD	0.57	0.34	0.34	0.38
	PCDFs	28.00	14.66	18.52	28.08	23.78
	PCDDs	11.14	8.71	10.47	11.14	8.55
	Total (PCDDs+PCDFs)	39.14	23.37	29.00	39.22	32.33

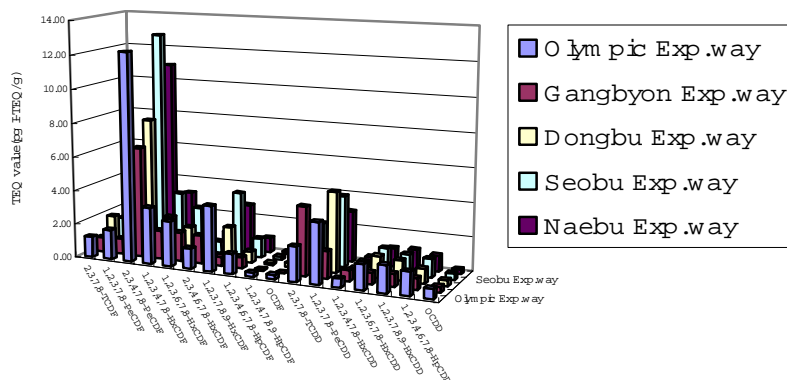


Figure 2. Isomer profiles of PCDD/Fs in soil accumulation

Isomer profiles of PCDDs/Fs in soil accumulation according to sampling site is shown Figure 2. Each isomer profile shows almost the same figure. There was a similarity between the isomer profiles of PCDDs/Fs in soil accumulation and the isomer profiles of the PCDDs/Fs in soil⁸ and in sediment⁹. The isomer profiles of PCDDs/Fs in soil accumulation was also similar to the isomer profiles of PCDDs/Fs in the air around municipal solid waste incinerator reported by i-Chen Cheng¹⁰. This suggests that, when dioxins are degraded by photolysis and hydroxylation in the atmosphere after exhaustion, the respective isomer have almost the same fate. The level of dioxins in soil accumulation on the edges of highway seems to have been affected by automobile exhaust gas. Furthermore, they may have been affected by stack gas from MSWI and by other pollution sources in the air.

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