

LEVELS IN ABIOTIC COMPARTMENTS

DISTRIBUTION CHARACTERISTICS OF PCDD/DFS IN SOIL AROUND THE MSWIS FROM KOREA

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Introduction

Municipal solid waste incinerators(MSWIs) have been constructed and operated from the mid-1980s in Republic of Korea and 23 large MSWIs are operating in the whole country at December 31, 2001.

And, 12,000 medium and scale type incinerators such as medical waste incinerators, industrial waste incinerators etc. are running in the whole country¹⁾.

The PCDDs/DFs released into the atmosphere from various emission sources can cause the soil contamination by dry or wet deposition, and there is an evidence that PCDDs/DFs concentrations in soil be increased as a result of cumulative atmospheric deposition²⁾⁻³⁾.

This study was carried out to investigate and evaluate the concentration level and distribution characteristics of PCDDs/DFs in soil around MSWIs that are known as a major source of PCDDs/DFs in Korea.

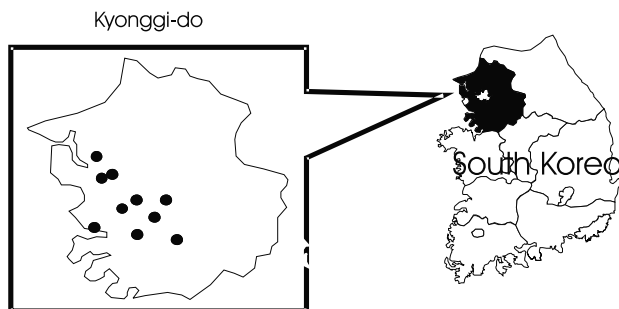


Figure 1. Location of MSWIs in Kyonggi-do (1:YT, 2:KC, 3:PC, 4:SJ, 5:YI, 6:SN, 7:KY, 8:JD, 9:DJ, 10:AS)

Methods and Materials

*Sampling*⁴⁾

Soil samples were collected around ten MSWIs having more than 50 ton/day treatment capacity which were located in Kyonggi-do area in march, 2001. Three sites were chosen and sampled for ten MSWIs. Sampling locations were shown as Figure 1, and sampling method was given as Figure 2.

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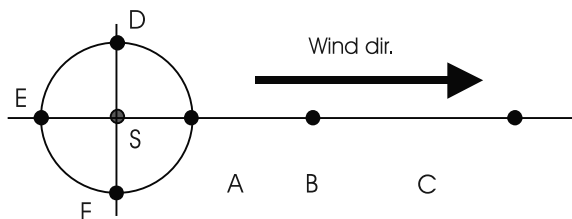


Figure 2. Sampling method for soil samples (S : incineration facilities, site-1 : 200m ; A, G, H, I, site-2:400m ; B, site-3 : 600m-800m ; C)

Experimental Procedures⁴⁾

20g of soil samples was added by 2ng of internal standard(³⁷Cl₄-2,3,7,8-TCDD), and was treated with 5N-HCl. Solid phase was extracted with soxhlet by 300ml of toluene, and liquid phase was extracted with dichloromethane.

All extracts were concentrated to 20ml. 10ml of concentrate adopted was added by add 1 ng of 15 kinds of internal standards (EDF-8999, CIL, USA) followed by sulfuric acid treatment. Sample clean-up was performed with silica gel-aluminum oxide column (FMS, USA) continuous clean-up according to HPLC column clean-up method⁵⁾. Add internal standard (EDF-5999, CIL, USA) and concentrated up to 50%. The samples were analyzed by HRGC/HRMS on GC 8000 series (Fisons Instruments, Italy) equipped with a CTC 200S auto sampler and coupled to an Autospec Ultima Mass Spectrometer (Micromass, UK). SP2331 column (60 m, 0.32 mm×0.2 μ film thickness, Supelco) was used for analyzing the samples. In this analysis, recoveries were 84%(52~112%) for internal standards. Also, minimum detection limit(MDL) was 0.05 - 0.1pg/g.

Results and Discussion

PCDDs/DFs concentrations in soil around MSWIs are given in Table 1. KC incineration facility has run from 1994, and KY and JD facilities have operated since 1995, and the other facilities have run since 1999.

PCDDs/DFs levels

PCDDs/DFs levels of sites located away from constant distance to the main wind direction for each incinerator showed that PCDDs/DFs levels of site-1, site-2 and site-3 were 1.060 ~ 4.750pg-TEQ/g d.w.(mean 2.508pg -TEQ/g d.w.), 1.340~6.360pg -TEQ/g d.w.(mean 3.553pg-TEQ/g d.w.), 0.800 ~ 11.190pg -TEQ/g d.w.(mean 3.365pg -TEQ/g d.w.) respectively. The concentration distribution of PCDDs/DFs by sites showed in the order of site-1 < site-3 < site-2. : PCDDs/DFs levels in soil around the target incineration facilities were 1.290~5.620pg-TEQ /g d.w.(mean 3.152pg-TEQ/g d.w.)

Distribution of PCDDs/DFs in soil

Figure 3 shows the isomer profile for 17 kinds of 2, 3, 7, 8 – substituted isomer in soils around the target incineration facilities. The distribution of PCDDs/DFs in target soil showed that PCDDs hold 60~70% of total levels, and the level distribution of homologues was in the order of OCDD > 1,2,3,4,6,7,8-HpCDD > 1,2,3,6,7,8-HxCDD > OCDF > 1,2,3,4,7,8,9-HpCDF. Especially, the distribution characteristics of OCDD gave the similarities with those of general PCDDs/DFs from MSWIs in Korea referred to S.C. Kim's⁶⁾ study.

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Table 1. The average concentration of PCDDs/DFs in soil around target incinerator Facility (unit :p-TEQ/g dry weight)

2,3,7,8-Substituted Isomers	Y T (n=3)	K C (n=3)	P C (n=3)	S J (n=3)	Y I (n=3)	S N (n=3)	K Y (n=3)	J D (n=3)	D J (n=3)	A S (n=3)
2,3,7,8-T ₄ CDF	0.063	0.120	0.110	0.047	0.047	0.153	0.160	0.253	0.180	0.263
1,2,3,7,8-P ₅ CDF/2	0.037	0.050	0.050	0.037	0.030	0.073	0.073	0.113	0.097	0.140
2,3,4,7,8-P ₅ CDF	0.433	0.737	0.723	0.613	0.367	1.563	0.953	1.563	0.853	1.390
1,2,3,4,7,8-H ₆ CDF/2	0.050	0.080	0.090	0.083	0.053	0.177	0.143	0.173	0.100	0.327
1,2,3,6,7,8-H ₆ CDF	0.093	0.147	0.167	0.147	0.097	0.383	0.247	0.337	0.377	0.423
1,2,3,7,8,9-H ₆ CDF	0.067	0.083	0.043	0.093	0.033	0.087	0.037	0.053	0.073	0.057
2,3,4,6,7,8-H ₆ CDF	0.107	0.167	0.173	0.167	0.137	0.780	0.250	0.360	0.213	0.347
1,2,3,4,6,7,8-H ₇ CDF	0.027	0.047	0.073	0.040	0.040	0.173	0.117	0.140	0.273	0.313
1,2,3,4,7,8,9-H ₇ CDF	0.010	0.017	0.020	0.030	0.010	0.040	0.013	0.020	0.140	0.057
OCDF	0.003	0.000	0.033	0.000	0.000	0.017	0.007	0.010	0.030	0.030
Total PCDFs	0.890	1.447	1.483	1.257	0.813	3.447	2.000	3.023	2.337	3.347
2,3,7,8-T ₄ CDD	0.110	0.207	0.133	0.153	0.097	0.143	0.160	0.197	0.193	0.273
1,2,3,7,8-P ₅ CDD	0.217	0.397	0.253	0.413	0.160	0.423	0.220	0.347	0.307	0.513
1,2,3,4,7,8-H ₆ CDD	0.047	0.083	0.040	0.097	0.033	0.093	0.040	0.067	0.090	0.097
1,2,3,6,7,8-H ₆ CDD	0.067	0.113	0.090	0.113	0.067	0.260	0.093	0.140	0.253	0.210
1,2,3,7,8,9-H ₆ CDD	0.073	0.107	0.073	0.107	0.060	0.180	0.073	0.107	0.193	0.143
1,2,3,4,6,7,8-H ₇ CDD	0.027	0.043	0.060	0.037	0.040	0.190	0.077	0.097	0.557	0.147
OCDD	0.020	0.023	0.040	0.017	0.020	0.047	0.060	0.073	1.690	0.087
Total PCDDs	0.560	0.973	0.690	0.937	0.477	1.337	0.723	1.027	3.283	1.470
Total PCDDs/Fs	1.450	2.420	2.173	2.193	1.290	4.783	2.723	4.050	5.620	4.817

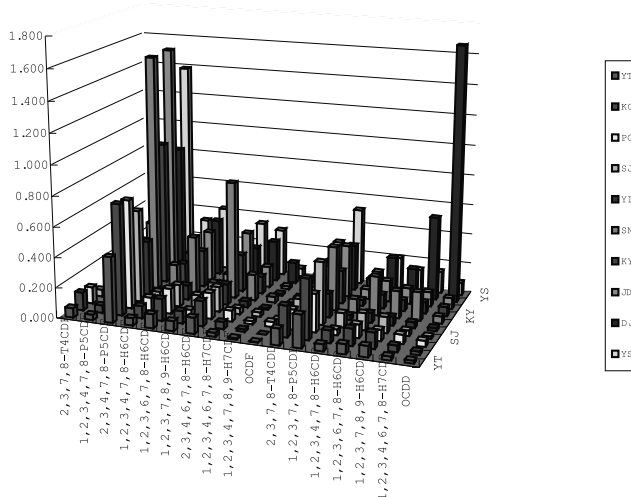


Figure 3. Isomer profile for 17 kinds of 2, 3, 7, 8 – substituted isomer in soil around the target incineration facilities

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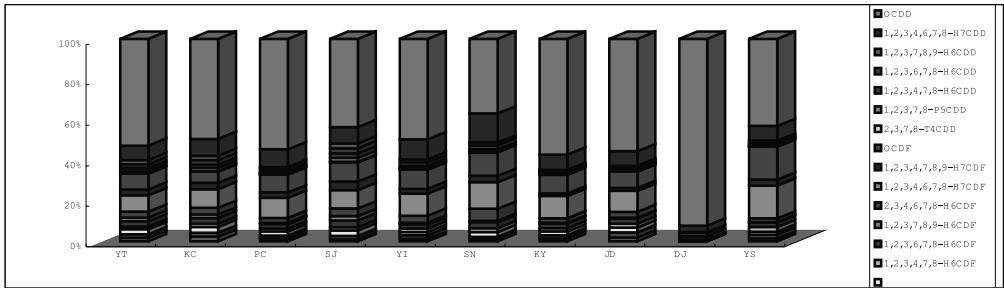


Figure 4. Isomer profile of TEQ concentrations for 17 kinds of 2, 3, 7, 8 – substituted isomer

Figure 4 shows the isomer profile of TEQ concentrations for 17 kinds of 2, 3, 7, 8 – substituted isomer. Ratio of PCDFs to PCDDs is 1.6~1.7 in TEQ concentration, and it was 2, 3, 4, 7, 8 – PeCDFs' concentration whole 30~35% and showed the similarities with general incineration pattern of PCDDs/DFs. PCDDs/DFs levels in soils around MSWIs are judged as accumulated by dry and wet deposition after PCDDs/DFs are exhausted to air environment from MSWIs, industrial waste incinerator, vehicle discharge gas etc.

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