LEVELS AND CONGENER PROFILES OF PCDD/FS IN THE ENVIRONMENTAL MEDIA IN THE VICINITY OF THE WASTE INCINERATORS, SOUTH KOREA

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Introduction

In Korea, incineration is a frequently used technology for the final disposal of municipal or industrial solid waste, in spite of major source for emission of PCDD/Fs into the environment.
To assess the potential impact of PCDD/Fs to the environment, soil and air samples including flue gas were colleted at the vicinity of 17 incinerators scattered all over the country.

Materials and Methods

Sample collection

Totally 443 soil, 30 air, and 24 stack samples were taken from July 2002 to May 2006 around seventeen incinerators; six designated waste incinerators, five paper mill incinerators, one general industrial waste incinerator, two mixed (general and designated) incinerators, and combustible waste incinerators. Soil samples were collected at about 24 sites around each incinerator. Sampling points were selected considering results a Gaussian plume model (Industrial Source Complex, ISC 3) and air samplings were carried out at the points estimated to be the maximum deposition concentration.

Extraction and cleanup

The stack and air samples were extracted through Soxhlet, and the soil samples were air-dried and manually ground before ASE (Accelerated Solvent Extractor) extraction (1500psi, 150°C, distilled toluene, 2 times for 7 min). The extracts were subjected to clean-up procedures as follows; H_2SO_4 treatment, silicagel column, alumina column and activated carbon column. The finally concentrated samples were spiked with 13C-labeled recovery standard for HRGC/HRMS analysis. Purified PCDD/Fs extracts were analyzed by a DB-5 column (60 m × 0.25 mm ID, 0.25 μm) and SP-2331 column (60 m × 0.25 mm ID, 0.25 μm) in order to identify 2,3,7,8-substituted PCDD/Fs. The average recovery of internal standard compounds ranged from 60% to 110%.

Water contents were determined by drying at 105 ~ 110°C for 2hr. Ignition loss, a measure of organic matter contents, was determined by heating at 600°C for 1hr after drying.

Table 1. The number of samples and the major characteristics of the incinerators

Incinerator	Types of waste incinerated	Number of samples			Year of start-up	Capacity t/hr	Flue gas cleaning technology	Stack Height (m)
		Flue gas	Air	Soil				
1	Designated waste	2	2	30	1979	1.25	WS[2)]	15
2	Paper mill	-[1)]	2	24	1998	2.9	ESP[3)]	30
3	Paper mill	2	2	28	1992	10	ESP[3)]	22
4	Designated waste	2	2	24	1996	1.5	BF[4)]	25
5	Paper mill	2	2	24	1991	6.3	ESP[3)]	35
6	Designated waste	-[1)]	2	28	1998	1	BF[4)]	25
7	Paper mill	2	2	24	1997	3.8	ESP[3)]	27
8	Designated waste	2	2	24	1997	3.0	ESP[3)]/BF[4)]	40
9	Combustible waste	1	2	28	1996	2.5	BF[4)]	25
10	Combustible waste	2	2	24	1994	1.9	BF[4)]	35
11	Paper mill	2	2	24	1998	4.0	S/C[5)]	30
12	Designated waste	2	2	24	1997	2.5	ESP[3)]/BF[4)]	40
13	General	-[1)]	1	24	2001	3	BF[4)]	29
14	General/designated	2	1	24	1996	2.4	BF[4)]	35
15[6)]	General/designated	1	4	89	2004	2.0	BF[4)]/WS[2)]	30
16[6)]	General/designated	1			1999	0.6	ESP[3)]/WS[2)]	70
17[6)]	Designated waste	1			2002	0.5	BF[4)]	27

1) The samples were not collected. 2) Wet scrubber 3) Electro-static precipitator

4) Bag filter 5) Spray scrubber and Cyclone scrubber

6) Incinerators, 15, 16, 17, are aggregated densely around the industrial complex

Results and Discussion

Concentration of PCDD/Fs

The concentrations of PCDD/Fs in samples are not given in this short paper due to lack of space. The highest concentration in soils was found to be 152.318 pg I-TEQ/g(d.w.) at the industrial complex(incinerator 15, 16, 17). Concentrations of soil and air samples ranged from N.D.~152.318 pg I-TEQ/g(d.w.) and 0.0002~9.946 pg I-TEQ/Nm^3, respectively. The highest average concentration in soil was found at around the incinerator 9.

Congener profile of PCDD/Fs

Tetra through octa-PCDD/Fs including non-2,3,7,8-substituted PCDD/Fs for the stack and six soil samples collected at 250~2000m from the incinerator 9 were analyzed in order to explain the possible dioxin source.

Three soil samples having relatively high concentration were collected at 250m from the incinerator 9 and the others were collected at 1~2km from the facility. PCDD/Fs congener profiles from stack and soil samples collected at 250m from the incinerator 9 are shown in Fig. 1. There is no differences in the PCDD/Fs congener profiles for three soil samples. It indicates that three soil samples are affected by the same emission sources. The PCDD/Fs congener profiles in each homologue of three soil samples were similar to those of stack samples. This result shows that three soil samples are mainly affected by the thermal processes including the incinerator 9.

On the other hand, as shown in Fig. 2, the rest of three soil samples collected at 1~2km from the facility show the characteristics of CNP in pattern of tetra chlorinated dibenzo-p-dioxins. However, the congeners pattern in penta-and hexa-PCDD/Fs are similar to those of stack samples. Therefore, three soil samples collected at the points relatively far away from the incinerator 9 seem to be complexly affected by thermal processes and pesticides.

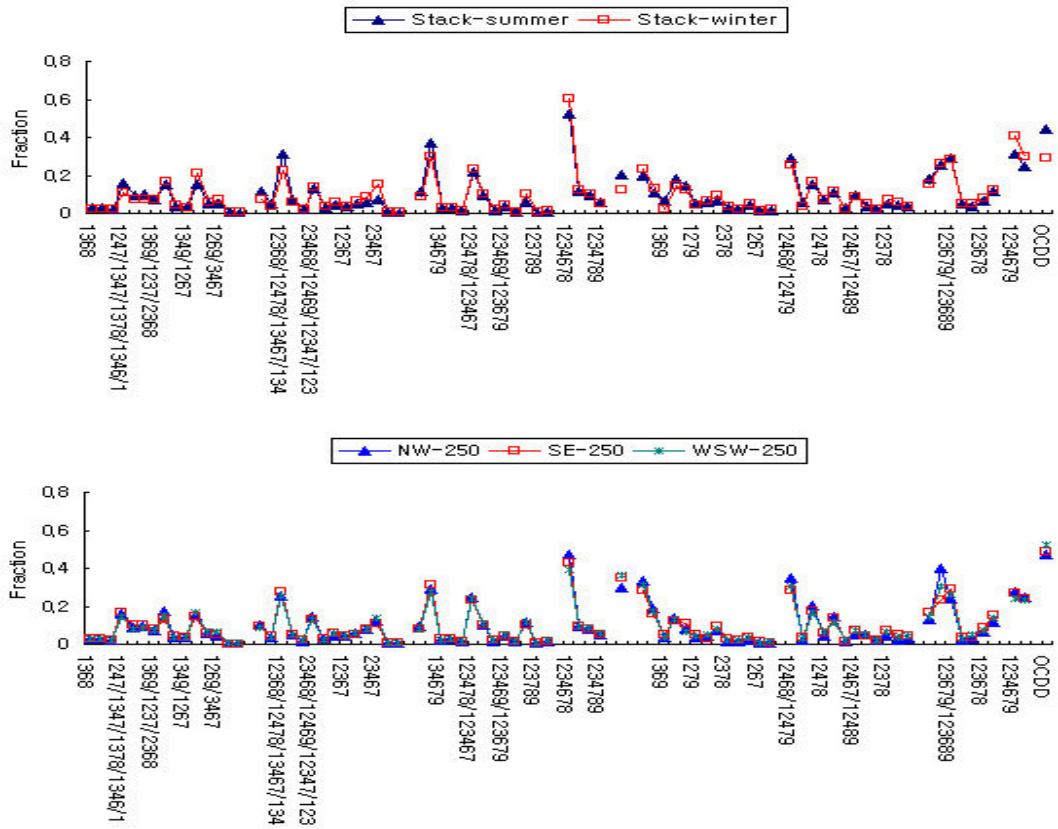

Fig. 1. Congener profiles of PCDD/Fs in stack and soil samples collected at 250m around the incinerator 9.

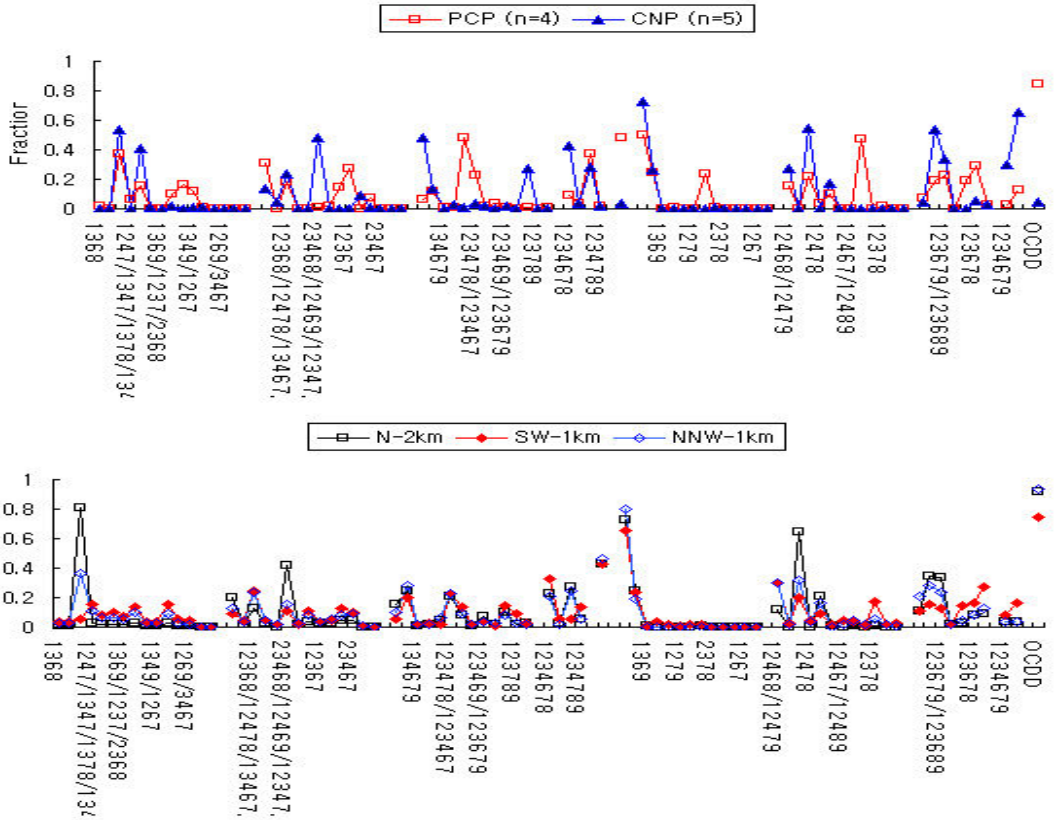

Fig. 2. Congener profiles of PCDD/Fs in PCP and CNP and soil samples collected at 1~2km from the incinerator 9

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References

1. S. Masunaga, T. Takasuga and J. Nakanishi, *Chemosphere* 2001;44:873.