Ambient Air Monitoring of PCDD/Fs and PCBs in Gyeonggi-do, Korea

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Introduction

In 1999, Ministry of Environment and National Institute of Environmental Research started the monitoring and testing program to collect data for PCDD/Fs, PCBs and other endocrine disrupting chemicals(EDCs) from all over the nation. However it has not been sufficient to get the clear picture of these compounds in Gyeonggi-do, enclosing Seoul, the capital of KOREA. Gyeonggi-do has an area of 10,183 (10.2% of Korea area), a population of 10million(about 21% of Korea, Jan. 2004). Moreover it has 12,670 air pollutant exhaust facilities[1]. Therefore it is important to get the detailed status of PCDD/Fs, PCBs and the other ECDs in Gyeonggi-do. We started monitoring PCDD/Fs in ambient air and in soil from August 2001, and PCBs from February 2003. This paper describes the analytical results and trends of PCDD/Fs, PCBs in ambient air of Gyeonggi-do.

Methods and Materials

Sampling Sites **:** Total Six sites(Suwon, Anyang, Ansan, Seongnam, Bucheon and Siheung) were selected and three sites among them, Seongnam, Bucheon and Siheung, were added from 2003. The following table gives information of the sampling sites.

Table 1. Sampling sites for monitoring of PCDD/Fs, PCBs in ambient air.

Sampling Site	Population(person)	Surrounding
Suwon	1,032,944	Residential, foresty
Anyang	604,505	Down town, residential
Ansan	651,625	Industrial
Seongnam	962,048	Residential
Bucheon	844,256	Residential, industrial
Siheung	368,223	Residential, industrial

Sampling **:** Sampling was performed monthly up to 2002 and bimonthly from 2003. Ambient air was sampled with a high volume air sampler(HV-1000F & HV-700F, SIBATA, Japan). The sampler was equipped a Quartz filter connected by two polyurethane foam(PUF) plugs. Quartz filter and PUF were pre-cleaned by baking at 800 for 4hrs, extracted by a soxhlet with acetone over 24hrs, respectively. All samples were collected with a suction speed of approximately 19 /hr for 96hrs, resulting in a sample volume of approximately 1800 . Prior to sampling, [$^{37}Cl_4$]2,3,7,8-T_4CDD standard(ED-2522, CIL, USA) was spiked on PUF in order to estimate a sampling performance.

Pretreatment **:** PCDD/Fs : After sampling, Quartz filter and PUF were extracted with toluene using soxhlet apparatus over 48hrs. $^{13}C_{12}$-labelled standards(EDF-8999, CIL, USA) were spiked before clean-up process. The sample clean-up was performed with disposal silica gel – aluminum oxide columns(FMS, USA) according to HPLC clean-up method[2]. Finally, the purified extracts were concentrated to approximately 50 and spiked internal standard(EDF-5999, CIL, USA) prior to analysis.

PCBs : The extracts identical to PCDD/Fs analysis were used and pretreatment was performed according to US EPA Method 1668A.

Analysis **:** All samples were analyzed by the HRGC/HRMS(Autospec Ultima NT, Micromass Co. UK) using SP-2331 and DB-5MS columns for PCDD/Fs and PCBs, respectively.

Results and Discussion

***Levels of PCDD/Fs in ambient air* :** The results of the August 2001~December 2003 are reported in Table 2. Seongnam, Bucheon and Siheung were added from June 2003. The yearly means were 0.555, 0.605, 0.441pg-ITEQ/N , respectively. The PCDD/Fs levels of Suwon and Anyang showed decreasing trends in concentration for sampling periods. Suwon's in 2003 decreased 47% compared with that of in 2001 and Anyang's decreased 37% as well. This was similar to the 4th EDCs Monitoring Result in Korea[3] and in Japan and Germany[4,5] for the ambient air.

However, Ansan's increased 53%, from 0.777 to 1.188pg-ITEQ/N contrary to Suwon and Anyang. Because Ansan is one of the most industrialized areas and has 2,809 factories, occupying 9% of entire factories in Gyeonggi-do[1], it may be subjected to the influence of near industries.

The PCDD/Fs concentration from 2001 to 2003 for each season are shown in Figure 1. The levels of PCDD/Fs were in order of winter>spring>summer>autumn and the concentrations of spring and winter were about twice as high as autumn's. However, the concentration of spring was higher than winter's in Ansan area, as Figure 2.

Table 2. The average concentration of PCDD/Fs by sampling sites.

(unit : pg-ITEQ/N)

	Suwon	Anyang	Ansan	Seongnam[1)]	Bucheon[1)]	Siheung[1)]
2001	0.505	0.382	0.777	-	-	-
2002	0.398	0.279	1.140	-	-	-
2003	0.269	0.239	1.188	0.079	0.342	0.531

1) Started from June

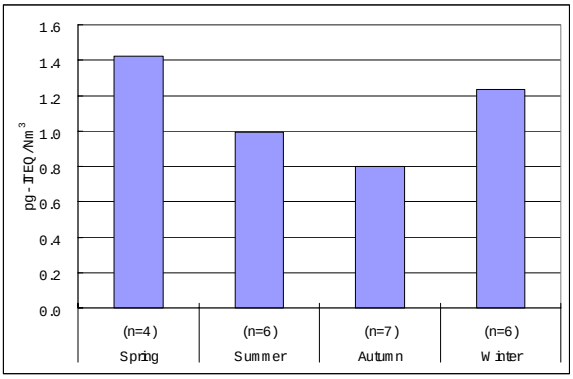

Figure 1. Seasonal Variations of PCDD/Fs

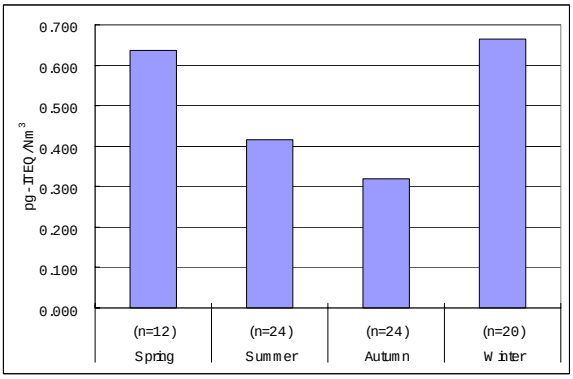

Figure 2. Seasonal Variations of Ansan

Levels of PCBs in ambient air **:** The analysis of PCBs was started from 2003. The average TEQ was 0.0243pg WHO-TEQ/N and similar to that of Japan in 2001[4]. The concentrations in Ansan and Siheung were 0.0443, 0.0437pg WHO-TEQ/N , respectively and higher than in other areas, as Figure 3. These were reported approximately twice as high as the average. Ansan's was the highest and Seongnam's was the lowest.

Figure 4 shows the measured concentrations of PCBs in ambient air. The measured concentrations of PCBs showed different trends against TEQ descriptions. Bucheon's was the highest and Anyang's was the lowest. Compared with the measured each isomer concentration, the PCB#118 and #105 concentrations of Bucheon were about 50% as high as Ansan's. On the contrary in PCB#126 concentration having the highest toxic equivalent factor, Bucheon's was 40% lower than those in Ansan. Seongnam and Anyang showed the same pattern as well.

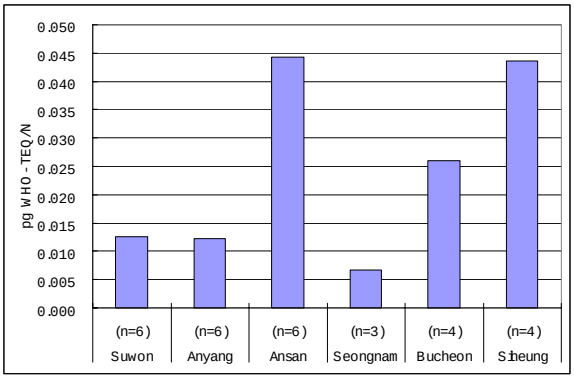

Figure 3. The average TEQ of PCBs by sites.

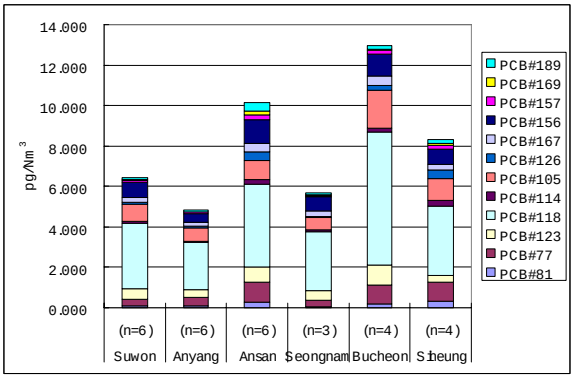

Figure 4. The measured concentrations of PCBs by sites.

References

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