Concentration Levels and Behavior Characteristics of PCDDs/DFs in Atmosphere

Gon Ok, Hyo-Bang Moon, Sung-Hee Ji, and Young-Ho Han

Faculty of Earth Environmental Sciences, Pukyong National University, Nam-gu Daeyeon3-dong 599-1, Pusan 608-737, Korea

Introduction

PCDDs and PCDFs are distributed in the environment via air, soil, water and sediment. PCDDs/DFs in ambient air exist as a form of vapor or particulate matter. Many researchers have carried out concentration levels, distribution, occurrences, transport and fate of PCDDs/DFs in ambient air.[1-3] In this study, we investigated concentration level and behavior of PCDDs/DFs for urban area, residential area and industrial area of Korea.

Experimental Methods

Sampling

Ambient samples were measured for 24 hours with high volume air sampler(DHV-1000GC type, Global Change Inc.). Samples were collected vapor and particulate matters using polyurethanefoam(PUF) and glass fiber filter(GFF). Before use, PUF and GFF were precleaned by microwave with pure water, acetone and methanol. A flow measured was 1,200~1,500m^3. Monitoring was undertaken at 3 sites including Urban, Residential and Industrial area over a period of a year from February 1998 to February 1999. Sampling sites were illustrated in Fig. 1.

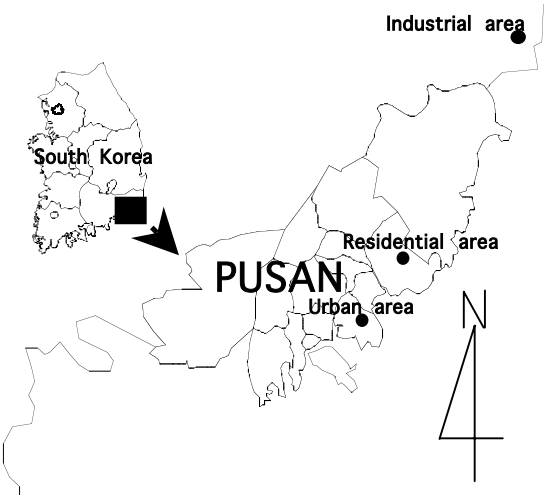


Fig. 1. Sampling locations of this study.

Analytical procedure

GFF samples were cut into a size of 0.5×0.5cm, and then extracted with 150ml of toluene for 6 hours under reflux. The extract was filtered and concentrated with a evaporator. PUF samples were also extracted with 400ml of toluene with soxhlet apparatus. After addition of keeping solvent(n-Noane), each sample was transferred to n-Hexane and then adjusted to a volume of 10ml. After spiking of internal standards(EDF-8999, CIL Inc.), purified using multi-layer silica gel chromatography and alumina column(Neutral, Activate I, Merck) chromatography and analyzed with HRGC(HP5970)/HRMS(JMS 700, Jeol). Analytical methods and conditions were similar with several papers described previously.[4-5]

Results and Discussion

Concentration levels

Fig. 1 shows the total and I-TEQ concentration of PCDDs/DFs measured at each area.

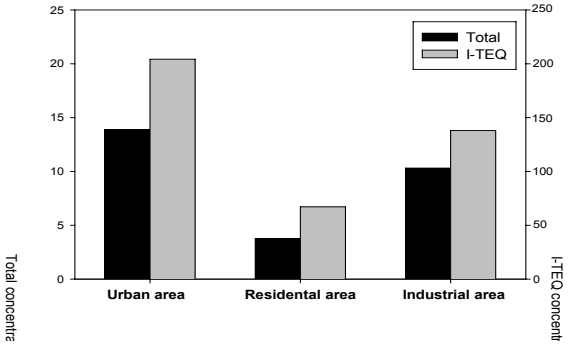


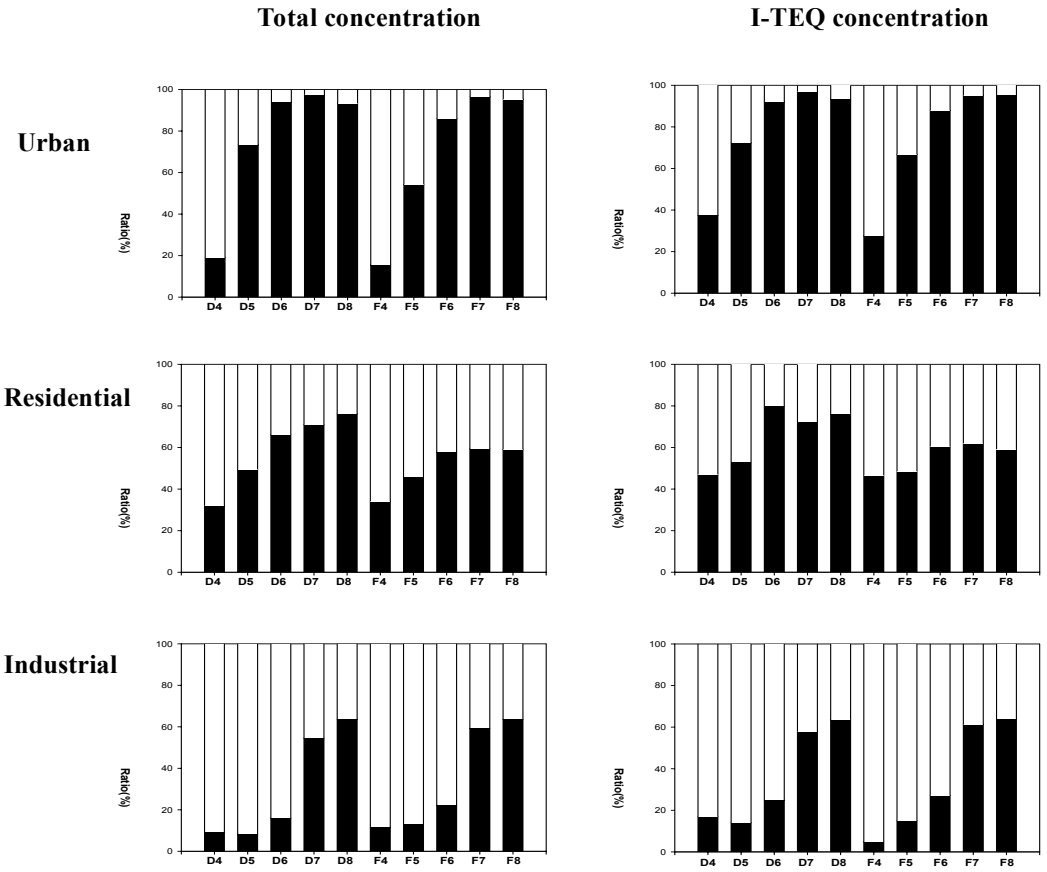
Fig. 1. Average concentration of PCDDs/DFs for each site.

At Urban area influenced by stationary and mobile source, total concentration of PCDDs/DFs was 2.16~46.96pg/m^3 and was 29～690fg/m^3 for I-TEQ concentration. Of these data, the sample collected over 8 to 14 May 1998 was measured at a period of yellow sand, the concentration of particulate matters had higher value of about 2 or 3 times as compared with an ordinary day. So concentration of PCDDs/DFs represented the highest value in this period. This result can be considered as PCDDs/DFs attributed to combustion of coal fuel were adsorbed to yellow sand and were transported as a form of aerosol. Therefore, a study on transport and fate of PCDDs/DFs in the period of yellow sand will be need to continue. Residential area, which gathered apartment houses and exists a MSWI in the vicinity, represented concentration range of 2.12~6.91pg/m^3 for total concentration, 23.91～140.33fg/m^3 for I-TEQ concentration. Concentration level of PCDDs/DFs was the lowest at this area of three sites. This result is a reason why different special sources excluding MSWI do not exist. Industrial area which gathered chemistry factory was showed 2.58~51.53pg/m^3 for total concentration of PCDDs/DFs, 41.01～647.3fg/m^3 for I-TEQ concentration. Industrial area was located at the place closed to sea by policy to diffuse

contaminants. Hence, this area showed low level owing to excellent atmospheric diffusion and transport.

Behavior of PCDDs/DFs in ambient air

Vapor/particle distribution for three area was summarized in Fig. 3. As illustrated in Fig. 3, according to increase chlorine number(D4→D8, F4→F8), a ratio of vapor to particle phase increased for three sites all together. This result was corresponded with a general behavior of PCDDs/DFs in atmosphere.[6] Especially, this result was the more obvious at Urban area. But Residential area influenced by MSWI and Industrial area showed a little different pattern as compared with Urban area. Vapor phase had higher ratio than particle phase at Industrial area. This is a reason why vapor pollutants emitted stationary source in the vicinity adsorb to particle and a time being formed aerosol is lack. Therefore, behavior of vapor/particle in ambient air was generally similar, but had a different existence ratio of vapor/particle in accordance with each source. From these results, it can be conclude that distribution ratio of vapor/particle will be the more important rather than concentration level of PCDDs/DFs in ambient air as aspects of risk assessment.Fig. 2. Average distribution of vapor/particle phase for three sites. ■ means particle



hase and □ means vapor phase.

Congener profile

Fig. 3 shows average congener patterns for each area. Congener profile for total concentration of PCDDs/DFs was a little different at three areas. But taking I-TEQ concentration into considering, HxCDDs of PCDDs was predominant, PeCDFs and HxCDFs for PCDFs represented as predominant congener. Congener pattern was similar for I-TEQ concentration in atmosphere at three areas.

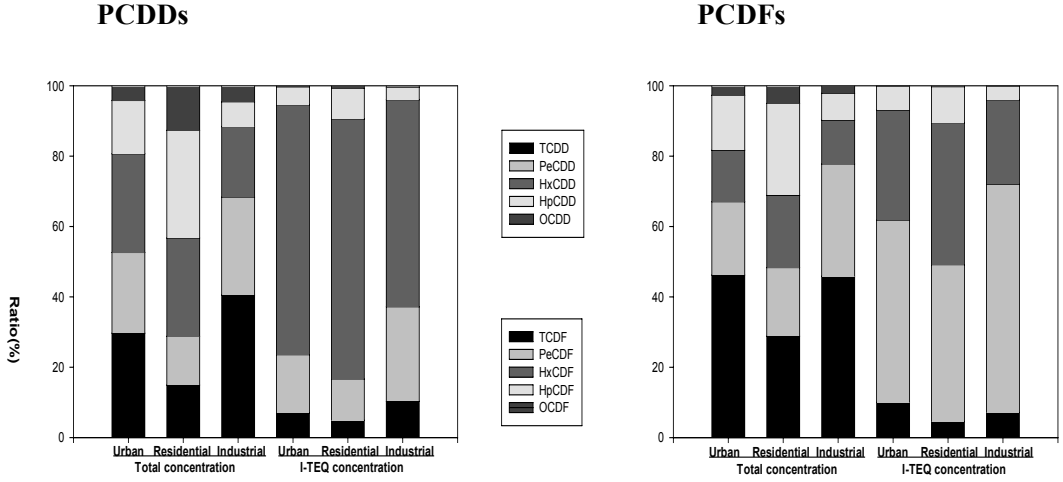


Fig. 3. Average congener profile for three area.

References

1. Billy J. Fairless, Dale I. Bates, Jody Hudson, Robert D. Kleopfer, Thomas T. Holloway, and Debra A. Morey, *Environ. Sci. Technol.*, **1987**, 21, 550-555
2. Gary T. Hunt and Bruce E. Maisel, *J. Air Waste Manage. Assoc.*, **1992**, 42, 672-680
3. Mats Tysklind, Ingrid Fangmark, Stellan Marklund, Anne Lindskog, Lennart Thaning, and Christoffer Rappe, *Environ. Sci. Technol.*, **1993**, 27, 2190-2197
4. J.-R. Lu, H. Miyata, C.-W. Huang., H.-T. Tsai, V.-Z. Sheng, T. Nakao, Y. Mase, O. Aozasa and S.
Ohta; *Chemosphere*, **1995**, 31, 2959-2970
5. Gon Ok, Hyun-Jin Suk, Sung-Hee Ji, Hyo-Bang Moon and Hyup-Hee Lee; *The Korea Society for Environmental Analysis*, **1998**, 1(1), 33-40
6. Shunji Hashimoto, Mariko Katsu, Hironobu Seki, Yukio Tsunetoh, Hiroyasu Ito and Masatoshi Morita, *Journal of Environmental Chemistry*, **1999**, 9(1), 53-69