

PCDDs/PCDFs LEVELS IN AMBIENT AIR IN SEOUL

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Introduction

Polychlorinated dibenzo-*p*-dioxins(PCDDs) and dibenzofurans(PCDFs) are typical persistent organic pollutants which have been known as extremely toxic and bio-accumulative¹. Combustion and incineration processes are believed to be major sources of dioxins to the atmospheric environment. The PCDDs/Fs levels in ambient air are influenced by meteorological parameters such as precipitation, temperature, wind velocity, solar intensity and humidity². To assess the relative importance of such processes, it is desirable to conduct simultaneous measurements of the concentration of PCDDs/Fs with meteorological factors such as temperature, wind velocity and precipitation.

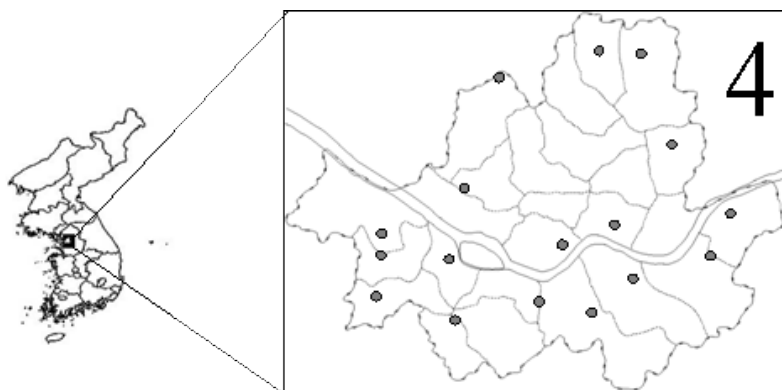


Figure 1. Locations of the sampling sites in Seoul

The pattern of climatic conditions show large seasonal variations in Seoul. Temperatures reach as high as 38.4 °C in the summer and drop as low as -19.2°C in the winter. The annual precipitation in Seoul averages 1,344.2 millimeters but 70 percent of the total annual precipitation is concentrated in the rainy months (monsoon period) of June through September.

In this study, the levels of PCDDs/PCDFs in ambient air were determined in Seoul area and monthly variations and abundance of PCDDs/Fs isomers were also investigated. We also inquired the relationship between the levels of dioxins in ambient air and meteorological parameters.

Method and Material

Sampling; Samples were collected using high-volume air samplers equipped with a quartz fiber filter and PUF (polyurethane foam) backup cartridge. Volumetric sampling flow rate was set on 0.2m³/min and 0.8m³/min. The samples were collected 3times a year from 2002 to 2004 in Seoul area(Figure 1). Additionally, we monitored 60 times(5times/month, 12 month a year) at one sampling site to investigate relationship between the level of dioxins in ambient air and some atmospheric parameters in 2004.

Analytical Procedure; Samples spiked with ¹³C₁₂-labeled PCDDs/Fs as an internal standard were extracted with toluene by soxhlet extractor. The extract was treated by sulfate conc. and the extract solution was cleaned by multiple silicagel chromatography column and alumina chromatography column and then spiked with ¹³C₁₂-labelled 1,2,3,4- and 1,2,3,7,8,9-substitued PCDDs as a recovery standard. Chromatograms were obtained from Gas chromatography electron impact mass spectrometry (GC-EIMS, a MicromassAutospecUltima) at a resolution of

10,000(10% valley) in SIM mode.

Result and Discussion

Spatial variations of PCDDs/F

The TEQ(2,3,7,8-TCDD equivalents) value of PCDDs/F in ambient samples from 2002 to 2004 ranged from 0.029–2.83pg I-TEQ/m³ and the average of TEQ values was 0.26 pg-TEQ/ m³. There were noteworthy levels of PCDDs/F, which the TEQ values of PCDDs/F at three samples collected from the southwest area were 2.57pg I-TEQ/m³, 2.83pg I-TEQ/m³, 2.05pg I-TEQ/m³, respectively. The TEQ values of those samples were much higher than the rest. There are adjacent to some industrial areas in the southwest of Seoul. It may affect to elevate the concentration of PCDDs/F in that area sporadically. In some Asian countries, TEQ values of PCDDs/F in ambient air ranged from 280 to 2500fg I-TEQ/ m³, reported by Makiya⁷. In this investigation, there was the wide gap in the concentration before and after rainfall despite the same sampling site and similar period, because of washing out effect(before rain fall 0.17 I-TEQ/m³:after 0.06 I-TEQ/m³ (January), before 0.10 I-TEQ/m³:after 0.03 I-TEQ/m³ (June), before 0.11 I-TEQ/m³:after 0.05 I-TEQ/m³ (July)). The physical atmosphere condition, such as precipitation may play an important role in the variation of PCDDs/F levels in ambient air.

Relationship between PCDDs/F and meteorological parameters

The PCDDs/F levels in this study were higher in the winter than in the summer(Figure 2). The seasonal variations of PCDDs/F levels are due to the increase in domestic heating, the presence of temperature inversion layer in winter and reaction with OH⁻ radicals in summer, reported by Lohmann.³

The concentration of PCDDs/F in ambient air is due to influence of meteorological parameters⁵. Especially, temperature, precipitation and wind velocity may be important factors. In this study, multiple regression analysis (MINITAB ver. 13) was used to examine fully the effects of ambient temperature precipitation and wind velocity on the variation of PCDDs/F.

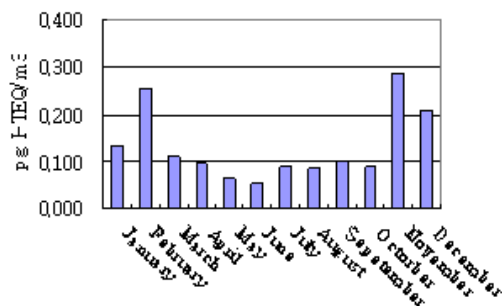


Figure 2. Monthly variations of PCDDs/F in ambient air in Seoul

The regression equation is

$$\text{TEQ} = 0.299 - 0.00289 \text{ precipitation} - 0.0431 \text{ wind velocity} - 0.00518 \text{ temp}$$

$$(r^2 = 0.43, p < 0.05)$$

Figure 3. shows the relationship between the level of dioxins in ambient air and temperature. Temperature was negatively significant factor for TEQ of PCDDs/F in atmosphere($r^2 = 0.28$, $p < 0.0015$). The regression plot indicated that the lower temperature, the higher TEQ values. Lohmann et al.³ also reported that air PCDDs/F levels were inversely correlated with temperature.

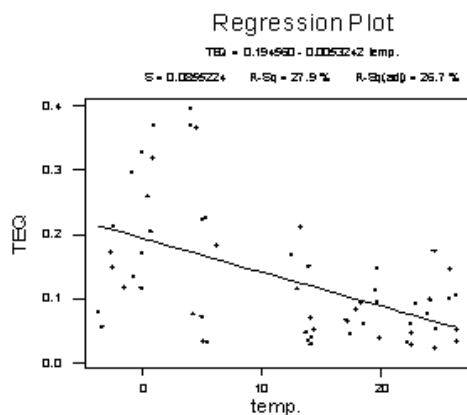


Figure 3. The relationship between the level of dioxins and temperature

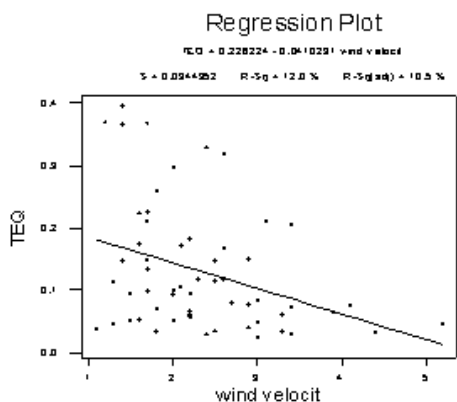


Figure 4. The relationship between the level of dioxins and wind velocity

Wind velocity was also negatively significant factor for TEQ levels of PCDDs/F (Figure 4. $r^2 = 0.12$, $p=0.001$).

The PCDDs/F in ambient air samples were measured in Seoul area. The TEQ value of PCDDs/F in samples ranged from 0.029 to 2.83pg I-TEQ/m³ and the average of TEQ values was 0.26 pg-TEQ/ m³. A seasonal variation of PCDDs/F was found in ambient air in Seoul. The PCDDs/F levels were higher in the winter than in the summer. The concentration may be affected to influence of meteorological parameters such as temperature and wind velocity. Based on result from this investigation, further research on other environment factors such as solar intensity and humidity are recommended to get more reasonable data.

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