POLYCHLORINATED DIBENZO-P-DIOXINS AND DIBENZOFURANS (PCDDs/DFs) IN SOILS FROM MASAN AND CHANGWON CITIES, KOREA

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Introduction

Recently, in Korea, the issue related to PCDDs/DFs emissions and exposures has evoked great public concern about PCDDs/DFs-contaminated foods and use of waste incinerators. There is a need for monitoring environmental distribution and sources of PCDDs/DFs in the Korean environment. PCDDs/DFs can be emitted from a number of anthropogenic activities including industrial processes, municipal and industrial waste incineration and natural events such as forest fires (1-3). Because of their potential to cause carcinogenic and reproductive effects, PCDDs/DFs have been given priority for study in Korea as well as other countries (4-6). Masan and Changwon Cities are located in southeastern Korea, and were selected as study areas because these two cities are moderately urbanized and industrialized areas, and data from these areas could be basic information to understand situation of Korean environment.

Because soils are a reservoir for hydrophobic contaminants like PCDDs/DFs, assessment of contaminants of soils in terrestrial circumstances has been a major research to investigate local and global pollution, detect the emission factors, and for source reduction.

The objectives of this research were to measure current concentrations of PCDDs/DFs in soils from Masan and Changwon Cities, Korea, to identify point sources, and to determine the primary factors affecting concentrations of PCDDs/DFs.

Materials and Methods

Masan and Changwon Cities were divided for sampling into four regions, the residential and rural area, the industrial and commercial area, a site 50 m from uncontrolled incinerator of industrial wastes, and the top of a 200 m mountain. Soils were collected from twenty three locations in August 1994. Samples were placed into polyethylene bags and stored at 4°C until analysis. Analytical methods for PCDDs/DFs in soils have been reported in detail elsewhere (7). Briefly, soils were Soxhlet extracted with iso-propanol followed by dichloromethane. Known amounts of

^{13}C-labeled PCDDs/DFs were added as internal standards. After a series of silica gel, alumina, activated carbon and Sep-pak column clean up, a high resolution gas chromatograph interfaced with a high resolution mass spectrometer (HRGC-HRMS) was used for the identification and quantification of PCDDs/DFs. A Hewlett Packard 5890 series II HRGC connected to a JEOL SX102A HRMS was employed. The capillary column was 50 m long and 0.25 mm i.d. with 0.2 μ m stationary phase film thickness. Concentrations of PCDDs/DFs are reported as the sum of all the quantifiable isomers and congeners. Concentrations that were less than the method detection limits were assigned zero when calculating means.

Results and Discussion

Total concentrations of tetra- through octachlorinated PCDDs/DFs in soils ranged from 35 to 121,400 pg/g, dry weight (dw). Concentrations of 2,3,7,8-tetrachlorinated dibenzo-*p*-dioxin (TeCDD) equivalents (TEQs) in soils estimated based on I-TEFs were in the range of 0.2 to 3,720 pg/g, dw. Although the concentrations varied considerably among the twenty three sampling locations, there was a positive relationship between concentrations of total PCDDs/DFs and concentrations of TEQs.

Total concentrations of PCDDs/DFs in soils from each sampling location and the spatial gradient were used to determine potential point sources in Masan and Changwon Cities. Four of the twenty three sampling sites near the industrial area contained relatively great concentrations, which suggests the presence of point sources. In particular, concentrations of PCDDs/DFs at the site of 50 m from uncontrolled incinerator of industrial wastes shows great concentrations as 121,400 pg/g, dw.

Almost all tetra- through octachlorinated PCDDs/DFs were present in all soils samples reflecting wide dispersal over the study area. Detections also occurred at the top of mountain of 200 m in elevation including many locations at higher elevations than the likely point sources. It indicates that contaminations in higher elevation of study areas are through air deposition from other polluted areas including point sources.

Different sources of PCDDs/DFs are characterized by different congener and homologue patterns (8, 9). PCDFs from PCBs have specific homologue patterns which are distinct from those produced during combustion. Nearly all PCDFs isomers and homologues have been identified in Japanese PCB preparations such as Kanechlors 300, 400, 500 and 600 (10). The homologue composition of PCDFs in soils from point source were correlated strongly with that of commercial PCB preparations such as Kanechlors 300 and 400 ($r=0.98$ and 0.95). These results indicate Kanechlors 300 and 400 are a sources of PCDFs in Masan and Changwon Cities. The wide range of PCDDs isomers and greater concentrations of PCDDs compared to PCDFs in certain locations suggest sources from diverse thermal processes such as uncontrolled incineration of industrial wastes, industrial processes and transportation.

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