PROFILES OF PCDDs/Fs IN VARIOUS EMISSION SOURCES AND THEIR INFLUENCE ON AMBIENT AIR IN AN INDUSTRIAL AREA

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Introduction

Waste incinerators, steel industries with electric and sintering furnace, nonferrous metal industry facilities with electric furnace and cement kilns with thermal process are most significant emission sources of PCDDs/Fs into ambient air. The interrelationship between characteristic of PCDDs/Fs distribution in emission sources and ambient air can be reasonably predicted by homologue and congener profiles of PCDDs/Fs in emission sources and ambient air. In this study the homologue and congener profile of PCDDs/Fs in various emission sources and in ambient air was investigated to characterize and estimate the emission sources of PCDDs/Fs and its association with ambient air in the large industrial area in Korea.

Material and Methods

The selected facilities were 3 municipal solid waste incinerators (MSWIs), 9 industrial solid waste incinerators (ISWIs), 3 infectious waste incinerators (IWIs), 6 waste-pulp and paper incinerators (WPPIs), 5 nonferrous metal industry facilities (NMIFs), 7 iron and steel industry facilities (ISIFs) and 9 chemical manufacturing industry facilities (CHIFs). The number of selected facilities from each emission source was based on distribution of each emission source in the industrial area. The stack sampler and gas probe were used and the samples were collected by Q/F, XAD-2 resin and absorbed in impingers. For the particle phase of sample, isokinetic method was used and the sampling amount was above 3 Sm^3 during 4hrs. All together 9 sampling points were taken for PCDDs/Fs measurement in ambient air which were based on the data investigated from ministry of environment, Korea from 2001 to 2004 and sampled using high volume air sampler (HVAS). All congeners of PCDDs/Fs (210 congeners) were analyzed according to Korean Standard Test Method (KSTM) for dioxins and furans and in addition reference were taken from previous papers to analyze MoCDDs/Fs-TrCDDs/Fs. The concentrated elute of each phase of

PCDDs/Fs samples was also separately analyzed by high resolution gas chromatograph/high resolution mass spectrometer (HRGC/HRMS) with SP2331 column. The homologue profile was developed by the ratio of concentration of each homologue to concentration of all homologues and congener profile was developed by the ratio of concentration or TEQ concentration of 2,3,7,8-substituted congeners to concentration of homologues from 4Cl to 8Cl.

Results and Discussion

Homologue profiles of PCDDs/PCDFs in various emission sources and ambient air

The incinerators had own homologue profile of PCDDs/Fs according to waste types. TeCDF was dominant homologue in MSWIs, IWIs and WPPIs but MoCDF was dominant homologue in ISWIs. Second dominant homologue was PeCDF in MSWIs, DiCDF in ISWs and TrCDF in IWIs and WPPIs. The homologue profiles in NMIFs and ISIFs were little similar. The dominant homologue was MoCDF in all industry sources followed by DiCDF in NMIFs and ISIFs. The homologue profiles of PCDDs in NMIFs and ISIFs were little more different than the homologue profiles of PCDFs in NMIFs and ISIFs. And CHFIs has own homologue profile of PCDDs/Fs. The dominant homologue was MoCDF and followed by MoCDD in CHFIs. It means that the mono congeners of PCDDs/Fs were emitted in higher amount from CHFIs. The homologue profile of PCDDs/Fs in ambient air did not show similarity with any homologue profiles of PCDDs/Fs in emission sources. MoCF was dominant compound in ambient air followed by TeCDF, DiCDF and PeCDF. Therefore, it was predicted that the own profile of PCDDs/Fs in various emission sources and ambient air can be characterized by homologue.

Congener profiles of PCDDs/PCDFs in various emission sources and in ambient air

OCDD was dominant congener and 1,2,3,4,6,7,8-HpCDD was second dominant congener for all emission sources except IWIs, based on concentration. 1,2,3,7,8-PeCDD was dominant and 2,3,7,8-TeCDD was second dominant congener for IWIs. The congener profiles in various waste incinerators were distinguishable, but the congener profiles in various industry facilities were little similar. OCDD was dominant congener and 1,2,3,4,6,7,8-HpCDD/F were second dominant congener in ambient air. The congener profile in ambient air showed similarity with the congener profiles in ISWIs. According to TEQ concentration, 2,3,4,7,8-PeCDF was dominant congener in MSWIs, 1,2,3,7,8-PeCDD in ISWIs, WPPIs, NMIFs and CHIFs, 2,3,7,8-TeCDD in IWIs and ISIFs. The second dominant congener was 1,2,3,7,8-PeCDD for MSWIs, IWIs and ISFIs, 2,3,4,7,8-PeCDF for ISWIs and NMFIs, 2,3,7,8-TeCDD for WPPIs and CHIFs. The congener profiles in MSWIs and IWIs was distinguishable, but the congener profiles of another emission sources was not distinguishable. In ambient air, 2,3,4,7,8-PeCDF was dominant and 1,2,3,7,8-PeCDD was second dominant congener. The congener profiles in ambient air showed similarity with the congener profiles in MSWIs. Therefore, for the characterization of PCDDs/PCDFs profile in various emission sources and ambient air, the congener profile of PCDDs/PCDFs by ratio of concentration of 2,3,7,8-substituted congeners to concentration of homologues from 4Cl to 8Cl is more useful than the ratio of TEQ concentration of 2,3,7,8-substituted congeners to concentration of homologues from 4Cl to 8Cl.

Relationship between emission sources and ambient air in study area

To examine the influence of major emission sources on concentration of PCDDs/Fs in ambient air in study area, the homologue and congener profiles in various emission sources and ambient air were compared. The homologue profile in ambient air showed differences from emission sources, so any relationship was not find. However, we can find some relationship between emission sources and ambient air since 2,3,7,8-substituted congener profile in ambient were similar with MSWIs and ISWIs. The 2,3,7,8-substituted congener concentration profile in ambient air was similar with ISWI. And based on TEQ concentration, the 2,3,7,8-substituted congener profile in ambient air were similar with MSWIs. From these results, we could predict that main sources of PCDDs/Fs associated with ambient air in this area were waste incinerators, especially MSWIs and ISWIs.

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