PCDDs/PCDFs in Suspended Particulate Matter in Tokyo Urban Air

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INTRODUCTION

The suspended particulate matter (SPM) from environmental air contain many kinds of hazardous compounds. While these compounds are very low concentration in environmental air, these are suspected the health effects by long term exposure. As a part of study to evaluate the pollution sources and human exposure to these compounds, concentration of the polychlorinated dibenzo-p-dioxins(PCDDs) and polychlorinated dibenzofurans(PCDFs) in SPM in urban air, diesel exhaust gas and tunnel air were compared. PCDDs/PCDFs distributions were also measured in particle size of SPM in urban air.

EXPERIMENTAL

Sample collection

SPM in urban air were collected every 1 week from June to October in 1997 on the roof of the 6th floor of the National Institute of Public Health, Minato-ku, Tokyo using electric precipitator (Fuji Electric Co.). After the SPM was brushed from the sampling unit, and was stored in glass bottle at -80°C in deep freezer.

An Andersen sampler equipped with a low pressure impactor (Tokyo Dylec. Co.) was used for the size separation sampling. This sampler can be used to classify particles in environmental air into 12 groups according to particle size, ranged from less than 0.13 μm (hereafter particle size is expressed as a 50% cut-

off value) to more than 12.1 μ m. The air samples were collected on the same roof of the building in December, 1995.

SPM in diesel exhaust gas was sampled by high-volume air sampler from the dilution tunnel equipped with diesel engine dynamo metor at the Research Institute of Tuberculosis, Japan Anti-Tuberculosis Association, Kiyose-shi, Tokyo. After sampling, SPM in diesel exhaust gas was brushed from the quartz fiber filter, and was stored in glass bottle at -80℃ in deep freezer.

The Tunnel particle (NIES No.8 as a standard materials) were offered from National Institute for Environmental Studies.

Analysis

The SPM samples undergone Soxhlet extraction for over 16 hours using toluene. After extraction, internal standards (IS) were spiked in each sample, and purified with H_2SO_4/silica-gel treatment, silica-gel column chromatography and alumina column chromatography [1]. After clean-up, samples were determined and quantified by HRGC-HRMS analysis.

RESULTS and DISCUSSION

There are many kind of hazardous components in SPM in ambient air depending on pollution sources, formation conditions, reactions in air, etc. In this study, we were compared PCDDs/PCDFs concentration and compositions in SPM in urban air, vehicle exhaust gas in tunnel (tunnel particle)and diesel exhaust gas. The results of PCDDs/PCDFs relative concentrations were shown in Fig.1. Relative concentration of homologues in each SPM were shown and TEQ concentration (pg-TEQ/m3) were shown in parenthesis in Fig.1. We recognized that SPM in urban air showed the highest PCDDs/PCDFs concentration (79,000pg/g) and tunnel particle showed the lowest PCDDs/PCDFs concentration (5,800pg/g). The compositions were varied through each particle. For example, tunnel particle has higher ratios of T4CDDs and O8CDD than the other SPM cases, PCDFs in urban air SPM were higher than other PCDFs. These results suggested that there would be the other sources such as MSW incinerator supplying higher concentration of PCDDs/PCDFs.

Seasonal variations of SPM concentrations and polycyclic aromatic hydrocarbons (PAHs) concentrations in Tokyo urban air were reported [2]. Thus, we have compared monthly sample to the concentration of PCDDs/PCDFs in SPM

that collected from June to October in 1997. The DIOXINs levels (concentration of PCDDs, PCDFs and TEQ) in air borne particles were not given big differences based on the particulate weight in Fig.2. Because of measurement of sampling air flow for electric precipitator was very difficult, we could not calculate PCDDs/PCDFs concentrations in air (gas based) accurately. Thus, we would need SPM concentration data at nearest monitoring station. In order to understand behavior of PCDDs/PCDFs in atmosphere, it is necessary to keep monitoring PCDDs/PCDFs concentration.

Since it is known that deposition efficiency of particle in the human respiratory organs is change depending on particle size, we had collected SPM in ambient air classified into 12 groups according to size using an Andersen sampler with a low pressure impactor. Size distribution of TEQ concentrations were shown in Fig.3. In Fig.3, TEQs shown one peak at 0.52 μ m (50% cut-off value) as same as size distribution of PAHs [2]. The particle under 2.5 μ m contributed to ca.90% of total TEQ that was estimated to be easily take into the human lung. It is suggested that monitoring of SPM under 2.5 μ m is necessary for human exposure to those hazardous compounds.

REFERENCES

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[2] K. Sugita, S. Chengiun, S. Goto, K. Tanabe, T. Ishii: Particle size distribution of polycyclic aromatic hydrocarbons in the air, INDOOR AIR '96 Proceedings of the 7th International Conference on Indoor Air Quality and Climate, Vol.3, 391-396(1996)

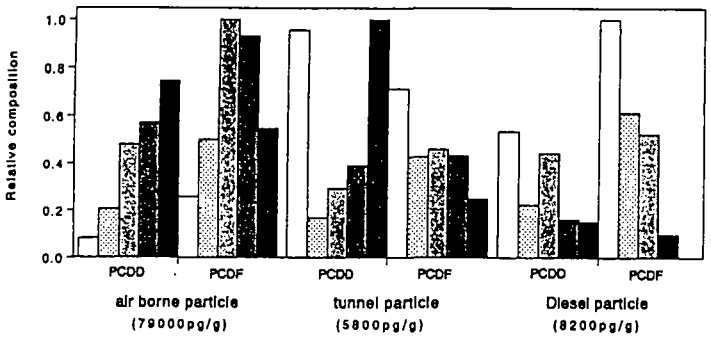
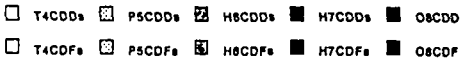


Fig.1 Relative composion of PCDD/F homologous in particulate matter



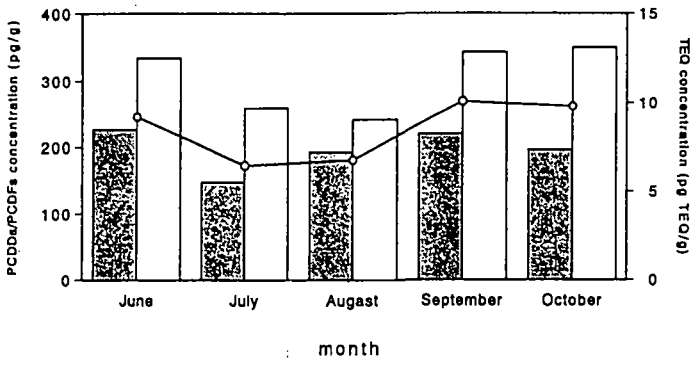
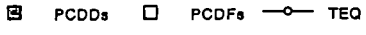


Fig. 2 DIOXIN concentration in SPM from ambient air



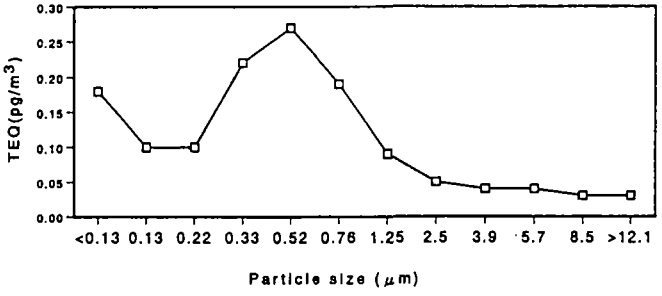


Fig. 3 Size distribution of TEQ concentration in SPM