CONGENER PATTERN AND CORRELATIVITY ANALYSIS OF PCDDS/DFS, DL-PCBS AND HCB IN THE EXHAUST GAS FROM DIESEL VEHICLES

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1. Introduction

Persistent organic pollutants (POPs) are typical environmental contaminants of which physical and chemical characteristics are toxic, bioaccumulative, persistent and long-range transportable. Since these agents cause severe side effects on the ecosystem including human beings, a variety of regulations and countermeasures against its usages, processing methods and reduction of emission density have been worked out internationally.

In addition to the studies on such point source contaminants as the incinerating facilities of wastes and the industrial facilities of steel and chemistry of which emission paths have been considerably examined closely for the present, studies on non-point source contaminants are also necessary. Although such mobile contaminative sources as auto exhausts are highly vulnerable to emit unintentionally produced POPs (U-POPs), related data are insufficient and uncertainty is also great due to the difficulty of measurement. Therefore, comparing with other non-point source contaminants, auto exhausts need a variety of studies.

The aim of this study was to examine U-POPs(PCDDs/DFs, DL-PCBs and HCB) focusing on diesel vehicle of which emission density was expected to be higher among mobile contaminative sources. This study presented the congener pattern of PCDDs/DFs and the Pearson correlation coefficient between PCDDs/DFs, DL-PCBs, and HCB.

2. Materials and methods

2.1 Classification of automobiles

This study examined Light duty diesel vehicle(LDDV) and Heavy duty diesel vehicle(HDDV). The sampling was carried out twice to reduce the measurement error and fixed speed of 80 km/hr.

Table 1. Classification of automobiles selected on this study

No.	Sample name	classification
A-1	truck	
A-2	truck	
A-3	bus	
A-4	bus	HDDV[1]
A-5	truck	
A-6	truck	
B-1	van	
B-2	van	
B-3	van	
B-4	van	LDDV[2]
B-5	van	
B-6	van	

1) HDDV (heavy Duty Diesel Vehicle) means truck and bus over 7 seats

2) LDDV (Light Duty Diesel Vehicles) means personal car and van under 6 seats

2.2 Sampling

The tailpipe exhaust sampling from dynamometer testing was focus on diesel vehicles. The diesel vehicle was fixed on the chassis dynamometer and started to sample.

Flue gas velocity was measured with a manometer. U-POPs sampling was carried out isokinetically at the port. Pyrex sampling probe inlet was positioned perpendicular to the exhaust flow at the center of the exhaust pipe. The sampling train was seperated into 4 parts(filter, absorber Ⅰ, XAD resin, and absorber Ⅱ). The filter supported in the pyrex filter housing which was kept under 120℃. The sample was cooled by passing through the sampling train in an ice bath. The temperature of XAD resin was about 15℃.

The coarse particles were collected on silica glass microfiber thimble Whatman. It is defined that the solid phase is trapped on the filter and the gas phase is passed through the filter and absorbed in absorber Ⅰ, XAD resin and absorber Ⅱ. U-POPs sampling apparatus was shown in Fig.1.

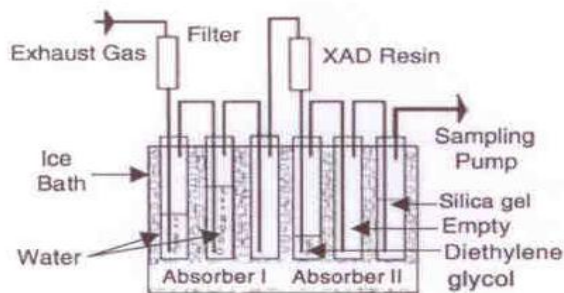Fig. 1. Sampling apparatus.

2.3 U-POPs pre-treatment and analysis

Sample extraction and clean-up were carried out in accordance with Korean Standard Method. Filter and absorbent were Soxhlet extracted with toluene for 16hours. To clean up the sample, equipment was comprised with a multi-layered silica column and alumina column. The PCDDs/DFs and DL-PCBs analysis was performed on selected ion monitoring mode with a JEOL JMS-800D high resolution mass spectrometer connected with high resolution gas chromatograph. HCB analysis was performed with THERMO DSQ Ⅱ low resolution mass spectrometer connected with high resolution gas chromatograph.

3. Results and discussion

This study examined congener pattern of PCDDs/DFs from diesel vehicle.

In case of HDDV, OCDF occupies 51∼86 % of total density of congener different from the other contaminant sources. LDDV also present different characteristic of congener distribution from the other contaminant sources. The ratio of PCDDs/DFs concentration from diesel vehicle was shown in Fig.2. Each bar means average concentration ratio of PCDDs/DFs congeners and The error bar maens standard deviation.
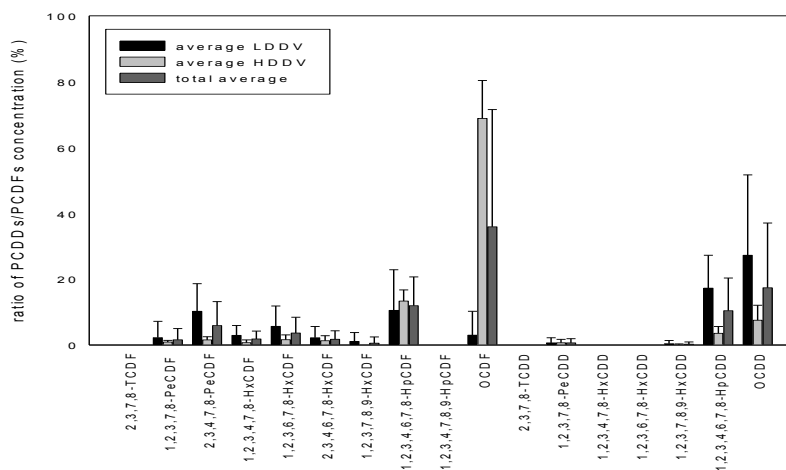

Fig. 2. PCDDs/DFs congener pattern of Diesel Vehicles

This study carried out a correlativity analysis between U-POPs which were generated by diesel vehicle. In case of LDDV, the Pearson correlation coefficient between PCDDs/DFs and DL-PCBs is 0.914 and therefore there is high correlativity. In case of HDDV, the Pearson correlation coefficient between HpCDF+OCDF and DL-PCBs is 0.916 and therefore there is also high correlativity.
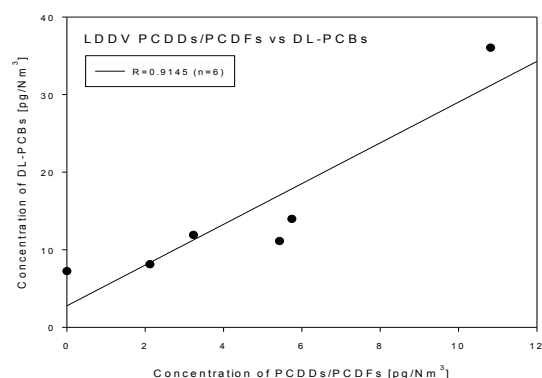

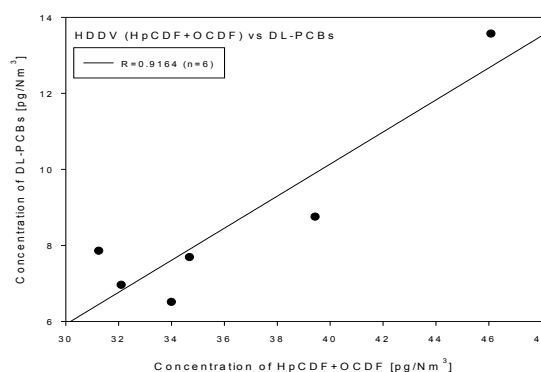Fig. 3. The Correlation between PCDDs/PCDFs and DL-PCBs from LDDV

Fig. 4. Correlation between HpCDF+OCDF and DL-PCBs from HDDV

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