

Formation of Polychlorinated Dioxins, Furans, Benzenes and Phenols in the Flue gas of the Municipal Waste Incinerator from the Republic of Korea

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Introduction

The emission of chlorinated aromatic compounds from the municipal waste incinerator has been increased environmental interest because of their toxicities such as polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDDs/PCDFs). Many investigators have been studied the formation of PCDDs/PCDFs in the municipal waste incinerators [1-7]. Numerous measurements have reported the formations of PCDDs/PCDFs across air pollution control devices such as electrostatic precipitators, bag filter, selected catalytic reactor by comparing the concentration of inlet and outlet.

The collecting sample and analysis of PCDDs/PCDFs were very difficult and dangerous, therefore the correlation between PCDDs/PCDFs and chlorophenols (CPhs) and chlorobenzenes (CBs) are studied in this research to find the index organic compounds in the incinerators which located in Korea.

Material and Methods

Two of the municipal waste incinerators were selected to analyse the PCDDs/PCDFs by using six samples in the stack and to find the correlation between the PCDDs/PCDFs formation and CPhs/CBs by using 27 samples. The Korean standard method[8] was used to collecting the sample and analysing the PCDDs/PCDFs and CPhs/CBs as shown Figure 1. The analytical condition also showed in Table 1.

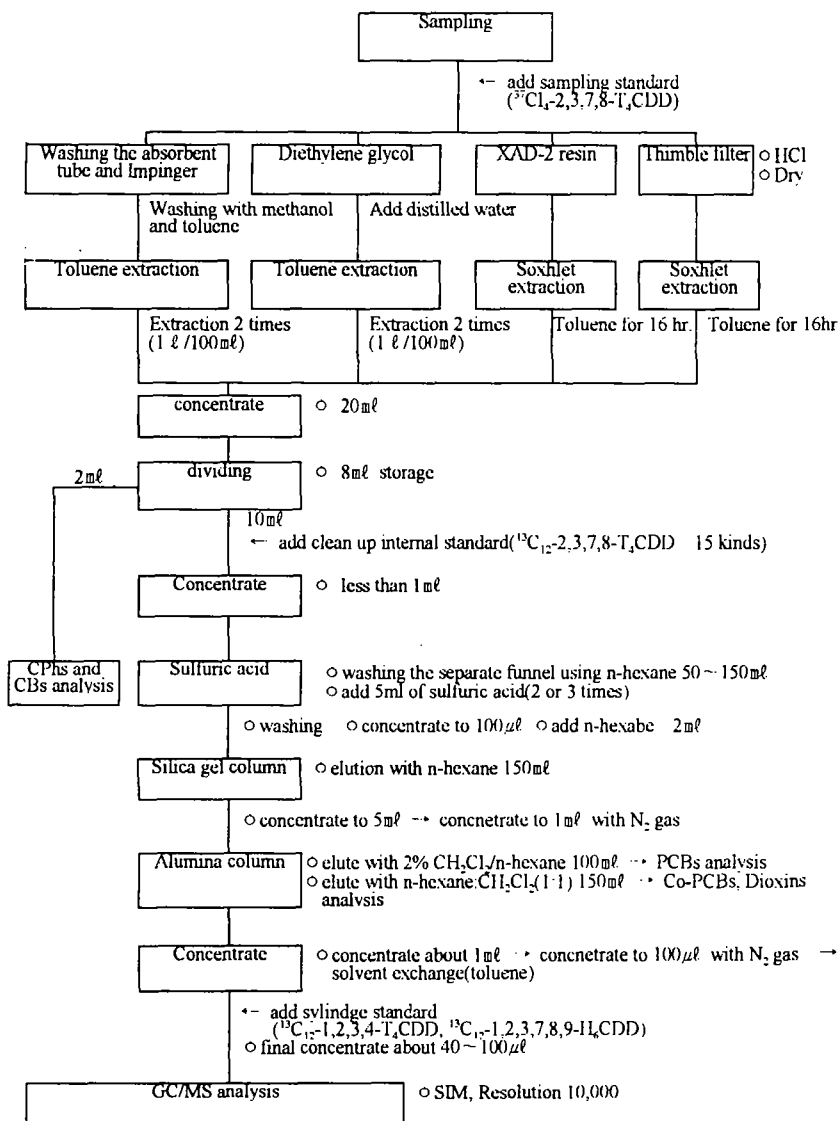


Figure 1. Flowchart of Dioxin analysis in Korean method

Table 1. GC/MS Analytical Condition of PCDDs/PCDFs and CPhs/CBs.

	PCDDs/PCDFs	CPhs/CBs
o GC/MS	VG Co., Autospec Ultima	VG Co., Autospec Ultima
o Injector Temperature	250°C	250°C
o Column	SP-2331 (60m×0.32mm ID×3.0µm)	DB-5 (60m×0.32mm ID×3.0µm)
o Oven Temperature	120°C(3min)→ 200°C(10 °C/min, 3min)→ 265°C(3°C/min, 15min)	50°C(4min)→ 260°C(10 °C/min, 5min)
o Carrier Gas	He, 2.5ml/min	He, 2.5ml/min
o Injection Mode	Splitless	Splitless
o Ionization Mode	EI	EI
o Ion Source temperature	36eV	36eV
o Resolution	260°C	250°C
o Scanning Rate	10,000	10,000

Results and Discussion

The summation of tetra(TCDDs/TCDFs) to octa(OCDD/OCDF) congeners of dioxins and furans were measured 21.06ng/Nm³, 9.35ng/Nm³ and the 2,3,7,8-substituted isomer of toxic equivalent concentration (TEQ) were measured 0.442 TEQ-ng/Nm³, 0.329 TEQ-ng/Nm³ in A and B incinerator, respectively. The PCDDs/PCDFs are also plotted in Figure 2 and 3.

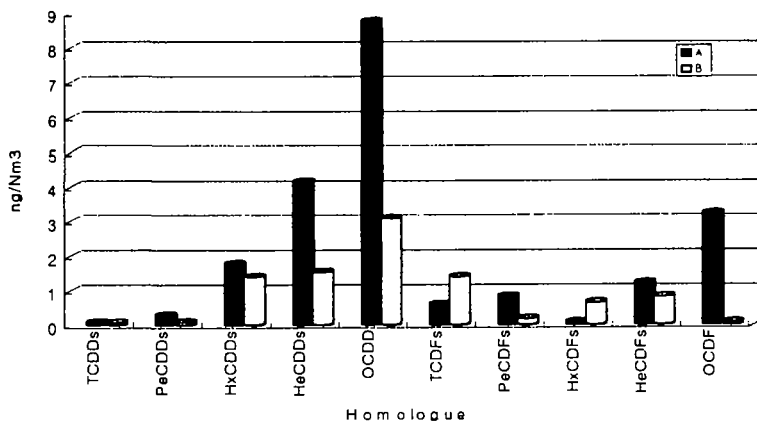


Figure 2. Total dioxins(PCDDs) and Furans(PCDFs) concentration of the flue gas in the A and B incinerators

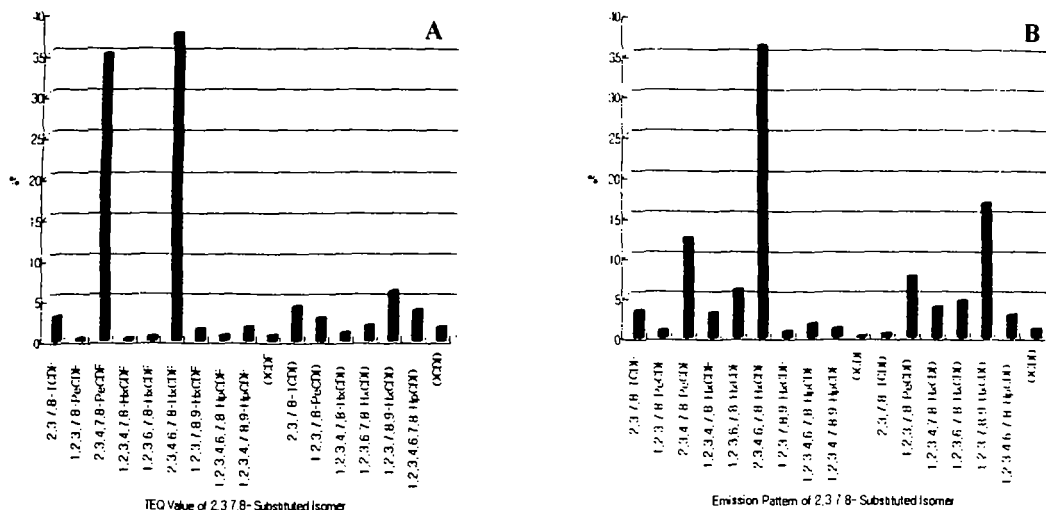


Figure 3. Distribution of 2,3,7,8-substituted isomer(TEQ) of the flue gas in the A and B incinerators

As shown the Figure 1, the ratio of Σ PCDDs to Σ PCDFs was measured about 70 : 30 in both incinerators and the HxCDDs, HpCDDs and OCDD were occupied 70% and 65%, respectively. The TEQ value of 2,3,7,8-substituted isomer showed the tendency of higher PCDFs ratio than PCDDs ratio in selected incinerators as shown in Figure 2. The highest concentration was measured 37% of 2,3,4,6,7,8-HxCDF followed by 2,3,4,7,8-PeCDF, 1,2,3,7,8,9-HxCDD in A incinerator and 36% of 2,3,4,6,7,8-HxCDF followed by 1,2,3,7,8,9-HxCDD, 2,3,4,7,8-PeCDF in B incinerator. Also, PeCDFs, HxCDFs and HpCDFs were occupied 76% and 61% of total concentration. Therefore, to deplete the emission amount of PCDDs/PCDFs in the municipal waste incinerator of republic of Korea need to decrease the formation of PCDFs by studying the operating conditions of the incinerator and air pollutant control device which is suitable of our country.

The 7 isomers of CPhs and 7 isomers of CBs also were measured in the flue gas as shown Figure 4. CPhs concentration was measured 1251.95 ng/Nm³, 3204.08 ng/Nm³ and the CBs concentration were measured 2667.86 ng/Nm³, 1770.20 ng/Nm³ respectively. The highly chlorinated compounds mainly emitted the 2,4,6-, 2,3,4,6-, and CPhs, and 1,2,4,5-, octa-, and hexa-CBs as shown the figure.

The correlation analysis was performed to surveyed the relationship between PCDDs/PCDFs formation and CPhs/CBs concentration. The total concentration of

PCDDs/PCDFs was very closely related to the penta-CPh, hexa-CB and Σ CBs as the result of correlation analysis. The Pearson correlation coefficient of these variables were calculated 0.59, 0.87, 0.79, respectively within 5% error range therefore the emission amount of PCDDs/PCDFs in the municipal waste incinerator may be predict by the measuring these concentration in Korea.

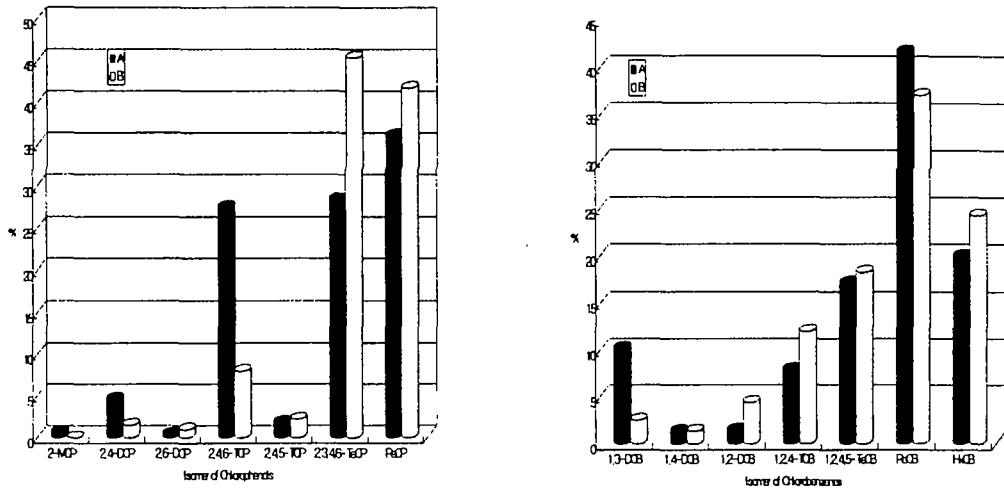


Figure 4. Isomer Distribution of CPhs and CBs of the flue gas in the A and B incinerators

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