THE BEHAVIOR OF DIOXINS, PCBS, CHLOROBENZENES AND CHLOROPHENOLS IN WET SCRUBBING SYSTEM OF MUNICIPAL SOLID WASTE INCINERATOR

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Introduction

Wet scrubbing system (WS) is better than any other flue gas treatment devices for acid gas removal. However, it is not enough to remove organic compounds such as PCDD/Fs, PCBs and chlorobenzenes (CBzs) from flue gas in WS. Though some researchers reported PCDD/Fs concentration in flue gas at inlet and outlet of WS in municipal solid waste incinerator (MSWI)[1-4], there is few investigation about scrubbing water, suspended solid (SS) in scrubbing water and sludge[5]. In order to understand the behavior of PCDD/Fs in WS and to make clear the effect of residence time of scrubbing water on the PCDD/Fs concentration in flue gas and scrubbing water, PCDD/Fs, PCBs, CBzs, chlorophenols (CPs) concentration were investigated at two MSWIs.

Materials and Methods

The sampling of flue gas at inlet and outlet of WS, fly ash from electrostatic precipitator (ESP), scrubbing water and sludge was conducted on 26 October and 3 August, 2000 at MSWI A and MWSI B respectively. The sampling and analysis of PCDD/Fs, PCBs, CBzs and CPs were based on the manual of Japan Industrial Standard (JIS K 0311 and 0312). Table 1 shows the configuration of each MSWI and WS. There are storage parts of internal circulation water at the bottom of cooling and absorption tower and the scrubbing water circulates with 260t/hr and 586t/hr in WS A and B respectively. Salt concentrations in scrubbing water of WS A and B are controlled to be kept 3% and 8% by adding NaOH solution or water respectively. The quantity of feeding and drawing water is much lower than that of internal circulation water. When the residence times of scrubbing water are calculated with considering the quantity of internal circulation water, they are 106 and 312 hr in WS A and B as shown in table1. Scrubbing water in WS A and B was respectively replaced with fresh water 1.5 and 2 months ago of these samplings.

Table 1 The configuration of two MSWIs and their wet scrubbing systems

facility	furnace	capa-city (t/hr)	APCD system	feeding water (t/hr)	drawing water (t/hr)	internal circulation water			residence time (hr)
						cooling (t/hr)	absorption (t/hr)	condensation (t/hr)	
MSWI A	stoker	8.3	ESP+WS	1.05	2.46	60	200	150	106
MSWI B	stoker	12.5	ESP+WS	5.20	1.89	293	293	356	312

Results and Discussions

The results of PCDD/Fs concentration in each sample at WS A and B were shown in Fig.1 and Fig.2 respectively. PCDD/Fs concentration in flue gas at outlet of WS was higher than that at inlet of WS in both MSWIs. Though inlet concentrations in MSWI A and B were same level, outlet concentrations were quite different. The concentration at outlet increased by 20 times of the concentration at inlet of WS A, whereas it was 1.5 times of inlet concentration at WS B. Moreover, it was observed that the homologue profiles changed considerably and the concentration of higher chlorinated compounds increased remarkably at outlet of WS A. The PCDD/Fs profile in flue gas at outlet of WS A was very similar to those of SS and sludge. Although O8CDD concentration increased in SS and sludge, the homologue profiles of PCDD/Fs

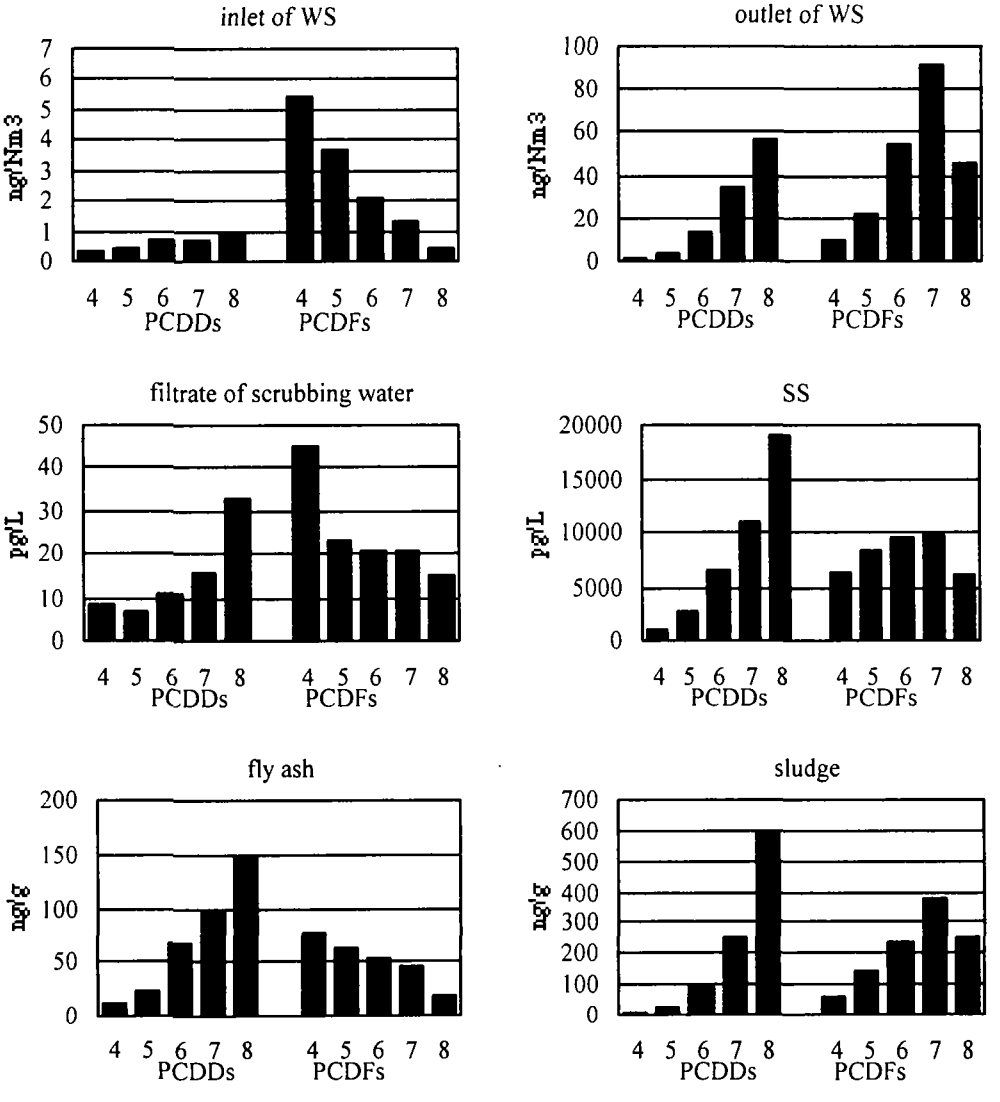

Figure 1 The results of PCDD/Fs concentration in each sample at WS A

in flue gas at outlet did not change remarkably in comparison to that at inlet in WS B. In both WSs, the profile at filtrate of scrubbing water was similar to that at inlet of WS. This indicated that gaseous PCDD/Fs in flue gas dissolved into scrubbing water and moved to the surface of SS particles. As total organic carbon in SS ranged from 2 to 8% and higher chlorinated compounds had low solubility, O8CDD in scrubbing water was adsorbed strongly to SS particles and finally the particular profile in SS was formed. According to the profiles of other chlorinated aromatic compounds, the increase of PCDD/Fs at outlet of WS was caused not by releasing SS particles into flue gas but by desorbing PCDD/Fs from the surface of wall or packing materials in WS.

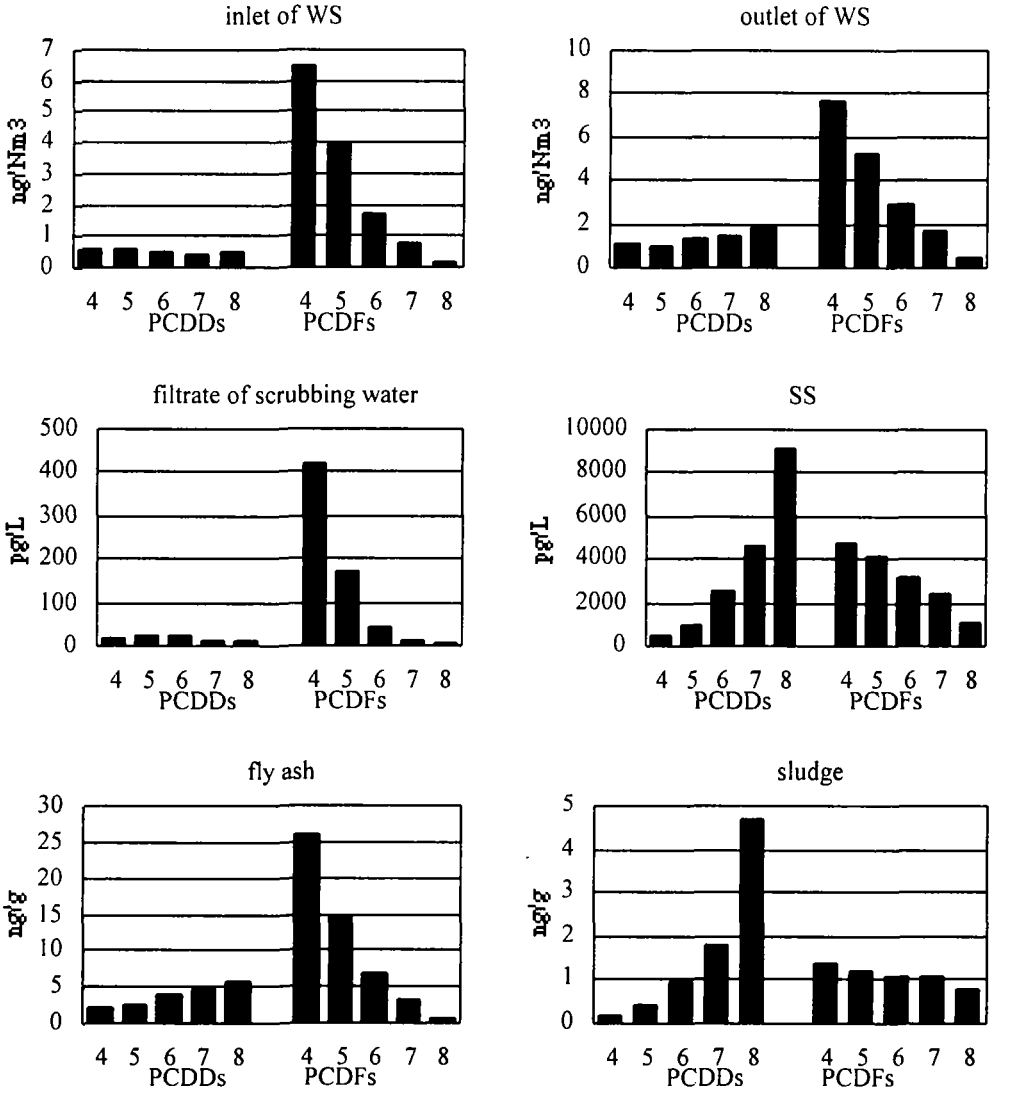

Figure 2 The results of PCDD/Fs concentration in each sample at WS B

The mass balance of each chlorinated aromatic compound around WS A and B was calculated and shown in Fig.3. In both WSs, only CPs were removed from flue gas and moved into scrubbing water. Only trace amounts for all compounds were not detected in WS B. Comparing WS A to WS B in the view point of plant operation, the residence time of scrubbing water was different between them. In WS B, salt concentration in scrubbing water is 8% and the residence time is longer. If the residence time is usually long, scrubbing water contains a lot of contaminants because the volume of flue gas which contact with scrubbing water is large. However, the accumulated quantity of PCDD/Fs in WS A was estimated to be much greater than that in WS B in this research. Therefore, it was considered that the accumulated quantity of PCDD/Fs became smaller because it was flashed out with high volume of circulation water in WS B.

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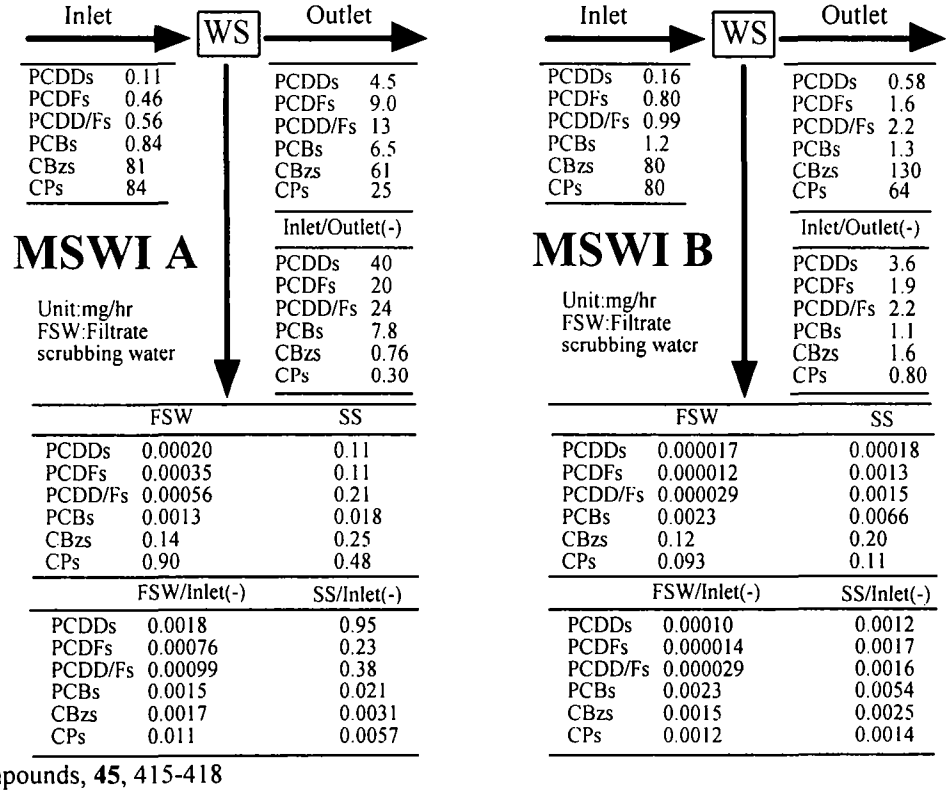

Figure 3 The mass balance of chlorinated aromatic compounds around both WSs