THE REMOVAL EFFICIENCY OF DIOXIN IN FLUE GAS OF MSW INCINERATOR
— COMPARISON OF A FABRIC FILTER WITH AN ELECTROSTATIC PRECIPITATOR —

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ABSTRACT

This study was carried out at the pilot plant which was equipped a fabric filter in order to confirm the removal efficiency of Dioxin. PCDDs and PCDFs can be removed by the fabric filter. The removal efficiency of PCDDs and PCDFs was 96.9 %.

INTRODUCTION

It has recently been shown that fabric filters can remove PCDD/PCDF from the flue gas of municipal solid waste (MSW) incinerators. We aimed to substantiate the removal efficiency of Dioxin and compared the efficiency of the fabric filter (FF) with that of an electrostatic precipitator (EP) using the same flue gas.

EXPERIMENTAL SECTION

The MSW incinerator, used often in this experiment, is equipped with a semi-continuous stoker and a water injection type incinerator with 200 tons/day capacity and EP for removal of fly ash.

The pilot plant is equipped with a gas cooling tower, a dry system and FF for removal of fly ash and of hydrogen chloride (as shown in Figure 1).

The pilot plant can deal with 2,800 m^3N/h of flue gas diverted from the EP inlet. The temperature of flue gas was about 270 degrees.

The flue gas samples were collected simultaneously at the five sampling points : at the incinerator outlet, inlet of the gas/air heat exchanger, EP inlet and outlet and FF outlet. The fly ash was sampled at the conveyer of EP and FF.

For sampling of flue gas, a probe was inserted at the sampling points, according to the authorized method by committee of research group of Dioxin in the Japan Waste Reseach Foundation. Fly ash was sampled with a stainless trowel and stored in a glass

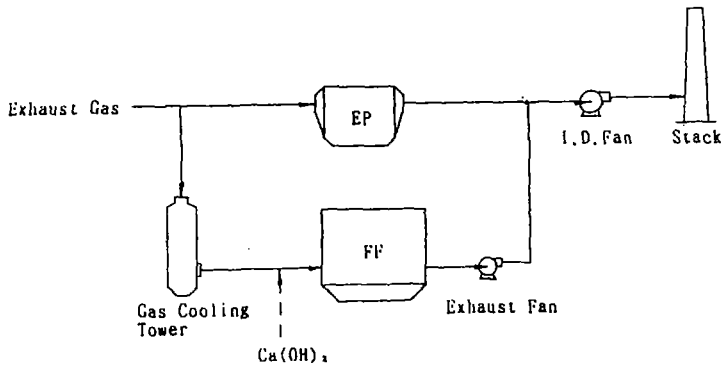

Figure 1 Schematic of the pilot plant

bottle.

PCDDs and PCDFs were analyzed on all the samples by using the capillary column GC/MS/SIM method.

RESULT and DISCUSSION

Table 1 and Figure 2-a) show the concentration of PCDDs in the flue gas samples. The findings are as follows :

(1) As the gas cooled rapidly at the water injection chamber, the concentration of PCDDs decreased.

(2) The concentration of PCDDs in flue gas increased from the gas/air heat exchanger to the EP inlet.

(3) PCDDs were removed by FF.

(4) The concentration of 2,3,7,8 - T_4CDD Toxic Equivalents (International) of PCDDs was 0.3 ng/m^{3}N. (Detection limit was 0.06 ~ 0.14 ng/m^{3}N.)

Table 2 and Figure 2-b) show the result of PCDFs analyzed in the flue gas samples. The findings are as follows :

(1) PCDFs were removed by FF.

(2) The concentration of 2,3,7,8 - T_4CDD Toxic Equivalents (International) of PCDFs was 0.2 ng/m^{3}N. (Detection limit was 0.07 - 0.10 ng/m^{3}N.)

Table 3,4 and Figure 3 show the concentration of PCDDs and PCDFs in EP ash and FF ash, respectively. It was found that the concentration of PCDDs and PCDFs in EP ash is higher than that in FF ash.

Table 1 PCDDs analysis of flue gas. (Unit : ng/dN)

	Temp.(℃)	T_4CDD	P_5CDD	H_6CDD	H_7CDD	O_8CDD	PCDDs
Outlet of incinerator	900	15	14.8	33.5	55.4	85.3	205.0
Inlet of gas/air heat exchanger	400	13.1	<0.25	21.2	50.5	19.1	101.15
Inlet of EP	270	28.6	33.7	84.3	132	141	420.6
Outlet of EP	270	21.5	49.1	78.8	117	108	374.4
Outlet of FF	160	2.67	0.90	5.63	3.34	4.02	16.56*

* 2,3,7,8 - T_4CDD Toxic Equivalents(International) : 0.3 ng/dN

Table 2 PCDFs analysis of flue gas. (Unit : ng/dN)

	Temp.(℃)	T_4CDF	P_5CDF	H_6CDF	H_7CDF	O_8CDF	PCDFs
Inlet of EP	270	71.6	99.8	118	80.9	57.8	428.1
Outlet of FF	160	2.89	2.52	2.44	1.37	0.41	9.63*

* 2,3,7,8 - T_4CDD Toxic Equivalents(International) : 0.2 ng/dN

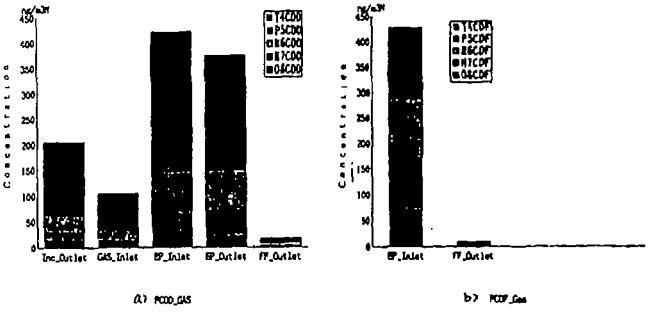

Figure 2 The concentration of PCDDs and PCDFs in the flue gas samples

Table 3 PCDDs analysis of ash. (Unit : ng/g)

	T₄CDD	P₅CDD	H₆CDD	H₇CDD	O₈CDD	PCDDs	TEQ
FF	6.52	11.6	20.6	28.6	13.8	80.82	0.941
EP	65.5	150	326	634	328	1503.5	17.398

* TEQ : 2,3,7,8 - T₄CDD Toxic Equivalents(International)

Table 4 PCDFs analysis of ash. (Unit : ng/g)

	T₄CDF	P₅CDF	H₆CDF	H₇CDF	O₈CDF	PCDFs	TEQ
FF	10.5	11.5	11.7	7.46	2.46	43.62	1.090
EP	96.0	197	264	243	140	940.0	22.277

* TEQ : 2,3,7,8 - T₄CDD Toxic Equivalents(International)

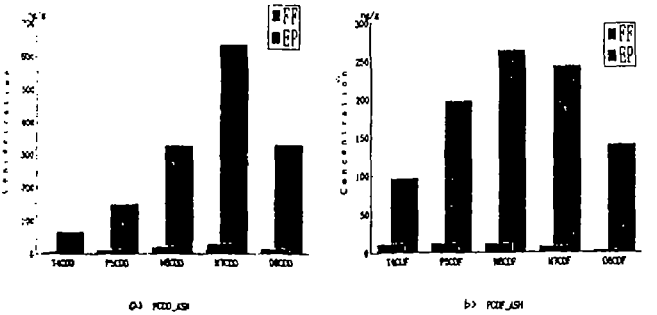

Figure 3 The concentration of PCDDs and PCDFs in FF ash and EP ash

PCDDs concentration is generally said to increase in the EP [1]. Therefore, the increase rate of PCDDs (IR_{PCDDs}) was used to investigate whether PCDDs were formed in the EP. The IR_{PCDDs} was defined as :

Table 5 The increase rate of PCDDs.

	T_4CDD	P_5CDD	H_6CDD	H_7CDD	O_8CDD	PCDDs
FF	0.86	1.16	0.87	0.71	0.34	0.87
EP	3.16	6.35	5.19	6.17	3.32	1.82

IR_{PCDDs} = (Outlet conc. + Ash conc.) / Inlet conc.

Table 5 shows the result of this calculation. This finding shows that PCDDs were formed in the EP in this incinerator.

CONCLUSION

These results lead to the following conclusion.

(1) As the gas cooled rapidly at the water injection chamber, the concentration of PCDDs decrease.

(2) PCDDs and PCDFs can be removed by fabric filters. The removal efficiency of PCDDs and PCDFs was 96.9 %.

(3) PCDDs were formed in the EP.

REFERENCE

1) M. Tanaka *et al.*, Chemosphere, Vol.18, Nos.1-6, pp 321-328, 1989.