Removal Technology of PCDDs/PCDFs in flue gas from MSW Incinerators by Fabric Filter and SCR System

Fujii T, Murakawa T, Maeda N, Kondo M, Nagai K, Hama T, Ota K
Hitachi Zosen Corporation, 3-40, Sakurajima 1-Chome
Konohana-ku Osaka, Japan

ABSTRACT

This study was carried out at the pilot plant equipped with fabric filter system and selective catalyst reduction (SCR) system in order to confirm the removal efficiency of Dioxin. As a result, the removal efficiency of Dioxin was 93.7~98.2% with fabric filter system and 90.5~97.4% with the SCR system.
We also confirmed the emission of Dioxin decreased less than 0.1 ng/Nm³-TE by using the association of fabric filter system and SCR system.

INTRODUCTION

Hitachi Zosen has many construction results of fabric filter system for cleaning the flue gas from the municipal solid waste (MSW) incinerators, and has continued to study highly developed technology of fabric filter system etc.
In this paper, we will introduce the results of PCDDs/PCDFs removal efficiency in a pilot scale test by the associated system of a fabric filter and a catalyst reactor.

PILOT TEST METHOD

Table 1 shows the outline of the MSW incineration plant and the test apparatus, where typical gas composition are given. The concentration of CO has been always kept less than 50 ppm which means stable combution. The test apparatus is composed of a fabric filter chamber for removal of dust, PCDDs/PCDFs, HCl, SOx and Hg, etc., and a catalyst reactor for decomposition of PCDDs/PCDFs and for reduction of NOx.

The gas stream was branched before the electric precipitator to the test apparatus. The gas temperature was controlled in the branch pipe to the test apparatus, and kept over the whole test apparatus by external electric heaters. A designated amount of slaked lime powder was injected into the gas stream for HCl removal in front of the fabric filter chamber, together with a certain kind of additive to reduce gas resistance of the dust cake formed on the fabric filters. In front of the catalyst apparatus, a designated amount of NH_3, was fed into the gas stream to reduce NOx. When the pressure drop through the fabric filters increased to about 110 mmH_2O, a pulse blow was operated in a regular order among 4th fabric filters, to blow away the dust cake on a fabric filter.

PCDDs/PCDFs were sampled at some designated points and analyzed by the Japanese standard method, evaluated by the international toxic equivalent facters, and expressed by DXN-TE for total toxic equivalent value. Each of concentration of O_2, H_2O, HCl, NOx and Hg was measured by conventional method.

TEST RESULTS and DISCUSSION

At the inlet of the test apparatus, PCDDs/PCDFs, as shown in Fig. 1, vary in a range of 1~11ng/N-m³ by DXN-TE, roughly relating to dust amounts. This correlation suggests that PCDDs/PCDFs yield on the dust in the waste heat boiler path and the flue gas duct from the furnace to the electric precipitator.

The efficiency of the fabric filter for the removal of PCDDs/PCDFs depends on the gas temperature, as shown in Fig. 2. Lower temperature operation is more effective. About 98% of them are removed at 130℃. It also is effective for HCl removal. The injection of active carbon powder makes their removal more effective, as well as Hg removal (see Fig. 3)

A higher filtration rate of flue gas affects the officiency of the fabric filter for the removal of PCDDs/PCDFs. A higher filtration rate brings a faster increase in fabric filter resistance, and does frequent pulses blow for the removal of the dust cake on fabric filters. The frequent pulse blow will cause a increase in the amount of fly ash passing through the fabric filter. Since the fly ash contains PCDDs/PCDFs, a higher filtration rate results in a decrease of fabric filter efficiencyfor their removal.

After the fabric filter chamber, the flue gas is electrically heated to 230℃ for effective reduction of NOx and effective decomposition of PCDDs/PCDFs. This heating brings some increases in the amount of PCDDs/PCDFs. However, in the downstream of the catalyst reactor, the emission level of PCDDs/PCDFs is very low, because, on the catalyst, PCDDs/PCDFs were decomposed effectively. Some test results are given in Table 2. The association of a fabric filter system and a catalyst system is so available that the emission of PCDDs/PCDFs decreases less than 0.1 ng/N-m³ by DXN-TE, besides it is also available for dust, HCl, SOx and Hg removal, and NOx reduction.

CONCLUSION

These pilot test results lead to the following conclusion:

(1) DXN-TE in flue gas from MSW incinerators roughly relates to fly ash amounts.

(2) Highly removal efficiency of Dioxin by a fabric filter system depends on the lower flue gas temperature, lower filtration rate and amount of active carbon injected.

(3) Reheating of flue gas after a fabric filter can increase the amount of PCDDS/PCDFs.

(4) The removal efficiency of PCDDs/PCDFs by SCR system was 90.5~97.4% at the operation condition SV was 6000^{-1} and flue gas temperature was 230℃.

(5) The association of a fabric filter system and a catalyst system is so available that the emission of PCDDs/PCDFs decreases less than 0.1 ng/N-m³ by DXN-TE.

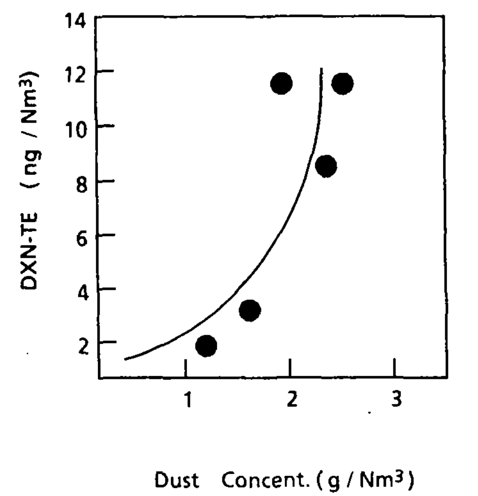


Fig.1 Dust concentration and DXN-TE in flue gas in front of electric precipitator

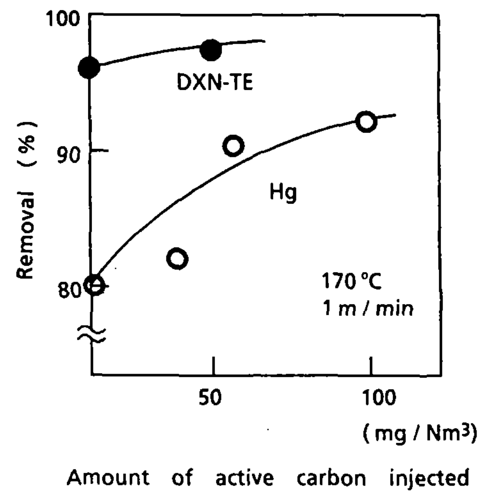


Fig.3 Effect of active carbon injected

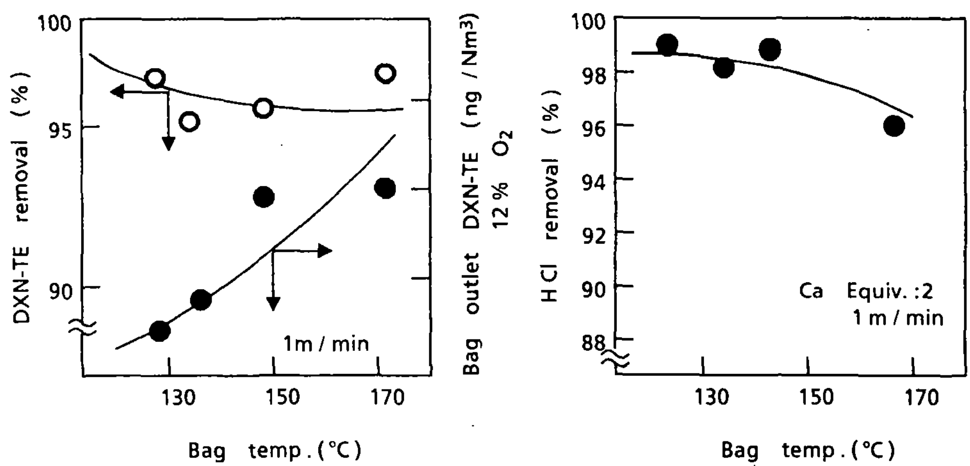
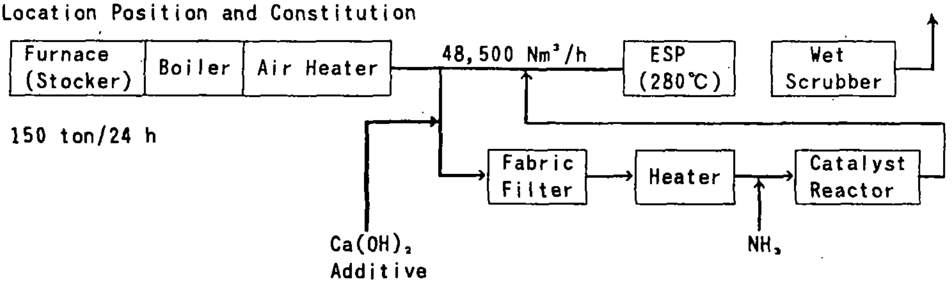


Fig.2 Effect of bag temperature

EMCO

Table 1 Outline of Test Apparatus

Location Position and Constitution



Gas Flow to Test Apparatus:	~100 m^3/h
Fabric Filter :	116ϕ, 1300L, four, double fold glass fiber cloth pulse type
Heater :	Electric heater
Catalyst :	11.3 ℓ, V_2O_5/TiO_2+W etc., Cell pitch 5.0 mm
Typical Gas composition at Inlet of Test Apparatus :	20% H_2O, 11% O_2, 1,000 ppm HCL, 140 ppm NOx, 50 ppm CO_2, 0.1 mg/Nm^3 Hg, 2 g/Nm^3 Dust

Table 2 Example of Test Result

Fabric Filter Condition and Result							Catalyst Reactor Condition and Result						
Temp. (℃)	Gas Speed (m/min)	Ca Equiv. (mol/mol)	HCl		DXN-TE		Temp. (℃)	SV h^{-1}	NH_3/NOx (mol/mol)	NOx		DXN-TE	
			in	out	in	out				in	out	in	out
150	1.0	2	980	13	5.8	0.22							
140	1.0	2	920	16	1.8	0.08	230	6000	1.0	150	3.5	0.63	0.06
130	1.0	2	700	7.0	2.2	0.04							
170	1.5	2	-	-	8.4	0.53	230	6000	1.0	144	4.0	1.9	0.05

HCl, NOx; ppm dry, 12% O_2 DXN-TE; ng/Nm^3, dry, 12% O_2