COMPARATIVE STUDY OF PCDDs/DFs EMISSION AND ATMOSPHERIC ENVIRONMENT IN THE PRE- AND POST-RETROFITTING MSW INCINERATION PLANT

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Introduction

Reduction of polychlorinated dioxins and furans (PCDDs/DFs) emission from MSW(municipal solid waste) incineration is still an urgent issue in Japan. In January of 1997, the "Guideline for controlling PCDDs/DFs in MSW Management– PCDDs/DFs Reduction Program–" (commonly known as the New Guideline) was announced, and since December of 1998, Air Pollution Control and Waste Management Laws have been revised to control PCDDs/DFs emissions strictly. The actual measures for the reduction of PCDDs/DFs in MSW incineration are: reducing the amount of MSW by promoting recycling, continuous operation of incineration plants, more efficient combustion with higher temperatures, and reduced emission by intensifying emission gas control. Many examples on reduction technologies of PCDDs/DFs and actual retrofitting have been reported[1]. There were few studies,however, which measured the impact on neighboring environments in the pre- and post-retrofitting or building the MSW incineration plant[2,3,4].

Recently, a continuously operating MSW incineration plant in accordance with the New Guideline was built in the neighboring site of an old batch-operational MSW incinerator that had been roughly 20-year in operation. In order to evaluate the effect of environmental emission reduction by means of PCDDs/DFs control technologies, we have obtained comparative data on PCDDs/DFs emission from the plants under operation. PCDDs/DFs concentrations in the neighboring atmospheric environment were also measured and compared.

Methods and Materials

Outlines of the plants are shown in **Table 1, Figure 1 and Figure 2.**

Table 1

	Old Plant	New Plant
Capacity	30t/8h × 4 units = 120t/day	85t/24h × 3 units = 255t/day
Furnace Type	Furnace with Stoker + Water Spray (1 system/2 furnaces)	Furnace with Stoker + Boiler (Power Generation)
Flue Gas Treatment	Multicyclone (1 system/2 furnaces) + EP (1 system/4 furnaces)	Quenching Chamber + BF (Activate Carbon Injection)
Stack Height	55m	59m
Remarks		Wide-area treatment of MSW has been introduced.

PCDDs/DFs were measured in flue gases and incineration residues from the old and new plants. Ambient air concentrations and atmospheric deposition were also measured. Operating conditions and measuring date are listed in Table 2.

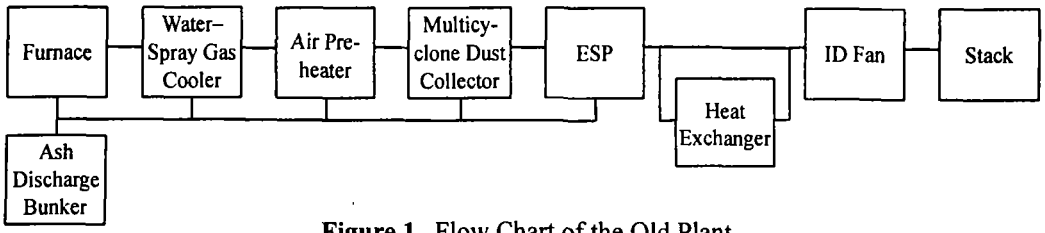

Figure 1 Flow Chart of the Old Plant

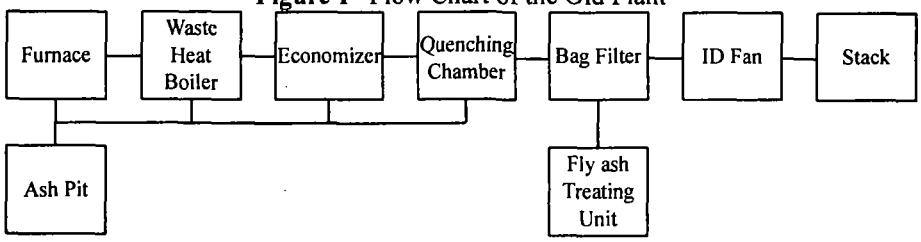

Figure 2 Flow Chart of the New Plant

The sampling points atmospheric environment start with the plants, the point immediately below the stack as the midpoint. They span east and west as the dominant wind direction, at 1km, 2km, and 5km, with a background spot at 10km west of the midpoint, for the total of 8 spots. Air samples were collected for 24hrs at eight points using a high volume air sampler fitted with a glass fiber filter and polyurethane foam (PUF) plug adsorbent to collect atmospheric PCDDs/DFs. Atmospheric deposition samples were collected using dust jar (500mm x 600mmH) at the same points for 22 days (old plant operating period) and 31 days (new plant operating period) respectively.

Table 2 Operating Conditions and Measuring Date of the Old and New Plant

	Old Plant Operation		New Plant Operation	
	Measuring Date	Operating Conditions and MSW treated	Measuring Date	Operating Conditions and MSW treated
Operating Condition (Average. CO/Dust O_2=12%)	11/09/98	Furnace temp: 1029□ EP outlet temp:241□ O_2%:14.3%, CO%:63ppm Dust:0.64g/m^{3}N	04/12/98	Furnace temp: 792□ BF outlet temp:162□ O_2%:15.5%, CO%:23ppm Dust:0.0037g/m^{3}N
Flue Gas and Incineration Residue	11/09/98	90t/10hrs by 4 units	04/12/98	240t/24hrs by 3 units
Surrounding Atmosphere	10/09/98 11/09/98	138t/12hrs by 4 units 90t/10hrs by 4 units	03~04/12/98 & (05~06/03/99)	457t/48hrs by 3 units
Atmospheric deposition	25/08/98~ 17/09/98	2862t (operated for 22 days)	03/12/98~ 12/01/99	5,104t (operated for 31 days)

The analyses of PCDDs/DFs in the flue gas and incineration residue were conducted according to "The Manual of the Standard Measuring Analysis of Dioxins for Waste Control," whereas those of ambient air was based on "The Manual for Measuring Toxic Substances in Atmosphere" of EPA-Japan.

Results and Discussion

Comparison of PCDDs/DFs Emissions between the Old and New Plants

Analytical results are shown in **Table 3**. A marked reduction of PCDDs/DFs in emission gas from the new plant was observed compared with 97ng-TEQ/m^{3}N of old plant. PCDDs/DFs in bottom ash and fly ash also decreased. PCDDs/DFs release from the flue gas was calculated by the volume of emission gas and the PCDDs/DFs concentration. PCDDs/DFs release as bottom ash and

fly ash were calculated in the same manner(**Figure 3**).

The PCDDs/DFs release at the old plant was estimated to be approximately 1,000μg-TEQ/ton of MSW. The distribution of PCDDs/DFs releases was 49% for the flue gas and 51% for fly ash, respectively.

On the other hand, the total PCDDs/DFs at the new plant was estimated to be about 25μg-TEQ/ton of MSW, approximately one-fortieth of that of the old plant. The distribution was 1:1:98 for the flue gas, bottom ash and fly ash, respectively. A prominent reduction was indicated, particularly in the flue gas.

Table 3 Analytical Results of PCDDs/DFs

	Old Plant	New Plant
PCDDs/DFs in Flue Gas (Dry, O_2=12%)	97ng-TEQ/m^3N	av. 0.031 ng-TEQ/m^3N
Flue Gas Volume (Dry)	65,960 m^3N/h/4 units	av. 37,450 m^3N/ h/unit
PCDDs/DFs in Bottom Ash	0.008ng-TEQ/g	av. 0.0025 ng-TEQ/g
Bottom Ash Amount	9,400 kg/day/4 units	22,000 kg/day/3 units
PCDDs/DFs in Fly Ash	20ng-TEQ/g	av. 0.84ng-TEQ/g
Fly Ash Amount	2,400 kg/day/4 units	7,000 kg/day/3 units

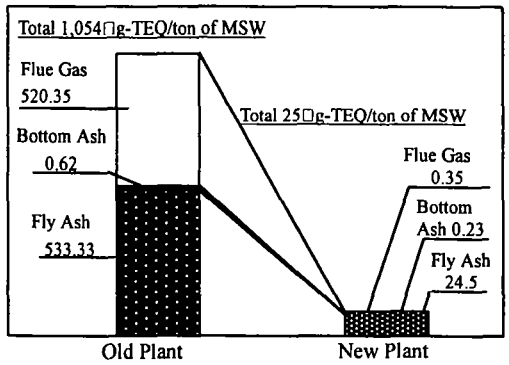

Figure 3 Comparison of PCDDs/DFs Emission from the Old & New Plants

Comparison of PCDDs/DFs in Ambient Air and Atmospheric Deposition

Analytical results of PCDDs/DFs in the ambient air and atmospheric deposition are shown in **Figure 4** and **Figure 5.**

PCDDs/DFs in the ambient air, while the old plant was in operation, was within the range of 0.061~0.41 pg-TEQ/m^3, and was at the highest point directly under the stack. It decreased rapidly as the distance from the stack increased. With the new plant in operation, the range is 0.048~0.17 pg-TEQ/m^3, lower than when the old plant was operating. It does not go down uniformly in proportion to the distance from the stack. Air measurements to the new plant reveals that the highest score is at a point 1km east of the plant. At a point 10km west of the plant, PCDDs/DFs count was 0.042 pg-TEQ/m^3 with the old plant and 0.023 pg-TEQ/m^3 with the new one. These numbers are considered to be the background value of this regional area.

PCDDs/DFs in atmospheric deposition with the old plant in operation showed a trend similar to that of ambient air and the range was 22~1,900 pg-TEQ/m^2/d, although the spike near the plant was more prominent than that of ambient air. With the new plant working, the range is 20~25 pg-TEQ/m^2/d, somewhat similar to the value at the 10km-west point chosen as a background spot(21 pg-TEQ/m^2/d), and the distance seems to make little difference.

The reason for the big difference when the old and new plants are in operation, can be found in that the old plant was equipped with an ESP of which dust removal efficiency is lower under normal operation compared to the baghouse in the new plant. It also can be attributed to the large dust emission during an operation of startup and shutdown, and that the old plant had an outdoor ash handling unit.

Conclusion

The following results have been obtained regarding the reduction of PCDDs/DFs and of the environmental load as a result of adopting a new plant built according to the New Guideline.

1) PCDDs/DFs concentration in the flue gas from the incineration plant recently built according to the New Guideline is 0.031ng-TEQ/m^3N(0.02□0.038 ng-TEQ/m^3N, 12%O_2) for an average of

3 furnaces. Most of the PCDDs/DFs from the plant remain in the fly ash, and the amount is roughly 25μg-TEQ/ton of waste.

2) PCDDs/DFs in the ambient air near the new plant does not show the prominent spike that was shown in the operation of old plant.

3) PCDDs/DFs in the atmospheric deposition near the new plant is similar to the background value.

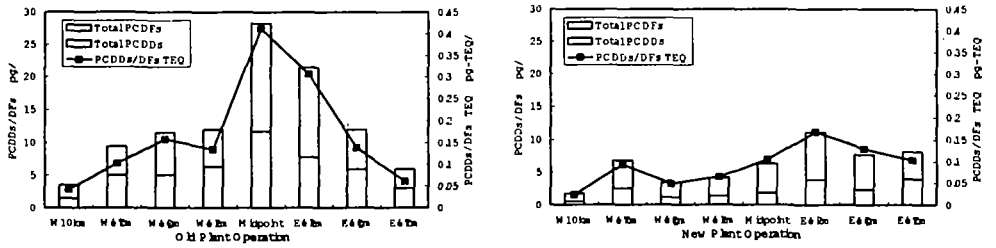

Figure 4 PCDDs/DFs Concentration in Ambient Air

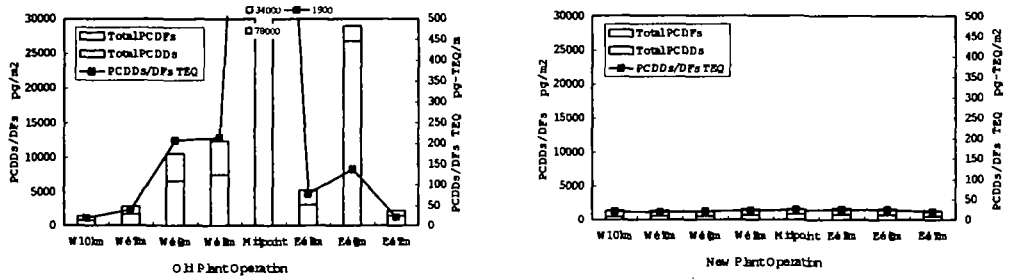

Figure 5 PCDDs/DFs Concentration in Atmospheric Deposition

Acknowledgement

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