COMPARATIVE STUDY OF DIOXIN FORMATION IN TWO MSWIs

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Introduction

Two typical MSWIs were studied to approach and research for the dioxin formation behavior in several ways. Facility A has a basic specification of 1500 ton/day disposal capacity, four sets of stokers, design calorific value average of 1600 Kcal/kg, and stack height 150 m. The APCD (air pollution control device) consists of EPC, wet scrubber and a newly installed SCR (fig 1). Dust is removed by the electrostatic precipitator to keep it under 50 mg/Nm^3, HCI gas removed by the wet scrubber to keep under 60 ppm. The entire plant was formally put into operation on March 28th, 1995. Facility B has a specification of 1800 ton/day disposal capacity, four sets of stokers, design calorific value average of 2400 Kcal/kg, and stack height also 150 m. The APCD consists of lime plus activated carbon (AC) injection in a semi-dry scrubber (SDS) and a bag-house filter (BF). HCl gas is removed by SDS to maintain a concentration lower than 20 ppm, dust is removed by BF to keep it under 20 mg/Nm^3. The entire facility was formally put into operation on July 12th, 1998.

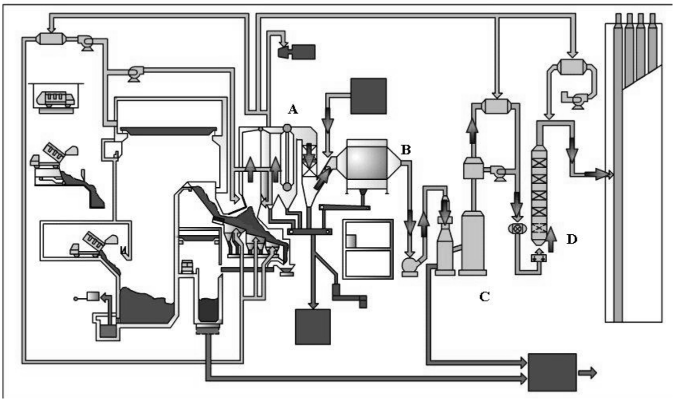

Figure 1. Demonstration of the APCDs in facility A
A: waste heat recovery boiler, B: ESP, C: wet scrubber, D: SCR

Methods and Materials

Two samplings were conducted in facility A at August and September on 2001, respectively. Four slag samples, and four fly ash samples from the super-heater, waste heat recovery boiler, economizer (EM), and electrostatic precipitator (ESP) were collected at each time. A total of forty samples were collected. One gas sample each was also collected at the entrance and exit of the selective catalytic reactor (SCR). Four sampling were carried out at September, October and November on 2000. A total of eighty-four samples were colleted, nineteen for slag samples, twenty-three for fly ash samples at semi-dry scrubber entrance and bag house filter entrance, nineteen for stack gas samples, another nineteen for process gas sample at the inlet of semi-dry scrubber and last four for process gas samples at the bag house filter entrance.

The analytical procedure referred ROC EPA NIEA A808.70B method and US EPA Method 1613B to analyze the dioxin content in gas and ash samples. All data fulfill the QA/QC requirements. Instrumental analysis was carried out with a HP 5890 series high resolution gas chromatography coupled with a VG Autospec Ultima high resolution mass spectrometer (HRGC/HRMS). The analysis of PCDD/Fs congener was performed with a DB5-MS capillary column (60 m × 0.25 mm i.d. × 0.25µm film thickness)

Results and Discussion

For facility A: The dioxin content in the slag is about 4 pg-TEQ/g dm. The incinerator was at start-up period on Sep. 4th, and was forced to stop on the following day. The dioxin content in the fly ash increased significantly. The average concentration in the fly ash were 4689, 9698, 15330 pg-TEQ/g dm, respectively, on Aug. 6th~7th, Sep. 4th and Sep. 5th. The annual dioxin emission from the fly ash is about 8.02 g-TEQ/year. The results also show that the removal efficiency of the SCR is 93% and 98%, respectively.

For facility B: The dioxin concentration in the slag ranges 2.45 to 16.13 pg-TEQ/g(average 7.26 pg-TEQ/g); in the fly ash ranges from 576.29 to 4842.85 pg-TEQ/g (average 1373.29 pg-TEQ/g); in the stack-emission ranges from 0.035 to 0.182 ng-TEQ/Nm^3 (average 0.07 ng-TEQ/Nm^3); in the process ranges from 1.39 to 15.75 ng-TEQ/Nm^3(average 4.74 ng-TEQ/Nm^3). The annual dioxin emission from the fly ash sample is 5.11 g-TEQ/year. The dioxin removal efficiency ranging from 97% to 99% (average 98 %) during four sampling periods(1).

The comparisons of the PCDD/PCDF ratios for two facilities are showing in fig. 2 and 3. In the slag samples, the PCDD/PCDF ratio for facility B ranged from 0.2~0.4. The results were identical to those

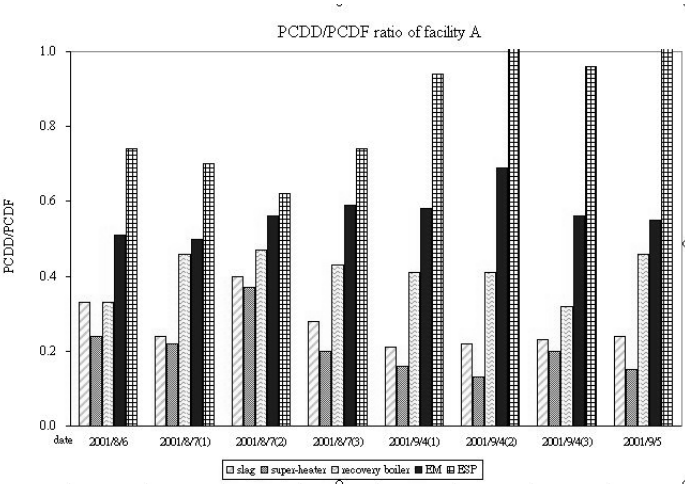

Figure 2. The PCDD/PCDF ratio of facility A

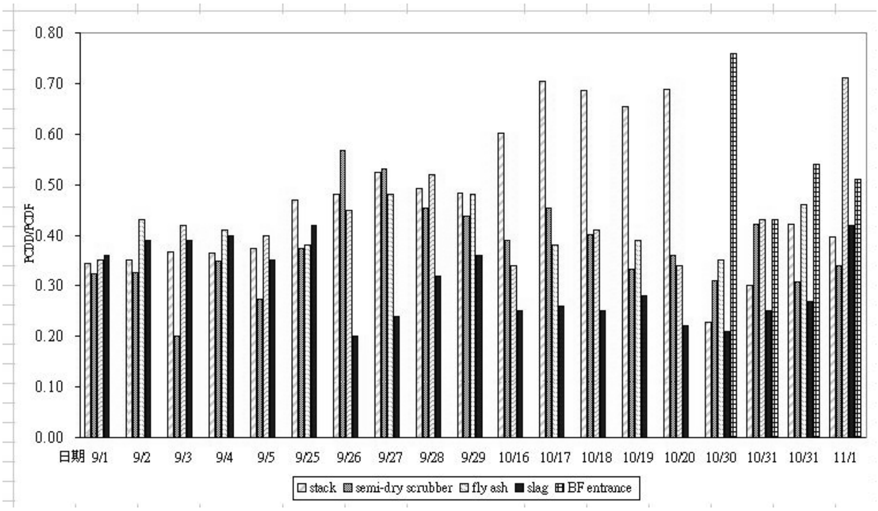

Figure 3. The PCDD/PCDF ratio of facility B

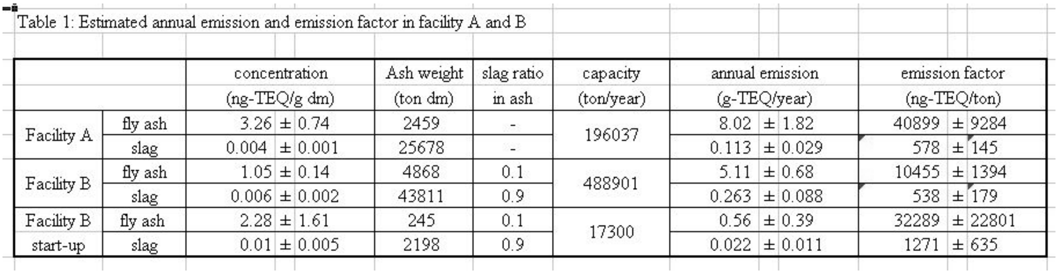

Table 1: Estimated annual emission and emission factor in facility A and B

		concentration	Ash weight	slag ratio	capacity	annual emission	emission factor
		(ng-TEQ/g dm)	(ton dm)	in ash	(ton/year)	(g-TEQ/year)	(ng-TEQ/ton)
Facility A	fly ash	3.26 ± 0.74	2459	-	196037	8.02 ± 1.82	40899 ± 9284
	slag	0.004 ± 0.001	25678	-		0.113 ± 0.029	578 ± 145
Facility B	fly ash	1.05 ± 0.14	4868	0.1	488901	5.11 ± 0.68	10455 ± 1394
	slag	0.006 ± 0.002	43811	0.9		0.263 ± 0.088	538 ± 179
Facility B	fly ash	2.28 ± 1.61	245	0.1	17300	0.56 ± 0.39	32289 ± 22801
start-up	slag	0.01 ± 0.005	2198	0.9		0.022 ± 0.011	1271 ± 635

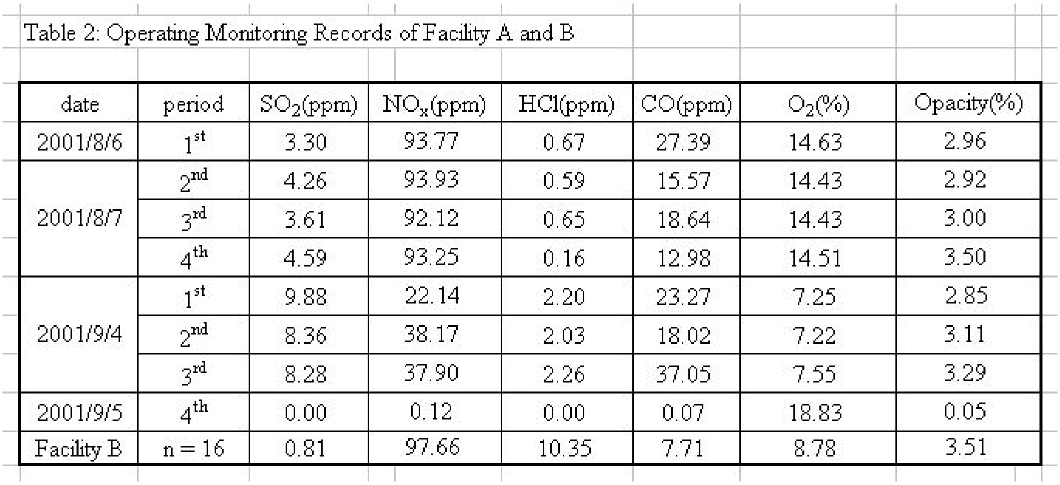

Table 2: Operating Monitoring Records of Facility A and B

date	period	SO_2(ppm)	NO_x(ppm)	HCl(ppm)	CO(ppm)	O_2(%)	Opacity(%)
2001/8/6	1st	3.30	93.77	0.67	27.39	14.63	2.96
2001/8/7	2nd	4.26	93.93	0.59	15.57	14.43	2.92
	3rd	3.61	92.12	0.65	18.64	14.43	3.00
	4th	4.59	93.25	0.16	12.98	14.51	3.50
2001/9/4	1st	9.88	22.14	2.20	23.27	7.25	2.85
	2nd	8.36	38.17	2.03	18.02	7.22	3.11
	3rd	8.28	37.90	2.26	37.05	7.55	3.29
2001/9/5	4th	0.00	0.12	0.00	0.07	18.83	0.05
Facility B	n = 16	0.81	97.66	10.35	7.71	8.78	3.51

in facility A. Nevertheless, in the fly ash samples, the ratios between two facilities have tremendous differences, which refer to different APCDs. On the other hand, ratios of different fly ash samples increase from super-heater to ESP (facility A), indicates that during *de novo* synthesis(2), PCDDs have higher chances in the formation of dioxins.

When compare with the operating monitoring records, the SO_2 emission in facility A is higher than facility B, same situation been observed in CO content. The NOx(3) and opacity for both facilities are similar. The HCl concentration is lower in facility A due to wet scrubber when compare with semi-dry scrubber in facility B (table 1).

The annual emission based on slag in facility A is 0.011±0.003 g TEQ/year, emission factor of 55±14 ng TEQ/ton similar with 60±20 ng TEQ/ton in facility B. The annual emission based on fly ash in facility A is 8.02±1.82 g TEQ/year, higher than the annual emission of 5.11±0.68 g TEQ/year in facility B. The emission factor in facility A is 40899±9284 ng TEQ/ton, therefore, about four times higher than 10455±1394 ng TEQ/ton in facility B (table 2).

Acknowledgments

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