FULL-SCALE PLANT STUDY ON REDUCTION OF DIOXIN EMISSION OF BATCH OPERATION TYPE MSW INCINERATION PLANT

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1. Introduction

In DIOXIN '92, we explained the emission rate of dioxins during start up and shut down of batch operation type MSW incineration plant and the method of reducing its emission[1]. In the plant A which was explained in our previous report, the gas treatment system was a dry-powder lime injection and ESP. The plant B this time had an exhaust gas treatment equipment which consists of quench chamber, dry-powder lime injector and bag house. These two type of equipment are compared from the standpoint of dioxin removal efficiency at the time of starting up and shutting down the equipment. We would also like to explain the dioxins behavior, when the exhaust gas from the incineration furnace passes through each equipment.

2. Outline of plants A and B

The table-1 shows the outline of the equipment in plants A and B.

Table 1 Outline of plant

	A plant	B plant
Furnace type	Stoker furnace(16 hours operation)	Stoker furnace(16 hours operation)
Gas colling method	Water spray	Water spray
Exhaust gas treatment	Dry-powder lime injection + ESP	Quench chamber + Dry-powder lime injection + Bag house
Refuse quality	1,400–2,200 kcal/kg	2,100–2,400 kcal/kg
Sampling points	Fig. 1 (1), (2), (3)	Fig. 1 (4), (5), (6), (7)

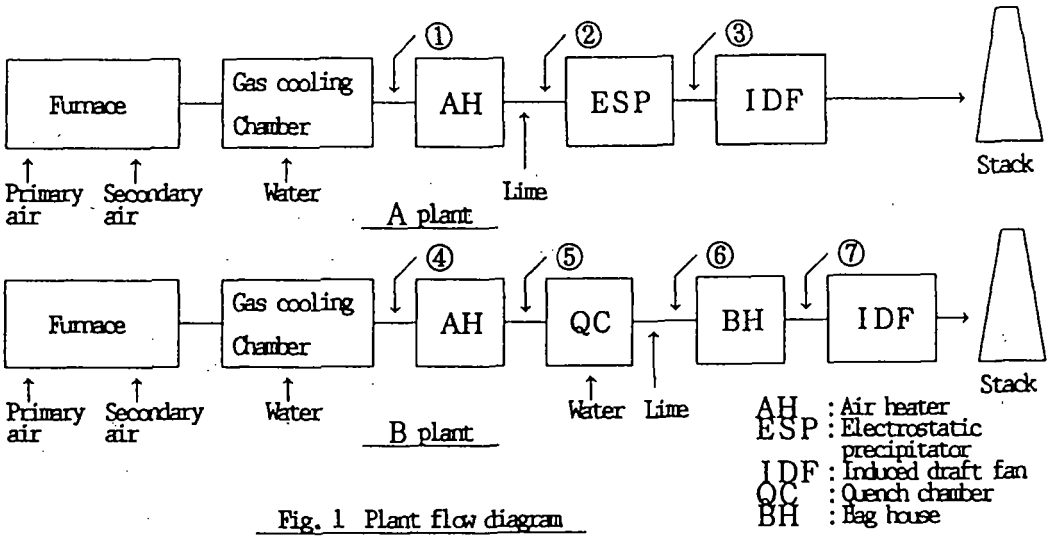

Fig. 1 Plant flow diagram

3. Dioxin emission rate during start up and shut down

The table-2 shows the pattern of operation, the plant data and dioxin concentrations on starting up and shutting down of the equipment both at the plants A and B. Dioxin emission at the inlet of dust collector was lower at plant B. At plant A, refuse was charged in the furnace at the time of starting up the equipment and burnt immediately after starting. At the plant B, kerosene was burnt in the burner for approx. 20 min.immediately after starting up the system and the refuse was burnt only after heating up. Because of this, dioxin emission at the plant B was lower than that at plant A.

At the plant B, the secondary combustion air was fed into the furnace at the time of shutting down the equipment to let the gas and air mix well. This worked well to control the emission of dioxin. When the auxiliary fuel was used, starting time was short while shutting down time became long.

Table 2 Pattern of operation mode, gas, dioxins(TEQ) data

Plant name	Run No.	Operation mode	State	CO(ppm) [ESP/BH Outlet]	O_2(%) [ESP/BH Outlet]	TEQ (ng/Nm³) [ESP/BH Inlet]	TEQ (ng/Nm³) [ESP/BH Outlet]	Operation time (min)
A	①	Start up		255	16.8	176	344	75
	②	Start up	Auxiliary Burner ON **	134	16.5	123	130	50
	③	Shut down		364	17.2	61	120	80
	④	Shut down	Auxiliary Burner ON	171	16.6	71	115	104
B	⑤	Start up	Auxiliary Burner ON *	97	17.2	29	4.2	47
	⑥	Start up	Auxiliary Burner ON **	97	17.8	13	1.8	36
	⑦	Shut down		210	17.3	22	1.5	85
	⑧	Shut down	Auxiliary Burner ON	189	16.8	15	0.2	105

* (Start up ~ gas temperature 700℃(Furnace outlet)
** (Start up ~ gas temperature 800℃(Furnace outlet)

Burner operation made dioxin emission low both at the time of starting up and shutting down the equipment. This tendency was observed at the plants A and B. It was confirmed that operating the burner was effective to control emission of dioxin. We have noted, however, from the time chart of CO, that there were some CO peaks during start up and shut down, in which CO was emitted at a higher rate than during normal operation. To lower the dioxin emission, we have to grade up the burner capacity or adopt a more advanced combustion control technology.
With ESP (plant A, Run ① to ④), dioxin emission increased along with the gas stream. During starting up or shutting down period, there was a time band in which "the temperature of the gas that passed through the ESP" became as high as 250 to 300℃ and dioxin was synthesized during that time band. On the other hand, with BH (plant B, Run ⑤ to ⑧), since the inlet gas temperature was controlled to 190 ℃ or lower, synthesizing of dioxins was avoided. Further, most dioxins at the dust collector inlet were thought to be absorbed to the dust. This BH has better dust collecting function than ESP. This means that BH also removes dioxins better than ESP. Because of these two reasons, dioxin emission at the BH outlet in runs ⑤ to ⑧ was lower than at ESP.

4. Behavior of dioxins during normal operation

The Fig.2 shows the relation ship between exhaust gas temperature and PCDDs/DFs at steady operation time. In each run, dioxins increased when the exhaust gas passed through the AH. The gas flow rate in AH was higher than in the duct and thus gas retention time was short. Although, the retention time was short, dioxins were synthesized because the gas temperature was between 250 and 350℃ range.
In Run 14, the gas temperature was dropped to 217℃ in gas cooling chamber before AH and therefore, dioxin synthesis was low. Likewise, when the gas temperature were quickly lowered in the QC almost no increase of dioxins were shown. (Run No.10,11 and 13). To prevent dioxin synthesis, it is necessary to lower the gas temperature to below 250 ℃ quickly by, for example, spraying in water.

Table 3 Pattern of operation mode, gas temperature and O_2, CO

Run No.	Plant name	Operation mode	Gas temperature (℃)				O_2 (%)	CO(ppm)
			AH Inlet	QC Inlet	ESP BH Inlet	ESP BH Outlet	(ESP Outlet / BH)	(ESP Outlet / BH)
9	A	ESP inlet temperature 250℃ Supply secondary air	372	—	243	218	16.7	148
10	B	Before improvement of secondary air nozzel	327	287	190	175	14.1	736
11		After improvement of secondary air nozzel	341	299	190	175	13.9	43.4
12		BH inlet temperature 160℃	299	269	160	150	13.1	61.2
13		No heat absorbing at AH	317	299	190	175	13.6	87.6
14		No water spray at QC	217	199	187	173	12.7	98.8

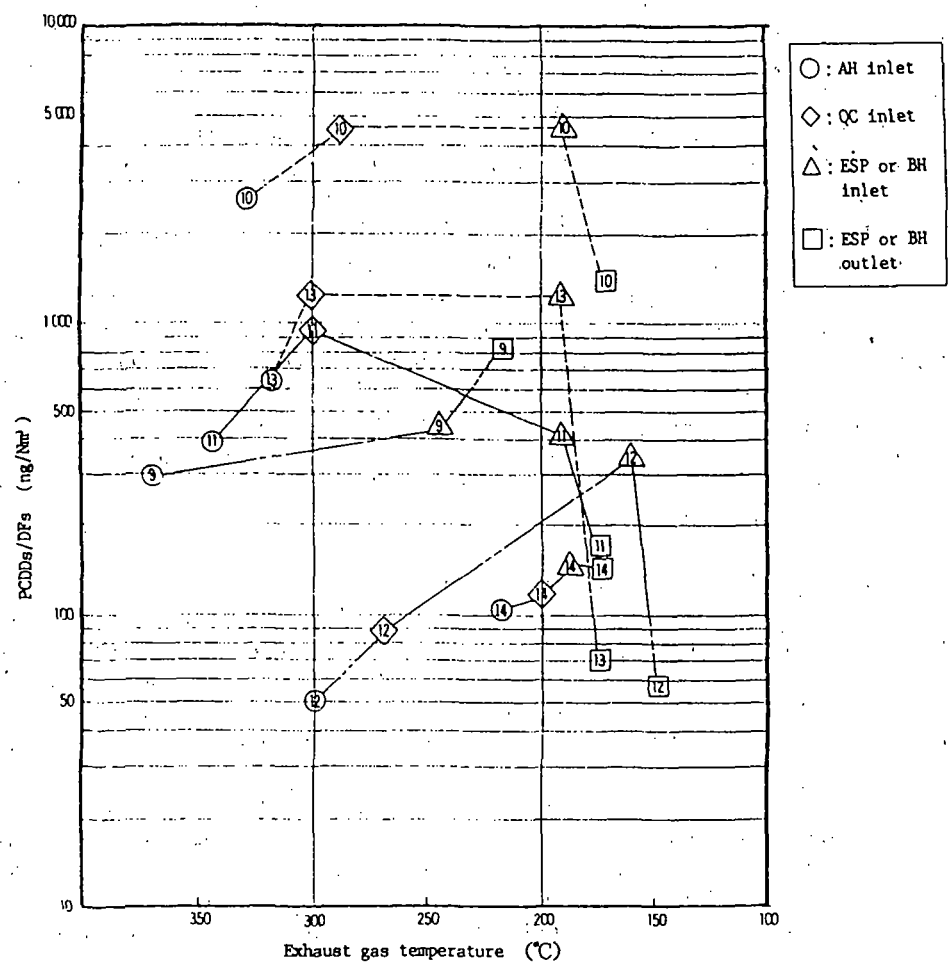

Fig. 2 Relation of gas temperature and PCDDs/DFs

5. Conclusion

(1) To control dioxin emission at the time of starting up and shutting down the plant, it is recommended to operate the burner.

(2) As for dust collector, BH is better to control dioxin emission because it can be operated with the lower temperature gas. The lower the gas temperature, the lower the emission of dioxin.

(3) To lower the gas temperature without heat recovery so as to avoid synthesis of the dioxins, spraying water is more effective than AH.

6. Reference

1. Karatsu Y, Tejima H, Kawashima M, Honda T, Sakai S. Reduction of dioxin emission on starting up and shutting down of batch operation type MSW incineration plant (Dioxin '92).