BEHAVIOR OF DIOXINS AND PRECURSORS IN INDUSTRIAL WASTE INCINERATION

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Introduction

The industrial waste in Japan amounts to 16,500,000 tons/year,while incineration of municipal solid waste(MSW) reaches 40,000,000 tons/year. The total dioxin emission in Japan was 2,900~2,940 g-TEQ/year, of which 960 g-TEQ/year came from the industrial waste incineration, and 1,340 g-TEQ/year from MSW incineration in 1998.[1)] A lot of data have been gathered concerning with dioxin emission control from MSW. But we have a little data on the industrial waste, because a wide variety of industrial waste is incinerated, and also there are numerous types and sizes among the furnaces[2)]. This has prevented the development of an effective means of controlling dioxin generation from the incineration of industrial waste. A few studies about correlation between the dioxins and chlorobenzene (CBz) /chlorophenol (CPh) after gas cooling tower of MSW incinerator[3,4)] and those on fluidized bed furnaces for industrial waste incineration[5,6)] have been reported.

For our test, we used two kinds of pilot incineration plants, and burned waste wood, waste oils, coffee mill residue and waste plastics. Our aim was to develop criteria for the prevention of dioxin generation in an industrial waste incinerator by identifying the relationship between dioxins and Co-PCB,H6CBz, CBz, CPh in the combustion gas.

Methods

We chose a rotary-kiln+stoker furnace and a fluidized-bed furnace, both used normally for industrial waste incineration. We burned waste wood and coffee mill residue for low-HClconcentration waste, and waste oils and waste plastics for high-HCl concentoration waste. Flow sheets are shown in **Fig. 1** and **Fig. 2**. The outline of experimental conditions are listed in **Table 1**. The sampling of combustion gas in the rotary kiln+stoker furnace was done with sampling nozzle A (residence time at1.1 ~2.2 seconds, depending on the test condition), while sampling nozzle B (residence time at 3.1~3.5 seconds, depending on the test condition) was used in the fluidized bed furnace. We measured PCDD, PCDF, Co-PCB, CBz (M1CBz, D2CBz, T3CBz, T4CBz, P5CBz and H6CBz) and CPh, besides ordinary flue gas parameters. From these data, we gain involution lines and co-relation coefficients between DXN (PCDD + PCDF + Co-PCB) and Co-PCB / CBz / H6CB / CPh / four homologues CBz (T3CBz, T4CBz, P5Cbz and H6CBz) based on the non-linear least squares approximation in log-log plots.

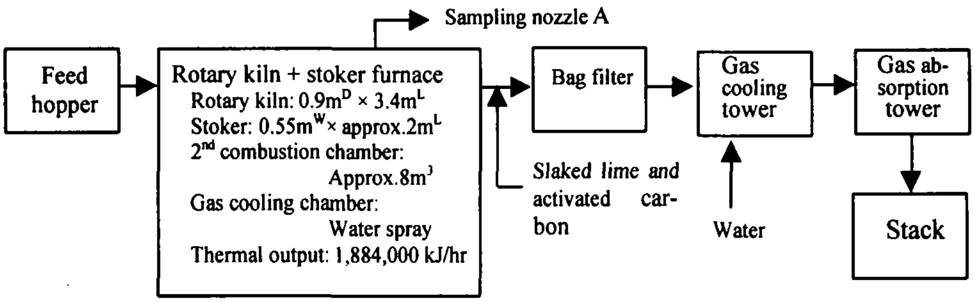

Fig. 1 "Rotary kiln + stoker furnace" flow sheet

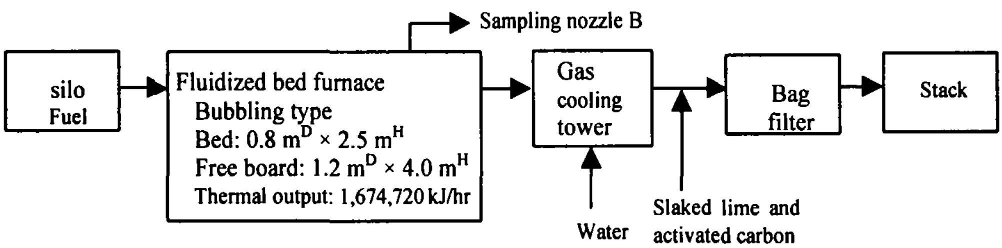

Fig. 2 "Fluidized bed furnace" flow sheet

Table 1 Outline of experimental conditions
(These keys are used in the graphs)

Furnace type / □□□□ Material	Rotary kiln + stoker furnace					Fluidized bed furnace				
	Feed rate [kg/h]	Combustion temperature [C]				Feed rate [kg/h]	Combustion temperature [C]			
		700	800	900	900 (NH_3)		700	800	900	900 (NH_3)
Waste wood	45	●	□	○	□	□	□	□	□	□
Coffee mill residue	240	▲	□	△	□	170	▲F	□	△F	□
Waste oils	210	■	□	□	□	□	□	□	□	□
Waste plastics	PE 48 + PVC 3.9	◆	◈	◇	◆	PE 36.5 + PVC 3.5	◆F	◈F	◇F	◆F

Results and Discussion

There is a high correlation(R=0.95) between Co-PCB concentrations and DXN(PCDD + PCDF + Co-PCB) concentrations shown in **Fig. 3**.There is also a high correlation(R=0.94)between CBz and DXN shown **Fig. 4** and a significant correlation(R=0.98) between H6CBz and DXN shown in **Fig. 5**.When we remove M1CBz and D2CBz that are apt to include analytical errors from six CBz,there is a correlation(R=0.88) between remained four homologues CBz(T3CBz, T4CBz, P5CBz and H6CBz) and DXN. There is also a correlation(R=0.88) between CPh and DXN shown in **Fig. 6**.

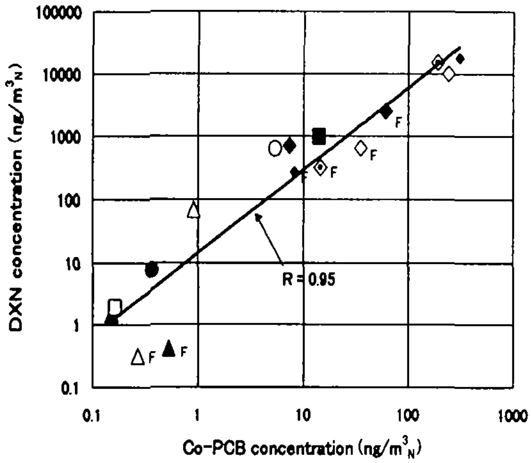

Fig. 3 Co-PCB concentration versus DXN concentration

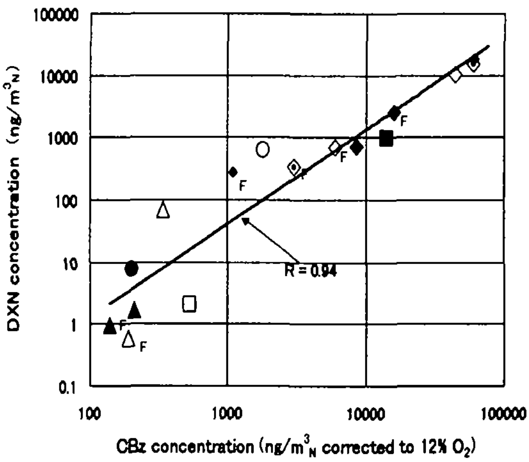

Fig. 4 CBz concentration versus DXN concentration

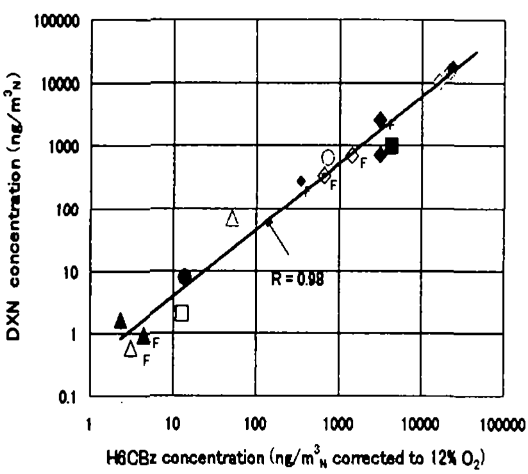

Fig. 5 H6CBz concentration versus DXN concentration

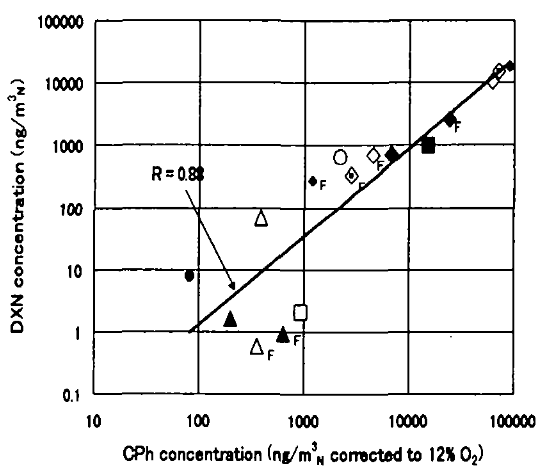

Fig. 6 CPh concentration versus DXN concentration

Conclusions

By using two types of furnaces and four different kinds of industrial wastes, we have drawn the following conclusions:

Even with two different types of furnaces, and various wastes, combustion temperatures and residence times,

(1) We have found a significant correlation between H6CBz and DXN.

(2) We get a relationship between H6CBz and DXN , which is $DXN=0.34 \times H6CB^{1.061}$

(3) There is a high correlation between Co-PCB/CBz and DXN

(4) There is a correlation between CPh/four homologues (T3CBz, T4CBz, P5CBz and H6CBz)and DXN.

From the above observation, we can conclude that it is very effective to measure H6CBz of precursors as parameters for estimating DXN generation under certain conditions in the furnace. The correlation between the concentrations of DXN and Co-PCB/CBz was also confirmed.

Acknowledgments

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