STUDY ON THE EMISSION OF DIOXINS FROM VARIOUS INDUSTRIAL WASTES INCINERATORS

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Introduction

Recently in Japan, a lot of attention has been paid to the Dioxins-Emissions not only from the municipal refuse incinerators but also from industrial waste incinerators. Statistics by the Ministry of Health and Welfare, Japan shows 405 million tons of industrial wastes were discharged in fiscal 1996. Sludge ranks first in terms of weight, accounting for 48% of the total, followed by livestock excreta, and construction wastes. Those 3 types of wastes represent about 81% of the total. Industrial wastes subject to intermediate treatment stood at about 318 million tons (79%). As of December 1998, 3,840 incineration facilities were in operation and 16.5 million tons of wastes were incinerated.Although enough data on dioxins from municipal refuse incinerators are being accumulated, the data from industrial waste incinerators are much scarce compared to that of municipal refuse incinerators. Therefore, in this study, dioxin emissions from various industrial waste incinerators were studied.

Methods

In this study, 8 industrial waste incinerators, rotary kiln (1), kiln and stoker (1), fluidized bed (2), stoker (1), stationary-floor (1), fuel atomization (1), were investigated with respect to combustion condition and dioxins emission. Furnace types selected are listed in Table 1, in which incinerated wastes in the respective furnaces are shown. Gas samplings were made at the point just before dust removal equipment such as bag filter or electrostatic precipitator. The analyses of dioxins, co-PCB, HCl, CO, total hydrocarbons (THC) and dust concentration for flue gas were made. The analyses of dioxins, co-PCB for bottom ash and fly ash, and of total carbons in fly ash were conducted. Dioxin analysis was followed by the Manual for the Dioxin Analysis by the Ministry of Health and Welfare, Japan.

Results and Discussion

Results are summarized in Table 2. Dioxin emissions were varied significantly depending on the furnace type and properties of the wastes incinerated (Figure 1). Dioxins-emission varied from 0.012 up to 160ng-TEQ/m^3N (mean value: 27ng-TEQ/m^3N). Combustion temperature, CO and

HCl levels were 854～970℃, 4.8～756ppm and 12～1316ppm, respectively. Dioxin emissions are

Table 1 Furnace Types and Wastes Incinerated

Furnaces Wastes	Kiln	Stoker	Stationary-floor	Fluidized Bed	Fuel Atomization
Woods Chips	A	—	F	—	—
Sludge	B and C	—	—	G1	—
Liquids (oil, acid and alkali)	—	—	—	D	H
Medical Waste（waste plastics）	—	E	—	G2	—

shown in conjunction with the CO, HCl, retention time and combustion temperature in Figures 2, 3, 4 and 5,respectively. The furnace H emitted the lowest dioxin of 0.012ng-TEQ/m3N.
This is due to not only the property of the waste, which are chemical residues with high volatile content, but also the characteristics of the furnace, which is easy to have stable combustion condition. Compared with E with the highest dioxin of 160ng-TEQ/m3N and F, although F emits 2.5 times higher CO than E, F emits much lower dioxins of 2.9ng-TEQ/m3N than E. One of the main reasons for this significant difference is due to the wastes incinerated. E incinerated plastics including medical waste, which contains plastic bags and tubes mainly made of PVC, and wood chips, while F incinerated demolition waste such as wood chips. Another reason is likely due to the instability of the combustion, which reveal in the CO fluctuation. CO peak-frequency of the furnace coincides with the waste-feeding interval. Also, high O_2 of 17% in the flue gas of E suggests the air-leakage into the furnace. Concerning dioxin emission level with respect to Cl content of the wastes, it can be said that a well operation of the furnace can make the dioxin emission level low enough, even in a condition that emits HCl as high as 1316 ppm in the flue-gas. However, it is not necessarily obtained that the correlation between dioxins and CO and combustion temperature. Therefore, further investigations are necessary in order to find out the correlation between combustion condition and dioxins and to develop further discussion. We are now preparing to conduct pilot plant scale experiment to clarify the relationship among those parameters.

Acknowledgements

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References

1 Guidelines on the dioxin emission control on the waste treatment by the Ministry of Health and Welfare, Japan., January 1997.

Table 2 Summary of the Results

Furnace Ref.	A	B	C	D	E	F	G1	G2	H
Combustion Temp.,average (℃)	870	970	920	906	900	935	859	852	830
Sampling Gas Temp.,average (℃)	186	187	226	191	177	162	257	257	845
CO (ppm)	175	44	4.6	14	286	756	34	86	4.8
CO_2 (%)	5.9	8	6.9	7.4	6	4	8.9	8	11.5
O_2 (%)	13.3	10.7	12.8	12.1	14.8	16.5	8.5	12	4.1
THC (ppm)	77	164	37	103	919	305	80	33	161
HCl (ppm)	761	1316	107	78	1073	57	271	410	12
Flow Rate (m3N/h)	38651	21094	43953	27647	36105	30771	24052	24503	5440
Exhaust Gas									
TEQ/PCDD	0.72	6.5	0.13	3.7	40	1.1	2.4	2.7	0.00053
TEQ/PCDF	11	16	0.28	17	120	1.8	7.3	12	0.011
Total (ng-TEQ/m3N)	12	22	0.41	21	160	2.9	9.7	15	0.012
Co-PCB (ng/m3N)	10	31	5.3	76	170	3.9	34	54	0.47
TEQ (ng/m3N)	13	24	5.7	65	210	8.7	34	54	0.25
TEQ (ng-TEQ/m3N)	0.13	0.46	0.056	0.83	4.2	0.13	0.27	0.51	0.000024
Bottom Ash									
Total (ng-TEQ/g)	0.31	0.39	0.037	0.94	0.061	0.097	3.2	1.2	-
Co-PCB (ng/g)	-	0.37	0.18	-	-	-	6.1	2.5	-
TEQ (ng-TEQ/g)	-	0.0024	0.000018	-	-	-	0.077	0.029	-
Fly Ash									
Total (ng-TEQ/g)	6.7	3.3	0.089	2.8	48	1.2	1	0.36	-
Co-PCB (ng/g)	-	3.1	0.19	-	-	-	2.3	0.76	-
TEQ (ng-TEQ/g)	-	0.051	0.003	-	-	-	0.023	0.0085	-
Dust Conc. (g/m3N)	1.65	2.05	5.99	6.45	0.982	0.313	7.79	5.79	< 0.001
TC (wt. %)	2.8	1	< 0.1	0.8	5.2	10.1	0.4	1.1	-

Figure 1 Furnace Type and DXNs

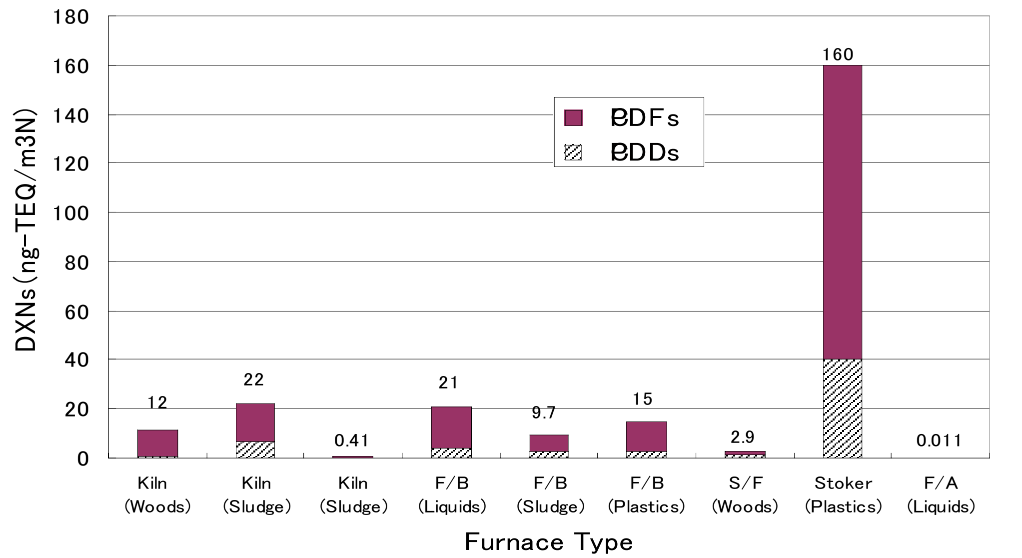
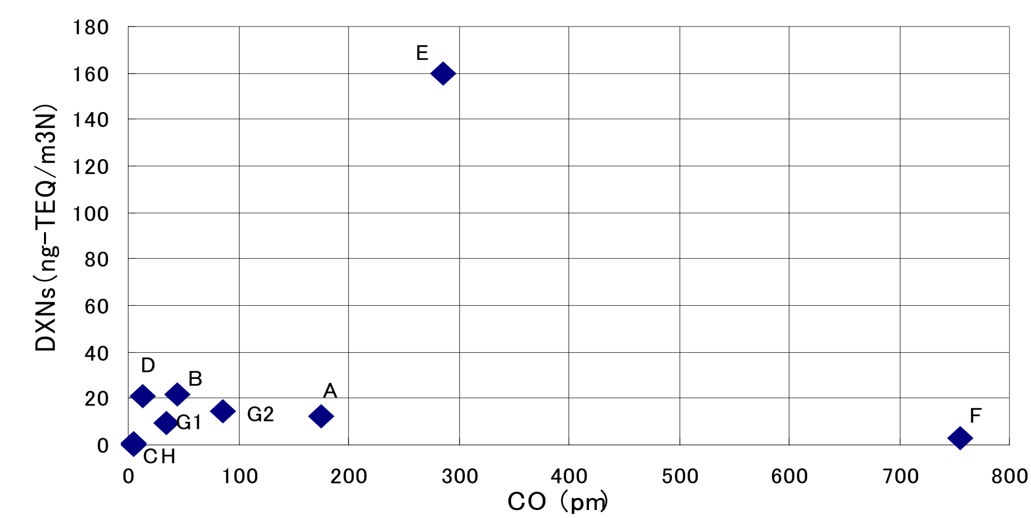


Figure 2 CO and DXNs



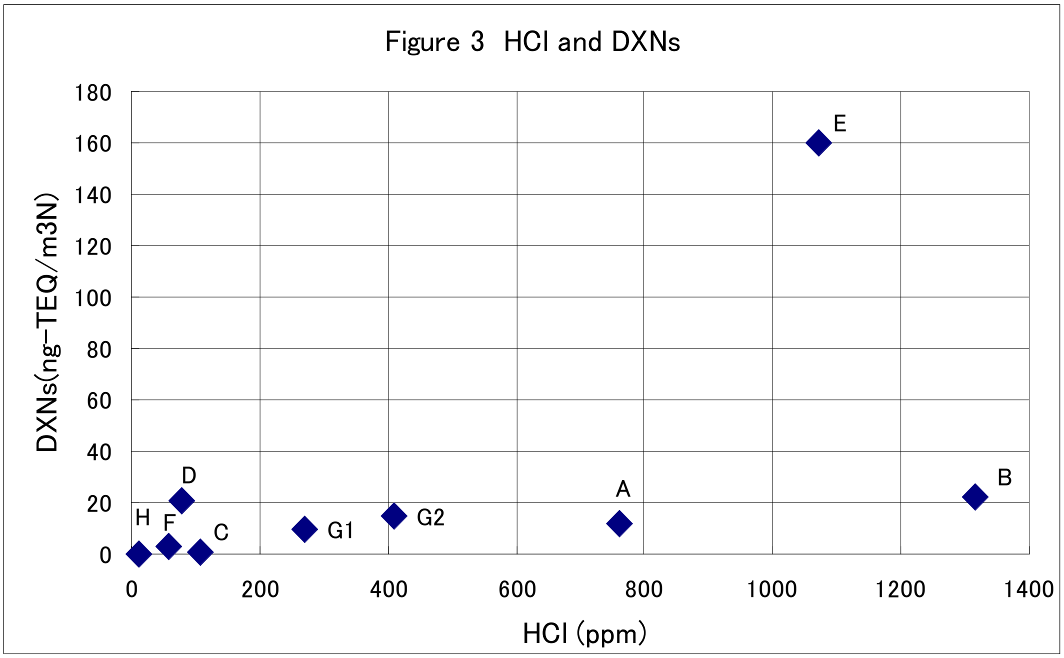


Figure 3 HCl and DXNs
DXNs(ng-TEQ/m3N)
180
160
140
120
100
80
60
40
20
0
0
200
400
600
800
1000
1200
1400
HCl (ppm)
E
D
H
F
C
G1
G2
A
B

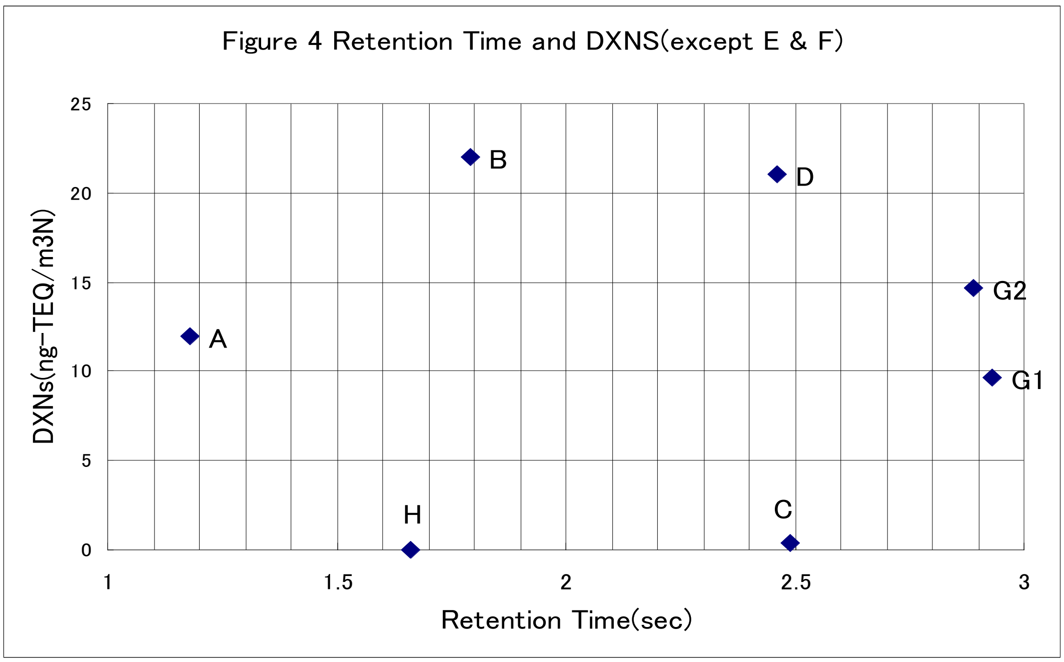


Figure 4 Retention Time and DXNS(except E & F)
DXNs(ng-TEQ/m3N)
25
20
15
10
5
0
1
1.5
2
2.5
3
Retention Time(sec)
B
D
G2
A
G1
H
C

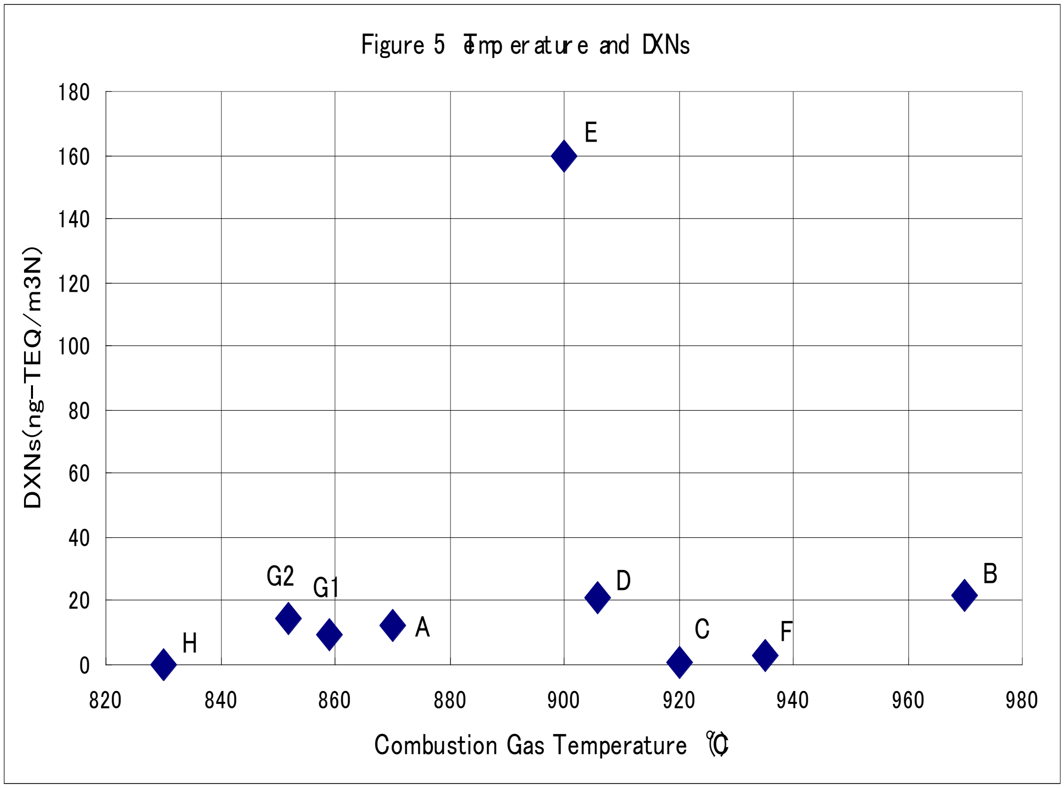


Figure 5 Temperature and DXNs
DXNs(ng-TEQ/m3N)
180
160
140
120
100
80
60
40
20
0
820
840
860
880
900
920
940
960
980
Combustion Gas Temperature ℃
E
G2
G1
D
B
A
C
F
H