Dioxin Emissions from Incinerators for Sludge from Night Soil Treatment Plants

Isamu Kawakami [A], Eiichi Sase [A], Masaru Tanaka [B] and Tetsushi Sato [C]

A:Sumitomo Heavy Industries,Ltd.,5-9-11 Kitashinagawa, Shinagawa-ku,Tokyo 141-8686, Japan
B:National Institute of Public Health, 4-6-1 Shiroganedai, Minato-ku, Tokyo 108-8638, Japan
C:Japan Waste Research Foundation, 1-15 Kagurazaka, Shinjuku-ku, Tokyo 162-0825, Japan

Introduction

The emission of dioxins from waste incinerators is a subject of much public concern in Japan, and measures to control such emissions from MSW incinerators have been advancing at a rapid pace with the formulation of new guidelines and revisions of existing laws.

Night soil (Human Waste) treatment plants play an indispensable role in protecting the local environment through the sanitary disposal of human waste and the treatment of septic tank sludge. However, little data has been gathered on dioxin emission levels from the sludge incinerators within such plants. In this study, we conduct on-site investigations of the level of dioxin emissions at two night soil treatment plants to obtain data for use in determining whether or not an urgent response is required.

Method

An outline of the two plants is presented as Table 1, and flow sheets are provided as Fig. 1. Both plants have incinerators of the same basic structure (Fig. 2). In order to determine the normal (current) emission levels, we took care not to change any daily operating conditions (Table 2) and kept the combustion chamber outlet temperature at approximately 750 ℃. Flue gas was sampled at the stack during normal (steady state) operation and shutdown.

Table 1. Outline of Plants

Name	Plant A	Plant B
N.S.* treatment System	High rate Denitrification system	Standard Denitrification system
N.S.* treatment Capacity	275Kl/day	120Kl/day
Incinerator Type	Round Shape Fix Bed	Round Shape Fix Bed
Incinerator Capacity	10t/d (1.8t/h × 6h/d)	7t/d (1.2t/h × 6h/d)

*N.S.=Night Soil(Actually Night Soil and Sludge from Septic Tank)

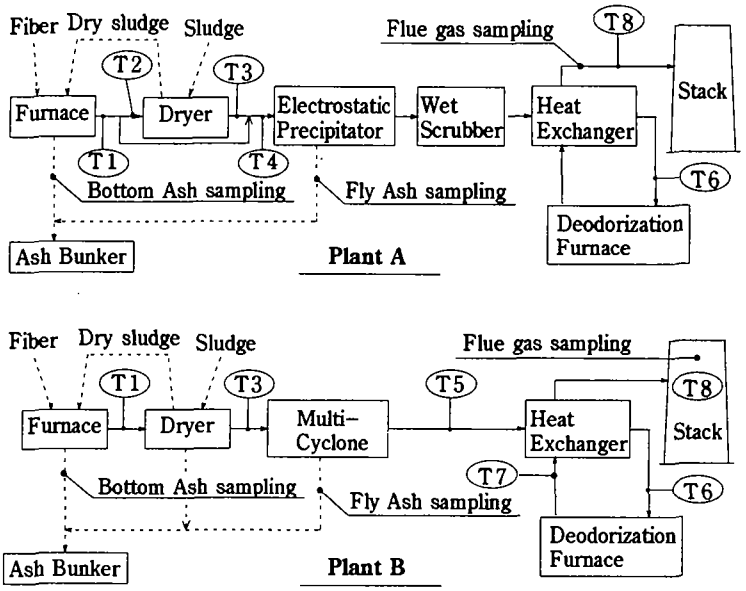

Fig.1 Flow sheet

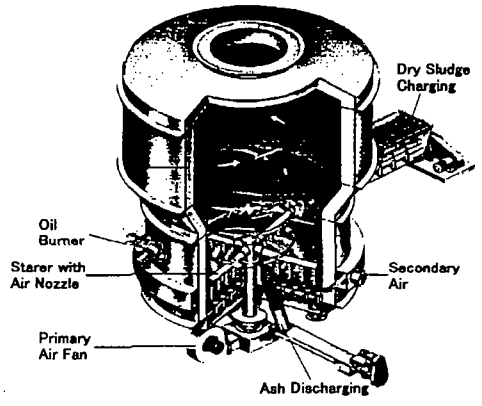

Fig.2 Furnace Structure

Table 2. Opation Condition

Item		unit	A	B
Fiber * Charging rate		kg/h	280	180
Fiber Water Content		%	60	80
Sludge Charging rate		kg/h	2,400	1,660
Sludge Water Content		%	80	80
G	T1	℃	730	750
a	T2	℃	680	
s	T3	℃	220	170
	T4	℃	270	
T	T5	℃		190
e	T6	℃	435	390
m	T7	℃		670
p	T8	℃	350	290

*Fiber = Removed with Rotary screen from Night Soil

Results and Discussion

Analysis results are shown in Table 3. Dioxin emission levels during steady-state operation are somewhat less than those of existing MSW incinerators (intermittent operation) of the same scale [1) 2) 3)] . While differences in the flue gas treatment capabilities of the two plants express themselves in HCl and SOx emission levels, the levels of dioxin emissions are

nearly the same (and below the regulatory value of 5 ngTEQ/m^{3}N for existing incinerators to take effect in 2002).

The flue gas treatment facilities at Plant B consist only of a multi-cyclone, with dilution by a kerosene-fired deodorization furnace. Relative to MSW incineration flue gas, these sludge incinerators have higher SOx level and lower HCl level. SOx may be acting as an inhibitor of dioxin formation.

Table 3. Analysis data (Concentration in gas:O_2=12% Converted)

	Item	unit	Plant A		Plant B	
			Stable state	Shut down	Stable state	Shut down
Gas	O_2	%	13.3	18.2	17.7	19.3
	CO	ppm	131	353	242	329
	SOx	ppm	11	-	68	-
	HCl	mg/m^{3}N	18	-	130	-
	NH_3	ppm	11	-	21	-
	dust	mg/m^{3}N	120	-	76	-
	PCBs	ng/m^{3}N	160	1,300	-	-
	Co-PCBs	ng/m^{3}N	5.65	33.81	-	-
	Co-PCBs(TEQ)	ng/m^{3}N	0.01	0.32	-	-
	PCDDs	ng/m^{3}N	18	920	10	24
	PCDFs	ng/m^{3}N	30	390	31	170
	PCDD/F(I-TEQ)	ng/m^{3}N	0.84	19	0.87	3.7
Bottom ash	PCBs	ng/g	0.14	-	-	-
	Co-PCBs	ng/g	0.0054	-	-	-
	Co-PCBs(TEQ)	ng/g	N.D.	-	-	-
	PCDDs	ng/g	0.084	-	N.D.	-
	PCDFs	ng/g	0.035	-	0.015	-
	PCDD/F(I-TEQ)	ng/g	N.D.(<0.001)	-	N.D.(<0.001)	-
Fly ash	PCBs	ng/g	7.1	-	-	-
	Co-PCBs	ng/g	0.715	-	-	-
	Co-PCBs(TEQ)	ng/g	0.0008	-	-	-
	PCDDs	ng/g	0.63	-	0.82	-
	PCDFs	ng/g	0.23	-	0.37	-
	PCDD/F(I-TEQ)	ng/g	0.0099	-	0.013	-

Reasons for the lower dioxin levels in sludge incinerator emissions relative to MSW incinerator emissions are believed to be (a) the substances incinerated are relatively uniform and contains little metal, (b) there are few plastics, so there are few high molecular weight hydrocarbons in the flue gas, (c) the flue gas is diluted by gas from kerosene combustion, and (d) other reasons (inhibitor, low HCl and etc.).

On account of the O_2 conversion, high concentrations of dioxins are apparent in the sample data taken during shutdown. The procedure used to shut down the incinerators is "burn-out stoppage," and the level of such emissions are not believed to be high enough to cause problems, unlike the case of the high concentration of dioxins (e.g., 646 ngTEQ/m^{3}N emitted during stock-fire shutdowns of intermittently operated MSW incinerators.

Furthermore, the reason that Plant B has lower shutdown dioxin levels than Plant A is probably that, at Plant B, the deodorization furnace is run for a while after the temperature of the incinerator has dropped.

The levels of dioxin in bottom ash were close to TEQ detection levels. However, some

dioxin has been detected in fly ash, although at very low levels, and it may be necessary to consider methods of fly ash separation and retainment.

We measured coplanar PCBs (Co-PCBs) at Plant A. The proportion of Co-PCBs to dioxins was almost same or a little bit less than that encountered at MSW incinerator plants [4] (Figs. 3 and 4).

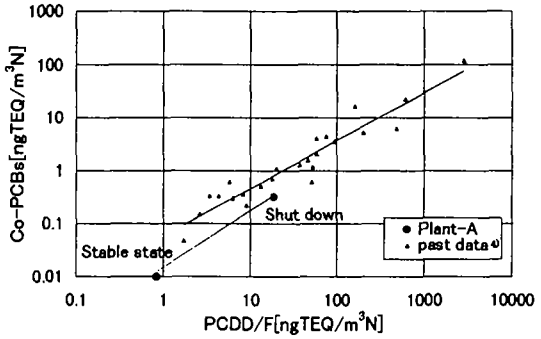

Fig.3 Relation between PCDD/F and Co-PCBs in Flue gas

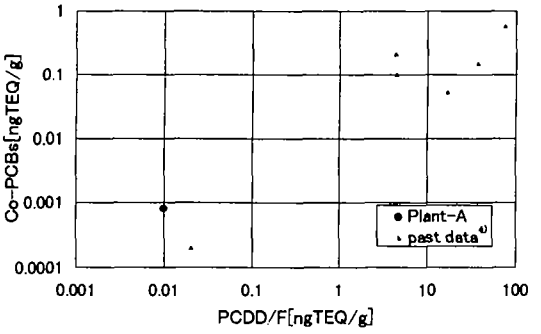

Fig.4 Relation between PCDD/F and Co-PCBs in Fly ash

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