Sintering of MSW Incineration Fly Ash

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1.Introduction

In Japan, most of the municipal solid waste (MSW) is incinerated and residues are disposed of in landfills. Nowadays it is important to have safe landfills. Therefore, further detoxification of the residues and long-term stability of the landfill are required. Moreover, efficient recovery of heavy metals and salt should be achieved. To solve these demands, a new technology has been developed based on the sintering technology in ironmaking industries. This paper reports a series of laboratory and bench-scale tests information conducted for treating of fly ash from a fluidized-bed MSW incineration plant.

2.Principal flow

Figure 1 shows the principal flow of sintering. That is, water and pulverized carbon are added to fly ash, and the ash is pressed into spherical lumps (green pellets) with a specified grain size distribution. Furthermore, by firing carbon content in the green pellets, they are indurated at a high temperature to products (sintered pellets).

3.Tests

Fly ash

In the tests, a fly ash sample was used as shown in **Table 1**.

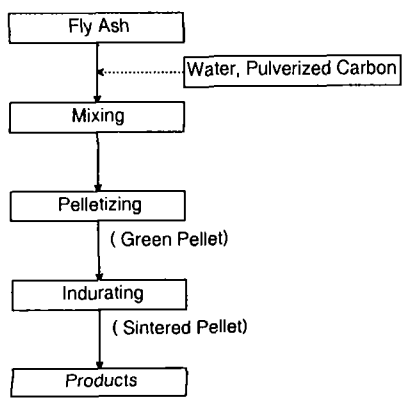

Figure 1 Principal flow of sintering

Table 1 Analysis results of fly ash

Item		Fly ash
SiO_2	(Dry %)	19.46-19.64
CaO	(Dry %)	21.29-23.85
Al_2O_3	(Dry %)	14.39-22.97
Fe_2O_3	(Dry %)	5.09- 9.50
K_2O	(Dry %)	1.45- 2.13
Na_2O	(Dry %)	2.79- 2.80
T-S	(Dry %)	0.57- 0.66
T-Cl	(Dry %)	4.64- 6.20
Free carbon	(Dry %)	0.68- 0.79
Average particle size	(μm)	21.0-39.6
Brain Index	(cm^2/g)	4,050-5,870
Specific gravity	(-)	2.53- 2.88
Melting point	(℃)	1,203-1,210

The fly ash was collected in the fabric filter of a fluidized-bed MSW incineration plant.

Laboratory tests

A tire-type pelletizer and an electric furnace are used for laboratory tests. **Table 2** shows the test conditions. Laboratory tests were done to determine suitable indurating conditions.

Table 2 Test conditions in laboratory tests

Item		RUN1	RUN2	RUN3
Indurating temperature	(℃)	900	1000	1100
Indurating time	(min)	9.0		
Air volume	(l/min)	0.5		

Bench-scale tests

The balling test equipment is a 0.9m diameter pan pelletizer, and for indurating, a test device is used as shown in **Figure 2**. On the pot grates, a green pellet layer is formed and the air circulated with fans is heated with burners and ventilated downward through the pellet layer. The green pellets are preheated, fired, and kept warm after induration, which is followed by cooling in the atomosphere.

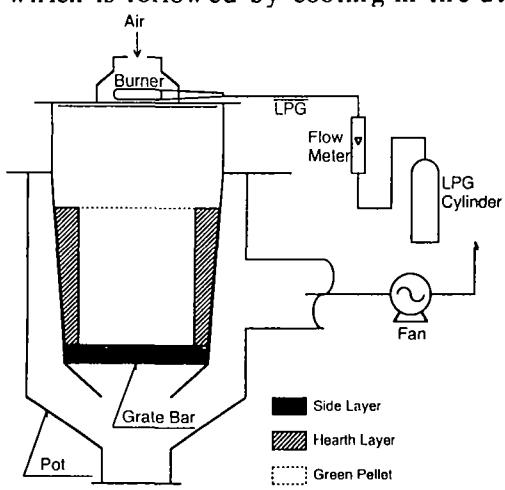

Figure 2 Indurating test device

Table 3 Operating data in bench-scale tests

Item		RUN
Ash feed rate	(kg/1batch)	8.5-10.3
Water content of green pellets	(%)	16.3
Average diameter of green pellets	(mm)	+5
Drop strength of green pellets	(-)	17.4
pellet layer thickness	(mm)	250
Indurating time (including cooling time)	(min)	43'30"-51'00"
Indurating temperature	(℃)	890-1,150
Fuel consumption	(kcal/kg)	1,730
Yield rate of sintered pellets	(%)	82.3

Table 3 shows the operating data. Stable pelletization was confirmed by adding 16% water to fly ash, and the average diameter of green pellets was 10 mm ϕ. Indurating operation was so stable without break of pellets by heat shock and melting, that the yield rate of the sintered pellets was more than 80% Fuel consumption was about 1700 kcal/kg-ash. **Photo.1** shows the appearance of the sintered pellets.

Photo.1 Sintered pellets

4. Results

Behavior of dioxins

Table 4 shows the results of dioxin analysis (PCDDs/PCDFs) in laboratory tests. Concentrations of dioxin contained in the sintered pellet are less than 0.01 ngTEQ/g, confirming that concentrations of dioxin in fly ash can be greatly reduced by sintering treatment above 800℃.

Table 5 shows the results of dioxin analysis in bench-scale tests. Concentratons of dioxin contained in the sintered pellet are less than 0.01 ngTEQ/g, too. Though concentrations of dioxin contained in exhaust gas are rather high, they can be reduced, using after-burning and sophisticated gas treatment process.

Figure 3 shows the balance of dioxin in the indurating device. More than 96% of PCDDs/PCDFs are decomposed and removed by sintering treatment and the environmental load can be greatly reduced.

Table 4 Analysis results of dioxin

(Unit : ng/g)

Item	Fly ash	Sintered pellet		
		RUN1	RUN2	RUN3
T_4CDDs	7.8	<0.004	<0.004	<0.004
P_5CDDs	14	<0.004	<0.004	<0.004
H_6CDDs	35	<0.004	<0.004	<0.004
H_7CDDs	9.3	<0.004	<0.004	<0.004
O_8CDD	16	0.016	0.016	0.016
PCDDs	82	0.016	0.016	0.016
T_4CDFs	28	<0.004	<0.004	<0.004
P_5CDFs	38	<0.004	<0.004	<0.004
H_6CDFs	52	<0.004	<0.004	<0.004
H_7CDFs	17	0.006	<0.004	<0.004
O_8CDF	18	0.022	0.022	0.025
PCDFs	150	0.028	0.022	0.025
PCDDs + PCDFs	230	0.044	0.038	0.041
T.E.Q(Int.)	3.7	0.00	0.00	0.00

Table 5 Analysis results of dioxin

Item	Fly ash (ng/g)	Sintered pellet (ng/g)	Exhaust Gas (ng/Nm^3)
T_4CDDs	5.6	0.023	24
P_5CDDs	12	0.024	25
H_6CDDs	33	0.039	26
H_7CDDs	30	0.065	27
O_8CDD	37	0.057	20
PCDDs	120	0.21	120
T_4CDFs	19	0.12	130
P_5CDFs	26	0.081	100
H_6CDFs	33	0.065	88
H_7CDFs	46	0.063	100
O_8CDF	29	0.023	55
PCDFs	150	0.35	470
PCDDs + PCDFs	270	0.56	590
T.E.Q(Int.)	2.8	0.00	8.3

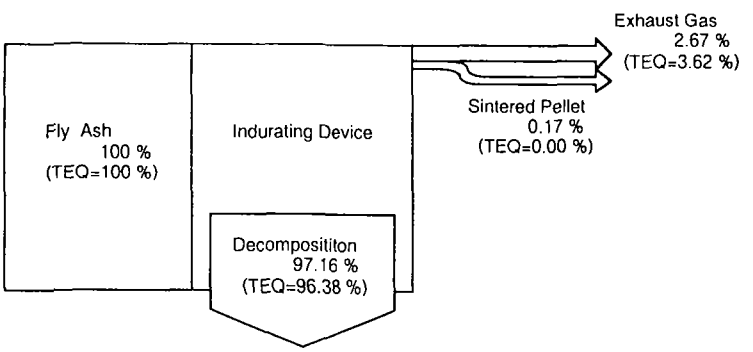

Figure 3 Balance of dioxin

Leaching test of sintered pellet

Table 6 shows leaching test results of the sintered pellet obtained in bench-scale tests. Even leaching values obtained by a low pH method clear the leaching standard for landfill.

Table 6 Leaching test results of sintered pellet

(Unit : mg/l)

Item	Public notice No.13	Low pH method (pH 4)	Leaching standard for landfill
T-Hg	<0.001	<0.001	<0.005
Pb	<0.02	<0.02	<3.0
Cd	<0.01	0.04	<0.3
Cr^{6+}	0.05	<0.02	<1.5
As	<0.02	0.05	<1.5
Org-P	<0.05	<0.05	<1.0
PCB	<0.0005	<0.0005	<0.003
CN^-	<0.02	<0.02	<1.0

5.Summary

1)Sintering tests of MSW incineration fly ash were conducted successfully.
2)Concentrations of dioxin contained in the sintered pellet are less than 0.01 ngTEQ/g.
3)Leaching values of the sintered pellet clear the leaching standard for landfill.

References

1)Terukina J. et al. (1993): Manufacturing of Artificial Lightweight Aggregates Utilizing Coal Fly Ash: The 3rd IUMRS Int. Conf. on Advanced Materials , K-26
2)Kumamoto J. et al. (1993): Development of Artificial Lightweight Aggregate Manufacturing Process from Coal Ash: The 1st Int. Conf. on Processing Materials for Properties , 823-826