DIOXINS EMISSION OF A FLUIDIZED-BED GASIFICATION AND MELTING PROCESS FOR MUNICIPAL SOLID WASTE

Tadashi Ito, Tomio Suzuki

Urban infrastructure Engineering Company, Kobe Steel, Ltd., Hyogo 657-0845, Japan

Introduction

In Japan, municipal solid waste (MSW) is mainly processed by incineration, and the discharged ash is disposed of at landfill site. Incineration offers stable and sanitary processing for large quantities, and that allows a large reduction in ultimate disposal volume. However, the further reduction of the volume of ash is required recently. Dioxins emission from MSW incinerators is also a big problem.

A gasification and melting process is drawing attention as the next-generation waste treatment technology that meets such demands. In 2000, the first fluidized-bed gasification and melting system for MSW (capacity: 30tons/day×2) was constructed[1], and has been operated. The present paper gives an outline of the process and some results of the commercial operation, including dioxins emission.

Materials and Methods

Process flow

Figure 1 shows the flow diagram of the fluidized-bed gasification and swirl-flow melting process, which is under operation. In this process, using the fluidized-bed furnace, partial combustion is carried out at an air radio of 0.3 to 0.5, and low temperature gasification at about 823 K is performed. The dust and pyrolysis gas generated in the gasifier are tangentially led into the swirl-flow melting furnace, and the combustibles are burned there at a total air ratio of about 1.3. In the melting furnace, high temperature combustion at about 1573 K is achieved, the ash is melted and separated as slag, and toxic substances in the gas are decomposed[2]. The flue gas from the melting furnace is passed through the boiler for heat recovery, cooled in the gas cooler, and dedusted with the bag house.

From the fluidized-bed gasifier, recovery of the non-oxidized steel and aluminum, which are of high value for material recycling, is possible. The slag is continuously discharged from the bottom of the melting furnace and water-quenched.

Characteristics of MSW

The lower heat value and the components of wastes sampled are listed in the Table 1. Cl concentrations in sampled wastes were about 0.2 %.

Results and Discussion

Adaptability for various waste characteristics

Figure 2 shows the weight of processed waste per day since October 2000. It was confirmed that the operating capacity of this plant is greater than the design capacity (30tons/day) for various waste characteristics in heat value through one-half year operation.

The typical timechart of the temperature in the furnaces, along with CO, NOx concentrations, is shown in Figure 3. The fluidized-bed temperature was in the range from 800 to 900 K, and the temperature in the swirl-flow melting furnace was about 1550 K. The gasification and melting process in the plant was very stable.

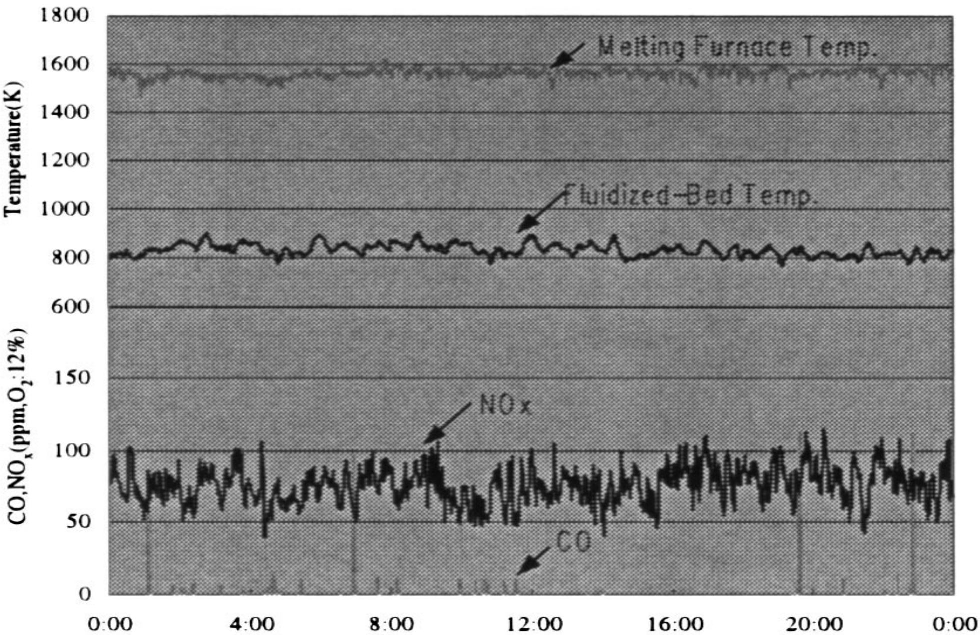


Figure 1. Flow diagram fluidized-bed gasification and melting system.

Table 1. Characteristics of MSW.

	No1	No2	No3	No4	No5
Combustibles (%)	35.3	37.3	36.7	37.8	32.8
Ash (%)	2.8	4.4	5.5	3.5	3.6
Moisture (%)	61.9	58.3	57.8	58.7	63.6
LHV (MJ/kg)	7.3	8.3	7.5	8.4	6.2

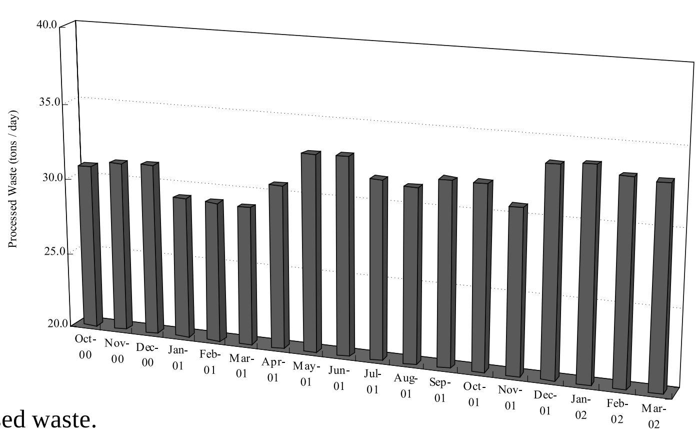


Figure 2. Processed waste.

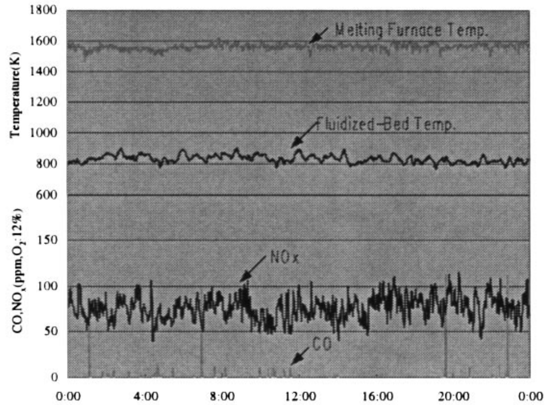


Figure 3. Time chart of operation.

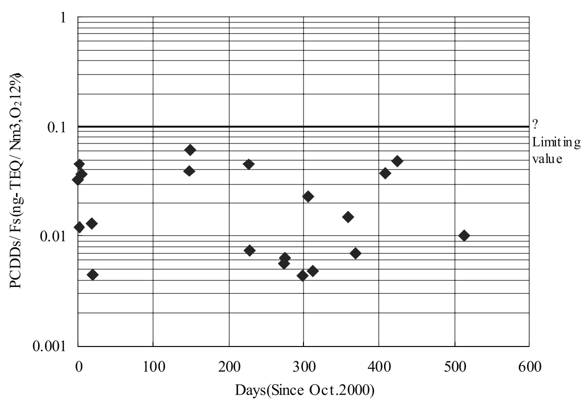
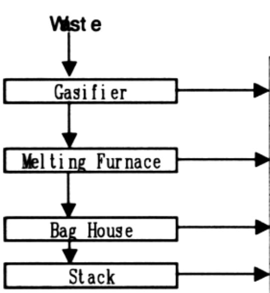


Figure 4. PCDDs / Fs in flue gas.



Botton Ash	12 kg/h	<0.0016 ng-TEQ/g	0.00 . g-TEQ/waste-ton
Slag	52 kg/h	<0.016 ng-TEQ/g	0.00 . g-TEQ/waste-ton
Fly Ash	17 kg/h	0.042 ng-TEQ/g	0.51 . g-TEQ/waste-ton
Flue Gas (Dry basis)	5,500 Nm3/h	0.023 ng-TEQ/Nm3	0.14 . g-TEQ/waste-ton
		Emission of PCDDs/Fs	0.65 . g-TEQ/waste-ton

Figure 5. Mass balance.

Dioxins Emission

Because pyrolysis gas is almost completely burned at high temperatures over 1523 K, there is few emission of dioxins in the flue gas at a low total air radio. Also, activated carbon is injected at up-stream of the bag house for high efficient dioxins removal.

Figure 4 shows measured dioxins concentrations in the flue gas at the stack. The dioxins concentrations were in the range from 0.0044 to 0.049 ngTEQ/Nm^3, and the average value of dioxins was 0.022 ngTEQ/ Nm^3, considerably below 0.1 ngTEQ/Nm^3, which is limiting value of the "New Guideline For Controlling Dioxin"[3] in Japan. Furthermore, no change of emission control ability of dioxins in flue gas was confirmed through one-half year operation.

The mass balance of dioxins in the gasification and melting process is illustrated in Figure 5. The dioxins concentrations of bottom ash and slag, flue gas were very low, almost negligible. The dioxins emission from the plant was 0.65 µg/ton of waste, lower than conventional MSW incineration plants, so environmental load of dioxins can be greatly reduced.

Acknowledgements

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