Abstract:

The Thermoselect process is a completely new solid waste treatment process which achieves pollution-free recycling of municipal solid waste and industrial waste by a high temperature gasifcation and reforming process. The process effectively recovers fuel gas from waste and recycles metal and other byproducts as resources. A stable gas engine power generation system using purifed synthesis gas from the Thermoselect process was

study of municipal solid waste treatment at the Thermoselect process Chiba plant, the condition of the industrial waste treatment/fuel gas business, including the characteristics and use of the gas, and a newly developed gas engine electric power generation system suitable for use with smaller-scale Thermoselect waste treatment plants in areas without major fuel gas-consuming industries.

2. Outline of Thermoselect Technology

2.1 General Process Flow

The standard treatment flow of the Thermoselect process is shown in **Fig. 1**. Wastes are compacted without pretreatment, followed by drying and pyrolysis by indirect heating in the degassing channel. The pyrolyzed waste product is then charged into the high temperature reactor, where it is melted at high temperature by reaction with oxygen and pyrolyzed carbon to form gas. This gas passes through the gas reforming/quenching/refining process and is recovered as a clean synthesized fuel gas.

2.2 Features of Process

The features of the Thermoselect process are described in outline below.

(1) Extremely low emission of dioxins and no generation of fly ash are possible.

Generated gas is held at 1 200°C for 2 s or longer, followed by quenching to approximately 70°C in an oxygen-free condition, to suppress the generation of dioxins to an absolute minimum, and is then recovered as fuel gas.

(2) 100% recycling of wastes is possible.

Industrial waste	LHV* (MJ/kg)	3 Components			Cl (%-wet)	S (%-wet)
		Moisture content (%)	Ash content (%)	Volatile matter (%)		
A	16.1	22.2	15.4	61.9	1.29	0.97
B	5.5	26.8	42.7	30.5	1.11	1.66
C	18.2	46.3	2.0	51.7	0.15	0.17
D	38.3	1.3	1.8	96.9	0.01	–
Average	13.7	44.4	9.8	45.8	1.15	0.64
MSW**	8.5	47.7	6.7	45.6	0.19	0.04

* Lower heating value, ** Demonstration

The average properties of the waste in the pit after mixing include a lower heating value (LHV) of 13.7 MJ/kg, and ash content of 9.8%, Cl content of 1.15%, and S content of 0.64% (waste standard).[8] Thus, in comparison with MSW, LHV is large and the ash, Cl, and S contents are high (compared with MSW received from Chiba City during demonstration). Based on the large amount of metal hydroxides recovered, this industrial waste also has a high content of heavy metals (**Table 5**).

Table 6 shows an example of the characteristics of the synthesis gas obtained by treating industrial waste. Table 5 shows the distribution and total amount of dioxins. Total emission of dioxins was 0.000 30 μg-TEQ/t-waste, which is virtually the same level as in the demonstration with MSW.

Slag quality satisfies leaching standards. Slag quality control includes on-line size adjustment and magnetic classification. Quality confirmation tests with recycling contractors have been completed for respective applications, and Thermoselect slag is now being used as fine aggregate for interlocking blocks, etc.[9]

3.3 Use of Purified Synthesis Gas

Since 1987, JFE Steel's East Japan Works (Chiba District) has operated a gas turbine combined-cycle power plant[10] using byproduct gases generated in the steel works (Blast furnace gas, coke oven gas, etc.; LHV: 4.6 MJ/Nm^3). Therefore, the purified synthesis gas recovered by the Thermoselect process is transferred to the works, where it supplies part of the fuel for the combined-cycle power plant. **Figure 3** shows the energy flow at Chiba District of East Japan Works, including the purified synthesis gas from the Chiba Recycling Center.

In cases where a Thermoselect process plant is sited at a steel works or similar energy-consuming facility, it is possible to use the purified synthesis gas in the works. However, under general siting conditions, highly efficient power generation on a comparatively small scale is required in order to utilize the purified synthesis gas recovered by waste treatment. Conceivable generating methods for such small-scale waste treatment operations include gas engine power generation and fuel cells, as these methods offer high generating efficiency with small-scale equipment.

To demonstrate the effectiveness of the Thermoselect process in this type of power generation, a 1.5 MW gas engine generator was installed at the site of the Chiba Recycling Center for demonstration. The appearance of the generator is shown in **Photo 2**; its main specifications are shown in **Table 7**. A demonstration test of gas engine power generation was performed using part of the

4. Summary

The Thermoselect process described in this paper offers numerous advantages as a waste treatment system. In particular, it can cope effectively with a diverse range of wastes in fuel gas recovery, it has demonstrated outstanding dioxins decomposition performance, and it is capable of direct reduction of nonferrous metals such as Zn at the site. JFE Engineering is confident that this technology can contribute to realizing a recycling-based society without final landfill disposal sites.

At present, orders have been received for the following Thermoselect process waste treatment facilities, which are now under construction.

(1) Mizushima Eco-Works Corp. (Okayama Pref.)
Treatment capacity: 555 t/d
(scheduled startup: 2005)

(2) Kenoukennan Regional Environmental Association (Nagasaki Pref.)
Treatment capacity: 300 t/d
(scheduled startup: 2005)

(3) Cyuoukouiki Environmental Facility Association (Tokushima Pref.)
Treatment capacity: 120 t/d
(scheduled startup: 2005)

(4) Yorii ORIX Eco Services Corp. (Saitama Pref.)
Treatment capacity: 450 t/d
(scheduled startup: 2006)

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