Commencement of Commercial Operations of Advanced MSW Incineration Plant (Fluidized Bed and Direct Ash Melting System) with Hybrid Power Generators

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Mitsubishi Heavy Industries Environmental & Chemical Engineering Co., Ltd. (MHIEC) has supplied fluidized bed gasifiers with an ash melting system for municipal waste treatment for more than a decade, and these gasifiers continue to operate stably. Aomori City Refuse Disposal Facility is equipped with the latest model of the Municipal Solid Waste (MSW) Gasification & Ash Melting System. The plant realizes the effective utilization of natural energy by using solar power generation to reduce the net peak power demand on the premises, in addition to conventional thermal recycling through power generation from waste, as well as material recycling by slagging ash. These features of the plant are introduced below.

1. Facility overview

Aomori City Refuse Disposal Facility (hereafter referred to as the facility) employs our latest model of fluidized bed gasifier with the direct ash melting system. Commercial operations at the facility commenced on April 1, 2015. Under the design-build-operate (DBO) scheme, the facility plant was constructed by MHIEC, and the business operation for the following 20 years would be managed by Aomori Eco-Creation Co., Ltd., MHIEC's wholly-owned special purpose company (SPC).

In addition to the gasification and ash melting system for combustible waste treatment, the facility is also equipped with a crushing/sorting system to treat bulky and non-combustible waste. The facility, as a whole, is capable of accepting/treating many types of waste such as combustible, bulky and non-combustible items, in addition to fecal and sewage sludge (**Table 1**).

Figure 1 gives a system flow diagram of the combustible waste treatment. In this system, the collected/accepted waste items are fed into the fluidized bed gasifier for gasification under a low-oxygen atmosphere. The resulting combustible gas and unburned dust are directly blown into the combustion melting furnace, allowing high-temperature combustion with air to take place to melt the ash contained in the dust to produce glassy crystals (molten slag). Molten slag is a valuable resource and is used as a material for products such as secondary concrete products (material recycling). This system realizes slagging only with the heat of MSW, requiring no auxiliary materials such as coke. This also indicates the superiority of the system from the perspective of minimizing greenhouse gas (CO_2) emissions.

In the boiler, waste heat from the flue gas, which is produced in the combustion melting furnace, is recovered as steam (thermal recycling). Part of the recovered steam is thermally utilized as a heat source for sludge drying on the premises, while the rest (i.e., most of the recovered steam) is led to the steam turbine to generate electricity. When waste is treated at the rated load (300 t/d), power generation by the turbine reaches the declared output of 7,650 kW. As the generated electricity considerably exceeds the power consumption on the premises, the excess is supplied (sold) to outside entities.

Of the acceptable types of waste, fecal and sewage sludge are pretreated by a specialized steam-heated dryer to produce dried granular sludge, which is then thrown into the refuse bunker to undergo treatment with combustible waste.

Table 1 Facility summary of the Aomori City Waste Incineration Plant

Combustible waste treatment system	Applicable type of waste	Combustible waste; urine and sewage sludge
	Employed method and capacity	Fluidized bed gasification and ash melting furnace 300 t/d (150 t/d x 2 furnaces)
	Boiler	Natural circulation type Normal operating pressure: 4.0 MPa Steam temperature: 400°C
	Steam turbine generator	Double extraction condensing type Power output: 7,650 kW
Crushing/sorting system	Applicable type of waste	Bulky waste; non-combustible waste
	Capacity	39.8 t/d
Other systems	Solar power generation system	Installation area: approx. 16,000 m^2 Power output: 731.8 kW

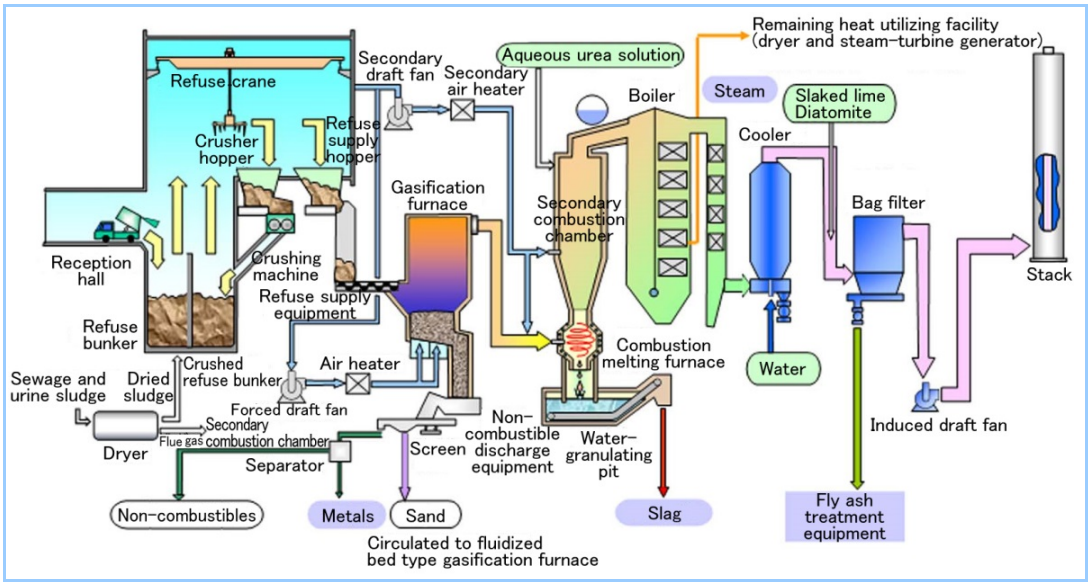

Figure 1 Flow diagram of combustible waste treatment system

2. Current operational situation of the facility

At this facility, the combustible waste treatment system operated successively for more than 90 days after the commencement of commercial operations in April 2015. During the six months from April to September of that year, a total of approximately 45,000 t of combustible waste and sludge were treated as planned (**Figure 2**).

The molten slag that is formed in the treatment process is used for secondary concrete products. These products have been approved and registered as recycled products by the Aomori Prefectural Government and are sold as such. The power generated by the turbine is supplied (sold) to electric power companies on a regular basis.

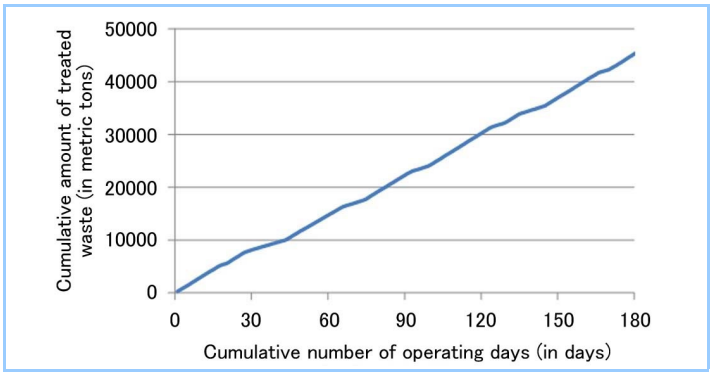

Figure 2 Amount of waste treated from April to September

3. Use of the solar power generation system (hybrid power generation)

The combustible waste treatment system of the facility is continuously operated 24 hours a day, whereas the crushing/sorting system is in operation only during the daytime. Therefore, the daytime power consumption on the premises is high, reducing the amount of electricity that can be

sold. To compensate for this reduction electricity for sale, as well as handle load fluctuations during the day, a solar power generation system has been installed in addition to steam-turbine power generation (i.e., hybrid power generation), thereby leveling the net power consumption (or reducing the net peak power demand) on the premises. Thus, without being disturbed, the steam-turbine power generator can stably provide electricity to outside entities.

Although the effect of reducing the net peak power demand by solar power generation depends on the weather and treatment load of the facility, the installed solar power generation system has suitably served this purpose since the commencement of commercial operations. The combined use with the steam-turbine power generator realizes a stable supply (sale) of electricity. **Figure 3** shows an example of daytime power consumption on the premises during commercial operations and the typical reduction effect on the net peak power demand resulting from solar power generation.

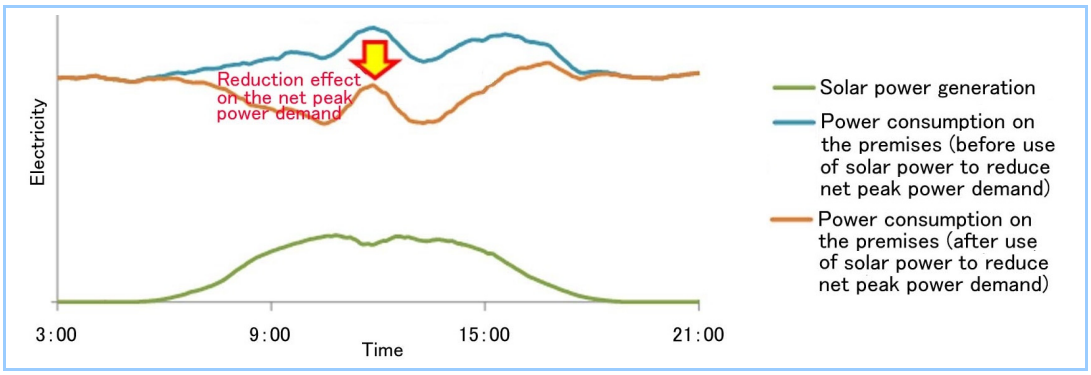

Figure 3 Reduction effect on the net peak power demand resulting from solar power generation

4. Remote monitoring system to support operation

To support the management of the facility, a remote monitoring system has been introduced (**Figure 4**). The head office of MHIEC (Yokohama City, Kanagawa, Japan) receives real-time monitoring images and operational data, which are collected at the central control room (**Figure 5**). The data is regularly checked and analyzed, and the results are used as feedback to improve facility operation. Should a problem arise, the data becomes a useful source of information to MHIEC technical support staff who need to work cooperatively with those at the site.

We will continue to use the system to provide support for stable commercial operations.

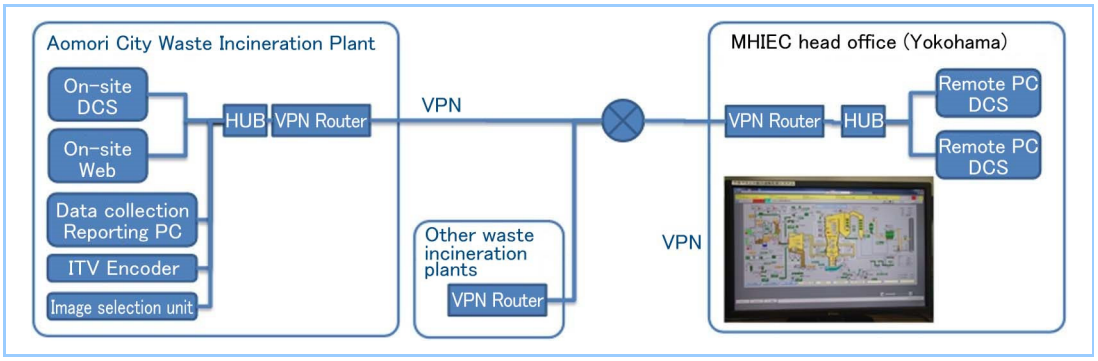

Figure 4 Remote monitoring system

Figure 5 Central control room under operation