Construction of Municipal Solid Waste Treatment Plant
“Central Waste Management Center 70 t/d Incinerator”

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Abstract
We delivered the municipal solid waste treatment plant Central Waste Management Center 70 t/d Incinerator to the Oyama Wide-Area Hygiene Union, and completed its construction work at the end of September 2016. In the municipal solid waste treatment plant, our latest incineration system, the Ebara model HPCC21 Grate-type Incinerator, operates at a low air ratio of 1.3 or below, generates up to 1 300 kW of electricity with boiler steam, feeds this electricity to existing facilities, and sells the excess electricity. Construction of this facility was a distinctive task, requiring work in a limited area while operating existing facilities.

Keywords: Municipal solid waste, Grate-type incinerator, Incineration plant, Environment, Low air ratio combustion, Renewable energy

1. Introduction
This construction work was the first-term work (construction, management, and operation of an incineration plant with a treatment capacity of 70 t/d) of the Basic Project for the Municipal Solid Waste Treatment Plant etc. for renewing an existing waste incineration plant (160 t/d). This project consisted of the aforementioned first term as well as a second term (addition, management, and operation of two incinerators with a treatment capacity of 70 t/d), and it was contracted in the form of a DBO package.

The facility was designed, procured, and constructed in a joint venture between Ebara Environmental Plant Co., Ltd., the representing company, and two construction companies (Sato Kogyo Co., Ltd., Itabashigumi Co., Ltd.) and was delivered to the Oyama Wide-Area Hygiene Union at the end of September 2016 (Figure 1).

The union treats waste from two cities and a town (Oyama City, Shimotsuke City, and Nogi Town) in Tochigi Prefecture, and the SPC (Special Purpose Company) in which Ebara invested has been managing and operating the facility for 20 years and six months since the facility started operation on October 1, 2016.
2. Overview of the Facility

2.1 Waste receiving system

The existing facilities of the Central Waste Management Center used a weighing scale (track scale) in two-way traffic. In addition, many vehicles carried municipal solid waste into the center, and during peak periods, the sites were surrounded by lines of vehicles waiting. Two weighing scales were added and integrated into the system with the existing weighing scale to reduce the time required for weighing when carrying in waste and carrying out ash and to relieve traffic of waste collection vehicles and vehicles carrying waste by citizen.

2.2 Solid Waste Treatment Plant

Figure 2 and Table 1 show a flow sheet of the Municipal Solid Waste Treatment Plant and an overview of the main systems, respectively.

3. Construction Work Processes

Since the construction work was to be carried out with the existing facilities in operation, we constructed a temporary rampway to secure a new route for carrying waste into the existing facilities, and removed the existing rampway. The main milestones of the construction work are shown in Table 2, and the
situation of the site during the construction work in Figure 3. The area marked with solid red lines is the construction site of this facility.

4. Features of the Facility

4.1 Comparison with the existing incinerator

The existing waste incineration plant Central Waste Management Center 160 t/d Incinerator was constructed by Ebara-Infilco Co., Ltd. (note: merged with Ebara Corporation in 1994) and completed in March 1986. Table 3 shows the old and new specifications of the facility for comparison. The design value of the calorific value of waste of the new facility is significantly increased compared to the old facility. The old incinerator operated for more than 30 years after it was completed, and the design values of that time (quality of waste, etc.) were not in keeping with the current situation.

4.2 Realization of high-efficiency energy recovery

To achieve satisfactory, stable combustion at a low air ratio and improve energy recovery efficiency, we adopted a flue gas recirculation system. In general, the bag filter outlet gas is used for flue gas recirculation in many cases, but this facility recirculates the economizer outlet flue gas by suction with a secondary fan. Thus, the flue gas treatment equipment was downsized and adapted to the site conditions, and the stirring and mixing of the gas inside the incinerator was accelerated by increasing the amount of circulated gas by 20 to 30% from the conventional level while maintaining the inside temperature of the incinerator, resulting in a reduction of the consumption of ammonia water used for denitrification. The ratio of the flow rate of ammonia water with the design value assumed to be 1 is shown in Figure 4.

4.3 Adoption of renewable energy

The facility actively adopts renewable energy.

(ii) Concentrator photovoltaic system (Figure 5 and Figure 6)

The facility was the first waste treatment facility to install a concentrator photovoltaic system, which collects sunlight with a special condenser lens and...
generates electricity while tracking the movement of the sun, instead of ordinary solar panels. The concentrator photovoltaic system can generate electricity with high efficiency in sunshine, but unlike ordinary solar panels, it does not output any electricity at all (0 kW) in cloudy weather.

The system, in general, is used in regions with a large quantity of direct solar radiation, such as desert areas close to the equator, but was installed with the aim of raising the awareness of elementary school students who visit the facility on field trips.

(2) Lighting ducts (Figure 7 and Figure 8)

The lighting ducts guide light into the room without converting sunlight into electricity. Unlike top lights, these lighting ducts look like ordinary lighting equipment in appearance and do not impair the indoor atmosphere. They can also secure some light even in cloudy or rainy weather. They are installed in the passage for visitors.

The Municipal Solid Waste Treatment Plant started receiving waste on June 1, 2016, and actual load incineration commissioning on June 10. It completed a pre-use self-inspection as a power generation plant by the end of July 2016 and performed a preliminary performance test in July 2016 and a delivery performance test in August 2016.

Table 4 shows the measurement results of flue gas and

<table>
<thead>
<tr>
<th>Item</th>
<th>Criteria</th>
<th>Results</th>
<th>Day 1</th>
<th>Day 2</th>
<th>Judgment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incineration capacity</td>
<td>70 t/d or over (100 % or over)</td>
<td>100% or over</td>
<td></td>
<td></td>
<td>Passed</td>
</tr>
<tr>
<td>Dust concentration</td>
<td>0.01 g/m³ (NTP) or less</td>
<td>Less than 0.001</td>
<td></td>
<td></td>
<td>Passed</td>
</tr>
<tr>
<td>Sulfur oxides</td>
<td>30 ppm or less</td>
<td>7</td>
<td>11</td>
<td></td>
<td>Passed</td>
</tr>
<tr>
<td>Nitrogen oxides</td>
<td>50 ppm or less</td>
<td>37</td>
<td>35</td>
<td></td>
<td>Passed</td>
</tr>
<tr>
<td>Hydrochloric acid</td>
<td>50 ppm or less</td>
<td>30</td>
<td>31</td>
<td></td>
<td>Passed</td>
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<tr>
<td>Carbon monoxide (4 hours)</td>
<td>30 ppm or less</td>
<td>10</td>
<td>11</td>
<td></td>
<td>Passed</td>
</tr>
<tr>
<td>Dioxins</td>
<td>0.05 ng-TEQ/m³ (NTP) or less</td>
<td>0.00041</td>
<td>0.00019</td>
<td></td>
<td>Passed</td>
</tr>
</tbody>
</table>

5. Status of Operation of the Facility

![Fig. 4](Image) Consumption of ammonia water when the amount of flue gas recirculation increases

![Fig. 5](Image) Photovoltaic system (in the morning)

![Fig. 6](Image) Photovoltaic system (in the afternoon)

![Fig. 7](Image) Lighting ducts (daylighting units)

![Fig. 8](Image) Lighting ducts (indoor illumination)
other data obtained in the delivery performance test.

The oxygen concentration at the outlet of the boiler was 3.4% on average (wet basis), and the facility achieved stable operation at an air ratio of 1.3 or less. Carbon monoxide and nitrogen oxides were 11 ppm and 36 ppm, respectively, on average, which were far below the judgment criteria. Note that all of the judgment criteria were met satisfactorily under other pollution control conditions concerning dioxins, etc.

6. Supply of Electricity by New Power Generation Facility

The electricity generated by this facility covers the power required on the premises and is supplied to existing facilities. During the daytime on weekdays, when the existing facilities are in full operation and the recycling plant, in particular, is operating, this facility needs to purchase electricity, but it sells excess electricity when only the 70 t/d incinerator is operating.

This facility sells electricity to our new power producer and supplier (PPS), Oyama E-Service Co., Ltd., to realize local generation and local consumption of electricity (Figure 9).

7. Conclusion

This facility was completed on September 30, 2016 and is operating in good condition. We are determined to ensure that the facilities are managed and operated smoothly for a long period of the next 20 years and six months, and long into the future, and to contribute to the establishment of a sustainable society.

In conclusion, we would like to express our sincere gratitude to the staff members of the Oyama Wide-Area Hygiene Union and to all those who offered a great deal of advice and cooperation to us in the construction of this facility.

References