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JFE Advanced Stoker System "Hyper 21 Stoker System"†

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Abstract:

JFE Engineering offers an advanced stoker-type incineration system, the JFE Hyper 21 Stoker System, which is equipped with new technologies to meet the requirements of municipal solid waste (MSW) treatment, including minimization of environmental pollutants, effective use of energy, applicability to various types of MSW, and reduction of operating costs. Low excess air ratio combustion based on high temperature air combustion technology and an ash treatment system integrated with the incinerator are features of this system. This paper describes the results of the experimental study carried out with a test plant (12 t/d) at R&D Center of JFE Engineering and a practical operation test with an MSW incinerator (105 t/d) in commercial operation.

1. Introduction

JFE Engineering has developed and constructed a variety of stoker-type waste incinerators which meet changes in market needs since receiving its first order in 1971, such as (1) GR-type Incinerator, (2) DG-type Incinerator, and (3) HGDG-type Incinerator. The strong points of each incinerator are as follows: (1) GR-type Incinerator: equipped with rotary kiln and suitable for low calorific value waste, (2) DG-type Incinerator: two-way gas flow incinerator with three-stage grate steps, which is suitable for high calorific value waste and effective to suppress CO and NOx emissions, (3) HDG-type incinerator: two-way gas flow incinerator with JFE Hyper Grate System which offers excellent combustion stability and combustion efficiency, meeting the requirements of modern waste with high contents of aluminum, plastics, etc. JFE Engineering now has over 15 years of experience in the construction of the HDG-type incinerator.

In recent years, there is a great demand for further reduction in the volume of toxic products, higher energy efficiency, and low construction and maintenance costs in waste incineration.

The stoker-type incinerator has a number of outstanding features, including (1) no requirement of special pretreatment such as crushing, (2) high reliability, (3) capability of stable combustion of waste with inhomogenous and fluctuating properties. The stoker-type incinerator accounts for more than 80% of municipal solid waste (MSW) incineration plants in Japan (throughtput base) and is expected to play a major role in waste incineration plants in the future.

With this background, JFE Engineering has developed an advanced stoker-type incinerator with greater superiority in both technology and economy.[1)]

First, a fundamental study of waste combustion was carried out using a bench-scale test plant to clarify waste combustion characteristics. Next, reflecting these findings, a 12 t/d pilot-scale test plant was constructed at R&D Center of JFE Engineering and experimental tests were conducted to study waste incineration with advanced stoker system technologies. Then, based on these results, a practical operation test was carried out at a 105 t/d scale MSW incinerator in commercial operation.

This paper presents the results of the demonstration tests for the JFE Hyper 21 Stoker System obtained with both the pilot-scale test plant and the commercial plant.

2. JFE Hyper 21 Stoker System

The basic concept of the JFE Hyper 21 Stoker System was to realize the following features in a stoker-type

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incinerator with high reliability and excellent operational stability as essential characteristics, based on JFE Engineering's long experience in the field. The target features were:

(1) Substantially improved heat recovery efficiency
(2) Reduction of environmental pollutants
(3) Simple and compact components
(4) Reduction of costs in both construction and operation
(5) Applicability to wide range of wastes

They were realized by combining existing technologies such as the two-way gas flow incinerator[2] and hybrid automatic combustion control (ACC) system[3], and new technologies such as an exhaust gas recirculation system, water-cooled grate technology[4], and dioxins volatilization and decomposition system for fly ash[5] in the system at a high level. In particular, the original features of the system include a low excess air ratio combustion technology based on high temperature air combustion technology and integration of the ash treatment process with the incinerator. The corresponding technologies and the expected effects are shown in **Fig. 1**.

A conceptual diagram of the system is shown in **Fig. 2**. As shown in this figure, the system supplies high temperature air, consisting of a mixture of high temperature air and exhaust gas, to the combustion beginning region in the two-way gas flow incinerator. This mixture is defined as "high temperature mixed-gas (hereafter HTMG)" in this paper. Injection of HTMG stabilizes combustion in the waste combustion beginning region, realizing stable combustion under a low excess air condition (excess-air ratio: 1.3), which cannot be achieved in the conventional stoker-type incinerators.

If a low excess-air ratio is used in the conventional combustion, that is, without HTMG injection, the combustion beginning point fluctuates greatly and combustion in the incinerator is unstable. As it is impossible to maintain a high temperature over a wide region in the incinerator, the content of incombustibles and toxic pollutants in the exhaust gas and ash increases rapidly, and in some cases, continuing operation is difficult. **Figure 3** shows an image of flame stability in the incinerator combustion beginning region with HTMG injection.

Major system components
(1) JFE two-way gas flow type incinerator
(2) Low excess-air combustion
(3) Utilization of high-temperature air
(4) Re-circulation of exhaust gas
(5) Integration of ash treatment furnace
(6) JFE hybrid ACC system
(7) JFE water-cooled Hyper grate system
(8) Dioxins removal and decomposition system for fly ash

Features
(1) Formation of stable flame and high-temperature zone above the waste
(2) Decrease of heat loss
(3) Selective application of ash melting and thermal treatment (not melting)
(4) Applicability to various quality of waste
(5) Easy application to the existing stoker type incinerator

Improvement

・Reduction of NO_x:	20% decrease
・Reduction of exhaust gas (at stack):	30% decrease
・Cost reduction for operation:	30% decrease
・Increase of surplus electric power (for sale):	30% increase
・Reduction of dioxins	
At the exit of boiler:	50% decrease
At the exit of stack:	Less than 0.01 ng-TEQ/Nm^3
Total emission of dioxins:	Less than 0.5 μg-TEQ/waste
・Disposal by landfill:	Remarkable decrease

Fig. 1 Expected effect of advanced stoker system

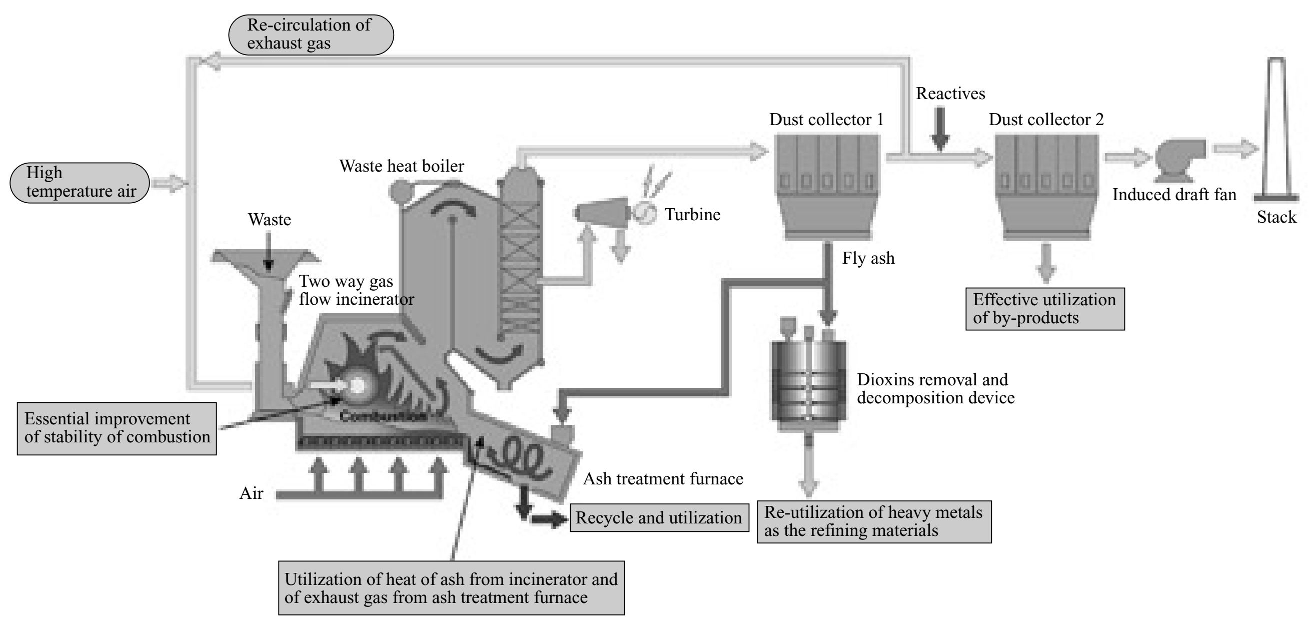

Fig. 2 Conceptual system flow of JFE advanced stoker system

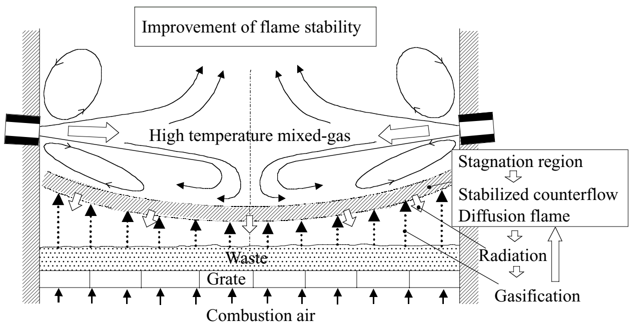

Fig. 3 Flame stabilization image in the combustion beginning region

High-speed injection of HTMG from both incinerator sidewalls forms a stable combustion region (stagnation region) above the waste layer (the flow is blocked to prevent sudden bursts of flame), and a stable diffusion flame can be maintained consistently in this region. Unlike the conventional technology, combustion instability in the combustion beginning region with HTMG injection is not amplified even under a low excess air ratio combustion condition, soot and other pollutants are suppressed, and uniform and stable combustion can be expected.

Integration of the incinerator and ash treatment system has the following advantages: Bottom ash from the incinerator can be charged directly into the ash treatment furnace without passing through complex pretreatment and transportation equipment, and it is possible to recover heat from the ash treatment exhaust gas with the waste heat boiler attached to the incinerator and clean the exhaust gas in the incinerator exhaust gas treatment system. Based on the above-mentioned simplification, this integrated incineration and ash treatment system reduces equipment costs, construction space requirements, running costs, and manpower for operation. Moreover, because effective use of the sensible heat of the bottom ash and waste heat from the ash treatment furnace is possible, the thermal efficiency of the system as a whole is significantly improved.

3. Development History

Unstable combustion is an intrinsic problem in waste incineration due to the diverse types of waste treated and inhomogeneous properties of the waste. Because high temperature air combustion technology has proven its effectiveness in realizing high performance in industrial furnaces, JFE Engineering carried out a fundamental study for application of this technology to waste incinerators as a means of improving their combustion stability. In 1999, JFE Engineering began research and development on a stable low excess air ratio combustion technology with injection of HTMG into the incinerator, applying high temperature air combustion technology, and conducted a systematic study for development of a high efficiency, low environmental pollutant emission system, which was designed as an integrated process from incineration through ash treatment. This work was subcontracted to JFE Engineering by the Energy Conservation Center, Japan, which had been commissioned with the project by New Energy and Industrial Technology Development Organization (NEDO), and was carried out with financial assistance from Ministry of International Trade and Industry (now Ministry of Economy, Trade and Industry).[6-10]

Basic research on the combustion characteristics of waste was still insufficient at that time. Therefore, first, a fundamental combustion study of waste was conducted using refuse derived fuel (RDF) solid fuel produced from MSW, and basic data were obtained on the gas concentration, temperature distribution, and other characteristics of the gasification gas above the waste layer in the stoker-type incinerator.

Next, gas combustion studies were carried out as part of a detailed investigation of the effects of high temperature mixed-gas injection and appropriate injection conditions, and the effectiveness of HTMG injection in improving combustion was confirmed.

Based on the results of these fundamental studies, incineration studies were conducted with a 12 t/d pilot-scale test plant, in which the ash treatment furnace was part of an integrated system with the incinerator. The materials used were RDF with uniform properties (with water addition equivalent to the moisture content of MSW) and MSW with inhomogeneous properties. These studies showed that HTMG injection realizes stable combustion even under a low excess-air condition, while also reducing environmental pollutants, thus demonstrating the feasibility of practical application of this system.

4. Pilot-scale Test Plant

4.1 Experimental Facility

The pilot-scale test plant consisted of an incinerator, a rotary kiln, and gas treatment systems, as shown in **Fig. 4**. Commercial waste adjusted by addition of water prior to the experiment to simulate typical household waste was used as the test material. The composition of the material is shown in **Table 1**. The material is fed to the incinerator after heating with a burner.

The materials are burned in the incinerator (throughput: 500 kg/h of MSW), which is a two-way gas flow stoker-type incinerator. The dimensions of the incinerator were 1.6 m wide, 3.7 m long, and 6.8 m high. The bottom ash is fed to a rotary kiln of 2.4 m long and 0.3 m in inner diameter for thermal treatment. The combustion gas is led to a cooling tower to lower the gas temperature, then to a bag house to filter the fly ash, and finally

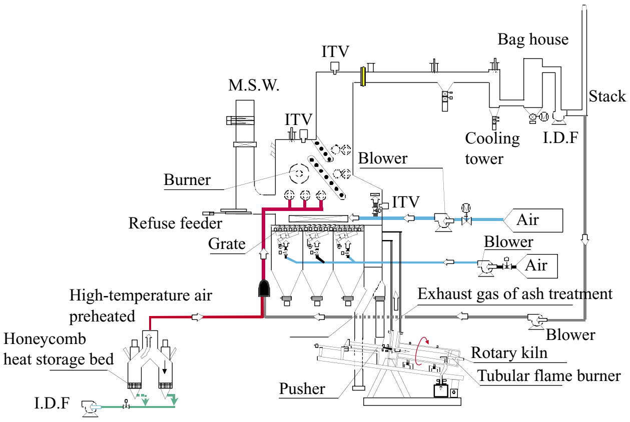

Fig. 4 MSW incineration test plant of pilot scale

Table 1 Chemical composition of the material used in pilot scale test

			Tested material	MSW
Proximate analysis	Moisture	(%)	40	49.5
	Ash	(Dry wt%)	13.8	13.9
Ultimate analysis	Combustibles	(Dry wt%)	86.2	86.1
	C	(Dry wt%)	47.9	47.8
	H	(Dry wt%)	6.6	7
	N	(Dry wt%)	0.8	0.9
	S	(Dry wt%)	0.1	0
	Cl	(Dry wt%)	0.5	0.6
	O	(Dry wt%)	30.3	29.8
Low heat value		(MJ/kg-wet)	10.4	8.9

to an induced draft fan for discharge from the stack.

A mixture of high temperature air produced by a regenerative-type generator (flow rate: 100 Nm^3/h, highest temperature: 1 000°C) and de-dusted exhaust gas is supplied to the incinerator. (As mentioned above, this mixture is defined as HTMG.)

4.2 Experimental Conditions

An experimental study was conducted changing the excess-air ratio, λ as a parameter. The conditions were as follows: (1) a conventional combustion condition with $\lambda = 1.7$ without HTMG injection, (2) a conventional combustion condition with $\lambda = 1.3$ without HTMG injection, and (3) an advanced combustion condition with $\lambda = 1.3$ and HTMG injection (temperature: 600°C, O_2 concentration: 12%).

The exhaust gas was sampled from a sampling port, and combustion gases such as O_2, CO, CO_2, and NOx were analyzed continuously. A K-type thermocouple was used to measure the exhaust gas temperature in the incinerator.

4.3 Results and Discussion

4.3.1 Change in gas composition

With an excess-air ratio of $\lambda = 1.3$ in the conventional combustion condition, large fluctuation was observed in the concentration of gas component and particularly in the CO concentration. The changes in gas composition are shown in **Figs. 5** and **6**. Compared with the conventional combustion without HTMG injection, which showed an instantaneous peak of CO concentration exceeding 100 ppm, combustion was dramatically improved with HTMG injection. As discussed in Chapter 2, this is attributed to the formation of a stagnation region in the space immediately above the waste layer by the injection of HTMG from the incinerator sidewalls, resulting in a steady, stable flame in the region.

4.3.2 NOx concentration

A comparison of the NOx concentration in the exhaust gases with excess-air ratios of $\lambda = 1.7$ and 1.3 in the conventional combustion and $\lambda = 1.3$ with injection of HTMG in the advanced combustion is shown in **Fig. 7**. The NOx concentration shows a low value in case of an excess-air ratio of $\lambda = 1.3$ with HTMG injection. The reasons are considered to be as follows: The main

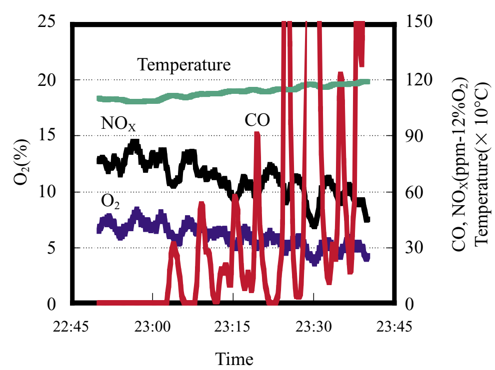

Fig. 5 Changes in O_2, CO, NOx and gas temperature with time in test plant under conventional combustion at $\lambda = 1.3$

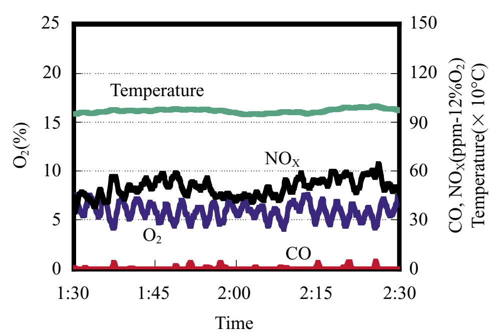

Fig. 6 Changes in O_2, CO, NOx and gas temperature with time in test plant under advanced combustion at $\lambda = 1.3$

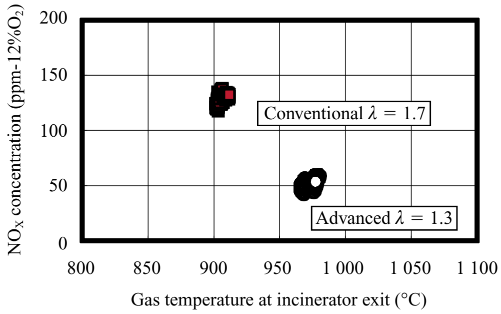

Fig. 7 NOx concentrations at incinerator exit in test plant

components of the gasification gas above the waste layer are CO, H_2, and hydrocarbons, while the conversion ratio of the N fraction in the fuel to NOx is held to a low level by reducing the excess-air ratio in the combustion chamber. At the same time, uniform mild combustion is achieved (local high temperature and an excess O_2 atmosphere are avoided) and unstable combustion is prevented by injection of HTMG.

4.3.3 Dioxins concentration in exhaust gas

Dioxins emission showed a value of 0.76 ng-TEQ/Nm^3 at the incinerator outlet and 0.13 ng-TEQ/Nm^3 at the stack. This means that the dioxins of small-scale incinerators can be substantially reduced by HTMG injection. One factor is that HTMG injection seems to affect the reduced concentration of particulate incombustibles and the relative components in the incinerator.

4.3.4 Dioxins concentration in bottom ash

The bottom ash discharged from the incinerator was melted at a representative furnace temperature of 1 150°C in the rotary kiln. The dioxins concentration of the molten slag showed an extremely low level of 0.000 1 ng-TEQ/Nm^3 or less. A similar result of 0.000 1 ng-TEQ/Nm^3 or less was also obtained with heating treatment at a lower temperature of 950°C.

4.3.5 Leaching test

Table 2 shows the results of a leaching test of the bottom ash with heating treatment and melting treatment. Similarly to the dioxins analysis, the materials were treated by heating at 950°C and melting at 1 150°C. The samples were analysed for Pb and Cr^{6+}, which were particular problems for ordinary bottom ash. The results showed that in both cases, i.e., with a representative furnace temperature of 950°C or 1 150°C, the values of Pb and Cr^{6+} satisfied the environmental standard for soil.

Table 2 Leaching test result for treated ash in test plant

Treatment		Heating	Melting
Furnace temperature	(°C)	900	1 150
Pb	(mg/*l*)	< 0.005	< 0.005
Cr^{6+}	(mg/*l*)	< 0.02	< 0.02
pH		12.5	11.1

5. Test in Commercial Plant

5.1 Experimental Facility

Based on the series of research results described in the previous chapter, the advanced stoker-type incineration technologies consisting of high temperature air combustion technology, bottom ash treatment technology, and water-cooled grate technology were added to a commercial plant with a scale of 105 t/d to demonstrate their effectiveness.

The demonstration operation was conducted at Tomakomai City, Numanohata Clean Center, which was constructed by JFE Engineering in 1999. The plant specifications are shown in **Table 3**, and a schematic diagram of the plant with the experimental facilities is shown in **Fig. 8**. The conventional plant consisted of an HDG-type incinerator, a waste heat boiler, a bag house, an induced draft fan, and various other equipments. The commercial plant was improved to an advanced stoker-type inciner-

Table 3 Specifications of the commercial plant

Plant	Numanohata Clean Center, Tomakomai City
Furnace type	JFE Hyper stoker-type incinerator
Capacity	105 t/d×2 lines
Flue gas cooling	Heat recovery boiler (2.8 MPa, 300°C) and cooling tower
Flue gas treatment	Bag house with lime and activated carbon supply
Heat utilization	Steam turbine (2.6 MPa, 295°C) and generator (2 000 kW)

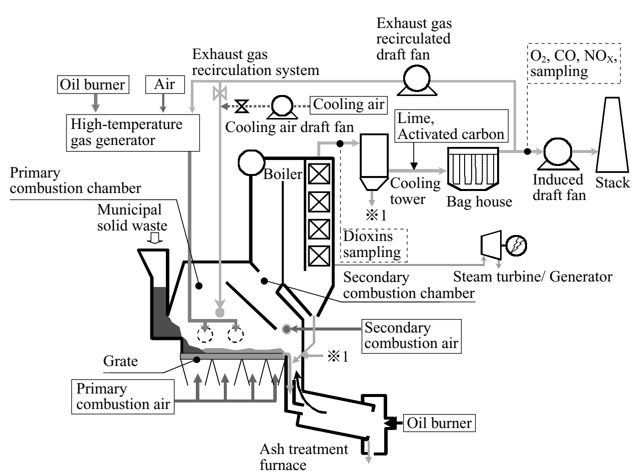

Fig. 8 Schematic flow of the commercial plant with advanced stoker system

ator by adding a HTMG generator and its injection system, an exhaust gas recirculation system, and an ash treatment system. A water-cooled grate system was also installed in this plant.

5.2 Experimental Procedure and Conditions

5.2.1 Low excess air ratio combustion

An experimental study was carried out by changing λ as in the pilot-scale study. The conditions were as follows: (1) conventional combustion, meaning normal excess air ratio combustion ($\lambda \fallingdotseq 1.6$) without HTMG injection and with water spray in the incinerator to prevent extreme high temperatures, and (2) advanced combustion, meaning low excess air ratio combustion ($\lambda = 1.3$) with HTMG injection and no water spray.

The concentrations of CO, NOx, and O_2 in the exhaust gas, the gas temperature, and the exhaust gas flow rate were measured continuously. The dioxins concentration in the exhaust gas was measured at the outlet of the waste heat boiler. These gas properties and the waste heat recovery efficiency during low excess air ratio combustion were compared with those in the conventional combustion.

In the conventional combustion, combustion air is supplied to (1) the primary combustion chamber through the grate and the sidewalls to control gas temperature, and (2) the secondary combustion chamber for post-combustion. On the other hand, in advanced combustion, HTMG using a mixture of kerosene burner combustion gas, de-dusted exhaust gas, and air is also injected above the waste layer from both sidewalls, and de-dusted exhaust gas is supplied from the sidewalls in place of cooling air.

The properties of the HTMG were set at a temperature of 400°C and the O_2 concentration of 12%.

5.2.2 Integrated ash treatment with incinerator

The objectives of the integrated ash treatment with incineration are to save construction space, reduce costs (in comparison with incinerator construction and an independent ash melting furnace), and improve energy utilization efficiency. In this study, the minimum equipment necessary for continuous ash melting was installed in the limited space of the existing ash conveyor room of the commercial plant. The main equipment consisted of an ash feeder connected directly to the incinerator ash chute, a rotary kiln (burner heating), and a slag granulating conveyor.

The sensible heat of the ash is used for ash melting by direct connection of the incinerator and ash treatment furnace. Energy efficiency is improved by recovering the waste heat of the ash treatment exhaust gas with an incinerator waste heat boiler, and the reduction of construction and operation costs is practicable.

5.3 Results and Discussion

5.3.1 Flame phenomena in incinerator

The photographs of the flame phenomena in the primary combustion chamber under both conventional combustion condition and advanced one (low excess air ratio combustion with HTMG injection) are shown in **Photo 1**. In the conventional combustion condition, the combustion chamber was covered entirely by a luminous flame, whereas in the advanced combustion condition, a stable luminous flame was observed below the position of HTMG injection and above this space, flame luminousness decreased. This difference in the flame is due to the uniform low O_2 concentration atmosphere in the primary combustion area and dilution of the combustible gas produced by gasification of the waste, which is caused by injection of HTMG and recirculated exhaust gas in the main combustion region.

5.3.2 Change in gas composition

The change in gas composition in the exhaust gas during the conventional and the advanced combustion is shown in **Fig. 9**. The O_2 concentration in the exhaust gas at the waste heat boiler outlet for the conventional combustion averaged 8.1% ($\lambda = 1.6$), while that in the advanced one averaged 4.8% at the same position, meaning $\lambda = 1.3$ and low excess-air ratio combustion was achieved. In addition, the CO concentration in the exhaust gas at the stack during the advanced combustion under a low excess-air condition was less than 5 ppm, and no peaks exceeding 20 ppm were observed. The CO

(a) Conventional combustion

(b) Advanced combustion

Photo 1 Flame photographs in incinerator

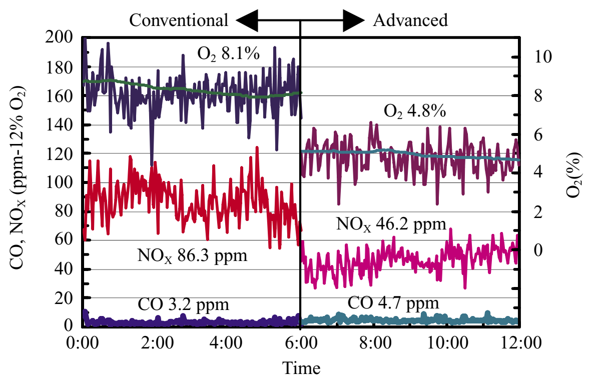

Fig. 9 Changes in O_2, CO and NOx in flue gas with time

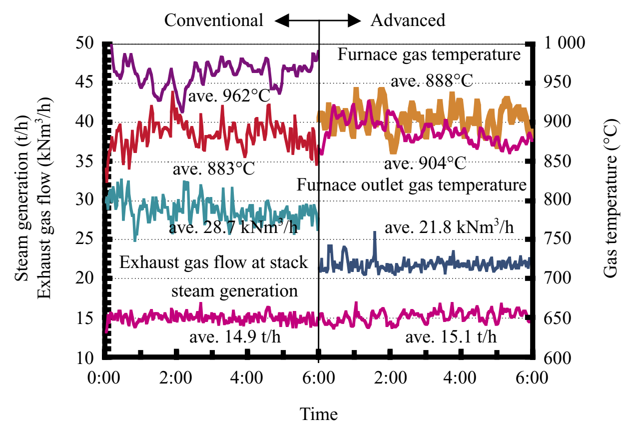

Fig. 10 Changes in steam generation, exhaust gas flow rate and gas temperatures with time

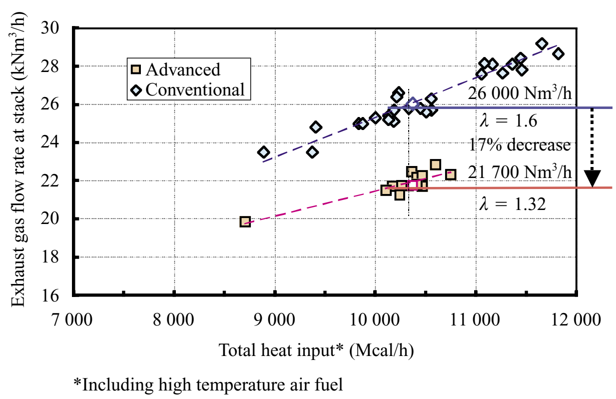

Fig. 11 Relationship between total heat input and exhaust gas flow rate at stack

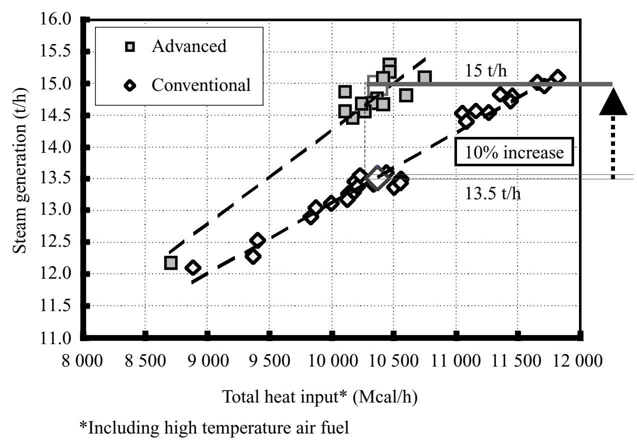

Fig. 12 Relationship between total heat input and steam generation

concentration showed the same low level as that in the conventional combustion, and stable combustion was demonstrated even with low excess-air ratio combustion. The NOx concentration showed an average value of 86.3 ppm for the conventional combustion, whereas it was reduced by approximately one half to an average of 46.2 ppm in the advanced one, even without water spray in the primary combustion chamber. The same results as mentioned in the previous chapter concerning the pilot-scale test plant were obtained in the commercial plant. They owe to the promotion of uniform mild combustion by injecting HTMG and recirculated exhaust gas (de-dusted exhaust gas) into the main combustion region. Moreover, the conversion ratio of the fraction of N in the fuel was held at a low level by reducing the excess air ratio in the combustion chamber.

5.3.3 Exhaust gas flow rate

The change in the exhaust gas flow rate at the stack is shown in **Fig. 10**. The exhaust gas flow rate was greatly reduced in the advanced combustion under a low excess-air condition in comparison to the conventional one. **Figure 11** shows the relation between total heat input and exhaust gas flow rate at the stack. In case where the total heat input in the advanced combustion is the same as in the conventional combustion, for example, when the total heat is 10 370 Mcal/h, the exhaust gas flow rate at the stack is 17% lower in the advanced combustion than in the conventional one. Because the excess-air ratio, λ is 1.6 and the exhaust gas flow rate is 26 kNm^3/h at this time, trial calculations predict that the exhaust gas flow rate can be reduced by approximately 25% in an incinerator operating at an excess-air ratio of $\lambda = 1.7$ and 30% in operation at $\lambda = 1.8$.

5.3.4 Heat recovery ratio (Increase in steam generation)

The effect of heat recovery improvement in the advanced combustion is shown in **Fig. 12**. For example, assuming the total heat input is 10 370 Mcal/h, as in the trial calculation of exhaust gas reduction, steam generation is approximately 10% greater in the low excess-air ratio combustion than in the conventional one. This is due to a reduction in heat carried out by the exhaust gas and improved combustion by promoting uniform/mixed combustion in the combustion chamber.

Based on this result, a trial calculation of power generation by a plant with a 4 MPa, 400°C boiler-turbine at an incineration facility with a capacity of 100 t/d × 2 units predicts an increase in generated output of approximately 670 kWh in comparison with a conventional

Table 4 Dioxins concentration in flue gas at boiler exit of the commercial plant

	Conventional combustion	Advanced combustion
Dioxins concentration (ng-TEQ/Nm^3)	0.71	0.43

Table 5 Ash treatment furnace operation data

Treated ash	Bottom ash Boiler bottom ash Gas cooler bottom ash
Ash throughput (kg/h)	200 – 400
Melted slag temperature (°C)	1 300 – 1 400

Table 6 Leaching test result for slag

Element	Leachate concentration (mg/*l*)
Pb	< 0.005
Cr^{6+}	< 0.02
Cd	< 0.005
T-Hg	< 0.000 5
As	< 0.005
Se	< 0.005

incineration plant. In this case, power generation efficiency is expected to be 17%.

5.3.5 Dioxins concentration in exhaust gas

The dioxins concentration in the exhaust gas at the waste heat boiler outlet is shown in **Table 4**. As a result of combustion improvement by injection of HTMG and re-circulated exhaust gas (de-dusted exhaust gas) in the main combustion region, the dioxins concentration was reduced by approximately 40% in comparison with the conventional combustion. It indicates that a stable flame is formed as a result of HTMG injection, even under a low excess-air condition, and consequently, stable combustion is achieved. A very low dioxins concentration on the order of 0.001 ng-TEQ/Nm^3 was observed at the stack after the bag house for both the conventional and the advanced combustion.

5.4 Results of Ash Treatment Test

The main operating conditions in ash melting treatment are shown in **Table 5**. Bottom ash and fly ash from the boiler and cooling tower were fed continuously to the ash treatment furnace without crushing or other pretreatment. Ash which was unsuitable for melting, such as large lumps, and other materials were separated before the ash feeder. The temperature of the slag was maintained between 1 300 and 1 400°C using a kerosene burner, and the exhaust gas from the ash treatment furnace was introduced into the incinerator. Continuous ash melting was satisfactory, with no adverse effect on the stability of low excess air ratio combustion.

The appearance of melting slag sampled from the granulating conveyor exit was basically the same as that of slag from the conventional ash melting furnaces and the gasifying and direct melting ones.

The bulk density of the melting slag was 1.5 (specific gravity: 2.8), or a volume reduction of roughly 60% in comparison with bottom ash having a bulk density of approximately 1.0.

Typical results of a leaching test of melting slag are shown in **Table 6**. All items satisfy the "Guidance for Promoting Recycling of Melted Municipal Solids Waste," Notification of Environmental Health Division of Ministry of Health and Welfare, March 26th, 1998. The properties of the melting slag were suitable for recycled materials.

6. Summary

This paper has described the development of the JFE Hyper 21 Stoker System and the results with a pilot-scale plant and a practical operation test at a commercial plant.

In the practical demonstration operation, which was performed based on the results of the pilot plant study, stable low excess-air ratio combustion was achieved by applying high temperature air combustion technology, which is the key technology in JFE Engineering's advanced stoker system. Moreover, the technology was implemented successfully in an integrated system including the incinerator and ash treatment equipment at a 105 t/d commercial plant. The advanced stoker-type waste incineration system applying the technology described in this paper demonstrated excellent operational stability and easy operating features, while also minimizing environmental pollutants, improving energy recovery, and reducing operating costs

This advanced system is applicable not only to new plant construction, but also to the existing stoker-type incinerators, which account for the great majority of waste incinerators. Even when applied to the existing plants, heat recovery performance is substantially improved. In recent years, many waste incineration plants which were built with large waste heat recovery systems (waste heat boiler, steam turbine, generator) in anticipation of increase in the amount of waste and waste with low calorific values now have a comparatively large potential for operation relative to their capacity of facility as a result of progress in waste reduction, separated collection, and recycling. The JFE Hyper 21 Stoker System is also an effective technology for plants of this type as a result of its improved heat recovery efficiency.

JFE Engineering will actively propose systems for these plants to meet the increasing requirement for renewal and improved performance in existing stoker-type incinerators.

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