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JFE High-Temperature Gasifying and Direct Melting Furnace System —Operational Results of "Fukuyama Recycle Power"—†

1. Preface

The JFE High-Temperature Gasifying and Direct Melting Furnace System has been applied for the treatment of various kinds of wastes such as refuse derived fuel (RDF), sewage sludge, industrial wastes, incineration ash, excavated wastes and/or asbestos in addition to municipal solid waste (MSW).

JFE has delivered 10 plants (20 lines) in total to Japanese clients since the first one was completed in 2003.

In this report, the outline and operational results of "Fukuyama Recycle Power" in Hiroshima Prefecture, Japan, delivered in March 2004, are described.

2. Plant Outline

The process flow and outline of the plant are shown in **Fig. 1** and **Table 1** respectively.

The JFE High-Temperature Gasifying and Direct Melting Furnace is one of the most compact furnaces, which is able to gasify combustibles and melt ash in a

Table 1 Plant outline

Capacity	13 t/h (314 t/day), 1 line
Feedstock	Pelletized RDF from MSW
Furnace type	JFE High-temperature Gasifying and Direct Melting Furnace (Vertical shaft furnace)
Energy recovery system	Boiler 90.8 t/h, 450°C/60 bars Steam turbine generator 20 MW
Flue-gas treatment	Dry type: Slaked lime and activated carbon injection, Bag filter, De-NOx reactor
Slag treatment	Water-granulation conveyor, Magnetic separator, Slag crusher

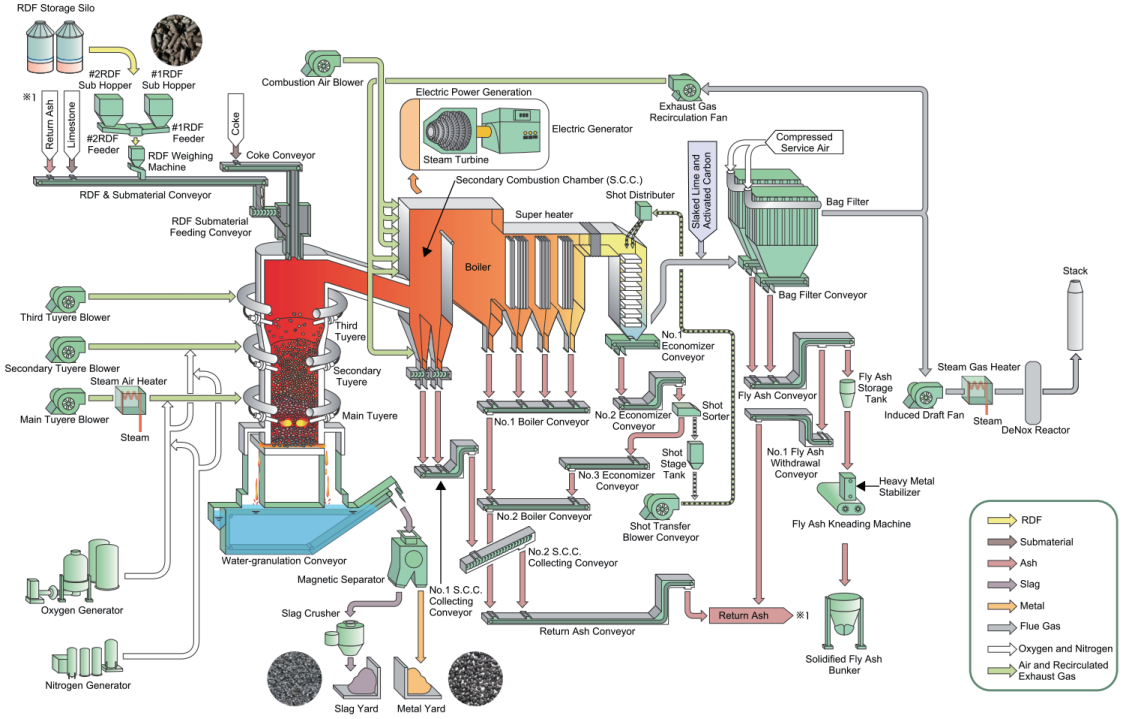

Fig. 1 Process flow of Fukuyama Recycle Power

† Rearranged form *JFE GIHO* No. 25 (Feb. 2010), p. 70–71

single step. Combustibles of wastes are gasified by the high temperature of the furnace. Non-combustibles of wastes are melted and turned into slag and metals which can be reused.

Since a reducing atmosphere is maintained in the interior of the furnace, hazardous heavy metals are vaporized to the gaseous phase and molten ash is converted to safe slag. The molten ash from the furnace bottom is quenched in a water-granulation conveyor to form granulated slag and metals.

Moreover, the working load for discharge of slag and metals is decreased by the adoption of JFE's original molten ash continuous discharge system.

3. Results of Plant Operation

3.1 Characteristics of RDF

The average characteristics of RDF in fiscal year 2009 were nearly equal to the planned ones, even though some fluctuation was observed (**Table 2**).

3.2 State of Operation

3.2.1 Material balance

The plant has been operated without any major trouble for over 6 years. **Table 3** shows the material balance of slag and metals, and also shows their ratio against the annual RDF throughput, 70 753 t, treated in 2009. The slag discharged from the plant is effectively reused as backfilling material for road construction. All the metals produced are also recycled.

3.2.2 Electricity balance and high electrical efficiency

Table 4 shows the electricity balance in 2009. The electric power demand for plant operation is covered by the electricity produced at the generator, and most of the remaining electric power is sold to the grid.

The plant is designed to input high calorific RDF of 18 MJ/kg into the furnace and operate at steam parameters of 60 bar, 450°C, resulting in an electrical efficiency close to 27%.

Table 2 Characteristics of refuse derived fuel (RDF)

	Designed RDF	Result of analysis (Fiscal year 2009)
Lower calorific value (kJ/kg)	18 200	17 520 to 19 280
Water (wt%)	8.0	3.6 to 5.5
Combustible fraction (wt%)	81.4	80.5 to 85.1
Ash (wt%)	10.6	10.6 to 14.6

Table 3 Material balance

	Weight (t/y)	Ratio (wt%)
Total RDF throughput	70 753	100
Slag	7 012	9.9
Metal	439	0.6

RDF: refuse derived fuel

Table 4 Electricity balance

Item	Electric power (MWh/y)
Generated	104 245
Consumed	20 407
Sold	86 387
Purchased	2 549
Electrical efficiency	27%

4. Environmental Standards

4.1 Flue Gas

Table 5 shows the regulatory values (self-restricted) of flue-gas emissions and the analysis values of emissions from the plant in 2009. All the values analyzed are within the regulatory values.

4.2 Slag

Table 6 shows the measurement results of leaching of toxic substances. All the measured leaching amounts of toxic substances are lower than the standard values.

Table 5 Results of emission analysis

(Dry gas at 11% O_2)

Emission	Regulatory value	Analysis value
Dust (mg/m^{3}N)	<11	ND <5.6 (DL)
SOx (mg/m^{3}N)	<63	ND <31.7 (DL)
NOx (mg/m^{3}N)	<114	75.2
HCl (mg/m^{3}N)	<89	46.7
Dioxins (ng-TEQ/m^{3}N)	<0.06	0.0019

ND: Value is below the detection limit (DL).

Table 6 Results of slag measurement

	Leaching amount (mg/*l*)	
	Standard	Measured
Cd	<0.01	<0.001
Pb	<0.01	<0.005
Cr^{6+}	<0.05	<0.02
As	<0.01	<0.005
T-Hg	<0.005	<0.0005
Se	<0.01	<0.002
F	<0.8	<0.08
B	<1.0	<0.01

All of the slag produced by the plant is used.

5. Conclusion

As shown above, the results of plant operation of Fukuyama Recycle Power in 2009 were satisfactory. JFE Engineering is making further efforts to contribute to resources recycling in this field and to achieve lower environmental loads and running costs and higher operational efficiency.

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