About JFE Engineering Corporation

▶ JFE’s WtE Experiences & Track Record

▶ JFE’s Gasifying & Melting Technology
JFE History

1912
NKK Nippon Kokan

1925
Standardkessel GmbH

1935
Baumgarte Boiler Systems GmbH

1951
Kawasaki Steel

2003
JFE Holdings Inc.

2004
Standardkessel Baumgarte Group

2014
JFE Engineering Group
JFE Group Structure

**JFE Holdings**
- Net Sales (billion $): 30
- Employees: 60,400

**JFE Steel**
- Net Sales (billion $): 21,4
- Employees: 44,400

**JFE Shoji Trade**
- Net Sales (billion $): 15,2
- Employees: 6,800

**JFE Engineering**
- Net Sales (billion $): 3,9
- Employees: 9,200

**Standardkessel Baumgarte (JFE Eng. Gr.)**
- Net Sales (million $): 94
- Employees: 230

**Japan Marine United**
- JFE Holdings: 45.93%
- IHI: 45.93%
- Hitachi Zosen: 8.15%

Result in 2016FY
JFE Engineering’s Business Field

- Net Sales (mil USD) 3,870

- Industrial Machinery: 9%
- Steel Structure: 18%
- Environment: 48%
- Energy: 25%

- Images of projects: 2nd Bosporus bridge, Industrial Machinery, Steel Structure, Environment, Energy.
Global Network

Operating in 20 sites in 14 countries, 1,200 members
About JFE Engineering Corporation

JFE’s WtE Experiences & Track Record

JFE’s Gasifying & Melting Technology
GASIFICATION
Gasifying & Melting System

GRATE FIRING
JFE Hyper Grate System

OTHERS
Circulated Fluidized Bed
Bubbling Fluidized Bed
Rotary Kiln
Stoker Kiln etc.
JFE’s WtE Track Record in Japan

EPC

WTE presence in Japan since 1968
171 plants (354 Furnaces)

O&M

Operation 68 Plants
Maintenance 115 Plants

- Gasifying & Melting
- Stoker & others
JFE’s WtE Track Record Overseas

China
- Stoker 500 tpd x 3
- Stoker 400 tpd x 2

Taiwan
- Stoker 300 tpd x 3

Thailand
- Fluidized Bed 110 tpd x 1
- Stoker 70 tpd x 2

Malaysia
- Fluidized Bed 240 tpd x 1
- Rotary Kiln/Stoker 60 tpd x 1

Myanmar
- Stoker 60 tpd x 1

Over 70 References
About JFE Engineering Corporation

JFE’s WtE Experiences & Track Record

JFE’s Gasifying & Melting Technology
Gasification R&D and References

1975-1977
R&D start

1992-1996
Pilot plant construction

2000-2003
First Track Record
(Kagamigahara Plant)

2017
First Overseas Project in Singapore - completion in 2018

11 plants + 1 under construction
(Capacity/line: 18t/d – 314t/d)
Process Flow (Movie)
System Flow Against Incineration

Gasification

- Waste
- Coke & Limestone
- Gasifier

- 900℃
- 1600-1800℃

- Slag
- Metal

- Recycle
- Road Material
- Construction Material

Incineration

- Waste
- Stoker Furnace

- 850℃

- Ash

- Landfill
Principle of Gasifying & Melting

Waste/RDF

Coke
Heat Energy Source

Syn-Gas
3.0–6.0 MJ/m³

Freeboard (Gas Reforming Zone)
800 to 950 degree C

Gasifying Layer (Drying and Gasifying Zone)
550 to 650 degree C

Coke Layer (High-temperature Melting Zone)
1,600 to 2,000 degree C

Oxygen Enriched Air

Melting Ash with Coke

Slag and Metal
Features of JFE Gasification

- Fuel Flexibility
- Low Emission
- Sustainable Technology
- Safe & Easy Operation
JFE Gasification can treat various wastes with wide range of calorific value.

Waste Calorific Value

- Landfilled Waste: 0 MJ/kg
- Sewage Sludge: 5 MJ/kg
- MSW: 14 MJ/kg
- ASR: More than 20 MJ/kg
- RDF: 20 MJ/kg

JFE Gasification can handle a range of wastes with calorific values from 0 to more than 20 MJ/kg.

- Incinerator (air-cooled grate): 5 MJ/kg
- (water-cooled grate): 12 MJ/kg
- More than 20 MJ/kg
## Fuel Flexibility (Hazardous Waste Treatment)

<table>
<thead>
<tr>
<th>Name</th>
<th>Eco-frontier Kasama WTE Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Ibaraki pref., Japan</td>
</tr>
<tr>
<td>Owner</td>
<td>Ibaraki Environment Protection Foundation</td>
</tr>
<tr>
<td>Operator</td>
<td>JFE Environmental Service Co. (Subsidiary of JFE Engineering Co.)</td>
</tr>
<tr>
<td>Start of Operation</td>
<td>Since March 2006</td>
</tr>
<tr>
<td>Capacity</td>
<td>145tpd (72.5tpdx2)</td>
</tr>
<tr>
<td>Feedstock</td>
<td>MSW, Industrial and Hazardous Wastes</td>
</tr>
<tr>
<td>Scope</td>
<td>EPC full turnkey</td>
</tr>
<tr>
<td>Energy</td>
<td>Power Generation: 7.2 MW</td>
</tr>
</tbody>
</table>

### Design Condition of Waste

<table>
<thead>
<tr>
<th></th>
<th>Min. LHV</th>
<th>Ave. LHV</th>
<th>Max. LHV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7,118 kJ/kg</td>
<td>15,491 kJ/kg</td>
<td>19,259 kJ/kg</td>
</tr>
</tbody>
</table>
Treated Wastes in Kasama Plant

Industrial Wastes

Bulky Wastes

Incombustible Wastes

Hospital Wastes
Treated Wastes in Kasama Plant

- Sewage Sludge
- Plastic Film roll
- Asbestos
- Dust (fly ash)
Features of JFE Gasification

- Fuel Flexibility
- Low Emission
- Sustainable Technology
- Safe & Easy Operation
**Very Low DXNs Emission**

- **Gasification**
  - Emission: 0.0001
- **Grate firing**
  - Emission: 0.02
- **EU Regulation**
  - Emission: 0.1

*Average of 10 candidate plants for “WtERT 2006 Award”

**200 times less DXNs** emission is expected for JFE Gasification.
This client has 2 plants with both of technologies below.

<table>
<thead>
<tr>
<th><strong>1st Plant</strong></th>
<th><strong>2nd Plant</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology</strong></td>
<td><strong>Technology</strong></td>
</tr>
<tr>
<td>Grate Firing</td>
<td>Gasification</td>
</tr>
<tr>
<td><strong>Capacity</strong></td>
<td><strong>Capacity</strong></td>
</tr>
<tr>
<td>800t/d (200t/d x 4 lines)</td>
<td>300t/d (150t/d x 2 lines)</td>
</tr>
<tr>
<td><strong>Start of Operation</strong></td>
<td><strong>Start of Operation</strong></td>
</tr>
<tr>
<td><strong>Tech Provider</strong></td>
<td><strong>Tech Provider</strong></td>
</tr>
<tr>
<td>●●●●●</td>
<td>JFE</td>
</tr>
</tbody>
</table>
### Result of the DXNs value in 2016

#### Data of the Incineration (1st Plant)

<table>
<thead>
<tr>
<th>吞入炉</th>
<th>1回目</th>
<th>2回目</th>
<th>3回目</th>
<th>4回目</th>
</tr>
</thead>
<tbody>
<tr>
<td>测定值</td>
<td>0.019</td>
<td>0.017</td>
<td>0.006</td>
<td>0.018</td>
</tr>
</tbody>
</table>

(平成28年8月18日) (平成28年10月13日) (平成28年12月9日) (平成28年9月2日)

#### Data of the Gasification (2nd Plant)

<table>
<thead>
<tr>
<th>排ガス (ng-TEQ/m³N)</th>
<th>1回目</th>
<th>2回目</th>
<th>3回目</th>
<th>4回目</th>
</tr>
</thead>
<tbody>
<tr>
<td>测定值</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>33</td>
<td>0023</td>
<td>89</td>
<td>36</td>
<td></td>
</tr>
</tbody>
</table>

(平成28年6月14日) (平成28年9月26日) (平成28年12月7日) (平成28年9月2日)
Features of JFE Gasification

Fuel Flexibility

Low Emission

Sustainable Technology

Safe & Easy Operation
Sustainable Technology

**Slag Utilization**

- **Waste**
  - 800-950°C
  - 1600-2000°C

- **Gasifier**

- **Slag**

- **Metal**

- **Slag Composition (Sample)**
  - SiO2 36%
  - CaO 33%
  - Al2O3 20%
  - MgO 5%

- **Cement raw material**

- **Road Material**

- **Construction Material**

- **Interlocking and building blocks**

- **Sintered tiles**
Features of JFE Gasification

- Fuel Flexibility
- Low Emission
- Sustainable Technology
- Safe & Easy Operation
Safety & Easy Operation

Negative Pressure Operation

High temperature and negative pressure in free board

No gas leakage

Continuous Slag Discharging

Heat reservoir with special burner

Gas temperature

Operation range

Natural ignition area

Explosion range

Lower limit Line

Upper limit Line

0 % Gas content rate 100 %

850 deg.C

609 deg.C (CO ignition)

571 deg.C (H2 ignition)

Gas temperature

操作范围

自然点火区域

爆炸范围

下限线

上限线

0 % 气体含量 100 %

850 deg.C

609 deg.C (CO 点火)

571 deg.C (H2 点火)
Thank you for your attention!
Reference Sheets
# JFE Gasification Reference Lists

<table>
<thead>
<tr>
<th>#</th>
<th>Municipality / Owner</th>
<th>Capacity</th>
<th>Waste</th>
<th>Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>①</td>
<td>Kagamihara City, Gifu</td>
<td>192 t/d (64 t/d x 3 Lines)</td>
<td>MSW (incl. Bulky Waste)</td>
<td>Mar. 2003</td>
</tr>
<tr>
<td>②</td>
<td>Amagi, Asakura and Mii Association, Fukuoka</td>
<td>120 t/d (60 t/d x 2 Lines)</td>
<td>MSW (incl. Bulky Waste)</td>
<td>Mar. 2003</td>
</tr>
<tr>
<td>③</td>
<td>Hidaka-chubu Association, Hokkaido</td>
<td>38 t/d (19 t/d x 2 Lines)</td>
<td>MSW (incl. Bulky Waste)</td>
<td>Feb. 2003</td>
</tr>
<tr>
<td>⑥</td>
<td>Fukuyama Recycle Power Corp., Hiroshima</td>
<td>314 t/d (314 t/d x 1 Line)</td>
<td>RDF</td>
<td>Feb. 2004</td>
</tr>
<tr>
<td>⑦</td>
<td>Ibaraki Environment Protection Foundation, Ibaraki</td>
<td>145 t/d (72.5 t/d x 2 Lines)</td>
<td>MSW and Industrial Waste (incl. Bottom Ash)</td>
<td>Mar. 2006</td>
</tr>
<tr>
<td>⑧</td>
<td>Aki Area Association, Kochi</td>
<td>80 t/d (40 t/d x 2 Lines)</td>
<td>MSW (incl. Bulky Waste, Excavated Waste)</td>
<td>Mar. 2006</td>
</tr>
<tr>
<td>⑨</td>
<td>Hamada Area Association, Shimane</td>
<td>98 t/d (49 t/d x 2 Lines)</td>
<td>MSW (incl. Bulky Waste)</td>
<td>Nov. 2006</td>
</tr>
<tr>
<td>⑫</td>
<td>R3C Gasification Project, Singapore</td>
<td>18 t/d(18 t/d x 1 Line)</td>
<td>MSW and others, (for R&amp;D purpose)</td>
<td>In 2018</td>
</tr>
</tbody>
</table>
## Reference Plant

### Fukuyama Recycle Power

<table>
<thead>
<tr>
<th>Name</th>
<th>Fukuyama Recycle Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Place</td>
<td>Hiroshima, Japan</td>
</tr>
<tr>
<td>Input</td>
<td>RDF</td>
</tr>
<tr>
<td>Capacity</td>
<td>314t/d x 1</td>
</tr>
<tr>
<td><strong>Power Generation</strong></td>
<td><strong>20MW (31%)</strong></td>
</tr>
<tr>
<td>Completion</td>
<td>2004</td>
</tr>
</tbody>
</table>
### Reference Plant

**Higashi Saitama Plant (Japan)**

<table>
<thead>
<tr>
<th>Name</th>
<th>Higashi Saitama Plant</th>
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</thead>
<tbody>
<tr>
<td>Place</td>
<td>Saitama, Japan</td>
</tr>
<tr>
<td>Input</td>
<td>MSW</td>
</tr>
<tr>
<td>Capacity</td>
<td>297t/d</td>
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<tr>
<td>Power Generation</td>
<td>9.4MW</td>
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<tr>
<td>Completion</td>
<td>2016.3</td>
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