JFE Engineering Corporation

JFE

INTEGRATED SOLID WASTE MANAGEMENT ENGINEERING

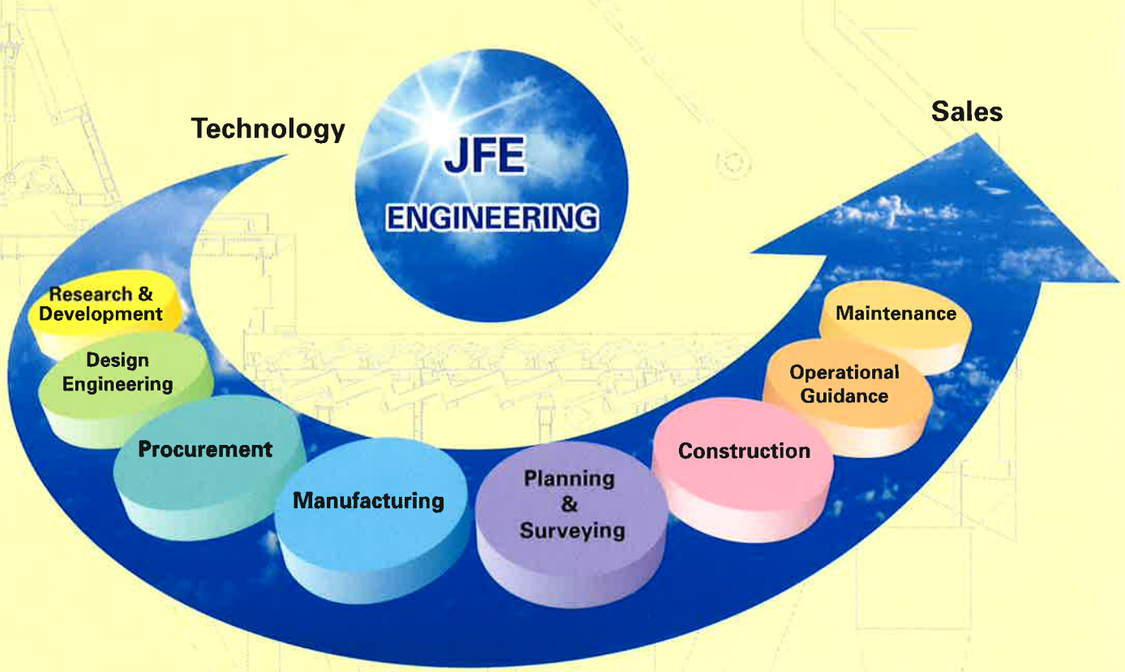
JFE Engineering Corporation has continually strived to improve living standards and act in harmony with nature in its worldwide business activities.

JFE has more than 30 years of experience with waste-to-energy plants, making use of advanced technologies such as flue gas cleaning and purification of waste water to offer advantageous ways to manage of municipal and industrial solid waste.

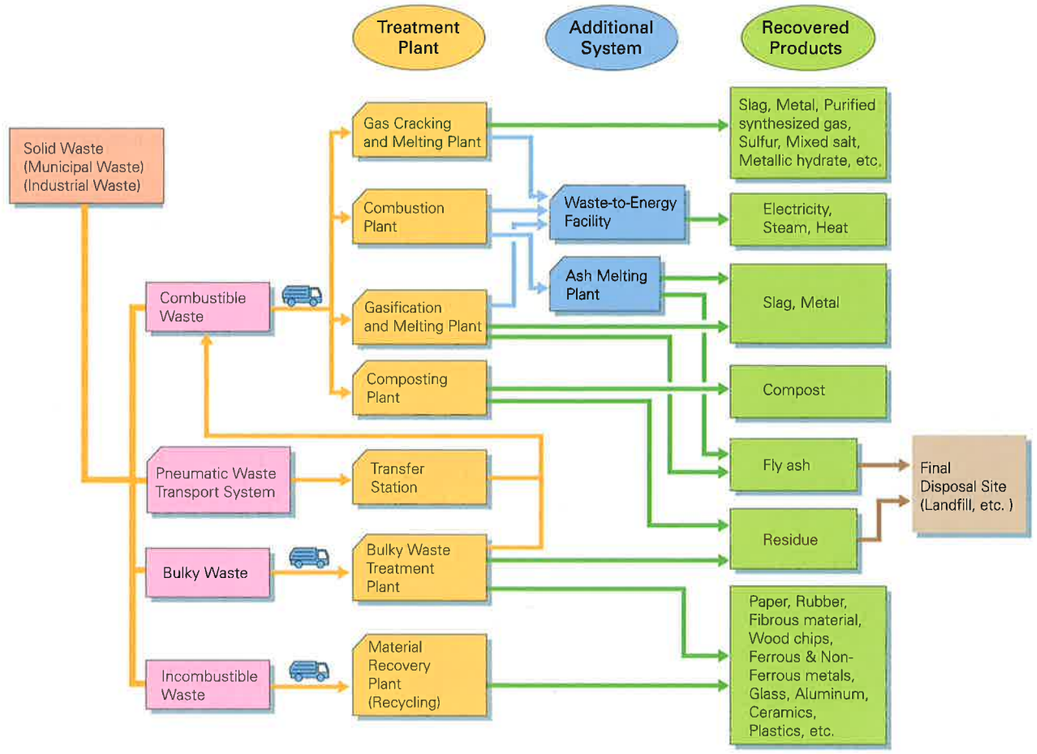
JFE's environmental engineering approach consists of an integrated high quality waste management system based on total waste-to-energy technology; including the waste transport system, and energy / materials recovery and control. In all of these fields, JFE has made unique developments and holds patents backed up by know-how gained over many years of operations with this innovative technology. JFE's business capabilities in environmental engineering extend from research & development to maintenance of waste-to-energy plants built for customers. New developments and their application to specific business fields are aimed at satisfying customers who desire an environmentally friendly society.

To meet the increasing demands of environmentally conscious society, JFE is able to offer its experience and originality as a strong partner able to deliver the best technological and economical solution to your environmental issues.

For responsible management of your environment, think JFE.



General Flow of Solid Waste Management Activities



With its abundant technical experience, JFE is able to design, construct, and operate treatment facilities of all types as an integral part of your solid waste management strategy.
For earth-friendly business opportunities, consult JFE.

CONTENTS

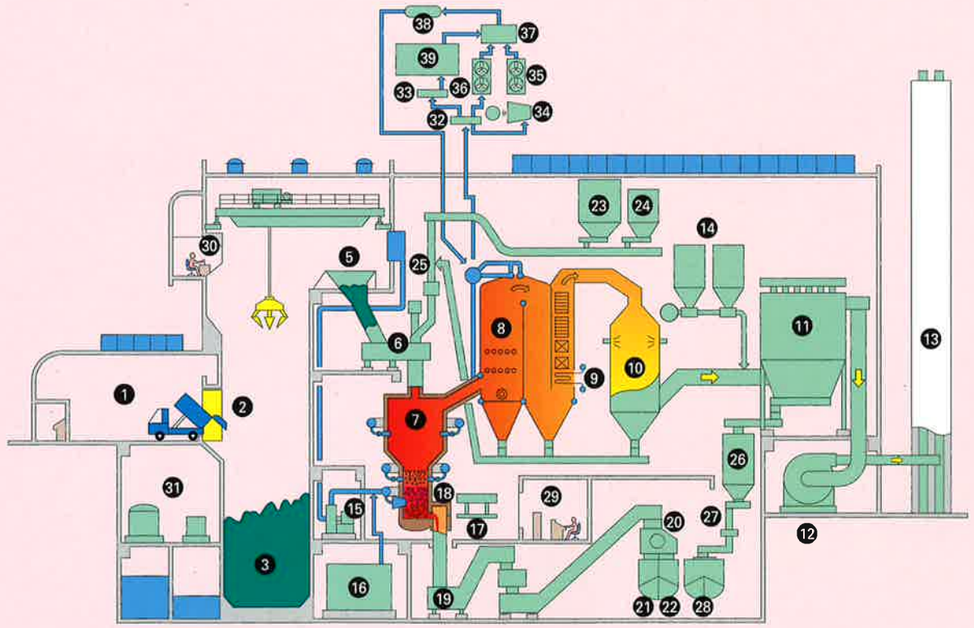
JFE High-Temperature Gasifying and Direct Melting Furnace

To meet the most important objectives of waste disposal, which are to reduce the volume of waste for recycling using a non-polluting process, JFE has developed a Gasification and Melting Furnace.

1. **The furnace handles a broad range of waste types. By excavating waste and ash from existing landfill sites together with the soil cover, and processing the material into recyclable slag using this furnace, the life of final landfill sites can be extended.**
2. **The addition of coke into the furnace results in high-quality slag, which is free from heavy metals. Also, the reducing atmosphere developed at the furnace's high temperature prevents the formation of dioxins.**
3. **Fly ash is the only product requiring final disposal. The addition of coke means that high slag conversion efficiency.**
4. **An innovative continuous tapping system means easier operation than conventional batch systems.**
5. **Melting and gasification take place instantaneously in the compact furnace. Heat generated by the coke contributes greatly to enhance the power generation output.**

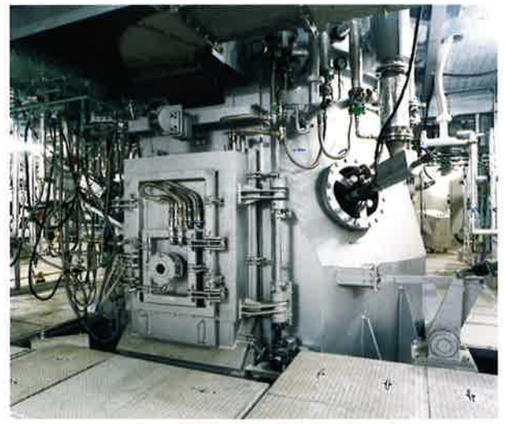
Detail explanation of the melting mechanism;

1. **Waste, coke and limestone are fed from the top of the furnace and go through the Freeboard, Fluidized layer, Coke bed and Molten slag basin.**
2. **At first, the fed waste lands on the Fluidized layer where pyrolysis take place. In this layer, waste is decomposed to combustible gas, fixed carbon and ash.**
3. **The combustible gas flows up to the Freeboard. With the high temperature and reducing atmosphere, dioxins in the gas are cracked and removed. The cracked gas is combusted by the minimum amount of air in the Secondary Combustion Boiler.**
4. **The fixed carbon and the ash drop to the top of the Coke bed layer by gravity The ash starts to melt with heat from the combustion of the fixed carbon and coke. The limestone controls the viscosity and the melting temperature of the molten slag.**
5. **The molten slag flows through the Coke bed. While flowing, the molten slag is mixed and homogenized. After homogenization, the molten slag is discharged from the extracting port located at the bottom of the Molten slag basin.**
6. **A water-granulating conveyor and magnetic separator are prepared for the discharged molten slag. With the quenching and separating, the molten slag is separated into slag and metal, which can be reused in various ways.**



1 Tipping floor
2 Tipping gate
3 Waste pit
4 Crane
5 Hopper
6 Feeder
7 Furnace
8 Secondary combustion boiler
9 Superheater
10 Gas cooling tower
11 Bag filter
12 Induced draft fan
13 Stack
14 Lime and activated carbon silo
15 Forced draft fan
16 Oxygen generator
17 Opening and shutting-off device
18 Continuous tapping hole
19 Water granulating conveyor
20 Magnetic separator
21 Slag bunker
22 Metal bunker
23 Coke bunker
24 Limestone bunker
25 Coke and limestone feeder
26 Fry ash silo
27 Fry ash treatment equipment
28 Fry ash bunker
29 Central control room
30 Waste crane operation room
31 Waste water treatment system
32 High pressure steam header
33 Low pressure steam header
34 Steam turbine generator
35 Low-pressure steam condenser
36 High-pressure steam condenser
37 Condensate tank
38 Deaerator
39 Heat utilization

ECO CENTER BANJYO, Saiki area kouiki waste administration union
55 tons/day×3 furnaces (JFE High-Temperature Gasifying and Direct Melting Furnace). 1,600kW of power generation, completed in 2003.



Furnace

Clean center, Morioka-Shiwa Environmental facility union
80 tons/day×2 furnaces (JFE High-Temperature Gasifying and Direct Melting Furnace). 1,990kW of power generation, completed in 2003.

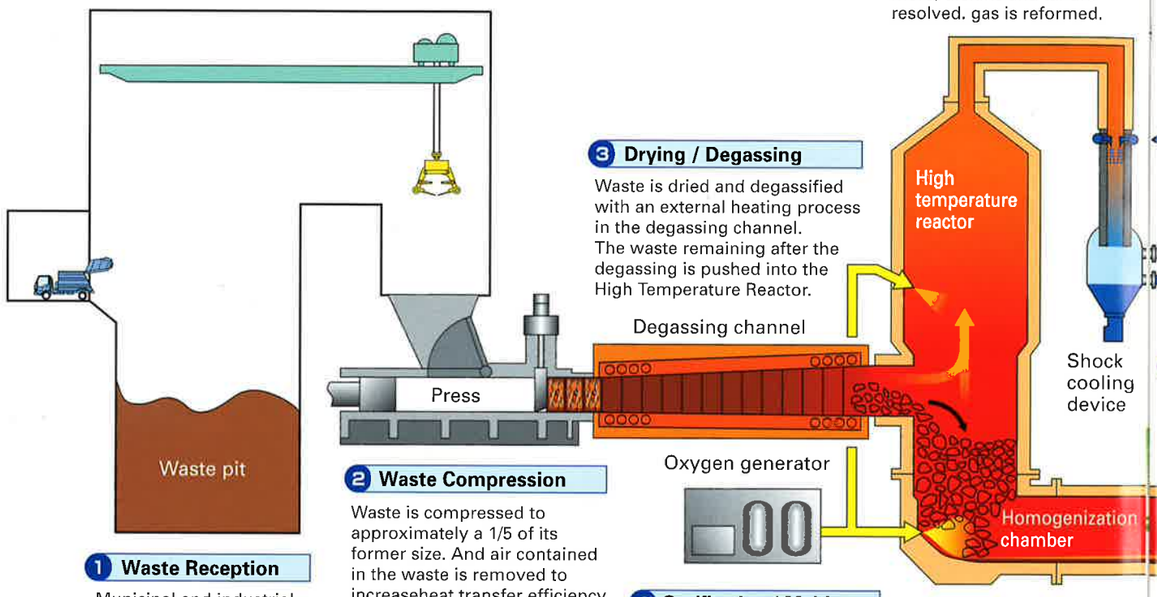
Slag discharge conditions

Hidaka chubu environment center, Hidaka chubu sanitary union.
20 tons/day×2 furnaces (JFE High-Temperature Gasifying and Direct Melting Furnace). With a heat recovery system for the air conditioning of the facility, completed in 2003.

Central control room

JFE Thermoselect System

Link the earth's natural processes, converting waste into energy and new resources.



1 Waste Reception

Municipal and industrial wastes are brought into the pit that is provided with deodorizing devices.

2 Waste Compression

Waste is compressed to approximately a 1/5 of its former size. And air contained in the waste is removed to increaseheat transfer efficiency

3 Drying / Degassing

Waste is dried and degassified with an external heating process in the degassing channel. The waste remaining after the degassing is pushed into the High Temperature Reactor.

4 Gasification / Melting

Highly concentrated oxygen is injected into the reactor. Rubble, metal and other materials are melted by the heat reaction with the oxygen and pyrolysis carbon.

5 Slag / Metal Homogenization

After passing through the homogenization chamber, melted rubble and metal are water-cooled and become metal and slag.

6 Gas Cracking

By maintaining pyrolysis gas at 1200°C for 2 seconds or more, dioxins and tar are resolved. gas is reformed.

7 High-speed Gas Cooling

Gas is cooled from 1200°C to 70°C at high speed, blocking dioxins reformation. It produces no emissions of fly ash.

8 Gas Refining

Recovered gas is desulfurized, dehumidified, and purified into clean fuel gas.

9 Water Treatment

water used in shock cooling is recirculated. Furthermore, excess water is reused after metallic hydrates and mixed salts are removed through a water treatment system.

Central control room

High temperature reactor

Water treatment system

A wide variety of waste products can be 100% recycled and reused.

Purified synthesized gas (700~1,000m³N/ton-waste)* → Electricity generation/ Chemical materials

Sulfur (approximately 0.5kg/ton-waste)* → Sulfuric acid and other materials

Mixed salt (approximately 10kg/ton-waste)* → Soda plant materials

Reused water (600~900kg/ton-waste)* → Factory cooling water, etc.

Metallic hydrate (approximately 4kg/ton-waste)* → Non-ferrous metal materials (Return metal refining)

Metal (1~6kg/ton-waste)* → Metallic materials, Counterweights, etc.

Slag (approximately 60kg/ton-waste)* → Construction materials, etc.

*Quantities are based on municipal solid waste processing

1. Environmental Friendly

Almost zero dioxins emission. Total dioxins formation is reduced to the minimum.

No fly ash is generated from JFE Thermoselect system. Also, dioxins content of the recovered products is kept to very low level.

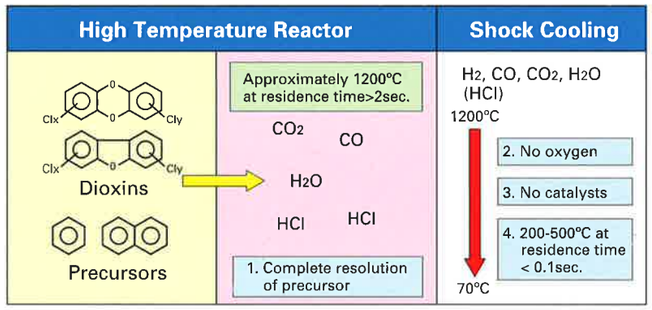
Dioxins content and amount of the recovered products. (Data of the performance test)

Recovered products	Content		Amount (Data of solid is dry base)		Distribution of dioxins μg-TEQ/ton-waste
Purified synthesized gas	0.00039	ng-TEQ/m³N	722	m³N/ton-waste	0.00028
Slag	0.0007	ng-TEQ/kg•DS	62.5	kg/ton-waste	0.00004
Sulfur	0.35	ng-TEQ/kg•DS	0.52	kg/ton-waste	0.00018
Metallic hydrate	0.29	ng-TEQ/kg•DS	0.63	kg/ton-waste	0.00018
Reused Water	0.01	pg-TEQ/ℓ	680	ℓ/ton-waste	0.00001
Total amount of dioxins discharge					0.00069

Note: All of the data in this table are the actual value of the Chiba plant.

Avoiding dioxins reformation through a unique high-speed cooling process.

In eliminating dioxins emissions, there are some points to be considered. First, dioxins must be completely broken down. Second, reformation during the gas cooling and treatment process must be prevented. JFE Thermoselect system applies high temperature for a sufficient period of time inside the reactor to completely break down dioxins and their precursor chemical compounds. Moreover, compared to conventional incineration systems that comply with regulatory values by eliminating dioxins reformed during the gas cooling process through an exhaust gas device, JFE Thermoselect system blocks recomposition through a unique high-speed cooling process called Shock Cooling.



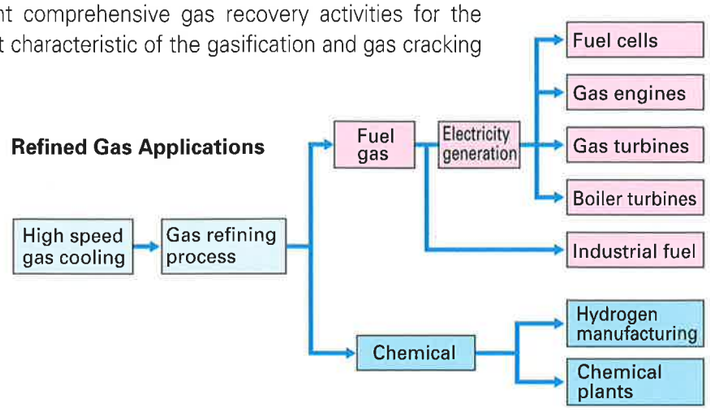
2. Power generation

Purified and synthesized gas electricity generation system for the 21st century.

The clean, high-calorie gas recovered by Thermoselect system can be efficiently used to generate electricity. By combining Thermoselect system with an electricity generation system, it is possible to obtain clean heating and electricity and to implement comprehensive gas recovery activities for the community. This is precisely an important characteristic of the gasification and gas cracking system.


Gas engine electricity generation system

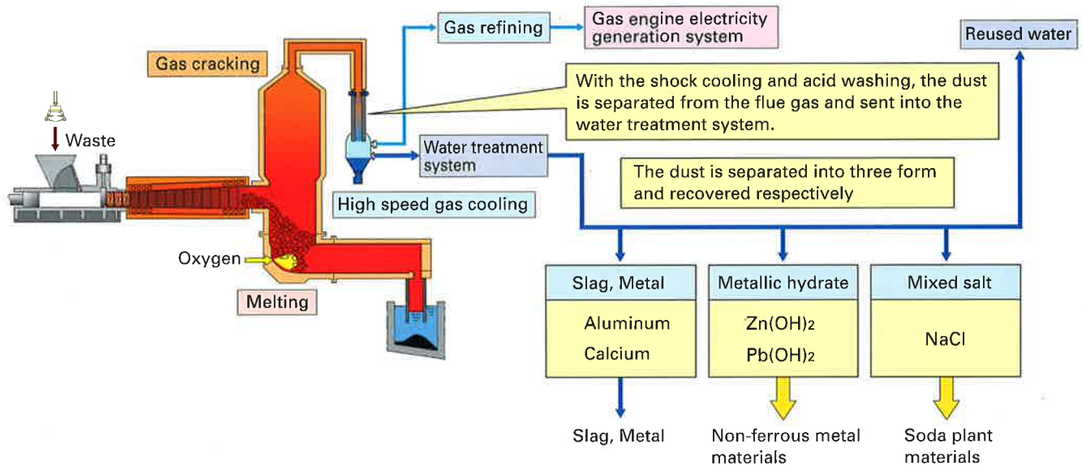
Refined Gas Applications



3. Minimized lifecycle cost

No fly ash, No need of a landfill.

The pyrolysis gas after the cracking process is cooled and washed. So, all of the dust (including particles, salts, heavy metals, chlorides and others) is sent to the water treatment system. The system recovers all of the dust in three forms. Thus, JFE Thermoselect needs no construction and operation fee of a landfill. It results in minimizing the lifecycle cost of waste disposal.



Reference Plants

Plants for municipal solid waste

Client	Total capacity	Configuration	Date of completion	Location
Kenou Kennan kouiki Environment union	300 tons/day	100 tons/day, 3units	March, 2005	Isahaya city Nagasaki prefecture, Japan
Chuou kouiki Environment facility union	120 tons/day	60 tons/day, 2units	March, 2005	Yoshino-cho Itano-gun Tokushima prefecture, Japan

Plants on Private Finance Initiative (PFI) projects

Mizushima Eco-works corporation (Enterprise for operation and maintenance of facility for the Recycle based society in Kurashiki city)	555 tons/day	185 tons/day, 3units	March, 2005	Kurashiki city Okayama prefecture, Japan
Yorii ORIX environment corporation (Enterprise for founding the facility of resource recycle in Sai no Kuni (Saitama Prefecture)	450 tons/day	225 tons/day, 2units	March, 2005	Yorii-cho Osato-gun Saitama prefecture, Japan

A plant for Industrial Solid Waste (ISW) or Plastics waste due to "Containers and packaging recycling law in Japan"

Japan recycle cooperation (An Enterprise for the gasification and recycling of wastes)	300 tons/day	150 tons/day, 2units	Sep, 1999	Chiba city Chiba prefecture, Japan (Located in the area of East works in JFE Steel corp.)


Kenou Kennan kouiki Environment union


Chuou kouiki Environment facility union


Mizushima Eco-works corporation


Yorii ORIX environment corporation

JFE Hyper 21 Stoker System *(Stoker System of Next Generation)*

Concept

Major System components

1. JFE two-way gas flow furnace
2. JFE hybrid ACC
3. JFE water-cooled HYPER grate
4. High temperature air injection
5. Flue gas recirculation
6. Integrated ash treatment system

Features

1 Stable high temperature combustion zone
- Uses the re-circulated flue gas and a high temperature air as secondary air.
- Enables lower air ratio (1.3~1.5) → Decreases the amount of the flue gas.
- Homogenized temperature in the furnace → Stable and optimum combustion.

2 Decrease of heat loss
- Sending ash directly from furnace to the ash treatment system.
- Heat recovery from ash treatment system.

3 Applicable to wide variety of wastes
- Cope to the change of waste character.

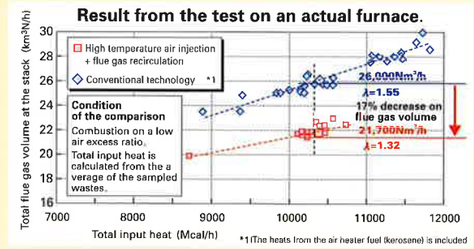
4 Easy application to the existing stoker furnace
- Because it is base on stoker system, each components of new generation technology can be easily adopted to existing plants separately.

5 Selective application of ash melting and thermal treatment (not melting)
- Ash treatment method can be chosen based on the way of utilization.

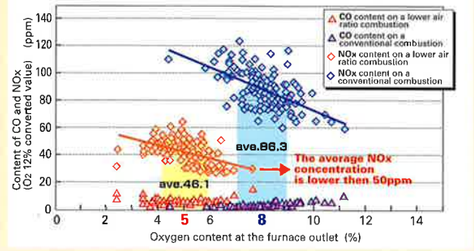
Reduce dioxins and can chose the ash melting system by its use.

1. Reduction of amount of flue gas
2. Reduction of amount of NOx
3. Reduction of operation cost
4. Increase of surplus electric power (for sale).
5. Reduction Dioxins
6. Reduction of load on landfill

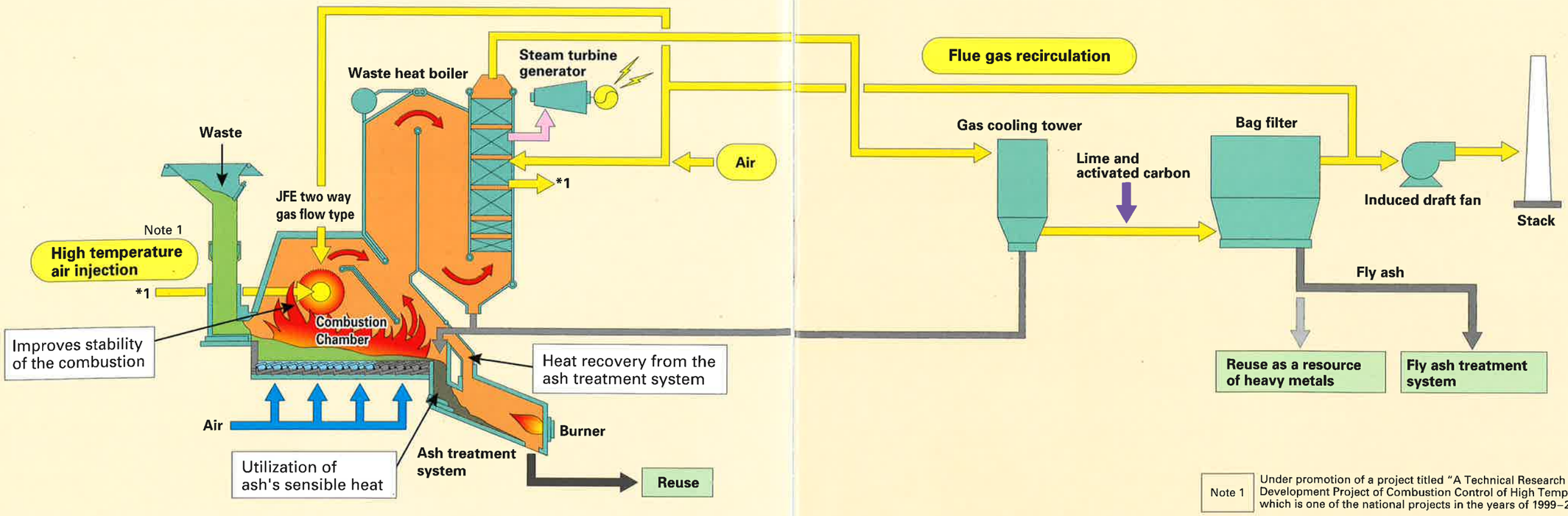
Result from the test on an actual furnace.



Flue gas content data on an actual furnace test.



System flow

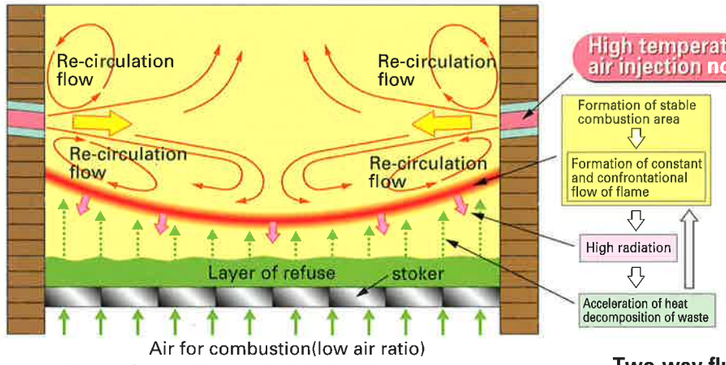


Note 1 Under promotion of a project titled "A Technical Research and Development Project of Combustion Control of High Temperature Air" which is one of the national projects in the years of 1999–2001

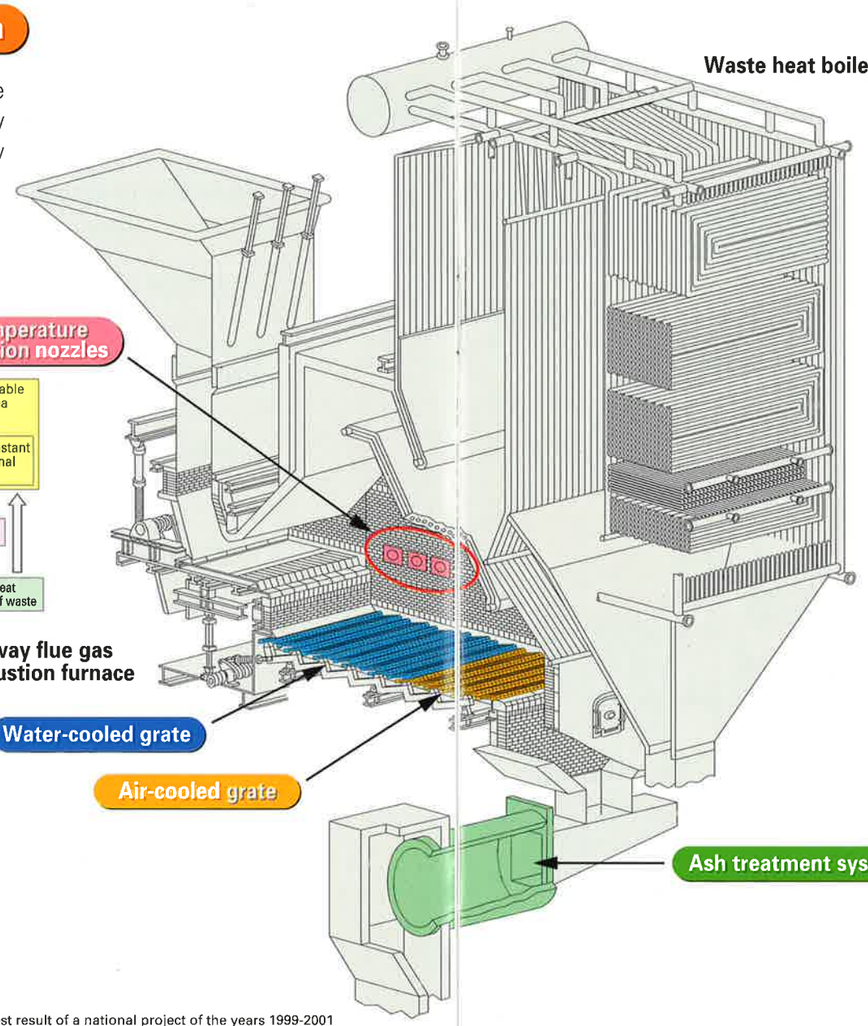
Combustion Technology of High Temperature Air injection

By blowing-in the high temperature air, the stabilized formation of flame can be effectively maintained on the upper layer of waste, by even in low air ratio. And the ideal combustion can be obtained with a low concentration of CO.

Combustion stability is essentially improved at the combustion starting zone.

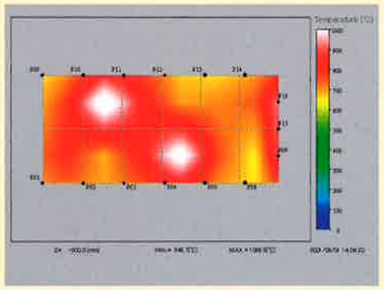


Flame formation around high temperature air injection nozzles (sketch of concept)



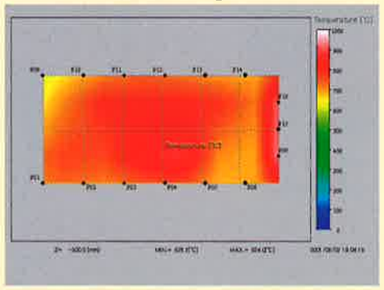
Horizontal temperature distribution in furnace ※ (a case of air ratio 1.3)

Air ratio λ=1.3 No high temperature air is supplied.



●Unevenness of temperature and spotty high temperature emerge.

Air ratio λ=1.3, High temperature air is supplied /Exhaust gas is recirculated



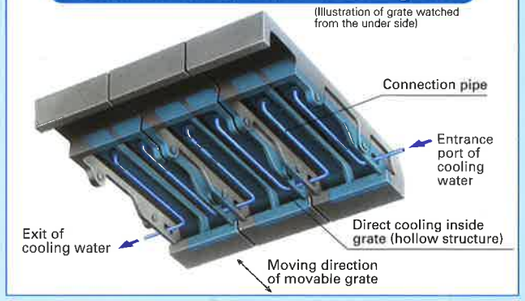
●Stable and high temperature combustion occurs.

※Test result of a national project of the years 1999-2001 "The technical research and development project for control of combustion of high temperature air"

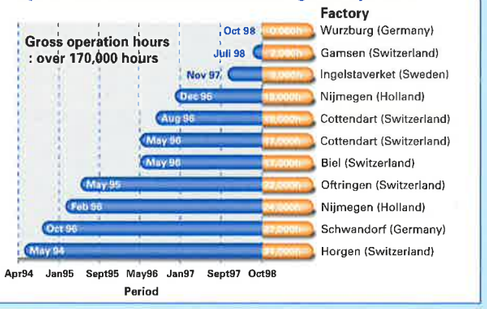
Water-cooled HYPER grate

JFE has realized a long life of grate by high cooling performance with thermally and environmentally high efficiency, taking a measure to combine HYPER grate developed by JFE itself with water-cooled grate technology of German firm, Noell (present BBPE).

Outline form of water-cooled grate

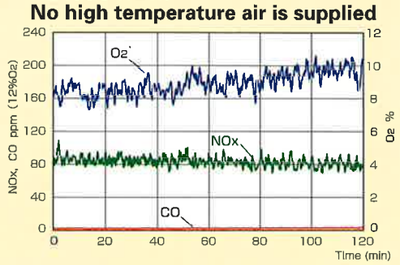


Operation result of water-cooled grate by Noell



The trend of data on the exhaust gas at the furnace outlet※

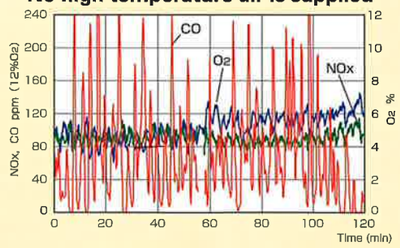
Air ratio λ=1.7 No high temperature air is supplied



A conventional stoker furnace

Conventions of exhaust gas ingredient are stable

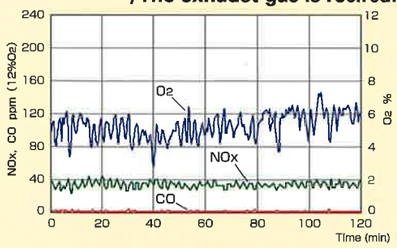
Air ratio λ=1.3 No high temperature air is supplied



Low air ratio operation on a conventional stoker furnace

Heavy fluctuation of CO and NOx, and the volume of their emission increases
⇩
Unstable combustion

Air ratio λ=1.3 High temperature air is supplied /The exhaust gas is recirculated



JFE HYPER 21 STOKER SYSTEM

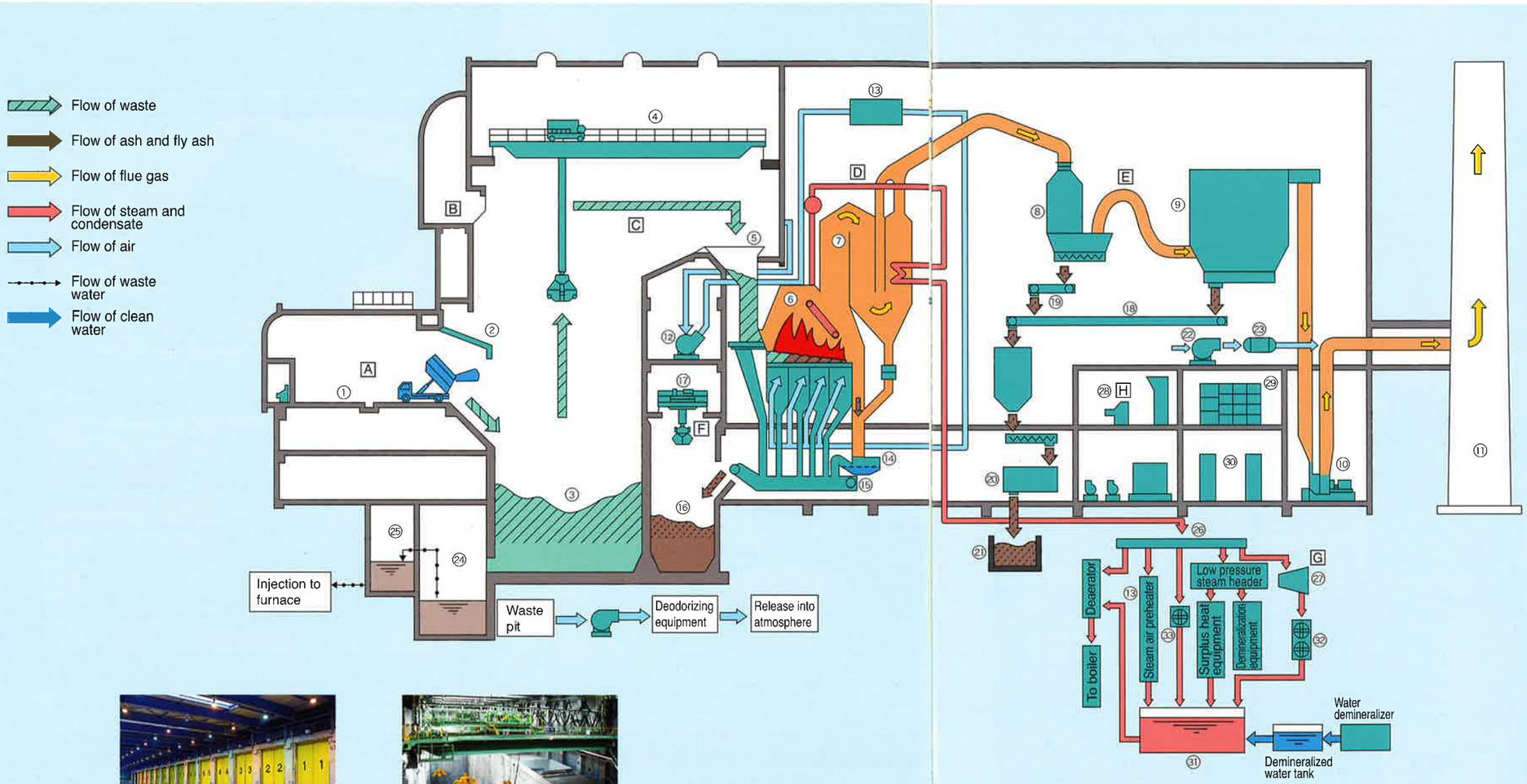
Concentrations of exhaust gas ingredient are stable, and concentration of CO is very small
⇩
Achievement of stable combustion

JFE Hyper Grate System

JFE offers a state-of-the-art solid waste combustion system with maximum utilization of waste heat. This technology is backed by our long experience in delivering over 80 plants.

JFE's design puts emphasis on;

1. **Complete combustion of a wide range of waste.**
2. **Minimum environmental impact through effective removal of harmful substances from effluent.**
3. **Easy operation using various automatic control systems, including the JFE-ACC system.**
4. **Easy, low-cost maintenance due to simple structure and tough equipment.**



① Platform (Tipping floor)
② Waste dump gate
③ Waste pit
④ Traveling waste crane
⑤ Hopper
⑥ Furnace
⑦ Waste heat boiler
⑧ Gas cooling tower
⑨ Bag filter
⑩ Induced draft fan
⑪ Stack
⑫ Forced draft fan for combustion air
⑬ Steam air preheater
⑭ Ash pusher
⑮ Ash conveyor
⑯ Ash pit
⑰ Ash crane
⑱ Fly ash conveyor
⑲ Fly ash conveyor below scrubber
⑳ Fly ash treatment equipment
㉑ Fly ash pit
㉒ Fan for prevention of white vapor emission
㉓ Steam air heater
㉔ Waste water tank
㉕ Waste water storage tank
㉖ High-pressure steam header
㉗ Steam turbine generator
㉘ Central control room
㉙ Computer room
㉚ Switch gear room
㉛ Condensate tank
㉜ Low-pressure steam condenser
㉝ High-pressure steam condenser


A Platform


C Waste pit/waste hopper


B Waste crane operation room


D Boiler


E Flue gas treatment system


F Ash crane


G Steam turbine generator room


H Central control room

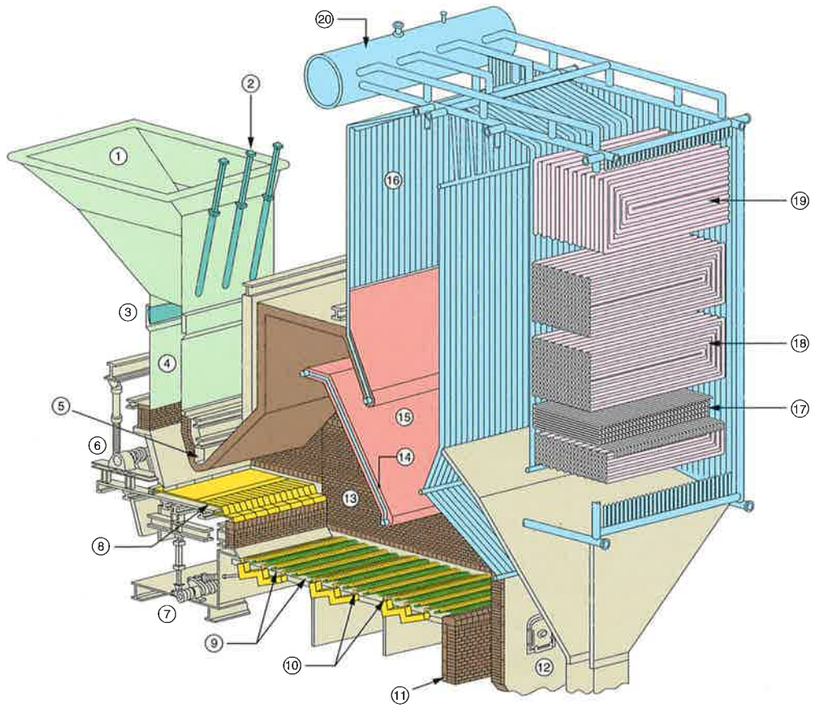
JFE Hyper Grate System

JFE has developed a new grate system based on a completely original concept which ensures stable and uniform combustion while achieving complete combustion for a wide range of waste.
The Hyper Grate system consists of movable and fixed grates. Each grate slopes 20 degrees upward in the direction of waste flow. Movable grates slide upward over fixed grates. The Hyper Grate system controls movement of the waste through the furnace by adjustment of stroke and speed of the movable grates and, at the same time, promotes combustion by effective mixing of the waste with combustion air. This allows combustion air to pass through the waste evenly, thereby maintaining satisfactory and efficient burning. An air injection port in the front edge of each grate introduces air at high velocity to enhance the uniform combustion.

The JFE Hyper Grate system offers the following features:

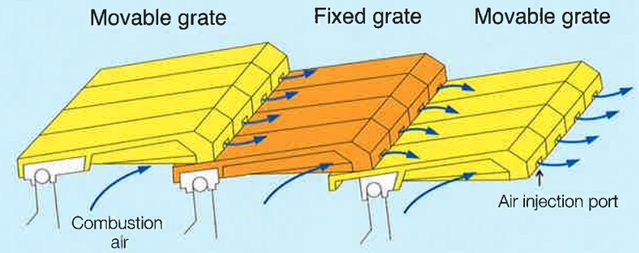
1. **Wide application**
2. **Excellent and stable combustion**
3. **High-quality, low volume ash due to high combustion efficiency and reduced shifting of waste**
4. **Compact furnace due to horizontal grate structure**
5. **No grate fouling by molten aluminum waste**

JFE Two Way Gas Flow Type furnace with Hyper Grate *(Horizontal Grate System)*

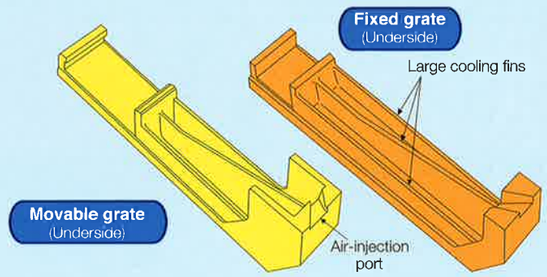


① Hopper	⑧ Waste feeder	⑮ Gas mixing chamber
② Bridge removing equipment	⑨ Fixed grate	⑯ Radiant heat exchange tubes
③ Hopper gate	⑩ Movable grate	⑰ Superheater
④ Chute	⑪ Ash discharge port	⑱ Contact heat exchange tubes (horizontal evaporation tubes)
⑤ Cooling-air	⑫ Access manhole	⑲ Economizer
⑥ Hydraulic drive system for waste feeder	⑬ Furnace(Combustion chamber)	⑳ Boiler drum
⑦ Hydraulic drive system for movable grates	⑭ Intermediate ceiling	

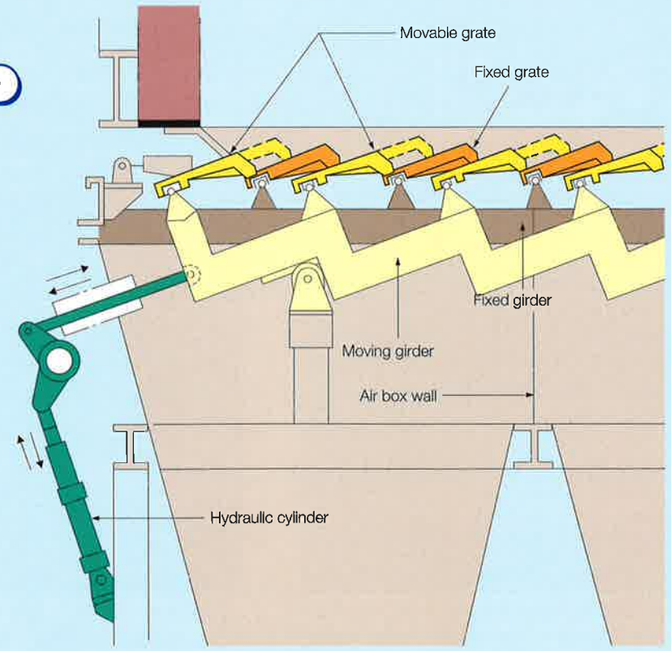
Grate system design



Grate design

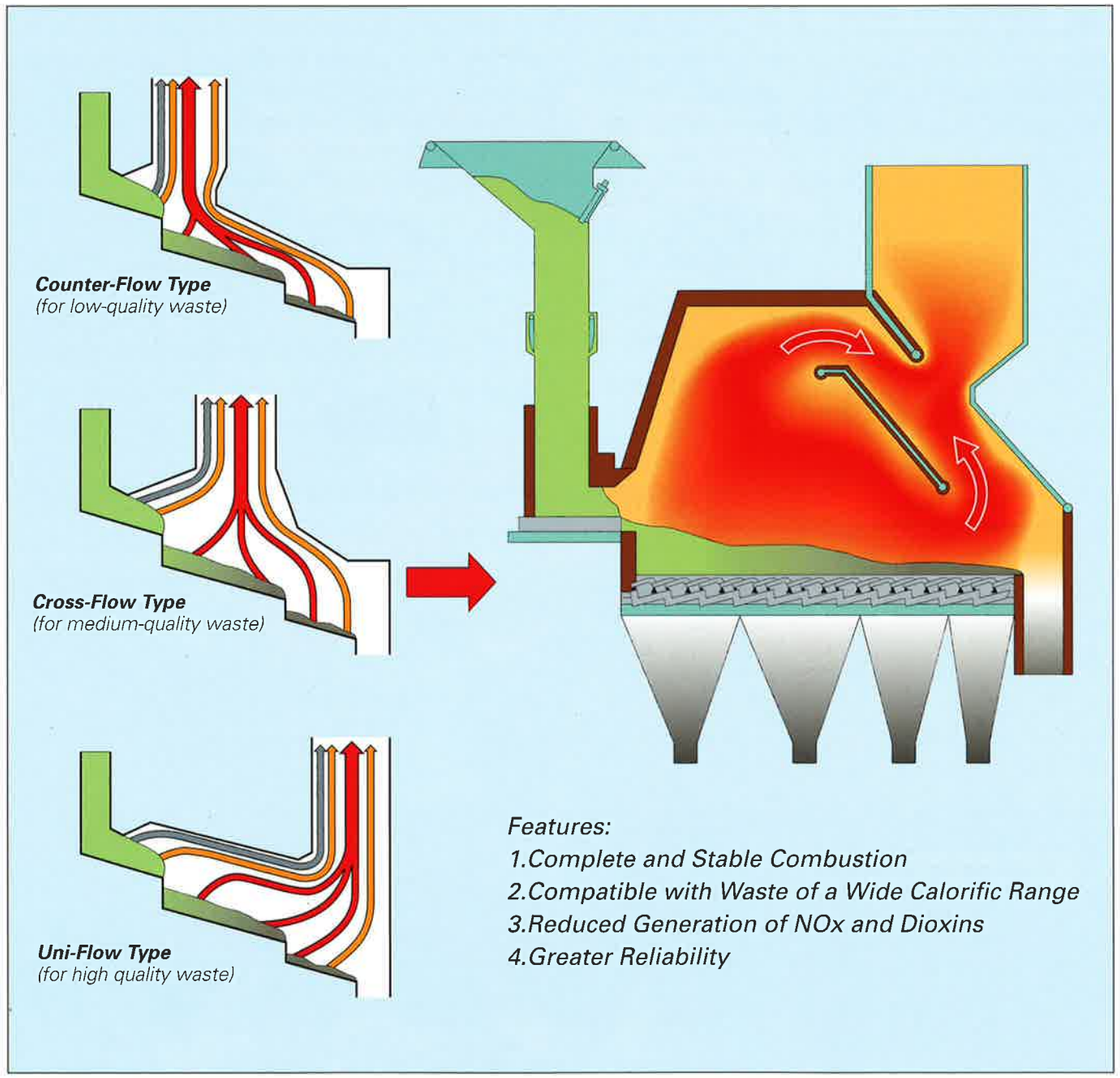


Grate system structure



JFE Two-Way Flue Gas Combustion System

A Unique System in waste Combustion Technology



Combustion Chamber

If priority is given to combustion of low calorific value waste (approx. 4,200kJ/kg), the Counter-flow type is suitable due to its waste drying ability. For optimum combustion of high calorific value waste (approx. 12,600kJ/kg), the Uni-flow type is preferable. The Cross-flow type is a combination of the former two and suits middle calorific value waste (approx. 8,400kJ/kg). JFE's Two-Way Flue Gas Combustion System combines these three features. With a water-cooled intermediate ceiling in the furnace, the combustion gas is directed in two directions to collide with each other. It promotes gas mixing and results in perfect combustion with low excess air. Also, with the help of JFE-ACC (Automatic Combustion Control), this contributes significantly to reduction of NOx and dioxins emissions. With these features, the gas at the furnace outlet has uniform composition and temperature. Also, a minimum of unconsumed combustible components remains in the residue.

Reference Plants

Taichung Municipal Waste Incineration Plant. Republic of China
300 tons/day×3 furnaces (JFE-VØLUND Grate).
14,500kW of power generation,
completed in 1995.

Tobu Clean Center, Tokorozawa city
115 tons/day×2 furnaces (JFE Hyper Grate),
2,500kW of power generation,
completed in 2003.

Kasugai Clean Center, Kasugai city
140 tons/day×2 furnaces(JFE Hyper Grate),
7,000kW of power generation, with 40 tons/day Ash Melting Furnace(bottom ash and fly ash), completed in 2002.

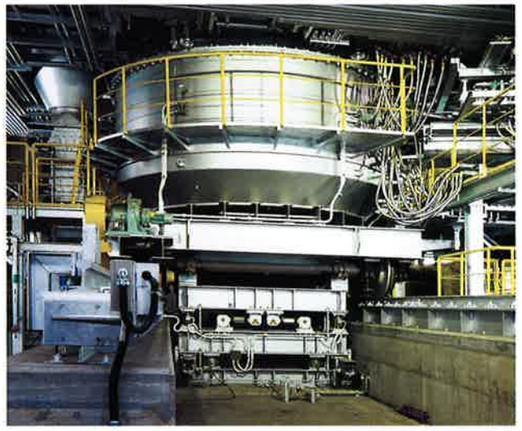
Hachiouji Tobuki Refuse Disposal Center. Metro. Tokyo
100 tons/day×3 furnaces (JFE Hyper Grate),
1,990kW of power generation, with 36 tons/day Ash Melting Furnace(bottom ash), completed in 1998.

Hirano Incineration Plant, Osaka city
450 tons/day×2 furnaces(JFE Hyper Grate),
27,400kW of power generation,
completed in 2003.

Kanazawa Refuse Incineration Plant. Yokohama
400 tons/day×3 furnaces (JFE-VØLUND Grate).
35,000kW of power generation, with 60tons/day Ash Melting Furnace(bottom ash), completed in 2001.

JFE Ash Melting System *(Electric Resistance Type)*

With an ever increasing amount of ash being generated, its disposal has become a major problem. It is getting difficult to find new landfill sites, and pollution can be caused by leachates from dumped ash. In an attempt to solve this problem, JFE has developed this ash melting system which relies on electrical resistance heating. It reduces the volume of ash to about one third, and turns it into a pollution-free molten slag plus metal which can be used as construction material, etc.

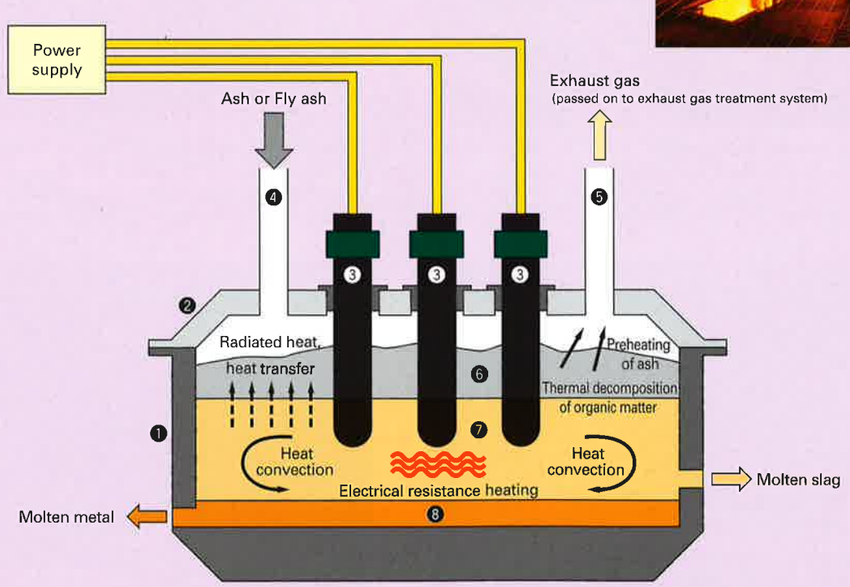


Furnace

JFE Ash Melting System (Electric Resistance Type) has the following features:

1. **Simple heating method gives complete melting of ash and offers stable operation.**
2. **High electrical and thermal efficiency reduces electricity consumption.**
3. **Electrode consumption is minimized by the adoption of a reducing atomospher.**
4. **Use of head pressure for extracting slag and no need for melting flux.**
5. **Furnace structure allows slag to be continuously discharged since metal is separated by specific gravity. The life of furnace refractories and the extracting sections is also prolonged.**
6. **Slag is uniform in quality and contains no metals, so it suits many applications.**

Slag discharge conditions



1 Furnace casing
2 Furnace cover
3 Electrode
4 Ash charging chute
5 Exhaust gas outlet
6 Combustion ash layer
7 Molten slag layer
8 Molten metal layer

JFE Ash Melting System *(Plasma Type)*

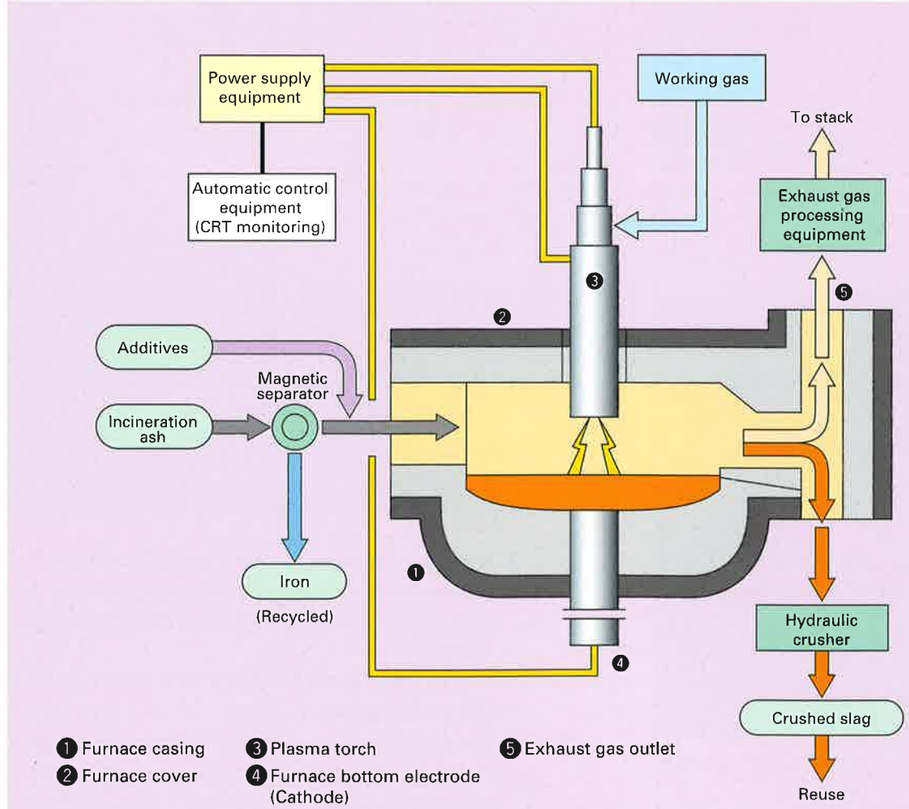
JFE also prepares Plasma Type Ash Melting Furnace. The temperature of the plasma surface is up to 3,000°C Celsius. With this high temperature, the furnace can promote soloalkaline fly ash melting, industrial waste ash melting and contagious medical waste melting. The volume of ash is reduced to one third.

Furnace

JFE Ash Melting System (Plasma Type) has the following features:

1. **High temperature of the furnace enables to treat wide variety of ashes and wastes.**
2. **The lifetime of an electrode is more than 800 hours.**
3. **Not like fuel type ash melting system, the system generates small amount of exhaust gas.**
4. **The generated slag is stable and harmless substance. It can be used as variety of applications such as building materials.**

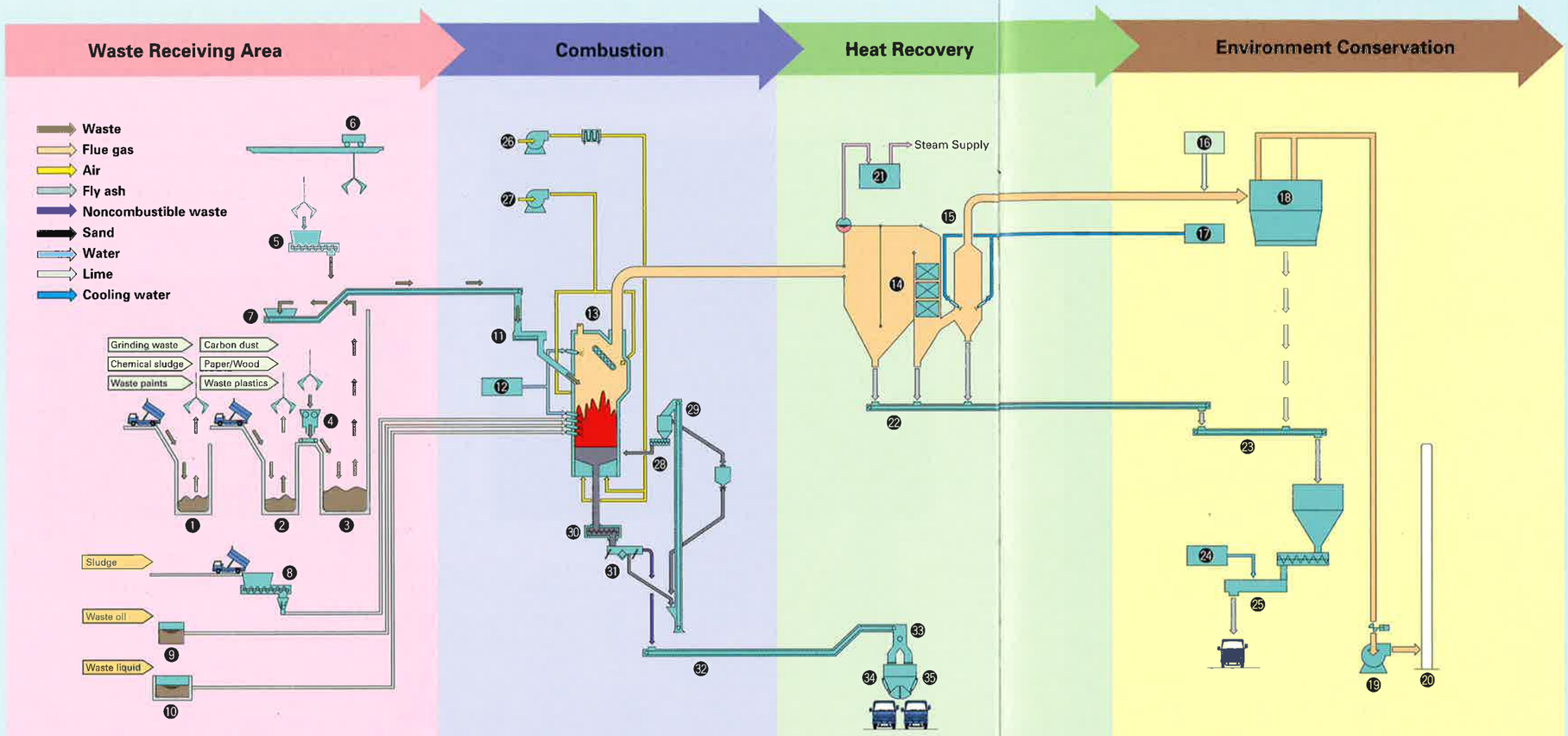
In-furnace conditions



1 Furnace casing
2 Furnace cover
3 Plasma torch
4 Furnace bottom electrode (Cathode)
5 Exhaust gas outlet

Fluidized Bed Furnace

Typical Flow of Fluidized Bed Combustion System



1. Waste paint pit
2. Bulky waste pit
3. Shredded waste pit
4. Shredder
5. Charging hopper
6. Traveling waste crane
7. Waste supply conveyor
8. Sludge receiving hopper
9. Waste oil storage tank
10. Waste liquid storage tank
11. Feeder
12. Water pump
13. Fluidized bed furnace
14. Waste heat boiler
15. Gas cooling tower
16. Lime and activated carbon
17. Water pump
18. Bag filter
19. Induced draft fan
20. Stack
21. Steam storage
22. No.1 Fly ash conveyor
23. No.2 Fly ash conveyor
24. Water pump
25. Fly ash treatment equipment
26. Forced draft fan
27. Secondary air fan
28. Sand supplier
29. Sand recirculation conveyor
30. Incombustibles discharge conveyor
31. Vibrating screen
32. Incombustibles conveyor
33. Magnetic separator
34. Metal storage bunker
35. Incombustible waste bunker

The JFE Fluidized Bed Waste Combustion System also offers the following advantages:

1. Feeder system capable of handing bulky waste
The dual-pusher feeder, which incorporates a dispersion mechanism, allows the passage of bulky waste with ease.

2. Two way gas flow
The design promotes complete combustion of flue gases and minimizes the emission of nitrogen oxides.

3. JFE air dispersion system
The air dispersion system, which has no projecting parts, generates clean vortex flows of sand to uniformly distribute waste in the furnace and force out noncombustibles.

4. Simplified pretreatment
The waste bag breaker consumes little power and can handle a variety of waste types.

5. Discharge of bulky non-combustibles
The clog-free discharge port for bulky non-combustible items operates with a large screw conveyor.

Genting Sanyen Industrial Paper SDN BHD,
The model project for waste treatment of paper sludge and utilization of waste heat from combustion of paper sludge in Malaysia.
237.7 tons/day × 1 furnace,
17.3 tons/h saturated steam generation at 2.25MPa,
completed in 2003.

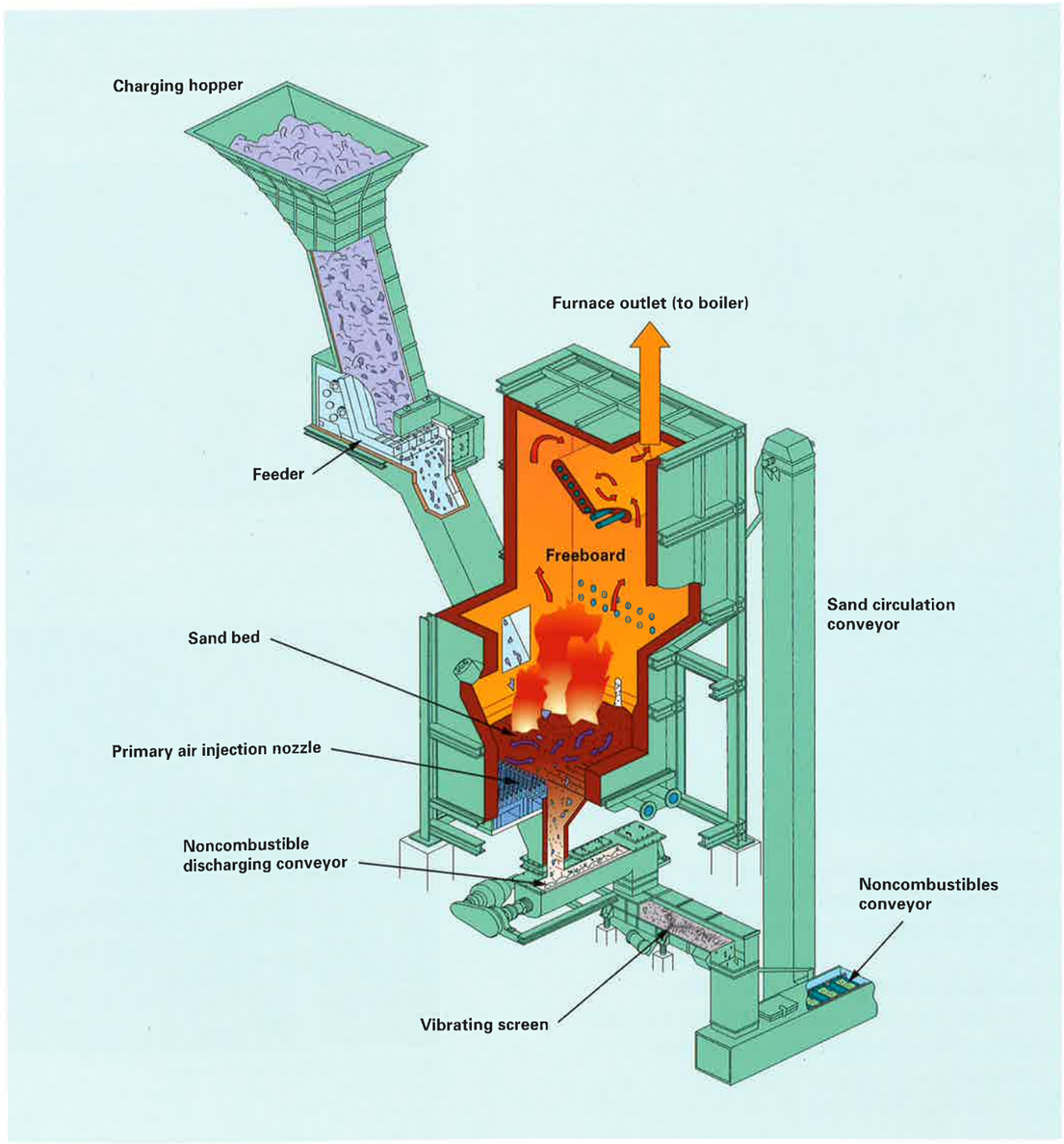
Hamura Clean Center
60 tons/day × 1 furnace, for general industrial waste, plastics and paint, and sludge, etc.,
completed in 1992.

Motomachi Environment Center
160 tons/day × 1 furnace, for general industrial waste, plastics, vinyl, rubber, sludge, waste/chemical oil, paper, etc., completed in 1997.

Besides conventional stoker and rotary kiln furnaces, JFE has developed fluidized bed combustion technology to meet a wide range of waste disposal requirements, from plastic waste and waste oil of high calorific value to low-calorie sewage sludge, it allows the co-combustion of MSW(Munincipal Solid Waste) and sewage sludge in one furnace, resulting in less investment by clients. A fluidized bed furnace also offers the following advantages;

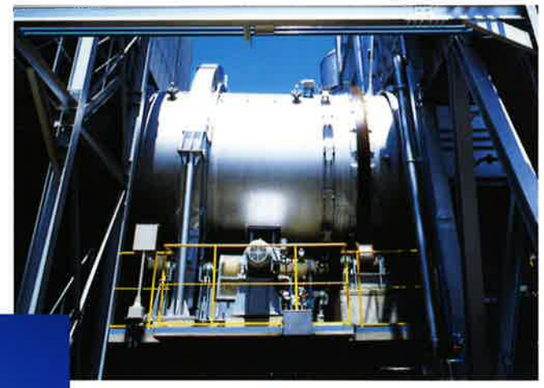
1. **Easy start up and shut down due to the good heat retention of the sand bed after use. The system is suitable for plants with semi-continuous operation for less than 24 hours a day.**
2. **Flexibility to co-combust a wide range of fuels including RDF(Refuse Derived Fuel)**
3. **Improved ash burnout and handling**
4. **Easy operation and maintenance, since the furnace has no moving parts**

Fluidized Bed Waste Combustion System



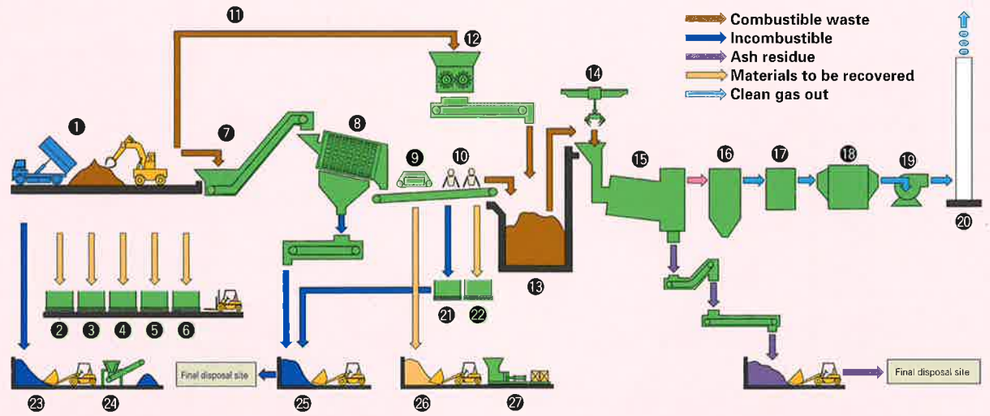
Rotary Kiln Furnace

The Rotary Kiln Waste Combustion System Is commonly used for industrial waste disposal because it can handle a range of waste types including plastics, metal, wood, glass, and ceramics. The system is particularly useful for disposing of construction waste when coupled with waste sorting and recovery systems. Further, it is easily operated and maintained as a result of its simple mechanical structure.



Funabashi Clean Center, Kanematsu, Chiba
75 tons/day × 2 furnace units for construction waste including waste plastics and wood, etc., completed in 1994.

Typical Flow of Rotary Kiln Combustion System (Industrial solid waste)



1. Receiving yard
2. Corrugated cardboard
3. PVC (Poly vinyl Chloride)
4. Electric cable
5. Aluminum
6. Ferrous metals
7. Receiving conveyor
8. Trommel
9. Magnetic separator
10. Manual sorting
11. Large-size combustibles
12. Crusher
13. Combustible pit
14. Traveling waste crane
15. Rotary kiln furnace
16. Gas cooler
17. JFE-LIMAR (Dry type)
18. Bag filter
19. Induced draft fan
20. Stack
21. Incombustibles
22. Materials to be recovered
23. Concrete
24. Concrete crusher
25. Residue
26. Ferrous scraps yard
27. Press

JFE Flue Gas Treatment System JFE-LIMAR and Wet System

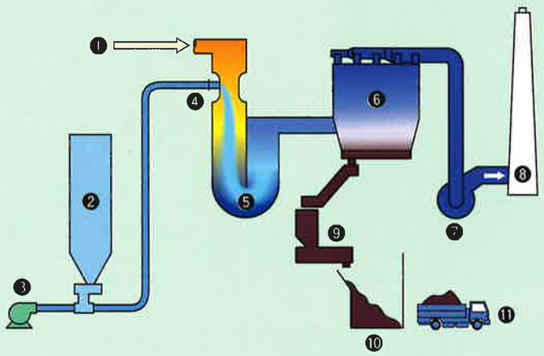
Flue gas treatment systems are becoming more and more important every year, as environmental and health concerns increase worldwide. Backed up by many years of experience in the design and delivery of various systems, JFE can tailor a design to given conditions and deliver a system optimized for the client's requirements.

1. JFE-LIMAR (Dry & Semi-Dry Types)

JFE-LIMAR is a system for efficiently removing acid gases such as HCl and SOx from flue gas, It has a number of special features:

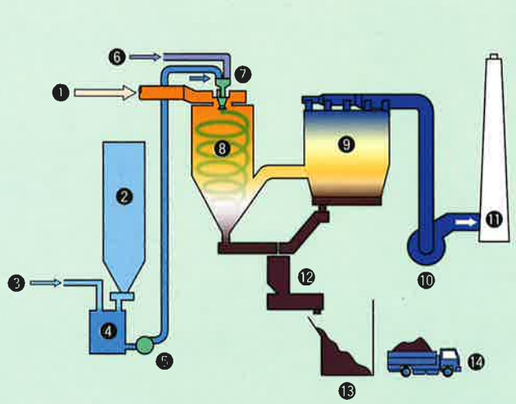
1. **High ratio of acid component removal and good mechanical reliability**
2. **Low installation cost, easy maintenance, and low operational cost**
3. **Does not require a waste water treatment facility**

System Flow (Dry Type)

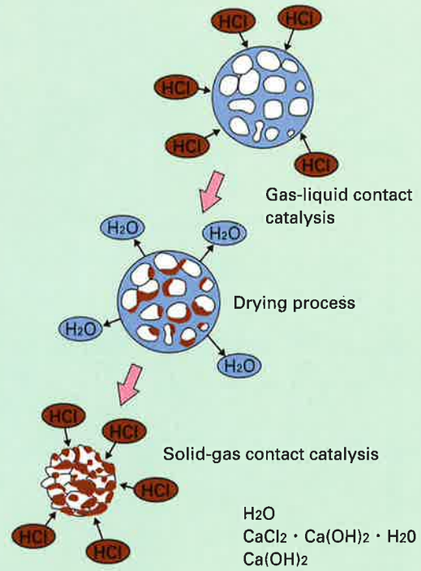


1. Flue gas from furnace
2. Lime storage silo
3. Blower
4. Injection nozzle
5. Flue gas chamber
6. Bag filter
7. Induced draft fan
8. Stack
9. Fly ash treatment equipment
10. Fly ash pit
11. To landfill

System Flow (Semi-Dry Type)

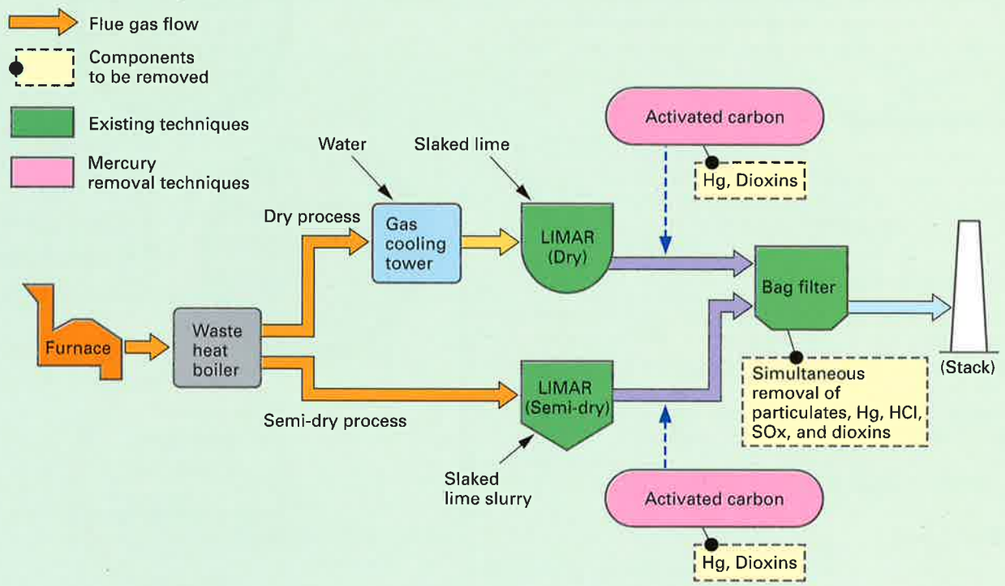


1. Flue gas from furnace
2. Lime storage silo
3. Solvent (Water)
4. Slurry tank
5. Slurry pump
6. Temperature control water
7. Atomizer
8. Reactor tower
9. Bag filter
10. Induced draft fan
11. Stack
12. Fly ash treatment equipment
13. Fly ash pit
14. To landfill



JFE-LIMAR is offered in both dry and semi-dry types and, in combination with other environmental protection devices, it is possible to produce the optimum flue gas treatment including NOx, heavy metal, dioxins removal and thus meet any air emission standards.

Integrated Approach to Flue Gas Treatment Multi-Functional System (Compact Type)

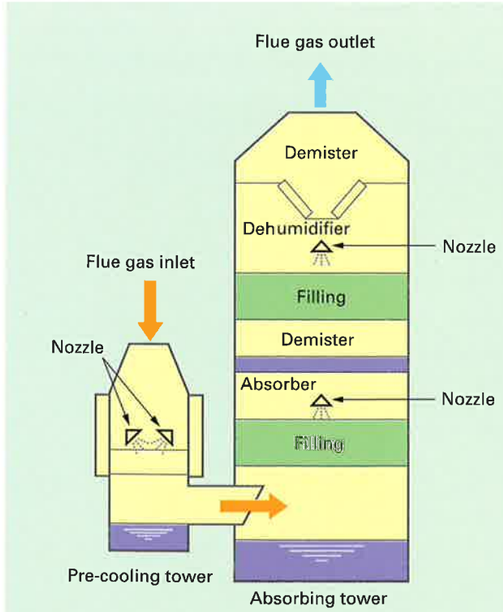


2. JFE Wet Scrubber

The JFE Wet Scrubber, based on a technology developed by Kurabo Industries Ltd., Japan, attains the highest removal efficiency for HCl, SOx, and other acid components in flue gas.

1. **High removal efficiency for acid components (less than 10 ppm)**
2. **Two tower units offer good system durability and efficiency**
3. **Effective and stable scrubbing even under flue gas load fluctuations**
4. **Low pressure loss in the absorption tower**

This system, combined with JFE's Drying Tower (atomizing type), is also able to function as a waste water treatment system. In this configuration, it can handle the problematic solid salts contained in waste water discharged from the Wet Scrubber. In comparison with conventional drum dryers, using JFE's Drying Tower offers optimum ease of maintenance and cost efficiency in operation.



JFE GasClean DX

Compact absorption tower for the flue gas treatment especially for the dioxins removal absorbs dioxins to the 0.01ng-TEQ/m³N.

Features

1. High-performance

With the high absorption ability of the pelletized activated carbon, dioxins can be reduce to 0.01ng-TEQ/m³N or less and mercury to 10mg/m³N or less. Also the pellet has ignition proof feature to 200°C Celsius.

2. Down sizing

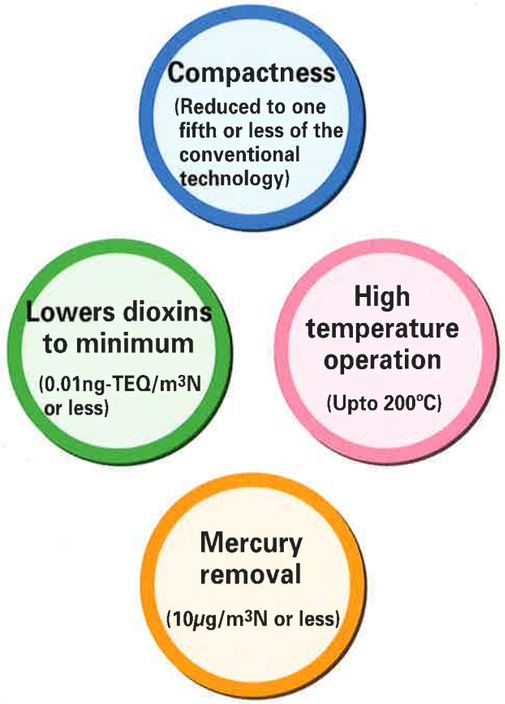
By the original structure of the pellet cartridge, efficiency of Flue gas-Carbon contact is improved. Thus the size of the casing is reduced to 1/5 of the conventional absorption tower. Also, it can be unified with bag filter and reduce the total size more.

3. Simple & Easy

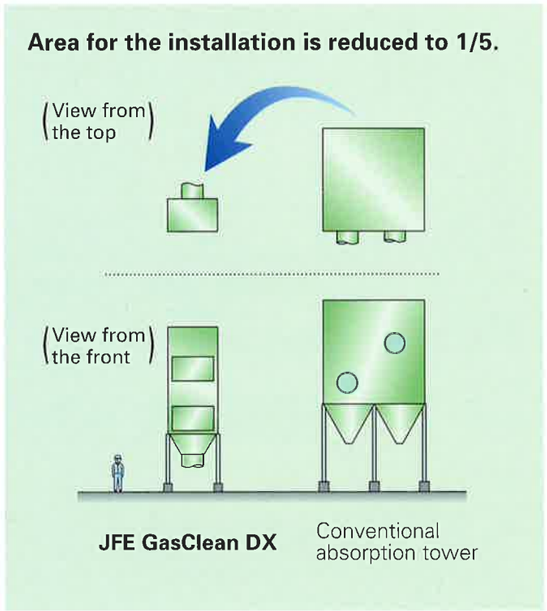
The flue gas is clean by going through the activated carbon lawyer and the system has no moving part. So that dairy operation or maintenances is seldom needed and contribute to reduce operation cost.
With ignition proof activated carbon, nitrogen gas, which was indispensable for the conventional absorption tower for fire prevention is now not needed. Also the carbon cartridge has a lifetime for about a year so that the work for changing is small.

4. Low-cost

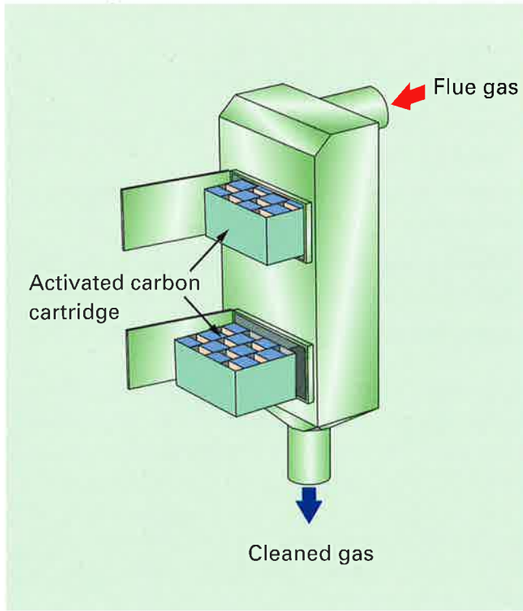
With its compactness and less accessories, the cost of installation is minimized.



Size comparison to the conventional absorption tower. (Capacity approx 30,000m³N/h)



External view of JFE GasClean DX



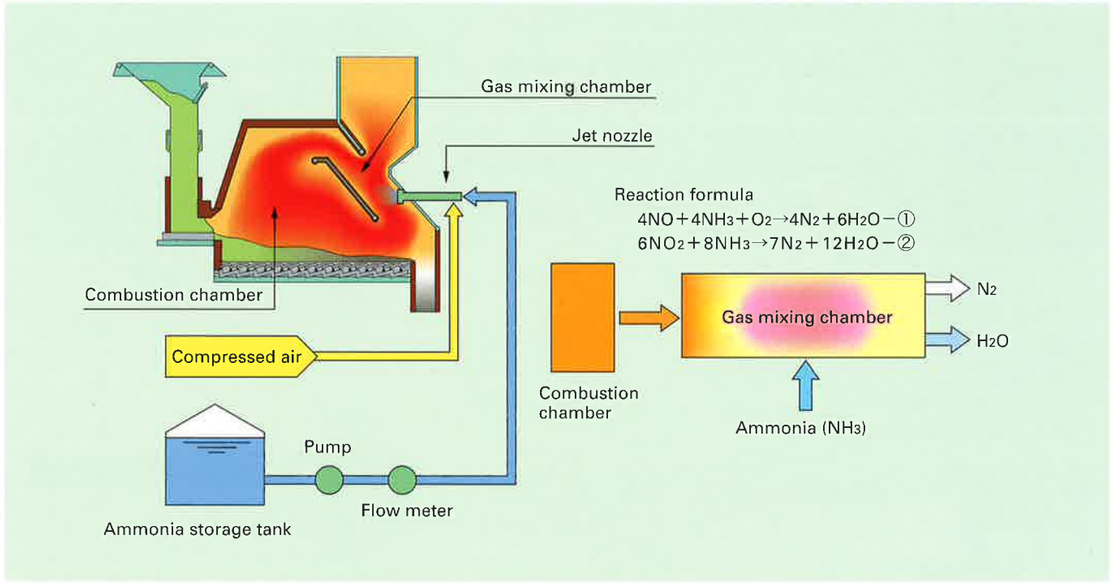
JFE De-NOx System

The JFE Two-Way Gas Flow System used in conjunction with the JFE-ACC System can create optimum conditions for reducing generation of NOx in the furnace. To increase denitrification efficiency, however, the following additional systems are also recommended:

1. Selective Non-Catalytic NOx Reduction System

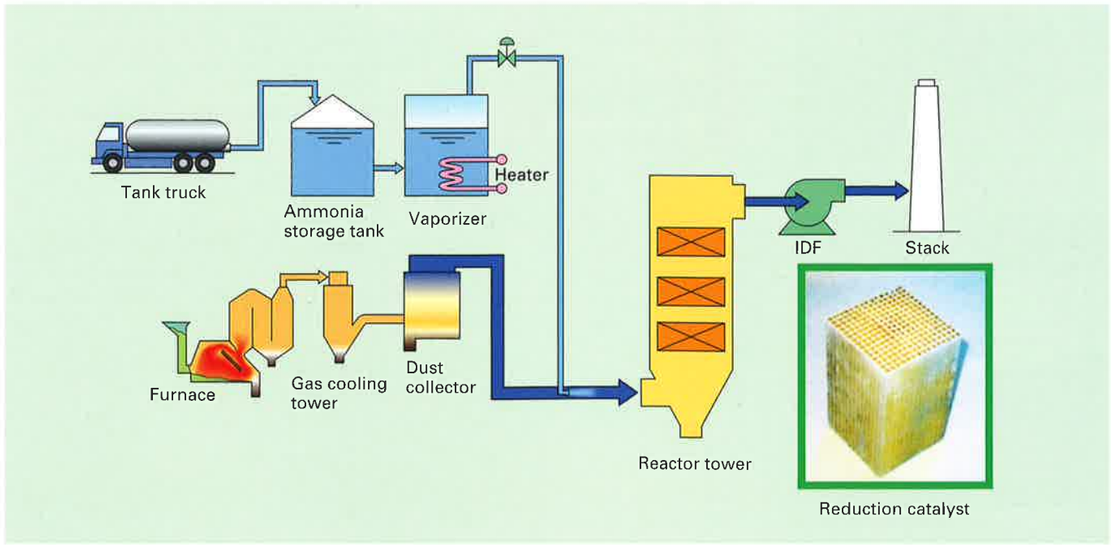
This system injects ammonia into the furnace. The NOx content is reduced by the resulting reducing reaction.

Features:
1.Simple and maintenance-free installation
2.Favorable cost/removal ratio



2. Selective Catalytic NOx Reduction System

This system achieves greater NOx reductions and can meet the requirements of more stringent environmental regulations when used in conjunction with the Non-Catalytic De-NOx System.

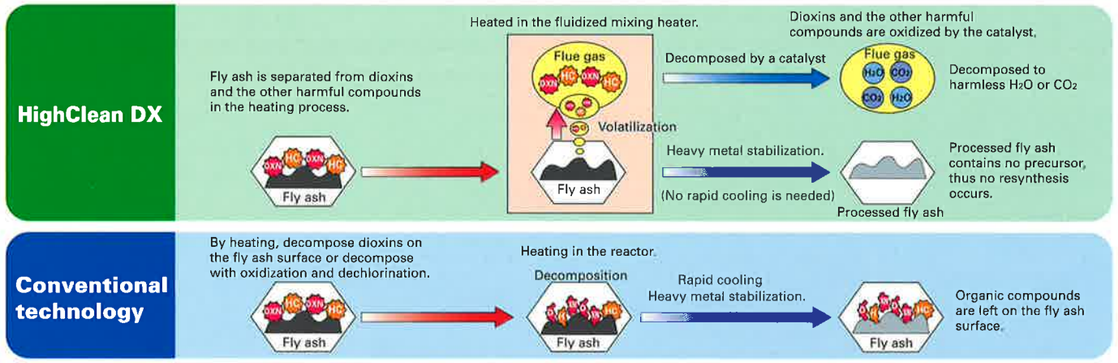


HighClean DX *New generation technology to remove dioxins of the fly ash*

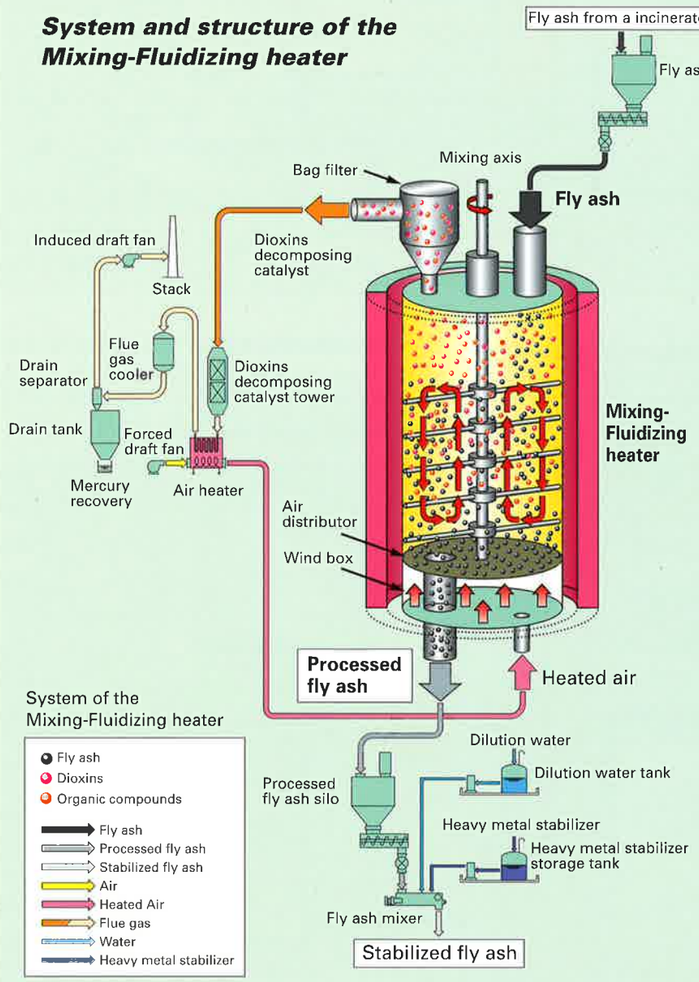
HighClean DX is the JFE's original technology to remove dioxins of a fly ash. By heating a fly ash to 400°C Celsius or over, vaporized the dioxins and decompose with Oxidation catalyst.

Reduces dioxins of fly ash to the 0.1ng-TEQ/g Vaporizing-Decomposing process is the ideal technology for a dioxins removal. Vaporized dioxins are decomposed to H_2O and CO_2

Comparison between HighClean DX and Conventional technology



System and structure of the Mixing-Fluidizing heater



Features

1.High heating efficiency

- With superior heat convention, surplus heating on the surface in not needed.
- Mixing homogenizes the temperature of the heater and keeps the process stable.
- With the high contacting efficiency, volatilization is promoted.

2.No clogging of a fly ash

- Fly ash don't clog due to the no excess heating.

3.Needs less installation area

- No recomposing occurs in the HighClean DX, so that the system needs not to have rapid cooling process.
- High heating efficiency enables small size heater.

4.Reduces the amount of heavy metal stabilizer.

- By heating a fly ash to 400°C or more in the air, heavy metal in the fly ash will be changed into less solubility. So that amount of heavy metal stabilizer after heating is reduced.

5.Lower cost

- Heating cost is minimized by its high efficiency.
- Can save cost of the heavy metal stabilization.
- The size of the catalyst can be minimized by the small amount of the flue gas.
- Heat recovery from flue gas is possible.

6.Wide range of capacity can be designed

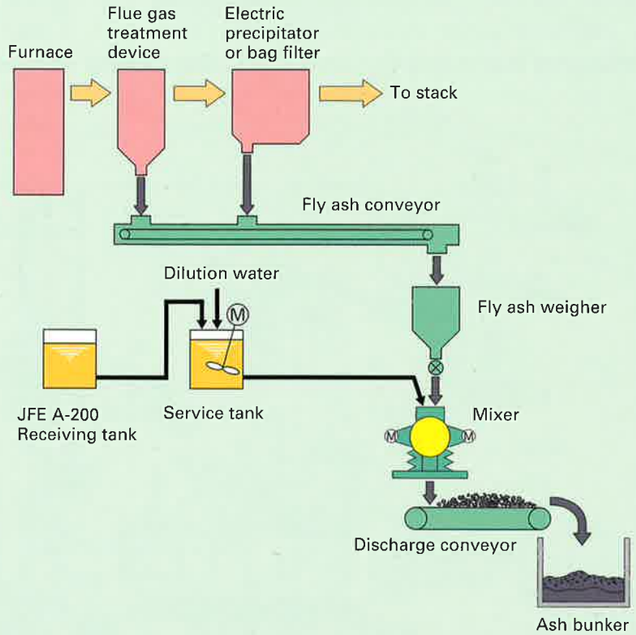
- From 100kg/h to 1,000kg/h

JFE Heavy Metal Stabilization System

This system was developed to stabilize heavy metals (Zn, Cd, Pb, Cr, T-Hg, etc.) present in fly ash discharged by the flue gas treatment system. A small JFE A-200 heavy metal stabilizer ensures the solidification of these harmful metals in a non-leachable form. The system is extremely simple and easily maintained at low cost.

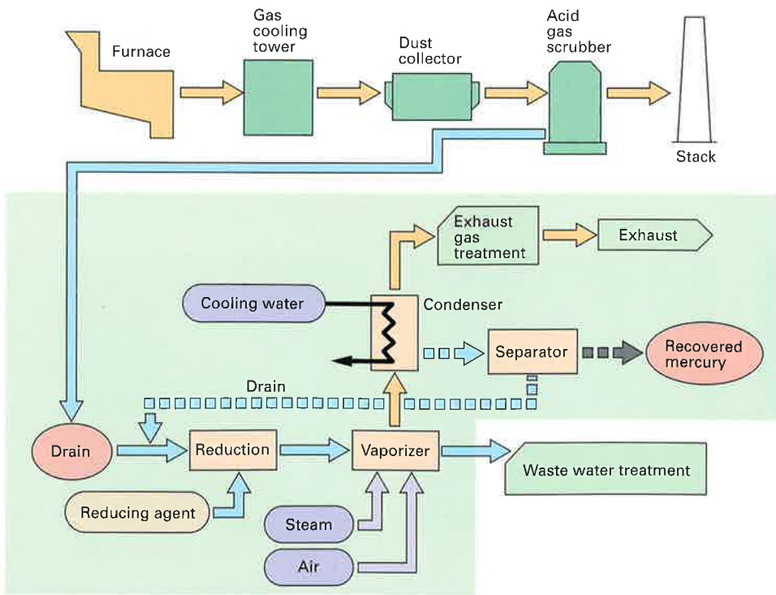
Processed fly ash

Fly Ash Treatment using JFE Heavy Metals Stabilizer A-200



JFE Mercury Recovery System

In combination with JFE's Wet Scrubber, this system efficiently removes up to 99% of mercury components from flue gas.



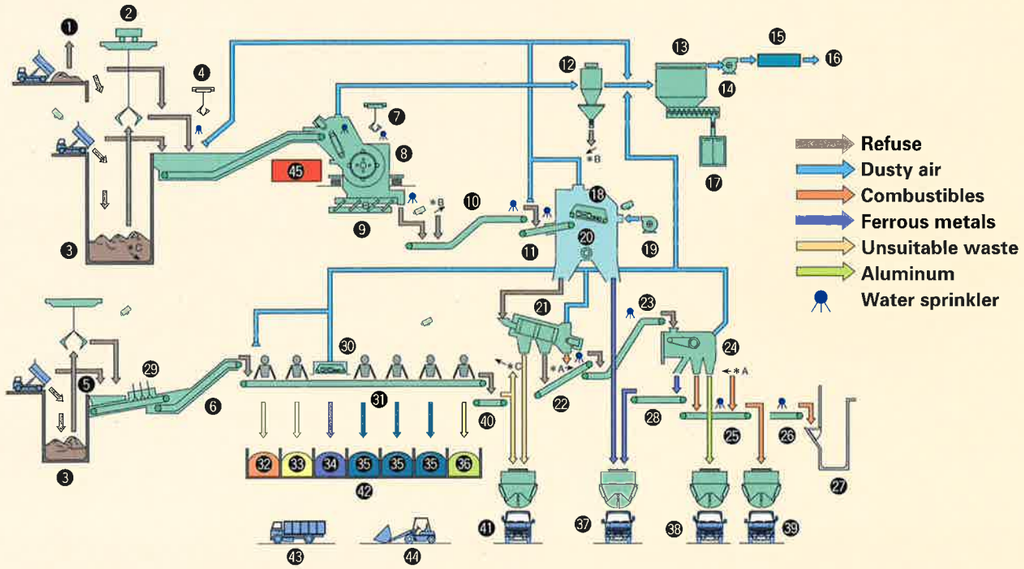
Mercury recovery equipment

Recovered mercury

Material Recovery System

JFE offers flexible recovery systems which allow a wide range of waste materials to be recovered according to the particular requirements of the client.

1. Material Recovery System for Bulky Waste or Incombustible & Hard-to-Burn Waste



1. Unsuitable waste removal
2. Bulky solid waste charging crane
3. Bulky solid waste bunker
4. Oversized and unsuitable waste extracting crane
5. Charging hopper
6. Charging conveyor
7. Maintenance hoist
8. Crusher
9. Discharging conveyor
10. No.1 conveyor
11. No.2 conveyor
12. Cyclone
13. Bag filter
14. Induced draft fan
15. Silencer
16. Emission
17. Dust container
18. No.1 magnetic separator
19. Blower
20. Separation roller
21. Trommel sieve
22. No.1 conveyor for aluminum sorter
23. No.2 conveyor for aluminum sorter
24. Aluminum sorter
25. Combustibles conveyor
26. Odor and fire barrier
27. Refuse bunker
28. Ferrous metal conveyor
29. Bag breaker
30. No.2 magnetic separator
31. Manual sorting conveyor
32. Broken bags
33. Unsuitable waste
34. Ferrous metals
35. Glass
36. Aluminum
37. Ferrous metal hopper
38. Aluminum hopper
39. Combustible hopper
40. Residue conveyor
41. Residue hopper
42. Recyclables storage yard
43. Recyclables transport
44. Shovel loader
45. Explosion protection gas

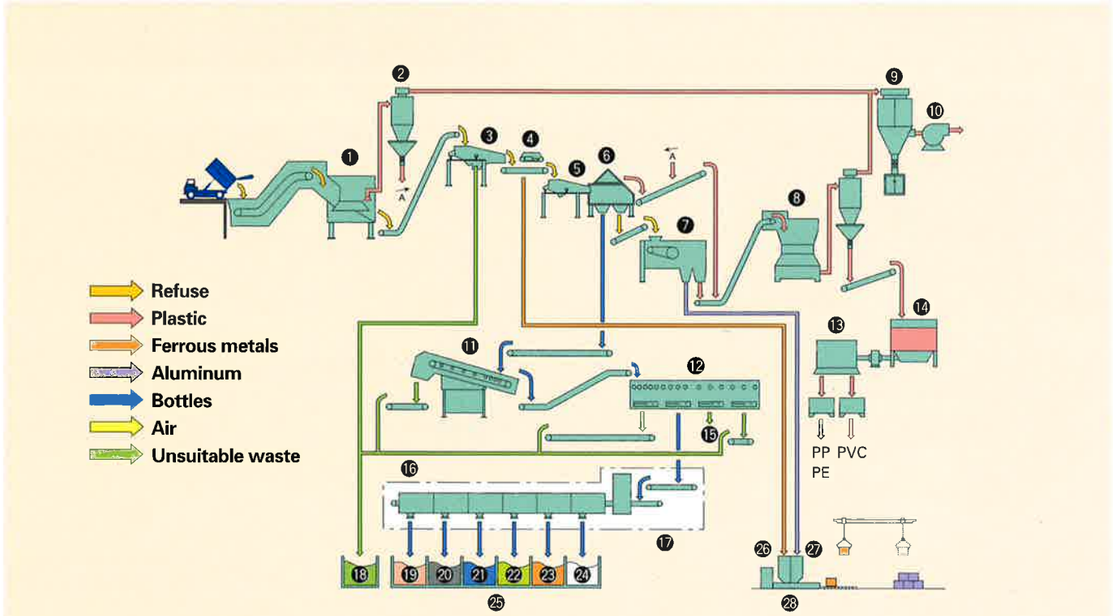
JFE Crusher


Trommel sieve


Cyclone

2.JFE Automated Waste Sorting and Recovery System

JFE has developed a fully automated waste sorting and recovery system in order to meet today's demand for reduced manual work. The newly developed waste sorting and recovery system incorporates a combination of various systematized sorting equipment, including a bag breaker & remover, air-classifier, and aluminum, plastic, and bottle-color sorter. The air-classifier, the system's core technology, can sort bottles from cans and plastic bottles in addition to films and papers with a recovery ratio of more than 95% and at a minimum air supply of 3 Nm³ per minute.



1. Bag breaker & remover
2. Cyclone
3. Inapplicable waste sorter
4. Magnetic separator
5. Feeder
6. Air-classifier
7. Aluminum sorter
8. Crusher
9. Bag filter
10. Induced draft fan
11. Round object sorter
12. Sizer
13. Plastic sorter
14. Washer
15. To other line
16. Two lines
17. System for sorting bottles by color (Lining up equipment, identifier, sorter)
18. Unsuitable waste
19. Others
20. Black
21. Blue
22. Green
23. Brown
24. Transparent
25. Glass bottle storage yard
26. Steel cans
27. Aluminum cans
28. Press


Air-classifier


Sizer


Glass bottle sorter

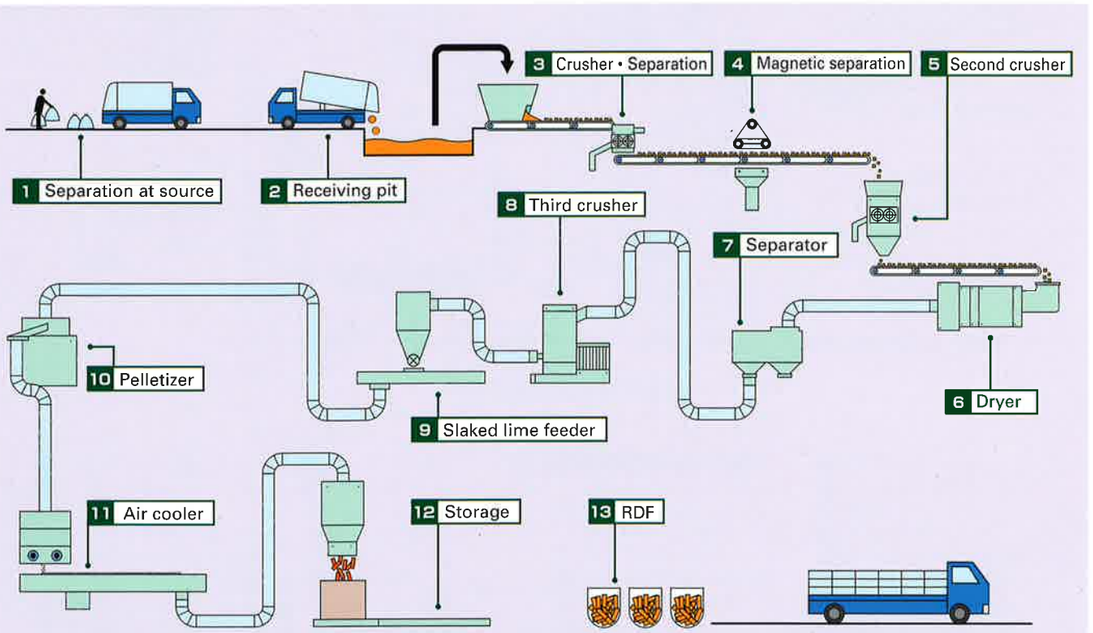
JFE RDF System

The system extract the combustibles of wastes and turns into solid fuel.

RDF
(Refuse Derived Fuel)

Yume Energy Center, Hiroshima completed in 2003

RDF production system flow chart




2 Pit and Crane


3 Primary crusher


6 Dryer


RDF plant


12 Storage


10 Pelletizer


7 Separator


Control room

Compost Production System

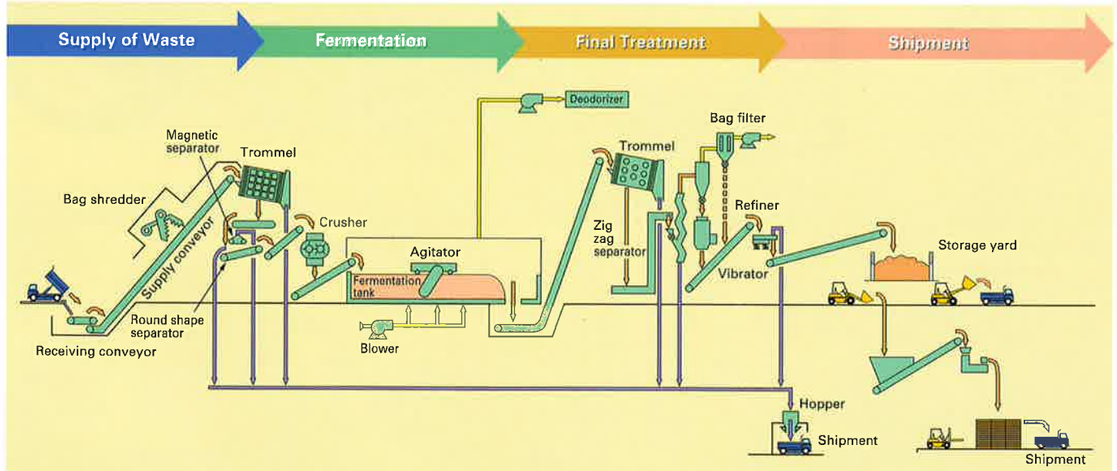
This system produces top-quality compost from ordinary household waste. It features good productivity, energy savings, and safe, easy operation.

Morioka-shiwa Refuse Disposal Center, Iwate
completed in 1993

Hodogaya, Advanced Compost Production System, Yokohama completed in 1994

Kuki-miyashiro Refuse Disposal Center, Saitama
completed in 2003

Tokyo Compost Center, Metro. Tokyo
completed in 1985




Fermentation tank

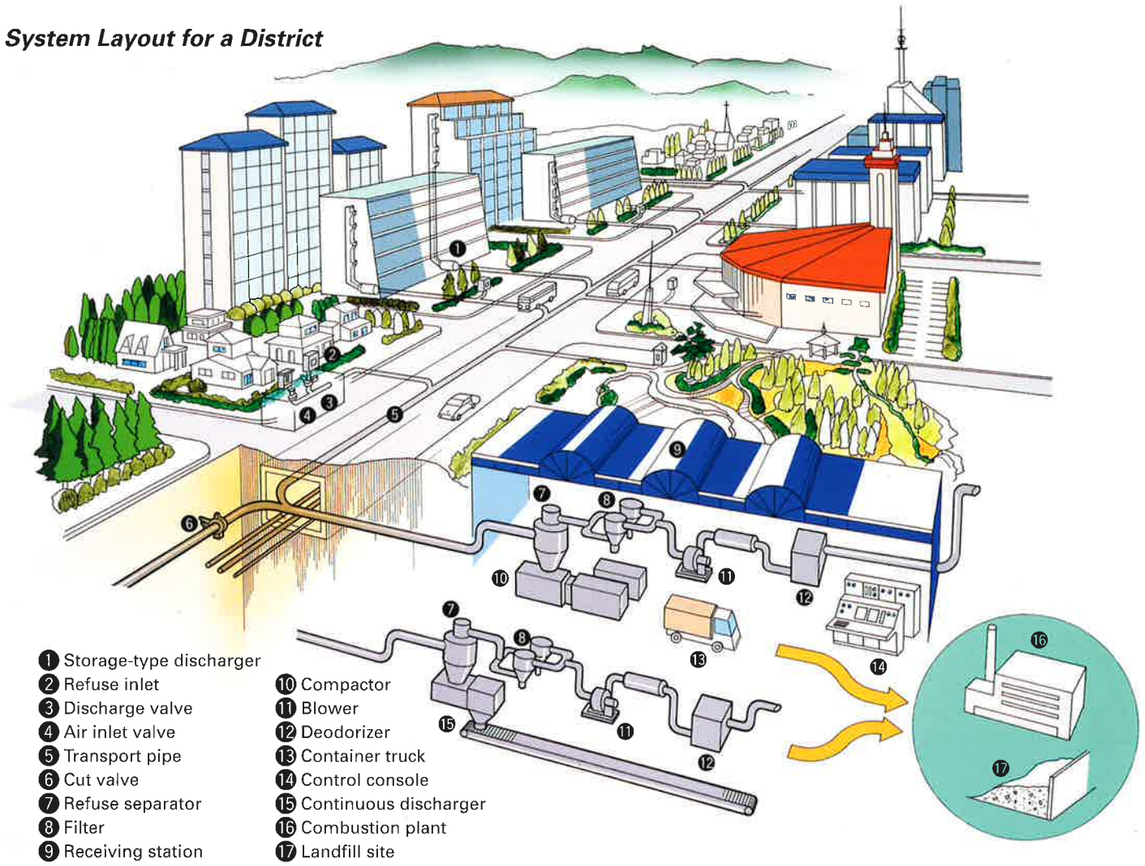

Compost products

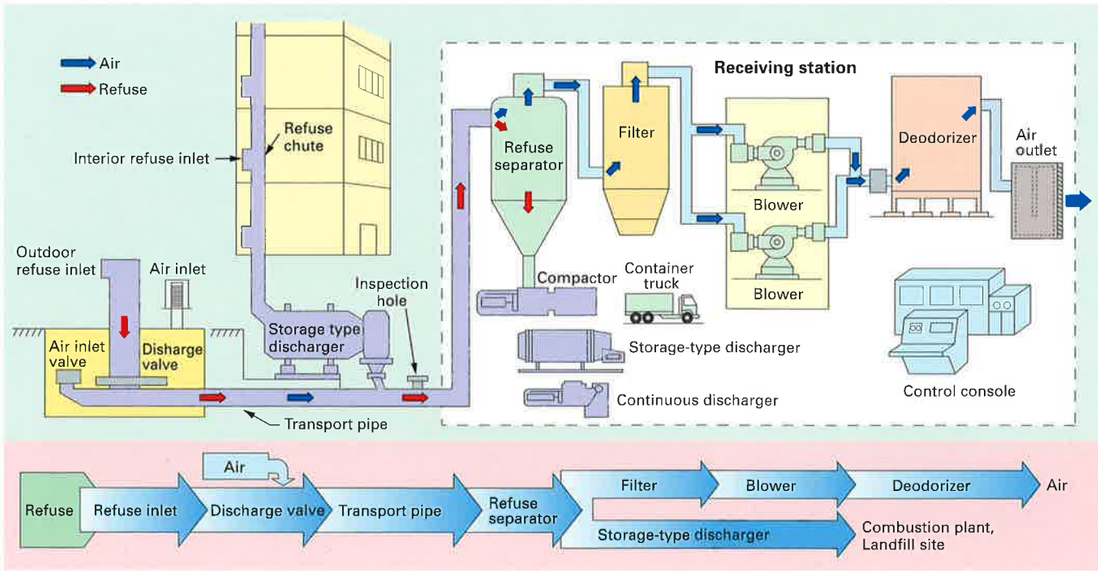

Packaging

JFE Pneumatic Refuse Transport System

This system enhances amenity and sanitation by pneumatically moving municipal solid waste to the refuse combustion plant. It contains few moving parts, so consumes small amount of energy.

System Layout for a District





INTEGRATED SOLID WASTE MANAGEMENT ENGINEERING

CA 3040

JFE

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