Environment -friendly Engineering Technologies

JFE Holdings				
JFE Steel	JFE Engineering	Kawasaki Microelectronics	JFE Urban Development	JFE R&D

Realizing Energy Savings in Air-Conditioning Systems

Clathrate Hydrate Slurry (CHS) Latent Heat Air-Conditioning System

Because energy consumption for social sector air-conditioning is increasing annually, energy saving in air-conditioning systems is important for reducing CO_2 emissions. Moreover, cooling loads tend to be concentrated in the daytime hours, requiring technical development for load leveling in air-conditioning. Regenerative (heat-storage) air conditioning systems using chilled water or ice as the heat storage medium are one solution to these problems, and are being promoted by power companies.

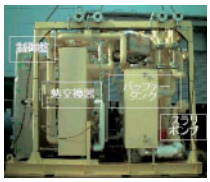
With chilled water heat storage systems, the refrigerator can generally be operated at a high coefficient of performance (COP*1), but in comparison with ice systems, the heat storage capacity is small, requiring space for a large heat storage tank. On the other hand, although ice storage systems have a larger heat storage capacity than chilled water, refrigerator COP is smaller and power consumption tends to be large. To realize an energy saving air-conditioning system with a high COP, it is necessary to use a new heat storage/transportation medium with the optimum balance of heat storage capacity and refrigerator power consumption.

JFE Engineering confirmed that it is possible to maintain the optimum balance of heat storage and power consumption, and a large increase in COP can be expected, by utilizing a thermal storage/transportation medium with a higher thermal density than chilled water in the temperature range (approx. 5-12°C) used in air-conditioning, and developed a new thermal medium called "Clathrate Hydrate Slurry (CHS)"*2 as a substitute for chilled water and ice. CHS is a mixed solid-liquid fluid composed of fine particles of clathrate hydrates and an aqueous solution. Advantages include high thermal density at 5-12°C, excellent heat storage/transportation, and heat transfer properties. In comparison with conventional chilled water transportation, pumping power consumption can be reduced by up to 80%. In comparison with ice, the energy required to produce cooling can be reduced by 40% and direct transportation to room air-conditioning units is possible.

***1) COP**
Abbreviation for Coefficient of Performance. Value which expresses the cooling/heating capacity (kW) per kW of power consumption; calculated by the following equation:
COP = Cooling or heating capacity (kW) ÷ Power consumption (kW)

***2) Slurry**
Solid-liquid mixed fluid with a smooth consistency.


Clathrate hydrate slurry


Energy saving air-conditioning system


Energy saving air-conditioning system

Total Engineering for Wind Power Generation

Wind Power Generation Business

Wind power generation has drawn considerable attention as form of clean energy and has been introduced rapidly in recent years. JFE Engineering supplies total engineering for wind power plants from site selection through project planning, design, manufacture, construction, and maintenance.

The 750 kW/J-50 model wind turbine manufactured by JFE Engineering features a gearless direct-drive synchronous-type generator. The rotor and generator are directly coupled without a step-up gear, eliminating mechanical loss during operation and reducing noise. Synchronous power generation prevents power surges during system interconnection, and the power factor can be controlled to a constant value, realizing a stable supply of high quality power.

In FY2003, JFE Engineering began handling the large-scale "G80" wind turbine manufactured by Gamesa (Spain), which pursues improved cost performance. With a rotor diameter of 80 m, total height of 100 m, and output of 2 MW, this wind turbine is the largest class in Japan and has an annual output of 3.5 million kWh, which is equivalent to the consumption of about 700 average families.

JFE Engineering is Japan's leader in the field, with a record of orders received for 124 units, and a total installed capacity of 92,000kW (end of March 2004). As a clean power producer, JFE Engineering is participating in wind power projects in Hokkaido and Mie Prefecture to encourage wider use, giving it a strong presence in the large-generator sector.

To encourage wider use of wind power, JFE Engineering is developing wind power generation equipment suitable for various wind conditions peculiar to Japan, such as wind turbulence in mountainous areas, and weather conditions including typhoons and winter lightning on the Japan Sea coast.


Wind power plant (Kushizaki, Chinzei-cho, Saga Pref.)

High Efficiency, Compact Design Activated Carbon Adsorption System for Dioxins

JFE Gas-Clean DX

Legal regulations on the concentration of dioxins in flue gas from waste incinerators set a level of 0.1 ng-TEQ/Nm^3[*1] or less (for new incinerators with capacity of 4 t/hr or more). However, in recent years, there have been increasing calls for a reliable dioxin removal method which can consistently satisfy standard values at much lower concentrations (0.01 ng-TEQ/Nm^3 or less) and also removes volatile toxic heavy metals such as mercury.

To meet these requirements, JFE Engineering introduced a "Moving Bed Activated Carbon Adsorption System" which has a record of use in Europe and is capable of removing dioxins to the level of 0.01 ng-TEQ/Nm^3 or less. However, the system is large and uses a large quantity of flammable carbon, requiring a fire prevention system. To solve this problem, in November 2003, JFE Engineering developed a high efficiency, compact design activated carbon adsorption system, "JFE Gas-Clean DX."

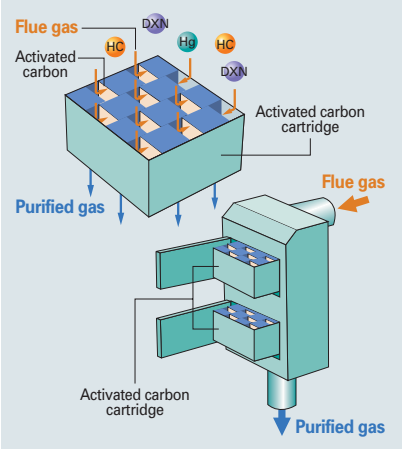
JFE Gas-Clean DX uses a cross-flow method in which the flue gas and activated carbon are placed in contact in a bed-shaped cartridge filled with granular activated carbon, which has an excellent thermal conduction property. This substantially improves contact efficiency with the activated carbon, making it possible to reduce the installation area to less than 1/5 that with the conventional technology while maintaining the same removal performance. Because the system does not have a drive section, there is no danger of fire, greatly improving routine operation and maintenance work and allowing worry-free use.

At present, JFE Engineering is conducting a long-term performance test using a demonstration unit at the waste incinerator in the Hamura Clean Center operated by Hino Motors with satisfactory results.

Application of this system is not limited to waste incineration facilities. Because flue gas treatment at steelworks and removal of volatile organic compounds (VOC) and foul smells are also possible, JFE Engineering is carrying out applied development work to further expand the range of applications.

***1) ng-TEQ/Nm^3**
Unit showing concentration of dioxins, where ng (nanogram) is 1 billionth of a gram, TEQ is the concentration obtained by equivalent conversion of the toxicity of dioxins to 2,3,7,8 tetrachloride dioxin, and Nm^3 means "normal cubic meter," which is a unit showing the volume when the sampled flue gas volume is converted to conditions of 0˚C and 1 atm.

JFE Gas-Clean DX



Easy Retrofitting as Advanced Sewerage Treatment

Bio-Tube System

Progressive eutrophication[*1] of closed natural water area, such as lakes, marshes and inner bays, and deterioration of water quality in public waters, including rivers, lakes, marshes, and bays have become serious problems. Removal of the nitrogen (N) and phosphorus (P) which cause these problems from sewerage requires an advanced sewerage treatment plant with approximately double the tank capacity of the standard activated sludge method[*2] used in conventional sewerage treatment. This involves various problems, as considerable revamping of civil structures is necessary, and when land cannot be secured for construction, the treatment capacity of the plant is inevitably reduced by half.

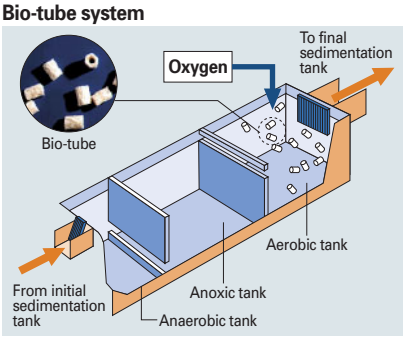
JFE Engineering developed a practical advanced sewerage treatment system called the "Bio-Tube System," which greatly increases the N and P treatment capacity while saving space and reducing costs.

Because it is possible to fix a large quantity of nitrification bacteria and other useful bacteria which have the slow reproduction rates indispensable for N removal on the carrier surface, a high concentration of effective bacteria can be maintained in the reaction tank by using Bio-Tubes in the reaction tank as a microorganism fixing carrier. This makes it possible to reduce the capacity of the reaction tank by approximately half in comparison with conventional advanced sewerage treatment systems. Moreover, a space-saving, low-cost advanced system can be introduced using the civil structures of the existing standard activated sludge facility.

***1) Eutrophication**
Phenomenon in which nutrient salts in water increase rapidly due to a cycle in which N and P in closed natural water area increase due to sewerage or industrial waste water, vegetable plankton and large aquatic plants multiply explosively, and, after their death, N and P generated by the decay process are released into the water.

***2) Standard activated sludge process**
The most commonly used sewerage treatment process in Japan. It is, however, not suitable for removal of N and P in sewerage.

Bio-tube system



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Greatly Increased Energy Recovery in Waste Incineration
Hyper 21 Stoker System

For environmentally-sound waste treatment, it is important to reduce discharges of organic substances and increase the energy recovery rate by thermal recycling, using the waste heat generated during incineration.

Using technical know-how gained with a large number of waste treatment plants, in April 2003, JFE Engineering developed the "Hyper 21 Stoker System," which simultaneously increases energy recovery by thermal recycling in waste incineration treatment and reduces discharges of harmful substances such as NOx and dioxins.

Combining a high temperature mixed-gas injection technology, in which high temperature air combustion technology is applied, and two-way gas flow as a stoker incinerators[*1] combustion technology, the Hyper 21 Stoker System employs a low excess-air ratio combustion technology to realize stable perfect combustion at a low excess-air ratio of λ = 1.3. This increases heat recovery by the boiler by approximately 10% in comparison with conventional stoker incinerators, while reducing exhaust gas by approximately 20% and NOx emissions by 50%. Adoption of an integrated incinerator-ash treatment furnace system greatly increases the heat recovery rate of ash treatment furnace input heat and the latent heat of bottom ash, which could not be recovered with conventional stoker incinerators. Approximately 40% of ash treatment furnace input heat can be recovered, and the equipment is compact and economical.

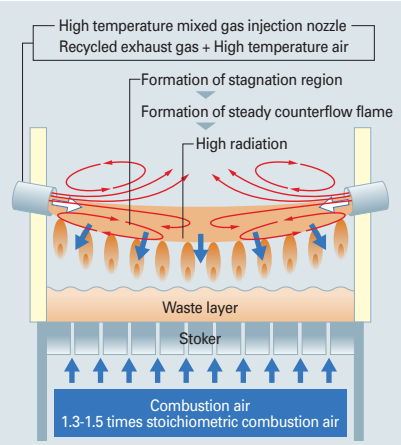
A water-cooled grate[*2] increases grate life by approximately 3 times, even under high thermal load conditions, and is suitable for a wide range of waste treatment, including mixed incineration of industrial waste, which will be required in the future.

JFE Engineering applies these technologies not only to new incinerators, but also in revamping of existing incinerators, and will continue to propose the optimum systems for waste treatment needs.

***1) Stoker incinerators**
Type of waste incinerator in which waste is transported on a grate-type combustion device called a stoker and incinerated at a high temperature exceeding 1000°C.

***2) Water-cooled grate**
In stoker combustion systems, the grate promotes combustion by enabling air supply from below while waste is stirred and transported through the combustion chamber. With the water-cooled type, combustion damage to the grate is prevented by internal water cooling and durability is greatly improved. Use of a hollow cast grate and pressurized water circulation improves cooling efficiency by enabling direct cooling of the grate, and stable operation with no internal steaming in the grate is achieved by using pressurized water to raise the saturation temperature of the cooling water.

Stabilization of combustion by high temperature mixed-gas injection



Effective Use of Biomass
BIGADAN Process Biogas System

Since establishment of the Biomass Nippon Strategy[*1] for encouraging positive use of biomass, recycling technologies for organic waste have become increasingly important.

One such technology which has attracted attention is biogasification of organic waste. Because biogas contains 60-65% methane and its properties are stable, it has the advantage of easy conversion to electric power on site. However, disposal of the digested liquid remaining after biogasification had become a problem. The digested liquid contains large amounts of chemicals with a fertilizing effect, such as nitrogen and phosphorus, and thus can be recycled to agricultural land as liquefied fertilizer, but treatment to kill and deactivate microbes and weed seeds was necessary.

To solve this problem, JFE Engineering developed the "BIGADAN Process[*2] Biogas System," which recovers biogas from organic waste such as livestock and food waste. Because organic waste is sterilized at 70°C for 1 hour (100% pasteurization) before methane fermentation, the discharge can be used safely as liquefied fertilizer. If the digested liquid is to be dewatered and the solid portion composted, the product is adequately sterilized in the heat exchanger and can be used safely without separate high temperature sterilization.

A non-closed double screw type heat exchanger was adopted to recover heat from the slurry between the pasteurization and methane fermentation processes. This prevents clogging of the heat exchanger by the highly concentrated slurry, which contains calcium and magnesium. Although conventional systems used indirect heat exchange by warm water, in this system direct heat exchange from high concentration slurry to high concentration slurry is possible, realizing waste-free heat recovery. These innovations made it possible to perform sterilization treatment with no loss in the total thermal efficiency of the plant.

***1) Biogas Nippon Strategy**
One national strategy for promoting a recycling society, with a framework finalized in July 2002 by the main Japanese Ministries. The Strategy presents concrete policies and schedules for positively utilizing biomass and recycling energy, biodegradable materials, animal feed/fertilizers, etc.

***2) BIGADAN process**
The name derives from the company from which this technology was introduced, BIGADAN A/S (BIGADAN stands for Bio-Gas Denmark).

BIGADAN process Biogas System