JFE TECHNICAL REPORT
No. 8 (Oct. 2006)

Energy and Environmental Technologies of the JFE Group†

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1. Introduction

The JFE Group is contributing to create a sustainable society by supplying Only one and Number One environment-friendly products and technologies which reduce environmental influence in everyday life and industrial society.

Figure 1 shows environment and energy-related technologies which have been created by research and development and applied practically by the JFE Group. Although also presented in JFE Group's "2004 Environmental Report," this figure shows how JFE Group technologies are contributing in diverse forms, expanding in scope from the familiar to the global scale. These are summarized in the areas "in everyday life," "in society," and "for the planet."

2. In Everyday Life

In everyday life, steel is used in diverse forms. JFE Steel supplies a wide variety of environment-friendly steel products, such as "laminated steel sheets for food cans," which generate no waste solvents or waste paints in the canmaking process, and "high tensile strength automotive steel sheets (HITEN)," which improve fuel efficiency and passenger safety. Various other JFE Steel products also contribute to improve environment by their presence in everyday life. For example, "chromate-free coated steel sheets" do not contain the toxic substance hexavalent chrome (Cr (VI)), "Stainless steel sheets/tubes for automotive exhaust systems" have excellent oxidation resistance when used in automobiles, and "lead-free steel sheets for fuel tanks" are 100% lead-free zinc-coated sheets with excellent resistance to gasoline degradation. Others include "high efficiency electrical steel sheets," which reduce power loss in electrical equipment, and "tailor welded blanks" for automobile bodies. In particular, tailor welded blanks are a product which realizes a total solution encompassing the entire life cycle of the automobile from design to end-of-life disposal.

3. In Society

In addition to Only One and Number One environment-friendly steel products, a wide variety of other JFE Group technologies are also actively used in society.

JFE Steel applies the world's most advanced energy saving technologies in its iron and steel manufacturing processes in order to maintain the highest level of energy efficiency. "Regenerative burners," which satisfy energy-saving requirements while greatly reducing NOx emissions, are a representative example.

"Thermo-mechanical control process (TMCP) high strength steel plates" are manufactured with TMCP technology using JFE Steel's *Super*-OLAC (on-line accelerated cooling), which is the world's most advanced technology in its field. Used in shipbuilding and construction, these products are important measure for preventing global warming as wll as high corrosion-resistance steel products.

Use of waste plastic as blast furnace feed contributes to reducing CO_2 emissions while also cooperating with society to solve waste problems. As a material recycling technology for waste plastic, "NF Board" for concrete forms is a product which is made from waste plastic instead of plywood. Used NF Boards can be recovered and recycled as raw material for ironmaking, achieving recycling and zero emissions, thereby contributing to the creation of a recycling-oriented

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† Originally published in *JFE GIHO* No. 6 (Dec. 2004), p. 1–4

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society.

To reduce the amount of landfill disposal of wastes discharged from its steel works, JFE Steel already effectively utilizes iron and steel slag as aggregate for cement, etc. More recently, high expectations have been placed on new environmental remediation products and technologies using this slag. Newly-developed JFE Steel products of this type include the blast furnace slag sand-capping material, "Marine Base," submerged embankment material, "Marine Stone," and artificial reef material for seaweed/coral breeding, "Marine Block (which is produced by absorbing and fixing CO_2 in slag)," all of which are used to improve marine environments, and a heat island-mitigating paving material, "Road Cool," which reduces the temperature in urban environments.

JFE Engineering is involved in product development related to waste treatment which responds to a wide range of needs, including next-generation technologies, based on an accumulation of waste treatment technologies spanning more than 30 years. Examples include not only treatment of municipal solid waste, but also the "high temperature gasifying & direct melting furnace" which treats "refuse derived fuel (RDF)" and realizes high efficiency in power generation, and the "JFE Thermoselect gasifying & melting furnace," which produces zero waste requiring landfill disposal. Although JFE Engineering's "stoker furnace" already has a top-class record of use in Japan, the company developed the "Hyper 21 Stoker System" by applying high temperature air combustion technology to its existing stoker furnace. Among environmental load reduction technologies, JFE Engineering offers the "High Clean DX" dioxins detoxification technology with energy saving and space saving features.

JFE Engineering has commercialized a diverse range of technologies which are contributing to society, such as the "circulating fluidized bed (CFB) boiler turbine power generation," the advanced high efficiency technology "sewerage sludge methane fermentation," the "Bio-Tube System" which applies biotechnology to water purification using microorganisms, and the "seawater exchange-type hybrid caisson," which reduces environmental loads by adding a seawater exchange function to the conventional hybrid caisson.

As a leading-edge energy saving technology, the new heating and cooling medium "clathrate hydrate slurry (CHS)," which was developed and applied practically for the first time in the world by JFE Engineering as a substitute for chilled water, is a product which envisions the next-generation of air-conditioning technology.

The JFE Group also provides environmental project planning services for total solutions to environmental problems.

With JFE Holdings as a nucleus, the JFE Group is involved in planning Eco-Town Projects, Eco-Industrial Complexes, and environmental urban development in cooperation with local governments and other companies throughout Japan, taking advantage of the total technical capabilities of JFE Steel, JFE Engineering, and JFE R&D. The JFE Group is actively involved in building a recycle oriented society using all of its environmental and energy technologies in order to realize a zero emission society/energy saving society.

4. For the Planet

To improve the global environment, the JFE Group is applying all of its energies to technical development aimed at creating and popularizing clean energy. In addition to efforts to improve service in power supply projects carried out to date, the JFE Group has its gaze firmly fixed on the future, as can be seen in technologies such as dimethyl ether (DME), wind power, fuel cells, and other technologies which respond to the need for clean energy.

In the field of wind power generation, JFE Engineering has already received orders for more than 120 windmills in Japan, and has also begun to expand this business aiming at popularization of high output wind power generating systems. In fuel cells, which have attracted much attention as a next-generation power generating device, JFE Engineering has been developing and demonstrating a "solid oxide fuel cell (SOFC)" which boasts high generating efficiency, even among the numerous fuel cell technologies under development today.

In particular, high expectations are placed on DME as a leading candidate for clean energy in the 21st century. Dimethyl ether can be produced from a variety of resources, including natural gas, coal, biomass, and others, and can be used in a wide range of fields, from power generation and industrial applications to transportation and the general private sector, and therefore can contribute to energy security. Dimethyl ether is a clean fuel, as it produces no particulate matter (PM), ash, or SOx emissions, while also reducing emissions of NOx and CO_2. With a high cetane number, it is expected to be used as a clean diesel automobile fuel. Two DME cars have already been exhibited at the Tokyo Motor Show 2004. Because low temperature hydrogen reforming is possible, DME is also extremely promising as a fuel for fuel cells. As a hydrogen carrier, it has a high storage capacity and is easy to handle, suggesting that it will play a key role in supporting a future hydrogen-based society. A direct DME synthesis process has already been established as a proprietary JFE technology, and a 100 t/d pilot plant, which is a practical level, is currently in operation in a long-term proof test in the Kushiro area of Hokkaido.

The JFE Group has also developed a “natural gas hydrate (NGH),” which enables a substantial reduction in natural gas transportation energy, and has achieved a formation rate more than 60 times faster than that with the conventional production process.

5. Conclusion

An overview of the environmental and energy technologies of the JFE Group was presented. JFE R&D and the Steel Research Laboratory, JFE Steel are playing the core role in the technical development of these technologies. Two laboratories are constantly engaged in creating new Only One and Number One technologies in mutual cooperation, taking full advantage of the strengths of the JFE Group, in order to contribute to society with global top level technical capabilities.

In today’s rapidly changing times, the JFE Group is always conscious of the responsibilities placed on “steel” and “engineering,” and is committed to being a business group which responds to the demands of the age with “technology.”

Reference

JFE Holdings. Environmental Report 2004.

In everyday life

Toxic substance-free steel sheets
- Chromate-free coated steel sheets

Low environmental load products
- Laminated steel sheet for food cans

Long-life low environmental load products
- Steel-framed House

In society

High strength sheets & tubes for weight reduction
- High tensile strength automotive steel sheets (HITEN)
- Ferritic stainless steel with high corrosion resistance and ultra-deep drawing property
- HISTORY, ERW steel tubes
- As-sintered alloy steel powder (heat treatment-free)
- Tailor Welded Blanks

Low environmental load materials
- Lead-free steel sheets for fuel tank
- Stainless steel sheets/tubes for automotive exhaust system

Low core loss electrical steel sheets
- High efficiency electrical steel sheets

Waste detoxification and recycling
- High-temperature gasifying & direct melting furnace
- JFE THERMOSELECT gasifying & melting furnace
- Electric resistance and plasma-type ash melting furnaces
- Hyper 21 Stoker System
- Circulating fluidized bed boiler turbine power generation
- Sewerage sludge methane fermentation
- BIGADAN process biogas system

Contribution to recycling-oriented society
- Waste plastic recycling for BF feed
- NF Board
- Home electric appliance recycling
- Food waste recycling
- Eco-Town Concept

High strength plates for weight reduction
- TMCP high strength steel plates

High corrosion-resistance tubular products & steel plates
- Martensitic stainless steel tubes
- Weathering steel/ Rust stabilization treatment

For the planet

Environmental load reduction technologies
- Flue gas & fly ash dioxin treatment technology
- Bio-Tube system
- Sewerage sludge circulating fluidized bed (CFB) incinerator

Environmental improvement technologies
- Marine Block
  Marine Base
  Marine Stone
- Seawater exchange-type hybrid caisson
- Dam sediment removal, Dam/river water quality preservation
- Protection of soil environment

Supply of energy-saving equipment
- Gas engine cogeneration system
- Regenerative burners
- Clathrate hydrate slurry (CHS) latent heat air-conditioning system

Creation and popularization of clean energy
- Wind power generation
- High-purity silicon for solar cells
- DME (dimethyl ether)

Fig.1 Map of environment/energy related technologies of the JFE Group