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## JFE Steel Corporation

**Development of Technology to Recycle Waste Plastic Into a Blast Furnace Reducing Agent**



# Recycling of Waste Plastic Reduces CO<sub>2</sub> Emissions in a Blast Furnace. Pulverization Further Improves Efficiency

## Recycling 15,000 Tons Per Year of Waste Plastic Into a Blast Furnace Reducing Agent Reduces CO<sub>2</sub> Emissions by 42,000 Tons

In Japan, the Waste Management and Public Cleansing Act was enacted in 1970, and since then waste has been disposed of in accordance with the act. In the middle of the 1980s, however, a landfill shortage, hazardous substances contained in waste, and other waste problems grew to become serious issues. Since it was difficult to combat the situation by waste disposal regulations alone, the Act on the Promotion of Effective Utilization of Resources was enacted in 1991 to promote recycling. This act stipulates the types of businesses in which recycling should be promoted and the items to be recycled. It also prescribes that recycling be promoted by the autonomous efforts of each industry assisted by administrative guidance. The Waste Management and Public Cleansing Act was significantly revised in the same year, and the Basic Environment Act was enacted in 1993 as a basic law to deal with all environmental issues, including waste and recycling problems. Subsequently, the Act on the Promotion of Sorted Collection and Recycling of Containers and Packaging was enacted in 1995 and was fully enforced in April 2000. Also, the Act on Recycling of Specified Kinds of Home Appliances was enacted in 1996 and fully enforced in April 2001.

In addition to its activities in the energy field, NEDO established a framework for research and development of industrial technologies in 1988. Since then, it has worked to develop technologies to reduce environmentally harmful substances and dispose of and recycle waste, and has helped companies to develop technologies and introduce equipment for improving energy efficiency and reducing CO<sub>2</sub> emissions. In particular, the effective use of waste plastic is a major issue. Domestic plastic production has exceeded 12 million tons per year since 1990, while domestic plastic consumption has been more than 10 million tons per year over the same period. As a result, the amount of waste plastic has been nearly 10 million tons per year since 1988. It is also important to improve energy efficiency in manufacturing, where a large amount of energy is consumed, in order to improve competitiveness and reduce CO<sub>2</sub> emissions.

NKK Corporation, the predecessor of JFE Steel, developed technology to inject waste plastic as a reducing agent into a blast furnace as a way to effectively use the growing amount of waste. The technology was put into practical use in 1996. In 2000, it started to use plastic containers and packaging instead of industrial waste plastic made of mixed materials as a blast furnace reducing agent. After this, technology using a blast furnace reducing agent was further developed into technology for manufacturing pulverized plastic, which is highly reactive in a blast furnace, by heating and melting waste plastic before dechlorinating, cooling, and solidifying it. An advanced plastic recycling (APR) plant was constructed in 2007 with financial support from NEDO and it has been in operation since then. This contributes to reducing both the consumption of coal as a reductant and CO<sub>2</sub> emissions, per unit weight, in pig iron manufacturing.



Melted and mixed waste plastic is rapidly cooled and sent to a coarse crusher



Inside the APR plant, pulverized waste plastic is pushed out of a pipe



Pulverized waste plastic

**Q. Why did this project start?**

In the early 1990s, waste disposal problems such as a shortage of landfills to keep up with increasing waste became a major social issue. The amount of waste plastic was increasing year after year and reached approximately 10 million tons per year in the mid-1990s, which was roughly a twofold increase from ten years earlier. However, less than 30% of waste plastic could be utilized, and the disposal of waste plastic thus developed into an urgent issue.

In response to these trends, the Ministry of Economy, Trade and Industry, along with the Ministry of the Environment, conceptualized the Act on the Promotion of Sorted Collection and Recycling of Containers and Packaging to reuse waste containers and packaging discarded from households so as to reduce the amount of waste. Also, NEDO began to address the development of a broad range of technologies related to the recycling of plastic containers and packaging before the enactment of legislation in 1995.

**Q. What was the aim of the project?**

As a chemical recycling method for plastic containers and packaging, NEDO implemented the development of technology to use waste plastic as a blast furnace reducing agent. By promoting the development of new technology for the chemical recycling of plastic, NEDO aimed not only to increase the efficiency of plastic recycling, but also to reduce CO<sub>2</sub> emissions. This was done by using plastic instead of coke in the iron manufacturing process, thereby contributing to global environmental conservation.

**Q. What is the role of NEDO?**

In addition to thermal recycling using plastic as a fuel, a technology which had already been under development, NEDO also took a new chemical recycling approach in which used plastic is converted into a raw material for reuse. NEDO specifically focused on plastic containers and packaging, which account for 40% of waste plastic, and worked to develop a broad range of technologies, including those for making raw material for blast furnaces, pulverization, injection into a blast furnace, and gasification prior to the enactment of the Act on the Promotion of Sorted Collection and Recycling of Containers and Packaging in 1995. These technologies were not all commercialized due to economic reasons resulting from difficulties in securing materials and product marketing, but they helped to establish part of a recycling system under the government's new recycling regulations. Today, thanks to methods such as chemical recycling, thermal recycling, and material recycling, more than 80% of waste plastic is being utilized, and the amount of waste plastic is decreasing each year.