NIPPON STEEL TECHNICAL REPORT No. 70 JULY 1996

UDC614.7:628:009

Recent Environmental Problems and Related Corrective Measures

Takashi Furukawa*1

Abstract:

Opinion concerning recent environmental problems has shifted from the solution of conventional pollution problems to the emergence of global-scale environmental issues and the increase of substances that require regulating. Products now must have "environmental friendliness" as well as conventional functional and aesthetic appeal. Iron and steel products and their manufacturing processes must be "environment-friendly" or "earth-friendly". Products must also be assessed for their environmental impact during their life cycle, and information regarding their effects on the environment must be disclosed to the public. Companies must study and implement corporate activities to meet these societal changes in this area.

1. Introduction

During the past 20 years when its economy grew 120%, Japan implemented many pollution control measures and achieved remarkable progress in reducing industry's impact on the environment. For example, the nation has reduced oxides of sulfur and nitrogen emissions by 82% and 21%, respectively; achievements unparalleled throughout the world. To combat air pollution, water pollution, and waste generation, the steel industry has continuously invested in improving operations and equipment and developing new technology.

The focus of Japanese thinking on environmental problems has shifted from the solution of conventional pollution problems to the emergence of global-scale environmental problems and the increase of substances that require regulating. Issues include problems stemming from urban and lifestyle changes, global warming, depletion of the ozone layer, destruction of tropical rain forests, acid rain, marine pollution, pollution in the developing countries, and dwindling resources.

Global environmental issues began to be discussed in 1972 when the Club of Rome published the report "The Limits to Growth" and stressed the finiteness of resources to people throughout the world. As shown in **Table 1**, environmental problems, including global warming and ozone layer depletion, have come to be discussed worldwide as critical issues since 1990.

In this way, viewpoints now embrace transnational environmental problems, complicated relations between polluters and victims, and future as well as present environmental issues. We steelmakers now must understand what temporal and spatial effects our products will have on the global environment.

2. Recent Trends in Environmental Policies

In Japan, the Basic Law for Environmental Pollution Control and the Nature Conservation Law has lost touch with the current of the times. The Japanese Government enacted the Basic Environment Plan and the Environment Basic Law in November 1993 and December 1994, respectively, to replace the two former

*1 Head office

laws and to build a new environmental policy framework based on the conclusions of the 1992 United Nations Conference on Environment and Development (Earth Summit).

Local governments then established basic environmental ordinances within the new framework.

The Basic Environment Plan has mainly:

(1)Established an outline for environmental conservation measures, roles of the national government, local governments, businesses and people, and policy means for realizing a low environmental load socioeconomic system based on natural cycles.

(2)Defined the roles of businesses in (i) reducing the environmental load in all stages of business activities; (ii) developing products in consideration of their life cycle; and (iii) voluntarily following International Organization for Standardization (ISO) guidelines, such as formulation of environmental policy and implementation of an environmental audit.

Nippon Steel drafted its environmental policy in March, 1993. In April 1994, the environmental policy was reviewed in light of subsequent changes, such as the Basic Environment Law, industrial environmental vision, national pioneering action plan, a life cycle concept and ISO environmental management.

The basic policy embraced contributions to "building an environment-friendly society", "reducing the environmental load in all stages of business activities", and "ensuring environmental protection on a global scale from an international viewpoint".

Nippon Steel started concrete activities aimed at 1) environmental protection in all stages of business activities; 2) energy conservation and reduction in carbon dioxide emissions; 3) resource conservation and effective utilization of resources; 4) development of materials, plants, and systems contributing to environmental protection, energy conservation, and resource conservation; 5) improvement in material flow; 6) development of innovative technology; 7) creation of a rich environment; 8) international technical cooperation; 9) promotion of environmental education and public relations activities; and 10) inauguration of environmental management system and introduction of environmental auditing system.

Table 1 History of environmental globalism

March 1972	The Club of Rome published the report "The Limits to Growth" and stressed the finiteness of global resources.
September 1987	The Montreal Protocol on ozone layer depleting substances was adopted.
May 1988	Japan's Environmental Agency addressed the issue of the global environment for the first time in its "White Paper on the Environment".
November 1988	The Intergovernmental Panel on Climate Change (IPCC) was formed.
July 1990	Japan's Environmental Agency established the Global Environment Department.
October 1990	The Japanese Government formulated the Action Program to Arrest Global Warming.
June 1992	The Earth Summit [United Nations Conference on Environment and Development (UNCED)] was held in Rio de Janeiro.
October 1992	Japan's Ministry of International Trade and Industry asked companies through trade associations to formulate voluntary plans about the environment.
June 1993	ISO/TC207 held the first meeting on international standardization of environmental management, auditing, etc.
November 1993	The Basic Environment Law was enacted.
March 1994	The United Nations Framework Convention on Climate Change was enforced.
September 1994	The Japanese Government issued a report based on the United Nations Framework Convention on Climate Change.
December 1994	The Japanese Government formulated the Basic Environmental Plan based on the Basic Environment Law.
March 1995	The First Conference of the Parties to the United Nations Framework Convention on Climate Change (COP1) was held.
December 1995	The IPCC published its second report.

3. Environmental Control Measures Implemented by Nippon Steel

Nippon Steel has developed and applied technologies to reduce its impact on the environment during the ironmaking and steelmaking processes, such as air pollution control, water pollution control, reducing pollutants generated, energy conservation, and revegetation. These technologies may be classified into five major categories: 1) improvement in operations and equipment; 2) elimination of pollutants, volume reduction of pollutants, and removal of pollutants; 3) improvement in recovery rate of pollutants and effective utilization of pollutants; 4) recovery of waste energy; and 5) simulations to predict the effectiveness of environmental control measures taken. By making use of these new technologies, Nippon Steel has implemented comprehensive environmental control measures in terms of both hardware and software.

The measures implemented to reduce oxides of sulfur and nitrogen emissions, two representative types of air pollutants, are listed in **Table 2**. Some 70% of the emissions of oxides in the steel industry are generated at sinter plants. Implementation of control measures has steadily reduced these emissions as shown in **Fig. 1**.

Production activities will not be maintained at present levels

Table 2 Principal measures for desulfurization, denitrification, and energy conservation

Process	Coke	Raw material	Blast furnace	Steelmaking	Rolling
Measure	Low-NO_x combustion	Use of low-sulfur raw material	Fuel gas recovery	Fuel gas recovery	Low-NO_x combustion
	Smokeless charging	Sinter plant exhaust gas desulfurization, denitrification	Top gas pressure recovery turbine	Waste gas CO_2 recovery	Direct rolling
	Fuel gas recovery	Sinter plant exhaust gas recirculation	Top gas recovery		Hot charging
	Dry coke quenching	Sinter sensible heat recovery	Dry dust collection		Hot slab delivery
	COG sensible heat recovery		Hot-blast stove waste heat recovery		Air and fuel preheating

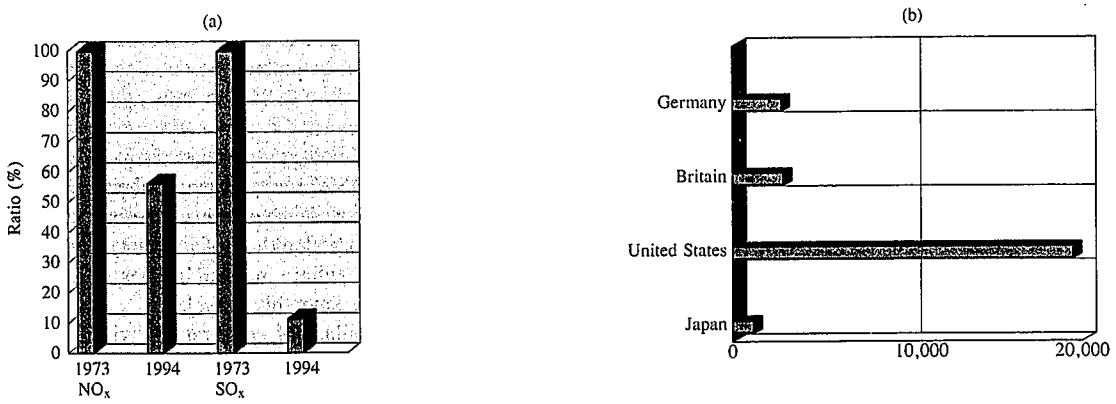

Fig. 1 Percent reduction in NO_x and SO_x emissions at Nippon Steel (a), and comparison of NO_x emissions (t/year) among major countries (b)

without such measures to reduce their environmental load. As one of its corporate responsibilities, Nippon Steel will undertake technology development at still higher levels.

The exhaust gas recirculation technology commercialized at the No. 3 sinter plant of the Yawata Works in 1992 is one recent outcome of Nippon Steel's air pollution control technology developments. This technology succeeded in reducing sinter plant exhaust gas emissions by about 30%.

Steelworks use large amounts of water. Water pollution control is another critical environmental control priority for the steel industry. Ammonia liquor from coke plants and other effluents from iron and steel production are biologically treated by the activated sludge process. One of the recent research results is the development of technology for biologically treating sulfur compounds and iron compounds; removal of which is expected to become more urgent with the increasing stringency of effluent standards.

Revegetation and beautification in and around the steelworks have been implemented to respond to continued urbanization around the steelworks and to ensure an aesthetic balance with the surrounding communities. As a result of these efforts, the steelworks have achieved a level of harmony with the local communities.

4. Environmental Load Reducing Activities Required of Companies

Traditionally, products have been accepted by consumers for their economic, functional and aesthetic value. With mounting interest in global environmental problems, the value of products is now being described in terms of "environment-friendly" and "earth-friendly".

This trend calls on the steel industry to manufacture "environmentally-conscious materials" or "ecomaterials" that impose a minimum of environmental load during their product life.

The concept of "life cycle assessment (LCA)" is being studied as a technique for evaluating the environmental load of specific products. The LCA concept has become popular in product development and manufacture. No methods are established yet for evaluating whether or not specific products are environment friendly or impose a minimal environmental load.

Last year, the International Iron and Steel Institute (IISI) formed a LCA study group. This group is scheduled to undertake LCA surveys and conduct one year's research to develop standard life cycle inventory (LCI) techniques for iron and steel products and to collect and present world-standard LCI data on iron and steel products.

In Japan, the Life Cycle Assessment Society of Japan was founded with the financial support of the Ministry of International Trade and Industry in October 1995. The society is studying the LCA technique and the formation, operation, and application of a LCI database.

Nippon Steel is creating the concept of low-environmental load products to discharge its corporate responsibility, as represented by basic research in the LCA technique using input-output analysis tables and applied research into LCA for product development. An in-house LCA research system was established to develop new processes, products, and materials by considering the environmental load throughout their life cycle.

As shown in **Fig. 2**, ferrous materials account for about 70% and 50% of automobiles and household electrical appliances, respectively. It is important to develop such iron and steel products that help reduce the life cycle environmental load of automobiles and electric appliances. Examples are high-strength, low-weight automotive sheet steel, and low-core-loss electrical sheet steel.

If a passenger car runs a distance of 100,000 km with fuel consumption of 12 km/L, for example, it is estimated that 70% of the carbon dioxide emitted by the vehicle during its life cycle is attributable to the fuel it burns. Refrigerators are estimated to produce 95% of their carbon dioxide emissions during operation. All related industries will have to work together in developing products and processes that are friendly to the environment.

In Japan and abroad, environment-friendly products are marked with labels to indicate that they are less polluting than

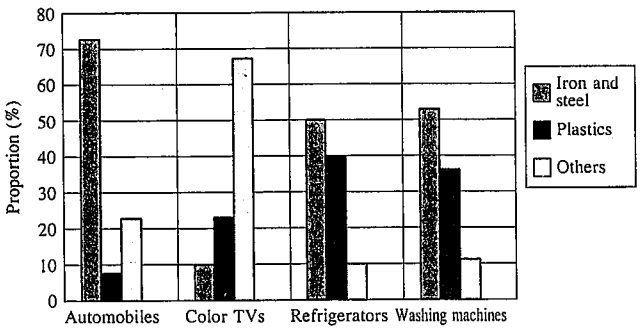

Fig. 2 Proportions of materials used in automobiles and household electric appliances

standard products. International standards for such labels are under preparation by the ISO. Standards based on the LCA technique are also being developed.

One recent trend is the consideration of environmental labels in government procurement, or what is called green procurement. Established at the beginning of 1996, a green purchase network started activities to popularize the purchase of environment-friendly products. This trend is expected to expand in the future. Companies must consider providing information on environment-friendly products in a format readily acceptable to consumers.

Generally speaking, increasing the service life and recycling rate of products is believed to reduce their environmental load throughout their life cycle.

Iron is a resource that can be completely recycled if properly processed. It is our role to evaluate the life cycle environmental load of recyclable ferrous products and to manufacture many environment-friendly ferrous products.

As shown in **Fig. 3**, the national recycling rate of steel cans in Japan was 37% in 1986 and grew to 70% in 1994. Nippon Steel is increasing the reuse of steel cans by such methods as charging crushed and bailed steel cans and steel cans generated at steelworks into basic oxygen furnaces. If steel cans are more efficiently separated and collected at source, their recycling rate will improve further.

The increase in the amount of iron and steel accumulated in society is predicted to boost the amount of iron and steel to be recovered as scrap and the amount of ferrous scrap to be reused as raw material. Iron and steel scrap contains elements that greatly affect the quality of ferrous products, including copper, nickel, and tin. The increase in the content of these elements is likely to cause such problems as reducing composition control. Such obstacles require the development of technology for removing these metals from iron and steel scrap and the construction of a social framework for facilitating the collection of ferrous scrap separately. The entire steel industry is developing steelmaking technology as part of a national project for environment-friendly steelmaking technology development. The Law for Promotion of Source-Separated Collection and Recycling of Containers and Packages (abbreviated to the Container and Package Recycle Law) and other mechanisms will encourage the recycling of resources. It is also essential to make such products in order not to break the recycling circle of iron and steel in the future.

Materials are discarded as wastes if they cannot be recycled. At present, landfill sites for both municipal solid waste (MSW) and industrial solid waste are rapidly diminishing in capacity. Reducing waste generation is a pressing issue. Nippon Steel is promoting the development of technology for reducing MSW volume, rendering the MSW nonpolluting, and recycling the MSW by making the most of its ironmaking and steelmaking equipment engineering technology and blast furnace operating technology. Some of the MSW management technologies are already commercialized. We will have to improve our technology if we want to contribute to the building of a society based on resource recycling economy where natural cycles can be maintained and resources can be smoothly recycled.

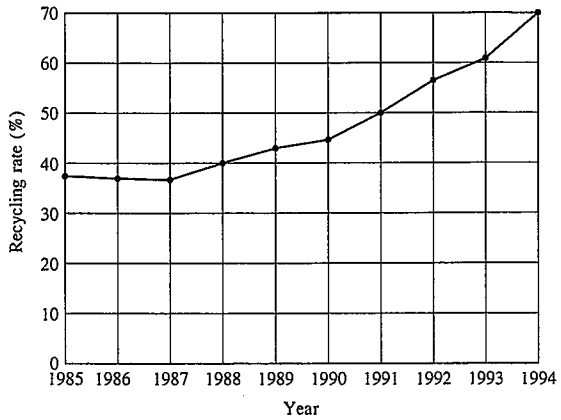

Fig. 3 Change in recycling rate of steel cans

The main pillars of corporate activities in the future will be the development of techniques for quantifying the life cycle environmental load of products, the collection of necessary data, the manufacture of environment-friendly products on the basis of analyzed results, and the public disclosure of environmental information demonstrating the nonpolluting nature of products.

5. Global Environmental Problems

Global environmental problems cannot be separately solved by individual companies or countries. Despite this fact, we must take as many initiatives as possible.

To combat ozone layer depletion, Nippon Steel has already abolished the use of all ozone layer depleting substances, including trichloroethylene, chlorofluorocarbons (CFCs), and carbon tetrachloride.

Concerning global warming, the Japanese government published the "Action Program to Arrest Global Warming" in October 1990, and pledged to stabilize carbon dioxide emissions per capita in and after 2000 at 1990 levels.

At the Rio de Janeiro Earth Summit, the participating nations agreed to strive for both economic development and environmental protection at the same time under the idea of sustainable development. The countries that signed the United Nations Framework Convention on Climate Change (UNFCCC) had their first conference in 1995. The policies and measures of advanced countries under the present convention were deemed insufficient for meeting carbon dioxide emission projections by the year 2000. It was decided to review corrective measures within the long-term framework to 2020 until the second conference in 1997. Given this situation, it is urgent to develop concrete measures to reduce carbon dioxide emissions.

The Intergovernmental Panel on Climate Change (IPCC), composed of some 1,000 scientists, economists, and other experts throughout the world, stated in the second assessment report: "The average temperature and the sea level on Earth will rise about 2°C and 50 cm, respectively, by 2100. It is confirmed that greenhouse gases continue to increase as a result of human activities. Temperatures in the past few years are the highest since 1860".

Nippon Steel recognizes the importance of this issue. It is necessary to conserve energy by making effective use of energy-saving technology and to search for more efficient methods for preventing global warming through joint implementation on a worldwide basis.

6. Conclusions

In recent years, people in the world have acquired greater awareness of global environmental problems. The time has already passed when the environmental load of processes alone

could be taken as an issue. When we evaluate the value of a product, we must now take the environmental load generated by the use of the product as an additional criterion. The idea that the environmental load of each product during its life cycle must be evaluated and disclosed to consumers is gradually taking root. This way of thinking is expected to establish a new framework for environmental conservation in society.

ISO 14000 is one such framework. Companies will have to study and implement their activities to meet such frameworks.