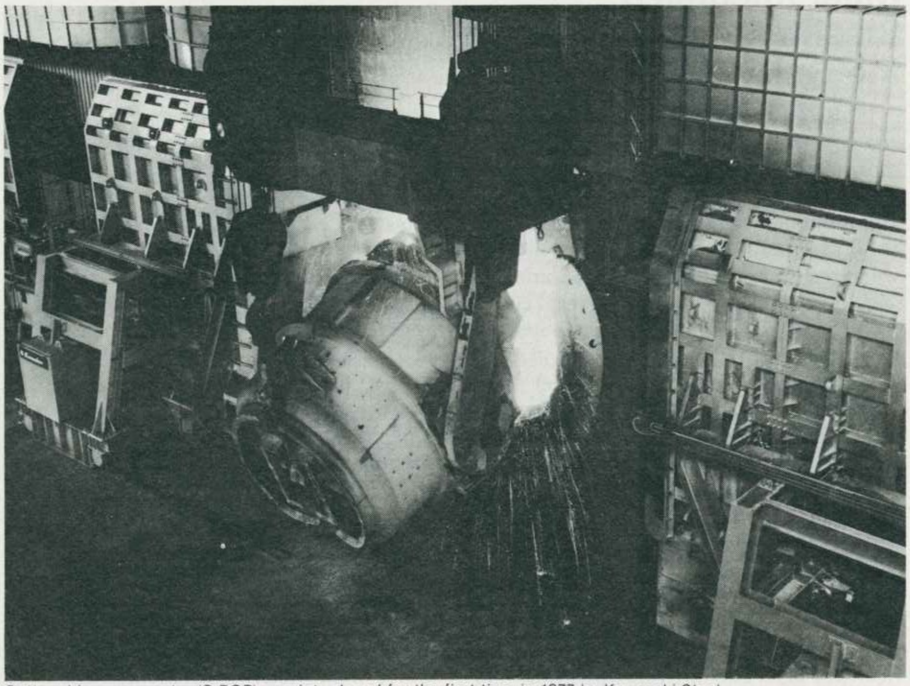
Kawasaki Steel Corporation

Combined Top & Bottom Blown Converter Makes its Debut



Bottom blown converter (Q-BOP) was introduced for the first time in 1977 by Kawasaki Steel.

One of the important challenges of the modern steel industry is to devise ways to make steel of outstanding quality in the most efficient manner.

Kawasaki Steel Corporation is grappling positively with this problem. A good example is its success in the application of combined blown refining to the converter.

The converter is the facility in which purified oxygen is blown through a pipe into molten iron produced in the blast furnace, giving the finished steel the properties required for specific purposes. The process is said to be as delicate, and as important, as the compounding of medicine by a chemist.

In the conventional method, molten iron and scrap are placed in the converter and oxygen is blown in from above through a pipe to oxidize and remove the carbon and other impurities in the pig iron. Known as the LD converter method (top blown method), this was for many years the main method used.

Although a bottom blown method giving better yield was also developed, its productivity was low because it tended to damage the refractories at the bottom of the converter. For years the top blown method remained the prevalent process in use.

Kawasaki Steel focused its attention on the bottom blown converter (Q-BOP) and was the first in Japan to introduce it in 1977. Through many technical developments, the company succeeded in extending the converter's life far beyond expectation and established a world record in furnace life and hit rate. This success ushered in the era of the "bottom blown converter."

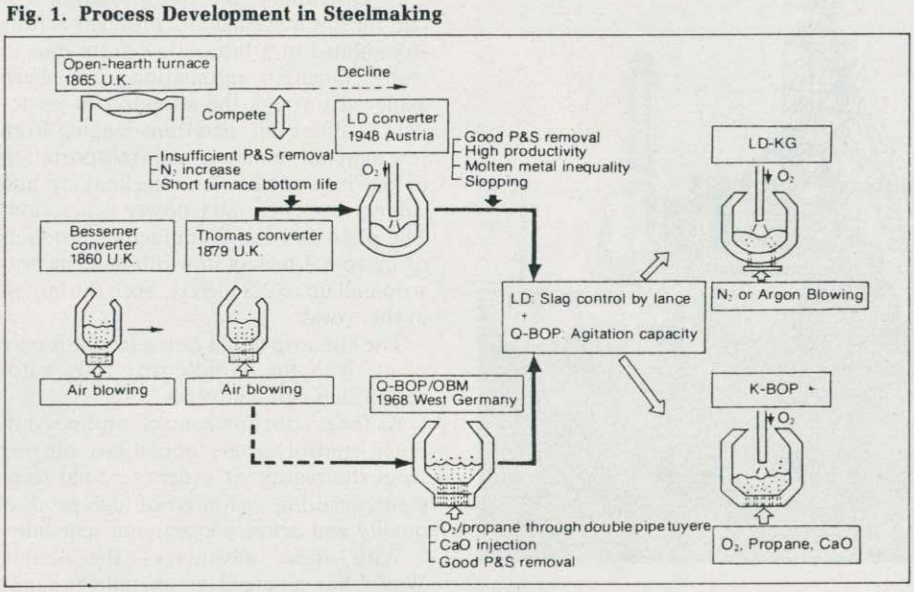
In order to meet today's exacting demands for quality steel materials, the steel industry is working to further develop clean steel technology for practical application. Kawasaki Steel has gone on to combine the advantages of both the bottom blown converter and the top blown converter in this "top and bottom blown converter."

The company developed two types of this converter. In the first type, oxygen is blown in from both the top and the bottom. In the second type, oxygen is blown in from the top and inert gas blown in from the bottom. The first method is known as K-BOP and the second as LD-KG. Conventional top blown converters can be remodelled into either of these combined blown refining configurations at a low cost. Since each type has its own distinctive features, they are effective in manufacturing steel for many different purposes as well as in making clean steel.

At Kawasaki's Chiba Works, K-BOP is used to make stainless steel and electromagnetic steel plates and sheets, while LD-KG is used to make high tensile steel for line pipe and 9% nickel steel for LNG containers. The Q-BOP is used at the plant to make sheet for use in automobiles, tinplate, and galvanized steel sheets. At the company's Mizushima Works, too, one K-BOP and three LD-KG are now in operation, with the remaining two conventional converters scheduled to be remodelled into K-BOP type by next spring. Kawasaki Steel will thus be the first steel company in Japan to remodel all its converters into the top and bottom blown type.

Kawasaki's technology in this field has gained a high reputation overseas and the company has received many inquiries. This technology is certain to be the most talked about product in steel-making engineering. The company expects that its combined blown refining technology will trigger a global switch from the top blown converter to the combined blown refining converter.

Fig. 1. Process Development in Steelmaking



Kobe Steel, Ltd.

Qatar Integrated Steelworks—the First in the Gulf Area

In 1974, Kobe Steel, Ltd. successfully concluded a contract to construct an integrated steel mill in Qatar in the Middle East. In those days, Qatar's economy was almost 100% dependent on oil but the country was already preparing for the day when the wells would run dry. Qatar's aim was to build itself into an industrial country by making best use of its abundant reserves of natural gas. Top priority was given to the construction of a steel plant to manufacture steel bars, the basic material used in the construction industry. Qatar sought a company that would implement the project from beginning to end, including design, construction, operation and management.

Thus, Kobe Steel signed a full turn-key contract with Qatar. The contract worth ¥75 billion covered not only engineering, manufacture of equipment, and construction but also guidance in operation and management of the mill.

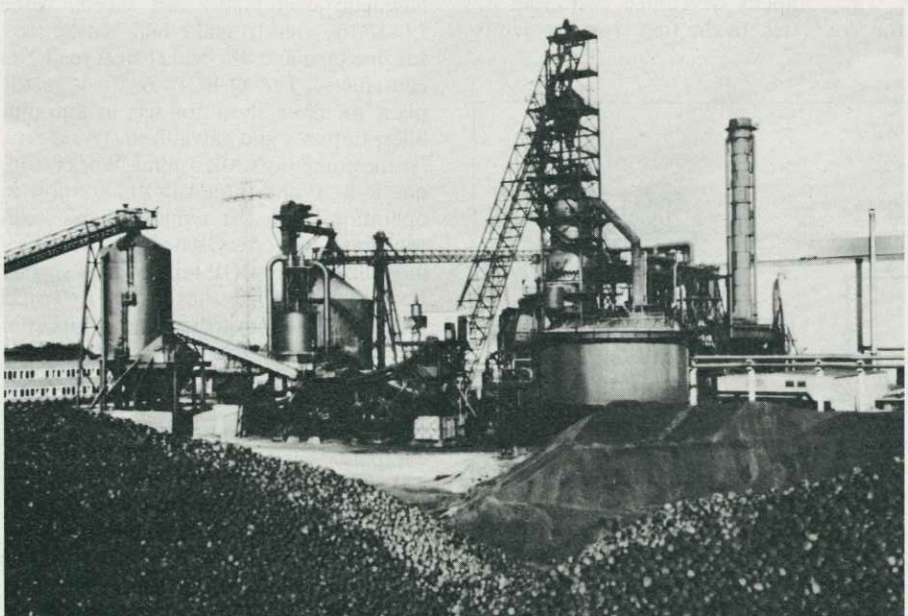
After four years of all-out effort, Kobe Steel completed the works in 1978. The result is a steel mill equipped with a direct reduction furnace with an annual production capacity of 400,000 tons. It also has two electric furnaces, two continuous casting machines, a rolling mill, and various facilities attached to these major plants.

Kobe Steel dispatched more than 100 specialists in all fields to provide management services. They undertook the following tasks: (1) arranging financing, (2) recruiting labor, (3) training local personnel, (4) procuring principal raw materials, auxiliary materials, and machinery and equipment, (5) developing management tools (such as systems, ledgers, slips and manuals), (6) computer applications and (7) marketing of products.

The steel mill began commercial operation in April 1978, and the following year produced results beyond the designed capacity. Today it is continuing to produce at above its nominal capacity to annually turn out 330,000 tons of steel bars. Nearly 20% of the steel bars produced at this mill are used domestically and the rest is exported to neighboring countries. The Qatar Steel Company enjoys an excellent reputation among other Arab nations.

The success of the Qatar steel project has led to other overseas orders for Kobe Steel, including construction of the Katsina wire rod mill in Nigeria, modernization of the Lenin Works' steelmaking plant, the construction of a steel wire rod/bar rolling mill and a section mill for the Misurata Steelworks in Libya, and participation in the El Dikheila integrated steelworks project in Egypt. The Qatar project also led to Kobe Steel's successful bids for engineering projects in fields other than steel. They include the construction of three cement plants in Indonesia and Jordan, an LPG recovery plant in Algeria, sulfuric acid plants in Zambia and Iraq, urea fertilizer plants in Malaysia and Indonesia, and a casting and forging plant in Bulgaria, and participation in the casting and forging project in Mexico.

Kobe Steel functions under a composite management system, having versatile divisions of steel, nonferrous metals, welding consumables, machinery and engineering. In short, the company is capable of providing clients with managerial and operational know-how, and training of operators, as well as engineering, supply of equipment and construction. Thus, the company's engineering business is expected to be the mainstay in parallel with the steel business.



Direct reduction furnace facility

Nippon Kokan K.K.

Ohgishima Project—A Model Steelworks

During the 70 years since its foundation, Nippon Kokan K.K. (NKK) has undertaken many projects in keeping with the needs of the times. One of the most important examples was the construction of the Ohgishima complex with an annual crude steel capacity of 6,000,000 tons.

NKK's Keihin Works in Kawasaki suffered from various problems, including its proximity to urban areas, the small site, dispersed siting of manufacturing plants and superannuation of production facilities.

The Ohgishima project was designed to revitalize the Keihin Works. The project called for replacing the major facilities with a giant steelmaking complex on manmade Ohgishima island in Tokyo Bay. The land was reclaimed with 8.5 million cubic meters of earth—more than that dug to build the Suez Canal. The project, undertaken from 1971 to 1979, may be the last case in this century of an integrated steelworks being built completely from scratch in Japan.

In the past, most integrated steelworks construction in Japan was aimed at boosting production capacity. The Ohgishima project was an epoch-making undertaking in that it was aimed at increasing the efficiency of plant operation and preventing pollution.

The Ohgishima complex has the following three major features:

(1) Rational plant layout, up-to-date production facilities and high-level production control system

In Ohgishima, the transportation system for raw materials and products is fully streamlined in a linear flow from east to west. Greater automation has been achieved through the adoption of up-to-date facilities for operations ranging from raw materials handling and transportation to pig iron production, steelmaking and rolling processes, and power generation. The plate mill can manufacture products of up to 5.3 meters in width and the hot-strip mill up to 2.3 meters, both the largest in the world.

The hot-strip mill is also a revolutionary plant, with the world's first fully automated slab and coil yards.

As for production control, on-line computer control covers operations ranging from the receipt of orders to final shipment, ensuring customers of high product quality and delivery exactly on schedule.

With these advantages the Keihin Works has emerged as an outstandingly

Aerial view of the Ohgishima complex that has an annual crude steel processing capacity of 6,000,000 tons.

efficient steel plant. Productivity (crude steel output per plant worker) nearly doubled from 240 tons in 1967 to 410 tons in 1981.

(2) Energy-saving measures

A. Representative of energy-saving facilities in the production process is its continuous casting lines which are important as well from the viewpoint of conserving resources. The continuous casting rate has been rising recently in Japanese steelworks. At the Keihin Works, the rate rose from 53% in 1978 to 90% in 1981.

B. Most energy generated within the complex, such as gas, heat and pressure, is recovered for effective utilization. All energy is centrally controlled by computer.

(3) Pollution prevention measures

About 20% of the total $36 million investment in the complex went to pollution prevention measures, such as minimizing the emission of SOx, NOx and dust. Efforts were made to improve the environment of the working site and neighboring areas.

NKK's Ohgishima project is a model of steel plant construction, an ideal example of a steel mill sited near an urban area and of the modernization of aging steelworks.

Nippon Steel Corporation

Ultra Energy-Saving Raw Material Carrier

Two mammoth iron ore carriers of the 200,000 DWT-class, the Shinho Maru and Hoei Maru, were completed in August and September this year. Both ships are revolutionary ultra energy-saving carriers designed under the "go-slow" concept, involving a switch from conventional high-speed mass transport to an era of fuel-economizing low-speed mass transport. The bunker oil consumption per ton of cargo is about one-third that of conventional carriers and about half that of an earlier series of energy-saving ships completed in 1980.

The Shinho Maru, built by Mitsubishi Heavy Industries, Ltd. for Shinwa Kaiun Kaisha, Ltd., and the Hoei Maru, constructed by Kawasaki Heavy Industries, Ltd. for Nippon Kisen K.K., 209,000 DWT respectively, were immediately assigned to Nippon Steel's raw material transport fleet. They are already in operation carrying iron ore from Australia to the company's mills in Japan.

Japan's integrated steelmakers import almost all their iron ore and coking coal, the principal raw materials of steel. Nippon Steel alone imports about 70 million tons of raw materials annually from far-flung supply sources, including Brazil and Australia. The distance is much longer for Japanese steelmakers than for those of other major steel-producing countries. Moreover, most raw material imports are on an FOB basis.

Faced with the greater costs these entailed, Nippon Steel took the initiative in seeking to cut shipping costs. In cooperation with shipping firms, the company put jumbo special-purpose carriers into service in the Pacific and introduced mammoth ore/oil combination carriers on the Atlantic run.

However, the oil crises of 1974 and 1978 sent the price of bunker oil skyrocketing and the cost of transporting raw materials rose sharply. The proportion of fuel cost in the freightage paid to shipping companies rose from about 10% in 1973 to 30% the following year and to more than 50% in 1980.

After the oil crises, Nippon Steel made energy conservation one of its top management goals. The corporation succeeded in reducing its consumption of energy by about 14% per ton of crude steel. To reduce oil consumption, the corporation worked to achieve oil-less operation of its blast furnaces, which consumed 2,300,000 tons of diesel oil in 1978. Blast

Hoei Maru, one of the two mammoth iron ore carriers of 200,000 DWT-class furnace consumption of oil has now been reduced to almost zero. Another major target in the energy conservation and cost cutting drive was to reduce the consumption of bunker oil used by raw material carriers.

A first series of energy-saving transports were completed at the time of replacement shipbuilding in 1980. For the construction of the two new ultra energy-saving transports the company took things even farther. Five project teams were organized horizontally linking Nippon Steel, shipping companies and shipbuilders. Nippon Steel made its energy-conservation wishes as the consigner of cargo known to the project teams, while experts of the shipping and shipbuilding companies expressed their outspoken views. As a result, in contrast to the first series which only partially incorporated energy-conservation technology, the new ships adopted energy-saving technology comprehensively, resulting in a revolutionary new type of carrier.

Forming the backbone of the many energy-saving measures was the adoption of the "go-slow" concept mentioned at the outset. The basic thinking switched from the "high speed and high fuel consumption" of the era of cheap bunker oil to "speed reduction, higher fuel efficiency, low horsepower engines and reduction in bunker oil consumption." In concrete terms, the carrier's optimum speed was reduced by about 20% from 15-16 knots to 12 knots. To conform with the reduction in speed, the shape of the hull was modified into a bulging low-speed form. In addition, daring use was made of numerous new technologies, such as large-diameter slow-revolution propellers and gear reduction in low-speed engines.

Many inquiries have been received from overseas concerning the ultra energy-saving carriers, while other Japanese steel works have been stimulated into building similar ships of their own. Nippon Steel's conventional raw material carriers will soon start reaching replacement age, at which time the performance of the Shinho Maru and the Hoei Maru will serve as reference for the construction of even more fuel-efficient vessels.

Sumitomo Metal Industries, Ltd.

Coal Utilization Technologies

The steel industry in Japan has been making great efforts to reduce energy costs and develop a substitute energy source for oil. Sumitomo Metal Industries has been engaged in the development of coal utilization technologies, such as all-coke operation of the blast furnace, use of COM (coal-oil mixture) or CTM (coal-tar mixture), and coal gasification and liquefaction. Research on the commercial development of carbon fiber is also in progress.

All-coke operation

As of March 1981, Sumitomo Metal Industries achieved oil-less operation, with all six of the blast furnaces in operation having been converted to operate on coke and tar only.

COM injection into blast furnaces

Since 1978 Sumitomo Metal Industries has been conducting basic research on injecting COM into blast furnaces. A series of tests at Kashima Steel Works put the company ahead of other steelmakers, since the tests proved conclusively the possibility of using COM as a supplementary blast furnace fuel, and also established the validity of Sumitomo's COM injection technology.

One-ton/day process development unit for coal liquefaction

Coal gasification

A 60t/day pilot plant for coal gasification was completed in February 1980 at Kashima Steel Works and is being used on an experimental basis. Data obtained indicate that coal can be gasified with a high degree of efficiency. The technology is a unique method developed by Sumitomo Metal Industries, utilizing basic oxygen furnace operating technology. Pulverized coal is blown onto the hot spot of molten iron, rapidly producing clean gases, chiefly carbon monoxide and hydrogen. One advantage of this method is that any type of coal can be gasified, including brown coal or the residue from the coal liquefaction process. With the basic technology for gasification now established, Sumitomo is engaged in a feasibility study for the design and construction of a large-scale plant.

Coal liquefaction

Sumitomo Metal Industries began research on coal liquefaction in 1978 with a commission from the New Energy Development Organization, an affiliated organization of the Ministry of International Trade & Industry's Agency of Industrial Science and Technology. A 1t/day Process Development Unit was completed in December 1981 and is under experimental operation. Present plans call for continued experiments through March 1984 to refine the Sumitomo Process and accumulate engineering data sufficient to construct large-scale facilities. This research is a joint project with several coal, chemical and engineering companies.

This "extractive coal liquefaction process" gives high yields of naphtha and fuel oils at moderate reaction temperatures. Another advantage is that the residue from the coal liquefaction process can be gasified and the dust produced in the gasification process can be used as catalyst in the liquefaction reaction.

Carbon fiber

Sumitomo Metal Industries began research in 1978 to produce carbon fiber from coal tar. This research is now continuing with a pilot plant constructed at Kashima Steel Works in May 1981. This plant can process 500 liters of coal tar per hour to produce the raw material for making carbon fiber. Sumitomo Metal Industries is joining forces with the Kureha Chemical Industry Co., Ltd. to study carbon fiber production processes: research with the Kajima Corporation is underway on compounds of carbon fiber and cement. A successful result of this research was the world's first concrete reinforced with carbon fiber.