

**KOBELCO**

# **KAKOGAWA WORKS**

**KOBE STEEL, LTD.**



# A production system that combines state-of-the-art facilities with the last word in sophisticated technology

Situated on the banks of the clear-running Kakogawa River and surrounded by lush greenery, Kakogawa Works is blessed with a beautiful natural setting. Since the start of operations as a fully integrated steel-making plant in 1970, Kakogawa Works has consistently manufactured high-quality products to meet a wide range of user needs through constantly upgraded state-of-the-art facilities and highly refined technology. The plant, which covers a total area of 5.7 million square meters, has been logically laid out for efficient, computer-controlled production and includes mills for hot and cold rolling and surface finishing, as well as facilities for producing steel plates and wire rods.

At Kakogawa Works, we're providing the quality steel products necessary to build a rich and pleasant living environment. At the same time, we understand the importance of protecting the natural environment and taking into full consideration the mutual benefit of both the plant and the local economy. We are striving to carefully and efficiently utilize the earth's limited resources, including the recycling of energy, in order to achieve steel production, which should be gentle to the natural environment.

## FEATURES OF KAKOGAWA WORKS;

- Customer confidence through quality control and faithful compliance with set delivery times
- Products based on state-of-the-art facilities and highly refined technology
- A production plant surrounded by greenery realized through measures to protect the natural environment
- A plant that benefits both the local economy and the company
- Integrated operation through the use of equipment designed and manufactured by Kobe Steel
- Efficient use of the earth's limited resources, including the recycling of energy
- A rational plant layout designed to accommodate production flow

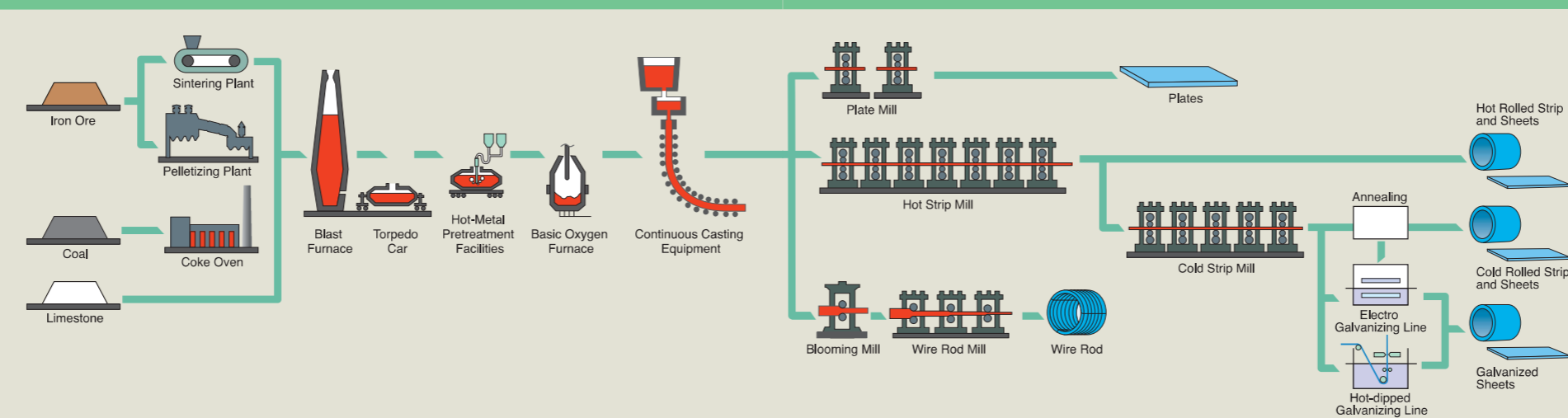


## KAKOGAWA WORKS: OUR PROGRESS OVER THE YEARS

- |   |   |
|---|---|
| <ul style="list-style-type: none"> <li>● <b>April, 1968</b><br/>Steel plate mill begins operation.</li> <li>● <b>August 1970</b><br/>Initial blow-in of No.1 blast furnace.</li> <li>● <b>April 1971</b><br/>Hot strip mill begins operation.</li> <li>● <b>April 1972</b><br/>Cold strip mill begins operation.</li> <li>● <b>January 1973</b><br/>Initial blow-in of No.2 blast furnace.<br/>No.8 Wire rod mill begins operation.</li> <li>● <b>January 1973</b><br/>No.1 Continuous casting equipment (slab) begins operation.</li> <li>● <b>June 1974</b><br/>No.1 Electro galvanizing facilities begin operation.</li> <li>● <b>October 1974</b><br/>The second blow-in of No.1 blast furnace.</li> <li>● <b>July 1975</b><br/>No.1 Hot-dipped galvanizing facilities begin operation.</li> <li>● <b>February 1978</b><br/>Initial blow-in of No.3 blast furnace.</li> <li>● <b>February 1980</b><br/>The second blow-in of No.2 blast furnace.</li> </ul> | <ul style="list-style-type: none"> <li>● <b>December 1980</b><br/>No.2 Continuous casting equipment (bloom) begins operation.</li> <li>● <b>March 1984</b><br/>No.3 Continuous casting equipment (slab) begins operation.</li> <li>● <b>October 1986</b><br/>No.2 Electro galvanizing facilities begin operation.</li> <li>● <b>April 1987</b><br/>No.1 continuous coating facilities begin operation.</li> <li>● <b>January 1988</b><br/>The third blow-in of No.1 blast furnace.</li> <li>● <b>April 1988</b><br/>Composite damping steel sheet manufacturing facilities begin operation.</li> <li>● <b>June 1989</b><br/>No.4 Continuous casting equipment (slab) begins operation.</li> <li>● <b>January 1991</b><br/>No.2 Hot-dipped galvanizing facilities begin operation.</li> <li>● <b>April 1996</b><br/>The second blow-in of No.3 blast furnace.</li> <li>● <b>May 2007</b><br/>The third blow-in of No.2 blast furnace.</li> </ul> |
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## DIAGRAM OF PROCESSES



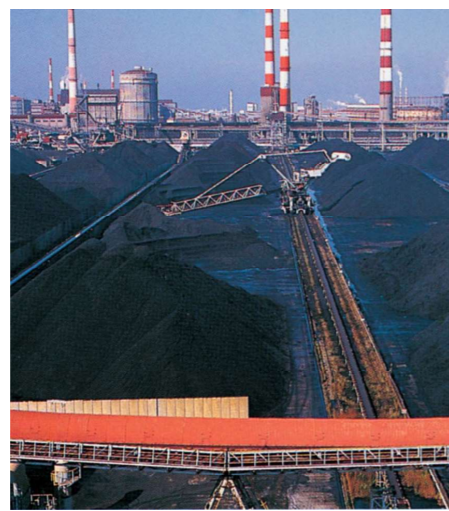
## PRODUCT APPLICATIONS

- **PLATES:**  
Ships, Bridges, Buildings, Industrial machinery, Plant equipment, Line pipes.
- **HOT ROLLED STRIP and SHEETS:**  
Automobiles, Buildings, Ships, Industrial machinery, Pipes, Material for rerolling.
- **COLD ROLLED STRIP and SHEETS:**  
Automobiles, Household electric appliances, Steel household items, Material for galvanization.
- **GALVANIZED SHEETS:**  
Automobiles, Household electric appliances.
- **WIRE RODS:**  
Steel tire cord, Pre-stressed concrete and strand, Spring, Rope, Fasteners (bolts nuts), Welding electrodes.
- **TITANIUM:**  
Automobiles, Power plants, Chemical plants, Roofs.





Ore & Coal Wharf



Coal Yard



Sintering Plant



Pulverized Coal Injection Equipment



Basic Oxygen Furnace



Continuous Casting Equipment



Stacker & Reclaimer in Materials Yard



Coke Oven



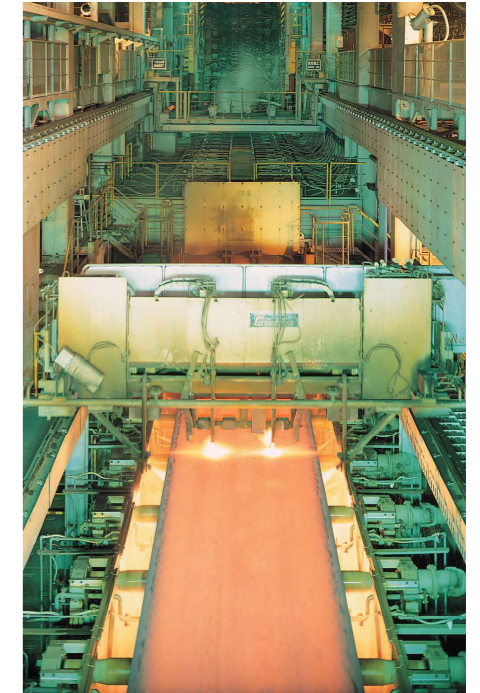
Pelletizing Plant



Blast Furnace



RH Vacuum Degassing Equipment



Continuous Casting Equipment

## RAW MATERIALS FACILITIES

### ● MATERIALS FACILITIES

A vast majority of the raw materials used at Kakogawa Works are imported. Almost all of the iron ore is supplied by Australia, Brazil, and India, while about 90% of the coal comes from Australia, Canada, and the U.S.A. The materials are unloaded at the wharf facilities of Kakogawa Works, where the depth is 17 meters and 200,000-ton bulk carriers can come alongside, and are stock-piled in the appropriate storage yards.

### ● UNLOADER

Main materials	3,000 / 2,100 tons × 1 unit		
	1,800 tons × 1 unit		
	1,500 tons × 3 unit		
Submaterials	700 tons × 1 unit		
	700 tons × 1 unit		

Wharfs	object	Wharf length	Depth
Main materials wharf	Iron ore and coal	1,250 m	14~17m
Submaterials wharf	Limestone	470 m	7~12m

### ● COKING FACILITIES

Coal is automatically fed from the coal yard to the mixing reservoir by a computer programmed reclaimer. High-quality cokes and gases are then produced in the coke oven by baking the blended coal at the temperature of about 1,100°C for about 20 hours.

A carbonized red-hot coke (1,000°C) is carried to the CDQ (Coke Dry Quenching), where it is cooled down to 150°C. After screening, the coke is charged into the blast furnace.

At the CDQ the apparent heat of coke is recovered as steam for power generation, thereby contributing to energy saving.

Facilities	Type	Nominal capacity
Coke oven	Koppers	2,500,000 tons/year

Facilities name	Nominal capacity	Recovered steam
CDQ No.1	150 tons/h	84 tons/h
No.2	165 tons/h	90 tons/h

### ● PRETREATMENT FACILITIES

Iron ore is fed to the crushing plant where it is crushed and shaped. The granular ore is subsequently sintered at the sintering plant and the ore powder is pelletized and fired at the pelletizing plant.

Since Kakogawa Works incorporates both a sintering plant and a pelletizing plant, iron ore is used more efficiently and the quality of the pig iron is improved.

A part of the exhaust gas generated in the sintering plant is returned to the sintering plant, and its apparent heat is used as sintering heat.

And, for the purpose of minimizing the discharge of air pollutants, the dust and SOx contained in the exhaust gas are removed with the electric dust collector and desulfurizing facilities.

Facilities	Nominal capacity
Sintering plant	16,800 tons/day
Pelletizing plant	11,000 tons/day

## IRONMAKING FACILITIES

### ● BLAST FURNACE

Coke and pretreated iron ore are fed into the blast furnace by conveyor belts. In the blast furnace, air heated to about 1200°C is blown through the tuyeres to transform the ore into pig iron. The molten iron is then discharged into a torpedo car and transported to the steelmaking plant.

In place of coke, the low cost grained coal fuel is injected from the tuyere. This grained coal injection technology is most advanced technologies.

Further, the waste plastic is also injected from the tuyere as a reducer. The high-pressure energy in the furnace is recovered as an electric energy through the turbine, which is effectively used in the plant.

Facilities	Size	Nominal capacity
No.1	4,550m <sup>3</sup>	10,000 tons/day
No.2	5,400m <sup>3</sup>	11,200 tons/day
No.3	4,500m <sup>3</sup>	10,000 tons/day

## STEELMAKING FACILITIES

### ● STEELMAKING PLANT

Within the torpedo car, molten iron still contains carbon, phosphorus, silicon, sulphur, and other impurities that must be either adjusted or removed. Desulphurization and dephosphorization devices provided in the torpedo car enable the removal of a portion of the phosphorus, silicon and sulphur before the molten iron arrives at the basic oxygen furnace. Inside the furnace, pure oxygen is blown on the surface of molten iron and simultaneously inert gas is blown into the molten iron through bottom tuyeres to adjust the carbon content and temperature as well as to remove impurities. The resulting molten steel is then refined by LF, CAS or RH degassers.

Facilities	Number	Heat capacity	Nominal capacity
Basic oxygen furnace (LD-OTB)	3	250 tons	567,000 tons/month

## CONTINUOUS CASTING FACILITIES

### ● CONTINUOUS CASTING EQUIPMENT

After refining, molten steel is continuously cast to produce such high-quality semi-finished products as slabs and blooms.

This streamlined production process eliminates the ingot making and blooming stages and results in energy savings as well as improved yields.

Kakogawa Works has four Kobe Steel-made continuous casting systems: three for producing slabs and one for producing blooms.

Facilities	Nominal capacity	
No.2 (bloom)	140,000 tons/month	
No.3 (slab)	220,000 tons/month	
No.4 (slab)	1 strand	105,000 tons/month
	2 strand	135,000 tons/month





Plate Mill



Hot Strip Mill



5 Stand Tandem Mill



Electrogalvanizing Line



Continuous Coating Line



No.8 Wire Rod Mill



Laminar Cooling Facilities



Continuous Annealing Line



Hot-dipped Galvanizing Line



Pallet Yard

## ROLLING FACILITIES

### ● PLATE MILL

Two computer-controlled, four-high mills roll slabs into plates for ships, bridges, industrial machinery, and plant equipment. Every plate is produced under a strict quality control system that guarantees high product quality. In fact, Kakogawa Works is designated an approved steel plate mill by such quality assurance societies as the American Society of Mechanical Engineers and Lloyd's Register of Shipping.

Facilities	Stand number	Nominal capacity
Roughing mill	1	140,000 tons/month
Finishing mill	1	

### ● No.8 WIRE ROD MILL

The blooming mill feeds  $155\text{mm} \times 11\text{m}$  billets to the wire rod mill. These billets are heated and then rolled at a maximum speed of 85m/second to produce wire-rod ranging from 5.5 to 18mm  $\phi$ .

The 2-ton coils are used in a wide variety of products including cold headers, steel tire cord, piano wire, rope wire, and welding electrodes.

Nominal capacity	Product specifications	
	Diameter ( $\phi$ )	Max. weight
115,000 tons/month	5.0~18mm	2 tons

### ● HOT STRIP MILL (CONTROL COOLING UNIT)

Our hot strip mill employs the work roll shift system for optimum crown control, hydraulic screw-down AGC for gauge control, and a coiling temperature control system to enable the production of high-tensile strength steel endowed with high formability.

Our steel products are manufactured to fully meet the high standards of quality necessary for the automotive, construction and machinery fields. Half of the hot strips we produce are shipped as they are, while the remainder undergoes further processing in the cold strip mill.

Facilities	Stand number	Nominal capacity
Roughing mill	4	360,000 tons/month
Finishing mill	7	

### ● COLD STRIP MILL

Both of the rolling mills (a 68-inch, 5-stand tandem mill and a 51-inch reversing mill) in the cold strip mill process hot rolled coils into cold strip products and mother coils for coated sheets, electrogalvanized sheets, and hot-dipped galvanized sheets. Continuous annealing line provides high-grade cold rolled sheets for deep drawing and high-tensile strength steel sheets.

Facilities	Stand number	Nominal capacity
Tandem mill	5	150,000 tons/month
Reversing mill	1	10,000 tons/month

Annealing facilities	Number	Nominal capacity
Continuous annealing line	1	45,000 tons/month
Unitized annealing department	66	85,000 tons/month

### ● ELECTROGALVANIZING LINE

The two electrogalvanizing lines process mother coils into highly corrosion-resistant electrogalvanized sheets and double-layer electrogalvanized alloy sheets that have good surface and formability characteristics. Further, the steel sheet is coated with film having high finger-print-free quality and lubricating properties.

Line	Nominal capacity	Product specifications	
No.1	25,000 tons/month	Thickness	0.3~3.2mm
		Width	600~1,550mm
		Max. weight	20 tons
No.2	35,000 tons/month	Thickness	0.3~2.3mm
		Width	600~1,600mm
		Max. weight	25 tons

### ● HOT-DIPPED GALVANIZING LINE

Mother coils are dipped into a molten zinc bath continuously. Easy-to-paint, highly weldable steel-alloy sheets, and minimized spangle steel sheets, having high corrosion resistance are manufactured in our plant.

Line	Nominal capacity	Product specifications	
No.1	23,000 tons/month	Thickness	0.3~4.5mm
		Width	600~1,250mm
		Max. weight	23 tons
No.2	33,000 tons/month	Thickness	0.4~2.3mm
		Width	700~1,880mm
		Max. weight	25 tons

### ● CONTINUOUS COATING LINE

Cold rolled or galvanized coils are roll-coated continuously and made into various coated coils.

This line has a 2-coat & 2-bake system and produces uniform coating and high quality products, organic composite coated steel sheet and pre-coated metal sheet.

Line	Nominal capacity	Product specifications	
No.2	5,000 tons/month	Thickness	0.3~2.3mm
		Width	600~1,600mm
		Max. weight	25 tons

## SHIPMENT FACILITIES

### ● SHIPPING

The products manufactured at each rolling mill are efficiently transported to the warehouse or the pallet yard by freight train and separation type vehicle.

At the warehouse, the products are stored utilizing the address control system, and shipped by ship and track according to the customer's requests.

Wharfs	Berths	Wharf Length	Depth
Domestic	3	879m	5~8m
Export	3	775m	8~12m

## ENERGY LINE

### ● ENERGY LINE

The energy supply section has an independent generating facility to ensure management of energy, such as electric power and fuel, used in our steelworks.

Energy conservation is also promoted with power generation using a CDQ waste heat recovery facility and the introduction of highly efficient gas turbine power generating equipment.

Facilities name	Number of units	Rated output
Independent generating facilities	9	686.2 MW





# KOBE STEEL, LTD.

## IRON & STEEL BUSINESS

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