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CISDI

NEWSLETTER

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CISDI-designed high-speed cantilever mill for cold-rolled ribbed rebar line arrives at Heli Techtronic

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TOTAL SOLUTIONS AND TECHNOLOGY PROVIDER
PREFERRED BY GLOBAL METAL INDUSTRY

► **FULL-PROCESS SERVICES**

CISDI provides full-process services from the bulk material handling yard to the post-processing line of the hot mill.

► **FULL-FUNCTION SERVICES**

CISDI provides standard and customized consulting, execution and operations management services.

► **FULL-LIFE-CYCLE SERVICES**

CISDI provides the FEED (front-end engineering & design), implementation, and production and operations management services through the entire project life cycle.



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CISDI FEATURES IN IN-DEPTH REPORT IN GLOBALLY-RESPECTED INDUSTRY MAGAZINE

An in-depth report on CISDI's core technology and products has featured in The Association for Iron & Steel Technology's April publication.

USA-based, the AIST is a non-profit organisation with 17,500 members from more than 70 countries. It aims to advance the technical development, production, processing and application of iron and steel.

Its widely-circulated and well-respected monthly publication, Iron & Steel Technology is dedicated to providing the latest information on international breakthroughs and trends in equipment, processes and operating practices.

The article highlights CISDI's role as a core subsidiary of the Metallurgical Company of China (MCC) under China Minmetals. It details CISDI's ranking in the Fortune Global

500 and describes the company as a technology and solution partner for global metals industry.

Of the world's top 50 steel enterprises, 39 are CISDI's clients. Thanks to its operations around the globe, CISDI has provided multiple competitive systematic solutions to new plants along the Belt and Road Initiative routes, and upgrades for numerous European and American plants.

With a commitment to overall optimisation, CISDI re-engineers systems and units which improve the client's competitiveness and boost economic and sustainable development. Backed up with expert project management and manufacture and construction quality control systems, CISDI is a leading specialist in the modes of E, EP, EPC, EP+CM and EPCM.



Formosa Ha Tinh Steel (FHS) in Vietnam

CISDI has delivered the overall technological solution and the economic and financial models

Considering the client's needs first, CISDI provides one-stop services throughout the whole life cycle of the FHS project by means of overall process management and technology consulting



Baosteel Zhanjiang in China

The biggest Greenfield steel complex in south China showcases CISDI's uniquely strong competitiveness

CISDI has employed the combined tools of economic and technology consulting and simulation-based optimization, providing reliable and advanced overall integrated solutions

CISDI'S ROLE AT BAOSTEEL ZHANJIANG FEATURES ON NATIONAL CHINESE TV

A major TV station in China has conducted a major international report on Baosteel Zhanjiang's role in China's 40-year reform and opening up outcomes.

The report, by China Central Television 2, follows on from the station's widely-followed recent report on CISDI's role at Formosa Ha Tinh Steel in Vietnam for the series *Chinese Brands in Overseas Markets*.

Mr Zou Zhongping, of CISDI, who headed up the blast furnaces' technological process at Zhanjiang and was on the scene at both the Shanghai and the Zhanjiang plants, featured in the latest report. He commented: "In the many years spent on building Baosteel Shanghai and Zhanjiang plants, CISDI has been committed to applying innovative and green technologies and equipment.

"Our high-efficiency, low consumption mega blast furnaces, smart stockyard and rotary hearth furnace technology and our ZLD water treatment system have been successfully implemented. They are active players in transforming China's steel industry from relying mainly on import to export, and in upgrading its model, quality and speed of development".

In China's steel progression, CISDI is a metallurgical front-runner, responding competitively to the tests of transforming the steel industry into an intelligent and more environment-friendly sector of the national economy.



Screenshots from the CCTV-2 report

CISDI CREATES WORLD'S FIRST INTELLIGENT CONTROL CENTRE FOR LARGE BLAST FURNACE

The world's first large blast furnace control centre, designed by CISDI, has now gone into operation at Baosteel's Shanghai plant.

It is now conducting the centralised control of operations for Baosteel's four blast furnaces and managing their production.

The control centre crystallises Baosteel's upstream-BF intelligence, and will provide remote technical support for other blast furnaces at Baosteel plants in Shanghai, Zhanjiang, Qingshan and Meishan.

CISDI's teams managed two stages in the development of the world-leading intelligent and digital management model, which greatly enhances energy efficiency.

At the consulting stage, CISDI proposed a plan for intelligent control flows and a scheme for building an upstream blast furnace big data platform, plus blast furnace intelligent diagnosis and decision-making.

During the design stage, CISDI created a prefabricated steel structural model for

beams and columns, which were incorporated with brick walls. This concept saved construction time while controlling costs.

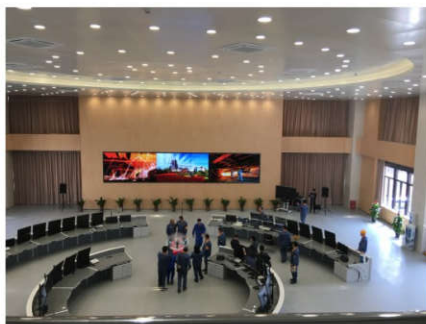
The architectural style took into account the functions of the centre. Functional divisions were optimised and streamlined. The total height of the building is 24 metres and the lobby rose is 8 metres tall, thanks to the co-ordination of engineering factors governing structure, architecture, water, heating and power.

The blast furnace emergency operation system has been given its own integrated intelligent power supply and distribution system to ensure safe operations. An integrated safety control unit replaces the conventional control consoles.

The intelligent control centre lays a solid foundation for upgrading Baowu Steel Group to an eco-friendly and sustainable complex as it continues to lead China's steel industry.



A visual of the exterior of Baosteel's Blast Furnace Intelligent Control Centre



Inside the lobby at the Intelligent Control Centre

ASSB REPORTS HEAT-UP OF BLAST FURNACE 1



ASSB's two blast furnaces

ASSB in Malaysia reports the successful heat-up of its blast furnace 1 at the end of March.

Another milestone on from the successful heat-up of the stoves for BF1 in early February, the furnace heat-up will last for ten days and is a major leap towards startup.

As part of ASSB's plans to build two blast furnaces, each with a volume of 1,080m³, the largest and most advanced ironmaking facilities in China, blast furnace 1 was designed and supplied by CISDI.

A stable, high-performance, low-consumption and intelligent furnace, it features numerous advanced CISDI technologies and equipment, including the patented new-model no-bell tops, top-combustion stoves, long-service-life hearths and shafts, compact single-ladle hot metal transport systems and combined casthouses, and highly-efficient and environmental-protection slag granulation systems.



Aerial shot of ASSB's site



CISDI's team, pictured at the BF 1 heat-up ceremony

ASSB SUB-STATION PUT INTO OPERATION

ASSB's 35kV sub-station for its Section Mill was put into operation at the end of March.

CISDI has built six substations at the site on an EP basis and all are now fully operational, ensuring power conditions are ready for a plant-wide startup.

CISDI contributed total solutions to the 35kV sub-stations, which power the rolling mill, sinter plant, captive power plant, coking plant, air separation station and section mill.

Installation of the substations began in August 2017. The first was operational three months later and ASSB has spoken highly of CISDI's quality products and services.

The main facilities for ASSB sub-stations with IIPR-based technologies are all manufactured and supplied by CISDI. Its systematic design and integration expertise consolidates sub-station protection and control. Its service includes system commissioning, operation supervision and training.



Cabinets supplied by CISDI for ASSB



A newly built ASSB substation

CISDI WINS BID TO SUPPLY TO BAOSTEEL'S INTELLIGENT HIGH-STRENGTH STEEL PLANT

CISDI has won the contract to supply a skin-pass mill and coil dividing line at Baosteel's 2,050mm intelligent high-strength steel hot mill.

The processing line will have an annual target of 800,000 tonnes and will feature world-class productivity methods, be capable of producing a variety of products and operate at intelligent levels.

CISDI has been awarded the contract on an EPC basis and will supply machinery, hydraulic, electric and automation equipment, and an intelligent control system.

CISDI has a vast amount of expertise in automatic coil preparation stations, automatic uncoiling threading, high-strength coil rebound press, integration of intelligent equipment, intelligent control and production model. It strives to achieve optimal technical indicators, including maximum yield strength of 1,000MPa and a maximum tensile strength of 1,500MPa.

The Baosteel processing line will be considered only two attended duty positions and pursue automatic and intelligent production in all procedures.

SANBAO STEEL AWARD CONTRACT TO CISDI

Sanbao Steel in Fujian province has awarded a contract to CISDI for a four-strand flat blank caster.

The qualified strands will be produced at a rate of 1.50 million tonnes a year and in a section size range of 150mm/160mm/180mm x 165mm-900mm. The steel grade to be cast will be carbon structural steel.

CISDI is contracted to package supply and installation. The task to create an advanced, reliable and cost-effective caster will involve the application of vertical-curved roller aprons for the caster, equipped with the butterfly-type turret, segments with closely-arranged rollers, the creation of a dynamic secondary cooling water distribution system, and process model.

Construction will take 8-9 months.



Aerial view of the mega blast furnaces at Zhanjiang Plant

Baosteel Zhanjiang Plant's two mega blast furnaces are among the most modernised in the world.

They represent China's state-of-the-art blast furnace ironmaking production and their clean production and energy conservation statistics are proving outstanding.

Each has a volume of 5,050m³ and both are designed and mostly supplied by CISDI. Critical equipment has been made in China and CISDI's independent design, integration and innovation have been crystallised for the ironmaking process, technology and equipment.

Both blast furnaces have been started up successfully and have been running with satisfactory indicators. They are presenting low consumption rates of energy and materials, high recycles and zero liquid discharges.

CISDI plays a vital role in developing for the ironmaking industry self-integrated blast furnace proper process systems, top-combustion stoves, raw gas dry-way dedusting systems, main process control systems, hardware and software. It applies self-developed BCQS serial-hopper no-bell tops, blower units, casthouse facilities and TRT units.

Optimised design for cost competitiveness

General design

The general design for Zhanjiang Plant followed the master principle for highly-efficient production; blast furnaces should be built at a low cost and result in a high performance.

To optimise the design, CISDI applied blast furnace engineering simulation technology. Reliable and tailored designs are recreated by simulation analyses on hot metal transport process. The average transport distance for hot metal torpedo ladle cars has been greatly reduced, creating the shortest distance in large blast furnaces throughout China. In so doing, logistics, energy consumption and operational costs have been reduced.

Optimised designs also work for the least investment per unit of blast furnace volume.

Advanced typhoon and corrosion resistance technologies and reliable complex foundation treatments are performing very effectively and safely, thanks to numerous studies on onshore construction, complicated geological conditions and corrosive atmosphere and numerous adjustments to on proposals and solutions.

To control investments, technological designs were optimised through multiple revisions of feasibility studies and preliminary schemes. The four running blast furnaces at Baosteel's Shanghai Plant were studied to find methods of improving the construction and production rate of Zhanjiang's furnaces. As a result, Zhanjiang's casthouse areas are much smaller and its conventional copper and cast-iron cooling staves have been upgraded to full cast-iron staves. These proven solutions are playing an important role in cost control.

Optimised profile

Zhanjiang blast furnace's profiles benefit from studies of Shanghai blast furnace 3. It was found the gas flows and burden dynamics of the segmented shaft angles for the profile can be better matched, to enable the shaft to be better adapted to the variations of gas flows. The furnaces will run more stably as a result.

Zhanjiang blast furnace 1 is known for withstanding the strength of the Mujigae typhoon in 2009 and for its fast restart capability after regular repairs. The full cast-iron staves and segmented shaft angles play an important function.

Optimised cooling system

Zhanjiang's cooling systems have been fitted with full cast-iron staves, in line with those at Shanghai blast furnace 3, which are ensuring a one-campaign service life that could last as long as 19 years.

Full cast-iron staves give an easier operation and recover more readily from unsmooth operations. Their manufacture quality and maintenance technique have been improved in recent years and now, even if they become worn at later stage of the service life, they can be repaired quickly during a planned shutdown period.

Former references with copper staves found that in practice they were causing blast furnace wall accretion and the force falling of skulls, which made the marginal gas flows harder to control. Cast-iron staves, however, avoid those problems and save costs.

A serial-connected cooling water system has been designed for Zhanjiang blast furnace 1 and 2. Total water volumes have been reduced, while single-pipe water flows are increased for a higher cooling efficiency.

This is also making a contribution to the plant's economy.

The cascade cooling water system consists of two circuits of pure water subsystems. Pure water subsystem 1 is designed for cooling the blast furnace's bottom water-cooled pipes, hearth's cross staves, and staves from bosh to throat. The cooled water returns to the pump station after being degassed by the top degassing tank. Subsystem 1 is divided into three sections in height, which are connected in series. Such an arrangement facilitates the system's thermal load measurement and leakage detection.

Pure water subsystem 2 is designed as the return water booster for subsystem 1. It has three branches connected in parallel. The three branches provide pressurised water for the tuyere coolers, blowpipes and stove system's valves.

All the inlet water for subsystem 2 must be degassed by the top degassing tank, a safety measure against gas-carried boosting operation. It causes no obvious temperature rise in the boosted water system.



Zhanjiang blast furnaces in operation

CISDI GROUP CO., LTD.

Optimised arrangements

1) A peninsula layout shortens the hot metal transport distance, in most circumstances, by an average of 900 metres and reduces the temperature drop of hot metal

2) A rain canopy facility at ladle charge positions at the casthouse has been built as a further measure for protecting hot metal from temperature drops in transport

A central control building has been built between Zhanjiang blast furnace 1 and 2. Both blast furnaces are connected to it by elevated passages. This arrangement occupies a smaller area, which saves cost, and requires fewer operators and maintenance staff.

Zhanjiang's blast furnaces also share a combined and centralised stockhouse, circulating water and PCI systems, which reduces investment costs and land use.

Self-reliant innovations and integrations

An environmental-protective no-bell top, domestically designed and manufactured

The no-bell top for a large blast furnace was technologically the monopoly of companies outside of China. In their mission to build a Chinese world-class blast furnace, Baosteel and CISDI organised a team to develop breakthrough technological equipment.

After four years of extensive research and tests, an IIPR-based no-bell top has been successfully produced.

Named the BCQS from the names Baosteel, CISDI, Qinye and Seng Quansong, the equipment is the result of theoretical studies, sample manufacture trials, the building of life-size equipment to simulate cold and hot state and critical innovations on the distributor's hydraulic compound control.

The BCQS top boasts a simpler structure, a lower rate of faults and a lower cost to those of imported models.

Features:

1) A renovated distributor's hydraulic compound control technology controls the precision of distributor's α angle within plus or minus 0.1° , a world-leading level

2) New-model water cooling and sealing structures for the distributor enhances cooling intensity and improves air-tightness and consumes less cooling water and nitrogen to reduce equipment operational costs

3) A hold-latch structure for installation of the distributing chute ensures easy assembly and disassembly and keeps the chute's change time to within 4 hours, half the time it takes to change on an imported model

4) Improved distributor's guide racks modify the one-block system into fabricated racks and lubricating racks which suffer less wear or damage under the synchronised control of distributor's three cylinders, helping extend the distributor's service life

Zhanjiang blast furnaces' top systems are examples of home-made tops which operate to world-leading main performance indicators.



A close-up of the Chinese-made blast furnace top equipment

Innovative top-combustion stoves with long life service and high-temperature blasting capabilities

Top-combustion stoves symbolise a technological advancement with their high-temperature blasting capabilities, low cost and stable structure.

The stoves at Zhanjiang's blast furnaces are upgraded designs which incorporate the strongest features of top and external combustion models. Eddy effusion combustion technology and hot-blast pipeline for external-combustion stoves,

features operating successfully at the Shanghai plant, have been integrated

1) Four top-combustion stoves are equipped with four independent mixed-blast rooms, improving working conditions for shells at hot blast outlets and for refractories. This protects the shells from being overheated red. The blast temperature at hot blast main and branch pipes is also reduced and piping system is stabler and more enduring.

2) Openings of stoves have been installed with self-locked assembled bricks, improving stress conditions of the openings and enhance stability of brickwork

3) Bellows and tie rod configuration have been optimised by analysis software in line with hot blast piping arrangements. Refractory bricks are tailored to the piping system, ensuring the hot-blast piping refractory can work longer and safely at a temperature of 1,300°C.

4) Preheating stoves and fume excess heat recovery system have been considered for the working condition that only blast furnace gas is fuelled for reaching a high temperature of 1,300°C.



Close up of the stoves at Zhanjiang blast furnaces

Critical equipment for large blast furnaces to be manufactured in China

Blast furnace top gas recovery turbine (TRT)

Zhanjiang's blast furnaces are equipped with TRT facilities. The host turbines are of a dry axial-flow reaction model. Brushless excitation synchro generators match for the turbines with a nominal power of 33MW and an upper water-cooling mechanism.

During a short shutdown of the blast furnaces, the TRT generators can be used temporarily as electric motors, avoiding frequent starts and stops of electric apparatus.

All the safety control signals are interlocked with fast shut-off valves for securing a safe operation of the TRTs. In case one signal is sent out, the fast shut-off valves will be automatically closed to stop the TRTs. Simultaneously, the fast-opening valves for a relief valve block will be automatically opened. These simultaneous-responsive automatic operations are designed for keeping a stable top pressure.

TRTs at Zhanjiang are the first units designed and manufactured in China. Those in operation for 5,000m³-level blast furnaces around the globe have been mastered by companies based outside China.

Features:

An improved safety control system with unique protection functions for the TRT and relief valve block in case of serious faults, with oil, power and signal shutoff switches

Improved materials for critical components: highly-effective TRT anti-clogging inhibitor to protect equipment from being corroded or brushed; improving the thermal gunning process and treating with blade's surface by shot-blasting, resulting in a better binding property between the gunned layer and the blade's base material

Optimised turbine structure: new-shape blades, newly-designed flow passages, and improved flash vessel's structure reduce resistance loss while increasing generation capacity

Blower station

Zhanjiang's blast furnaces are equipped with three blowers for their respective blower stations. The No.3 blowers are made in China and are the first for 5,000m³-level blast furnaces.

Test run results have shown the Chinese-made blowers are performing to the world's leading levels, and their pneumatic and mechanical performances meeting with design requirements.

1) An axial air-inlet structure is an improvement on the conventional radial air-inlet structure. Its advantages include a reduction of inlet piping loss and the machine's power consumption by 1%. The structure is also cost-saving as it lowers the mounting platform height of the blower unit

2) A fixing between the blower's bearing box and casing makes an easier adjustment on the coaxiality between rotors and casing

3) Three layers of cylinders for blower casing (the stator blade's loading cylinder, stator blade's regulation cylinder and external

cylinder). A complete layer of external cylinders can form effective protection for the stator blade's regulation mechanism and prevent dust and noise discharge. It also helps maintain an even temperature distribution between the stator blade's loading cylinder and regulation cylinder. This thermal insulation helps to stop condensation forming in the front of the casing when the incoming air temperature is too low

4) An advanced control system not only protects the safety of the blower units, it also allows a series of blast furnace production control functions - a constant air volume, a constant air pressure, air filling into stoves and a good control of oxygen enrichment



One of the blower stations at Zhanjiang's blast furnaces

Energy conservation and environmental protection

Environment-friendly vertical screens

The blast furnaces are installed with new-model vertical screens under their sinter and coke bins. The screens present a simplified

arrangement in a small area. Meshes can easily be changed and repaired and they enhance the screening efficiency while enclosing flying dusts within the structures.



Vertical screens around Zhanjiang's blast furnaces are better for the environment

Dry gas cleaning system

An upgraded model of dry gas cleaning equipment has been adopted for higher-efficiency and environment-friendly bag filters.

Features:

A large-diameter filter enables gas to be cleaned to enter and exit via the top of the cleaning system. Gas is distributed uniformly and equipment can easily be accessed for maintenance.

Dense-phase fluidised pneumatic conveyance of dusts creates a more stable operation of the dust conveyance system and extends the conveyor's service life

An automatic anti-clogging device on the dust conveying piping saves labour

Anti-corrosion spray coatings on the inner walls of clean gas piping renders them resistant to acid damage, moist heat and other erosions, bringing about a longer service life

To ensure the safety of blast furnace gas holders and reduce investment costs on plant-wide gas pipeline networks, the

temperature of the pipeline should be controlled to a maximum 60°C. To that end, a sprinkling tower is needed downstream of each blast furnace's relief valve block and TRT.

- 1) Clean gas temperature is reduced to the allowable range
- 2) Chloride ions and acid are separated from the gas and dissolved into water
- 3) Internal grates help a uniform diversion of gas flows
- 4) Irregular depressurised gas is introduced directly into the tower for a buffer
- 5) Multi-layer thermal and sound insulators are wrapped onto the external walls of the tower, a successful substitute for the conventional use of a silencer at a blast furnace plant

The sprinkling tower is a total solution to the large blast furnace. Its unified functions include acid removal, temperature control, dehumidification and silencing. This is the first reference for mega blast furnaces.



An upgraded bag filter for Zhanjiang's blast furnaces

Equalised gas recovery

To tackle the sources of pollution and noise emitted from the top of the blast furnace, the top gas bleeder applies CISDI's IIPR-based dry-way equalised gas recovery expertise.

Top gas with an equalised pressure will not directly bleed out into atmosphere. Instead it is cleaned by a cyclone deduster, recovered and then charged into the clean gas pipeline network near the sprinkling tower.

This process recovers and conserves energy, reduces carbon and dust emissions and saves costs. It also eliminates noise, which occurs during conventional bleeding.

Stove's thermal equalisation

Zhanjiang's blast furnaces recover high-pressure gas from internal stoves. It is charged into a pressurising stove for reuse.

This feature alleviates fluctuations in blasting air flow rate and pressure, helps to stabilise the blast furnace status and recycles thermal and pressure energies.

Cover manipulator for torpedo ladle car

Cover manipulators designed for the 380 tonnes of torpedo ladle cars reduces temperature drop of both ladle car and hot metal during transportation from ironmaking to steelmaking shops. It also helps suppress fume discharge.

Practice runs show that a good energy conservation and emission reduction result has been achieved by the cover manipulators.

Dedusting facility

Ore bins and coke bins have been fitted with independent dedusting systems. Ore fines are collected and sent to the sinter plant, while coke fines are sent to coal batching bins.

Casthouse C1 and C2 have been installed with dedusting equipment. In accordance with optimised arrangements of dust collecting points and air flow distributions, casthouse dusts are channelled into an enclosed environment.

The dedusting equipment is filled in with Chinese-made high-quality membranes. The upgraded structures make filtering operate at a low resistance, a high efficiency and result in a low-dust-concentration discharge.



The image below shows an optimal dust collection at the casthouse in Zhanjiang's plant.

CISDI-DESIGNED HIGH-SPEED CANTILEVER MILL FOR COLD-ROLLED RIBBED REBAR LINE ARRIVES AT HELI TECHTRONIC



A cantilever mill for a high-ductility cold-rolled ribbed rebar line has been designed, developed and delivered by CISDI to the Shandong steelworks of Anyang Heli Techtronic.

The CRMCD mill is a core unit for cold rolling the hot-rolled coils in a diameter range of $\Phi 8\text{mm}$ - $\Phi 18\text{mm}$ into high-ductility ribbed rebars in a diameter range of $\Phi 4\text{mm}$ - $\Phi 14$.

It is an intensified model, with characteristics of a modular and short-flow drive mechanism. CISDI's technical expertise enables rolling speeds to reach 1,200m/min, with added benefits of stable running and easy maintenance.

This unique mill is now being built at 11 plants across China. Once in operation the mills are expected to reach a total output of 1.50 million tonnes a year.

It is seen as a strong endorsement of China's commitment to green building materials, municipal works and high-speed railways.

The mill's mechanical structures are shown in the images below.



CISDI'S ROTARY HEARTH FURNACE

CISDI self-developed rotary hearth furnace is an environment-friendly treatment for solid waste.

The furnace utilises coal-based direct reduction technology to treat metallurgical dusts containing zinc.

Cooled dusts are reduced to metallised pellets within 15-25 minutes. This process allows iron, carbon and zinc elements to be recovered from the smelted zinc and alkali-rich dusts.



PROJECTS IN DETAIL



Baosteel Zhanjiang's rotary hearth furnace project

- Raw materials to be treated: blast furnace secondary dusts, converter's OG dusts, dedusting ashes from refining procedure
 - Treatment capacity: 200,000t/a
 - Technical indicators: metallisation ratio $\geq 75\%$; dezincification ratio $\geq 85\%$
 - Product to be used as the raw materials for the blast furnace and converter.
- Started up in June 2016



Yanshan Steel's rotary hearth furnace project

- Raw materials to be treated: blast furnace dusts from bag filter system, ore bin dusts, steelmaking dedusting ashes
 - Treatment capacity: 200,000t/a
 - Technical indicators: metallisation ratio $\geq 70\%$; dezincification ratio $\geq 85\%$
 - Product to be used as the raw materials for blast furnace and converter.
- Started up in June 2015