WISDRI IBF

WISDRI Intelligent Blast Furnace Solution Promotes BF Digital Transformation

China • Wuhan Nov. 17, 2022

CONTENTS

01

智慧高炉概况

WISDRI iBF Overview

01 BF Overview

- High temperature, high pressure enclosed black box for continuous production
- Multiple parameters, big lag, non-linear

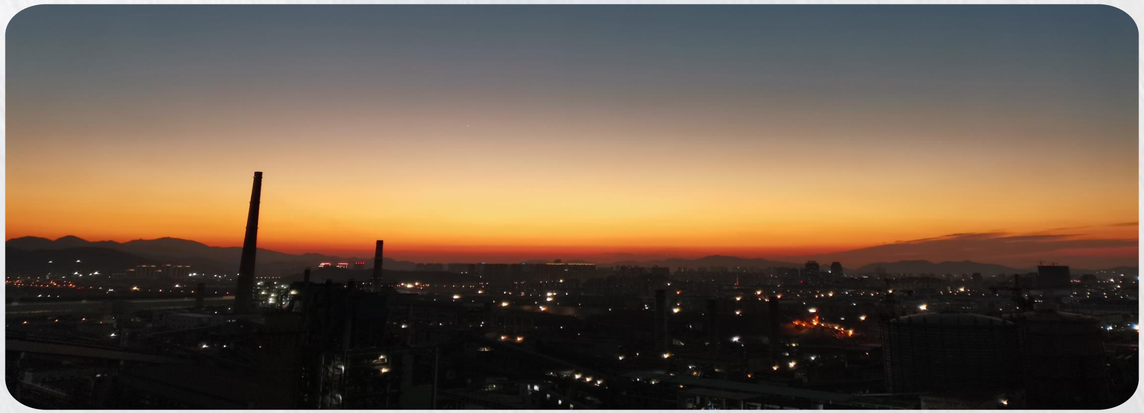
Features 01

- Lack of inside information
- A variety of adjustment methods, difficult for selection

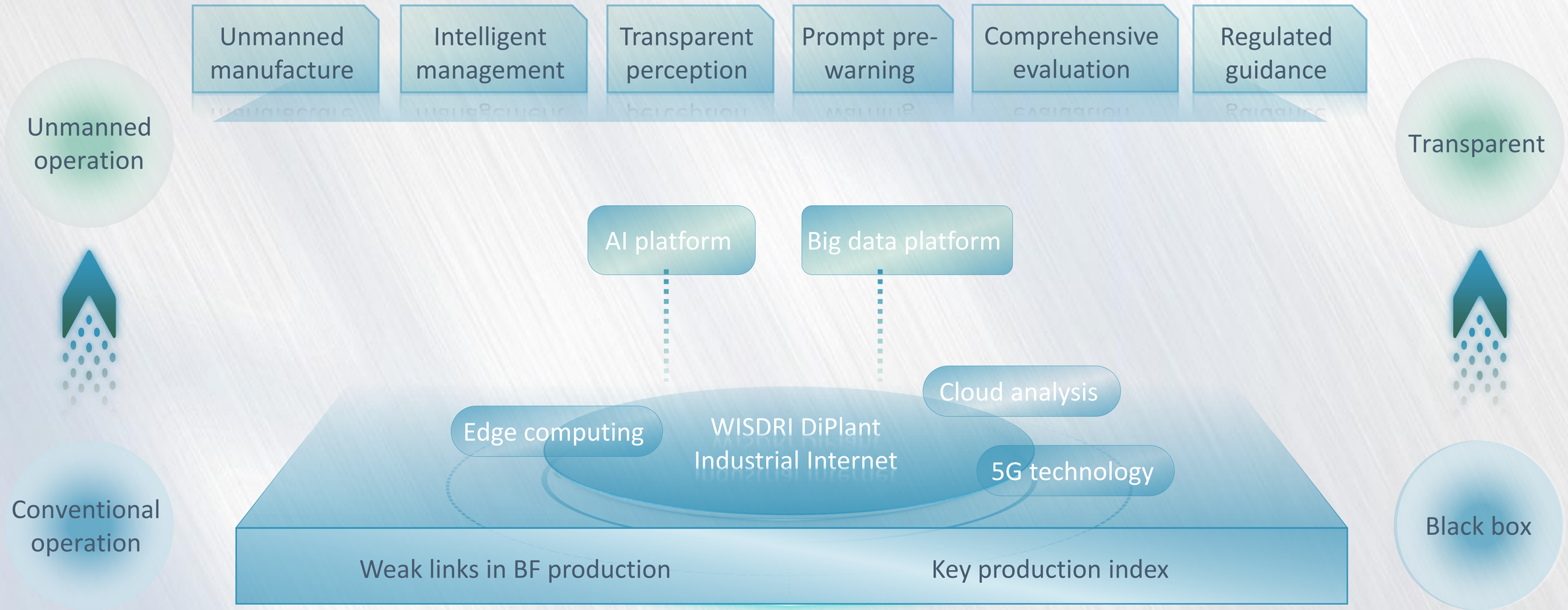
Difficulties 02

- BF smelting production based on operators' experience
- Furnace abnormalities handled improperly

Current status 03



01 IBF overview



02

生产无人化

Unmanned Manufacture

02 Unmanned manufacture

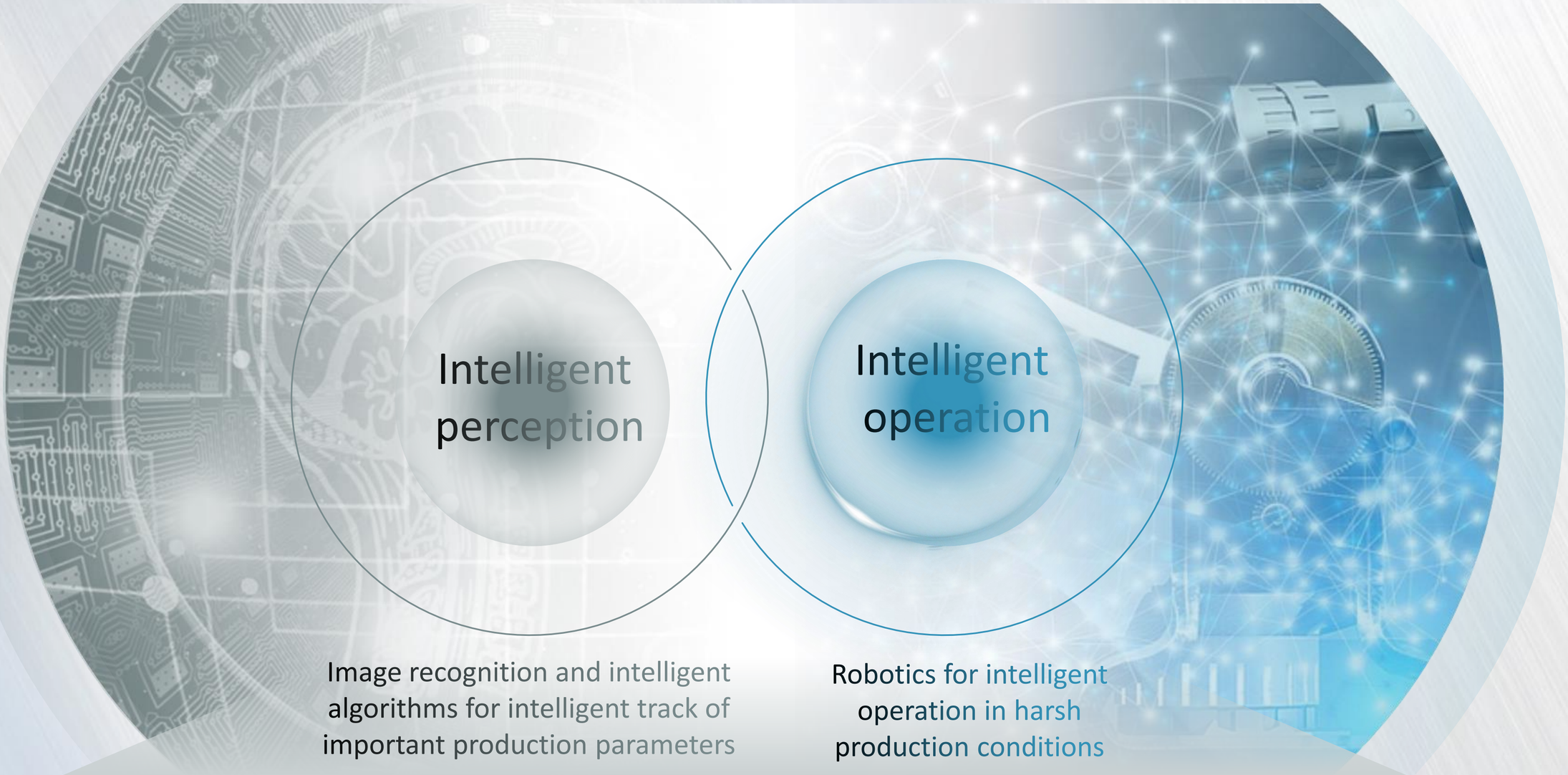


Image recognition and intelligent algorithms for intelligent track of important production parameters

Robotics for intelligent operation in harsh production conditions

Working together for realizing a safe, comfort and intelligent production environment

02 Unmanned manufacture

Intelligent slag grab technology

Intelligent and unmanned slag grab operations are realized through slag surface laser scanning, automatic precise positioning and optimal control strategy

Application Effects

7x24 unmanned operation, reducing 2 working posts and 8 operators

Equipment collision caused by human factors decreased through high precision positioning, resulting in less maintenance costs and less impact on production

Improving work efficiency by 25% while ensuring safety through intelligent slag grab path planning and interlocked operation of multiple equipment

Performance index

7x24	35 min.	10 min.	<5cm	<0.5 degree
100% Reliable	Single-layer grabbing time	Faster than manual operation	Control accuracy of trolley and carriage	Grab swing during travelling

02 Unmanned manufacture

Automatic drill rod change and mud adding robot

Robot, laser scanning, image recognition and positioning technologies are integrated to realize the combination of automatic mud adding and drill rod change functions; one such robot can work for two adjacent tapholes.

Application Effects

Cooperating with drill machine and clay gun to realize automatic taphole opening and plugging, improving intelligent operation of tapping

Emancipating operators from high-risk and heavy operations

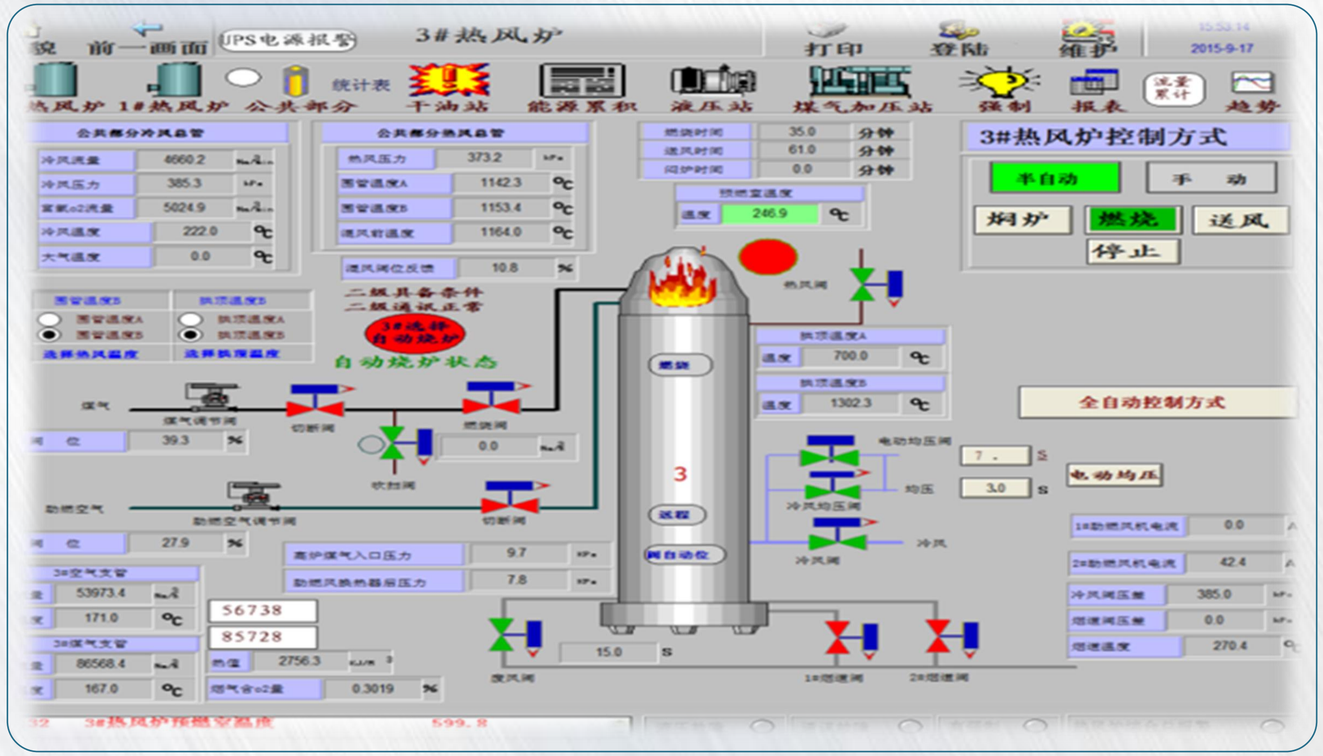
02 Unmanned manufacture

Intelligent combustion technology of hot stove

The optimal stove combustion strategy is realized on the basis of full-process automatic combustion to ensure stable hot air supply to the blast furnace in an efficient way with less energy consumption.

Application Effects

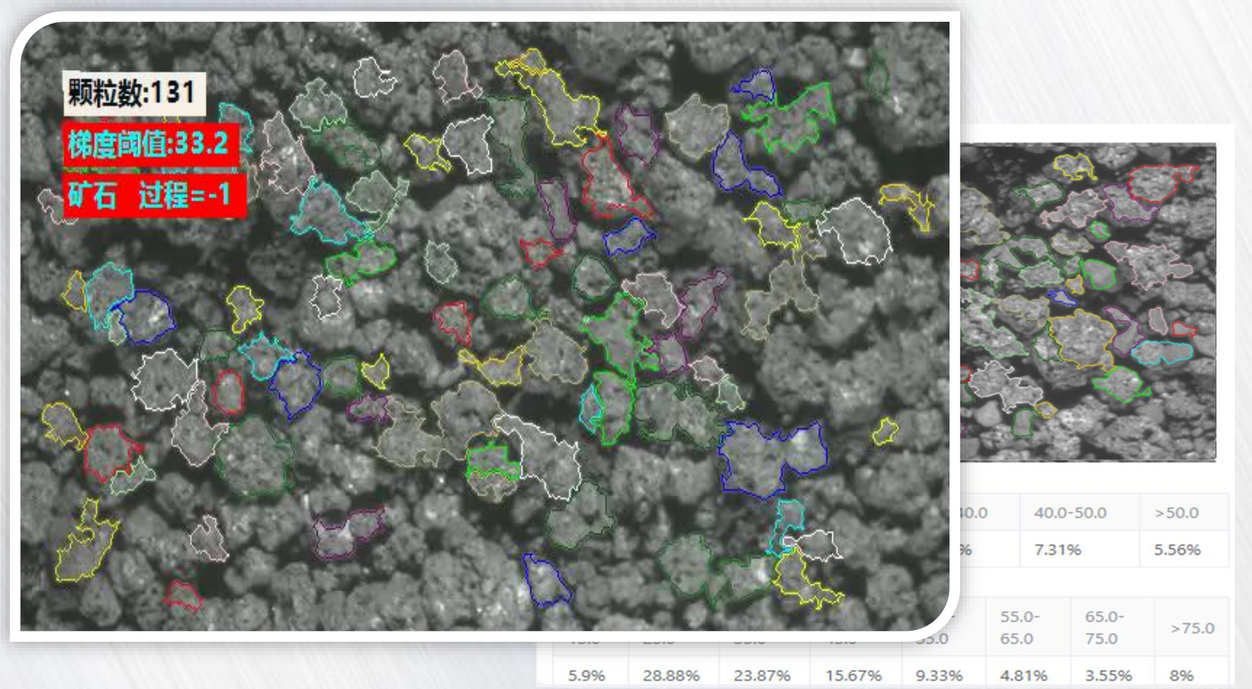
- Reducing gas consumption and carbon emission by 3% compared with manual combustion
- Raising the stable hot blast temperature by 2.6℃
- Lessening the work intensity of operators



02 Unmanned manufacture

Grain size measuring of raw material

Image recognition algorithm is employed to automatically identify the type, particle size and grain size distribution of raw materials on the belt.



Application Effects

- Addressing the problems of untimely manual sampling and incomplete sampling results
- Providing data reference for BF operation through real-time availability of grain size of raw material
- Lessening sampling workload of lab. personnel

Performance index

<±2mm

Calculation error of raw material dia.

>99%

Identification accuracy of raw material type

02 Unmanned manufacture

Gas stream measuring of furnace top

The machine vision technology is used to conduct depth mining on the infrared video data of the furnace top, identify the air stream distribution and capture the channeling to realize the monitoring and evaluation of the top gas stream, thus assuring smooth operation of the blast furnace.

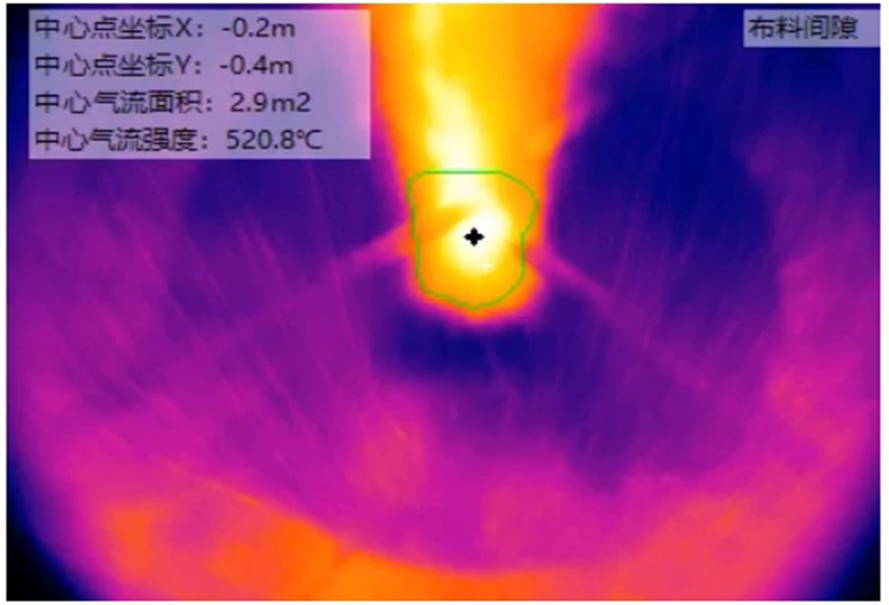
Application Effects

Obtaining position and strength of the center and edge gas stream to provide basis for automatic judging of furnace condition

Capture the channeling to ensure smooth operation of the furnace

Capable of providing the overall temperature distribution measuring on the top plane of the furnace, a supplement to the conventional cross temperature measuring

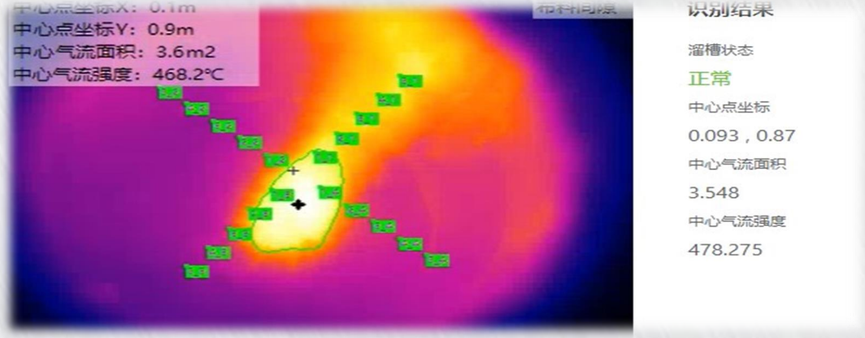
炉顶红外成像



Performance index

$<\pm 5℃$

Error of infrared temperature measuring



03

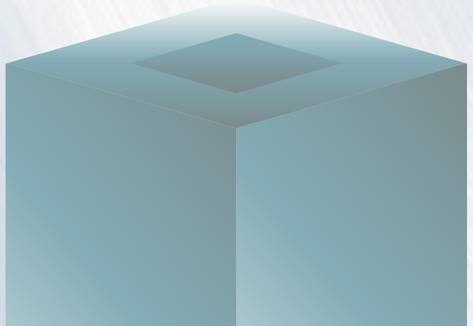
管理智能化

Intelligent Management

03 Intelligent Management

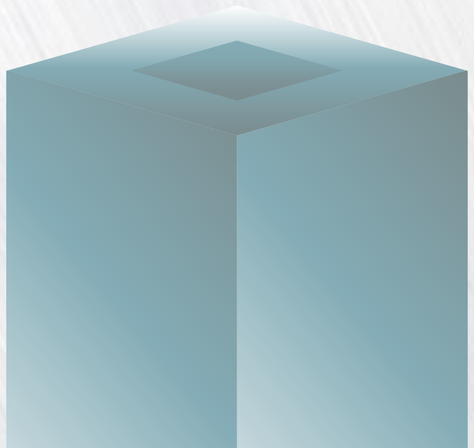
Lean production management

- ✓ Integrated control of burden blending and charging
- ✓ Intelligent management of equipment maintenance
- ✓ Intelligent tracking of tapping
- ✓ Comprehensive grading of BF
- ✓ Management cockpit for furnace chief
- ✓ Formatted shift handover log
- ✓ Operation deviation evaluation



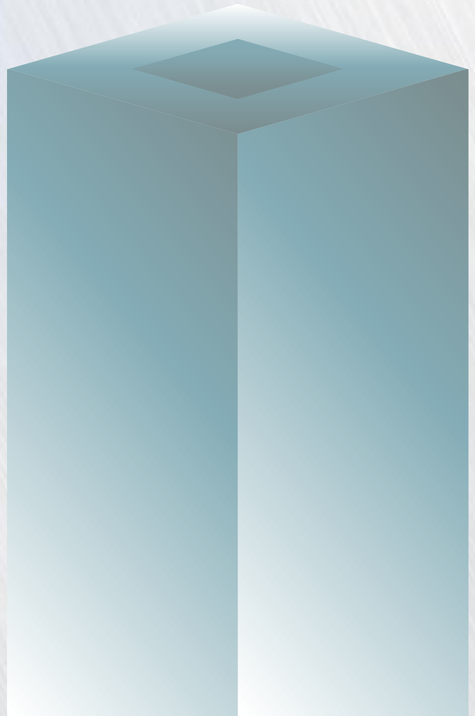
Mobile APP

- ✓ Key production parameters
- ✓ Technical index evaluation
- ✓ Overall diagnosis of furnace condition
- ✓ Mobile data analysis platform



Centralized control

- ✓ Centralized operation & control and flat management
- ✓ 3-D visualization for BF production
- ✓ 3-D visualization for BF inside

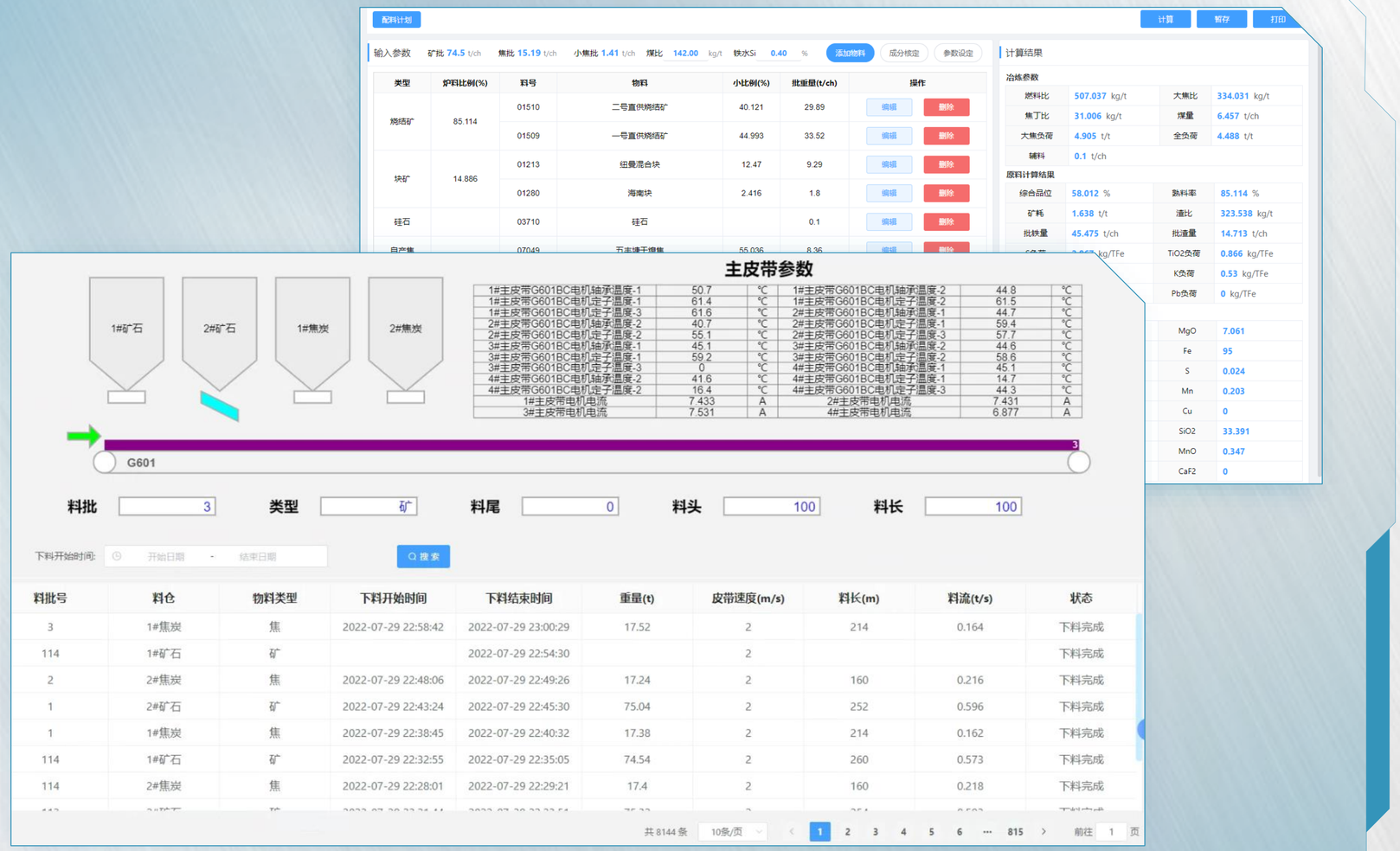


03 Intelligent Management

Lean production management

Integrated control of material blending and charging

- Full-process tracking of material bins, belts and furnace top
- Identification of material blending matrix change, intelligent assignment of material weight to bins and accurate material distribution
- Forman’s command issued to the basic automation system for automatic execution



03 Intelligent Management

Lean production management

Tapping tracking

- Automatically identifying the start and end of HM receiving event based on change of HM weight
- Analyzing stability of tapping load to provide auxiliary information for judging smooth operation of BF
- Tracking change of residual HM inside furnace for optimization of tapping time

03 Intelligent Management

Lean production management

BF Comprehensive Grading

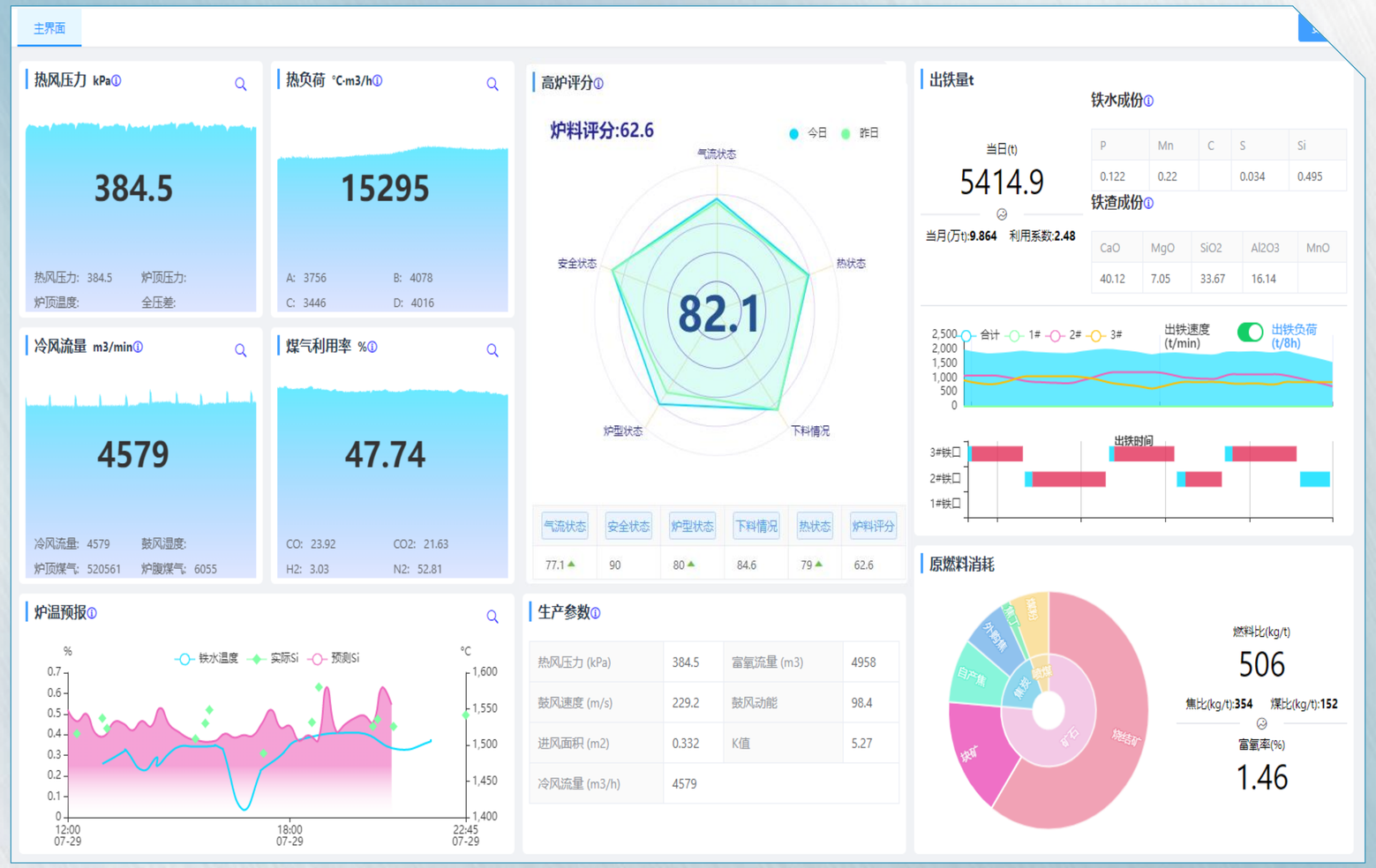
- Performing comprehensive grading for the BF production from the following five aspects: gas stream, safety, burden descending, hot state for grasping the overall furnace conditions

03 Intelligent Management

Lean production management

Cockpit for furnace chief

- Designing the cockpit for the furnace chief based on his/her operation habit
- Performing overall monitoring and operation for BF production



03 Intelligent Management

Mobile App

- Push the key production parameters, techno-economic indices and overall furnace conditions on real time basis to the BF management staff to realize remote pre-warning, analysis and guidance.

03 Intelligent Management

Integrated control of BF

Centralized Control & flat management

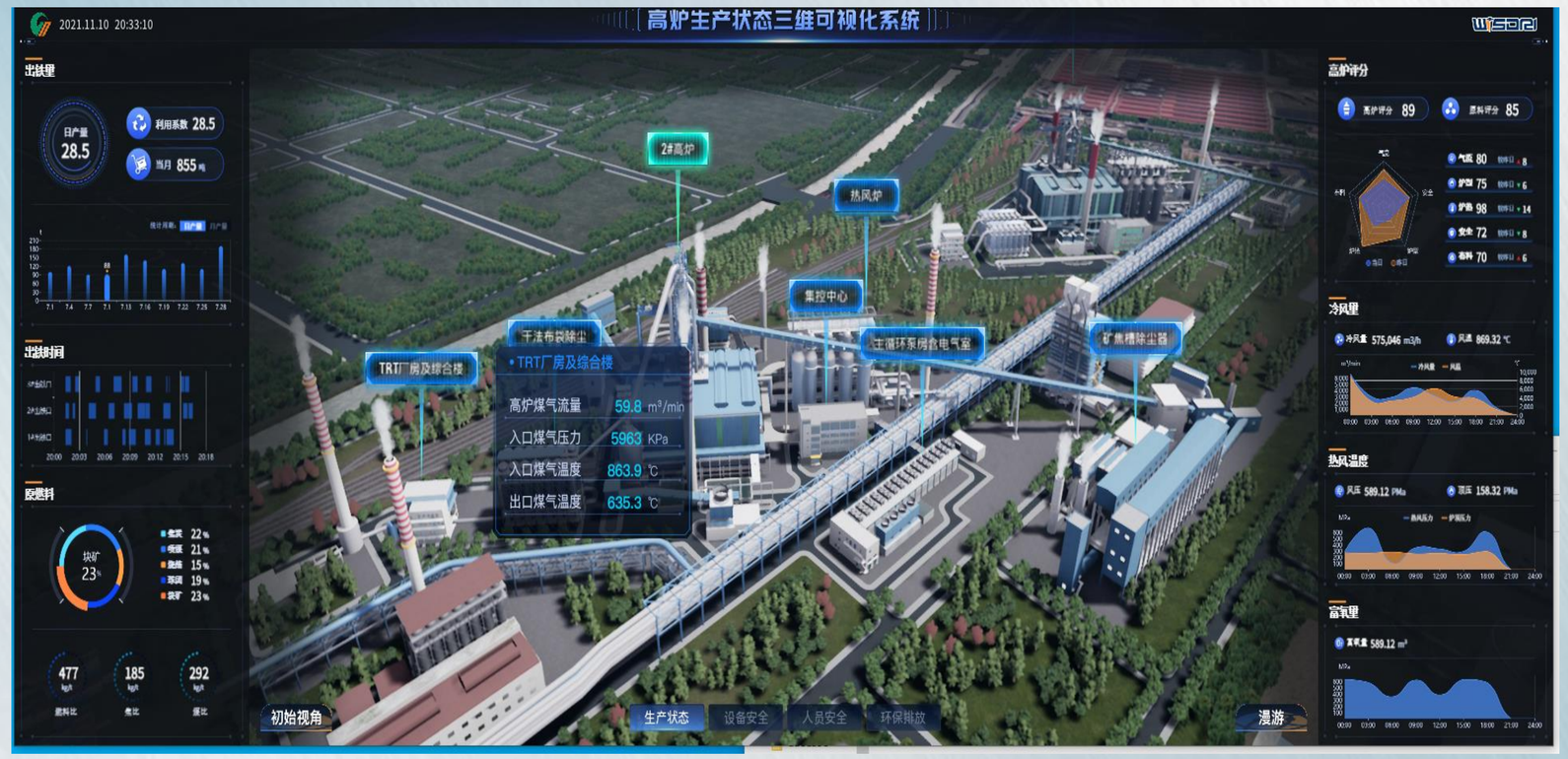
- Centralized control for production of multiple BFs with posts reasonably configured to prepare for future combination and optimization
- Improving decision-making efficiency and timeliness of handling abnormal furnace conditions through flat management

03 Intelligent Management

Integrated control of BF

BF plant 3D visualization

- Production status
- Equipment safety
- Personal safety
- Environment-friendly emission



04

炉内透明化

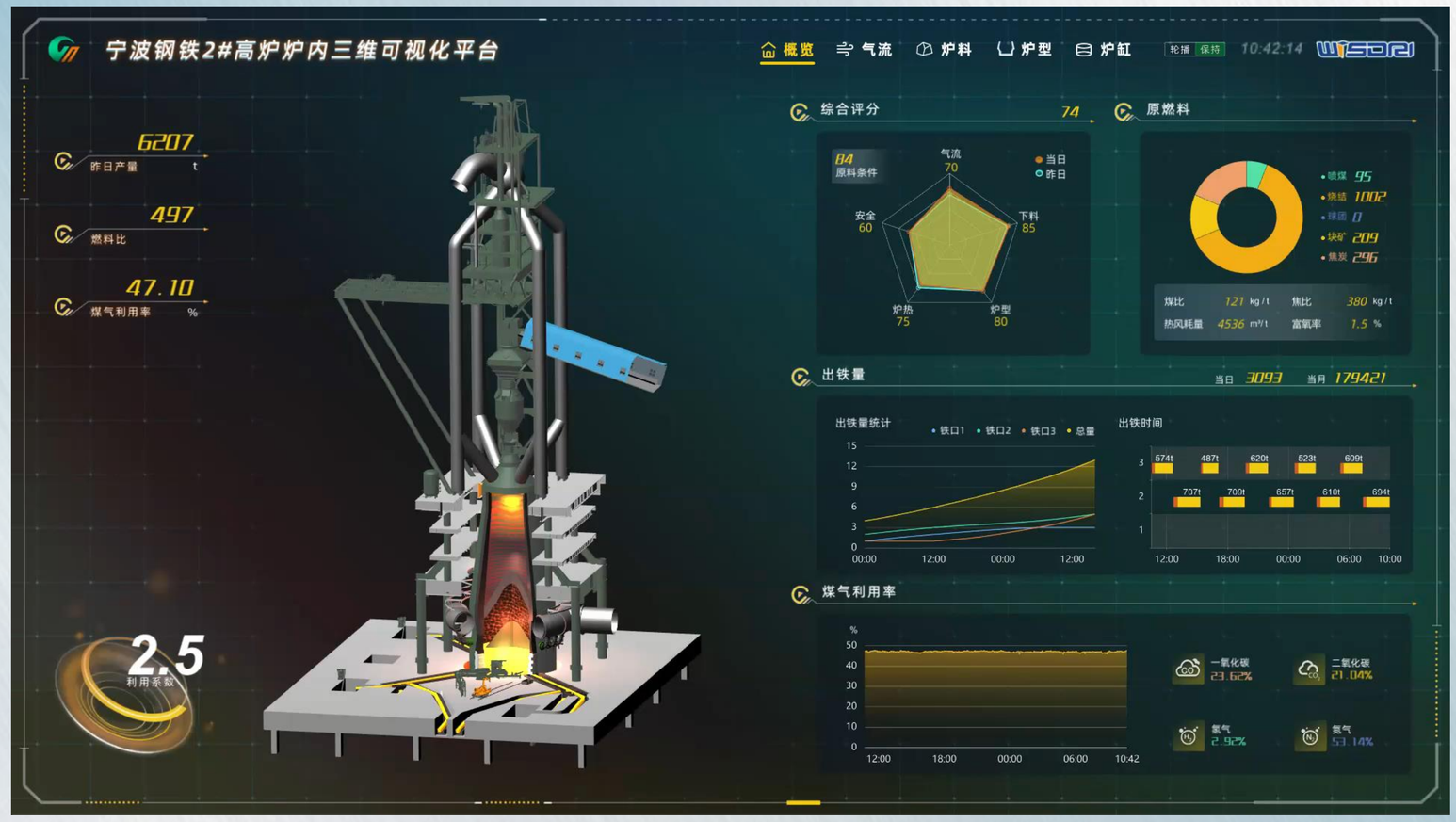
In-furnace Transparency

04 In-furnace transparency

Integrated control of BF

In-furnace 3D visualization

- Overview
- Burden
- Gas stream
- Furnace profile
- Hearth

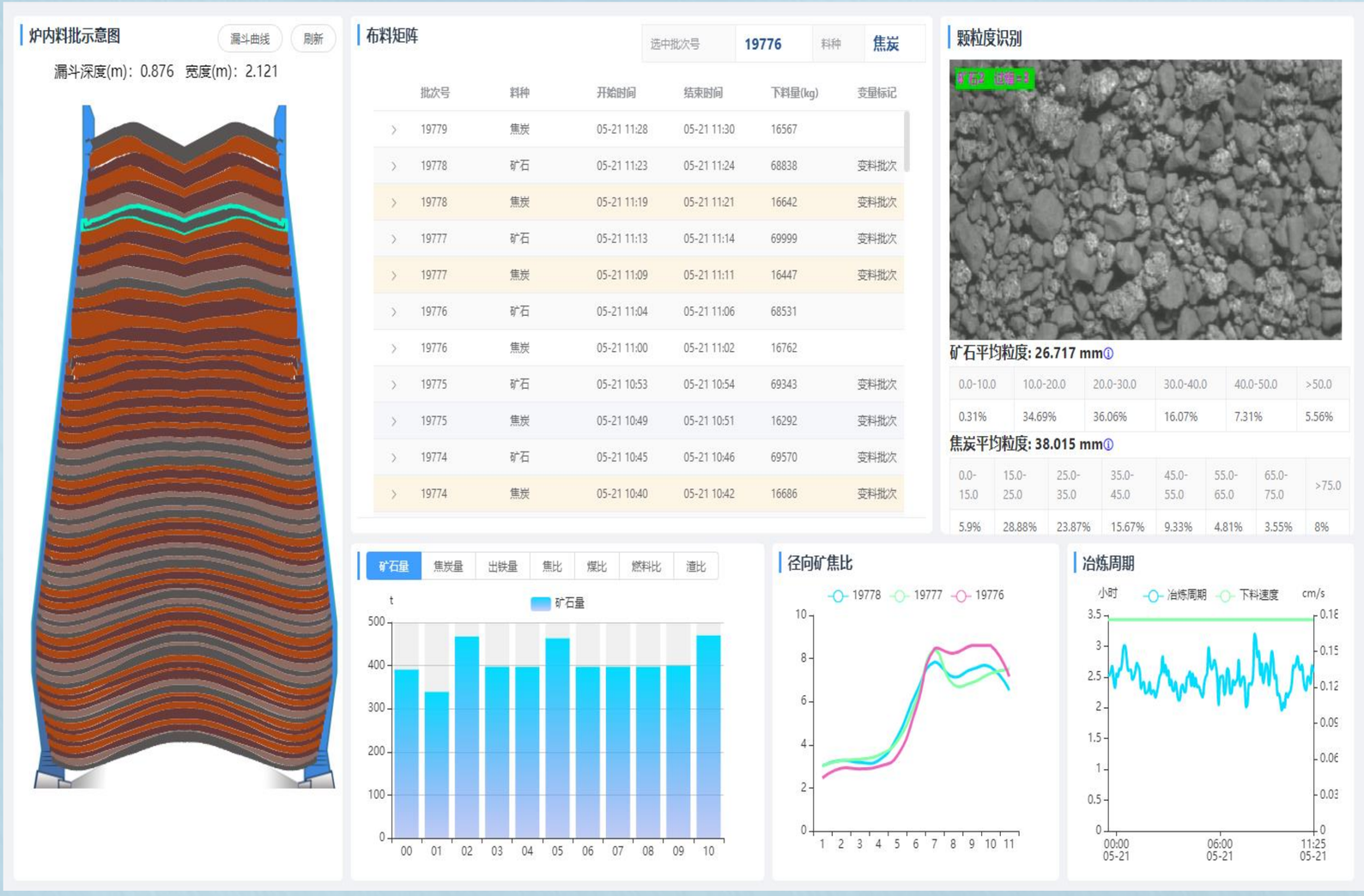


04 In-furnace transparency

Burden visualization

Burden tracking model

- Collecting the actual weight of each material batch to obtain the actual iron content and coke ratio of the batch with reference to the charge component; measuring grain size of furnace burden on real time basis and correcting burden tracking
- Calculating on real time basis the position of each batch of material in the height direction after charging as well as the dynamic fuel ratio
- Forming a mirror image of the position and shape of the material batch in the furnace, so as to provide data for determining the desired coal injection amount for the descending charge column



04 In-furnace transparency

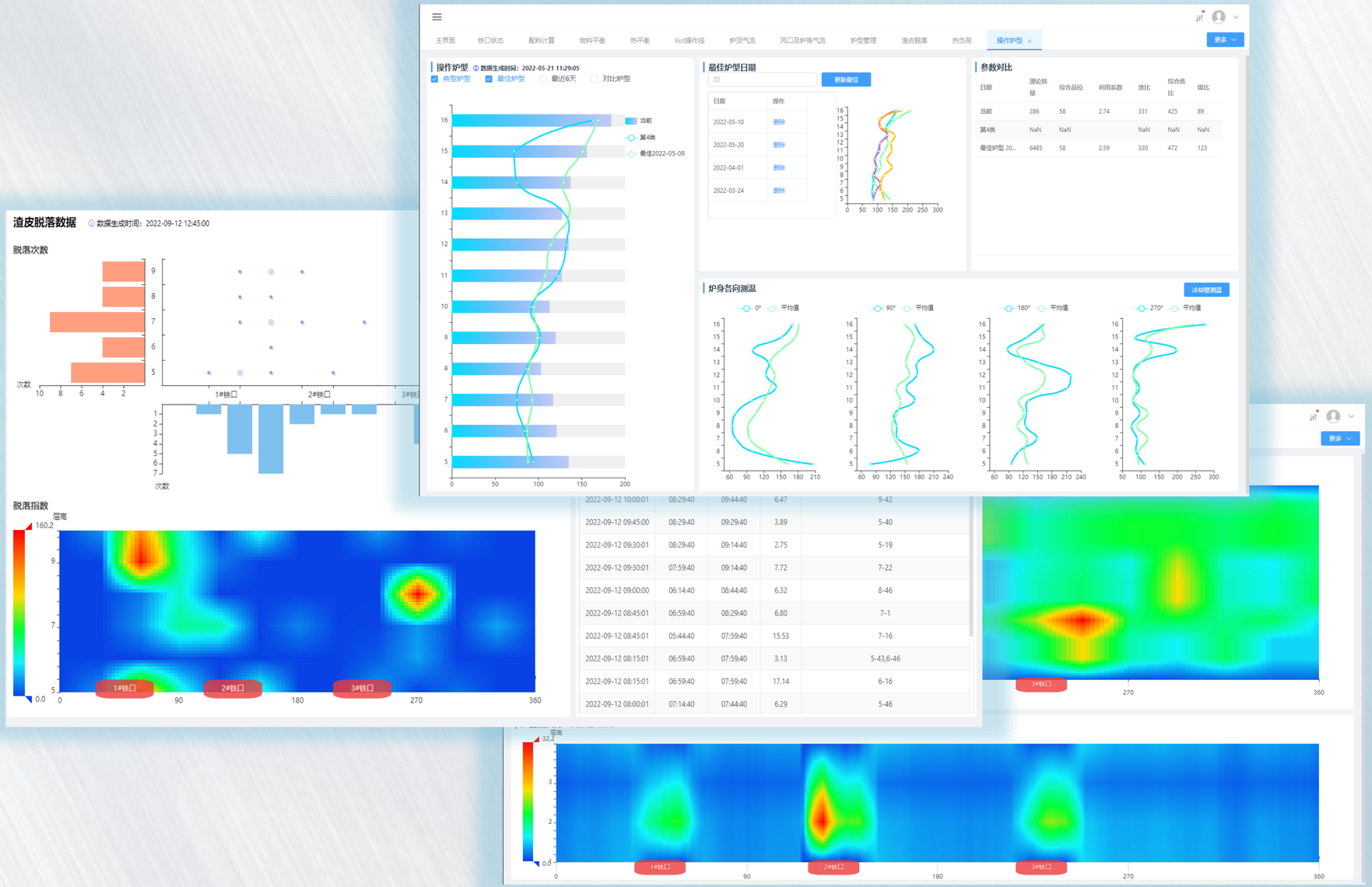
Gas stream visualization

- Realizing comprehensive understanding of the overall evolution of gas stream in the furnace through in-depth mining of the infrared camera data of furnace top and monitoring of furnace body and tuyere state; capturing the abnormal conditions inside the furnace such as gas stream segregation, channeling and charge collapse to provide re-warning for timely adjustment

04 In-furnace transparency

Furnace profile visualization

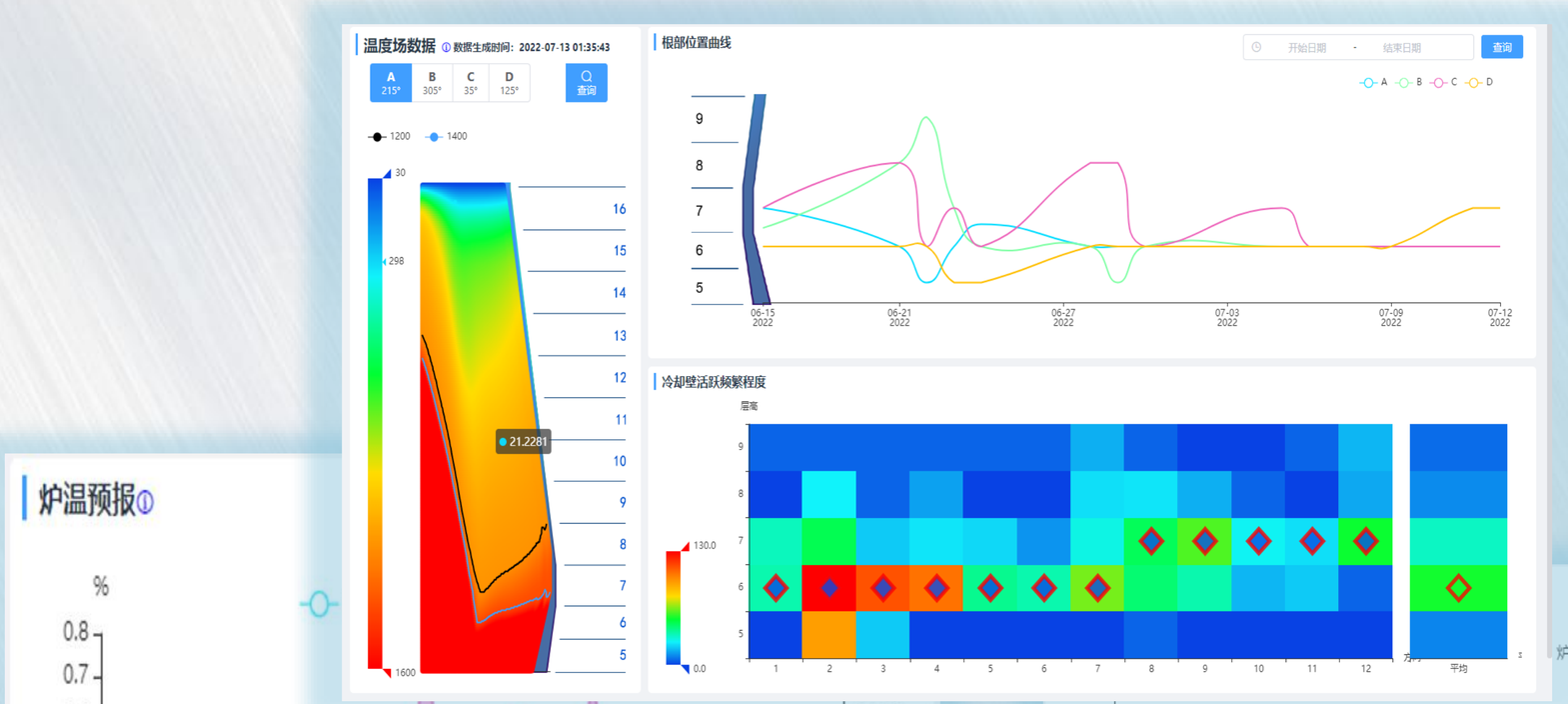
- Digital reconstruction of the furnace profile through intelligent perception of heat load and skull thickness;
- Pre-warning of such abnormal conditions as peeling of large skull and frequent peeling, etc.



04 In-furnace transparency

Furnace heat visualization

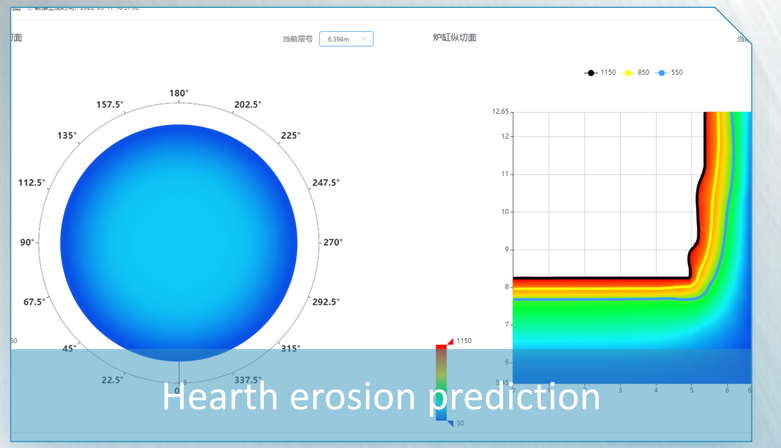
- Fully displaying the thermal state in the furnace, tracking the root position of the adhesive zone, and predicting the thermal state change of the hearth and the tapping temperature for guiding the optimized tapping

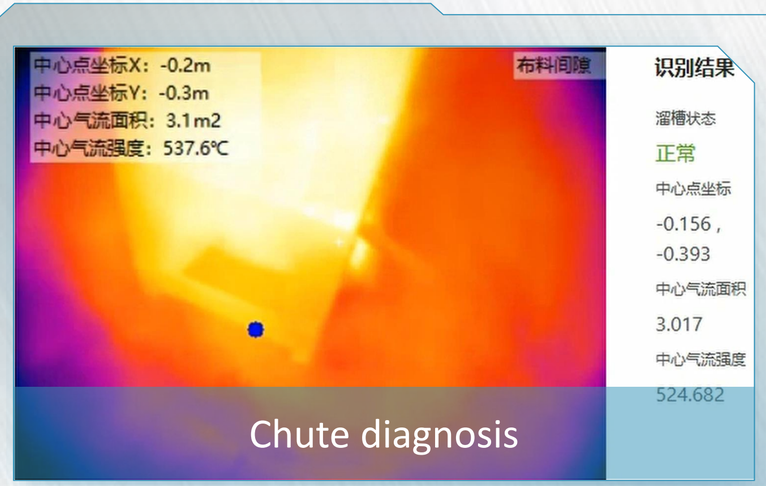


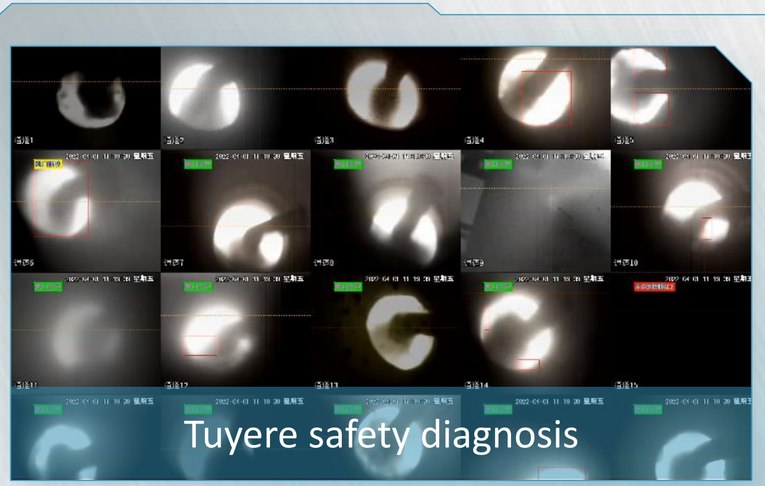
04 In-furnace transparency

Safety visualization

- Providing preventive services such as cooling water leak detection, hearth erosion prediction, tuyere safety diagnosis, distribution chute abnormity diagnosis, etc. to reduce the safety accidents of the furnace







05

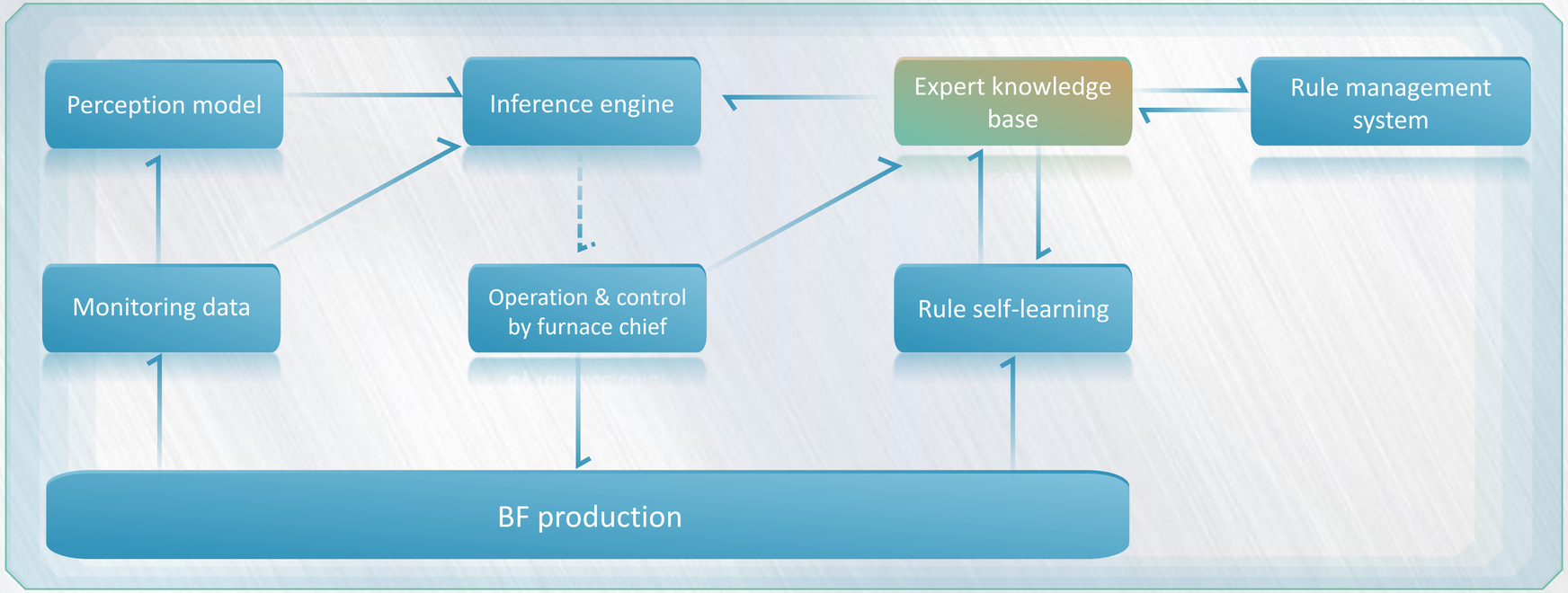
预警、评估及操作指导

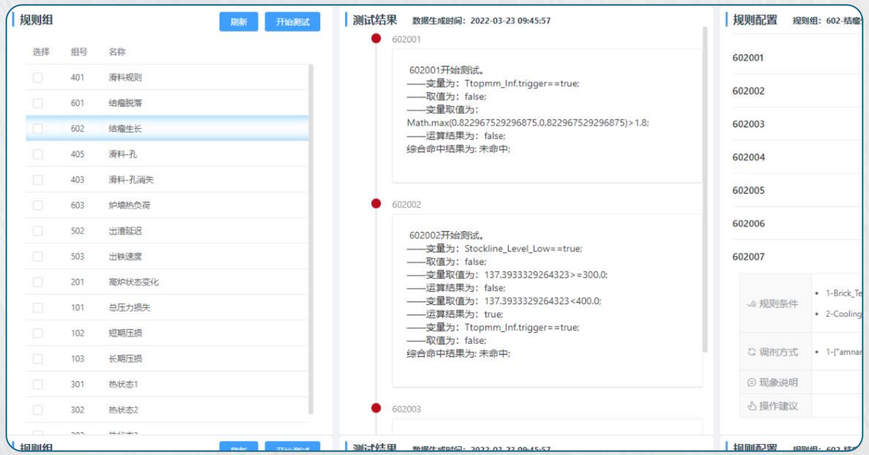
Pre-warning, Evaluation & Operation Guidance

05 Pre-warning, Evaluation and Operation Guidance

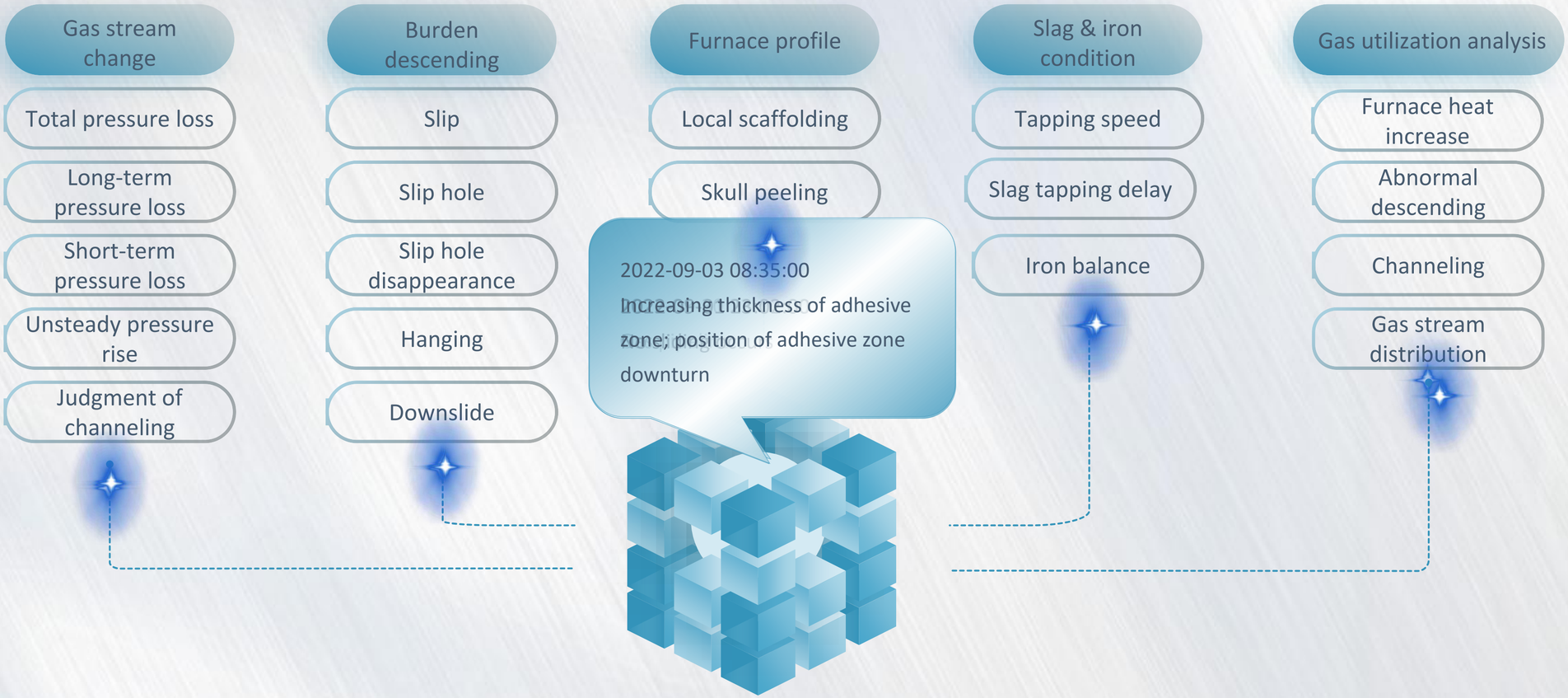
Inference engine

- Establishing the expert knowledge base and developing corresponding inference engine system
- Based on production data and model outputs, performing inference according to expert rules to achieve furnace condition evaluation and give operation suggestions.
- Self-learning of inference rules according to adjustment feedback of the furnace chief.





05 Pre-warning, Evaluation and Operation Guidance



To provide pre-warning and guidance for operators based on comprehensive analysis of short-term change of furnace condition

05 Pre-warning, Evaluation and Operation Guidance

Channeling

Capturing the gas stream change in the furnace for judging the channeling according to the pressure difference and other information, with successful pre-warnings given for 29 such cases since operation

Slipping

Accurately judging slipping in the furnace according to stock line change and giving an early warning to reduce the probability of material hanging and collapse

Skull peeling

Calculating the peeling thickness with warnings given to the locations with a large such value; counting the frequency of skull peeling in horizontal and vertical directions, with 34 warnings given to the locations with obvious more slag peeling to provide reference for timely troubleshooting

Judgment of adhesive zone root

Judging the root position and thickness change of the adhesive zone according to the temperature change of the stack cooling stave and the model of the adhesive zone to provide a basis for determining the change of furnace conditions

Partial scaffolding

Giving warnings for locations with local scaffolding to avoid or reduce the adverse impact on normal production of the blast furnace, with 13 such warnings given in total since operation

BF gas stream distribution

Prompting the change of gas stream distribution at the furnace top and providing reference information for the judgment of gas stream distribution

06

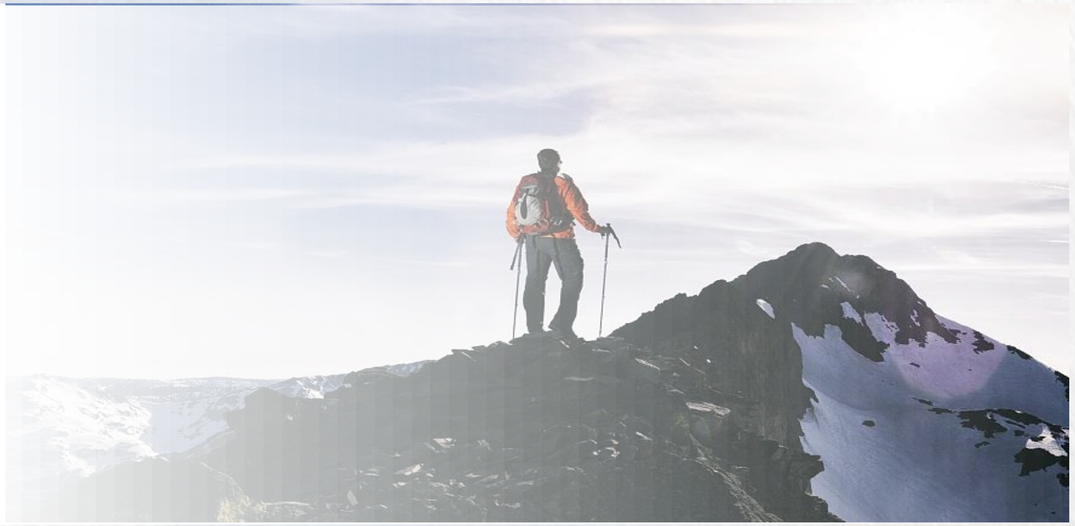
成果与展望

Benefits and Outlook

06 Benefits and Outlook

Application in project

The production cost of hot metal and process energy consumption of Ningbo Steel's 2 # blast furnace setting an industry benchmark based on the application of the intelligent platform and integrated control of blast furnace



30%

Lower labor cost

Posts for integrated control optimized
Unmanned operation in dangerous area
Realizing safe, comfortable and efficient production

0.2t/(m³·d)

Higher productivity

Ensuring stable and smooth operation
Improving safety and longevity of BF

10kg/t

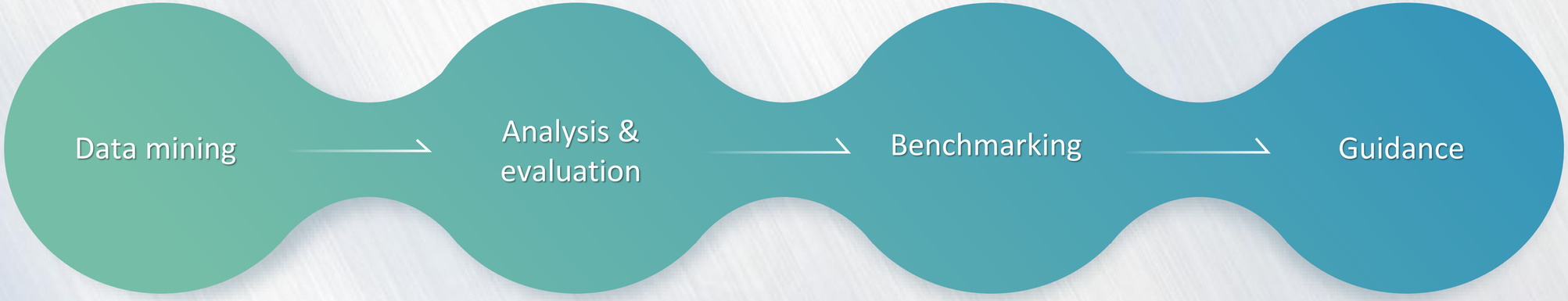
Lower coke ratio

Reducing coke consumption
Decreasing carbon emission
Contributing to carbon neutralization

06 Benefits and Outlook

Big data service

The blast furnace production is a long-term continuous process, with one campaign reaching 15~20 years. In different stages of the blast furnace, the judgment and adjustment standards for furnace conditions will vary depending on abrasion and erosion of the cooling stave and lining bricks. Hence, we hope to work closely with our customer to continuously optimize the process model and expert rules through long-term tracking and in-depth mining of the production data and operation adjustment. And a blast furnace rating system in the cloud will be built to benchmark against advanced technical indicators, tap potential for improvement, and remotely assist in continuous optimization of production, thus ensuring efficient and stable operation.



In-depth mining of production process and operation data

Establishing a multi-process big data cloud analysis and evaluation mechanism

Benchmarking against advanced production indices in the industry and tapping potential for improvement

Remotely assisting in continuous optimization of production, and ensuring stable and efficient operation

One Core, Two Wings

Focusing on building intelligent plants;

Realizing automation of production line while assisting steel producer in intelligent management & control

Intelligent manufacture

Total solution provider in metallurgical industry

Automation and intelligent operation upgrading service provider

专业 专注

PROFESSIONAL DEVOTED

致恒 致远

CONSTANT ORESIGHTED