

# WISDRI Intelligent Blast Furnace Solution Promotes BF Digital Transformation

China • Wuhan

Nov. 17, 2022



# CONTENTS





Unmanned Manufacture



In-furnace Transparency



Pre-warning Guidance





Intelligent Management

## 预警、评估及操作指导

Pre-warning, Evaluation & Operation



Benefits & Outlook









WISDRI iBF Overview





# Ol BF Overview

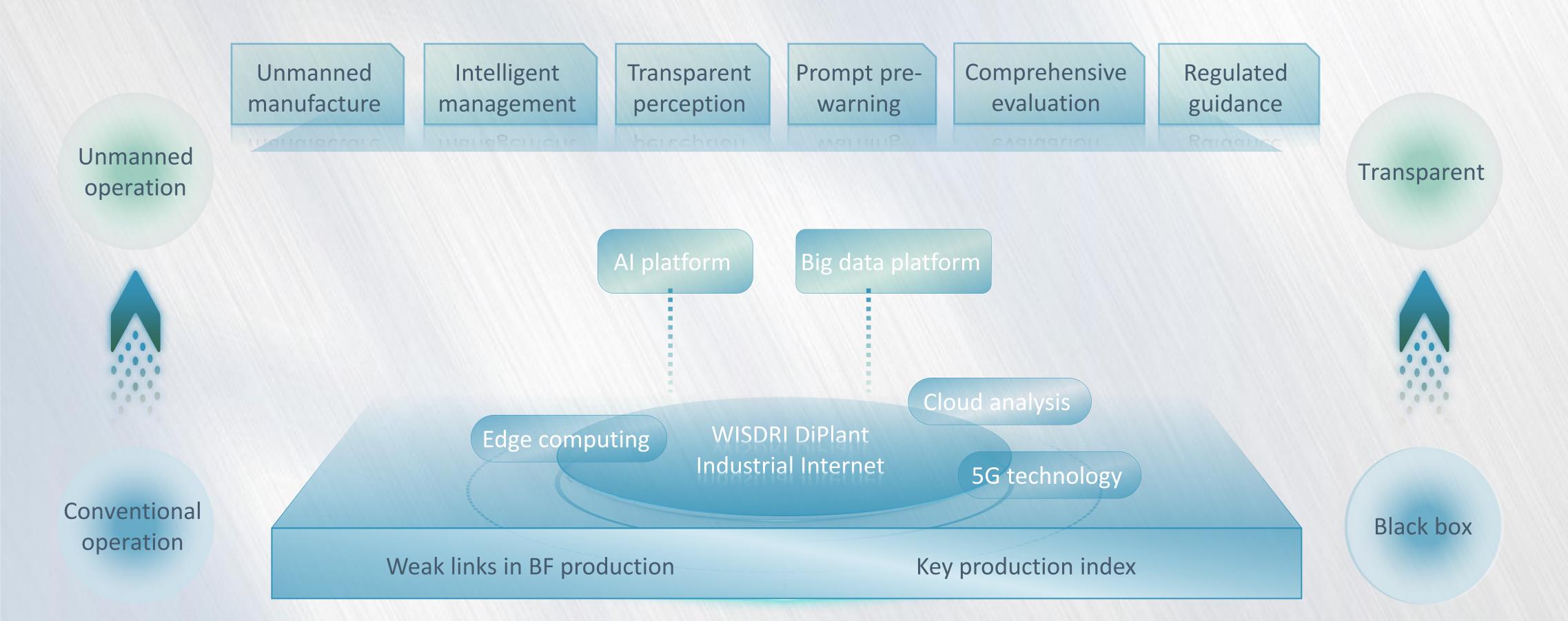
High temperature, high pressure enclosed black box for continuous production Multiple parameters, big lag, non-linear 01 Features • Lack of inside information • A variety of adjustment methods, difficult for selection 02 Difficulties BF smelting production based on operators' experience • Furnace abnormalities handled improperly 03 Current status







# Ol IBF overview









• •



## 02 Unmanned manufacture

## Intelligent perception

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

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



## Intelligent operation

Robotics for intelligent operation in harsh production conditions



## 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**

(	2	0
٢	7	h

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

100% Reliable



## 35 min.

Single-layer grabbing time

## 10 min.

Faster than

### <5cm

Control accuracy of manual operation trolley and carriage

#### <0.5 degree

Grab swing during travelling



#### 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











#### 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**

$\mathbf{v}$	

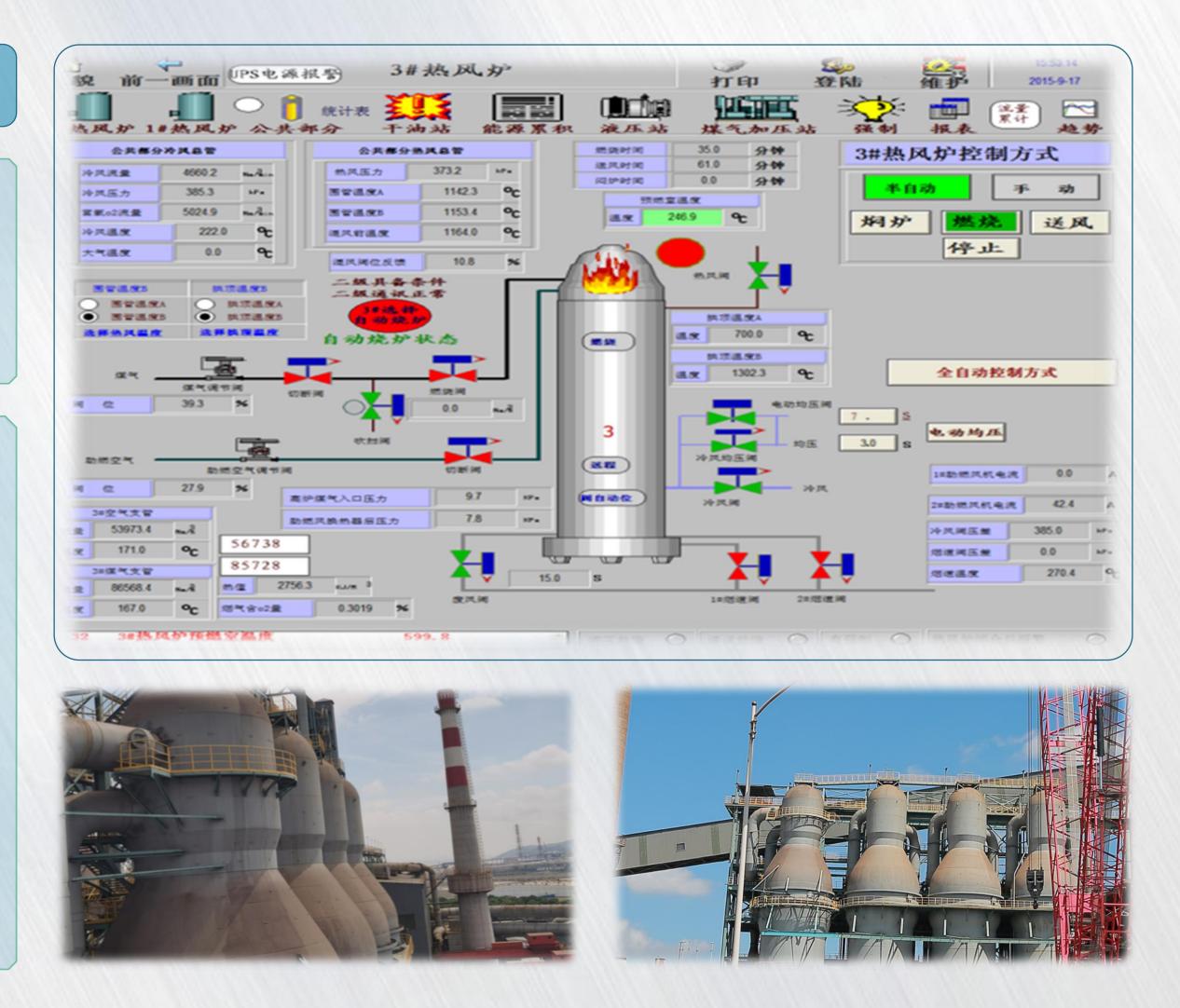
Reducing gas consumption and carbon emission by 3% compared with manual combustion



Raising the stable hot blast temperature by 2.6°C



Lessening the work intensity of operators







#### 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**



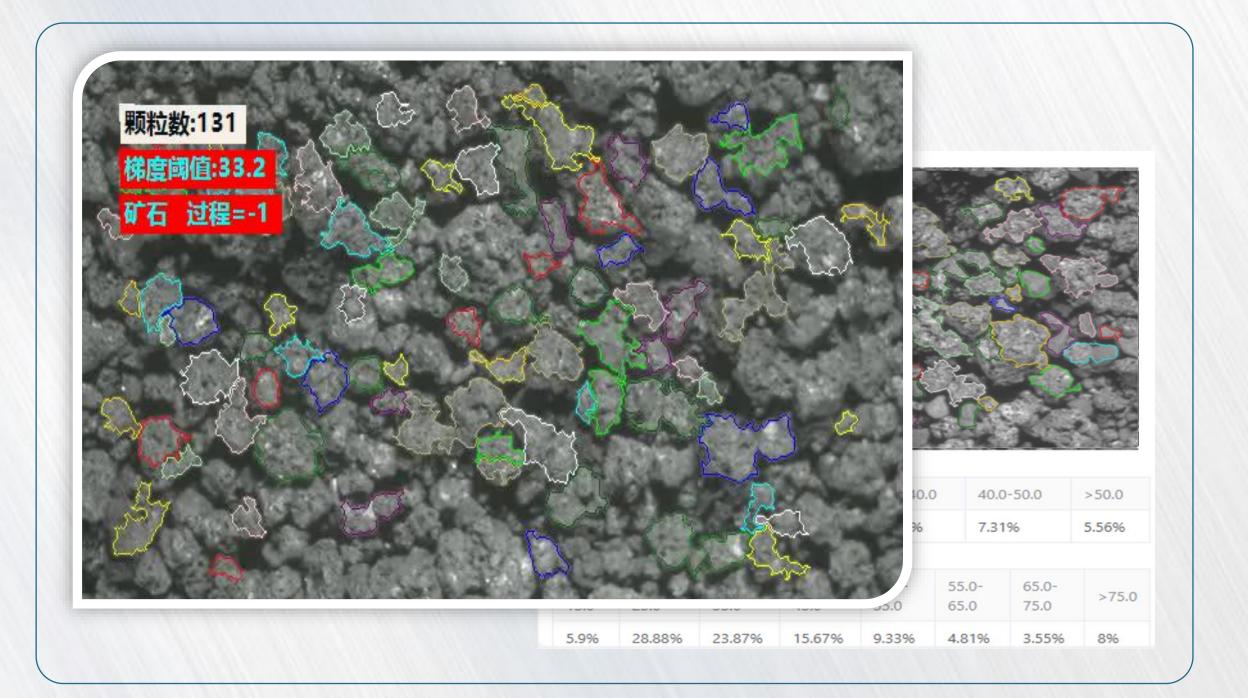
Addressing the problems of untimely manual sampling and incomplete sampling results



Providing data reference for BF operation through real-time availability of grain size of raw material



Lessening sampling workload of lab. personnel







**Performance index** 



Calculation error of raw material dia.

#### >99%

**Identification accuracy** of raw material type



#### 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







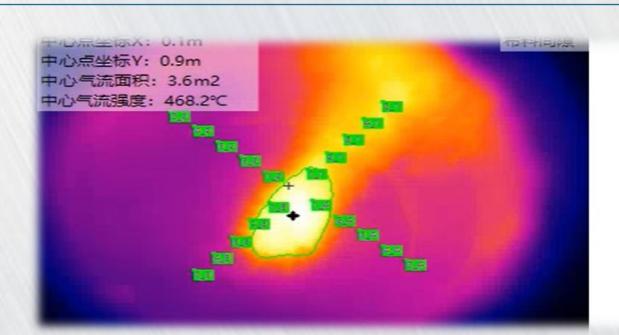
Error of infrared temperature measuring



[外成像	
心点坐标X: -0.2m	布料间隙 识别结果
心点坐标Y: -0.4m 心气流面积: 2.9m2	· · · · · · · · · · · · · · · · · · ·
心气流强度: 520.8℃	正常
	中心点坐标
	-0.166 ,
	-0.384
	中心气流面积
	3.012
	中心气流强度
	522.641

#### Performance index

 $<\pm5^{\circ}C$ 



#### 以别结果

溜槽状态

正常

中心点坐标 0.093, 0.87 中心气流面积 3.548 中心气流强度 478.275





# 03 管理智能化

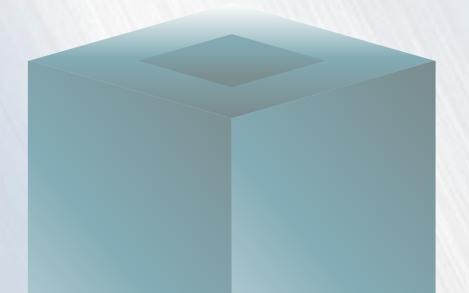
Intelligent Management





#### 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



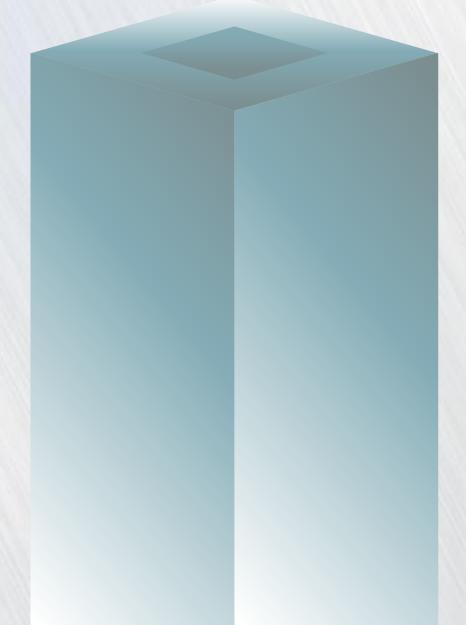
#### **Mobile APP**

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



#### **Centralized control**

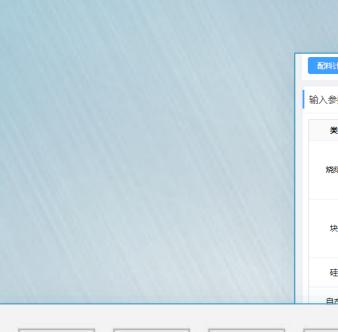
- Centralized operation & control and flat management
- ✓ 3-D visualization for BF production
- ✓ 3-D visualization for BF inside



#### 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





			配料计划								计算	暂存 打印
			输入参数 矿	比 <b>74.5</b> t/ch   焦批 <b>15.1</b> 9	t/ch 小焦批 1.41 t/ch 煤比 14	2.00 kg/t 铁水Si 0.40	0 % 添加物料	成分核定参数设定	计算结果			
			类型	炉料比例(%) 料号	物料	小比例(%)	批重量(t/ch)	操作	冶炼参数			
				01510		40.121	29.89	編辑 删除	燃料比	507.037 kg/t	大焦比	334.031 kg/t
			烧结矿	85.114		44.993	33.52		焦丁比 大焦负荷	31.006 kg/t	煤量	6.457 t/ch
				01509	—号直供烧结矿	44.993	33.02	编辑	く無の何	4.905 t/t	全负荷	4.488 t/t
			块矿	01213	纽曼混合块	12.47	9.29	编辑	原料计算结果			
				01280	海南块	2.416	1.8	编辑	综合品位	<b>58.012</b> %	率料處	85.114 %
			硅石	03710	硅石		0.1	编辑	矿耗	1.638 t/t	渣比	323.538 kg/t
			自产生	07049	五主博干炮隹	55.036	8.36	编辑	批铁量	45.475 t/ch	批渣量 TiO2负荷	14.713 t/ch 0.866 kg/TFe
				-		主皮带参	参数			19/110	K负荷	0.53 kg/TFe
				1#主皮带G 1#主皮带G	601BC电机轴承温度-1 601BC电机定子温度-1 601BC电机定子温度-3	50.7 ℃ 61.4 ℃ 61.6 ℃	1#主皮带G601E 2#主皮带G601E	3C电机轴承温度-2 3C电机定子温度-2 3C电机由承温度-1	44.8 61.5 44.7	℃ ℃ ℃	Pb负荷	0 kg/TFe
	1#矿石 2#	矿石 1#焦	炭 2#焦炭	2#主皮带G	601BC电机轴承温度-2 601BC电机定子温度-2 601BC电机轴承温度-1	40.7 ℃ 55.1 ℃ 45.1 ℃	2#主皮带G601E	3C电机定子温度-1 3C电机定子温度-3 3C电机轴承温度-2	59.4 57.7 44.6	ູ ເ ເ ເ ເ ເ ເ ເ ເ ເ ເ ເ ເ ເ ເ ເ เ เ เ เ	MgO	7.061
				3#主皮带G	601BC电机定子温度-1 601BC电机定子温度-1 601BC电机定子温度-3	45.1 C 59.2 ℃ 0 ℃	3#主皮带G601E 4#主皮带G601E	3C电机定子温度-2 3C电机症子温度-2 3C电机轴承温度-1	58.6 45.1	°C	Fe	95
				OT LOCIDO								
2	$\sim$	$\checkmark$ $\searrow$	$ \leq $	4#主皮带G 4#主皮带G	601BC申机轴承温度-2	41.6 °C	4#主皮带G601E	3C电机定子温度-1	14.7	°C	S	0.024
1				4#主皮带G	601BC电机轴承温度-2 601BC电机定子温度-2 E皮带电机电流	41.6 ℃ 16.4 ℃ 7.433 A	4#主皮带G601E 4#主皮带G601E 2#主皮特	3C电机定子温度-1 3C电机定子温度-3 带电机电流	14.7 44.3 7.431	°C °C	S Mn Cu	0.203
				4#主皮带G	601BC电机轴承温度-2 601BC电机定子温度-2	41.6 °C 16.4 °C	4#主皮带G601E 4#主皮带G601E 2#主皮特	3C电机定子温度-1 3C电机定子温度-3	14.7 44.3	°C	Mn	0.203
→.	G601			4#主皮带G	601BC电机轴承温度-2 601BC电机定子温度-2 E皮带电机电流	41.6 ℃ 16.4 ℃ 7.433 A	4#主皮带G601E 4#主皮带G601E 2#主皮特	3C电机定子温度-1 3C电机定子温度-3 带电机电流	14.7 44.3 7.431	°C °C	Mn Cu	0.203
<b>-</b>	) G601			4#主皮带G	601BC电机轴承温度-2 601BC电机定子温度-2 E皮带电机电流	41.6 ℃ 16.4 ℃ 7.433 A	4#主皮带G601E 4#主皮带G601E 2#主皮特	3C电机定子温度-1 3C电机定子温度-3 带电机电流	14.7 44.3 7.431	°C °C	Mn Cu SiO2	0.203 0 33.391
料批	3 ④ 开始日期 - 料仓	结束日期 物料类型	で、「「「「」」のでは、「「「」」」では、「「」」では、「「」」では、「「」」では、「」」では、「「」」では、「「」」では、「「」」では、「「」」では、「」」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」、「」	4#主皮带G       1#3       3#3 <b>料尾</b> 下料结束时	601BC电机轴承温度-2 501BC电机定子温度-2 E皮带电机电流 E皮带电机电流 0 <b>半</b>	41.6 ℃ 16.4 ℃ 7.433 A	4#主皮带G601E 4#主皮带G601E 2#主皮节 4#主皮节 100 100	3C电机定子温度-1 3C电机定子温度-3 带电机电流 带电机电流 (m) 料流(t/	14.7 44.3 7.431 6.877 100	°C A A	Mn Cu SiO2 MnO	0.203 0 33.391 0.347
下料开始时间:	3 ③ 开始日期 - <b>料仓</b> 1#焦炭	结束日期 物料类型 焦	Q 搜索	4#主皮带G         1#1         3#3 <b>料尾</b> 下料结束时         2       2022-07-29 23	601BC电机轴承温度-2 601BC电机定子温度-2 E皮带电机电流 E皮带电机电流 0 <b>半</b> 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	41.6 °C 16.4 °C 7.433 A 7.531 A	4#主皮带G601E 4#主皮带G601E 2#主皮节 4#主皮节	3C电机定子温度-1 3C电机定子温度-3 带电机电流 带电机电流 (m) 料流(t/	14.7 44.3 7.431 6.877 100	℃ A A 3 び び A 5 6 5 <p< td=""><td>Mn Cu SiO2 MnO</td><td>0.203 0 33.391 0.347</td></p<>	Mn Cu SiO2 MnO	0.203 0 33.391 0.347
下料开始时间: <b>\$1批号</b>	3 ④ 开始日期 - 料仓	结束日期	Q 捜索 下料开始时间	4#主皮带G       1#3       3#3 <b>料尾</b> 下料结束时	601BC电机轴承温度-2 601BC电机定子温度-2 E皮带电机电流 E皮带电机电流 0 <b>半</b> 0 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	41.6 °C 16.4 °C 7.433 A 7.531 A /头	4#主皮带G601E 4#主皮带G601E 2#主皮节 4#主皮节 100 100	3C电机定子温度-1 3C电机定子温度-3 带电机电流 带电机电流 (m) 料流(t/	14.7 44.3 7.431 6.877 100	°C A A	Mn Cu SiO2 MnO	0.203 0 33.391 0.347
下料开始时间: \$ <b>1批号</b>	3 ③ 开始日期 - 料仓 1#焦炭	结束日期 物料类型 焦	Q 捜索 下料开始时间	4#主皮带G         1#=         3#=         米尾         2       2022-07-29 23         2022-07-29 22	601BC电机轴承温度-2 601BC电机定子温度-2 E皮带电机电流 E皮带电机电流 0 <b>筆量(t)</b> :00:29 17.52 :54:30	41.6     °C       16.4     °C       7.433     A       7.531     A	4#主皮带G601E 4#主皮带G601E 2#主皮节 4#主皮节 100 100	3C电机定子温度-1 3C电机定子温度-3 帯电机电流 帯电机电流 (m) 料流(t/ 4 0.164	14.7 44.3 7.431 6.877	℃ A A 3 び び A 5 6 5 <p< td=""><td>Mn Cu SiO2 MnO</td><td>0.203 0 33.391 0.347</td></p<>	Mn Cu SiO2 MnO	0.203 0 33.391 0.347
「料开始时间: <b>排批号</b> 3 114	3 ③ 开始日期 - 料仓 1#焦炭 1#矿石	结束日期 <b>物料类型</b> 焦 矿	Q 搜索 下料开始时间 2022-07-29 22:58:4	4#主皮带G         1#=         3#=         米尾         2       2022-07-29 23         2022-07-29 22         6       2022-07-29 22	601BC电机轴承温度-2 601BC电机定子温度-2 E皮带电机电流 E皮带电机电流 0 単 10 単 17.52 54:30 :49:26 17.24	41.6     °C       16.4     °C       7.433     A       7.531     A       以供用     A       皮带速度(m/s)     2       2     2	4#主皮带G601E 4#主皮带G601E 2#主皮节 4#主皮节 100 100 料长( 214	3C电机定子温度-1       3C电机定子温度-3       第电机电流       第电机电流       第电机电流       (m)     料流(t/ 4       4     0.164       0     0.216	14.7 44.3 7.431 6.877	℃ <sup>®</sup> C A A A A A	Mn Cu SiO2 MnO	0.203 0 33.391 0.347
料开始时间: <b>批号</b> 3 114 2	3       ③ 开始日期 -       料仓       1#焦炭       1#矿石       2#焦炭	结束日期 <b>物料类型</b> 焦 矿 焦	へ捜索 下料开始时间 2022-07-29 22:58:4 2022-07-29 22:48:0	4#主皮带G         1#=         3#=         米尾         2       2022-07-29 23         2022-07-29 22         6       2022-07-29 22         4       2022-07-29 22	601BC电机눺承温度-2 501BC电机定子温度-2 E皮带电机电流 E皮带电机电流 0 単量(t) :00:29 17.52 :54:30 :49:26 17.24 :45:30 75.04	41.6       °C         16.4       °C         7.433       A         7.531       A         /火	4#主皮帯G601E       4#主皮帯G601E       2#主皮青       4#主皮       100       100       100	SC电机定子温度-1       SC电机定子温度-3       常电机电流       第电机电流       第电机电流       (m)     料流(t/ 4       0     0.216       2     0.596	14.7 44.3 7.431 6.877	C ∩ A A 3 5 5 5 5 7	Mn Cu SiO2 MnO	0.203 0 33.391 0.347
<ul> <li>料开始时间:</li> <li>114</li> <li>1</li> </ul>	3         ③ 开始日期 -         料仓         1#焦炭         1#ボ石         2#焦炭         2#矿石	结束日期 <b>物料类型</b> 集 び 集 び	へ捜索 下料开始时间 2022-07-29 22:58:4 2022-07-29 22:48:0 2022-07-29 22:43:2	4#主皮蒂G         1#         3#         米尾         2       2022-07-29 23         2       2022-07-29 22         6       2022-07-29 22         6       2022-07-29 22         6       2022-07-29 22         5       2022-07-29 22	601BC电机速子温度-2         801BC电机定子温度-2         E皮带电机电流         正皮带电机电流         0         重量(t)         :00:29       17.52         :54:30         :49:26       17.24         :49:32       17.38	41.6       °C         16.4       °C         7.433       A         7.531       A         次       A         皮带速度(m/s)       2         2       2         3       3         3       3       3         3       3       3         3       3       3         3       3       3         3	4#主皮帯G601E         4#主皮帯G601E         2#主皮青         4#主皮         100         100         100         100	3C电机定子温度-1       3C电机定子温度-3       常电机电流       市电机电流       市电机电流       (m)     料流(t/ 4       4     0.164       0     0.216       2     0.596       4     0.162	14.7 44.3 7.431 6.877	C ∩ A A A 3 5 5 5 7 <p< td=""><td>Mn Cu SiO2 MnO</td><td>0.203 0 33.391 0.347</td></p<>	Mn Cu SiO2 MnO	0.203 0 33.391 0.347
F科开始时间: #批号 3 114 2 1	3         ③ 开始日期 -         料仓         1#集炭         1#矿石         2#焦炭         2#矿石         1#集炭	結束日期 物料类型 焦 矿 焦 び 点	へ捜索 下料开始时间 2022-07-29 22:58:4 2022-07-29 22:48:0 2022-07-29 22:43:2 2022-07-29 22:38:4	4#主皮蒂G         1#1         3#3         米尾         2       2022-07-29 23         2       2022-07-29 22         6       2022-07-29 22         6       2022-07-29 22         5       2022-07-29 22         5       2022-07-29 22	601BC电机速子温度-2         801BC电机定子温度-2         度常电机电流         正皮带电机电流         601BC电机定子温度-2         正皮带电机电流         601BC电机定子温度-2         正皮带电机电流         601BC电机定子温度-2         正皮带电机电流         601BC电机定子温度-2         正皮带电机电流         601BC电机电流         601BC电         601BC电         601BC电         601FC目         <	41.6     °C       16.4     °C       7.433     A       7.531     A       P     2       2     2       2     2       2     2       2     2       2     2       2     2       2     2       2     2       2     2       2     2       2     2       2     2	4#主皮帯G601E       4#主皮帯G601E       2#主皮青       4#主皮       100       100       100       100	3C电机定子温度-1       3C电机定子温度-3       常电机电流       市电机电流       市电机电流       (m)     料流(t/       4     0.164       0     0.216       2     0.596       4     0.162       0     0.596       4     0.162       0     0.573	14.7 44.3 7.431 6.877	CC A A A A A A A A A A A A A	Mn Cu SiO2 MnO	0.203 0 33.391 0.347



#### 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

									ľ	出铁	≣t			钧	水成	份①				
											当	日(t)			P	N	In	С	S	Si
											78	0.7			0.109	0	.21		0.03735	0.48
											10 0000	3		钧	渣成	份①				
										当月の日	:18.097	利用	系数:2.5	0	CaO	M	90	SiO2	AI2O3	MnO
日期:		开始日期	- 2	结束日期		铁次号	清輸入铁	次号							39.71	6.9	9	31.92	16.1	
铁信息	》出铁开始	0 110	明白(	9 2004 <b>9</b>	当前选中铁	穴: B62047														
# 日期		铁次号	铁口号	开口时间	出渣时间	] 堵口时间	铁口深度	铁水温度	铁水									ante:		0.00
																				The second second
	-07-30	B62049	2#铁口	03:14	03:26					2,500	Q- 合计	-0-1	# -0-	2# -0	- 3#		出铁速 (t/min	度)	(1/8	t页何 h)
2022			2#铁口 3#铁口	03:14 01:05	03:26 01:21	03:09	3.4	1508	4,444	2,000		-0-1	# -0-	2# -0	3#		出铁速 (t/min)	度 )	① 出設 (t/8	t负荷 h)
2022 2022						03:09 01:00	3.4 3.4	1508 1507	4.444	2,000 1,500		-0-1	# -0-	2# -0	3#		出铁速 (t/min	/夏 )	① 出形 (t/8	t页面 h)
2022 2022 2022	-07-30 -07-29	B62048	3#铁口	01:05	01:21					2,000 1,500 1,000 500		-0-1	*-0-	2# -0	- 3#		出铁速 (t/min)	度 )	① 出形 (t/8	t页何 h)
2022 2022 2022 2022 2022	-07-30 -07-29 -07-29	B62048 B62047	3#铁口 2#铁口	01:05 22:47	01:21	01:00	3.4	1507	4.489	2,000 1,500 1,000		-0-1	# -O-	2# -0	- 3#		出铁速 (t/min)	<i>授</i>	① 出形 (t/8	t页何 h)
2022 2022 2022 2022 2022 2022 2022 202	-07-30 -07-29 -07-29 -07-29 -07-29	B62048 B62047 B62046 B62045 B62044	3#铁口 2#铁口 3#铁口	01:05 22:47 20:18	01:21 23:00 20:33	01:00	3.4 3.5	1507 1509	4.489 4.528	2,000 1,500 1,000 500		-0-1	# -O-	2# -0		时间	出铁速 (t/min)	度)	① 出形 (t/8	t页何 h)
2022 2022 2022 2022 2022 2022 2022 202	-07-30 -07-29 -07-29 -07-29 -07-29 -07-29	B62048 B62047 B62046 B62045 B62044 B62043	3#铁口 2#铁口 3#铁口 2#铁口 3#铁口 2#铁口	01:05 22:47 20:18 18:43	01:21 23:00 20:33 19:00	01:00 22:40 20:12 18:38 16:22	3.4 3.5 3.5	1507 1509 1517 1507 1500	4.489 4.528 5.160	2,000 1,500 1,000 500		-0-1	# -O-	2# -0		时间	出铁速 (t/min)	度)	C HB (t/8	积文何 h)
2022 2022 2022 2022 2022 2022 2022 202	-07-30 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29	B62048 B62047 B62046 B62045 B62044 B62043 B62042	3#铁口 2#铁口 3#铁口 2#铁口 3#铁口 2#铁口 3#铁口	01:05 22:47 20:18 18:43 16:29 13:42 11:49	01:21 23:00 20:33 19:00 16:39 13:57 11:57	01:00 22:40 20:12 18:38 16:22 13:38	3.4 3.5 3.5 3.5	1507 1509 1517 1507 1500 1506	4.489 4.528 5.160 4.272 4.592 4.633	2,000 1,500 1,000 500 0 3#铁口		-0-1	# -O-	2# -0		时间	出铁速 (t/min)	度)		天灾何 h)
2022 2022 2022 2022 2022 2022 2022 202	-07-30 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29	B62048 B62047 B62046 B62045 B62044 B62043 B62042 B62041	3#铁口 2#铁口 3#铁口 3#铁口 2#铁口 3#铁口 3#铁口	01:05 22:47 20:18 18:43 16:29 13:42 11:49 09:49	01:21 23:00 20:33 19:00 16:39 13:57	01:00 22:40 20:12 18:38 16:22	3.4 3.5 3.5 3.5 3.5 3.5	1507 1509 1517 1507 1500 1506 1498	4.489 4.528 5.160 4.272 4.592	2,000 1,500 1,000 500 0		-0-1	# -O-	2# -0		时间	出铁速 (t/min)	度)		天灾何 h)
1         2022           2         2022           3         2022           4         2022           5         2022           7         2022           3         2022           2         2022           3         2022           3         2022           3         2022           3         2022           3         2022	-07-30 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29	B62048 B62047 B62046 B62045 B62044 B62043 B62042 B62041	3#铁口 2#铁口 3#铁口 2#铁口 3#铁口 2#铁口 3#铁口	01:05 22:47 20:18 18:43 16:29 13:42 11:49	01:21 23:00 20:33 19:00 16:39 13:57 11:57	01:00 22:40 20:12 18:38 16:22 13:38	3.4         3.5         3.5         3.5         3.5         3.5         3.4	1507 1509 1517 1507 1500 1506	4.489 4.528 5.160 4.272 4.592 4.633	2,000 1,500 1,000 500 0 3#铁口		-0-1	# -O-	2# -0		时间	出铁速 (t/min)	度)		天灾何 h)
1     2022       2     2022       3     2022       4     2022       5     2022       6     2022       7     2022       8     2022       9     2022       0     2022	-07-30 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29	B62048 B62047 B62046 B62045 B62044 B62043 B62042 B62041 B62040	3#铁口 2#铁口 3#铁口 3#铁口 2#铁口 3#铁口 3#铁口	01:05 22:47 20:18 18:43 16:29 13:42 11:49 09:49 07:11	01:21 23:00 20:33 19:00 16:39 13:57 11:57 10:00	01:00 22:40 20:12 18:38 16:22 13:38 11:45	3.4         3.5         3.5         3.5         3.5         3.4         3.4	1507 1509 1517 1507 1500 1506 1498	4.489 4.528 5.160 4.272 4.592 4.633 4.354	2,000 1,500 1,000 500 0 3#铁口 2#铁口		-0-1		2# -0		时间	出铁速 (t/min)			天灾何 h)
1     2022       2     2022       3     2022       4     2022       5     2022       6     2022       7     2022       8     2022       9     2022       10     2022	-07-30 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29	B62048 B62047 B62046 B62045 B62044 B62043 B62042 B62041 B62040	3#铁口 2#铁口 3#铁口 3#铁口 2#铁口 3#铁口 2#铁口 3#铁口	01:05 22:47 20:18 18:43 16:29 13:42 11:49 09:49 07:11	01:21 23:00 20:33 19:00 16:39 13:57 11:57 10:00 07:18	01:00 22:40 20:12 18:38 16:22 13:38 11:45	3.4         3.5         3.5         3.5         3.5         3.4         3.4         3.4         3.4	1507 1509 1517 1507 1500 1506 1498	4.489 4.528 5.160 4.272 4.592 4.633 4.354	2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口		5i(%)					(t/min	反		E页何 h)
1     2022       2     2022       3     2022       4     2022       5     2022       6     2022       7     2022       8     2022       9     2022       10     2022	-07-30 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29	B62048 B62047 B62046 B62045 B62044 B62042 B62041 B62040	3#铁口 2#铁口 2#铁口 3#铁口 2#铁口 3#铁口 3#铁口 3#铁口	01:05 22:47 20:18 18:43 16:29 13:42 11:49 09:49 07:11 07:11	01:21 23:00 20:33 19:00 16:39 13:57 11:57 10:00 07:18	01:00 22:40 20:12 18:38 16:22 13:38 11:45 09:45	3.4 3.5 3.5 3.5 3.4 3.4 3.4 3.4	1507 1509 1517 1507 1500 1506 1498 1521	4.489 4.528 5.160 4.272 4.592 4.633 4.354 4.354	2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口			5(%)		<u>Ш</u> (%) Ті(%	) C(%)	(t/min			EDQ(同 h)
1     2022       2     2022       3     2022       4     2022       5     2022       6     2022       7     2022       8     2022       9 <t< td=""><td>-07-30 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29</td><td>B62048 B62047 B62046 B62045 B62044 B62042 B62042 B62040 B62040</td><td>3#铁口 2#铁口 2#铁口 3#铁口 2#铁口 3#铁口 3#铁口 3#铁口 3#铁口 3#铁口</td><td>01:05 22:47 20:18 18:43 16:29 13:42 13:42 13:42 09:49 07:11 09:49 07:11</td><td>01:21 23:00 20:33 19:00 16:39 13:57 11:57 10:00 07:18 07:18</td><td><ul> <li>01:00</li> <li>22:40</li> <li>20:12</li> <li>18:38</li> <li>16:22</li> <li>13:38</li> <li>11:45</li> <li>09:45</li> </ul></td><td>3.4 3.5 3.5 3.5 3.5 3.4 3.4 3.4 3.4 3.4</td><td>1507 1509 1517 1507 1500 1506 1498 1521</td><td>4.489 4.528 5.160 4.277 4.592 4.633 4.354 4.768</td><td>2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口 5 <b>8</b> <b>8</b> <b>9</b> <b>8</b> <b>9</b> <b>1</b> 47 19</td><td></td><td>Si(%) 0.48</td><td><b>5(%)</b> 0.037</td><td>P(%) M</td><td><b>H</b> <b>(%)</b> <b>Ti(%</b> 1 0.04</td><td>) <b>C</b>(%)</td><td>(t/min</td><td>)</td><td></td><td>E页何 h)</td></t<>	-07-30 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29 -07-29	B62048 B62047 B62046 B62045 B62044 B62042 B62042 B62040 B62040	3#铁口 2#铁口 2#铁口 3#铁口 2#铁口 3#铁口 3#铁口 3#铁口 3#铁口 3#铁口	01:05 22:47 20:18 18:43 16:29 13:42 13:42 13:42 09:49 07:11 09:49 07:11	01:21 23:00 20:33 19:00 16:39 13:57 11:57 10:00 07:18 07:18	<ul> <li>01:00</li> <li>22:40</li> <li>20:12</li> <li>18:38</li> <li>16:22</li> <li>13:38</li> <li>11:45</li> <li>09:45</li> </ul>	3.4 3.5 3.5 3.5 3.5 3.4 3.4 3.4 3.4 3.4	1507 1509 1517 1507 1500 1506 1498 1521	4.489 4.528 5.160 4.277 4.592 4.633 4.354 4.768	2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口 5 <b>8</b> <b>8</b> <b>9</b> <b>8</b> <b>9</b> <b>1</b> 47 19		Si(%) 0.48	<b>5(%)</b> 0.037	P(%) M	<b>H</b> <b>(%)</b> <b>Ti(%</b> 1 0.04	) <b>C</b> (%)	(t/min	)		E页何 h)
1     2022       2     2022       3     2022       4     2022       5     2022       6     2022       7     2022       8     2022       9     2022       10     2022   <	-07-30 -07-29 -07-20 -07-29 -07-20 -	B62048 B62047 B62046 B62045 B62044 B62043 B62041 B62040 B62040 B62040 B62040 B62040 B62040	3#铁口 2#铁口 2#铁口 3#铁口 3#铁口 3#铁口 3#铁口 3#铁口 3#铁口 3#铁口 3	01:05 22:47 20:18 18:43 16:29 13:42 11:49 09:49 07:11 11:5 11	01:21 23:00 20:33 19:00 16:39 13:57 11:57 10:00 07:18 07:18 07:18	<ul> <li>01:00</li> <li>22:40</li> <li>20:12</li> <li>18:38</li> <li>16:22</li> <li>13:38</li> <li>11:45</li> <li>09:45</li> </ul>	3.4 3.5 3.5 3.5 3.5 3.4 3.4 3.4 3.4 3.4 3.4	1507 1509 1517 1507 1500 1506 1498 1521	4.489 4.528 5.160 4.277 4.597 4.633 4.354 4.768 <b>9</b> <b>9</b> <b>9</b> <b>9</b> <b>9</b> <b>9</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b>	2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口 5 <b>8</b> <b>8</b> <b>9</b> <b>8</b> <b>9</b> <b>1</b> 47 19	иннение и предоктазии и предокт И предоктазии и	<b>Si(%)</b> 0.48 0.42	<b>5(%)</b> 0.037 0.046	P(%) M 0.109 0.2	<b>11</b> 0.04	) <b>C</b> (%)	(t/min	)		EDD(何)
1     2022       2     2022       3     2022       4     2022       5     2022       6     2022       7     2022       8     2022       9     2022       10     2022       20     2022       9	-07-30 -07-29 -07-20	B62048 B62047 B62046 B62045 B62044 B62043 B62041 B62040 B62040 <b>C C C</b> <b>THHHHHH</b> <b>D</b> <b>D</b> <b>C C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b>	3#₩□ 2#₩□ 2#₩□ 3#₩□ 3#₩□ 3#₩□ 3#₩□ 3#₩□ 3#₩□ 3#₩□ 3	01:05 22:47 20:18 18:43 16:29 13:42 11:49 09:49 07:11 11:5 11	01:21 23:00 20:33 19:00 16:39 13:57 11:57 10:00 07:18 07:18 07:18	<ul> <li>01:00</li> <li>22:40</li> <li>20:12</li> <li>18:38</li> <li>16:22</li> <li>13:38</li> <li>11:45</li> <li>09:45</li> </ul>	3.4 3.5 3.5 3.5 3.5 3.4 3.4 3.4 3.4 3.4 3.4	1507         1509         1517         1507         1507         1507         1507         1507         1507         1507         1507         1507         1507         1507         1507         1500         1500         1521         ****         ****         ****         ****         ****         ****         ****         ****         ****         ****	4.489 4.528 5.160 4.277 4.597 4.633 4.354 4.768 <b>9</b> <b>9</b> <b>9</b> <b>9</b> <b>9</b> <b>9</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b>	2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口 5 47 19	иння и иння и и и и и и и и и и и и и	<b>Si(%)</b> 0.48 0.42	<b>5(%)</b> 0.037 0.046	P(%) M 0.109 0.4 0.099 0.4	<b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b>	) <b>C</b> (%)	(t/min	· 检验I 2022 2022		E页何 h)
1         2022           2         2022           3         2022           4         2022           5         2022           6         2022	-07-30 -07-29 -07-20 -	B62048 B62047 B62046 B62045 B62044 B62043 B62041 B62040 B62040 <b>C C C</b> <b>THHHHHH</b> <b>D</b> <b>D</b> <b>C C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b> <b>C</b>	3#₩□ 2#₩□ 3#₩□ 2#₩□ 2#₩□ 2#₩□ 3#₩□	01:05 22:47 20:18 18:43 16:29 13:42 11:49 09:49 07:11 11:5 11	01:21 23:00 20:33 19:00 16:39 13:57 11:57 10:00 07:18 07:18 07:18	<ul> <li>01:00</li> <li>22:40</li> <li>20:12</li> <li>18:38</li> <li>16:22</li> <li>13:38</li> <li>11:45</li> <li>09:45</li> </ul>	3.4 3.5 3.5 3.5 3.5 3.4 3.4 3.4 3.4 3.4 3.4	1507         1509         1517         1507         1507         1507         1507         1507         1507         1507         1507         1507         1507         1507         1507         1500         1500         1521         ****         ****         ****         ****         ****         ****         ****         ****         ****         ****	4.489 4.528 5.160 4.277 4.597 4.633 4.354 4.768 <b>9</b> <b>9</b> <b>9</b> <b>9</b> <b>9</b> <b>9</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b>	2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口 5 47 19	иння инна иннна инна инна инна инна инна инна инна инна инна инна инна инна инна инна	<b>Si(%)</b> 0.48 0.42	<b>S(%)</b> 0.037 0.046 0.031	P(%) M 0.109 0.4 0.099 0.4	<b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b> <b>1</b>	) <b>C</b> (%)	(t/min	▲短川 2022 2022 2022		EDD 何

									ľ	出铁量	Ēt			钧	水成	份①				
											当日	∃(t)			P	N	In	С	S	Si
											78	07			0.109	0.	21		0.03735	0.48
												9		钧	渣成	份①				
									1	当月(万t)	18.097	利用到	系数:2.5	0	CaO	Mg	0	SiO2	AI2O3	MnO
日期:	a	开始日期		结束日期		铁次号:	清输入铁	大号							39.71	6.9	9	31.92	16.1	
铁信息	◎ 出鉄开始	a 0 38	町台(	東部和田 勇	当前选中铁》	穴: B62047			_											
	IB	铁次号	铁口号	开口时间	出渣时间	1 堵口时间	铁口深度	铁水温度	铁水											
B	43									100000	100000			2242- 22	2017		141 午生 1 南		14165	
	22-07-30	B62049	2#铁囗	03:14	03:26					2,500	Q- 合计	-0-1	# -0-	2# -0	3#		出铁速 (t/min)	受	(1/8	t负荷 h)
20			2#铁口 3#铁口			03:09	3.4	1508	4.444	2,000	_	-0-1	# -0-	2# -0	3#		出铁速 (t/min)	포	① 出物 (t/8	t负荷 h)
20.	22-07-30	B62049		03:14	03:26		3.4 3.4	1508 1507		2,000 1,500		-0-1	# -0-	2# -0	3#		出铁速 (t/min)	Ŧ	(t/8	ŧ负荷 h)
20) 20) 20)	22-07-30 22-07-30	B62049 B62048	3#铁口	03:14 01:05	03:26 01:21	03:09			4.444	2,000 1,500 1,000 500	<	-0-1	# -0-	2# -0	3#	_	出铁速 (t/min)	<b>受</b>	<b>O</b> 出移 (t/8	ŧ负荷 h)
20) 20) 20) 20)	22-07-30 22-07-30 22-07-29	B62049 B62048 B62047	3#铁口 2#铁口	03:14 01:05 22:47	03:26 01:21 23:00	03:09 01:00	3.4	1507	4.444	2,000 1,500 1,000	<	-0-1	# -0-	2# -0	3#		出铁速 (t/min)	E.	<b>O</b> 出移 (t/8	ŧ负荷 h)
20. 20. 20. 20. 20. 20.	22-07-30 22-07-30 22-07-29 22-07-29	B62049 B62048 B62047 B62046 B62045	3#铁口 2#铁口 3#铁口	03:14 01:05 22:47 20:18	03:26 01:21 23:00 20:33	03:09 01:00 22:40	3.4 3.5	1507 1509	4.444 4.489 4.528	2,000 1,500 1,000 500 0	<	-0-1	# -0-	2# -0		时间	出铁速 (t/min)	5	<b>O</b> 出物 (t/8	ŧ负荷 h)
201 201 201 201 201 201 201	22-07-30 22-07-30 22-07-29 22-07-29 22-07-29	B62049 B62048 B62047 B62046 B62045 B62044	3#铁口 2#铁口 3#铁口 2#铁口	03:14 01:05 22:47 20:18 18:43	03:26 01:21 23:00 20:33 19:00	03:09 01:00 22:40 20:12	3.4 3.5 3.5	1507 1509 1517 1507 1500	4.444 4.485 4.528 5.160 4.272 4.592	2,000 1,500 1,000 500 0	-	-0-1	# -0-	2# -0		时间	出铁速 (t/min)		① 出移 (t/8	ŧ负荷 h)
200 200 200 200 200 200 200 200	22-07-30 22-07-30 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29	B62049 B62048 B62047 B62046 B62045 B62044 B62043 B62042	3#铁口 2#铁口 3#铁口 2#铁口 3#铁口 2#铁口	03:14 01:05 22:47 20:18 18:43 16:29 13:42 11:49	03:26 01:21 23:00 20:33 19:00 16:39	03:09 01:00 22:40 20:12 18:38	3.4 3.5 3.5 3.5	1507 1509 1517 1507	4.444 4.485 4.528 5.160 4.272 4.592 4.633	2,000 1,500 1,000 500 0 3#铁口	-	-0-1	# -O-	2# -0		时间	出铁速 (t/min)	b.	C 出移 (t/8	ŧ负荷 h)
200 200 200 200 200 200 200 200 200 200	22-07-30 22-07-30 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29	B62049 B62048 B62047 B62046 B62045 B62044 B62043 B62042 B62041	3#铁口 2#铁口 3#铁口 3#铁口 2#铁口 3#铁口 3#铁口	03:14 01:05 22:47 20:18 18:43 16:29 13:42	03:26 01:21 23:00 20:33 19:00 16:39 13:57	03:09 01:00 22:40 20:12 18:38 16:22	3.4 3.5 3.5 3.5 3.5 3.5	1507 1509 1517 1507 1500	4.444 4.485 4.528 5.160 4.272 4.592 4.633	2,000 1,500 1,000 500 0	-	-0-1	# -O-	2# -0		时间	出铁速 (t/min)		C 出彩 (t/8	ŧ负荷 h)
200 200 200 200 200 200 200 200 200	22-07-30 22-07-30 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29	B62049 B62048 B62047 B62046 B62045 B62044 B62043 B62042 B62041	3#铁口 2#铁口 3#铁口 2#铁口 3#铁口 2#铁口	03:14 01:05 22:47 20:18 18:43 16:29 13:42 11:49	03:26 01:21 23:00 20:33 19:00 16:39 13:57 11:57	03:09 01:00 22:40 20:12 18:38 16:22 13:38	<ol> <li>3.4</li> <li>3.5</li> <li>3.5</li> <li>3.5</li> <li>3.5</li> <li>3.4</li> </ol>	1507 1509 1517 1507 1500 1506	4.444 4.485 4.528 5.160 4.272 4.592 4.633	2,000 1,500 1,000 500 0 3#铁口	-	-0-1	# -O-	2# -0		时间	出铁速 (t/min)		C 出彩 (t/8	ŧ负荷 h)
200 200 200 200 200 200 200 200 200 200	22-07-30 22-07-30 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29	B62049 B62048 B62047 B62046 B62045 B62043 B62043 B62042 B62041 B62040	3#铁口 2#铁口 3#铁口 3#铁口 2#铁口 3#铁口 3#铁口	03:14 01:05 22:47 20:18 18:43 16:29 13:42 11:49 09:49 07:11	03:26 01:21 23:00 20:33 19:00 16:39 13:57 11:57 10:00	03:09 01:00 22:40 20:12 18:38 16:22 13:38 11:45	3.4 3.5 3.5 3.5 3.5 3.5 3.4 3.4	1507 1509 1517 1507 1500 1506 1498	4.444 4.489 4.528 5.160 4.277 4.592 4.633 4.354	2,000 1,500 1,000 500 0 3#铁口 2#铁口	-	-0-1		2# -0		时间	出铁速 (t/min)			ŧ负荷 h)
は、 このの このの このの このの このの このの このの この	22-07-30 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29	B62049 B62048 B62047 B62046 B62045 B62043 B62043 B62042 B62041 B62040	3#铁口 2#铁口 3#铁口 3#铁口 2#铁口 3#铁口 2#铁口 3#铁口	03:14 01:05 22:47 20:18 18:43 16:29 13:42 11:49 09:49 07:11	03:26 01:21 23:00 20:33 19:00 16:39 13:57 11:57 10:00 07:18	03:09 01:00 22:40 20:12 18:38 16:22 13:38 11:45	3.4 3.5 3.5 3.5 3.5 3.4 3.4 3.4 3.4	1507 1509 1517 1507 1500 1506 1498	4.444 4.489 4.528 5.160 4.277 4.592 4.633 4.354	2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口	-	-0-1					出铁速 (t/min)	受		ŧ负荷 h)
には、「日本の」では、「日本の」、「日本の」では、「日本の」、「日本の、「日本の、「日本の、「日本の、「日本の、「日本の、「日本の、「日本の	22-07-30 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29	B62049 B62048 B62047 B62046 B62043 B62043 B62043 B62042 B62041 B62040 B62040	3#铁口 2#铁口 3#铁口 3#铁口 2#铁口 3#铁口 3#铁口 3#铁口	03:14 01:05 22:47 20:18 18:43 16:29 13:42 11:49 09:49 07:11	03:26         01:21         23:00         20:33         19:00         16:39         13:57         10:00         07:18	03:09 01:00 22:40 20:12 18:38 16:22 13:38 11:45 09:45	3.4 3.5 3.5 3.4 3.4 3.4 3.4	1507 1509 1517 1507 1500 1506 1498 1521	4.444 4.489 4.528 5.160 4.277 4.592 4.633 4.354 4.354	2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口			5(%)		出的 (%) Ti(%	) C(%)	(t/min)			t负荷 h)
201 201<	22-07-30 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29 22-07-29	B62049 B62047 B62046 B62045 B62043 B62043 B62042 B62041 B62040 B62040	3#铁口 2#铁口 2#铁口 3#铁口 2#铁口 3#铁口 3#铁口 3#铁口 3#铁口 3#铁口	03:14       01:05       22:47       20:18       18:43       16:29       13:42       11:49       09:49       07:11       10:05       10:29       20:18       20:18       10:29       11:49       09:49       07:11       10:00       10:22       10:22	03:26         01:21         23:00         20:33         19:00         16:39         13:57         10:00         07:18	03:09 01:00 22:40 20:12 18:38 16:22 13:38 11:45 09:45	3.4 3.5 3.5 3.4 3.4 3.4 3.4 3.4 3.4	1507 1509 1517 1507 1500 1506 1498 1521	4.444 4.485 4.528 5.160 4.272 4.592 4.633 4.354 4.768 <b>IXXX</b>	2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口		Si(%)	5(%) 0.037	P(%) M	出想 (%) Ti(% 1 0.04	) <b>C(%)</b>	(t/min)	检验		t负荷 h)
200       200	22-07-30 22-07-29 20-07-29 20-07	B62049 B62047 B62046 B62045 B62044 B62044 B62042 B62041 B62040 € € € € F \$ 6 € € F \$ 6 € 1 C € 5 € 5 € 5 € 5 € 5 € 5 € 5 € 5 € 5 €	3#铁口 2#铁口 2#铁口 3#铁口 2#铁口 3#铁口 3#铁口 3#铁口 3#铁口 3#铁口 3#铁口 3#铁口	03:14       01:05       22:47       20:18       18:43       16:29       13:42       11:49       09:49       07:11       10:05       10:29       20:18       20:18       10:29       11:49       09:49       07:11       10:00       10:22       10:22	03:26       0         01:21       0         23:00       0         10:01       0         10:00       0         11:57       0         10:00       0         07:18       0         328       2         369       2	03:09 01:00 22:40 20:12 18:38 16:22 13:38 13:38 09:45 09:45	3.4 3.5 3.5 3.5 3.4 3.4 3.4 3.4 3.4 3.4	1507 1509 1517 1507 1500 1506 1498 1521	4.444 4.485 5.160 4.277 4.597 4.633 4.354 4.768 <b>!!!!!!!!!!!!!</b>	2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口 5 <b>8 2</b> 47 19	царана	<b>Si(%)</b> 0.48	<b>5(%)</b> 0.037 0.046	P(%) M 0.109 0.2	(%) Ti(%) 1 0.04	) <b>C(%)</b>	(t/min)	· · · · · · · · · · · · · · · · · · ·		t负荷 h)
200       200	22-07-30       22-07-30       22-07-29       12-07-29       12-07-29       13-07       14-07       15-07       16-07       26-07	B62049 B62048 B62047 B62046 B62043 B62043 B62042 B62041 B62040 € € € F\$\$B\$\$ B62040 B62040 B62040 B62040 B62040 B62040 B62040 B62041 B62041 B62045 B6205 B620	3#¥;□ 2#4;:□ 2#4;:□ 3#4;:□ 2#4;:□ 3#	03:14 01:05 22:47 20:18 18:43 18:43 18:42 13:42 11:49 09:49 07:11 09:49 07:11 09:49 07:11 09:49 228	03:26       0         01:21       0         23:00       0         10:01       0         10:00       0         11:57       0         10:00       0         07:18       0         328       2         369       2	<ul> <li>03:09</li> <li>01:00</li> <li>22:40</li> <li>20:12</li> <li>18:38</li> <li>16:22</li> <li>13:38</li> <li>11:45</li> <li>09:45</li> </ul>	3.4 3.5 3.5 3.5 3.4 3.4 3.4 3.4 3.4 3.4	1507 1509 1517 1507 1500 1506 1498 1521 ****	4.444 4.485 5.160 4.277 4.597 4.633 4.354 4.768 <b>!!!!!!!!!!!!!</b>	2,000 1,500 1,000 500 0 3=铁口 2=状口 1=狭口 47 19 47 16	Image: Constraint of the second s	<b>Si(%)</b> 0.48 0.42	<b>5(%)</b> 0.037 0.046	P(%) M 0.109 0.2 0.099 0.2	(%) Ti(%) 1 0.04	) <b>C(%)</b>	(t/min)	私会会 し し し し し し し し し し し し し し し し し し		t负荷 h)
1         20.           2         20.           3         20.           4         20.           5         20.           6         20.           7         20.           8         20.           9         20.	22-07-30 22-07-29 22-07	B62049 B62048 B62047 B62046 B62043 B62043 B62042 B62041 B62040 € € € F\$\$B\$\$ B62040 B62040 B62040 B62040 B62040 B62040 B62040 B62041 B62041 B62045 B6205 B620	3##; 2# 3 2# 3 2 # 3 2 # ; : : : : : : : : : : : : : : : : : :	03:14 01:05 22:47 20:18 18:43 16:29 13:42 11:49 09:49 07:11 09:49 07:11 09:49 228 07:11 228 228 221 228	03:26       0         01:21       0         23:00       0         10:01       0         10:00       0         11:57       0         10:00       0         07:18       0         328       2         369       2	は 、 、 、 、 、 、 、 、 、 、 、 、 、	3.4 3.5 3.5 3.5 3.4 3.4 3.4 3.4 3.4 3.4	1507 1509 1517 1507 1500 1506 1498 1521 ****	4.444 4.485 5.160 4.277 4.597 4.633 4.354 4.768 <b>!!!!!!!!!!!!!</b>	2,000 1,500 1,000 500 0 3#铁口 2#铁口 1#铁口 47 19 47 16 47 26	Image: Constraint of the second s	<b>Si(%)</b> 0.48 0.42 0.45	<b>S(%)</b> 0.037 0.046 0.031	P(%) M 0.109 0.2 0.099 0.2	(%) Ti(%) 1 0.04	) <b>C(%)</b>	(t/min)			t负荷 h)



#### **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

气流状态:	77.1分	计算时间

#### 炉顶气流

煤气利用率极差	分数: 76.90,耳
顶温极差	分数: 71.45,耳
煤气利用率	分数: 75.50,耳

#### 炉内气流

炉身静压力均匀性	分数: 50.00,/ 分: 50
炉身静压力分配波动(6-8段)	分数: 50.00, <sup>1</sup> 最终评分
透气性指数	分数: 80.51, B
炉身静压分配波动(风口-6段)	分数: 50.00, I 最终评分
炉身静压力分配波动(13段-炉 顶)	分数: 35.00, B 最终评分
炉身静压力分配波动(8-13段)	分数: 35.00, B 最终评分

#### 风口气流

风压变化	分数: 83.20,耳
理论燃烧温度	分数: 59.63,耳
炉腹煤气指数	分数: 84.96,耳
风量变化	分数: 76.94,耳





#### 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

主界面	
热风压力 kPa① Q	热负荷 ℃·m3/h①
384.5	15295
热风压力: 384.5 炉顶压力: 炉顶温度: 全压差:	A: 3756 B: 40 C: 3446 D: 40
冷风流量 m3/min① Q	煤气利用率 %①
<b>4579</b> 冷风流量: 4579 鼓风湿度: 炉顶煤气: 520561 炉腹煤气: 6055	<b>47.74</b> CO: 23.92 CO2: H2: 3.03 N2: 5
炉温预报①	112, 5,05 112, 5
% -O- 铁水温度 → 0.6 - 0.5 -	- 实际Si 预测Si
0.4 - 0.3 -	





#### 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.

9	宁波钢钅	跌2#高炊	户集控中心		terel
		- 100 100		R.	
			绿色宁钢、智慧	宁钢、活力宁	『钢、实力宁钢
Ģ	8	8			
原料	炉料	气流	炉型	炉缸	渣铁
高炉生	产参数			(J	历史参数
刷新时间:	2022-07-	30 03:04:24	÷		
456	3 3	393.5	380.5	20	05.3
冷风流 m3/m		令风压力 kPa	热风压力 kPa	]	顶压 kPa
205	5 ,	175.3	1143	2'	14.5
顶压设 kPa		全压差 kPa	热风温度 ℃	冷	风温度 ℃
153.	.2	5053	1.46	3	9.05
顶温 ℃	L	富氧量 m3/h	富氧率 %	時	<sup>我</sup> t/h
40		100.7	228.6	24	48.9
设定喷火 t/h		肢风动能 kJ/s	标准风速 m/s	(1)[[[]][[]][[]][[]][[]][[]][[]][[]][[]][	际风速 m/s
212	0	13.49	26.04	0.3	3320
理燃温		技风湿度 g/m3	透气指数 m3/min/kF	进	风面积 m2
<b>公</b> 首页		₩ UK	 操业	-	る辺辺
				182	



#### 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





#### Integrated control of BF

#### **BF plant 3D visualization**

Production status

- Equipment safety
- Personal safety
- Environment-friendly emission









# 你本

In-furnace Transparency



∽ 宁波钢铁2#高炉炉内三维可视化
<u>5207</u> © 昨日产量 t
497 © 燃料比 47.10 © 煤气利用率 %
₩ 操气利用单 %
利用系数 利用系数



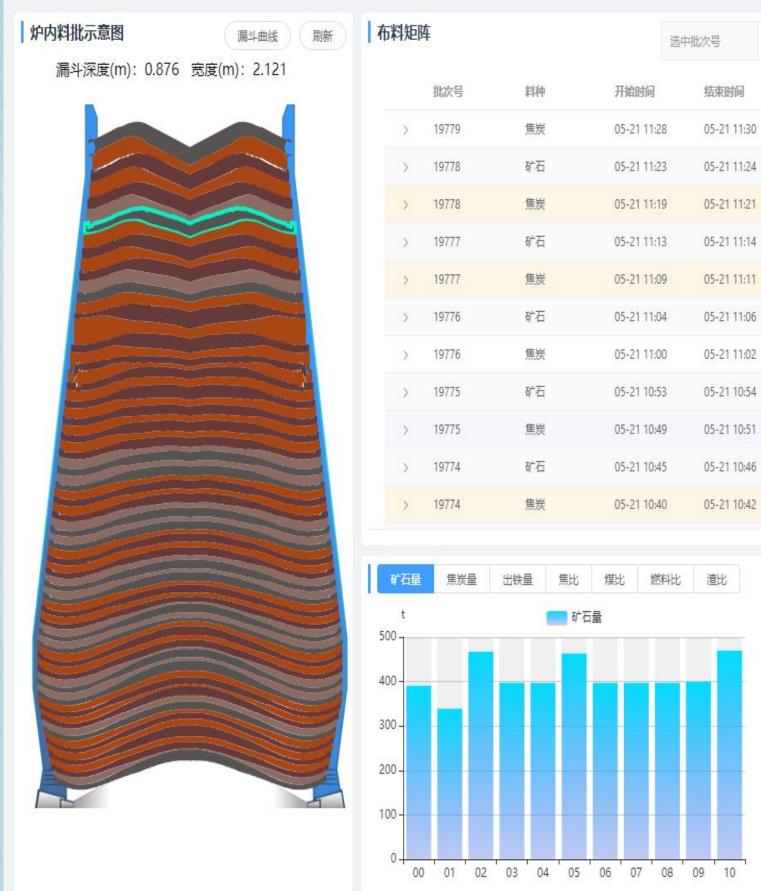


Q

#### **Burden visualization**

#### **Burden tracking model**

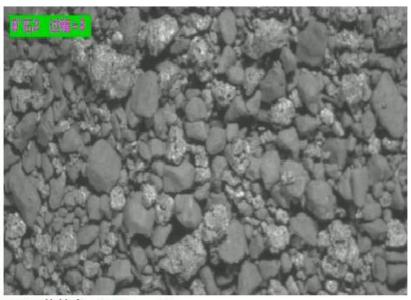
- > Collecting the actual weight of each material batch to obtain the actual iron content and coke ratio of the batch with reference to the charge component; measuring grain size of furnace burden on real time basis and correcting burden tracking
- > Calculating on real time basis the position of each 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





料矩	阵		送	師批次号	19776	料种	焦炭
	批次号	料种	开始时间	结束时间	下料量(kg	g)	变量标记
>	19779	焦炭	05-21 11:28	05-21 11:30	16567		
>	19778	矿石	05-21 11:23	05-21 11:24	68838		变料批次
>	19778	焦炭	05-21 11:19	05-21 11:21	16642		变料批次
Σ	19777	矿石	05-21 11:13	05-21 11:14	69999		变料批次
>	19777	焦炭	05-21 11:09	05-21 11:11	16447		变料批次
>	19776	矿石	05-21 11:04	05-21 11:06	68531		
>	19776	焦炭	05-21 11:00	05-21 11:02	16762		
>	19775	矿石	05-21 10:53	05-21 10:54	69343		变料批次
>	19775	焦炭	05-21 10:49	05-21 10:51	16292		变料批次
>	19774	矿石	05-21 10:45	05-21 10:46	69570		变料批次
>	19774	焦炭	05-21 10:40	05-21 10:42	16686		变料批次

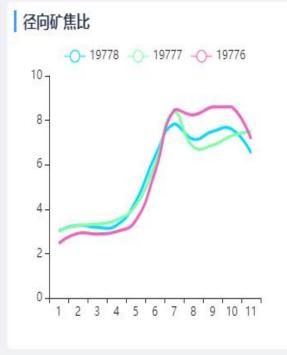
#### 颗粒度识别



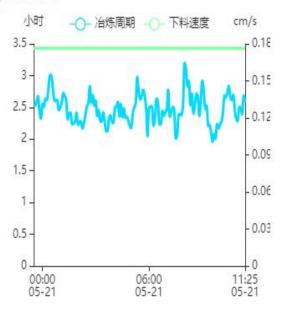
矿石平均粒度: 26.717 mm①

0.0-10.0	10.0-20.0	20.0-30.0	30.0-40.0	40.0-50.0	>50.0
0.31%	34.69%	36,06%	16.07%	7.31%	5.56%

0.0-	15.0-	25.0-	35.0-	45.0-	55.0-	65.0-	>75.0
15.0	25,0	35.0	45.0	55.0	65.0	75.0	
5.9%	28.88%	23.87%	15.67%	9.33%	4.81%	3.55%	8%



#### 冶炼周期



#### **Gas stream visualization**

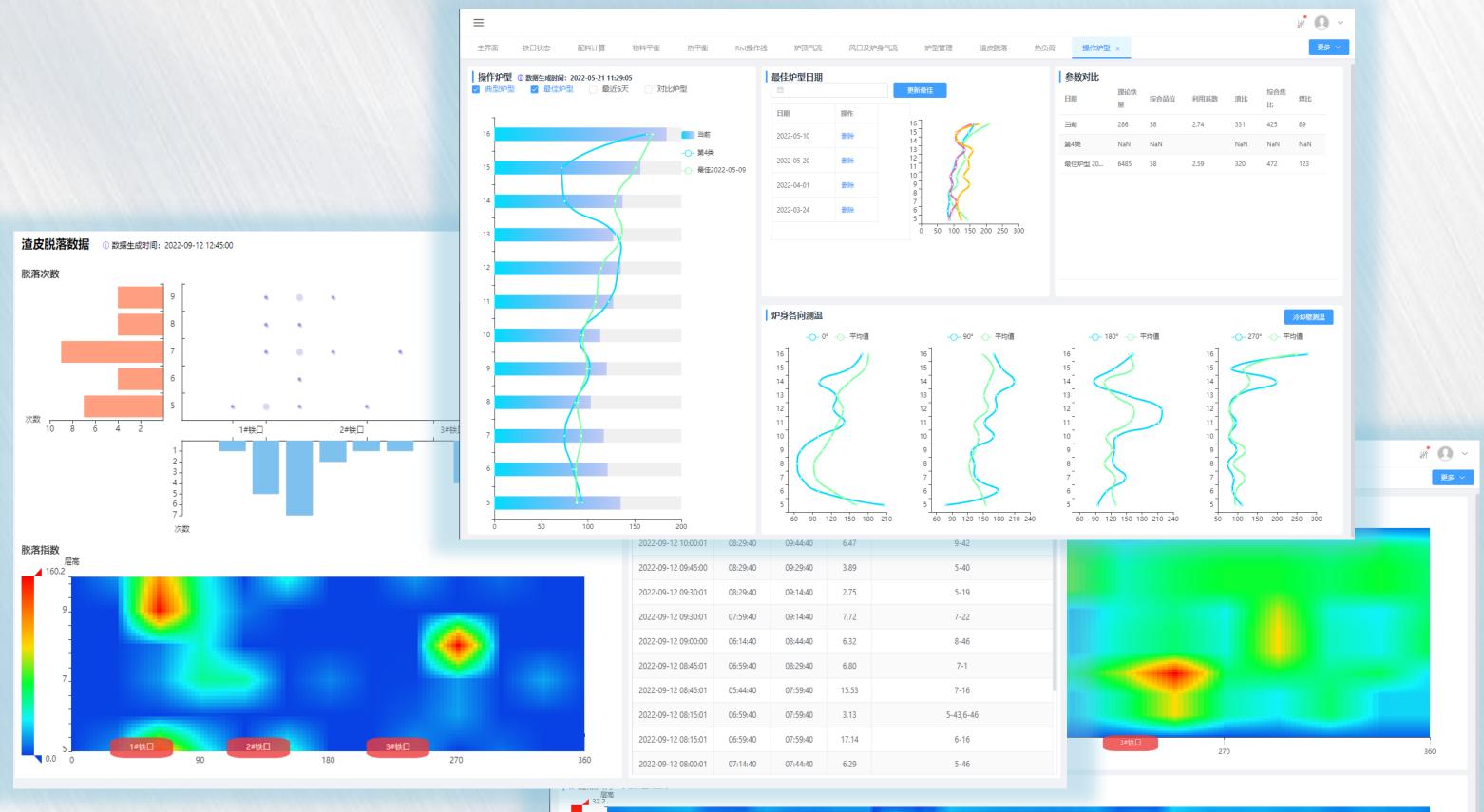
 Realizing comprehensive understanding of the overall evolution of gas stream in the furnace through in-depth mining of the infrared camera data of furnace top and monitoring of furnace body and tuyere state; capturing the abnormal conditions inside the furnace such as gas stream segregation, channeling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



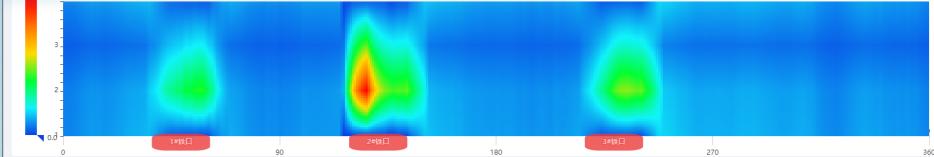


#### **Furnace profile visualization**

- 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.

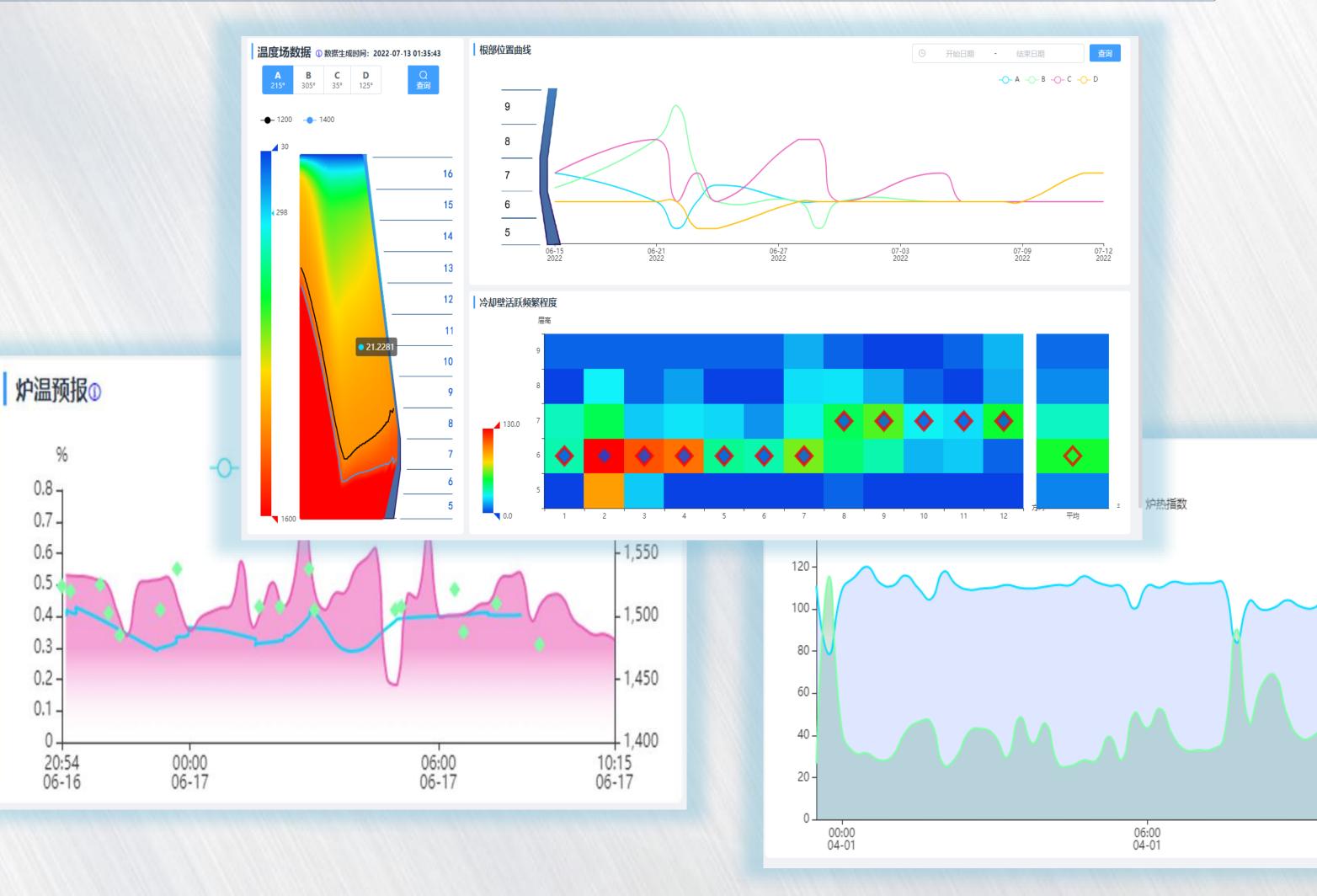






#### **Furnace heat visualization**

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

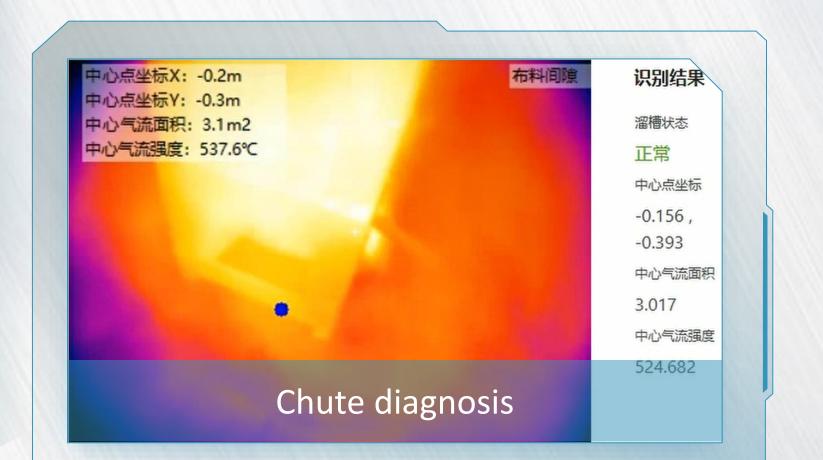




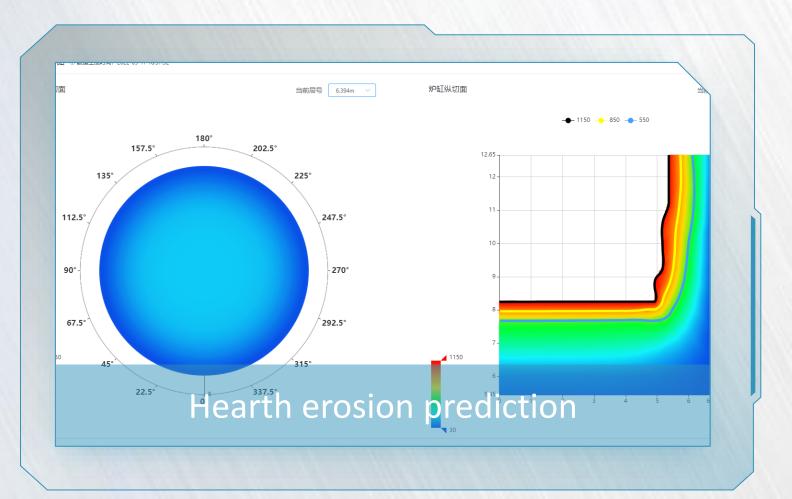
#### **Safety visualization**

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

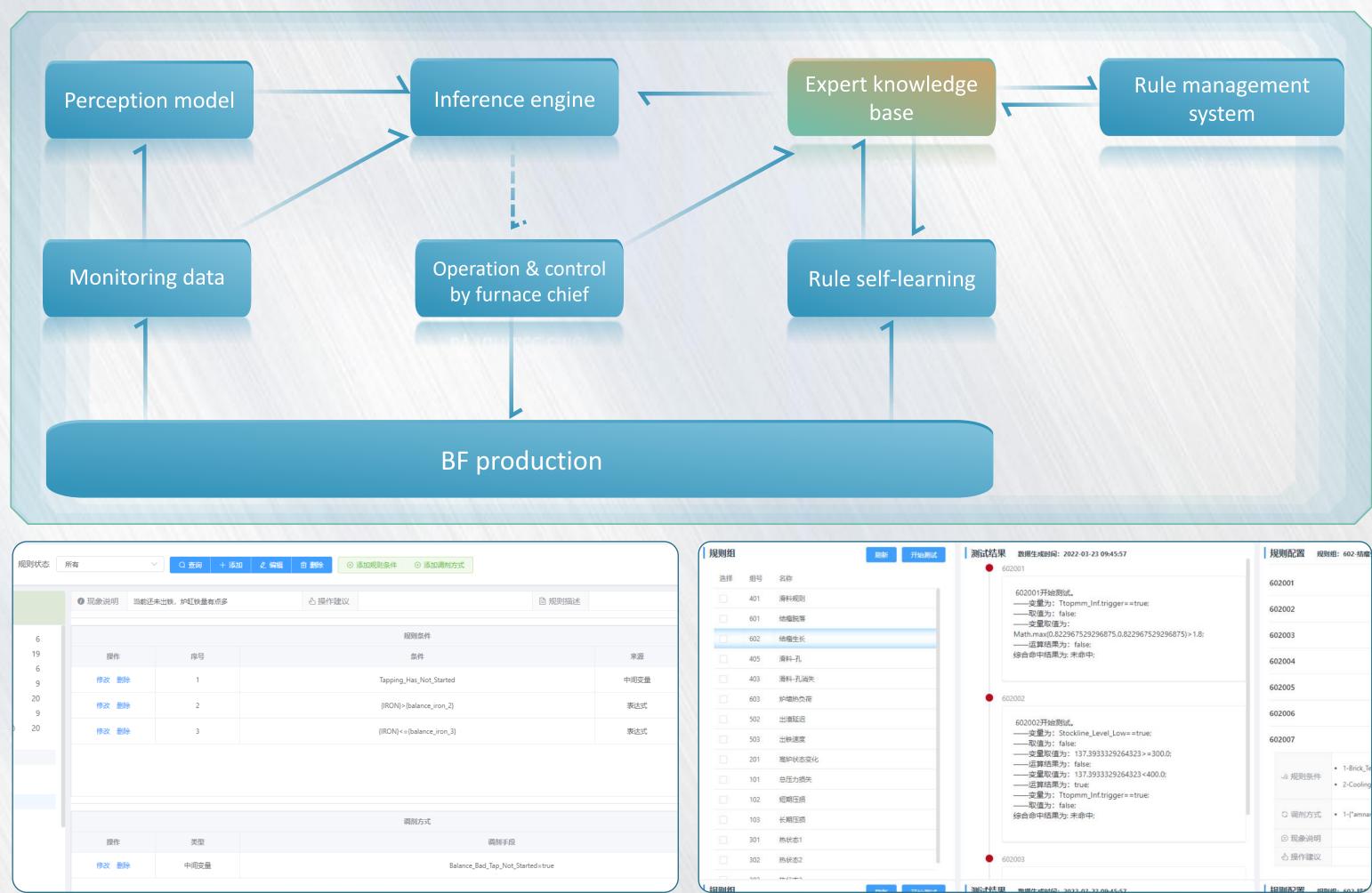
Pre-warning, Evaluation & Operation Guidance



## Pre-warning, Evaluation and Operation Guidance

#### **Inference engine**

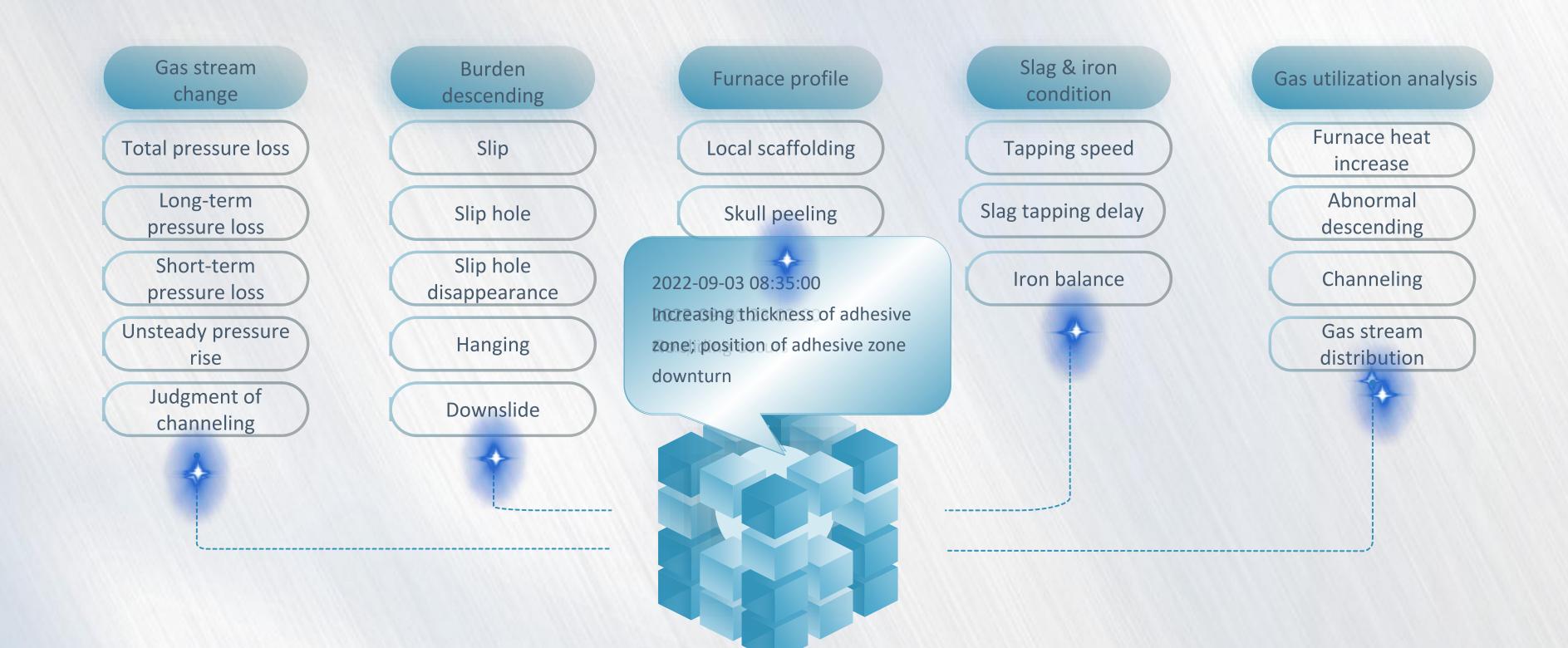
- Establishing the expert knowledge base and developing corresponding inference engine system
- Based on production data and model outputs, performing inference according to expert rules to achieve furnace condition evaluation and give operation suggestions.
- Self-learning of inference rules according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





đ		规则组		刷新 开始测定		数据生成时间: 2022-03-23 09:45:57	规则配置 规	则组: 602-结瘤
		选择	组号	名称	60	2001	602001	
自规则描述		0	401	滑料规则		602001开始测试。 ——变量为:Ttopmm_Inf.trigger==true:		
			601	结瘤脱落		——取值为:false; ——-安重取值为: Math.max(0.822967529296875,0.822967529296875)>1.8; ——-运算结果为:false;	602002	
			602	结瘤生长				
	来源		405	滑料-孔		综合命中结果为:未命中;	602004	
	中间变量		403	滑料孔消失			602005	
	表达式		603	炉墙热负荷	60	12002		
			502	出渣延迟		602002开始测试。	602006	
	表达式		503	出铁速度		——变量为: Stockline_Level_Low==true; ——取值为:false;	602007	
调剂手段			201	高炉状态变化		——···································		1-Brick
			101	总压力损失		<ul> <li>——变量取值为: 137.3933329264323 &lt;400.0;</li> <li>——运算结果为: true;</li> <li>——变量为: Ttopmm_Inf.trigger==true;</li> <li>——取值为: false;</li> <li>综合命中结果为: 未命中;</li> </ul>	~ 规则条件	2-Coolir
			102	短期压损				
			103	长期压损			こ 调剂方式	• 1-{"amn
			301	热状态1			③ 现象说明	
ance_Bad_Tap_Not_Started=true			302	执状态2	60	12003	心 操作建议	
			343	44. J > -4- %				

## 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



## 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 prewarnings given for 29 such cases since operation

#### **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

#### **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

**34** 

times

times

Total

times

43

times



## 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

#### 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



### 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

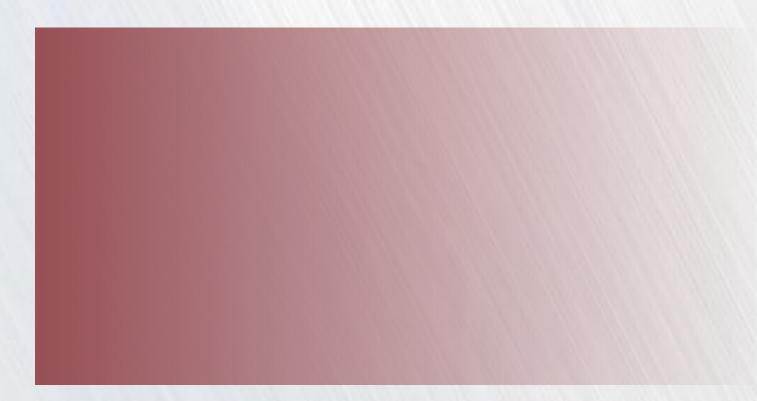




# 06 成果与展望

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

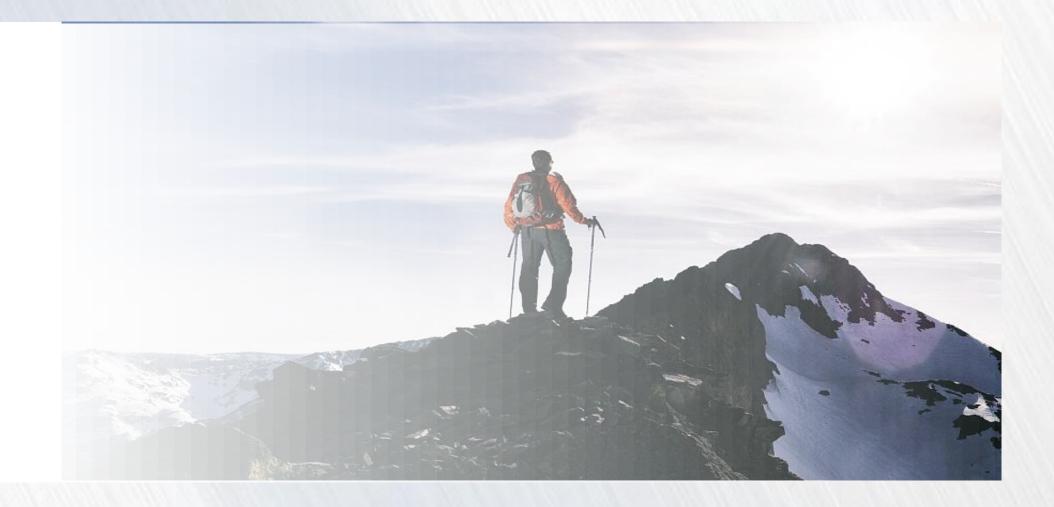


0.2t/(m<sup>3</sup>·d)

Higher productivity

Ensuring stable and smooth operation Improving safety and longevity of BF





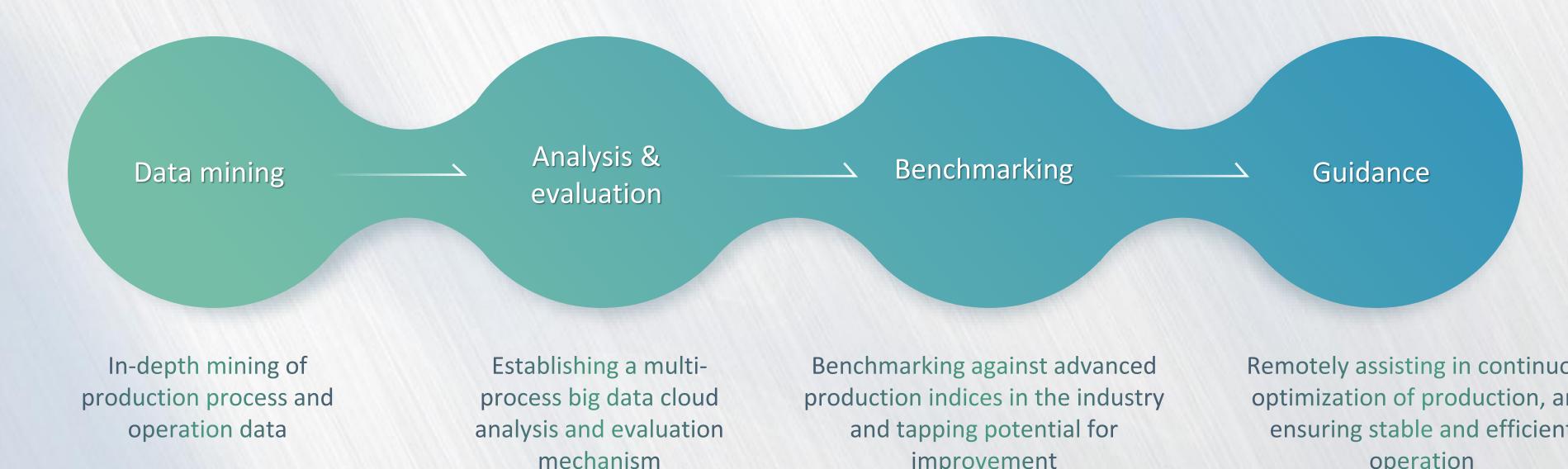


Reducing coke consumption Decreasing carbon emission Contributing to carbon neutralization

# **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 longterm 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.





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



#### PROFESSIONAL DEVOTED

CONSTANT



ORESIGHTED