

首钢国际工程公司始创于1973年，是由原北京首钢设计院改制成立、首钢集团相对控股的国际型工程公司，拥有工程设计综合甲级资质，是国家高新技术企业，提供冶金、市政、建筑、节能环保等行业的规划咨询、工程设计、设备成套、项目管理、工程总承包等技术服务。

首钢国际工程公司在钢铁厂总体规划、原料场、焦化、烧结、球团、炼铁、炼钢、轧钢、工业炉、节能环保单项设计，冶金设备成套等方面具有独到优势和丰富业绩。工程业绩覆盖武钢、太钢、包钢、济钢、唐钢、重钢、新钢、宣钢、承钢、湘钢等60余家钢铁企业及巴西、秘鲁、印度、马来西亚、越南、孟加拉、菲律宾、韩国、沙特、阿曼、津巴布韦、安哥拉等20多个国家。

首钢国际工程公司获得国家科学技术奖和全国优秀设计奖等50余项、冶金行业和北京市优秀设计及科技进步奖等300余项，拥有300余项专利技术，多个项目创造中国企业新纪录。

BSIET is an international engineering company relatively held by Shougang Group. It was reorganized from BSDI which was founded in 1973.

BSIET has attained the Compound Grade A Qualification for Engineering Design and the approval of High-tech Enterprise by Ministry of National Science and Technology. It provides technical services ranging from planning consultation, engineering design, equipment integration, project managing, EPC etc. for metallurgical, municipal, architectural, energy saving and environmental industries and so on.

BSIET has unique technology advantages and rich practical experience lie especially in overall design of iron and steel plants, individual design for stock yard, coking, sintering, pelletizing, iron making, steel making, reheating furnace, energy saving, environment protection and integration of metallurgical equipment. The projects cover more than 60 iron and steel enterprises of WISCO, TISCO, Baogang, Jigang, Tanggang, Chonggang, Xingang, Xuangang, Chenggang, Xianggang, and more than 20 nations as Brazil, Peru, India, Malaysia, Vietnam, Bangladesh, the Philippines, South Korea, Saudi Arab, Oman, Zimbabwe, Angola etc.

BSIET has been awarded with 50-odd national science & technology prizes and national excellent design prizes, 300-odd metallurgical industry and Beijing city excellent design and science and technology progress prizes, and achieved 300-odd national patents. A variety of projects created new records of Chinese companies.



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高炉喷煤技术 PULVERIZED COAL INJECTION FOR BLAST FURNACE



源自百年首钢 服务世界钢铁
Expertise from hundred-year Shougang



北京首钢国际工程技术有限公司
BEIJING SHOUGANG INTERNATIONAL ENGINEERING TECHNOLOGY CO.,LTD.

发展历程 History of Development

高炉喷煤是现代高炉的重要技术特征。喷煤可以降低焦炭消耗，减少炼焦污染，调节炉况，促进高炉稳定顺行，强化高炉冶炼，降低炼铁生产成本。首钢是该项技术的发明者，历史悠久，经验丰富，实践效果显著，在国内外享有很高声誉。

- ◎ 1963年，进行系统的研究与试验，1964年在首钢高炉上应用；
- ◎ 1966年，在首钢高炉上推广，年平均喷煤量达159kg/t，创造了当时的世界纪录；
- ◎ 1994年，在首钢1036m³-2536m³五座高炉上应用，采用集中制粉，间接喷吹，串联罐多管路喷煤；
- ◎ 2000年，进行重大技术改进，采用中速磨煤机制粉，布袋一级收粉，双系列串联罐直接喷吹，在首钢两座（1780m³、2536m³）高炉上应用，达到国际先进水平；
- ◎ 2004年，设计湘钢1800m³高炉，采用中速磨煤机制粉，并列罐间接喷吹；
- ◎ 2007年，设计首钢迁钢2号2650m³高炉，采用并列罐直接喷吹，实现全自动喷煤；
- ◎ 2009年，设计首钢京唐1号5500m³高炉，采用并列罐直接喷吹，全自动喷煤，浓相输送，两根喷煤总管流量在线监测和自动调节；
- ◎ 2010年，设计首钢迁钢3号4000m³高炉，采用并列罐直接喷吹，全自动喷煤，采用管式皮带机运煤，并可同时向其它高炉输送煤粉。

Pulverized Coal Injection (PCI) for Blast Furnace (BF) is an important technical feature of modern BF. PCI can reduce coke consumption, coking pollution, adjust furnace conditions, promote stable and smooth operation of BF, strengthen BF smelting and decrease iron-making production cost. Shougang was the inventor of this technology, having a long history and rich experiment, notable practice effects and a high reputation at home and abroad.

- ◎ Research and test of the system in 1963, application on Shougang BF in 1964;
- ◎ Promoted on Shougang BF in 1966, annual average coal injection rate 159kg/t, presenting a world record at that time;
- ◎ Application on Shougang five BF's (1036m³-2536m³) in 1994, adopting centralized pulverizing, indirect injection, serial hopper and multi-pipe coal injection;
- ◎ Significant technical improvement in 2000, introducing medium-speed coal mill for pulverizing, bag type first grade powder collection, two streams of serial hopper direct injection, applied on two BF's (1780m³, 2536m³) of Shougang, reaching international advanced level;
- ◎ Design of Xianggang 1800m³ BF in 2004, using medium-speed coal mill for pulverizing, parallel hopper indirect injection;
- ◎ Design of Shougang Qiangang 2# 2650m³ BF in 2007, adopting parallel hopper direct injection, realizing full-automatic coal injection;
- ◎ Design of Shougang Jingtang 1# 5500m³ BF in 2009, adopting parallel hopper direct injection, full-automatic coal injection, dense phase conveying, having on-line flow monitoring and automatic regulation of two PCI main pipes;
- ◎ Design of Shougang Qiangang 3# 4000m³ BF, adopting parallel hopper direct injection, full-automatic coal injection, adopting pipe type belt conveyor for coal transportation, also conveying coal powder for other BF's at the same time.

主要技术特点 Main Technical Characteristics

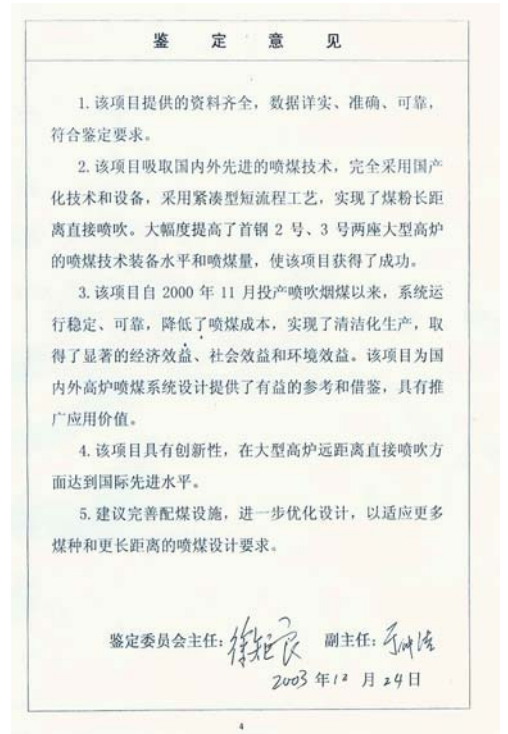
长距离直接喷吹 紧凑型布局 Long-distance Direct Injection Compact Type Arrangement

首钢国际工程公司设计的首钢2号、3号高炉喷煤工程，采用全国产化技术和设备，采用紧凑型短流程工艺，实现了煤粉长距离直接喷吹。2号高炉喷煤总管长度达到452m，被列入第九批中国企业新纪录。该项工程经专家鉴定，达到国际先进水平。

- ◎ 采用两台中速磨煤机分别为两座高炉磨煤，并实现煤粉的互相补充
- ◎ 喷煤厂占地面积在同等规模中是最小的，应用大倾角胶带机
- ◎ 实现喷吹烟煤

Shougang 2#, 3# BF PCI project designed by BSIET adopted fully-sinicized technology and equipment, compact type short flow process and realized the long-distance direct injection of coal powder. The length of 2# BF PCI main pipe is 452m and it is nominated for the 9th session of new record of Chinese enterprise. Appraised by experts, this project has reached international advanced level.

- ◎ Two medium-speed coal mills were provided for coal grinding of two BF's respectively. Mutual supplement of coal powder was realized
- ◎ The floor area of PCI building is the minimum in the same scale using the belt conveyor with large inclination
- ◎ Realizing the injection of bituminous coal



科技成果鉴定
Appraisal for the scientific result



北京市“大型高炉紧凑型长距离制粉喷煤技术工艺开发与设计研究”科技成果鉴定会
Beijing appraisal meeting for the scientific results of technological development and design research of compact long-distance PCI technology for large-scale BF

浓相输送 均匀喷吹 Dense Phase Conveying Uniform Injection

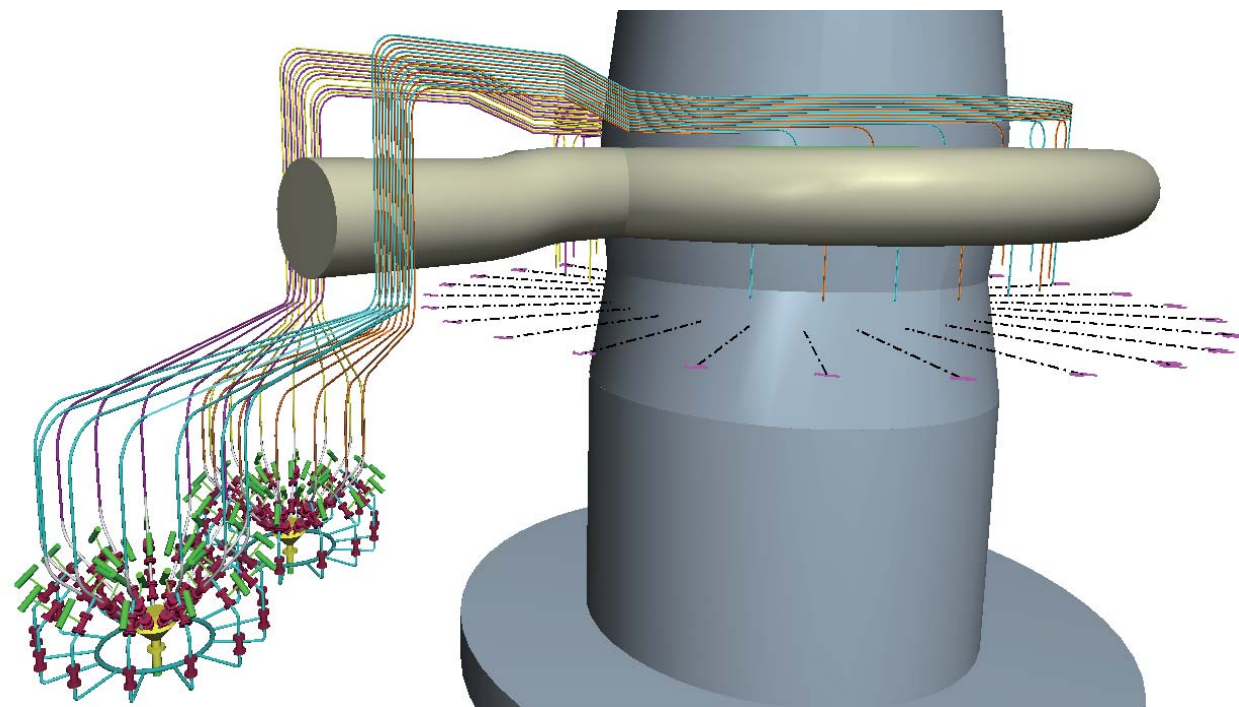
- ◎ 煤粉输送固气比 ≥ 40 ，节约输送气体消耗，减少管道磨损
- ◎ 喷煤支管均匀布置，当量长度误差小于1米，喷煤量误差小于4%
- ◎ In pulverized coal conveying, solid and gas rate is ≥ 40 , saving conveying gas consumption and reducing pipeline wear
- ◎ PCI branched pipes are uniformly arranged, the equivalent length tolerance is less than 1m, and the coal injection tolerance is less than 4%



上出料流化喷煤罐
Upper discharge fluidizing PCI hopper



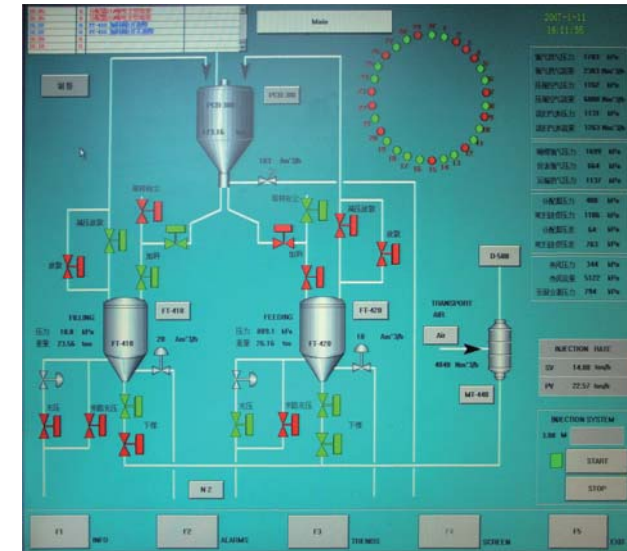
喷煤支管均匀布置
PCI branched pipes arranged uniformly



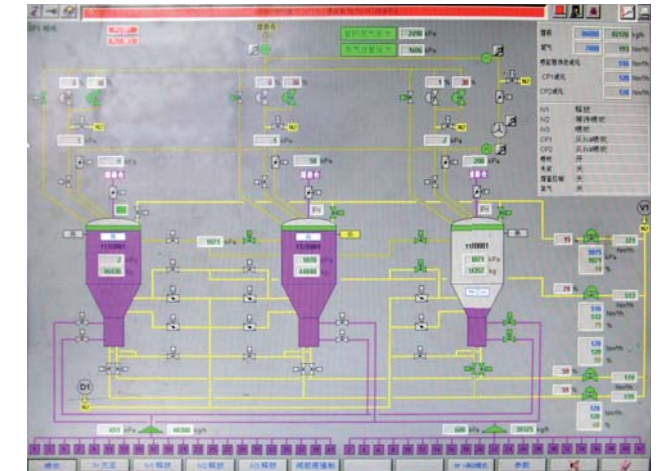
宣钢2号高炉喷煤支管均匀布置
PCI branched pipes arranged uniformly for Xuangang 2# BF

全自动喷煤 喷煤量自动控制调节 Fully-automatic Coal Injection Automatic Control and Adjustment of Coal Injection

- ◎ 喷吹过程采用自动化程序控制，操作简单，控制精确
- ◎ 根据高炉的要求设定喷煤量，相关参数自动调整
- ◎ The PCI process is controlled by PLC, with features of simple operation and accurate control
- ◎ Coal injection is set and the related parameters are automatically adjusted according to the requirements for BF



首钢迁钢2号高炉自动喷煤画面
Automatic PCI screen for Shougang Qiangang 2# BF



首钢京唐1号高炉自动喷煤画面
Automatic PCI screen for Shougang Jingtang 1# BF

喷煤支管喷吹状态实时监测 Real-time Monitoring of the Injection Status of PCI Branch Pipes

- ◎ 在线监测每根喷煤支管的喷吹状态，发现堵塞时立即自动反吹
- ◎ 确保每根喷煤支管处于正常工作状态，提高喷枪寿命，确保喷煤稳定运行
- ◎ On-line monitoring the injection status of each PCI branch pipe, automatic back-blow at once if blocking occurs
- ◎ Ensuring each PCI branch pipe under normal working conditions, improving the service life of lance and making sure the stable operation of PCI



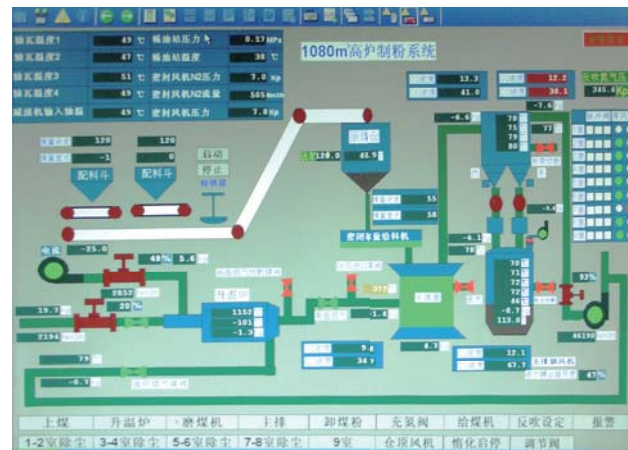
首钢京唐1号高炉喷煤支管监测
Monitoring of PCI branch pipe for Shougang Jingtang 1# BF



宣钢2号高炉喷煤支管监测
Monitoring of PCI branch pipe for Xuangang 2# BF

烟气自循环 Automatic Circulation of Fume

- ◎ 将排粉风机出口的尾气兑入到混风炉中，加热后作为磨煤所需的干燥剂
- ◎ 废气循环利用，减少排粉量，降低环境污染
- ◎ 更适合距离热风炉较远、引热风炉废气较困难的喷煤工程
- ◎ Offgas at exhaust fan outlet is added into mixing stove, taking as desiccant for coal grinding after heating
- ◎ Recycling of waste gas to reduce dust discharge and environmental pollution
- ◎ It is more suitable for the PCI project which is far from hot blast stove and hard for ignition of HBS offgas



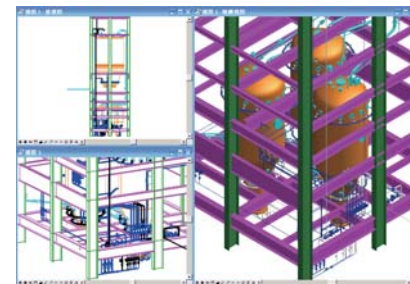
1080m³高炉烟气自循环喷煤工艺
Automatic fume circulating PCI process for 1080m³ BF

三维设计 3-D design

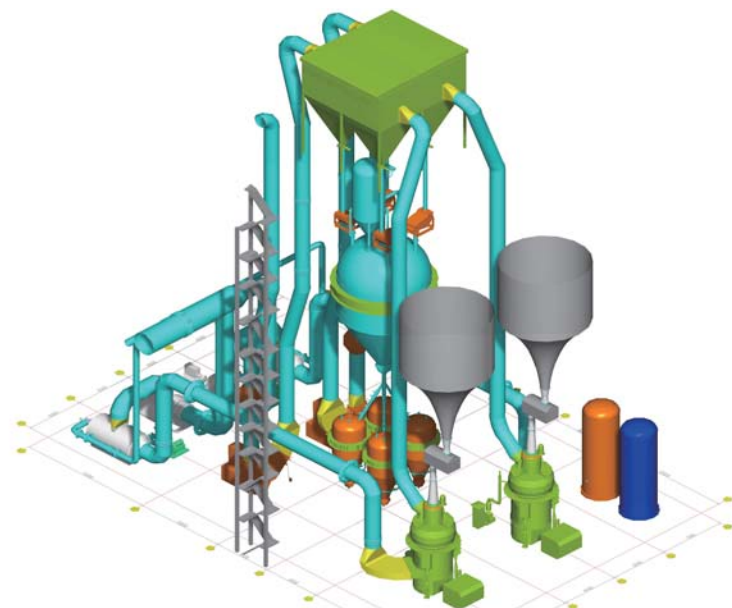
- ◎ 引进三维设计软件，对高炉喷煤系统工艺部分进行三维建模
- ◎ 实现模拟工厂浏览，完成模型间的碰撞检查
- ◎ 生成二维施工图指导现场施工安装
- ◎ Introducing 3-D design software, 3-D modeling for BF PCI system process part
- ◎ Realizing the simulation of plant browsing, completing 3-D check on model collision
- ◎ Creating 2-D construction drawing for guiding construction and installation on site



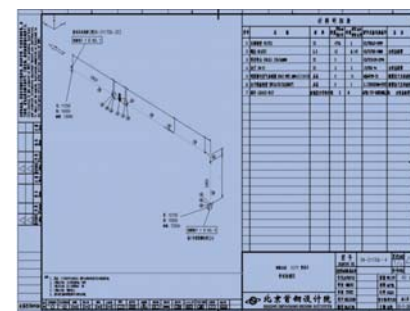
三维模型
3-D model



三维设计
3-D design



工艺效果图
Demo of the process



管线轴侧施工图
Pipeline axis side construction drawing

成熟可靠的喷煤专用设备 Mature and Reliable PCI Special Equipment



可调补气器，精确控制输送气量
Adjustable air make up device,
for accurate control of the transport gas flow



高温耐磨喷枪，使用寿命4-6个月
High-temperature wear-resistant lance,
with service life 4-6 months



高精度煤粉分配器，每根支管喷煤量更加均匀
High-precision pulverized coal distributor, reaching more
uniform coal injection of each branched pipe



喷煤总管流量计和调节阀，
在线监测瞬时流量，控制喷煤量的瞬时波动
PCI main flowmeter and regulating valve for on-line
monitoring instantaneous flow, controlling the momentary
fluctuation of injection

典型工程 Typical Projects



首钢2号、3号高炉喷煤系统
PCI systems for Shougang 2#,3# BFs

系统特点：首次采用大型中速磨煤机制粉，布袋一级收粉，双系列串联罐长距离直接喷煤。

Features of system: Adopting large medium-speed coal mill for pulverizing, bag for the first time, bag type first grade powder collection, two streams of long-distance serial hopper direct injection for the first time



首钢迁钢3号高炉喷煤系统
PCI system for Shougang Qiangang 3# BF

系统特点：管式皮带机上煤，浓相输送，全自动喷煤。

Features of system: Coal charge by pipe type belt conveyor, dense phase conveying, fully-automatic injection

首钢迁钢2号高炉喷煤系统
PCI system for Shougang Qiangang 2# BF

系统特点：并列罐直接喷吹，实现全自动喷煤。

Features of system: Parallel hopper direct injection, fully-automatic injection



首钢京唐1号、2号高炉喷煤系统

PCI systems for Shougang Jingtang 1#,2# BFs

系统特点：两座5500m³高炉，浓相输送，喷煤总管流量检测及调节，全自动喷煤。

Features of system: Two 5500m³ BFs, dense-phase conveying, monitoring and regulation of PCI main flow, fully-automatic coal injection

宣钢1号、2号高炉喷煤系统

PCI systems for Xuangang 1#,2# BFs

系统特点：两座2500m³高炉，两台中速磨煤机，共用一个煤粉仓，5个喷煤罐。

Features of system: Two 2500m³ BFs, two medium-speed coal mills, sharing one pulverized coal bin, five PCI hoppers

宣钢8号高炉喷煤系统

PCI systems for Xuangang 8# BF

系统特点：浓相输送，全自动喷煤。

Features of system: Dense-phase conveying, fully-automatic injection



主要技术指标 Main Technical Index

首钢迁钢1号2650m³高炉2009年喷煤操作主要技术指标
Main technical indexes of PCI operation in 2009 for Shougang Qiangang 1# 2650m³ BF

月份 Months	平均日产量 Average daily production t/d	利用系数 Utilization coefficient t/(m ³ ·d)	焦比 Coke ratio kg/t	煤比 Coal ratio kg/t	燃料比 Fuel ratio kg/t	风温 Air temperature ℃
1月 Jan.	6519	2.46	303.4	152.7	485.5	1218
2月 Feb.	6731	2.54	299.6	157.6	486.4	1238
3月 March	6599	2.49	299.6	156.5	485.0	1215
4月 April	6758	2.55	306.9	151.5	487.4	1223
5月 May	6652	2.51	306.3	149.1	485.1	1214
6月 June	6625	2.50	304.3	155.0	490.6	1194
7月 July	6493	2.45	303.7	156.7	490.4	1201
8月 Aug.	6652	2.51	306.4	151.6	488.2	1212
9月 Sep.	6413	2.42	304.9	155.7	489.7	1200
10月 Oct.	6811	2.57	297.0	165.2	487.9	1206
11月 Nov.	6572	2.48	295.9	165.1	489.4	1202
12月 Dec.	6678	2.52	298.6	160.0	487.4	1202
全年 Full year	6625	2.50	302.2	156.4	487.7	1210

首钢迁钢2号2650m³高炉2009年喷煤操作主要技术指标
Main technical indexes of PCI operation in 2009 for Shougang Qiangang 2# 2650m³ BF

月份 Months	平均日产量 Average daily production t/d	利用系数 Utilization coefficient t/(m ³ ·d)	焦比 Coke ratio kg/t	煤比 Coal ratio kg/t	燃料比 Fuel ratio kg/t	风温 Air temperature ℃
1月 Jan.	6784	2.56	286.75	181.00	489.99	1246
2月 Feb.	6678	2.52	282.44	180.28	484.60	1243
3月 March	6493	2.45	281.03	183.32	487.89	1247
4月 April	6599	2.49	291.01	172.90	487.85	1254
5月 May	6678	2.52	285.04	170.86	485.19	1254
6月 June	6413	2.42	285.41	167.88	485.23	1254
7月 July	6678	2.52	285.48	168.63	485.52	1251
8月 Aug.	6466	2.44	293.07	161.16	487.60	1250
9月 Sep.	6705	2.53	284.62	173.96	486.08	1277
10月 Oct.	6731	2.54	289.38	170.56	487.23	1278
11月 Nov.	6546	2.47	293.26	165.34	486.54	1273
12月 Dec.	6652	2.51	291.24	170.09	487.33	1277
全年 Full year	6625	2.50	287.4	172.2	486.8	1258.67

首钢迁钢3号4000m³高炉2011年喷煤操作主要技术指标
Main technical indexes of PCI operation in 2011 for Shougang Qiangang 3# 4000m³ BF

月份 Months	平均日产量 Average daily production t/d	利用系数 Utilization coefficient t/(m ³ ·d)	焦比 Coke ratio kg/t	煤比 Coal ratio kg/t	燃料比 Fuel ratio kg/t	风温 Air temperature ℃
1月 Jan.	9700	2.425	287.007	175.591	498.441	1241
2月 Feb.	9672	2.418	289.344	181.542	506.948	1221
3月 March	9220	2.305	291.273	174.641	502.159	1242
4月 April	10976	2.744	290.359	171.384	499.524	1242
5月 May	9632	2.408	288.111	175.107	496.275	1255
6月 June	9580	2.395	289.890	173.690	500.294	1255
7月 July	9108	2.277	298.036	178.296	514.880	1243
8月 Aug.	9304	2.326	299.350	175.869	514.887	1254
9月 Sep.	8836	2.209	308.615	168.719	516.433	1232
10月 Oct.	9404	2.351	320.522	154.533	517.118	1247
11月 Nov.	9172	2.293	320.571	160.387	521.968	1244
12月 Dec.	9509	2.38	312.161	161.293	520.912	1255
全年 Full year	9383	2.35	299.602	170.921	509.150	1246.25



工程业绩 Performance Reference

序号 No.	高炉名称 BF designations	高炉容积 BF volume	喷煤工艺 PCI process	实施方式 Modes of execution	投产时间 Start-up time
1	首钢4号高炉 (大修改造) Shougang 4# BF(overhaul)	2100m ³	双系列串联罐间接喷吹 Two streams of serial hopper indirect injection	设计 Engineering	1992
2	首钢3号高炉 (移地大修) Shougang 3# BF (relocated overhaul)	2536m ³	三系列串联罐间接喷吹 Three streams of serial hopper indirect injection	设计 Engineering	1994
3	首钢1号高炉 Shougang 1# BF	2536m ³	三系列串联罐间接喷吹 Three streams of serial hopper indirect injection	设计 Engineering	1994
4	首钢2号、3号高炉 Shougang 2#, 3# BF	1780m ³ 2536m ³	双系列串联罐直接喷吹 Two streams of serial hopper direct injection	设计 Engineering	2000
5	天津荣程钢铁厂2号高炉 2# BF of Rongcheng Iron and Steel Plant, Tianjin	550m ³	双系列串联罐直接喷吹 Two streams of serial hopper direct injection	设计 Engineering	2002
6	湘钢4号高炉 Xianggang 4# BF	1800m ³	并列罐间接喷吹 Parallel hopper indirect injection	设计 Engineering	2004
7	淮钢1号、2号高炉 Huaigang 1#, 2# BF	2×450m ³	双系列串联罐直接喷吹 Two streams of serial hopper direct injection	设计 Engineering	2004
8	首秦1号高炉 Shouqin 1# BF	1200m ³	双系列串联罐直接喷吹 Two streams of serial hopper direct injection	设计 Engineering	2004
9	新钢7号高炉 (大修) Xingang7# BF(overhaul)	1200m ³	并列罐直接喷吹 Parallel hopper direct injection	设计 Engineering	2004
10	首钢迁钢1号高炉 Shougang Qiangang 1# BF	2650m ³	双系列串联罐直接喷吹 Two streams of serial hopper direct injection	设计 Engineering	2004
11	首秦2号高炉 Shouqin 2# BF	1800m ³	双系列串联罐直接喷吹 Two streams of serial hopper direct injection	设计 Engineering	2006
12	首钢迁钢2号高炉 Shougang Qiangang 2# BF	2650m ³	并列罐直接喷吹 Parallel hopper direct injection	设计 Engineering	2007
13	太钢3号高炉 TISCO 3# BF	1800m ³	并列罐间接喷吹 Parallel hopper indirect injection	设计 Engineering	2007
14	宣钢1号、2号高炉 Xuangan 1#, 2# BF	2×2500m ³	并列罐直接喷吹 Parallel hopper direct injection	设计 Engineering	2008
15	首钢京唐1号高炉 Shougang Jingtang 1# BF	5500m ³	并列罐直接喷吹 Parallel hopper direct injection	设计 Engineering	2009
16	首钢京唐2号高炉 Shougang Jingtang 2# BF	5500m ³	并列罐直接喷吹 Parallel hopper direct injection	设计 Engineering	2010
17	首钢迁钢3号高炉 Shougang Qiangang 3# BF	4000m ³	并列罐直接喷吹 Parallel hopper direct injection	设计 Engineering	2010
18	宣钢8号高炉 (大修改造) Xuangan 8# BF(overhaul)	2000m ³	并列罐直接喷吹 Parallel hopper direct injection	总承包 EPC	2011
19	海威钢铁1号高炉 1# BF of Haiwei iron and steel plant	1380m ³	并列罐直接喷吹 Parallel hopper direct injection	总承包 EPC	2012
20	华菱涟钢新3号高炉 3# BF of Hua Ling Lian steel plant	2800m ³	并列罐直接喷吹 Parallel hopper direct injection	设计 Engineering	2012

