Technology of Coke Oven Battery - China Experience

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## Content

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coke making capability of China</td>
</tr>
<tr>
<td>2</td>
<td>Top charging coke oven</td>
</tr>
<tr>
<td>3</td>
<td>Stamp charging coke oven</td>
</tr>
<tr>
<td>4</td>
<td>Structure feature of JN coke oven proper</td>
</tr>
<tr>
<td>5</td>
<td>Some coke oven auxiliary equipment features</td>
</tr>
<tr>
<td>6</td>
<td>Technology for CDQ</td>
</tr>
<tr>
<td>7</td>
<td>Charging and pushing emission control</td>
</tr>
<tr>
<td>8</td>
<td>Technology for Desulfurization and denitration</td>
</tr>
<tr>
<td>9</td>
<td>Coke oven machinery</td>
</tr>
</tbody>
</table>
1. COKE MAKING CAPABILITY OF CHINA

1.1 ANNUAL OUTPUT

Output of coke (million ton)

- 2009: 355.1
- 2010: 387.57
- 2011: 427.79
- 2012: 443.23
- 2013: 476.36
- 2014: 476.91
- 2015: 447.78
- 2016: 449
1. COKE MAKING CAPABILITY OF CHINA

1.2 ANNUAL PRODUCTION CAPABILITY

Coke production capacity  (million ton)
1. COKE MAKING CAPABILITY OF CHINA

1.3 DIFFERENT TYPE OF COKE OVEN DISTRIBUTION

At the end of 2016, **1420 existing** coke oven batteries in total in China (not including semi-coke retort and heat recovery coke oven), in which **275** batteries with chamber height ≥6m.

coking plants: **500 or more**

<table>
<thead>
<tr>
<th>No.</th>
<th>Chamber height (m)</th>
<th>Quantity of batteries</th>
<th>Production capability ratio %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.63</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>58</td>
<td>12.3</td>
</tr>
<tr>
<td>3</td>
<td>6.25 (incl. stamp)</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>6~6.1 (incl. stamp)</td>
<td>189</td>
<td>39.6</td>
</tr>
<tr>
<td>5</td>
<td>5~5.5 (incl. stamp)</td>
<td>243</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>4.3 (incl. stamp)</td>
<td>902</td>
<td>48.1</td>
</tr>
<tr>
<td>7</td>
<td>total</td>
<td>1420</td>
<td>100</td>
</tr>
</tbody>
</table>
## 1. COKE MAKING CAPABILITY OF CHINA

### 1.4 MARKET SHARE OF ACRE(MCC)--THE LEADING COMPANY OF COKE MAKING TECHNOLOGY IN CHINA

<table>
<thead>
<tr>
<th>No.</th>
<th>Chamber height (m)</th>
<th>Market Share (%)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7.65</td>
<td>100</td>
<td>Under Construction (3 Projects)</td>
</tr>
<tr>
<td>2</td>
<td>7.63</td>
<td>100</td>
<td>Cooperate with UHDE</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>6.25 (incl. stamp)</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>6～6.1 (incl. stamp)</td>
<td>93</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>5～5.5 (incl. stamp)</td>
<td>75</td>
<td></td>
</tr>
</tbody>
</table>
2. TOP CHARGING COKE OVEN

2.1 TYPE OF OVEN

- **6 m coke oven (JN60 series)**
  - Chamber height: 6m
  - Coke output per oven: 10,000t/a
  - Coking plant scale: 0.8~1.2 million t/a

- **7 m coke oven (JN70 series)**
  - Chamber height: 7m
  - Coke output per oven: 12,000t/a
  - Coking plant scale: 1.2~1.5 million t/a

- **7.65 m coke oven (JN765)**
  - Chamber height: 7.65m
  - Coke output per oven: 15,000t/a
  - Coking plant scale: 2 million t/a
2. TOP CHARGING COKE OVEN

2.2 MAIN PARAMETERS OF TOP-CHARGING COKE OVEN

<table>
<thead>
<tr>
<th></th>
<th>6 m Coke Oven</th>
<th>7 m Coke Oven</th>
<th>7.65m coke oven</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oven size</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>JN60-6</td>
<td>JNX3-70-1</td>
<td>JNX3-70-2</td>
</tr>
<tr>
<td></td>
<td>15980×450×6000</td>
<td>17640×500×6980</td>
<td>18640×542×6980</td>
</tr>
<tr>
<td>2</td>
<td>Effective volume of oven</td>
<td>38.5 m³</td>
<td>55.6 m³</td>
</tr>
<tr>
<td>3</td>
<td>Coal charge /oven (t dry coal)</td>
<td>28.5</td>
<td>41.4</td>
</tr>
<tr>
<td>4</td>
<td>Oven center distance</td>
<td>1300</td>
<td>1500</td>
</tr>
<tr>
<td>5</td>
<td>Cycle time (h )</td>
<td>19</td>
<td>22</td>
</tr>
<tr>
<td>6</td>
<td>Annual output of a typical battery</td>
<td>$100 \times 10^4$ t/a</td>
<td>$150 \times 10^4$ t/a</td>
</tr>
</tbody>
</table>
3. STAMP CHARGING COKE OVEN

3.1 TYPE OF OVENS

- **5 m stamp coke oven (JND55 series)**
  - Chamber height: 5.5m or 5m
  - Coke output per oven: 10,000t/a
  - Coking plant scale: 1.1~1.3 million t/a

- **6.25 m stamp coke oven (JND6.25 series)**
  - Chamber height: 6.25m
  - Coke output per oven: 12,000t/a
  - Coking plant scale: 1.3(2.6) million t/a

- **6.78 m stamp coke oven (JND6.78)**
  - Chamber height: 6.78m
  - Coke output per oven: 14,000t/a
  - Coking plant scale: 1.5(3) million t/a
3. STAMP CHARGING COKE OVEN

3.2 MAIN PARAMETERS OF TOP-CHARGING COKE OVEN

<table>
<thead>
<tr>
<th>Item</th>
<th>6.25m Stamp-Charging Coke Oven</th>
<th>5.5m Stamp-Charging Coke Oven</th>
<th>6.78m Stamp-Charging Coke Oven</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>JNDK50-07</td>
<td>JNDK55-07</td>
</tr>
<tr>
<td>1 Oven size</td>
<td>15980×554×5000</td>
<td>15980×554×5000</td>
<td>15980×554×5550</td>
</tr>
<tr>
<td>2 Coal cake dimension L×W×H (mm)</td>
<td>15070/15210×500×4820</td>
<td>15070/15210×500×4820</td>
<td>15010/15210×500×5320</td>
</tr>
<tr>
<td>3 Coal charge /oven (t dry coal)</td>
<td>36.5</td>
<td>36.5</td>
<td>40.2</td>
</tr>
<tr>
<td>4 Oven center distance</td>
<td>1350</td>
<td>1350</td>
<td>1350</td>
</tr>
<tr>
<td>5 Cycle time (h )</td>
<td>25.5</td>
<td>25.5</td>
<td>25.5</td>
</tr>
<tr>
<td>6 Annual coke output per oven/t</td>
<td>12065</td>
<td>9279</td>
<td>10219</td>
</tr>
<tr>
<td>7 Annual output of a typical battery</td>
<td>150×10^4 t/a</td>
<td>100×10^4 t/a</td>
<td>120×10^4 t/a</td>
</tr>
</tbody>
</table>
4. STRUCTURE FEATURE OF MCC's COKE OVEN PROPER

4.1 WASTE GAS RECIRCULATION

- TWIN FLUES
- COG UNDERJET
- BFG SIDE INJECTING
- BOTTOME REGULATING
- WG RECIRCULATION
4. STRUCTURE FEATURE OF MCC's COKE OVEN PROPER

4.2 MULTISTAGE BURNING & WG RECIRCULATION

Features:
- 3 stages burning
- recirculating hole
4. STRUCTURE FEATURE OF MCC's COKE OVEN PROPER

4.3 FLOW CONTROL FOR REGENERATOR

- Regenerator is partitioned into 17 cells from PS to CS, and adjustable holes are arranged on the roof of side flue;
- At the bottom of the vertical flue, the outlet of the Corbel connecting duct need not regulate.
4. STRUCTURE FEATURE OF MCC's COKE OVEN PROPER

4.4 BRICK SHAPE STRUCTURE

Bottom of vertical flue
- High nozzles
- Uniform heating on height

Vertical flue
- High strength
- Simple brick shape

Adjusting brick for third outlet
- Adjustable
- Adjusting brick not easy falling down
4.5 STRUCTURE AND MATERIAL OF END FLUES

Head of combustion chamber

- High aluminium brick and silica brick;
- High thermal shock resistance and tightness.
5. FEATURES OF SOME COKING EQUIPMENT

5.1 AIR COOLING OVEN DOOR

Features:
- Air cooling, suspension
- Spring latch, flexible knife edge
- Adjustable plate (ACRE patent)
- Spring pressing
- Overall elastic oven technology
5. FEATURES OF SOME COKING EQUIPMENT

5.2 Chamber Pressure Stabilization (CPS)

- Pressure range of gas collecting main: +50Pa ~ -150Pa
- Pressure set at goose neck: different phase settings along with coking process.
- The emission will be evidently reduced with the help of HPLA and dedusting ground station
- Pressure at the bottom of coking chamber shall be maintained ≥ 5 Pa
- Operate automatically
WORK PRINCIPLE

Ammonia liquor

Pressure measurement

Charging Position

CONTROL BOX ON SITE

CPS Control system

pneumatic cylinder

Control signal

Sealing Valve

GCM

Raw gas
WORK PRINCIPLE

Ammonia liquor

Pressure measurement

CPS Control system

CONTROL BOX ON SITE

Control Position

CPS Control system

pneumatic cylinder
Control signal

pneumatic cylinder

Sealing Valve

GCM

Raw gas

STANDPIPE

STANDPIPE
WORK PRINCIPLE

CPS Control system

GC Main

CONTROL BOX ON SITE

pneumatic cylinder

Pushing Position

Control signal

Sealing Valve

GCM

STANDPIPE

STANDPIPE

CPS Control system

pneumatic cylinder

Pushing Position

Control signal

Sealing Valve

GCM
6. TECHNOLOGY FOR CDQ

- Improvement of coke quality
- Uniform quality of coke
- Prevention of toxic waste water and air pollution
- Energy recycle. Heat of red hot coke is recovered (>80%) emission
- Low coke ratio of Blast Furnace reduction
- Conservation of water
- Steam extracted from the turbine can be use for other facilities

- 1t coke recycles 0.54-0.56t 9.81MPa, 540°C steam
- Water consumption save 0.45t/t coke
- Emission reduction dust, SO₂, CO₂
- Almost no phenol, cyanide and sulfide emission
6. TECHNOLOGY FOR CDQ

ACRE(MCC) CDQ main Features

- apply analogue simulation technology to optimize the CDQ chamber and 1DC design
- adopt new type of corbel zone to avoid coke floating upward and increase the service life
- 1DC & 2DC have high de-dusting efficiency
- CDQ chamber with big diameter and small height reduce the running cost, increase service life and increase cooling efficiency
7. CHARGING & PUSHING EMISSION CONTROL

- Charging emission control:
  High pressure ammonia liquor spraying inside gooseneck; Stationary baghouse
- Pushing emission control:
  Stationary baghouse
7. CHARGING & PUSHING EMISSION CONTROL

7.1 CHARGING EMISSION CONTROL

Dedusting duct on the charging car

To bag house station

P ≈ -120Pa

Ammonia liquor spraying
7. CHARGING & PUSHING EMISSION CONTROL

7.2 PUSHING EMISSION CONTROL
8. TECHNOLOGY FOR DESULFURIZATION AND DENITRATION

In order to reduce the pollution from SO₂ and NOx as much as possible, ACRE developed desulfurization and low temperature denitration technology to decrease the SO₂ and NOx concentration in waste gas of chimney.

The first desulfurization and denitration device for coke oven has been put into operation successfully in BAO Steel, China.

Features
- Desulfurization efficiency not less than 97%
- Denitration efficiency not less than 85%
- De-dusting efficiency not less than 99.5%
- Outlet of the chimney, SO₂ concentration less than 30mg/Nm³, NOx concentration less than 150mg/Nm³, dust concentration less than 15mg/Nm³.
9. COKE OVEN MACHINERY

- Pushing sequence: 5-2 or 2-1
- One spot positioning
- Four machines interlocking
- Operation management and oven number identification
- Wire or wireless data and information transmission
9. COKE OVEN MACHINERY

9.1 CHARGING CAR FOR TOP CHARGING BAT.

Charging car: dedusting charging car
- Device for opening charging hole lid and sliding telescope
- Feeding device: screw feeding, sealing telescope
- Device for opening and closing coal tower gate
- Dust collecting device: connecting sleeve etc.
- Oven top cleaning device;
- Automatic cleaning charging hole frame and luting
9. COKE OVEN MACHINERY

9.2 PUSHING MACHINE FOR TOP CHARGING BAT.

- Compression air device for cleaning rank; display and record of pushing current;
- Sealing sleeve for leveling door;
- Coke spillage collection;
- Position detection and memory system for door opening mechanics;
- Door cleaning (combined mechanical with high pressure water);
- Dust collection and bag filter

- Purging and cleaning deposit carbon at root of standpipe;
- Emergency measure for power off
9. COKE OVEN MACHINERY

9.3 COKE GUIDE MACHINE FOR TOP & STAMP BAT.

- Door extracting and guide positioning;
- Mechanized cleaning of door, jamb and platform, coke spillage collection;
- Emission collection for oven end;
- Combination suction hoods for suctioning emission while receiving coke;

![Diagram of coke guide machine for top & stamp bat.](image-url)
9.4 SCP MACHINE FOR STAMP BAT.

2 spots positioning;
Including: coal bunker, devices for coal belt convey, stamping, driving, charging, pushing, opening and closing door, door and frame cleaning, frame sealing, collection of emission from PS oven end, purging and cleaning deposit carbon on roof and wall of coking chamber, and coke cake cutting manually.
9.5 Charging Gas Transfer CAR

1. Guide charging emission into gas collecting main, N+2 and N-1 chambers
2. Other functions: opening and closing of water seal cover of standpipe, valve disk of gooseneck, switch over between high and low pressure ammonia liquor, cleaning of standpipe etc.
9. COKE OVEN MACHINERY

9.6 LOCOMOTIVE AND COKE BUCKET MACHINE
10. Reference Projects of ACRE (MCC) in Coke Industry

10. 1 General Data

➢ Designed and Contracted Over 2000 Coke Oven Batteries in more than 400 Coke Plants

➢ Total capacity over 4 Million t/a

➢ Implement projects all over the world
Coke Projects Locations of ACRE (MCC) (E、EP+S、EPC)

- IRAN (2002)
- KAZAKSTAN (2005)
- VIETNAM (2012)
- JAPAN (2006)
- BRAZIL (2005)
- BRAZIL (2007)
- SOUTH AFRICA (2004)
- INDIA (1995 (E))
- INDIA (2014)
- INDIA (2009)
- INDIA (2011)
- VIETNAM (2009)
- MYANMAR (2002 (E))
10. 2 Representative Coke Projects of MCC

BaoSteel (Zhanjiang), **3.4 million t/a**, **4x65 ovens**, **7m top charging**
10. 2 Representative Coke Projects of MCC

PanSteel (Xichang), 1.38 million t/a, 2x56 ovens, 6.25m stamp charging
10. 2 Representative Coke Projects of MCC

AnSteel (Anshan), 1.5 million t/a, 2x60 ovens, 7m top charging
10. 2 Representative Coke Projects of MCC

TATA Steel (JSR India), **1.51 million t/a**, 4x44 ovens, 5m stamp charging
10. 2 Representative Coke Projects of MCC

TATA Steel (KPO India), 3 million t/a, 8x44 ovens, 5m stamp charging
10. 2 Representative Coke Projects of MCC

Formosa Steel (Viet Nam), **2.98 million t/a**, 4x60 ovens, **7m top charging**
10. 2 Representative Coke Projects of MCC

Usminas (Brazil), 0.75 million t/a, 2x40 ovens, 6m top charging
10. 2 Representative CDQ Projects of MCC

BaoSteel (Zhanjiang), 4x140 t/h
10. 2 Representative CDQ Projects of MCC

Xinyaxing Coke Plant (Tongling, China), 1x190 t/h
10. 2 Representative CDQ Projects of MCC

Baotou Steel (China), 2x200 t/h
Thank you for your attention!