



Low Carbon Green Cokemaking -- China Experience

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1. STEEL & COKE MAKING CAPABILITY OF CHINA

1.1 STEEL & COKE OUTPUT IN 2017 IN CHINA

steel & Coke output in 2017 in China

item	output 2017/2016 (m t)	Compare to 2016 (m t)	Increased by (%)
Crude steel	831, 73/808, 40	+23, 33	2. 89
Pig iorn	710, 76/700, 70	+10, 06	1. 44
Coke	431, 43 /449, 12	—17, 69	—3. 94
Steel product	634, 57/598, 14	+36, 43	6. 09

1. STEEL & COKE MAKING CAPABILITY OF CHINA

Steel & Coke output in 2017 in the world

item	Crude steel	Pig iron	Coke
World output (million ton)	1674.72	1174.78	633.96
Year-on-year growth (%)	5.5	1.1	-2.4
China output (million ton)	831.73	710.76	431.43
China output ratio (%)	49.66	60.50	68.05

1. STEEL & COKE MAKING CAPABILITY OF CHINA

1.2 ANNUAL OUTPUT OF COKE

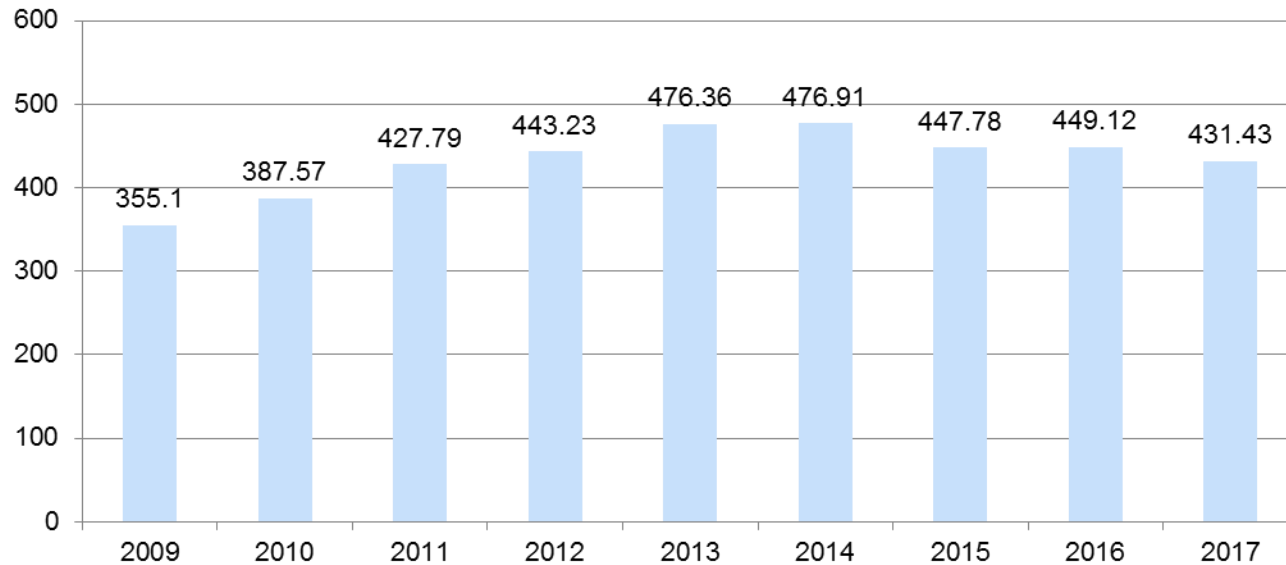


Fig. 1.1 Output of coke (million ton)

1. STEEL & 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 $\geq 6\text{m}$.

coking plants : ≥ 500 in 2016, 376 at the beginning of 2018

No.	Chamber height (m)	Quantity of batteries	Production capability ratio %
1	7.63	17	12.3
2	7	58	
3	6.25 (stamp)	11	
4	6~6.1 (incl. stamp)	189	39.6
5	5~5.5 (incl. stamp)	243	
6	4.3 (incl. stamp)	902	48.1
7	total	1420	100

1. STEEL & COKE MAKING CAPABILITY OF CHINA

1.4 COKING PRODUCTION CAPACITY STRUCTURE IN CHINA

TABLE 1.4.1 COKING PRODUCTION CAPACITY STRUCTURE IN CHINA IN 2016

Type of coke oven	Production capacity (mt)	ratio (%)	remarks
Conventional coke oven	585	87.6	32.4%, i. e. 194 mt from Iron and steel works
			67.6%, i. e. 391 mt from Independent coking plants
Semi coke retort	66	9.9	
Heat recovery coke oven	17	2.5	
Total	668	100	

1. STEEL & COKE MAKING CAPABILITY OF CHINA

1.4 COKING PRODUCTION CAPACITY STRUCTURE IN CHINA

TABLE 1.4.2 COKING PRODUCTION CHAIN STRUCTURE IN CHINA IN 2016

Industry chain	Annual production capacity
COG to Methanol	1.220 million tons
COG to LNG	3.6 billion m ³
Coal tar refining	2.280 million tons
Benzene hydrogenation	5.84 million tons

2. NEW COKE OVEN TECHNOLOGY FOR ENVIRONMENTAL PROTECTION

2.1 WIDELY USED

- **CHARGING & PUSHING EMISSION CONTROL**
- **OVEN SEALING EQUIPMENT**
- **WASTE WATER BIOCHEMICAL TREATMENT**

2.2. TECHNOLOGY FOR DESULFURIZATION AND DENITRATION

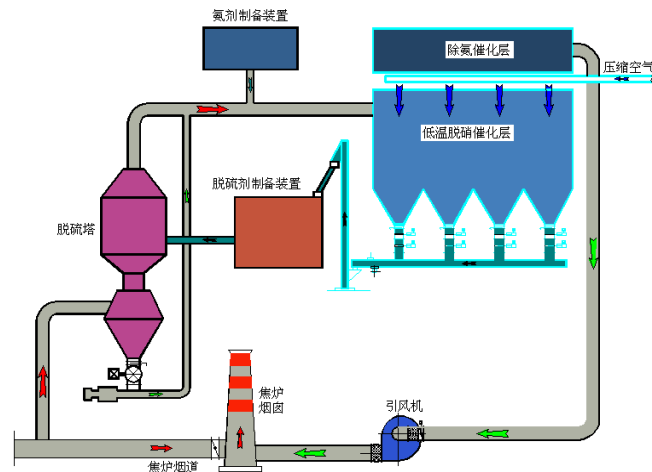


In order to reduce the pollution from NO_x and SO₂ as much as possible, ACRE developed desulfurization and low temperature denitration technology to decrease the NO_x and SO₂ concentration in waste gas of chimney

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

Features

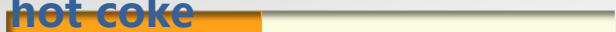
- Denitration efficiency not less than 90 %;
- Desulfurization efficiency not less than 90 %;
- De-dusting efficiency not less than 99.5 %
- Outlet of the chimney, NO_x concentration less than 100mg/Nm³, SO₂ concentration less than 10mg/Nm³, dust concentration less than 15mg/Nm³



3. WASTE HEAT UTILIZATION

HEAT OUTPUT OF COKE OVEN

Heat taken away with pushed
hot coke



37% ——— 950~1050°C coke

Heat taken away
with crude gas



36% ——— 650~700°C raw gas

Heat taken away with waste
flue gas



17% ——— 200~300°C flue waste gas(COG)
150~250°C flue waste gas(MG)

Heat loss from external
surface of coke oven



10% ——— coke oven surface

3.1 HIGH TEMPERATURE WASTE HEAT RECOVERY- CDQ

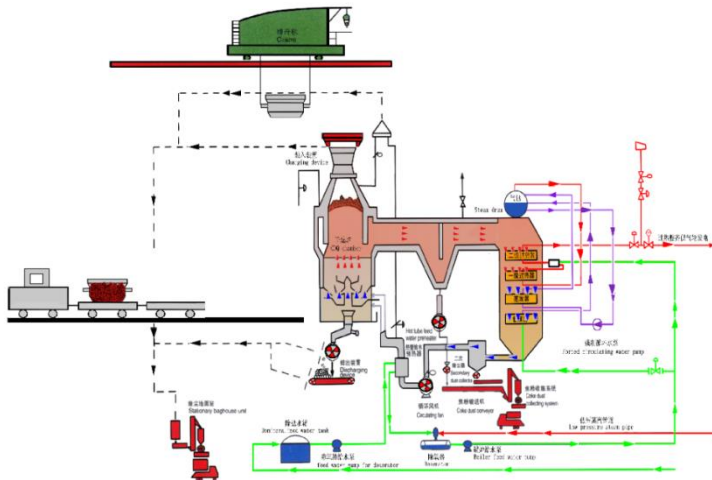


- Improvement of coke quality
- Uniform quality of coke
- Prevention of toxic waste water and air pollution
- Energy recycle. Heat of red hot coke is recovered.($>80\%$)
- Low coke ratio of Blast Furnace reduction
- Conservation of water
- Steam extracted from the turbine can be use for other facilities

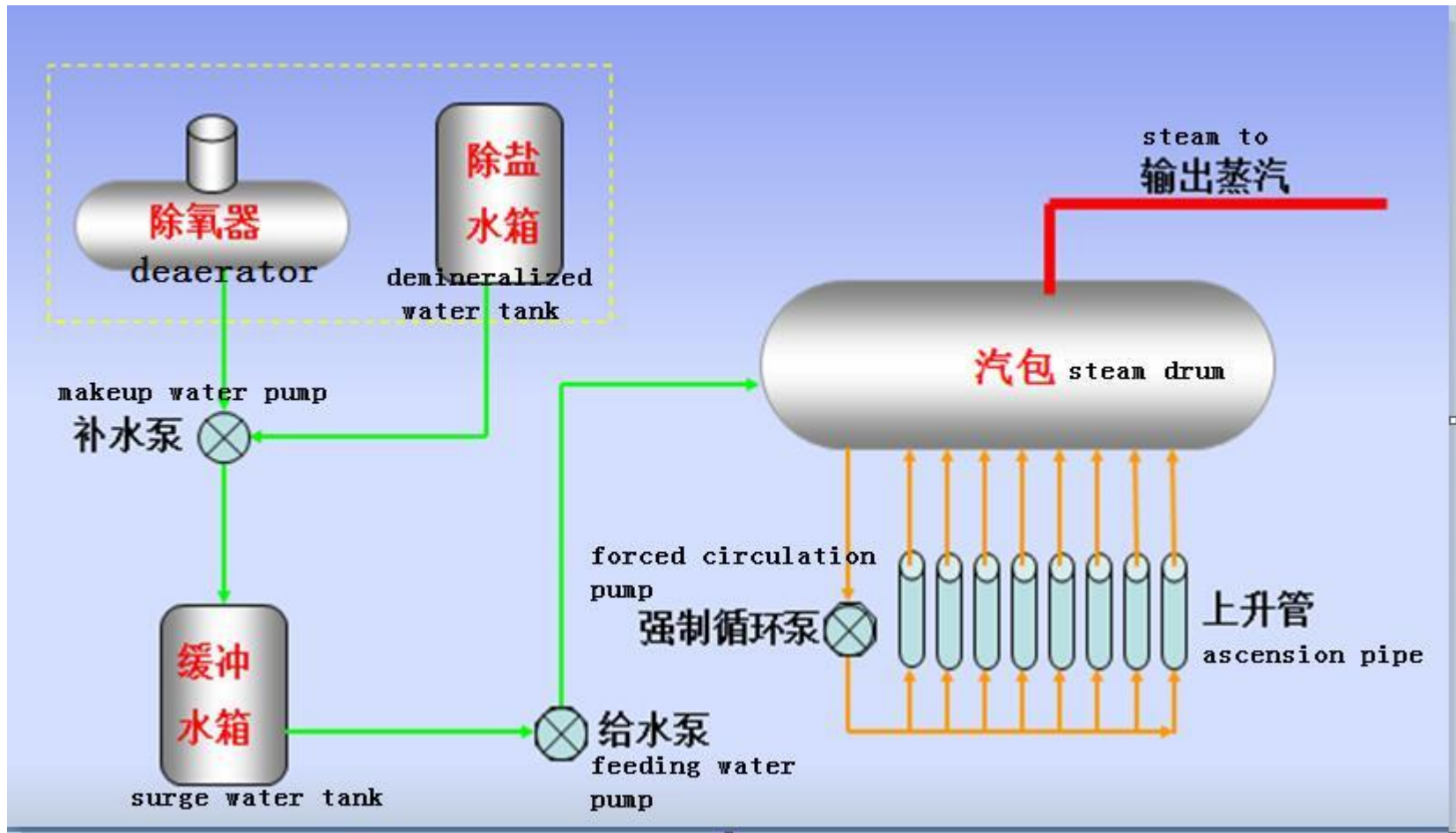


- 1t coke recycles 0.5-0.6t 9.81MPa, 540°C steam
- Water consumption save 0.45t/t coke
- Emission reduction dust, SO_2 , CO_2
- Almost no phenol, cyanide and sulfide emission

CDQ for standby gradually



3.2. MEDIUM TEMPERATURE WASTE HEAT RECOVERY- ASCENSION PIPE HEAT RECOVERY UNIT



Benifits:

- 1、 Steam: 100kg/t coke, pressure 0.5~0.8.MPa. energy consumption reduction :>10kg standard coal/t coke.
- 2、 Discharge reduction: for instance, 2*55ovens 6m high coke oven with capacity of 1.1 million ton coke per year , output of steam 110,000t ,energy saving 10,000t standard coal,CO₂ discharge reduction 30,000t
- 3、 Operating environment: Temperature surface of ascension pipe will be reduced to less than 100C° , and improve the working condition .

3.3. LOW TEMPERATURE WASTE HEAT RECOVERY

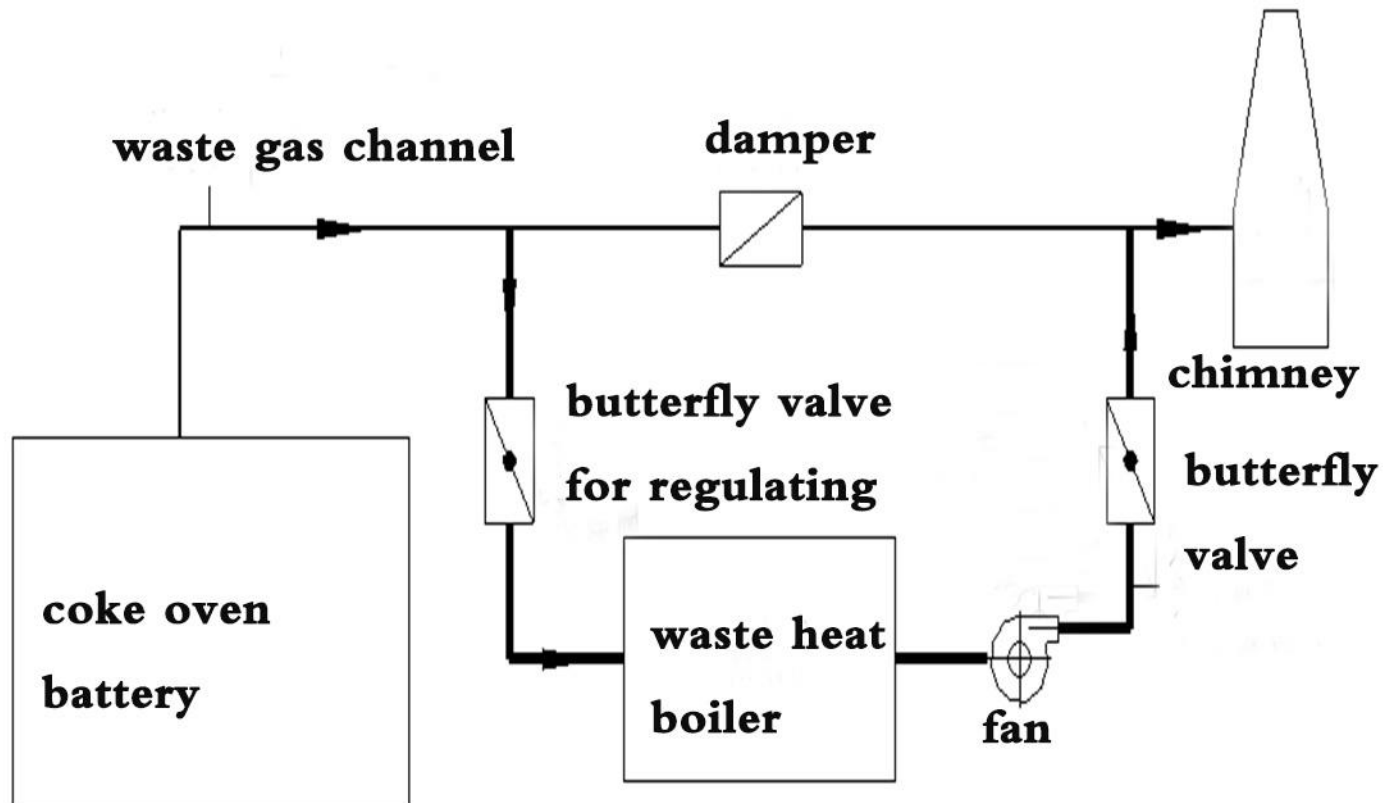
3.3.1 WASTE GAS HEAT RECOVERY

Temperature of waste gas inside of waste gas flue of coke oven:

180~250°C (heated with MG);

200~300°C (heated with COG)。

A, WASTE GAS RECOVERY--PRODUCING STEAM



Flow chart of waste gas heat recovery by means of hot tube boiler (200 coking plants)

Benefits:

1. saturated Steam: 90~100kg/t coke, pressure 0.8.Mpa. The steam produced is equal to one quarter of steam required by coking plant
2. Process energy consumption reduction :>8kg standard coal/t coke.
3. Discharge reduction: for instance, 2*55ovens 6m high coke oven with capacity of 1.1 million ton coke per year ,energy saving 8,800t standard coal,CO₂ discharge reduction 22,000t,SO₂ discharge reduction 145.2t.

B, WASTE GAS RECOVERY--PRODUCING SUPERHEATED WATER

2.2MPa、85℃ water \leftrightarrow waste gas

150℃ water \rightarrow dry up coal for coke oven charging

Benefits: reduce moisture of coal by 4-7%

3.3.2 RECIRCULATING AMMONIA LIQUOR HEAT RECOVERY

77℃ ammonia liquor

77℃ \rightarrow 67℃ ammonia liquor

For producing low temperature water by lithium bromide regenerating unit

Benefits: recovering heat 11,814kW/a,
saving steam 51,840t/a

4. COG FURTHER PROCESSING

4.1 COG TO METHANOL (CH_3OH)

1900~2100Nm³ COG---1t methanol

from 2005 on, production capacity from COG in 2016 ,

12.2 million ton/a

4.2 COG TO LNG

2.5~2.7m³ COG---1m³ NG

from 2009 on , production capacity from COG in 2016,

3.6 billion m³ NG/a, more than 32 projects, and 1 billion m³ LNG/a is under construction.

4.3 COG TO HYDROGEN

- ✚ Physical method, 1000Nm^3 COG \rightarrow 476Nm^3 H_2 , Tail gas is used for heating coke oven;
- ✚ Transfer by O_2 , 1000Nm^3 COG \rightarrow 1198Nm^3 H_2 , Tail gas is used for heating coke oven;

4.4 COG TO ETHYLENE GLYCOL (EG, $(\text{CH}_2\text{OH})_2$)

$240,000\text{t/a}$ is under construction. started in July, 2017.



Thank you for your attention!

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