Industrial Application of Two Stage Dry Pulverized Coal Gasification Technology

Huaneng Clean Energy Research Institute

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China Huaneng Group

The Largest Independent Power Company In China, No.2 in the world.

Clean Energy Research Institute (HNCERI)

Research on clean coal power generation and renewable generation technology.

Thermal Power Research Institute (TPRI)

A principal and leading research institute in the field of thermal power engineering.

Dr. Xu Shisen
President of HNCERI
Scientist of Gasification
15 years efforts on coal gasification technology

- The first stage—Theoretical Research and Simulation (1993~1997);
- The second stage—Bench Scale Experiments (1997~2001);
- The third stage—Pilot Scale Experiments (2001~2005);
- The fourth stage—Industrialization (2006~);
Coal gasification and IGCC

Pilot Scale: 36t/d (10MWth), 2005

Bench Scale: 0.7t/d, 1998

Commercial Scale: 1000t/d ~ 2000t/d, 2012
Gasifier Type:
- Entrained flow
- Dry feed
- Pure oxygen
- Water wall
- Pressure: ~4.0MPa
- Two Stages Reaction
- Cold syngas efficiency: >81%
- CO+H2>90%
- Carbon conversion>99%
- Syngas cooler and quencher

Configuration of HCERI Two-stage Entrained Flow Gasifier
Syngas Cooler Process (SGC)

Syngas Quencher Process (SGQ)
CHNG GreenGen Project

华能天津ICCC电站示范工程
The First IGCC Power Plant in China

- China Huaneng Group, Holding Company, financial contribution 52%
- China Datang Group 6%
- China Huadian Corporation 6%
- China Guodian Corporation 6%
- China Power Investment Corporation 6%
- Shenhua Group 6%
- State Development & Investment Co. 6%
- China Coal Group 6%
- Peabody Energy USA 6%
CHNG Green Gen Project

Design Points

- SGC Process
- Gasifier Capacity: 2000t/d;
- Pressure: 3.0 MPa;
- Entrained gas: N₂
- Effective syngas flow (CO+H₂+CH₄): 137,600Nm³/h;
- Cold gas efficiency: 83%;
- Effective component (CO+H₂+CH₄): 91%;
- Net Power: 250MW;
CHNG Green Gen Project

Commissioning and Operation

- Apr.16th; 17h; Active Shutdown
- May 9th; 70h; Pulverized Coal Fill Filter Leakage
- May 27th; 31h; Misoperation
- Jun.9th; 27h; Syngas Pipe Leakage
- Jun.25th; 96h; Misoperation
- Jul.10th; 16h; Air Separator Unit Faults
- Jul.16th; 77h; Muffle Burn Out
- Agu.8th; 22h; Whole Plant Cooling Water Pipe Burst
- Agu.29th; 175h; Active Shutdown
CHNG Green Gen Project

Commissioning and Operation

- Gasification Unit Commissioning Work Finished
- Technological Process Proved
- Two Stage Gasification Experiment Finished
- Different Kinds of Coal Tested
- Chinese Equipment and Instrument
- Technology Improvement
Greengen Gasifier Start Transportation on 29th Sep. 2010
CHNG Green Gen Project

Performance Index (Shenhua bituminous)

- Cold Gas Efficiency: 84.1%
- Oxygen consumptions: 303 Nm3/1000Nm3 CO+H2
- Coal consumptions: 580 kg/1000Nm3 CO+H2
- Syngas compositions: CO2<2%
- Steam produced: 150t/h
Effects of The Second Stage Gasification

- The Second stage Coal Input Rate 5~6%
- Total Carbine Reaction Rate >99%
- Cold Gas Efficiency Improved: 0.5~1%
- Coal consumptions deceased: 4~8 kg/1000Nm3 Effective syngas (CO+H2)
- Oxygen consumptions deceased: 10~20 kg/1000Nm3 Effective syngas (CO+H2)
- Syngas temperature deceased: 100~200 °C
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Next Work

- Gas Turbine Commissioning
- Whole Plant 72+24h Operation Acceptance Test
- Operation Optimization
Shilin Methanol Project

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Shilin Methanol Project
Shilin Methanol Project

Design Points

- SGQ Process
- Gasifier Capacity: 1000t/d;
- Pressure: 4.0 MPa;
- Entrained gas: CO₂
- Effective syngas flow (CO+H₂): 71500Nm³/h;
- Cold gas efficiency: 82%;
- Effective component (CO+H₂) of dry syngas: 91%
- Methanol production: 300,000 t/a;
Shilin Methanol Project

Commissioning and Operation

- Agu.9th; 1h; Misoperation
- Agu.27th; 22h; Pump Fault
- Agu.29th; 43h; Instrument Wrong Signal
- Sep.15th; 15h; Misoperation
- Sep.20th; 124h; Misoperation
- Sep.28th; 624h; Still Operating
Why run so easy?

- Experience in Greengen Project
- System Simple
Shilin Methanol Project

Performance Index (Shenhua bituminous)

- Cold Gas Efficiency: 83%
- Carbine Reaction Rate >99%
- Oxygen consumptions: 313 Nm3/1000Nm3 CO+H2
- Coal consumptions: 551 kg/1000Nm3 CO+H2
- Steam produced: 50t/h
Gasifier Arrives Shilin Site on 20th Jul. 2010
Shilin Methanol Project

Next Work

- Operation Optimization
- Gasify lignite
The Advantage of SGC

- Total Heat Recovery, Produce More Steam
- Lower Operation Cost
- Lower Water Consumption

The Advantage of SGQ

- Simple System
- Lower Investment
- Higher Operation Reliability
Conclusions

- Realized Long Period Operation in Both Industrialized Units.
- Two Stage Gasification Technology Improved Gasification Efficiency, Decreased Coal and Oxygen Consumption.
- One Step Forward comparing with One Stage Gasification.
- SGC Process Low Operation Cost
- SGQ Process Low Investment
- Chinese Design, Equipment, Installation in Both Project.
In Future

- Large scale Gasifier.
- Gasifier adaptability to Coal.
- Technology Improvement
Thank you for your attention!
Questions?

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