Update on ECUST Coal Gasification Technologies

Qinghua Guo
East China University of Science and Technology (ECUST)
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Industrial Technologies

Opposed Multi-Burner (OMB) Coal-Water Slurry Gasification Process

SE Dry Coal Gasification Process
About OMB Technology

R&D History

Innovation & Pilot Plant
22TPD

1996~2000

Industrial Demo.
1150TPD
750TPD

2001~2005

Scale up
2000TPD

2006~2010

Scale up
3000TPD

2011~2015
Technology Features

Impinging stream flow field

- Multi-burner: high operating capacity
- Impinging burner structure: better mixing
- Flow field and atomization: reasonable residence time distribution, high carbon conversion
Technology Features

**Performance:** Burner working life average ~90 days, longest 152 days

CWS Atomization

Burner head after online 152 days
Technology Features

Refractory wall

- Working life of refractory
  - 8000~16000hrs
  - 24000~26000hrs
  - 12000~16000hrs

Support frame structure

Performance: Increasing the effective volume, enhancing the working life
Online feeding without whole system shutdown
46 projects (128 gasifiers)

The total capacity of all projects is ~150,000 TPD

23 Projects, 60 gasifiers in operating

The capacity of single gasifier ranges from 750 to 3250 TPD
## Industrial Applications

### Gasifier capacity larger than 1500 t/d > 80%
Large-scale Gasifier Applications

2000 TPD OMB gasifier

Gasifiers: 2 (Phase I) + 1 (Phase II)
Pressure: 4.0 MPa(G)
Startup: June.15, 2009, Nov.3, 2015

Availability
2011: 97.8% (357d)
2012: 96.4% (352d)
2013: 97.2% (355d)
2014: 94.8% (346d)
2015: 93.7% (342d)

<table>
<thead>
<tr>
<th>Feed</th>
<th>Shenhua coal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Designed</td>
</tr>
<tr>
<td>Carbon conversion %</td>
<td>98</td>
</tr>
<tr>
<td>Specific oxygen consumption Nm³/1000Nm³(CO+H₂)</td>
<td>390</td>
</tr>
<tr>
<td>Specific coal consumption kg/1000Nm³(CO+H₂)</td>
<td>590</td>
</tr>
<tr>
<td>Syngas component v%</td>
<td>81</td>
</tr>
<tr>
<td>Cold gas efficiency %</td>
<td>74</td>
</tr>
</tbody>
</table>
Large-scale Gasifier Applications

3000 TPD OMB gasifier

- Owner: Inner Mongolia Rongxin Chemical Co. Ltd
- Gasifiers: 2+1
- Pressure: 6.5MPa
- Startup: June, 2014
- Performance Test: Sept. 2015

<table>
<thead>
<tr>
<th>Items</th>
<th>Guaranty</th>
<th>Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Conversion %</td>
<td>&gt;98</td>
<td>99.63</td>
</tr>
<tr>
<td>Oxygen Consumption Nm³/kNm³(CO+H₂)</td>
<td>&lt;400</td>
<td>388.3</td>
</tr>
<tr>
<td>Coal Consumption Kg/kNm³(CO+H₂)</td>
<td>&lt;600</td>
<td>559.5</td>
</tr>
<tr>
<td>CO+H₂ in dry syngas Vol%</td>
<td>&gt;80</td>
<td>80.98</td>
</tr>
</tbody>
</table>

No system shut down caused by gasifier itself
Industrial Applications

Ningbo Zhongjin Co., Ltd

Petcoke gasification process

- Gasifiers: 1+1
- Pressure: 1.5MPa(G)
- Startup: May 24, 2015
- Raw material: Coal+petcoke
- Product: Gas
Industrial Applications

New projects operating in 2016

China Salt Kunshan Co., Ltd

- Gasifiers: 1+1 (1200 t/d)
- Pressure: 6.5 MPa(G)
- Startup: Mar. 16, 2016
- Product: Syngas

Qinghai Salt Lake Co., Ltd

- Gasifiers: 2+1 (2500 t/d)
- Pressure: 6.5 MPa(G)
- Startup: Oct. 1, 2016
- Product: Methanol
- High Altitude: +2800 m
## Excellent Performance

### High carbon conversion

<table>
<thead>
<tr>
<th>Project name</th>
<th>Capacity TPD O.P.+S.P.</th>
<th>Carbon conversion</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hualu Hengsheng Chemicals Co., Ltd.</td>
<td>750 1</td>
<td>98.30%</td>
<td>Reported data</td>
</tr>
<tr>
<td>Yankuang Cathay Coal Chemicals Co., Ltd.</td>
<td>1150 2+2</td>
<td>98.80%</td>
<td>Dec.11-18, 2005 168 hours continuous performance test</td>
</tr>
<tr>
<td>Xinneng Fenghuang (Tengzhou) Energy</td>
<td>1500 2+1</td>
<td>99.16%</td>
<td>Oct. 13-16, 2010 72 hours continuous performance test</td>
</tr>
<tr>
<td>Shenhua Ningxia Coal Group</td>
<td>2000 2+1</td>
<td>98.90%</td>
<td>Sep. 24-27, 2010 72 hours continuous performance test (two gasifiers)</td>
</tr>
<tr>
<td>Jiangsu Linggu Chemicals Co., Ltd.</td>
<td>2000 2+1</td>
<td>99.20%</td>
<td>Nov. 25-28, 2011 72 hours continuous performance test</td>
</tr>
<tr>
<td>Anhui Huayi Chemicals Co., Ltd.</td>
<td>1500 2+1</td>
<td>98.94%</td>
<td>Aug. 20-24, 2012 72 hours continuous performance test (two gasifiers)</td>
</tr>
<tr>
<td>Shanghai Coking &amp; Chemical Corporation</td>
<td>2200 1+1</td>
<td>98.80%</td>
<td>Reported data</td>
</tr>
<tr>
<td>Yingde Gases in Anyang</td>
<td>2200 1+1</td>
<td>99.30%</td>
<td>Oct. 29-31, 2014 72 hours continuous performance test</td>
</tr>
<tr>
<td>Henan Xinlianxin Fertiliser Co., Ltd.</td>
<td>1200 2+1</td>
<td>98.70%</td>
<td>Jan. 12-14,2015 72 hours continuous performance test</td>
</tr>
<tr>
<td>Yantai Wanhua Co., Ltd.</td>
<td>1500 2+1</td>
<td>99.38%</td>
<td>Aug. 17-19, 2015 72 hours continuous performance test</td>
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<tr>
<td>Inner Mongolia Rongxin Chemical Co., Ltd.</td>
<td>3000 2+1</td>
<td>99.63%</td>
<td>Sep. 23-26, 2015 72 hours continuous performance test</td>
</tr>
<tr>
<td>Xinjiang Xinlianxin Fertiliser Co., Ltd.</td>
<td>1500 1+1</td>
<td>99.14%</td>
<td>Aug. 25-28, 2016 72 hours continuous performance test</td>
</tr>
</tbody>
</table>
Cooperation between Sinopec and ECUST (Aug. 10, 2011)

SE: Sinopec + ECUST

Target:
- Medium Capacity: 1000~2000 TPD
- Extremely high AFT: >1500 °C
- Simple gasifier structure
- Low investment
- More simple and safe operation
- **Dry feeding:** higher cold gas efficiency
- **Lined with membrane wall:** suitability for high AFT
- **Top set up of burner:** simple structure and operation

Especially designed for high AFT coal
Demonstration of SE Gasification Technology

Located: Sinopec Yangzi Petrochemical Co. Ltd
Gasifier pressure: 4.0MPa
Capacity: 1000TPD, 70000Nm³(CO+H₂)/h
Product: Hydrogen
Startup: Jan. 2014
### Operation Advantages

Excellent coal adaptability: $FT > 1500^\circ C$, $A > 20\%$

<table>
<thead>
<tr>
<th>Coal</th>
<th>Proximate analysis (d)</th>
<th>FT / °C</th>
<th>Ash composition%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>V</td>
<td>FC</td>
</tr>
<tr>
<td>Guizhou coal</td>
<td>22.34</td>
<td>10.34</td>
<td>67.32</td>
</tr>
<tr>
<td>Jincheng</td>
<td>20.49</td>
<td>8.09</td>
<td>71.42</td>
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<tr>
<td>Gaoping</td>
<td>12.68</td>
<td>7.68</td>
<td>79.64</td>
</tr>
<tr>
<td>Huainan</td>
<td>22.66</td>
<td>28.69</td>
<td>48.65</td>
</tr>
<tr>
<td>Shenhua</td>
<td>6.89</td>
<td>32.91</td>
<td>60.20</td>
</tr>
</tbody>
</table>

4 different coal types with blending Shenhua coal had been successfully gasified.
Operation Advantages

Gasification results for Huainan high AFT coal

Huainan/Shenhua blending 5:5+4%Limestone

- PC: FT ~1400℃, Ash ~17%
- Operating temperature ~1600 ℃
- Continuous commissioning 28 days
- Carbon conversion 99.2%

First application as raw material for Huainan coal in China
Thanks!

http://icct.ecust.edu.cn