OMB Coal-Water Slurry Gasification Technology and Its Applications

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East China University of Science and Technology
June 24, 2020
1. Introduction of ICCT at ECUST

2. OMB CWS gasification technology

3. Application of OMB CWS gasifiers

4. FactSage used for the gasifier operating
Introduction of ICCT at ECUST

- Institute of Clean Coal Technology (ICCT) since 1995
- ~100 persons (19 faculties including 7 Prof., 9 Associate Prof., and about 80 graduate students.)
- Coal Gasification Technology Research Center of National Energy Administration (NEA)
- Co-R&D center of ECUST and SINOPEC
- Gasification Engineering Center of Shanghai
Introduction of ICCT at ECUST

Research fields

- Coal property evaluation
- Hot model of entrained-flow gasifier
- Gas clean-up
- Coal liquefaction
- Biomass conversion
- Dense phase pneumatic conveying
- Cold model of entrained-flow
### Industrial technologies

<table>
<thead>
<tr>
<th>Type of feed</th>
<th>Technology</th>
<th>Technology</th>
<th>Application state</th>
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</thead>
<tbody>
<tr>
<td>Coal</td>
<td>Opposed Multi-burner (OMB)</td>
<td>CWS</td>
<td>Commercial</td>
</tr>
<tr>
<td>Petro-coke</td>
<td></td>
<td>Dry Feed</td>
<td>Designing</td>
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<td>NG</td>
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<td>COG</td>
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<td>Shale Gas</td>
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<td>Residual oil Pitch</td>
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<tr>
<td>Opposed Multi-burner (OMB)</td>
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<td>CWS</td>
<td>Demonstration</td>
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<td>Dry Feed</td>
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<td>Residual oil Pitch</td>
<td>POX</td>
<td>Pitch</td>
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![OMB Image](image1.png)

![SE Image](image2.png)

![POX Image](image3.png)
Development of OMB Coal Gasification Technology

- **Fundamental research Cold-model**
  - 1985~1995

- **Innovation & pilot plant 22TPD**
  - 1996~2000

- **Industrial demo. 1150TPD 750TPD**
  - 2001~2005

- **Scale up 2000TPD**
  - 2006~2010

- **Scale up 3000TPD**
  - 2011~2015

- **Scale up 4000TPD**
  - 2016~2020

Supported by State Development Planning Commission

Supported by MOST Hi-tech research and development program (863)
OMB CWS Gasification Technology

OMB CWS gasification technology process diagram
## 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>
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</thead>
<tbody>
<tr>
<td>Yankuang Cathay Coal Chemicals Co., Ltd.</td>
<td>1150 3+1</td>
<td>98.80%</td>
<td>Dec. 11-18, 2005 168 hours continuous performance test</td>
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<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</td>
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<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</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>
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<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>
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<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>

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Application of OMB CWS Gasifiers

OMB Coal-water Slurry Gasification Technology

- 58 projects (159 gasifiers) in total
- 31 projects (85 gasifiers) in operating
- The total capacity of coal for all projects is >220,000 TPD
- The capacity of single gasifier ranges from 750 to 4000 TPD
Coal consumption of OMB for various kinds of products
Projects started up in recent years

(1) Hengli Petrochemical (Dalian) Refinery Co., Ltd.

- Gasifiers: 5+1 (3000 TPD)
- Pressure: 6.5MPa(G)
- Products: Hydrogen & gas
- Syngas (CO+H₂) flowrate: 1,000,000Nm³/h
- Startup: Feb. 15, 2019
(2) Zhejiang Petrochemical Refinery Co., Ltd. Phase I and II

- Gasifiers: 8+4 (3000 TPD)
- Pressure: 6.5 MPa(G)
- Products: Hydrogen & gas
- Syngas (CO+H₂) flowrate:
  - 1.4 million Nm³/h
- Start construction: June, 2017
- Startup: Nov. 14, 2019
(3) Inner Mongolia Rongxin Chemical Co., Ltd
Largest single capacity gasifier in the world---4000 TPD

- **Gasifiers:** 2+1 (4000 TPD)
- **Pressure:** 6.5MPa(G)
- **Products:** Methanol & DMMn
- **Syngas (CO+H₂) flowrate:** 420,000Nm³/h
- **Phase II**
- **Startup:** Oct. 29, 2019
(4) Yankuang Yulin Energy Chemical Co., Ltd

- Gasifiers: 2+1(2000 TPD), 2 Quenching / 1 RSC
- Pressure: 6.5MPa(G)
- Products: DMMn
- Startup time: Oct. 31, 2019 / Oct. 2020 (as estimated)
Radiant Syngas Cooler (RSC) combined with quenching chamber

- Higher gasification efficiency than quenching process.
- By optimizing the combination of RSC and Quench chamber to adjust the syngas temperature and the steam/syngas ratio.
- Producing high pressure steam can meet the requirement of downstream, lower the coal consumption and pollutant emission.
Application of OMB CWS Gasifiers
FactSage used for the gasifier operating

**Slag phase change - Viscosity change** - Industrial application

**Fundamental research**  
**Viscosity-temperature control**  
**Gasifier discharging**

![Graph showing slag phase change and viscosity temperature control](image)

**Atmosphere-Slag-Temperature**

**Residual carbon-Slag-Temperature**
Application of FactSage thermodynamic calculation

-----Coal blending

Normal slag

Abnormal slag

Ash/slag liquidus temperature with different blending ratios
Application of FactSage thermodynamic calculation

-----Fluxant adding proportion

Change of main composition of coal ash with different ratio sand

<table>
<thead>
<tr>
<th>Sand/coal ash w/%</th>
<th>SiO₂</th>
<th>Al₂O₃</th>
<th>CaO</th>
<th>Fe₂O₃</th>
<th>S/A</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>29.48</td>
<td>18.18</td>
<td>23.73</td>
<td>14.76</td>
<td>1.62</td>
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<td>10</td>
<td>33.83</td>
<td>17.60</td>
<td>20.66</td>
<td>13.42</td>
<td>1.92</td>
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<tr>
<td>20</td>
<td>37.44</td>
<td>17.13</td>
<td>18.94</td>
<td>12.30</td>
<td>2.19</td>
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<td>40</td>
<td>43.12</td>
<td>16.37</td>
<td>16.24</td>
<td>10.54</td>
<td>2.63</td>
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<tr>
<td>60</td>
<td>47.38</td>
<td>15.81</td>
<td>14.21</td>
<td>9.23</td>
<td>3.00</td>
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<tr>
<td>80</td>
<td>50.69</td>
<td>15.37</td>
<td>12.63</td>
<td>8.20</td>
<td>3.30</td>
</tr>
</tbody>
</table>

Curves of ash fusion temperature with different ratio additive

Viscosity-temperature curve of JJT coal ash
Thanks for your attention!
gqh@ecust.edu.cn