Coal to Chemicals Industry In China

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At Woodrow Wilson International Center for Scholars
The whole chain of coal utilization industry is covered

1. Coal and water resources
2. Safe, high-efficiency and green coal mining technology
3. Coal upgrading technology and distribution
4. Pollution control and purification technologies
5. New clean coal combustion technology
6. Advanced coal-fired power generation technology
7. Transmission of electric power
8. Clean and high-efficiency coal conversion
9. Poly-generation technology
10. Energy saving technologies in coal exploration & utilization

Composite group

NICE leads the 8th project

Launched by the Chinese Academy of Engineering in cooperation with the Shenhua Group (2011.1-2012.6),

Clean, High-efficiency and Sustainable Exploration and Utilization of Chinese Coal

Project leader: Prof. Kechang Xie
Production line

Coal chemical conversion

Gas fuel
- SNG
- Direct liquefaction oil
- FT synthesis oil
- Gasification

Liquid fuel
- Thermal dissolution oil
- Liquefaction

Chemicals
- Carbonization oil
- Low carbon alcohol
- Methanol
- MTG
- MTO
- MTP
- Acetic acid/anhydride
- MTA
- Ethylene glycol
- Hydrogen

Others
- Coke
- Semi coke
- Synthesis ammonia
- Pyrolysis

Deliverables

20 COAL-BASED PRODUCT REPORTS

ONE INVESTIGATION REPORT

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Production Capacity

Product proportion in 2010

- Coke: 80%
- Ammonia: 7%
- Calcium carbide: 3%
- Methanol: 3%
- Coal tar processing: 1%
- Others: 2%
- Char: 4%

China's output in 2010

- Coke: 98%
- Calcium carbide: 66%
- Methanol: 23%
- Ammonia: 11%
<table>
<thead>
<tr>
<th>Products</th>
<th>Capacity (million tons)</th>
<th>Output (million tons)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coke</td>
<td>592.16</td>
<td>388.64</td>
</tr>
<tr>
<td>Ammonia</td>
<td>46.12</td>
<td>37.82</td>
</tr>
<tr>
<td>Char</td>
<td>31.55</td>
<td>20.00</td>
</tr>
<tr>
<td>Methanol</td>
<td>25.22</td>
<td>10.21</td>
</tr>
<tr>
<td>Calcium carbide</td>
<td>24.00</td>
<td>14.62</td>
</tr>
<tr>
<td>Liquefaction</td>
<td>1.08</td>
<td>—</td>
</tr>
<tr>
<td>F-T oils</td>
<td>0.50</td>
<td>—</td>
</tr>
<tr>
<td>MTG</td>
<td>0.10</td>
<td>—</td>
</tr>
<tr>
<td>DME</td>
<td>7.26</td>
<td>2.90</td>
</tr>
<tr>
<td>MTO/P</td>
<td>0.60</td>
<td>—</td>
</tr>
<tr>
<td>Acetic acid</td>
<td>6.70</td>
<td>3.84</td>
</tr>
<tr>
<td>Acetic</td>
<td>0.76</td>
<td>—</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>0.50</td>
<td>—</td>
</tr>
<tr>
<td>Glycol</td>
<td>0.20</td>
<td>—</td>
</tr>
<tr>
<td>Coal tar processing</td>
<td>4.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Alcohol ether fuel</td>
<td>—</td>
<td>3.00 (Methanol)</td>
</tr>
<tr>
<td>MTA</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>SNG</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>
~ 673 million ton coal was consumed in 2010 to produce chemicals, about 21% of total coal production of China.
~ 83% is converted via cokers.
In gasification path, most of coal is used to produce methanol & ammonia.
Water Consumption In Coal Conversion Industry

- ~1.5 billion m³ fresh water is consumed in 2010
- About 1.0% of the total fresh water consumed by industry
- Coke production used 67% fresh water
About 277 million ton CO2 was emitted in 2010,
3.6% of the total carbon emission of China
70% is from gasification path
Potential of Coal Conversion Industry

Note:
1) Capacity in coal bases only;
2) Coke not included;
3) The difference between two bars indicates a potential increased coal consumption in next 5-10 years.
Trend of Coal Conversion Industry

- Portion for coal to coke, ammonia & CaC2 reducing
- Coexist of coke, ammonia & other chemicals will last for years

Current
- Coke 79.6%
- Ammonia 6.0%
- Calcium Carbide 2.4%
- Methanol 4.8%
- DME 4.0%
- Liquefaction Product & F-T Oil 0.6%
- Acid & Acetic Anhydride 0.7%

Running projects
- 670 mt

2015-2020
- Coke 51.0%
- Gasoline & Aromatics 1.1%
- Liquefaction Product & F-T Oil 5.1%
- DME 5.1%
- Hydrogen 0.3%
- Olean 7.3%
- Calcium Carbide 1.3%
- Ammonia 6.1%
- Natural Gas 11.3%
- Methanol 5.4%
- Char 4.8%

Coal consumption comparison

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Challenges of Coal Conversion Industry

Future challenges:
- More resources would be consumed,
- More impacts on environment would be caused
Sustainable Development Strategy

Key technologies suggested

✓ Advanced coal chemical process and technology
✓ Advanced high-efficiency catalysis technology
✓ Material and Manufacture technology for super-large and specific equipment domestically
✓ Advanced energy-saving technology
✓ CCUS technology of the CO2 produced in coal chemical processes
✓ Advanced water-saving technology
✓ Reuse technology of the wastes discharged by coal chemical industry
SWOT Analysis on Coal Conversion Industry

- The **shale gas** in China and rest of the world & its impact on coal conversion industry
- Impact of the lower cost chemicals (LNG, methanol, C2, C3) from Middle-East, and from NG condensate in North America
- Impact of **carbon taxi** on coal conversion industry.

- The **roadmap** of coal conversion industry
- The **super-large national coal conversion industrial demo park** around coal production arena
- Develop the novel **technologies of energy-saving, water-saving** technologies
- The **national clean production standards**, assessment system.

- **Launch the multi-billion dollar national key project on coal** for the fundamental understanding of coal science (esp. low rank coal). Develop innovative technology & people.
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