PRESENTATION

FROM COAL TO STEEL CONFERENCE
Responsible Mining and Sustainable Steel

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Sichuan Tianyi Science & Technology Co. Ltd.(abb. as CTYC)
Deeply Rooted In R & D of Comprehensive Utilization of **Coal** and NG Chemical Industry in 1958

Provide Solution for

- Low Carbon
- Environment Friendly
- Clean Energy

Increase Comprehensive Utilization and Economic Benefits for Resources of Traditional Industry
Topic: Clean Energy from Coking By-product

- H₂ Separation and Purification from COG by PSA (Pressure Swing Adsorption) Technology
- Provide Cheap H₂ for Hydrogen Energy
Coke is essential raw material in the steelmaking industry.

Coking process brings a large amount of by-product COG.

COG is not used effectively, it will cause environmental pollution and waste of resources.
In 1987: PSA - H₂ from COG by CTYC

- COG composition:

<table>
<thead>
<tr>
<th>Composition</th>
<th>CO₂ %</th>
<th>CₙHₘ%</th>
<th>O₂ %</th>
<th>CO %</th>
<th>H₂ %</th>
<th>CH₄ %</th>
<th>N₂ %</th>
<th>Total</th>
<th>Qₓ/Nm³</th>
<th>Qᵧ/Nm³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average value</td>
<td>5.75</td>
<td>2.65</td>
<td>0.26</td>
<td>5.75</td>
<td>58.07</td>
<td>22.42</td>
<td>8.5</td>
<td>103.40</td>
<td>16670</td>
<td>18811</td>
</tr>
<tr>
<td>Min value</td>
<td>5.12</td>
<td>2.29</td>
<td>0.07</td>
<td>5.12</td>
<td>55.19</td>
<td>20.8</td>
<td>5.52</td>
<td>94.11</td>
<td>15944</td>
<td>17955</td>
</tr>
<tr>
<td>Max value</td>
<td>6.09</td>
<td>3.08</td>
<td>0.5</td>
<td>6.09</td>
<td>60.78</td>
<td>24.01</td>
<td>11.71</td>
<td>112.26</td>
<td>17390</td>
<td>19615</td>
</tr>
</tbody>
</table>

- Impurity content (mg/Nm³):

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>H₂Sg/100 NM³</th>
<th>Naphthalene g/100 NM³</th>
<th>BTX g/NM³</th>
<th>NH₃g/100NM³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average value</td>
<td>12.26</td>
<td>3.26</td>
<td>0.124</td>
<td>0.571</td>
</tr>
<tr>
<td>Min value</td>
<td>4.33</td>
<td>0.95</td>
<td>0.04</td>
<td>0.326</td>
</tr>
<tr>
<td>Max value</td>
<td>26.75</td>
<td>3.26</td>
<td>0.671</td>
<td>1.099</td>
</tr>
</tbody>
</table>
In 1988: Experimental PSA - $H_2$ unit from COG built by CTYC at Coking Plant of WISCO (Wuhan Iron and Steel (Group) Corp.)

In 1990: 1000Nm$^3$/h PSA - $H_2$ unit from COG, EPC by CTYC based on the above experiment at Coking Plant of WISCO which was the first PSA - $H_2$ unit from COG in the world
Flow Chart for PSA- $H_2$ from COG by CTYC

- **COG**
- **COG compression**
- **Naphthalene removal unit**
- **Desorbed gas**
- **Pre-treatment, S & Tar removal**
- **TSA**
- **PSA**
- **Dehydration unit**
- **Oxygen removal unit**
- **High purity $H_2$**

- **Op. pressure**: 0.7 - 1.6 Mpa
- **Unit capacity**: 500 – 140,000 Nm$^3$/h
- **$H_2$ recovery rate**: 70 - 85 %
- **Product $H_2$ purity**: 98 - 99.999 %

- **$H_2$ applications**:
  - Cold rolling protection gas
  - Hydrogenation
  - $H_2$ driving vehicle
**H₂ applications:**
- Cold rolling protection gas
- H₂ driving vehicle
- Chemical products
140,000 Nm³/h PSA-H₂ Unit from COG at Qinghai Salt Lake Company

The Largest PSA-H₂ Unit from COG in the world, EPC by CTYC
35,000 Nm$^3$/h PSA-H$_2$ Unit from COG in Shanxi
280,000 Nm³/h PSA-H₂ Unit
at Shenhua Erdos Direct Coal to Oil Complex, Inner Mongolia
170,000 Nm³/h PSA-H₂ Unit at Shenhua Ningmei Indirect Coal to Oil Complex
PSA-H₂ Unit for 700 kt/a CTO, Pucheng, Shanxi
120,000 Nm³/h COG-LNG & H₂-rich Tail Gas to Liquid Ammonia Unit in Cangzhou, Hebei
200 kt/a COG & NG - Methanol Plant at Tangshan Jiahua
200 kt/a COG & Coal to Methanol Plant in Shanxi Tongshida
Also,

*CO* separation and purification from

*blast furnace gas* and *converter gas* by PSA in Steelmaking Plants

for methanol synthesis and other chemical products.
15,000 Nm$^3$/h PSA-CH$_4$ Unit from Landfill Gas in Hong Kong in 2005, Which is the First Plant from Landfill Gas to City Gas in the World
What is the global focus on energy for the future?

The cleanest and most environmentally friendly energy resource $H_2$
References for PSA - H₂

- Feed Gas:
  - various H₂ mixed gases

- Product H₂ Purity:
  - 98 - 99.999 %

- Plants Capacity:
  - 20 - 400,000 Nm³/h

- Reference:
  - More than 1000 units

References for PSA - H₂ from COG

- Feed Gas:
  - COG

- Product H₂ Purity:
  - 98 - 99.999 %

- Plants Capacity:
  - 500 - 140,000 Nm³/h

- Reference:
  - More than 60 units
CTYC Strong Advantages for PSA – H₂ from COG:

- **the strongest technologies** in the world
- **the most references** in the world as the patent company and general contractor
- **the drafter and organizer** for International Technical Specification for Safety of PSA systems for H₂ separation and purification
Thank you!

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Over dozens of years of its existence, CTYC is a China's leading company in research & development and application of PSA technologies, CI chemical technologies and catalysts and also up to international advanced level.