BGL Gasification
Content

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What is Gasification?

- Gasification is conversion of a feedstock, usually coal or heavy oil, to syngas.

- Syngas is mostly CO and H₂.

- 70%-90% of coal energy converted to syngas.
What is coal?

- Carbon
- Hydrogen
  - Oxygen
  - Nitrogen
  - Sulphur
  - Other
- Moisture
- Ash

- High Ranked
  - Anthracite
  - Bituminous
  - Sub Bituminous
  - Lignite
- Low Ranked
Gasification Basics

\[ C + \text{O}_2 \rightarrow \text{CO}_2 + \text{HEAT} \]

\[ C + \text{H}_2\text{O} + \text{HEAT} \rightarrow \text{CO} + \text{H}_2 \]

(SYNGAS)
BGL Heritage

Developed by British Gas in collaboration with Lurgi for SNG production

BGL = British Gas / Lurgi
BGL Gasifier

- Fixed bed slagging gasifier
- Developed from the well proven Lurgi dry ash gasifier
Lurgi and BGL Comparison

Lurgi - Pressure Gasifier
(North Dakota/Sasol type)

Feed

Feed Lock

Gas Offtake

Wash Cooler

Crude Gas

Ash Grate (rotating)

Steam/Oxygen

Ash Lock

Ash

BGL Gasifier
(SVZ type)

Feed

Feed Lock

Stirrer (for caking coals only)

Steam, Oxygen and Tar

Slag Quench

Slag Lock

Slag

Gas Offtake

Wash Cooler

Crude Gas

About three fourths of global coal gasification capacity is based on Lurgi technology
Fixed Bed Gasifier Advantages

- Heat recovery from product gas by contact with coal bed
- Low oxygen consumption – 50-60% of that for entrained flow gasifiers
- High cold gas efficiency
- High carbon conversion
- Low gasifier outlet temperature
- Inexpensive and well proven conventional gas cooling train
- Low CO₂ content in Syngas
## Typical clean gas composition

<table>
<thead>
<tr>
<th>Component</th>
<th>Composition by volume %</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂</td>
<td>30.8</td>
</tr>
<tr>
<td>CO</td>
<td>57.2</td>
</tr>
<tr>
<td>CH₄</td>
<td>6.2</td>
</tr>
<tr>
<td>CO₂</td>
<td>4.9</td>
</tr>
<tr>
<td>Other hydrocarbons</td>
<td>0.4</td>
</tr>
<tr>
<td>Non-combustibles</td>
<td>0.5</td>
</tr>
</tbody>
</table>
BGL Background - Westfield

- Towns gas site with 4 Lurgi dry ash gasifiers
- Operated from 1960 to 1974
- Slagging gasifier developed in collaboration with Lurgi at Westfield using a series of demonstration scale gasifiers
Schwarze Pumpe

- Commercial production of power, methanol and heat from waste
- Commercial scale 3.6m gasifier developed from Westfield experience
- Start-up in 2000
- Successful co-gasification of coal, lignite briquettes and waste feedstocks
Lignite Briquette (binderless)
Yunnan

- Pilot scale slagging gasifier commissioned in 2006
- Raw lignite coal feed
- Most gasifier components locally sourced
- Existing gas processing train handles products
# Feedstock Comparison

<table>
<thead>
<tr>
<th>Feedstock</th>
<th>SVZ 3.6m Gasifier</th>
<th>Westfield 1.8m Gasifier</th>
<th>Yunnan 2.3m Gasifier</th>
<th>Westfield 2.3m Gasifier</th>
<th>Westfield 1.8m Gasifier</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Feedstock</strong></td>
<td>Waste + Coal</td>
<td>N. Dakota Lignite</td>
<td>Local Lignite</td>
<td>Pittsburgh 8</td>
<td>Petroleum Coke</td>
</tr>
<tr>
<td><strong>Moisture content (wt%)</strong></td>
<td></td>
<td>41</td>
<td>30-40</td>
<td>6.5</td>
<td>4.9</td>
</tr>
<tr>
<td><strong>Typical gas composition (mol%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H₂</td>
<td>18</td>
<td>32.6</td>
<td>26.1</td>
<td>27.8</td>
<td>30.0</td>
</tr>
<tr>
<td>CO</td>
<td>34</td>
<td>38.5</td>
<td>46.5</td>
<td>57.2</td>
<td>59.0</td>
</tr>
<tr>
<td>CO₂</td>
<td>16</td>
<td>18.1</td>
<td>12.7</td>
<td>4.0</td>
<td>0.6</td>
</tr>
<tr>
<td>CH₄</td>
<td>18</td>
<td>6.2</td>
<td>8.0</td>
<td>7.0</td>
<td>3.1</td>
</tr>
<tr>
<td>Carbon in slag (wt%)</td>
<td>-</td>
<td>-</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>2.2</td>
</tr>
</tbody>
</table>
Feedstock Flexibility

- Non-caking to strongly caking coals, UK and US
  - Ash: 0.5 - 21 wt%
  - Moisture: 3 - 28%
  - Sulphur: 0.5 - 5.6%
  - Chlorine: up to 0.6%
  - Size Range: 6 to 50 mm

- Metallurgical and Petroleum Cokes
- Briquetted coal
- Raw and briquetted lignite
- RDF and other waste fuels
- Total recycle of by-products
- Fuel can be switched whilst on line
BGL Gasifier Applications

- Coal
- Waste
- Industrial Fuel Gas
- Electrical Power
- SNG
- Chemicals and Transport fuels
Hulunbeier

- BGL selected by Hulunbeier New Gold Chemical Co. Ltd. in 2008 for a 500,000 t/year Ammonia plant (800,000 t/year Urea)
- Briquetted Lignite feedstock
- Currently under construction
- Plant commissioning expected in 2011
Hulunbeier

Courtesy of Hulunbeier New Gold Chemical Co. Ltd.
SNG and Fuel Gas

• BGL is the best technology for SNG application owing to high efficiency and presence of CH₄ in product gas
  ▫ See 8th European Gasification Conference paper
• Further SNG conversion efficiency realised through development of single stage shift and methanation – HICOM
• 70% coal to SNG efficiency based on Westfield demonstration – rising to 75% if based around high pressure BGL gasifier
• Process scale, high efficiency and low oxygen demand makes fuel gas application highly competitive
• South Heart Energy Development SNG project in North Dakota announced in November 2007 - planning to use 7 BGL gasifiers to produce 124 MMscfd SNG from lignite briquettes \((3.33 \times 10^6 \text{ Nm}^3/\text{day})\)
Power Generation

• 40-100 MWe scale of BGL makes it suitable for a range of industrial power applications
• Retrofitting to an existing GTCC is possible
• High cold gas efficiency eliminates need for integration with HRSG
• Possibilities for smaller scale units being examined
Summary

- Highest cold gas efficiency of commercially available gasifiers
- Ability to handle a wide range of coal feedstocks, refuse derived fuel (RDF) and sewage sludge
- Low oxygen consumption, 50-60% of entrained flow gasifiers
- Moderate outlet temperature
- Conventional materials
- Excellent load following characteristics
- No fly ash produced, only a non-leaching slag
- Proven and available for commercial exploitation