Commercial Application of BGL Gasifiers

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Something you’ll find only in the BGL gasifier…
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BGL Gasifier Development

- The improved “slagging” version of the existing Lurgi Gasifier was jointly developed with British Gas from 1974 onwards in Westfield/Scotland to:
  - have a reactor to produce non-leachable vitreous slag rather than dry ash
  - improve specific reactor throughput
  - increase fines content acceptable in feed
  - reduce steam consumption and consequent gas condensate production
  - recycle tars/oils to extinction
  - increase CO/H₂-yields

- The BGL achieved these goals, proved successfully its reliability and demonstrated its flexibility by testing a wide range of coals.

- First commercial plant at Schwarze Pumpe, Germany, in 2000, using broad range of feedstock including waste

- Technology now jointly owned by Envirotherm GmbH and GL Noble Denton
BGL Gasifier
Key Benefits

Operational
• Extensive development history (Lurgi: 75% of worldwide coal gasification experience)
• High cold gas efficiency between 82% and 93% / high specific throughput
• Low oxygen consumption (ca. 0.5-0.6 kg / kg Coal)
• Low steam consumption (ca. 0.3-0.4 kg / kg Coal)
• Lower aqueous liquor production
• Fuel flexibility (nearly all coal types and other types of fuels (e.g. waste) can be processed)
• Excellent load following capabilities
• Modularity (spare/reliability)
• Slag as by-product is non-leachable (vitrified) and can be utilized (road work)

Capital/Investment
• Simple gasifier design (no exotic materials, no sophisticated heat exchangers)
• Smaller air separation unit (ASU) due to low oxygen requirements
BGL Gasifier
Process Applications (overview)

- BGL Process has clear investment and operational advantages in a wide range of application.
- According to gas composition BGL is well suited to SNG production because of its high efficiency and the presence of CH₄ in product gas.
### BGL Gasifier
**Current Activities - SHED**

<table>
<thead>
<tr>
<th><strong>Client</strong></th>
<th>South Heart Energy Development, LLC (SHED) (Joint venture between Great Northern Power Development, L.P. (GNPD) and Allied Syngas Corporation (ASC))</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Location of facility</strong></td>
<td>South Heart, North Dakota, US</td>
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<tr>
<td><strong>Application</strong></td>
<td>SNG production (approx. 2.7 million Nm³/d) and utilization of CO₂ for enhanced oil recovery (EOR)</td>
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<tr>
<td><strong>Feedstock</strong></td>
<td>Briquetted lignite (14,000 t/d coal as received)</td>
</tr>
<tr>
<td><strong>Features</strong></td>
<td>Seven (7) + zero (0) BGL gasifiers</td>
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<td><strong>BGL Gasifier</strong></td>
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<td><strong>Current Activities - Hulunbeier</strong></td>
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</tbody>
</table>
| **Client** | Yuntianhua United Commerce Co., Ltd. Kunming, Yunnan, PRC  
Hulunbeier New Gold Chemical Co., Ltd., Hailaer, Hulunbeier, Inner Mongolia, PRC |
| **Location of facility** | Hulunbeier, Inner Mongolia, PRC |
| **Application** | Syngas for the production of 500,000 t/year Ammonia (800,000 t/year Urea) |
| **Feedstock** | Domestic dried and briquetted lignite |
| **Features** | Two (2) + one (1) BGL gasifiers (40 barg operating pressure)  
Synthesis gas production 119,000 Nm³/h |
| **Scope of Supply** | Process Design Package for gasification and gas liquor separation  
Process performance guarantees  
Plant erection and commissioning assistance |
| **Start-up** | Second half of 2010 |
| **Project challenges** | Fasttrack Project – Process Design Package completed end 2008  
Construction only during summer months possible  
(winter temperatures approaching -45 °C) |
BGL Gasifier
Current Activities - Hulunbeier

Plant model
BGL Gasifier
Current Activities - Hulunbeier

Gasifier Reactor during Manufacturing Process
BGL Gasifier
Current Activities - Hulunbeier

Gasifier Reactor Transport over more than 1,000 km Distance
BGL Gasifier
Current Activities - Hulunbeier

View of the Site (2009)
<table>
<thead>
<tr>
<th><strong>Client</strong></th>
<th>China Yituo Group Co. Ltd., Luoyang, Henan Province, PRC</th>
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</thead>
<tbody>
<tr>
<td><strong>Location of Facility</strong></td>
<td>Luoyang, Henan Province, PRC</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>Fuel gas</td>
</tr>
<tr>
<td><strong>Feedstock</strong></td>
<td>Local hard coal</td>
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<tr>
<td><strong>Features</strong></td>
<td>One (1) + one (1) BGL gasifiers</td>
</tr>
<tr>
<td></td>
<td>Gas production 43,000 Nm³/h</td>
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<tr>
<td><strong>Start-up</strong></td>
<td>Beginning of 2011</td>
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<tr>
<td><strong>Scope of Supply</strong></td>
<td>PDP for gasification, gas cooling and gas liquor separation</td>
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<tr>
<td></td>
<td>Process performance guarantees</td>
</tr>
<tr>
<td></td>
<td>Plant erection and commissioning assistance</td>
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**BGL Gasifier**  
**Current Activities - Shriram**

<table>
<thead>
<tr>
<th>Client</th>
<th>Shriram EPC Ltd., Chennai, India</th>
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<tbody>
<tr>
<td>Location of Facility</td>
<td>Haldia, West Bengal, India</td>
</tr>
<tr>
<td>Application</td>
<td>Syngas for the production of synthetic ammonia</td>
</tr>
<tr>
<td>Feedstock</td>
<td>High ash domestic hard coal (132 t/h, 3,200 t/d)</td>
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</tbody>
</table>
| Features                | Two (2) BGL gasifiers, one relocated from Germany, second gasifier built identically to relocated one  
                          | Raw gas production 150,000 Nm³/h |
| Scope of Supply         | Relocation and reengineering as far as required for gasification, gas cooling, gas liquor separation and phenol recovery  
                          | Basic engineering for new BGL  
                          | Plant erection and commissioning assistance on request |
| Start-up                | 3rd/4th Quarter of 2011         |
BGL Gasifier
Current Activities - Shriram

Dismantling of the Former SVZ BGL Gasifier for Relocation
BGL Gasifier
Current Activities - Shriram

Dismantling of the Former SVZ BGL Gasifier for Relocation
BGL Gasifier Outlook

- PreFEED Study for Coal-to-Liquid (CtL) plant using BGL technology currently in progress for American client
- Considerably growing interest in BGL technology for SNG production in Asia
- Increased demand in gasification of low grade coal
- Growing interest in substitution of gasifiers in existing plants or in already planned projects with BGL technology
- Less small scale but more large scale projects
BGL Gasifier
Summary

- Unique gasifier design offers major advantages including high fuel flexibility and low consumption of steam and oxygen
- BGL technology for all gasification routes applicable
- Currently 7 gasifiers are in construction or in detailed design phase
- Projects for production of fertilizers, SNG, fuel gas and CtL
- Start up of first multiple BGL gasifiers plant in second half of 2010
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