Further Developments and Commercial Progress of the BGL Gasification Technology

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ENVIROTHERM

BGL Gasifier
Envirotherm GmbH

is an experienced and qualified engineering partner with an extensive list of references and strong growth based on proprietary technologies acquired from Lurgi

- Envirotherm GmbH is a subsidiary of Allied Resource Corporation, Wayne, PA and sister company of Allied Syngas (ASC), Wayne, PA
- Headquarters in Essen, Germany
- Envirotherm’s Competence:
  - Flue Gas Treatment (DeNOx-SCR, Dedusting, Desulphurization)
  - Stationary and Circulating Fluidized Bed Combustion
  - Circulating Fluidized Bed Gasification
  - BGL Gasification
BGL Gasifier

Development and Application
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 consequently gas condensate production
  - recycle tars/oils to extinction
  - increase CO/H₂-yields

- Technology successfully demonstrated with a wide range of coals and proven on commercial size gasifier units until 1991

- First commercial plant at Schwarze Pumpe, Germany, from 2000 until 2007, using broad range of feedstock including waste
BGL Gasifier
Design Features / Comparison with Fixed Bed Dry Bottom

**Lurgi Fixed Bed Dry Bottom**
- Coal
- Coal Lock
- Gas Offtake
- Wash Cooler
- Crude Gas
- Rotating Ash Grate
- Steam / Oxygen
- Ash Lock
- Ash

**BGL Fixed Bed Slagging Gasifier**
- Coal
- Coal Lock
- Double Wall
- Refractory Lining
- Gas Quench
- Crude Gas
- Steam, Oxygen
- Tuyere
- Slag Quench
- Slag Tap and Burner
- Slag
BGL Gasifier
Key Benefits

- High cold gas efficiency
- High carbon conversion
- Low oxygen consumption
- Low steam consumption
- Low aqueous liquor production
- Ash converted to non-leachable vitrified slag
- Fuel flexibility (nearly all types of coal and other fuels, e.g. waste)

- Well suited for SNG applications

<table>
<thead>
<tr>
<th>Typical BGL Gas Composition for bituminous coal by volume %</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₂</td>
</tr>
<tr>
<td>33</td>
</tr>
</tbody>
</table>
BGL Gasifier
Further Development

- Increase in reactor diameter to 4m → higher throughput
- Increase in operation pressure (up to 40bar) → higher CH₄ content, less tars and oils
- Stirrer implementation for caking coals, if required

### Plant Data

<table>
<thead>
<tr>
<th>Plant</th>
<th>Start up</th>
<th>Feedstock</th>
</tr>
</thead>
<tbody>
<tr>
<td>BGL 1</td>
<td>1975</td>
<td>Coal</td>
</tr>
<tr>
<td>BGL 2</td>
<td>1981</td>
<td>Coal</td>
</tr>
<tr>
<td>BGL 3 SVZ</td>
<td>2000</td>
<td>Waste &amp; up to 80% waste</td>
</tr>
<tr>
<td>BGL 3 Hulunbeier</td>
<td>2011</td>
<td>Lignite</td>
</tr>
<tr>
<td>BGL 3 Yituo</td>
<td>2012</td>
<td>Hard coal</td>
</tr>
<tr>
<td>BGL 3 Shriram</td>
<td>2012</td>
<td>High ash hard coal</td>
</tr>
<tr>
<td>BGL 4</td>
<td>?</td>
<td>Lignite</td>
</tr>
</tbody>
</table>
BGL Gasifier

Current Activities
BGL Gasifier
Current Activities

China
| **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 (H₂+CO) |
| **Scope of Supply** | Process Design Package for gasification and gas liquor separation  
|          | Process performance guarantees  
|          | Plant erection and commissioning assistance |
| **Start-up (expected)** | Summer 2011 |
| **Project challenges** | Fasttrack Project  
|          | Construction only during summer months possible  
|          | (winter temperatures approaching -45 °C) |
BGL Gasifier
Current Activities – Hulunbeier

Progress

- May 2008 site clearance and civil work commenced
- Process Design Package delivered 4\textsuperscript{th} Quarter 2008
- Detailed Design completed 3\textsuperscript{rd} Quarter 2009
- Gasifier installations on site 2009-2010
- Plant operation staff training, August 2010
BGL Gasifier
Current Activities - Hulunbeier

View of the Site (2009)
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

Gasifier Installation

Courtesy of Hulunbeier New Gold Chemical Co. Ltd.
BGL Gasifier
Current Activities - Hulunbeier
Gasifier Building (2010)
BGL Gasifier
Current Activities - Hulunbeier

View from Gasifier Building (2010)
## BGL Gasifier
### Current Activities - Yituo

<table>
<thead>
<tr>
<th>Client</th>
<th>China Yituo Group Co. Ltd., Luoyang, Henan Province, PRC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location of Facility</td>
<td>Luoyang, Henan Province, PRC</td>
</tr>
<tr>
<td>Application</td>
<td>Fuel gas for industrial complex</td>
</tr>
<tr>
<td>Feedstock</td>
<td>Local hard coal</td>
</tr>
</tbody>
</table>
| Features | One (1) + one (1) BGL gasifiers  
Gas production 43,000 Nm³/h |
| Start-up (expected) | Beginning of 2012 |
| Scope of Supply | PDP for gasification, gas cooling and gas liquor separation  
Process performance guarantees  
Plant erection and commissioning assistance |
| Progress | Process Design Package delivered in April 2010  
Detailed Design commenced in August 2010 |
BGL Gasifier
Current Activities

USA
### 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>Engineer</strong></td>
<td>Black &amp; Veatch, Kansas City, US</td>
</tr>
<tr>
<td><strong>Location of facility</strong></td>
<td>South Heart, North Dakota, US</td>
</tr>
<tr>
<td><strong>Application</strong></td>
<td>H₂ Production (approx. 4.7 million Nm³/d for power production) and utilization of CO₂ (2.1 million mt/yr) for enhanced oil recovery (EOR)</td>
</tr>
<tr>
<td><strong>Feedstock</strong></td>
<td>Briquetted lignite (5747 t/d coal as received)</td>
</tr>
<tr>
<td><strong>Features</strong></td>
<td>Three (3) + zero (0) BGL gasifiers</td>
</tr>
</tbody>
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BGL Gasifier
Current Activities
## 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>
</tr>
<tr>
<td>Features</td>
<td>Two (2) BGL gasifiers, one relocated from Germany, second gasifier built identically to relocated one</td>
</tr>
<tr>
<td></td>
<td>Raw gas production 150,000 Nm³/h</td>
</tr>
<tr>
<td>Scope of Supply</td>
<td>Relocation and reengineering as far as required for gasification, gas cooling, gas liquor separation and phenol recovery</td>
</tr>
<tr>
<td></td>
<td>Basic engineering for new BGL</td>
</tr>
<tr>
<td></td>
<td>Plant erection and commissioning assistance on request</td>
</tr>
<tr>
<td></td>
<td>Project management for downstream ammonia plant (relocation and refurbishment)</td>
</tr>
<tr>
<td>Start-up (expected)</td>
<td>2th Quarter of 2012</td>
</tr>
<tr>
<td>Progress</td>
<td>Basic Engineering completed 4th Quarter 2010</td>
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<tr>
<td></td>
<td>Existing BGL Gasifier transported to India in September 2010</td>
</tr>
</tbody>
</table>
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

• Considerably growing interest in BGL technology for SNG production in Asia

• Increased demand in gasification of low rank 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 seven gasifiers under construction or in detailed design phase

• Projects for production of fertilizers, SNG, power, fuel gas and CtL

• Start up of first multiple BGL gasifiers plant in mid 2011
Thank you for your attention!

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