OLGA Tar removal

4 MW\textsubscript{t} commercial demonstration biomass gasification in France

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Presentation contents:

- Introduction tar problems in biomass gasification
- OLGA tar removal concept
- Performance of OLGA in Duration test
- 4 MWt gasification plant in France
Two gasification routes

Production of syngas
H₂ & CO
> 1200 °C
Entrained flow - O₂
Economy of (large) scale
Coal & refinery waste
Fisher Tropsch diesel & H₂

Production of ‘product gas’
H₂, CO & CₓHᵧ like CH₄ & tars
< 1000 °C
CFB, BFB, Fixed Bed – O₂, air, steam
Smaller plants are feasible
100% biomass or waste (local sources)
Electricity & SNG (CH₄)
The tar problem

1. Heavy tars
- Condensation leads to fouling < 350 °C
- Tar dew point is critical parameter
Tar removal in biomass gasification processes

The “heavy” tar problem

Cold side of gas engine intercooler after 1000 running hours
The tar problem

2. *Light tars*

- Heterocyclic compounds (phenol) are water soluble, condensate & scrubber water is poisoned
- Naphthalene can cause crystallization problems
Tar removal in biomass gasification processes

The “light” tar problem

Naphthalene crystals on gas engine control valve
Presentation contents:

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Tar removal in biomass gasification processes

Dew points are important!

- Cooler
- Particle separation cyclone or Hot Gas Filter

Temperature °C

Tar dew point ± 350 °C

Water dew point ± 60 °C

Dew points & process choices
Tar removal in biomass gasification processes

Dew points are important!
OLGA process

Temperature °C

Cooler

Particle separation cyclone or Hot Gas Filter

OLGA Separation of: tars & fine particles

TDP ± 350 °C

Absorption

Water dew point ± 60 °C

Dew points & process choices

Tar dew point < 10 °C
Tar removal in biomass gasification processes

Dew points are important!
OLGA process

Do not mix tar & water!
Tar removal in biomass gasification processes

PFD: OLGA with cyclone

Waste free system
Tar removal in biomass gasification processes

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**Line-up 0.5 MWₜ duration test**
Tar removal in biomass gasification processes

OLGA Performance

Stable temperatures
Tar removal in biomass gasification processes

OLGA Performance

Stable gas composition
Tar removal in biomass gasification processes

**OLGA Performance, gas analyses**

<table>
<thead>
<tr>
<th>Compound</th>
<th>Unit</th>
<th>Raw product gas</th>
<th>After OLGA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total tar</td>
<td>mg/m³ dry</td>
<td>16855</td>
<td>197</td>
</tr>
<tr>
<td>Tar dew point</td>
<td>°C</td>
<td>≈ 350</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Naphthalene</td>
<td>mg/m³ dry</td>
<td>4023</td>
<td>38</td>
</tr>
<tr>
<td>Phenol</td>
<td>mg/m³ dry</td>
<td>386</td>
<td>&lt; 2,5</td>
</tr>
<tr>
<td>Tar aerosols (incl. dust)</td>
<td>mg/m³ dry</td>
<td>--</td>
<td>10</td>
</tr>
</tbody>
</table>
Conclusion 0.5 MW$_t$ OLGA Pilot

- > 650 hours operation
- Stable & reliable process
- Excellent efficiency
- Clean water condensate after OLGA
- Gas engine operated problem free and proved to be clean after inspection, lube oil quality similar to natural gas operation
- Successful 50 hour test with micro gas turbine
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Biomass gasification projects in France

Government biomass tender in 2005

- Biomass or biogas for combined heat & power (CHP)
- Minimal output 12.5 MWe – 4000 hr/yr
- 15 years of electricity delivery
- Eneria / EBV awarded with 6 biomass plants, total 81 MWe
- Biomass source: wood (saw mills) & wine residue (distilleries)
- EBV decided to first build a 1 MWe demonstration plant
Tar removal in biomass gasification processes

**Line-up 4 MWₜ demonstration**

- **Biomass**
- **PRIME Gasifier**
- **Cyclone**
- **Hot Gas Fan**
- **OLGA Collector**
- **OLGA Absorber**
- **Gas Engine**
- **Pressure Fan**

- **Bottom Ashes**
- **Heat**
- **Coarse solids**
- **Heat**
- **Fine solids**
- **Heavy tar**
- **Light tar**
- **Condensate water**
- **Inorganic impurities** (NH₃ – HCl etc)

To Flare
Tar removal in biomass gasification processes

4 MW$_t$ demonstration plant

Design & production in 2005
Tar removal in biomass gasification processes

Commissioning & start-up
Summer 2006
Tar removal in biomass gasification processes

Results Moissannes 4 MW\(_t\) demonstration

<table>
<thead>
<tr>
<th>Biomass</th>
<th>Wood</th>
<th>Wine residue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation</td>
<td>Stable &amp; Reliable</td>
<td></td>
</tr>
<tr>
<td>Capacity</td>
<td>Lower (fuel density)</td>
<td>Full, 1,1 MWe reached</td>
</tr>
<tr>
<td>Heavy tars</td>
<td>Removed effectively</td>
<td></td>
</tr>
<tr>
<td>Phenol</td>
<td>Removed completely (&lt;2,5 mg/Nm(^3))</td>
<td></td>
</tr>
<tr>
<td>Naphthalene</td>
<td>Efficiency &gt; 99%</td>
<td>According expectations</td>
</tr>
</tbody>
</table>
Conclusion & Outlook

- Tar problem can successfully be solved
- Biomass gasification plants are technically feasible

- Duration tests in France in 2007
- ECN focus on development SNG production
- First 100% biomass CHP plants with OLGA technology (1-100 MW) are in development based on gas engines or cofiring on gas turbines
Blue flame indicates clean gas!

Thank you!

www.olgatechnology.com

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