Biomass gasification for CHP applications

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Overall Bio-CHP system based on fluidized bed gasification
MILENA Indirect Gasification

- Fluidized bed gasification
- Temperature level: 850°C
- Very little nitrogen in producer gas
- Complete conversion of the fuel
- No carbon in the ash
- High efficiency
- Heat transfer through bed material
- One single vessel: compact design
- Fuel flexible
## Comparison

<table>
<thead>
<tr>
<th></th>
<th>MILENA</th>
<th>CFB/BFB</th>
<th>Downdraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion</td>
<td>100% / white ash</td>
<td>~90% / black ash</td>
<td>~90% / black ash</td>
</tr>
<tr>
<td>Cold Gas Efficiency</td>
<td>~80%</td>
<td>~70%</td>
<td>~70%</td>
</tr>
<tr>
<td>Temperature control</td>
<td>Good control, no char accumulation</td>
<td>Lower control ability due to char hold-up</td>
<td>Very heterogeneous</td>
</tr>
<tr>
<td>Temperature versus Efficiency</td>
<td>lower temperature = higher efficiency</td>
<td>lower temperature = lower conversion</td>
<td>lower temperature = lower conversion</td>
</tr>
<tr>
<td>Fuel flexibility</td>
<td>waste, agricultural residues any size</td>
<td>less freedom any size</td>
<td>woody only large chunks</td>
</tr>
<tr>
<td>Gas</td>
<td>12-15 MJ/Nm³ essentially N₂-free</td>
<td>5-6 MJ/Nm³ ~50% N₂</td>
<td>5-6 MJ/Nm³ ~50% N₂</td>
</tr>
<tr>
<td>Scale</td>
<td>Scalable (&gt;100 MW)</td>
<td>Scalable (&gt;100 MW)</td>
<td>Max. 1 MW</td>
</tr>
</tbody>
</table>
Markets for MILENA gasifier

- **Co-firing in coal boilers or gas turbines**
  - Clean gas feeding to boiler or turbine
  - With Milena lower grade biomass or waste can be used, rather than the clean wood pellets needed for direct co-firing in boilers

- **Combined heat and power**
  - On-site conversion of waste to energy
  - In combination with gas engine or small gas turbine
  - Milena produces medium calorific gas, not diluted with nitrogen

- **Substitute Natural Gas production**
  - High methane content of producer gas makes Milena very suitable for SNG production (Bio-Methane / Bio-LNG)

- **(Co-)Production of fuels or chemicals**
  - FT, Ethylene, BTX
Gas Engine system efficiency
MILENA CHP configuration

Efficiency LHV basis [%]

Thermal Efficiency
Electrical Efficiency

GE
GE + ORC
GE + ORC + Dryer

Typical scale: several MWe.
ECN Experience with MILENA gasification technology
Milena Technology
test facilities at ECN

25 kW (~5 kg/h)

0.8 MW (~150 kg/h)

Extensive gas analyses
800 kW\textsubscript{th} MILENA + OLGA pilot plant

- MILENA gasifier in operation since 2008
- Typical input 150 kg/h
- Realistic fuel particles sizes.
- Refractory lined vessel.
- Runs in campaigns
- Connected to OLGA tar removal system

- OLGA pilot plant also tested in combination with CFB gasifier, gas engine and small gas turbine.
Tested feedstocks

- Clean Wood
- Demolition Wood
- Straw
- Soya stalk
- High-ash coals (> 50 wt% ash)
- Lignite
- RDF
- Sunflower husks
Results 500 hour test of 1 MW Milena + OLGA tar removal system

- Availability Milena 96%
- “Downstream downtime”: in OLGA tar removal system
Gas composition 2012 duration test

Remark: during test period, steam to air ratio was varied for testing purposes
Gas cleaning
The tar problem

- Tar starts to condense <400°C
  - Fouling coolers, blowers, inlet gas engines
- Water pollution
- Catalyst deactivation
ECN OLGA gas cleaning
Tar dew point < 10°C
No water pollution with tars!
MILENA and OLGA commercialisation with Royal Dahlman
Project in Development in Alkmaar, The Netherlands

- Project has changed several times over past years.
- 4 MW MILENA - OLGA – Methanation producing Bio-Methane
- Royal Dahlman will build the plant
- Main subsidy granted, waits for final investment decision by Province of North Holland.
RDF gasification demo-project by ETI in UK

- 7 MWₑ combined cycle using gas turbine
- MILENA – OLGA technology
- Dahlman leads consortium
- Phase 1 commissioned and funded by the Energy Technologies Institute (ETI).
- Three technologies / consortia compete in phase 1.
- Phase 1: Pilot scale testing + engineering in 2013
- After execution of phase 1 ETI will select one of the three competitors for the waste gasification demonstration.
Thermax Soya Residue

- 1 MWe Soya residue gasification demo.
- Construction ongoing
- Commissioning starts after summer 2014
Thank you for your attention!

Questions?

For more information:
www.milenatechnology.com

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