Main business development of renewable projects based on CHP units for ‘alternative’ fuels

Vapour Processing Systems
Biogas CHP
Syngas CHP
Bio-oil CHP
Dual/multi Fuel applications

Vapour Processing Systems
Total Fina refinery Lyon
Biogas plant

Synset 1400 kWe gasifier

Ash disposal container
Gascleaning
gasifier
gasbuffer
engine
flare
Start experience bio-oil CHP 2002

Different Bio-oils
- animal fat
- used frying fat
- RBD palm oil

Different engines
- Iveco
- MAN B&W
- Cummins

Different countries
- Austria (1)
- Belgium (1)
- Italy (3)
- Netherlands (1)
- Switzerland (1)
Learning moments

- Bio oils need to be pre-conditioned and of a constant quality
- How to deal with FFA’s (free Fatty Acids) and impurities.
- Combination of bio-oil with bio/syn gas (Dual Fuel) improves economics
- How to overcome emission requirements
- How to achieve reasonable maintenance intervals

Learning moments

- Oils pec limits for low maintenance vs acceptable maintenance.
- Injectors ➔ change every 1000 hr ➔ 4 hr stop of system +/- costs
- Cheaper fuel vs expensive fuel
- Expensive fuel ➔ no room for the extra costs
- Acceptability of the foreseen fuel (World wide food for fuel discussion).
Learning moments

• Engines are NOT developed for these applications.
• Set up a standard engine and adapt this engine to burn the bio fuel as good as possible.
• ‘normal’ in the engine market is a set-up for low emissions → this results in worse burn of the fuel (CO ⇐ Nox).
• Reducing Nox is more costly than reducing CO
• Nox = Urea (Denox) CO = Oxidation catalyst

• Always go for optimum fuel efficiency and not for emission optimisation. Solve this problem afterwards.

Fuel quality

• No harmful substances into the fuel (Phosphorous / Sulphur below harmful limits!)
• Acceptable standing times for components in the fuel system of engines.
• Make sure that the fuel system is the only system that is in ‘danger’ – or under suspicion for failure

• → Check bio-oil quality and adapt oil change intervals
• → Control ignition of all cylinders individually
• → Check max. lubrication oil levels in oil pan!
Learning moments

• To warrant running hours per year man need bio-oil with a constant quality and with minimum specifications.
• To overcome emissions, SCR technologies, Oxidation Catalyst units and Soot filtration is needed
• For quick delivery of spare parts use basic ‘of the shelf’ available (high-speed – 1500 rpm) engines
• Maintenance interval every 250 to 400 hours
• In dual fuel set-up injection of up to a maximum of 40% (bio)gas is possible

Conclusions

Cost of fuel ➔
Investment of the CHP system ➔
Running costs ➔
Costs for exhaust gas cleaning

Viable Project?

Depending on local subsidies given Greencalc AAA+ is sometimes preferred above economics.
<table>
<thead>
<tr>
<th>Property</th>
<th>Specification</th>
<th>Value</th>
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</thead>
<tbody>
<tr>
<td>Density</td>
<td>(w.i.a.) at 15°C calculated kg/L</td>
<td>0,9</td>
</tr>
<tr>
<td>Nett Calorific Value</td>
<td>ASTM D 240 MJ/kg</td>
<td>&gt;36</td>
</tr>
<tr>
<td>Gross Calorific Value</td>
<td>ASTM D 240 MJ/kg</td>
<td>39</td>
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<tr>
<td>Kinematic viscosity at 50°C</td>
<td>ASTM D 445 mm²/s</td>
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<tr>
<td>Flash point</td>
<td>ASTM D 93 °C</td>
<td>&gt;100</td>
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<tr>
<td>Pour point</td>
<td>ASTM D 97 °C</td>
<td>&lt;+40</td>
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<tr>
<td>Ash</td>
<td>ASTM D 482 wt%</td>
<td>0,001</td>
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<tr>
<td>Water Karl Fisher</td>
<td>ISO 8534 wt%</td>
<td>0,03</td>
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<tr>
<td>Conradson carbon residue</td>
<td>ASTM D 189 wt%</td>
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<tr>
<td>Sulphur</td>
<td>ASTM D 2622 wt%</td>
<td>0,001</td>
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<tr>
<td>Free Fatty Acids (Mw:256)</td>
<td>ISO 660 wt%</td>
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<tr>
<td>Total Acid Number</td>
<td>ISO 660 mg KOH/g</td>
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<tr>
<td>Copper Corrosion (3hrs at 50°C)</td>
<td>D 130</td>
<td>1A</td>
</tr>
<tr>
<td>Sodium (as Na)</td>
<td>AAS mg/kg</td>
<td>&lt;15</td>
</tr>
<tr>
<td>Phosphor</td>
<td>mg/kg</td>
<td>&lt;10</td>
</tr>
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</table>

**Bio-oils need a temperature of > 60°C**

[Diagram showing fuel storage tank and fuel line with tracing]
Urea-tank

Emission requirement in the Netherlands
NOx  450 mg/Nm³
SOx  200 mg/Nm³
Stof 50 mg/Nm³

2011 > 50.000 running hours

• Relative small amount of sites developed so far because of the bio-oil prices
• Successful in:
  - head office TNT in the Netherlands
  - bio-oil animal fat (Ecoson)
  - dual fuel CHP in Belgium
  - palmoil with biogas
Headoffice TNT Greencalc AAA
Most durable office in Europe

2MW biogas and 1MW bio-oil
to be sure delivering energy to
recreation parc
New challenges

Pyrolyses oil – Algae oils
- Research into technical possibility
- Fuel systems of engines need to be adapted.
- Fuel price / quality is still an important issue
- Economical viable?

• Thank you for your attention