**Techno-economic evaluation of a new Biomass-to-Liquid process concept for reduced biofuel production cost**

**COMSYN**

- **Motivation**
  - Compact and efficient process designs to enable reduced biofuels production costs via FT-synthesis
  - Identification of optimal process design for maximization of energetic efficiency
  - Approach: Different cases utilizing the FT-tailgas as energy provider in the gasification step
  - Detailed analysis of the influence of FT performance parameters on the overall process concept

**Basic process conditions**

- **Biomass input**:
  - 40 t/h
  - Moisture content: 50 wt.-%
  - LHV: 8.73 MJ/kg
  - Total energy input: 97 MW

- **FT operating conditions**:
  - **Autothermal reforming with air**
    - Operating at 5 bar
    - 80 % CO₂ is absorbed
  - **Allothermal reforming**
    - Required heat is provided by an additional burner
    - No air is led into the reformer

**Results**

<table>
<thead>
<tr>
<th>Case</th>
<th>Power consumption MWₑ</th>
<th>FT-product t/h</th>
<th>Energy flows MWₑ</th>
<th>Fuel MWₑ</th>
<th>Unused FT-tailgas MWₑ</th>
<th>Excess heat (&gt;400 °C) MWₑ</th>
<th>Efficiencies BtL HLV-based %</th>
<th>Fuel + FT-tailgas %</th>
<th>incl. excess heat %</th>
<th>Carbon usage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>8.1</td>
<td>2.6</td>
<td>31.9</td>
<td>33.3</td>
<td>20.4</td>
<td>81.4</td>
<td>30.2</td>
<td>62.0</td>
<td>81.4</td>
<td>21.0</td>
</tr>
<tr>
<td>Case 2</td>
<td>7.4</td>
<td>2.7</td>
<td>32.6</td>
<td>33.6</td>
<td>19.3</td>
<td>81.9</td>
<td>31.2</td>
<td>63.4</td>
<td>81.9</td>
<td>21.3</td>
</tr>
<tr>
<td>Case 3</td>
<td>7.1</td>
<td>3.1</td>
<td>38.3</td>
<td>22.2</td>
<td>22.7</td>
<td>79.9</td>
<td>36.8</td>
<td>58.1</td>
<td>79.9</td>
<td>25.0</td>
</tr>
</tbody>
</table>

**Outlook**

- Allothermal reforming allows the FT synthesis to work less effective and still achieve the same maximum BtL-efficiency as case 2

**Acknowledgments**

1) www.comsynproject.eu

**Summary**

- The effect of the FT performance parameters on the overall process of three different once-through process designs has been analyzed
- Decreasing the amount of inerts throughout the process allows high BtL efficiencies at moderate FT performance parameters

**Exemplary results: Influence of FT performance parameters**

**Case 1**

- CO conversion: 74.6 %
- FT-product: 20 bar, 20 °C
- Chain growth rate: 0.81
- C₅+ (LHVₚ = 44 MJ/kg)

**Case 2**

- CO conversion: 73.5 %
- FT-product: 20 bar, 20 °C
- Chain growth rate: 0.81
- C₅+ (LHVₚ = 44 MJ/kg)

**Case 3**

- CO conversion: 72.4 %
- FT-product: 20 bar, 20 °C
- Chain growth rate: 0.81
- C₅+ (LHVₚ = 44 MJ/kg)

The red line in Figure 1-A indicates how much energy the FT-tailgas needs to contain to provide the required amount of heat in the DFB.

**Outlook**

- Further information in the industry session: ‘An industrial approach to thermochemical biomass conversion’ (Session code: ICO.8)

**Acknowledgments**

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