Hydrothermal Liquefaction and Product Characterization of Barley Straw in Sub- and Super Critical Water
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Publication date:
2013

Document Version
Publisher's PDF, also known as Version of record

Link to publication from Aalborg University

Citation for published version (APA):
INTRODUCTION

With the rapid development of global economy and the continuous increase of the population, the demand and consumption of energy has been increasing. Biofuels are renewable liquid transportation fuels, which can be obtained by hydrothermal liquefaction (HTL).

HTL is a wet thermal conversion process that performed under relatively mild reaction conditions (temperature less than 400 °C, pressure between 10 and 25 MPa), often in the presence of catalysts and sometimes with reducing gases such as CO and H₂.

Energy-consuming drying process is avoided in this process. In addition, better quality bio-oil with low oxygen content and consequently a higher heating value can be produced under carefully control of operation conditions.

OBJECTIVE

- Investigate the effect of final reaction temperature on product distribution and yield.
- Characterize HTL bio-oils and solid residues obtained from different temperatures in order to have a better understanding of the reaction process.
- Evaluate the elemental content and distribution and energy recovery in these products.

MATERIALS AND METHODS

The Characteristic of Barley Straw

<table>
<thead>
<tr>
<th>C (wt%)</th>
<th>H (wt%)</th>
<th>N (wt%)</th>
<th>S (wt%)</th>
<th>O (wt%)</th>
<th>C/H</th>
<th>O/C</th>
<th>Water Content (wt%)</th>
<th>HHV (MJ/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>44.66</td>
<td>6.34</td>
<td>0.46</td>
<td>0.57</td>
<td>47.97</td>
<td>1.70</td>
<td>0.81</td>
<td>6.21</td>
<td>17.38</td>
</tr>
</tbody>
</table>

RESULTS AND DISCUSSION

Bio-oil yield increased slightly from 280 °C to 300 °C and peaked at 300 °C (35.24 wt%) and then declined as the temperature increased further, while the yield of solid residues showed the opposite trend.

High conversion of straw between 87.13 and 91.97 wt% could be reached under tested conditions.

CONCLUSIONS

- HTL of barley straw is an effective method to produce liquid fuels, which has the potential to be used as renewable fuels and a source of chemical materials.
- Both yield and characteristics of products (bio-oil and solid residues) were strongly dependent on final reaction temperature.
- A maximum bio-oil yield of 35.25 wt% of dry feedstock with 75.51% of carbon plus hydrogen content, representing 55.33% of the energy recovery of the feedstock was obtained at temperature of 300 °C.

FUTURE WORK

- Carry out high resolution parametric study (heating rate, amount and type of catalyst, reaction time, DM content) to study effect on the product yield and properties.