Depolymerization of fractionated wood by hydrothermal liquefaction

Felipe Buendia-Kandia  
CNRS, University of Lorraine, France, andres-felipe.buendia-kandia@univ-lorraine.fr

Nicolas BROSSE  
Wood Materials Research Laboratory (LERMAB), Sciences and Technologies Faculty, University of Lorraine, France

Guillain MAUVIEL  
Reactions and Chemical Engineering Laboratory (LRGP), CNRS, University of Lorraine, France

Anthony DUFOUR  
Reactions and Chemical Engineering Laboratory (LRGP), CNRS, University of Lorraine, France

Follow this and additional works at: https://dc.engconfintl.org/pyroliq_2019

Part of the Engineering Commons

Recommended Citation
Hydrothermal liquefaction of fractionated wood

Felipe BUENDIA-KANDIA, Bing SONG, Nicolas BROSSE, Guillain MAUVIEL, Yun YU, Hongwei WU, Anthony DUFOUR

CNRS - University of Lorraine
Laboratory of Reactions and Processes Engineering (LRGP)
Nancy, France
Hydrothermal liquefaction of cellulosic pulps

1. Liquefaction of pure cellulose (operating conditions)
2. Fractionation of beech wood and then hydrothermal liquefaction of the cellulosic pulp
   - Batch reactor
   - Semi-continuous reactor
Hydrothermal Liquefaction (Batch)

Fractioning:
- Organosolv (EtOH/H₂O)
  180°C, 1h, H₂SO₄
- S. Chlorite/A. Acid
  70°C, 6h (glass reactor)
Solid = Cellulosic pulp, Liquid = lignin rich

Sampling every 20 min

Analytical methods

**Gas products**
- Permanent gases
  - \( \mu \text{GC-TCD} \)

**Soluble products**
- Composition Screening
  - SEC-ELSD/MS
- Carbohydrates/Volatiles
  - Total carbohydrates
  - HPAEC-PAD
  - LC-LTQ-Orbitrap-MS
- Organic acids
  - HPLC-UV-RID

**Solid residue**
- Structure
  - DRX
Analysis of carbohydrates by HPAEC-PAD

RESULTS

RESULTS

Beech wood fractionation

Composition of the solid fraction showing cellulose, hemicellulose and lignin content

Delignification yields
Organosolv = 50.4 wt.%
Chlorite/acid = 91.3 wt.%

Cellulose recovery
Organosolv = 62.3 wt.%
Chlorite/acid = 67.2 wt.%

Hydrothermal liquefaction of pulps

**Sugar yield**

Total carbohydrates and sugar quantification by HPAEC-PAD after 2 h of reaction

Best case at 220°C:
- Avicel = 40.7 %
- Beech = 6.1 %
- Organosolv = 17.3 %
- SC/AA = 36.8 %

RESULTS

From wood to sugars

RESULTS

Raw Beech Batch Liquefaction

Organosolv Pulp Batch Liquefaction

SC/AA Pulp Batch Liquefaction

RESULTS

Semi-continuous liquefaction

Yields of sugar recovery (relative to the initial sugar content)

Conclusion

Fractionation:

Delignification yields of 50.4 and 91.3 % were achieved by Organosolv and SC/AA treatments.

Batch liquefaction:

HCW: 180 – 220°C
>220°C

Cellulose — Sugars — Degradation compound

Organosolv and SC/AA liquefaction pulps increased the total sugar yield relative to the raw beech wood, but yields are still low.

Semi-continuous liquefaction:

Around 95 wt.% of xylose and 80 wt.% of glucose can be recovered with temperatures around 250°C.
Thank you