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Hydrothermal liquefaction of cornstalk: 7-Lump distribution and characterization of products

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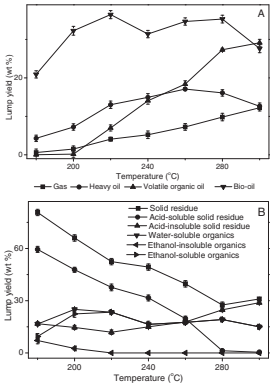
HIGHLIGHTS

- During Hydrothermal liquefaction of cornstalk, the polymerization reaction is mainly present at lower temperatures.
- The higher heating value of the solid residue obtained after treatment at 300 °C was 24.2 MJ/kg.
- Ethanol-insoluble organics originated from the decomposition of hemicelluloses.

GRAPHICAL ABSTRACT



Effect of temperature on product yields of (A) gas, heavy oil, volatile organic compounds, and bio-oil; (B) solid residue, acid-soluble solid residue, acid-insoluble solid residue, water-soluble organics, ethanol-insoluble organics, and ethanol-soluble organics (conditions: reaction time of 0 min, 10 g of cornstalk, 100 ml of water).

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ABSTRACT

Hydrothermal liquefaction of cornstalk at 180–300 °C at ratios of water to cornstalk of 6–14 was conducted, and the reaction products were lumped into gas, water-soluble organics (ethanol-insoluble and ethanol-soluble organics), heavy oil, volatile organic compounds, and acid-soluble and acid-insoluble solid residues. Low temperature, high ratio of water to cornstalk, and short reaction time favored the formation of bio-oil (ethanol-insoluble organics, ethanol-soluble organics, and heavy oil) but inhibited the formation of acid-insoluble solid residue. Increasing temperature and reaction time increased the yields of gas and volatile organic compounds, whereas decreased the yield of acid-soluble solid residue. Bio-oil yields increased first and then decreased at a ratio of water to cornstalk higher than 10. Overall, the studied reaction parameters influenced the conversion among the lumps and product properties. This study suggests that lump analysis provides a promising approach to describe the product distributions in biomass liquefaction.

1. Introduction

Thermo-chemical conversion processes (pyrolysis and liquefaction) are effective methods to convert biomass such as wood, forestry residues, and agricultural residues into products which are

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