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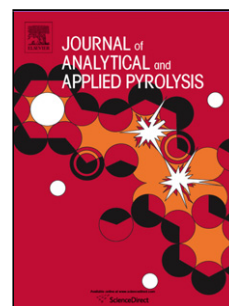
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Preparation of multipurpose bio-oil from rice husk by pyrolysis and fractional condensation

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Highlights

- Pyrolysis and condensation of biomass were mutually coupled.
- Pyrolysis temperature significantly affected the liquid yield and composition.
- High condensation temperature was suitable for the enrichment of phenols.
- A critical condensation temperature was suggested for water content control.
- Multipurpose bio-oils were obtained in fractional condensers.

Abstract

A set of fixed-bed biomass pyrolysis reactor incorporated with three-stage condensation columns was constructed in this study, and the effects of pyrolysis temperature, carrier gas flow rate and condensation temperature on biomass pyrolysis products were discussed systematically. Results show that as the pyrolysis temperature increased, the yield of liquid products initially increased with a maximum yield at 550 °C and then decreased. When the temperatures of the three-stage condensers were 110 °C, 0 °C, and -196 °C, the highest yields of bio-oil in each condenser were accordingly obtained at 550 °C, 450 °C, and 500 °C, respectively. Carrier gas flow rate and fractional condensation temperature indicated minimal influence on the total yield of liquid products. However, fractional condensation temperature had an obvious effect on the yields of the fractions. Gas chromatography/mass spectrometry revealed that the first fraction contained abundant phenolic compounds, the second fraction contained medium-boiling compounds with relatively high concentrations of water, acids, and ketones and the last fraction contained a minimal amount of hydrocarbons and water. Furthermore, higher pyrolysis temperature resulted in a higher yield of phenol products, whereas higher condensation temperature led to a higher concentration of phenols and dehydrated carbohydrates.

Keywords: Multipurpose bio-oil, Fixed-bed reactor, Pyrolysis, Fractional condensation

1. Introduction

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