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Short Communication

Ultrasound-assisted production of biodiesel from soybean oil using Brønsted acidic ionic liquid as catalyst

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HIGHLIGHTS

- Brønsted acidic ionic liquid has better catalytic ability for transesterification.
- Ultrasound can effectively promote the transesterification reaction.
- Optimization of reaction parameters were carried out.

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ABSTRACT

Biodiesel production from soybean oil with methanol was performed in the presence of a Brønsted acidic ionic liquid-based catalyst under ultrasound irradiation. The influences of various parameters on the transesterification reaction, including the amount of catalyst, the molar ratio of methanol to oil, the temperature and the ultrasound power, were investigated. The optimal conditions were: methanol/oil molar ratio of 9:1, 1.0 wt.% catalyst in oil, ultrasound power of 200 W, and reaction temperature of 60 °C. Under these conditions, the conversion of triglycerides to fatty acid methyl esters was about 93.2% within the reaction time of 60 min.

1. Introduction

Biodiesel has attracted increasing interest and has proved to be a good substitute for traditional fossil-based fuels due to its environmental advantages and availability from renewable resources such as refined and waste vegetable oils. Several studies have shown that biodiesel is a better fuel than the fossil-derived diesel in terms of engine performance, emissions reduction, lubricity and environmental benefits (Meher et al., 2006).

Biodiesel can be produced by transesterification of triglycerides with methanol or ethanol, using an alkali or acid as catalyst, yielding straight-chain molecules of methyl or ethyl esters (Marchetti et al., 2007). Homogeneous inorganic acids such as sulfuric acid and alkali (KOH and NaOH) can act as the transesterification catalysts. However, these catalysts have some disadvantages; they are strongly corrosive and nonrenewable and may easily cause saponification of products and environmental pollution through wastewater or sludge discharging. To overcome these problems, heterogeneous catalysts have been reported, but most of them suffer from low activity, use of solvents, high temperature, long reaction time, moisture sensitivity of the catalyst, high cost and high toxicity, and saponification.

Ionic liquids (ILs) have been revealed as green reaction media owing to their negligible volatility, excellent thermal stability, remarkable solubility, and the variety of structures available. Many acid-catalyzed organic reactions based on ILs have been reported, among which esterifications are a hot topic (Alexandre, 2008).

For example, the chloroaluminate ionic liquid synthesized by Liang et al. has been applied to the synthesis of biodiesel from soybean oil (Liang et al., 2009). These authors reported that this catalyst was also efficient for transesterification. Likewise, Han et al. have used a Brønsted acidic ionic liquid containing an alkanesulfonic acid group to produce biodiesel from waste oils. The yield of fatty acid methyl esters was 93.5% under the optimized reaction conditions and the catalyst was recovered by distillation (Han et al., 2009). Wu et al. synthesized several water-stable Brønsted-acidic ionic liquids with alkane sulfonic acid group and studied their catalytic performance in the preparation of biodiesel from cottonseed oil. These ionic liquids exhibited good catalytic activities, especially, 1-(4-sulfonic acid) butylpyridinium hydrogen sulfate ionic liquid gave similar catalytic activity as concentrated

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