



Synthesis and characterization of bifunctional magnetic nano-catalyst from rice husk for production of biodiesel

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ARTICLE INFO

Article history:

Received 18 July 2020

Received in revised form 28 November 2020

Accepted 3 December 2020

Available online 7 December 2020

Keywords:

Magnetic

Rice husk

Bifunctional magnetic nanocatalyst

Used cooking oil

Transesterification

Biodiesel

ABSTRACT

In this work, bifunctional magnetic nano-catalyst was successfully derived from rice husk char doped with potassium oxide and nickel oxide by impregnation techniques, and their catalytic ability was tested via transesterification of used cooking oil (UCO). The catalyst was characterized by thermogravimetric analyzer (TGA), X-ray diffraction spectroscopy (XRD), Fourier-transform infrared spectroscopy (FTIR), Temperature programmed desorption (TPD), Brunauer–Emmett–Teller (BET), Scanning electron microscopy equipped with energy dispersive x-ray analyzer (FESEM-EDX), and Vibrating sampling magnetometer (VSM) for magnetic properties. The optimized nanomagnetic bifunctional catalyst (RHC/K₂O-20%/Ni-5%) had 3.014 mmol g⁻¹ & 4.485 mmol g⁻¹ of acidity and basicity, respectively, with the magnetic strength was recorded at 2.312 emu g⁻¹. For the catalytic evaluation, a maximum biodiesel yield of 98.2% was accomplished with 4 wt% of catalyst loading, 12:1 methanol to UCO molar ratio at 65 °C within 2 h of reaction time. The catalyst was reused for up to 5 reaction cycles and producing 70% of biodiesel at the last cycles. The fuel properties of optimized biodiesel were measured using Biodiesel - American Standard Testing Method (ASTM) D6751. Due to the magnetic properties of the catalyst, it was easily recovered by an external magnetic device and has the potential to improve the separation and purification processes.

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1. Introduction

Fossil fuel resources take millions of years to develop, an alternative and sustainable renewable fuel such as biodiesel has gained popularity due to simple preparation and low production cost (Ahmad et al., 2018). Beside, biodiesel has similar properties to conventional diesel fuel, which can be utilized directly without engine modifications. Biodiesel can be produced through the reaction between oil or fatty acid with an alcohol in the presence of a suitable catalyst (Pandit

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