Fuel 120 (2014) 195–201

Contents lists available at ScienceDirect

Fuel

journal homepage: www.elsevier.com/locate/fuel

Synthesis and characterization of CuO/C catalyst for the esterification of free fatty acid in rubber seed oil

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HIGHLIGHTS

- Catalyst CuO/C was prepared by a novel technique where activated carbon was introduced with nano-sol.
- The free fatty acid conversion was achieved up to 95% using 8 wt% catalysts.
- High catalytic activity was observed and activity was lost about 20% after four cycles uses.

ARTICLE INFO

Article history:
Received 2 October 2013
Received in revised form 9 December 2013
Accepted 10 December 2013
Available online 21 December 2013

Keywords:
Copper sol
Biodiesel
Esterification
Free fatty acids
Rubber seed oil

ABSTRACT

Plant oils or animal fats that contain high free fatty acid (FFA) are not preferred for base catalyzed biodiesel production. Pre-esterification is widely used to reduce the FFA content of the oil for avoiding saponification and associated purification cost. In the present study, carbon supported copper oxide (CuO/C) catalyst was prepared for the esterification of FFA in the rubber seed oil (RSO) which was extracted from the fresh seed by soxhlet extractor using hexane as a solvent. Copper nanoparticles were synthesized by sol–gel method and the nanoparticles were impregnated into the pore network of the carbon support. The copper impregnated activated carbon powder was calcined at 400 °C in a furnace for 6 h, leading to the formation of CuO/C. The catalyst was characterized by using Brunauer Emmett Teller, X-ray photoelectron spectroscopy, Energy-dispersive X-ray spectroscopy and Thermogravimetric analysis. Moreover, Hammett indicator method was used to determine the acidity of the catalyst. The effects of reaction temperature, methanol/FFA molar ratio, catalyst concentration on the FFA conversion were also studied. Based on the experimental results, methanol to FFA ratio of 10:1, catalyst dose 8 wt%, reaction time of 6 h and temperature 65 °C were found as the optimum for the esterification reaction. Therefore, the developed catalyst could be effectively used for the esterification of FFA in plant oil.

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0016-2361/$ - see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.fuel.2013.12.015