Carbohydrate-derived solid acid catalysts for biodiesel production from low-cost feedstocks: a review

ABSTRACT

Currently, most biodiesels are produced from virgin vegetable oils using a transesterification reaction. However, there are a number of other potential cheap sources for biodiesels, such as deep-frying oils/fats and palm fatty acid distillate (PFAD). PFAD is a lower-value by-product of the palm oil industry and is an economical source for biodiesel production. Due to the high cost of biodiesel production, the formulation of a new method to produce a cheaper biodiesel is imperative. Low-quality feedstocks (especially PFAD) using green and highly reusable catalysts have gained popularity due to their low production cost. High free fatty acids (HFFA) in the feedstock causes problems during the biodiesel production process, especially with the use of basic heterogeneous and homogenous catalysts. Recently, the effectiveness of a solid acid catalyst to catalyze biodiesel production from HFFA feedstock has caught the attention of researchers. This comprehensive article explores the use of low-quality feedstocks and carbon-based catalysts for the conversion of a waste refinery crude palm oil product which contains a high percentage of FFA. The production and characterization of carbohydrate-derived solid acid catalysts are discussed, including their physico-chemical property measurements. Techniques used for the synthesis of biodiesels are also included. In addition, transesterification process variables such as the oil/methanol molar ratio, catalyst concentration, reaction time, and temperature are investigated. The final part of the article contains the combustion, emissions, and performance of produced biodiesels. Finally, conclusions, including perspectives and future developments, are also presented. The aim of this article is to demonstrate the current state of the use of low-quality feedstocks and green heterogeneous solid acid catalysts for the use in biodiesel production.

Keyword: Palm fatty acid distillate; Carbohydrate-derived solid acid catalysts; Transesterification; Characterizations; Biodiesel production methods