Algae derived biodiesel using nanocatalytic transesterification process

Abstract

This work investigates the nanocatalytic biodiesel production from algae (Nannochloropsis sp.). The hydrothermal synthesis route was used in this study to produce nano Ca(OCH3)2 (calcium methoxide) as a model catalyst. The effect of the main reaction parameters i.e. catalyst dosage, temperatures under constant pressure, methanol molar ratio and reaction time on the yield of FAME (fatty acid methyl ester) were examined. Kinetic study of biodiesel synthesis from crude microalgae oil using nanocatalytic transesterification reaction was appraised. The results indicate that CH_3O^- species (a cluster of tiny plate-like architectures) in Ca(OCH3)2 catalyst, and acted as main active sites for transesterification process. In additional, Ca(OCH3)2 catalyst has excellent catalytic performance in production of biodiesel. The highest FAME yield of 99.0% was obtained over 3 wt.% of Ca(OCH3)2 catalyst loading at methanol to oil molar ratio of 30:1 and reaction time of 3 h at 80 °C. Moreover, the catalyst displays a good stability and reutilization. A satisfactory FAME yield of 96% was achieved after use for five consecutive cycles without significant deactivation. The activation energy (Ea) of the transesterification reaction of crude N. oculata oil with methanol over Ca(OCH3)2 nanocatalyst was obtained as 58.62 KJ mol^{-1}. The results revealed that the yield of methyl esters obtained from algae-based triglycerides was follows a pseudo first order mechanism for the forward reaction. These results suggest that the nanocatalyst is a promising for a green biodiesel production process from algae.