Feasibility of honeycomb monolith supported sugar catalyst to produce biodiesel from palm fatty acid distillate (PFAD)

Abstract

Carbon coated monolith was prepared by sucrose solution 65 wt.% via dip-coating method. Sulfonation of incomplete carbonized carbon coated monolith was carried out in order to synthesize solid acid catalyst. The textural structure characteristics of the solid acid catalyst demonstrated a low surface area and pore volume. Palm fatty acid distillate (PFAD), a by-product of palm oil refineries, was utilized as oil source in biodiesel production. The esterification reaction subjected to different reaction conditions was performed by using the sulfonated carbon coated monolith as heterogeneous catalyst. The sulfonation process had been performed by using vapour of concentrated H_2SO_4 that was much easier and efficient than liquid phase sulfonation. Total acidity value of carbon coated monolith was measured for unsulfonated sample (0.5 mmol/g) and sulfonated sample (4.2 mmol/g). The effect of methanol/oil ratio, catalyst amount and reaction time were examined. The maximum methyl ester content was 89% at the optimum condition, i.e. methanol/oil molar ratio (15:1), catalyst amount (2.5 wt.% with respect to PFAD), reaction time (240 min) and temperature 80 °C. The sugar catalyst supported on the honeycomb monolith showed comparable reactivity compared with the sugar catalyst powder. However, the catalyst reusability studies showed decrease in FFA% conversion from 95.3% to 68.8% after four cycles as well as the total acidity of catalyst dropped from the value 4.2 to 3.1 mmol/g during these cycles. This might be likely due to the leaching out of SO_3H group from the sulfonated carbon coated monolith surface. The leaching of active species reached a plateau state after fourth cycle.