

Palm kernel shell-derived biochar and catalyst for biodiesel production

ABSTRACT

A promising catalyst based on a biomass pyrolysis by-product, biochar, has been developed to produce biodiesel. A carbon-based solid acid catalysts were prepared by sulfonating pyrolysis char with concentrated sulfuric acids. The catalysts were characterized using thermogravimetric analyses (TGA), scanning electron microscope (SEM), Fourier transform infrared spectroscopy (FTIR) and surface area analyzer. Prepared catalysts were studied for their ability to catalyze transesterification of vegetable oils. The catalyst sulfonated with the concentrated sulfuric acid demonstrated considerable conversion in free fatty acid esterification. Further investigation of the catalyst was conducted to determine the effect of sulfonation time (1 and 3 hours) and surface area on the transesterification reactions. The surface area of the biochar was increased by chemical treatment using 10M potassium hydroxide through porosity development. Results showed the catalyst with the highest surface area and acid density to have the highest catalytic activity to produce biodiesel from canola oil in the presence of methanol as the reagent. The effects of alcohol to oil (A:O) molar ratio, reaction time and catalyst loading on the esterification reaction catalyzed by the sulfonated biochar were also investigated. Results revealed that more than 90% biodiesel yield was achieved at 15 wt% of catalyst amount, methanol to oil molar ratio was 9:1 and the agitation rate was 700 rpm. As a conclusion, the prepared biochar-based catalyst has a tremendous potential to be used in a process converting a high Free Fatty Acids (FFA) feedstock to biodiesel.

Keyword: Transesterification; Vegetable oil; Palm kernel shell; Biochar-based catalyst