Palm oil-based biodiesel synthesis by radiation-induced kenaf catalyst packed in a continuous flow system

ABSTRACT

An efficient bio-based heterogeneous catalyst for biodiesel production was successfully fabricated by radiation-induced graft polymerization of 4-vinylbenzylchloride (VBC) followed by quaternary amination of trimethylamine (TMA) and ion-exchange with aqueous sodium hydroxide onto kenaf bast fiber using electron beam irradiation at a dose of 150 kGy. The produced catalyst was characterized by FESEM–EDX, CHNS, ATR-FTIR, TGA and XRD analyses. In this study, the continuous catalytic transesterification of triolein/ethanol in a bench-scale packed bed reactor (PBR) was designed and tested. The reaction process was focused at room temperature, different residence times from 1 min to 4 min and a molar ratio of triolein/ethanol (1:50). Besides, study on the transesterification of palm oil with ethanol under optimized conditions for maximum conversion of triolein to ethyl oleate (residence time of 3 min, LHSV = 8 h−1, short chain 150kGy catalyst) with temperature fixed at room temperature (˜25 °C) has been carried out. The extracted ethyl oleate was analyzed by HPLC and ATR-FTIR. The results found that the continuous flow system has a great potential for producing ethyl ester to be used as biodiesel and it is possible to generate 100% biodiesel with high purity from palm oil using radiation-induced kenaf catalyst.

Keyword: Bio-based heterogeneous catalyst; Kenaf fiber; Biodiesel; Radiation-induced graft polymerization; Fatty acid ethyl ester; Continuous flow system