CONVERSION OF GLYCEROL TO GLYCEROL CARBONATE USING HETEROGENEOUS BASE CATALYST DERIVED FROM OIL PALM KERNEL SHELL BIOCHAR (OPKSB)

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ABSTRACT

The surplus of crude glycerol (GL) has led to a decrease in its price and poses challenges for its disposal. To promote the development of the biodiesel (BD) industry, it has become focus of the researchers to convert GL into value-added chemicals. Glycerol carbonate (GC) is one of the value-added compounds that can be synthesized by the transesterification of GL. This study was conducted to utilize the waste of by-products from both the oil palm industry as well as the biodiesel industry for industrial purposes. The synthesis of GC through transesterification of GL and dimethyl carbonate (DMC) catalyzed by treated oil palm kernel shell biochar (OPKSB) with 20% potassium hydroxide (KOH) at 400°C, 500°C, 600°C, 700°C, and 800°C calcinations temperature has been studied. The chemical composition of untreated and treated OPKSB along with the final product obtained through transesterification reaction have been analyzed using ATR-FTIR. Scanning electron microscopy (SEM) was utilized to investigate the morphology, size, and clustering of the catalyst particles. Furthermore, Energy-dispersive X-ray (EDX) analysis was employed to ascertain the inorganic elemental compositions of both treated and untreated biochar. The prepared catalyst calcined at 700°C (OPKSB-700) shows the best performance with 54.51% potassium (K) weight obtained from EDX analysis before undergoing the reaction indicating a higher basic site for catalytic activity for transesterification reaction. OPKSB-700 displayed a very porous surface morphology with a rod-like structure on the biochar surface observed at 3000x magnification using SEM. Not to mention, all the catalysts can catalyze transesterification reactions; under reaction temperature of 110°C, reaction time of 90 min, GL: DMC molar ratio of 1:3 and 3% of catalyst loading, based on FTIR results. The appearance of the peak at 1770 cm^{-1} and a broad peak at 3300 cm^{-1} which correspond to C=O and O-H groups respectively, signifies the success of the transesterification reaction, into the desired product. Qualitative analysis using thin layer chromatography (TLC) showed GC spot clearly observed for all of the sample (reaction), indicated that GL have completely converted to GC. The results of TLC showed that, calcination pre-treatment has significantly provide sufficient actives site and catalytic surface, thus promoting towards increase of the catalytic activity in the transesterification reaction. The current study has opened a broad understanding towards application of biochar as potential catalyst in organic reaction.

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