(96)

Green Synthesis of Biolubricant from Palm Oil Biodiesel

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Abstract

Lubricants are the substances used to lubricate machinery parts to reduce friction and increase their lifetimes. Producing environment-friendly lubricants from renewable feed stocks as alternatives to depleting petroleum based resources has attracted considerable attention in recent years. The lubricants prepared from renewable feed stocks exhibited excellent lubricating properties and nontoxicity. The present study was carried out to synthesise biolubricant base stock from palm oil biodiesel using a green approach. Synthesis of biodiesel and biolubricants using green approaches have attracted much attention in last decade. Synthesis is mainly based on three steps: firstly, the synthesis of palm oil biodiesel, then epoxidation of biodiesel and finally ring-opening of epoxide to yield the potential biolubricant. The trans-esterification reaction was performed to yield biodiesel from palm oil using methanol and NaOH as a catalyst. The modification of biodiesel in to epoxidised form was carried out using glacial acetic acid, H_2O_2 and amberlite IR-120H resin as a catalyst. The ring opening of epoxidised biodiesel was performed using 1-naphthol in the presence of magnesium silicate catalyst, which was synthesise using rice hull ash. However, the expected ring opening product was not observed. Then, epoxidised biodiesel was reacted with lauric acid in the absence of magnesium silicate and the expected product was formed. The prepared magnesium silicate catalyst was characterised by X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM). Fourier Transform Infra-Red (FTIR) spectroscopy and GC-MS analysis were used to characterise the products. Both GC-MS and FTIR results indicates the formation of fatty acid methyl esters and their conversion to epoxidised form. Disappearance of epoxy characteristic band which appeared at 845 cm^{-1} in FTIR spectrum confirms the formation of potential biolubricant. Density and viscosity of potential biolubricant were measured in contrast to the biodiesel. The measured density values of biodiesel and biolubricant are 0.830 g/cm^3, 0.937 g/cm^3 respectively. The measured kinematic viscosity values of biodiesel and biolubricant at 40° C are 4.0932 cSt, 14.9087 cSt and at 100° C are 1.6009 cSt, 3.5539 cSt respectively. These results illustrate that synthesised biolubricant consist of better lubricant properties compared to the biodiesel.

Keywords: Biolubricants, Green approach, Biodiesel