SYNTHESIS OF NiMo-NH_2/MESOPOROUS SILICA CATALYST FOR THE CONVERSION OF USED COCONUT OIL INTO BIOFUEL

Savitri Larasati
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ABSTRACT

Arranging two metals in bimetallic system was reported to be effective in improving the catalytic activity and selectivity of each metal. In this work, bimetal comprising of Nickel (Ni) and Molybdenum (Mo) supported on Mesoporous Silica was used as a catalyst in the hydrotreatment process of used coconut oil. Amine group was grafted to the catalyst as a modification in order to improve the catalyst selectivity towards Free Fatty Acid (FFA).

Catalyst was prepared through two steps processes, consisting wet impregnation and grafting method. The silica in this work was extracted from Lapindo mud through acidic and basic reflux. It was then built into a mesoporous material using CTAB as templating agent. The pore of mesoporous silica was loaded with Ni and Mo metals through a wet impregnation process that was followed by reduction under the flow of H_2. Amine group was added through grafting method using APTMS in toluene as solvent. The catalyst obtained was characterized by using Surface Area Analyzer (SAA), X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF), Atomic Absorption Spectroscopy (AAS), Scanning Electron Microscopy (SEM), and Transmission Electron Microscopy (TEM). The product of liquid fraction from the conversion process was analyzed by using gravimetric method and Gas Chromatography-Mass Spectrometry (GC-MS).

During hydrotreatment process, it was found that bimetal catalyst (NiMo/MSN) that has the surface area and acidity value of 873.89 $m^2\ g^{-1}$ and 6.81 mmol g^{-1}, respectively, comprising 0.92% of Ni : 1.03% of Mo generated the highest conversion of liquid product compared to the corresponding monometal with over 82.4%. However, the content of FFA in the liquid product generated from the catalyst was still quite high (22.4%). Adding amine group to the bimetallic catalyst (NiMo-NH_2/MSN) decreased the surface area and total acidity value into 325.13 $m^2\ g^{-1}$ and 4.46 mmol g^{-1}, respectively. This modification successfully improved the selectivity towards FFA by decreasing its generation in the liquid product to 8.9%. Therefore, the amount of liquid hydrocarbon product that was obtained during the hydrotreatment of used coconut oil using NiMo-NH_2/MSN (65.60%) was greater than the amount of liquid hydrocarbon obtained from the conversion using NiMo/MSN (58.06%).

Keywords: bifunctional catalyst, biofuel, bimetal, mesoporous silica