ABSTRACT

The continued global reliance on fossil fuels has driven the development of more sustainable and environmentally friendly renewable fuels. One promising alternative is biomass-based biojet fuel derived from coconut oil, which is rich in medium- and long-chain triglycerides. The conversion of coconut oil into jet fuel-range hydrocarbons (C_8–C_{16}) can be achieved through catalytic hydrocracking, a process strongly influenced by catalyst properties, particularly the composition of active metals, acidity, and support characteristics. This study aimed to synthesize Ni–Mo–S/SiO_2 catalysts supported on mesoporous silica derived from rice husk ash with varying Ni:Mo ratios and to evaluate their physicochemical properties and catalytic performance in the hydrocracking of coconut oil. The hypothesis of this study was that increasing the Ni:Mo ratio would enhance biojet fuel selectivity by promoting hydrogenation and hydrodeoxygenation activities, thereby facilitating the conversion of oxygenated compounds into paraffinic hydrocarbons within the C_8–C_{16} carbon range.

Mesoporous silica was synthesized from rice husk ash using cetyltrimethylammonium bromide (CTAB) via a sol–gel method followed by hydrothermal treatment. The extracted silica contained 53.6% SiO_2. Ni–Mo–S/SiO_2 catalysts were prepared by impregnation using Ni:Mo molar ratios of 1:1, 2:1, and 3:1, designated as NiMo1, NiMo2, and NiMo3, respectively, followed by calcination, reduction, and sulfidation. Characterization was performed using X-ray fluorescence (XRF), X-ray diffraction (XRD), Fourier-transform infrared spectroscopy (FTIR), Brunauer–Emmett–Teller surface area analysis (BET), ammonia acidity measurements, and gas chromatography–mass spectrometry (GC–MS).

XRD analysis indicated the presence of amorphous SiO_2 and phases associated with MoS_2 and NiS, while FTIR confirmed the characteristic Si–O–Si and Si–OH groups of silica. The acidity values of NiMo1, NiMo2, and NiMo3 were 6.3645, 7.2308, and 6.3645 mmol NH_3 g^{-1}, respectively. BET analysis showed surface areas of 149.09, 137.27, and 144.48 m^2 g^{-1}, with average pore diameters of approximately 6.5 nm, indicating that the mesoporous structure was maintained across all metal ratios. Catalytic performance tests revealed that NiMo3 exhibited the highest selectivity toward the biojet fuel fraction (C_8–C_{16}), reaching 96.04%, with the lowest oxygenate content of 73.56%, whereas the highest catalytic activity, based on liquid product yield, was achieved by NiMo2 at 32%.

Keywords: *Biojet fuel, Hydrocracking, Ni:Mo ratio, Mesoporous silica, Coconut oil.*