ABSTRACT

The increasing consumption of aviation turbine fuel and its negative environmental impacts have driven the development of eco-friendly energy alternatives, such as bio-jet fuel. Coconut oil represents a potential feedstock for conversion into bio-jet fuel due to its compliant fatty acid composition with the jet fuel fraction and its abundant supply in Indonesia. Bio-jet fuel is typically produced via hydrocracking reactions utilizing heterogeneous Ni and Mo catalysts supported on mesoporous silica. This study evaluates the effect of the CTAB-to-silica mass ratio in the synthesis of mesoporous silica as a support for sulfided Ni-Mo catalysts, as well as the resulting characteristics, catalytic activity, and product selectivity. Mesoporous silica was synthesized via the sol-gel method with varying CTAB-to-silica mass ratios of 1:2, 1:4, and 1:8 to determine the optimum conditions that significantly influence its structural characteristics, including specific surface area, pore diameter, and pore volume. Subsequently, the sulfided Ni-Mo catalysts were prepared using the wet impregnation method. Catalyst characterization was performed using XRF, FTIR, GSA, and XRD instrumentation. The catalytic performance was evaluated through acidity testing, hydrocracking activity assays, and product selectivity analysis using GC-MS. The results showed that the sulfided Ni–Mo catalyst supported on mesoporous silica synthesized with a CTAB-to-silica mass ratio of 1:4 exhibited the highest specific surface area (408 $m^2\ g^{-1}$), pore volume (0.39 $cm^3\ g^{-1}$), average pore diameter (3.89 nm), uniform pore size distribution, and acidity (5.40 mmol g^{-1}). However, the sulfided Ni–Mo catalyst prepared with a CTAB-to-silica mass ratio of 1:2 achieved the highest hydrocracking activity (49.42%) and selectivity (95.51%) toward the C8–C16 biojet fuel fraction among the catalyst variations investigated. Meanwhile, the highest-quality biojet fuel fraction was obtained using the KG-14 catalyst, with paraffinic, olefinic, and aromatic hydrocarbons accounting for 45.79% of the product composition. Overall, the hydrocracking process over sulfided Ni–Mo catalysts proceeded effectively, exhibiting high selectivity toward the desired biojet fuel fraction.

Keywords: *Biojet fuel, coconut oil, hydrocracking, sulfided Ni-Mo catalyst, mesoporous silica, rice husk ash, reflux.*

Semarang, 22 Juni 2026

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