Hydroprocessing of rubber seed oil over Ni-Mo/γ-Al2O3 for the green diesel production

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Abstract

Hydrodeoxygenation is most considered route for up-gradation of biodiesel and triglycerides towards direct conversion into diesel range hydrocarbon (green diesel). Heterogeneous (Ni-Mo/γ-Al2O3 catalysts) catalysis offers more promising routes for transformation of biomass into value added bio-chemicals more likely selective hydrocarbons in a resourceful approach. In this study, the Ni-Mo/γ-Al2O3 type catalysts were investigated for the hydrodeoxygenation of rubber seed oil for the diesel range hydrocarbons (n-C15-n-C18). Monometallic solid acid catalysts (Ni/γ-Al2O3) and bimetallic (Ni-Mo/γ-Al2O3) catalysts were tested for HDO reaction at 340 °C, 21 bar, H2/oil ratio 150 Nm³/m³ using 5 g, WHSV = 10 h⁻¹ for 5 h time on stream in tubular fixed bed reactor (pilot scale). Among the sonochemically synthesized catalysts, 3 wt. % Ni/γ-Al2O3 showed the higher catalytic activity up to 15.4 wt. % and bimetallic Ni-Mo/γ-Al2O3 was perceived to be more active with 15.35 wt.% diesel range (C15-C18) hydrocarbons from rubber seed oil. The selectivity for n-C15-n-C18 hydrocarbons were determined as C15 (7.14 %), C16 (7.16 %), C17 (0.42%) and C18 (0.78%) among the liquid alkanes. The product distribution revealed that the reaction proceeded mainly with decarboxylation (DCO₂) and decarbonylation (DCO) with high C15/C16 ratio. The results from hydrodeoxygenation of rubber seed oil showed an innovative reaction path for the production of diesel range hydrocarbons. The monometalic 3 wt.% Ni/Al2O3 and 15 wt.% Ni/Al2O3 synthesized via conventional method showed lower triglycerides conversion with 63 wt.% and 70 wt.% respectively. All the sonochemically synthesized catalysts revealed complete conversion of triglycerides (99 wt.%) into other paraffin, olefins and oxygenates and showed better activity even at low operational parameters for hydrodeoxygenation of triglycerides present in rubber seed oil.