Biodiesel production from crude Jatropha Curcas oil using calcium based mixed oxide catalysts

Abstract

Calcium-based, CaO–NiO (calcium nickel) and CaO–Nd2O3 (calcium neodymium) mixed oxides, were synthesized via co-precipitation process. Non-edible crude Jatropha curcus oil (JCO) was used as feedstocks for fatty acid methyl esters (FAME) synthesis in the presence of CaO–NiO and CaO–Nd2O3 mixed oxides. It was found that mixed solid bases oxides depicted high basicity and stability. Temperature programmed desorption of CO2 (CO2-TPD) confirmed that both strong and strongest basic sites existed on the surface of CaO–NiO and CaO–Nd2O3 catalysts, respectively. Both mixed oxide catalysts also demonstrated high thermal stability, since X-ray diffraction (XRD) proved that the crystalline phases present in both mixed oxide catalysts preserved well as pure oxide even up to 900 °C. The FAME yield produced by CaO–NiO and CaO–Nd2O3 catalysts were studied and compared with calcium oxide (CaO), nickel oxide (NiO), and neodymium oxide (Nd2O3) catalysts. Both CaO–NiO and CaO–Nd2O3 catalysts exhibited high activity as CaO and were easily separated from the product. CaO–NiO catalyst was found more active than CaO–Nd2O3 during the transesterification reaction. The optimal reaction parameters for achieving the >80% of FAME yield were methanol/oil molar ratio 15:1, catalyst amount 5 wt.% and reaction temperature 65 °C. Reusability study suggests that catalysts could be recycled for six successive runs without significant loss in activity. As a result, these new solid base mixed catalysts showed remarkable activity and durability in the synthesis of fatty acid methyl esters from crude JCO. Hence, the mixed oxides catalyst might be a valuable heterogeneous catalyst for FAME production.

Keyword: Calcium-based mixed oxide; High stability; Jatropha curcas; Solid base; Transesterification