Effects of calcination temperatures of CaO/Nb2O5 mixed oxides catalysts on biodiesel production

Abstract

Calcination temperature greatly influences the total basicity and surface area of catalysts. Investigations were conducted on calcium and niobium (CaO-Nb2O5) mixed oxides catalysts prepared via conventional solid state method (oxides were mixed and ground in agate mortar) and calcined at different temperatures ranging from 300-800oC for 5 h. The catalysts were then characterized by using X-ray diffraction (XRD), CO2 temperature-programmed desorption (TPD-CO2), Brunauer-Emmett-Teller (BET) surface area analyzer and scanning electron microscope (SEM). The formation of Ca(OH)2 and CaCO3 at lower calcination temperatures (< 600oC) reduced the surface area of the catalyst and masked the basic active sites, hence lowered the total basicity of the catalyst. Besides, low surface area and total basicity were observed at higher calcination temperatures (> 600oC), due to sintering of the fine crystals, which promotes cluster agglomeration. Thus, the optimum calcination temperature for CaO/Nb2O5 mixed oxides was 600oC, which produced the largest surface area (7 m2/g) and total basicity (1301 μmol/g). The biodiesel was produced via transesterification of palm oil, methanol and the catalysts calcined at various temperatures. CaO/Nb2O5 mixed oxide calcined at 600oC showed the highest biodiesel conversion (98%) with methanol/oil molar ratio of 12, 3 wt.% of catalyst, a reaction temperature of 65oC and reaction time of 2 h.

Keyword: Biodiesel; Calcium oxide; Niobium oxide; Palm oil; Transesterification