Synthesis of waste cooking oil based biodiesel via ferric-manganese promoted molybdenum oxide / zirconia nanoparticle solid acid catalyst: influence of ferric and manganese dopants

ABSTRACT

The utilization of ferric-manganese promoted molybdenum oxide/zirconia (Fe-Mn-MoO3/ZrO2) (FMMZ) solid acid catalyst for production of biodiesel was demonstrated. FMMZ is produced through impregnation reaction followed by calcination at 600°C for 3 h. The characterization of FMMZ had been done using X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), thermal gravimetric analysis (TGA), temperature programmed desorption of NH3 (TPD-NH3), transmission electron microscopy(TEM) and Brunner-Emmett-Teller (BET) surface area measurement. The effect of waste cooking oil methyl esters (WCOME's) yield on the reactions variables such as reaction temperature, catalyst loading, molar ratio of methanol/oil and reusability were also assessed. The catalyst was used to convert the waste cooking oil into corresponding methyl esters (95.6%±0.15) within 5 h at 200℃ reaction temperature, 600 rpm stirring speed, 1:25 molar ratio of oil to alcohol and 4% w/w catalyst loading. The reported catalyst was successfully recycled in six connective experiments without loss in activity. Moreover, the fuel properties of WCOME's were also reported using ASTM D 6751 methods.

Keyword: Ferric-manganese promoted molybdenum oxide/zirconia (FMMZ); Waste cooking oil methyl esters (WCOMEs); Crystallite size; Debye-Scherrer’s relationship