Comparative study of the methanolysis and ethanolysis of maize oils using alkaline catalysts

ABSTRACT

With an increasing population and economic development, fuel from renewable resources needs to be widely explored in order to fulfill the future energy demand. In the present study, biodiesel from maize oil using transesterification reactions with methanol and ethanol was evaluated in the presence of NaOCH3, KOCH3, NaOCH2CH3, KOCH2CH3, NaOH and KOH as catalysts. The influence of reaction variables such as the alcohol to oil molar ratio (3:1-15:1), catalyst concentration (0.25-1.50%) and reaction time (20-120 min) to achieve the maximum yield was determined at fixed reaction temperatures. The optimized variables in the case of methanolysis were 6:1 methanol to oil molar ratio (mol/ mol), 0.75% sodium methoxide concentration (wt%) and 90 min reaction time at 65°C, which produced a yield of 97.1% methyl esters. A 9:1 ethanol to oil molar ratio (mol/mol), 1.00% sodium ethoxide concentration (wt%) and 120 min reaction time at 75°C were found to produce the maximum ethyl ester yield of up to 85%. The methanolysis of maize oil was depicted more rapidly as compared to the ethanolysis of maize oil. Gas chromatography of the produced biodiesel from maize oil showed high levels of linoleic acid (up to 50.89%) followed by oleic acid (up to 36.00%), palmitic acid (up to 9.98%), oleic acid (up to 1.80%) and linolenic acid (up to 0.98%). The obtained fatty acid esters were further analyzed by fourier transform infrared spectroscopy (FTIR) to ensure the completion of transesterification. The fuel properties of the produced biodiesels i.e. kinematic viscosity, cetane number, oxidative stability, pour point, cloud point, cold filter plugging point, ash content, flash point, acid value, sulfur content, higher heating value, density, methanol content, free glycerol and bound glycerol were determined. The analyses were performed using the FTIR method and the results were compared to the biodiesel standards ASTM and EN.

Keyword: Alkaline catalysts; Ethanolysis; Fuel properties; Maize seed oil; Methanolysis