Biodiesel Production from Crude Palm Oil with a High Content of Free Fatty Acids and Fuel Properties

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ABSTRACT

A technique to produce biodiesel from crude palm oil (CPO) having high free fatty acids (FFA) with acid value of 33.40 mg KOH/g has been developed. The high FFA level of CPO was reduced to less than 1 mg KOH/g by a two-step pretreatment process. The objective of this study was to optimize the parameters that affect transesterification of CPO to its corresponding fatty acid ethyl ester (FAEE). The first step was carried out with ethanol to oil mole ratio of 10:1 in the presence of 2% w/w $Fe2(SO_4)_3$ as a catalyst in 1 h reaction at 95°C. After the reaction, the mixture was allowed to settle for 2 h and the ethanol-water mixture separated at the top layer was removed. The second step was transesterified, using ethanol to oil mole ratio of 6:1 and 1% w/w KOH as alkaline catalyst to produce biodiesel at 65°C. The final yield for ethyl esters was achieved at 85% in 1 h. The physical properties of biodiesel were determined. It was found that kinematic viscosity at 40°C was 4.9 mm^2/s, specific gravity was 0.884, flash point was 182°C, cloud point was 18°C, water content was 0.101 and acid value was 0.3273 mg KOH/g oil, respectively.

Key words: Biodiesel, Ethyl Ester, Crude Palm Oil, Free Fatty Acids

INTRODUCTION

Due to the increase in crude oil prices and environmental concerns, a search for alternative fuels has gained recent significant attention. Among the different possible resources, diesel fuels derived from triglycerides of vegetable oils and animal fats have shown potential as substitutes for petroleum-based diesel fuels (Fukuda et al., 2001). Vegetable oils have become more attractive recently because of their environmental benefits. However, it is not competitive with petroleum fuel now because of its high viscosity and prices. The direct use of vegetable oils in a diesel engine can lead to a number of problems such as poor fuel atomization, poor cold engine start-up, oil ring stickening and the formation of gum and other deposits. Consequently, considerable efforts have been made to develop alternative diesel fuels that have the similar properties and performance as the petroleum-