UNIVERSITY OF NAIROBI

DEVELOPMENT OF SOLID CATALYST FOR TRANSESTERIFICATION OF CROTON MEGALOCARPUS HUTCH OIL IN BIODIESEL PRODUCTION AND BLENDING WITH KEROSENE

By

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Declaration

This is my original work and has not been presented for a degree in any other university:

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Dedication

To my parents who supported I, when I confronted setbacks encouraged me when I felt hesitant and depressed, and guided me when I could not make up my mind. It is their patience; unconditional love and support that helped me go through the difficult periods of my life journey, follow my interests and fulfill my dreams.

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ABSTRACT

The accelerating and frequently fluctuating price of conventional diesel, together with growing environmental concerns has sparked renewed attention on the search for alternative fuel. The awareness of the toxic effects related to the tailpipe emissions of vehicle has driven many countries to look for a less-polluted transportation fuel.

In this regard, biodiesel (alkyl esters) from vegetable oils or animal fats via transesterification is a catalyzed process and, traditionally, homogenous catalysts are employed. However, this type of catalyst is not able to be re-used and requires tedious washing and separating steps, hence, stimulating the conception of heterogeneous-catalyzed transesterification.

Despite the success of various heterogeneous catalysts, many are not viable for wide industrial usage as most of the catalysts are expensive and need additional preparation effort. Among them CaO seems to have a promising place and the increasing research on CaO is self-evidence of its capability in catalyzing the reaction.

Therefore, in this research CaO obtained from eggshell is employed as a catalyst in carrying out transesterification of Croton Megalocarpus Hutch oil and methanol. Methyl esters obtained were characterized by FT-IR and GC–MS and further tested for fuel properties with kerosene blend.

The results showed methyl hexadecanoate and methyl octadecanoate were common fatty acids esters both in CaO and KOH catalyzed reactions. Total unsaturation was highest for *Croton* ester with 68.0%. The esters viscosities at 40 °C were in the range of 4.16 - 4.63 mm^2/s. Croton Megalocarpus esters were found to be less volatile than kerosene fuel.

The density of the croton methyl ester was found to be higher than that of kerosene and automotive diesel. The heating value of the esters was lower compared to kerosene and diesel.

The esters of Croton Megalocarpus Hutch were further blended with kerosene in ranges of 5-10% on volume to volume ratio. Blend of 10% biodiesel in 90% kerosene demonstrated the most ideal properties with viscosity, density same as that of kerosene. The methyl esters were further tested in a multi-wick stove following standard water boiling test (WBT) and their performance in terms of time to boil, heat transfer efficiency, power output, specific fuel consumption CO, CO_2 and particulate matter emissions.

The esters burnt with odorless and non-pungent smell. Biodiesel blends took more time to boil and consumed more fuel by weight, than kerosene to boil 2.5 liters of water. Heat transfer efficiency for esters was lower than for kerosene during boiling phase while specific consumption for the esters was higher than kerosene. Biodiesel blends produced more particulate matter and CO_2 compared to kerosene, while CO was higher in kerosene than biodiesel blends.