UNIVERSITI PUTRA MALAYSIA

CHEMICAL ADDITIVES AS COLD FLOW IMPROVERS FOR PALM OIL AND JATROPHA OIL BIODIESEL

ODEIGAH, EDITH ANWUNLI

CHEMICAL ADDITIVES AS COLD FLOW IMPROVERS FOR PALM OIL AND JATROPHA OIL BIODIESEL

By

ODEIGAH, EDITH ANWUNLI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

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This work is dedicated to my mother
Mrs. Victoria C. Odeigah (R.I.P)

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

CHEMICAL ADDITIVES AS COLD FLOW IMPROVERS FOR PALM AND JATROPHA BIODIESEL

By

EDITH ANWUNLI ODEIGAH

November 2012

Chair: Rimfiel B. Janius, PhD

Faculty: Engineering

Palm oil and jatropha oil biodiesel are attractive renewable energy source, which could be used as a suitable substitutes for the non-renewable petroleum diesel. Biodiesel produced from these two sources are more environmentally friendly than petroleum diesel and could reduce a nation's dependence on crude oil imports. However, both biodiesel fuels exhibit very poor cold flow behavior causing engine start-up and fuel filter plugging problems in cold weather. Jatropha oil comparing to palm oil is a very promising source of biodiesel as it is non-edible and can grow in wasteland with very little nutrient requirement and has very high oil yield. Both are the two most widely used oil seeds for biodiesel production in Asia.

This study was conducted to evaluate the possibility of using hexane, ethanol, chloroform and kerosene as a cold flow improving component for jatropha and palm biodiesel. 1v/v%, 5v/v%, 10v/v%, 15v/v% and 20v/v% concentrations of these additives in palm and jatropha biodiesels were tested for their effects on the cold flow behavior of the biodiesel fuels as well as on other basic fuel properties such as viscosity, density, flash point and energy content. Performance tests of a Yanmar L48N model single cylinder 4-stroke compression-ignition engine running on palm and jatropha biodiesel containing these additives were then conducted.

Among the selected additives, chloroform was found to be the most effective in improving the cold flow behavior of the biodiesel fuels. At 10 v/v% additive concentration, the reduction in cloud point for palm and jatropha biodiesels were respectively 5^{o}C and 6^{o}C with chloroform, 4^{o}C and 5^{o}C with hexane, 4^{o}C and 4^{o}C with ethanol and 3^{o}C and 2^{o}C with kerosene. Kerosene and hexane resulted in good engine performance with about 6.36% and 5.01% increase in brake power at 10v/v%, while ethanol produced a 5.01% increase and chloroform produced a 3.87% decrease in engine brake power at the same concentration. However, overall, ethanol blends seemed to be the most favorable with a good balance between fuel analytical properties and engine performance. Cloud point and pour point were reasonably reduced with ethanol as additive and engine performance was also good because of its higher oxygen content.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk ijazah Master Sains

BAHAN TAMBAH KIMIA SEBAGAI PENAMBAHBAIK ALIRAN SEJUK BAGI BIODIESEL KELAPA SAWIT DAN JATROPHA

Oleh

EDITH ANWUNLI ODEIGAH

November 2012

Pengerusi: Rimfiel B. Janius, PhD

Fakulti: Kejuruteraan

Biodiesel Kelapa sawit dan minyak jatropha adalah sumber tenaga boleh diperbaharui yang menarik, yang boleh digunakan sebagai pengganti sesuai bagi diesel petroleum yang tidak boleh diperbaharui. Biodiesel yang dihasilkan daripada kedua-dua sumber adalah lebih mesra alam daripada diesel petroleum dan dapat mengurangkan kebergantungan sesuatu negara kepada import minyak mentah. Walau bagaimanapun, kedua-dua bahan api biodiesel mempamerkan sifat yang lemah dalam aliran sejuk, menyebabkan masalah penjanaan enjin dan petrasangan penapisminyak semasa cuaca sejuk. Minyak Jatropha berbanding dengan kepada kelapa sawit merupakan sumber yang sangat menjanjikan biodiesel kerana ia tidak boleh dimakan dan boleh tumbuh di tanah terbiar dengan keperluan nutrien yang sangat sedikit dan mempunyai keberhasilan

minyak yang sangat tinggi. Kedua-duanya adalah dua jenis bijian minyak yang digunakan dengan paling meluas untuk pengeluaran biodiesel di Asia.

Kajian ini dijalankan untuk menilai kemungkinan menggunakan heksana, ethanol, kloroform dan minyak tanah sebagai komponen penambahbaikan aliran sejuk bagi biodiesel jatropha dan kelapa sawit. Kepekatan 1 v/v%, 5 v/v%, 10 v/v%, 15 v/v% dan 20 v/v% bahan tambah ini dalam biodiesel minyak sawit dan jatropha tulin diuji untuk mengkaji kesan mereka ke atas tabiat aliran sejuk bahan bakar biodiesel itu serta juga ke atas sifat-sifat lain bahan bakar seperti kelikatan, ketumpatan, takat kilat dan kandungan tenaga. Ujian prestasi enjin Yanmar model L48N dengan 4-lejang dan cucuhan mampatan yang menggunakan biodiesel minyak sawit dan jatropha yang mengandungi bahan tambah ini kemudiannya dijalankan.

Di antara bahan tambah itu, kloroform didapati paling berkesan dalam menambah baik tabiat aliran sejuk bahan bakar biodiesel. Pada kepekatan 10 v/v%, penurunan takat keruh untuk biodiesel sawit dan jatropha adalah masing-masing 5 ^{o}C dan 6 ^{o}C dengan kloroform, 4 ^{o}C dan 5 ^{o}C dengan heksana, 4 ^{o}C dan 4 ^{o}C dengan ethanol dan 3 ^{o}C dan 2 ^{o}C dengan minyak tanah. Minyak tanah dan heksana menghasilkan prestasi enjin yang baik dengan peningkatan kuasa brek sebanyak 6.36% dan 5.01 pada 10 v/v%, sementara ethanol menghasilkan peningkatan 5.01% dan kloroform pula 3.87% penurunan pada kepekatan yang sama.

Walau bagaimana pun, secara keseluruhannya, campuran ethanol ternampak paling baik dengan keseimbangan yang baik di antara sifat analitk bahan bakar dan prestasi enjin.

Takat keruh dan takat tuang diturunkan dengan agak memuaskan dengan ethanol sebagai bahan tambah dan prestasi enjin adalah juga baik disebabkan oleh kandungan oksigennya yang lebih tinggi.

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Thank you all.

I certify that an Examination Committee has met on **date of viva voce** to conduct the final examination of **name of student** on her **degree** thesis entitled "CHEMICAL ADDITIVES AS COLD FLOW IMPROVERS FOR PALM OIL AND JATROPHA OIL BIODIESEL " in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the student be awarded the Master of Science.

Members of the Examination Committee were as follows:

Khalina bt. Abdan, PhD
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Azmi bin Dato Haji Yahya, PhD, P.Eng
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Tinia Idaty bt. Mohd. Ghazi, PhD
Associate Professor
Faculty of Engineering
Universiti Putra Malaysia
(Internal Examiner)

Masjuki bin Haji Hassan, PhD
Professor
Faculty of Engineering
Universiti Malaya
Malaysia
(External Examiner)

SEOW HENG FONG, PHD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfillment of the requirement for the degree of type of degree. The members of the Supervisory Committee were as follows:

Rimfiel B. Janius, PhD
Lecturer
Faculty of Engineering
Universiti Putra Malaysia
(Chairman)

Robiah Binti Yunus, PhD
Professor
Faculty of Engineering
Universiti Putra Malaysia
(Member)

BUJANG BIN KIM HUAT, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institution.

ODEIGAH, EDITH ANWUNLI

Date: 9 November, 2012

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