UNIVERSITI PUTRA MALAYSIA

TRANSESTERIFICATION OF PALM OIL USING HETEROGENEOUS NaOH/Al2O3 CATALYST FOR BIODIESEL PRODUCTION

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By

NURUL FITRIYAH BINTI ABDULLAH

Thesis Submitted to School of Graduate studies, Universiti Putra Malaysia, in

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

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Chairman: Professor Taufiq Yap Yun Hin, PhD, CChem, FRSC (UK)

Faculty: Science

Biodiesel fuel has become more attractive recently because of environmental concerns and the limited resources of fossil fuel. Biodiesel also recognized as "green fuel" with several advantages, ie; safe, non-toxic and biodegradable compared to petroleum diesel. In this work, biodiesel production by transesterification of palm oil with methanol has been studied in a heterogeneous system using sodium hydroxide loaded on alumina. A series of solid base catalyst consisting of NaOH supported on commercial alumina were prepared for the transesterification of palm oil with methanol in order to find a support which can work better compared to homogeneous catalyst. During catalyst preparation, different amount of sodium compounds were impregnated into alumina. A screening of the reaction conditions has been carried out by examining the effect of methanol/oil molar ratio, catalysts amount, reaction temperature and reaction time. The prepared catalysts were then characterized by using X-Ray Diffraction (XRD) Analysis, Fourier Transform Infrared (FT-IR) Spectrometer, Brunner-Emmett-Teller (BET) Surface Area Measurement, Scanning Electron Microscopy (SEM) and Temperature Programmed

Desorption of Carbon Dioxide (CO2-TPD). Gas Chromatography (GC) and FT-IR was further used for characterization of biodiesel samples. The experimental results indicated that alumina supported with 50 wt% NaOH and calcined in air at 250°C for 3h (50NaC) gave the highest basicity and the best catalytic activities for transesterification reaction. The catalytic activities of the catalyst are explained by formation of aluminates that originated the stronger basic sites of the catalyst. The formation of aluminates is shown by characterization using XRD and FT-IR. The highest conversion 99% reached when the transesterification reaction was carried out at 15:1 methanol/oil molar ratio with 3 wt% catalyst, reaction temperature 60°C and reaction time 3h.

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

PENGTRANESTERAN MINYAK SAWIT DENGAN MENGGUNAKAN MANGKIN HETEROGEN NaOH/Al2O3 UNTUK PENGELUARAN BIODIESEL

Oleh

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September 2011

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Biodiesel telah menjadi lebih menarik baru-baru ini kerana keprihatinan persekitaran dan sumber bahan bakar fosil yang terhad. Biodiesel juga diakui sebagai "bahan bakar hijau" dengan beberapa kelebihan, iaitu; selamat, tidak beracun dan boleh dikitar semula jika dibandingkan dengan hasil petroleum. Dalam kajian ini, pengeluaran biodiesel melalui pengtransesteran minyak sawit dengan metanol telah dikaji dalam suatu sistem heterogen menggunakan natrium hidroksida dimuat diatas alumina. Siri mangkin alkali NaOH yang terdiri daripada alumina komersial dihasilkan untuk tindak balas pengtransesteran minyak sawit dengan metanol dalam rangka untuk mencari sokongan yang boleh berfungsi lebih baik berbanding dengan mangkin homogen. Semasa penghasilan mangkin, jumlah sebatian natrium yang berbeza diresapkan ke dalam alumina. Kajian terhadap keadaan tindak balas telah dilakukan dengan menyemak kesan nisbah molar metanol / minyak, jumlah mangkin, suhu tindak balas dan masa tindak balas. Mangkin yang dihasilkan kemudian dicirikan dengan menggunakan difraksi sinar-X (XRD), spektrometer Fourier Transform infra merah (FT-IR), pengukuran luas

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Finally, to my beloved family, especially to my mother and husband, thanks for all moral encouragement, support and sacrifices which had helped me in undertakings and completing my study.

I certify that a Thesis Examination Committee has met on 23 September 2011 to conduct the final examination of Nurul Fitriyah binti Abdullah on her thesis entitled 'Transesterification of Palm Oil using Heterogeneous NaOH/Al2O3 Catalyst for Biodiesel Production' in accordance with the Universities and University College Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U(A) 106] 15 March 1998. The Committee recommends that the student be awarded Master of Science.

Members of the Thesis Examination Committee were as follows:

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

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DECLARATION

I declare that the thesis is my original work except for the quotation 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.

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NURUL FITRIYAH BINTI ABDULLAH

Date: 23 September 2011

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