



UNIVERSITI PUTRA MALAYSIA

***PREPARATION AND CHARACTERIZATION OF TRITON-WATER
DIESEL NANOEMULSION WITH AND WITHOUT CERIUM OXIDE***

BIDITA BINTE SALAHUDDIN

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BERILMU BERBAKTI

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By

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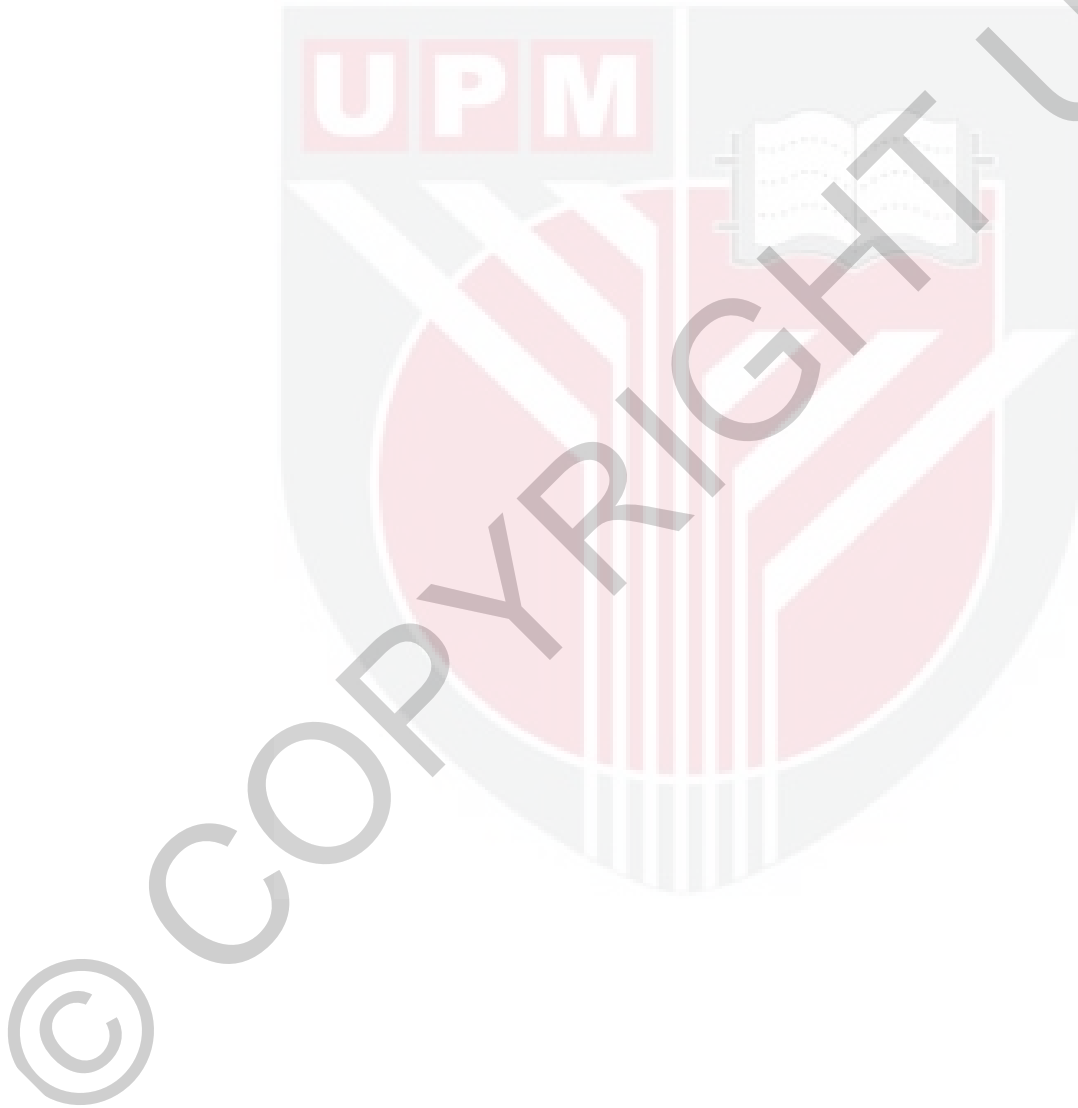
**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfillment of the Requirements for the Degree of Master of Science**

March 2014

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DEDICATION



To my beloved parents...

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

PREPARATION AND CHARACTERIZATION OF TRITON-WATER-DIESEL NANOEMULSION WITH AND WITHOUT CERIUM OXIDE

By

BIDITA BINTE SALAHUDDIN

March 2014

Chair : Associate Professor Suraya Binti Abdul Rashid, PhD
Faculty : Engineering

Water-in-diesel nanoemulsions are considered as alternative fuels for internal combustion engines, to enhance combustion efficiencies and reduce exhaust emissions. A high energy emulsification process using a range of ultrasonication amplitudes (20 to 35 % with 10 minutes processing time) was employed to prepare nanoemulsion fuels. Nanoemulsion fuels were formulated by using a range of surfactant (Triton X-100) concentrations (0.31 % to 0.49 % w/w) with varying water concentrations (0.80% to 1.15% w/w). Cerium oxide (CeO_2) was also incorporated into the nanoemulsion fuels in order to evaluate the effect of fuel additive on the nanoemulsion properties. A screening method was carried out to determine the most suitable experimental conditions for the formation of nanoemulsion fuel in terms of improved combustion and emission properties. The screening process was conducted by analysing the emission of fuels from an engine test bed, namely CO_2 , CO and NO_x . It was found that nanoemulsion fuels have the ability to reduce exhaust emissions compared to that of neat diesel. The exhaust temperature of neat diesel was found to be 290 °C along with the CO_2 , CO and NO emission concentrations of 21784, 766, and 276 ppm, respectively. A significant reduction of exhaust temperature (up to 33%) as well as NO_x emission (up to 61%) was obtained during the combustion of cerium oxide enriched nanoemulsions compared to those without. The physico-chemical properties of screened nanoemulsions such as color, density, fuel stability, kinematic viscosity, flash point, pour point, acid number, calorific value and cetane number were determined and comparison was made to neat diesel. The destabilization methods; mainly Ostwald ripening was discussed to investigate the stability of nanoemulsions. The morphology of the nanoemulsions was studied by using the micrographs obtained from transmission electron microscopy (TEM). The size of the droplets formed in the prepared nanoemulsion fuel was found in the range of 1.5 nm to 74.0 nm. Overall, nanoemulsion fuels show great potential as alternative fuels.

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

PENYEDIAAN DAN PENCIRIAN BAHAN API NANOEMULSI TRITON-AIR-DIESEL DENGAN DAN TANPA SERIUM OKSIDA

Oleh

BIDITA BINTE SALAHUDDIN

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Pengerusi : Profesor Madya Suraya Binti Abdul Rashid, PhD
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Nanoemulsi air-dalam-diesel dianggap sebagai bahan api alternatif bagi enjin pembakaran dalaman, untuk meningkatkan kecekapan pembakaran dan mengurangkan pelepasan ekzos. Bahan api nanoemulsi disediakan melalui proses pengemulsian tenaga tinggi dengan menggunakan pelbagai amplitud ultrasonifikasi (20 hingga 35% dengan 10 minit masa pemrosesan). Bahan api nanoemulsi dirumuskan dengan menggunakan kandungan surfaktan (Triton X-100) yang pelbagai (0.31% kepada 0.49% w/w) serta kandungan air yang berbeza (0.80% kepada 1.15% v/v). Serium Oksida (CeO_2) juga dimasukkan ke dalam bahan api nanoemulsi untuk menilai kesan aditif bahan api ke atas sifat nanoemulsi. Satu kaedah saringan telah dijalankan untuk menentukan kondisi kajian yang paling sesuai untuk pembentukan bahan api nanoemulsi yang boleh menghasilkan pembakaran dan mempunyai kandungan pelepasan yang lebih baik. Proses saringan telah dijalankan dengan menganalisis pelepasan bahan api dari katil ujian enjin, iaitu CO_2 , CO dan NO_x . Analisis ini menunjukkan bahawa bahan api nanoemulsi mempunyai keupayaan untuk mengurangkan pelepasan ekzos berbanding dengan diesel asal. Suhu ekzos diesel asal yang diperolehi ialah 290 °C bersama-sama dengan perlepasan CO_2 , CO dan NO pada 21784, 766, dan 276 ppm masing-masing. Pengurangan ketara suhu ekzos (sehingga 33%) dan juga pelepasan NO (sehingga 61%) telah diperolehi dari pembakaran bahan api nanoemulsi yang mengandungi serium oksida berbanding dengan tanpanya. Ciri-ciri fiziko-kimia bagi nanoemulsi seperti warna, ketumpatan, kestabilan bahan api, kelikatan kinematik, takat kilat, titik tuang, nombor asid, nilai kalori dan bilangan setana ditentukan dan perbandingan dengan diesel asal telah dibuat. Kaedah ketidakstabilan; terutamanya pematangan Ostwald telah dibincangkan untuk menyiasat kestabilan nanoemulsi. Morfologi nanoemulsi telah dikaji dengan menggunakan mikrograf yang diperolehi daripada mikroskop pancaran elektron (TEM). Saiz titisan ditemui pada bahan api nanoemulsi yang disediakan didapati dalam julat 1.5 nm ke 74.0 nm. Secara keseluruhan, bahan api nanoemulsi menunjukkan potensi yang bagus sebagai bahan api alternatif.

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I certify that a Thesis Examination Committee has met on 28 January 2014 to conduct the final examination of Bidita Binte Salahuddin on her thesis entitled "Preparation and Characterization of Triton-Water-Diesel Nanoemulsion with and without Cerium Oxide" in accordance with the Universities and University Colleges 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 the Master of Science.

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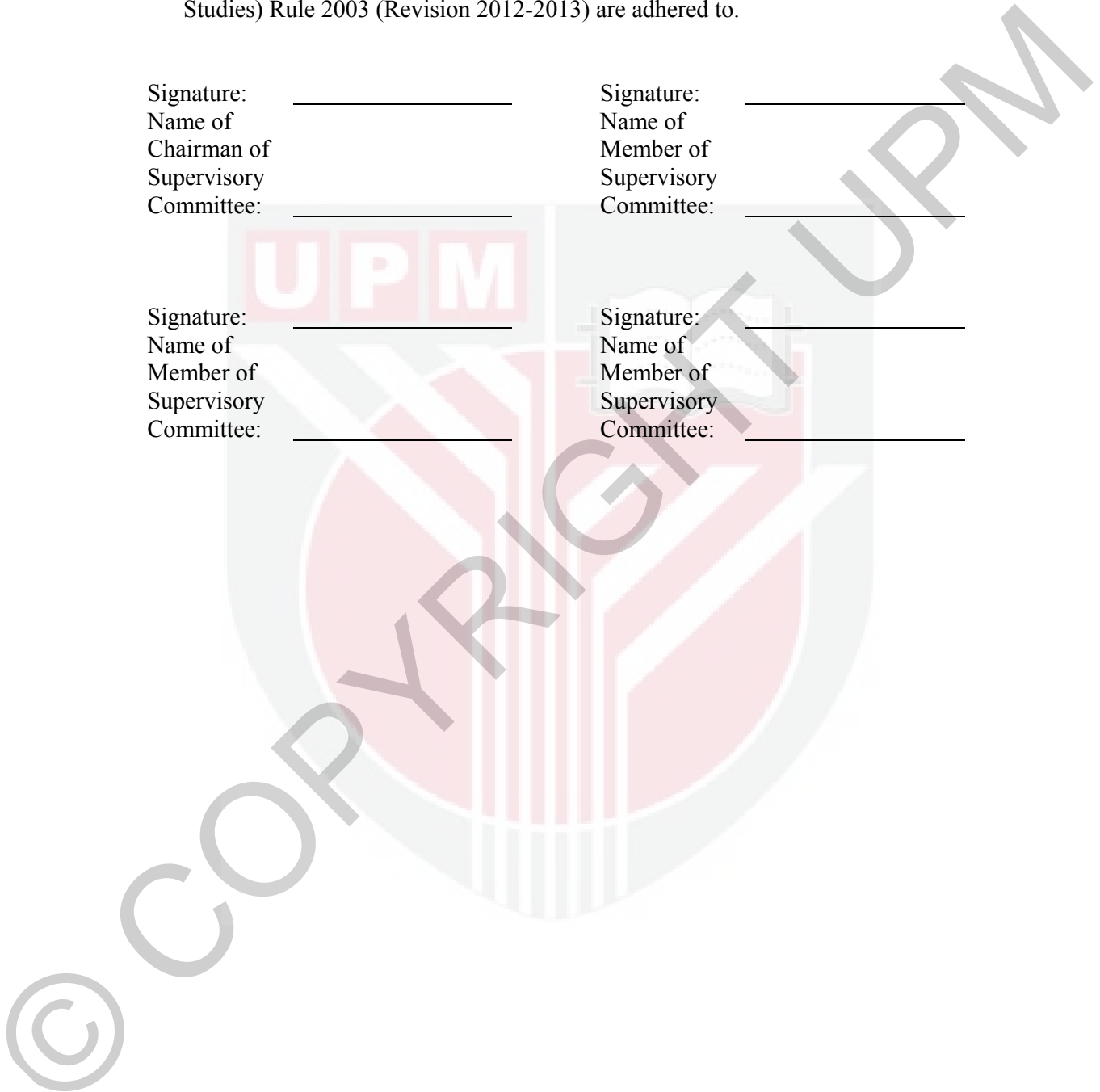


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