UNIVERSITI TEKNOLOGI MARA

NANO EMULSION PETROL USING DIETHANOL AMIDE METHYL ESTERS SYNTHESIZED FROM *JATROPHA CURCAS L.* OIL

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ABSTRACT

This research is about formulation of nano emulsion petrol (NEP) using an additive that has been synthesized from crude *Jatropha curcas l.* oil (CJO). Basically, NEP is a biofuel which composed of commercial petrol as main component, small portion of water and the additive as emulsifier. Currently, there are numerous of biofuel technology that have been developed either as fuel blending component or direct replacement to fossil fuel. Emulsion technology was found to be a future prospect fuel. However, there are few challenges in developing a sustainable and green technology emulsion petrol. First, there were not many additive in the marketplace were derived from non-edible feedstock. Secondly, emulsion fuel that currently developed has short shelf-life and easily destabilized. Thirdly, emulsion fuel has only certain improvement on greenhouse gas emission reduction. In order to address this, the objectives of this research were to synthesis a non-ionic surfactant from crude *Jatropha curcas* oil, to study the emulsion stability index (ESI) and also to compare the emission of greenhouse gas (GHG) respective to commercial petrol. Crude jatropha oil (CJO) was derived into fatty acid methyl ester (FAME) before achieved to final product which was diethanol amide methyl ester (DEAME). All the structural elucidation of the three compunds were analysed by GC, FTIR, ^{1}H and ^{13}C NMR. The hydrophilic lipophilic balance (HLB) value of DEAME was calculated at 8.311 which categorized as wetting and spreading agent but still considered as water-in-oil (w/o) type emulsion (below than 10) according to HLB scale. Both micellar and DEAME were premixed at 1 to 10 g/ml to determine the critical micelle concentration (CMC) during formulation of NEP. CMC of NEPs was computed by surface tension at 20, 30 and 40°C. By using ternary phase diagram, NEP was formulated following the PAW rule whereby the dictation of the formulation begin with percentage of petrol, additive followed by water. Out of 36 samples, 4 samples taken for further studies which were NE811, NEP721, NEP622 and NEP523. Morphological structure for each NEPs were analysed by transmission electron microscope (TEM) and particle size analyser (PSA) and observed for 10 consecutive months. The mode diameter for NEP811, NEP721, NEP622 and NEP523 for the first month were 11.70 nm, 10.1 nm, 6.503 nm and 8.721 nm. Emulsion stability index (ESI) for NEPs was determined using volumetric and backscattering method from month 1 to 10. Simple combustion test was conducted to measure the greenhouse gases (GHG) emission release for all NEPs. The combustion shown a substantial dropped of emission in unburnt hydrocarbon (CH_x), carbon oxide (CO_x), sulphur oxide (SO_x) and particulate matter (PM_{10}) for all NEPs except for nitrogen oxide (NO_x) compared to unmodified petrol.

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In the name of Allah, the most compassionate, the most merciful. Based from Quranic in Surah Al-Alaq: 1-5. “Proclaim! In the name of thy Lord and Cherisher, who created man, out of a (mere clot of congealed blood). Proclaim! And thy Lord is most bountiful. He who taught (the use of) the pen. Taught man which he knew not”. This holy verse emphasized on the need for mankind to gain knowledge as much as possible. Praise to Allah, the Lord Almighty, who has testify us man of science (people of knowledge) with His amazing creation to show the sign of His existence that everything beyond of this universe is under His dominion and ruling. A verse from Surah Yasin, verse 80 which say, “Who has made for you out of the green trees fire; then, only then, from it you do kindle” has enlightened me that Quran is not written by human but rather a book from the Creator Himself.

This thesis is an encyclopaedia of deriving crude Jatropha oil; one type of non-edible feedstock into an additive that capable of making water miscible into petrol. The additive is actually an emulsifier that helps the water to be encapsulated around petrol interfacial surface layer into nano discrete particles producing nano emulsion petrol (NEP). This thesis discussed about the formulations, physicochemical properties and greenhouse gases (GHG) emission release from its combustion.
Verily, I would like to seize this opportunity to thank so much to my lovely spouse, Siti Syazana Binti Che Ani, both my parents Yahya Bin Ahmad and Rosiyah Binti Yatni, my lovely kids; Ahmad Deedat Umar and Nur Amna Nafeesa, family members and friends whom do not give up in motivating me with moral support to complete this study. Those directly and indirectly support, guidance and encouragement from all parties will always be an unforgettable memory throughout my life.

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TABLE OF CONTENT

CHAPTER ONE
INTRODUCTION

This chapter is divided into five subtopics which include the background, problem statements, objectives, scope and limitations as well as significance of the study. The background of the study described the current scenario in biofuel development using various technologies and feedstocks. On top of that, emulsion technology has been chosen due to certain criteria. The content also justify the reason why jatropha is being preferred as the promising feedstock for the production of the biofuel. Problem statements will highlight the current problems in which edible oil supply being impinge and compete against food and other industries to be used as biofuel feedstock. In addition, the content also raised about the current problem on the short life-span of emulsion fuel and also the pollutants from greenhouse gases that still not resolved from combustion of emulsion fuel. The objectives are expounded on page 6. Meanwhile, scope and limitations are set to limit the boundaries or borderline of the research which will be explained further in page 7. Last but not least, the significance of the study is to discuss the importance of conducting this research and the research gap contribution to the research field.

1.1 Background of Study

Nowadays, a worldwide attention has focused on biofuel research and development for fossil fuel blending components or direct replacement for fuel in conventional engine. In general, biofuel produced from feedstocks that derived from biomass was considered as green technology due to its sustainability as the source of energy unlike fossil feedstock such as petroleum, coal and nuclear fuels (Demirbas 2011). There are abundances of biomass still available for renewable resources opening a good synergy between oil-gases industries and agricultural industries (Demirbas 2008). In general, biofuels can be classified in two ‘generations’; first and second generations. First generation biofuels are biofuels that produced from food-based crops such as sugarcane, palm oil, soybean oil and sunflower oil. Meanwhile, second