THE EFFECT OF *LOW SULPHUR WAX RESIDUE (LSWR)* AND *SORBITAN MONOOLEATE (SPAN-80)* TO THE EMULSION FUEL STABILITY

MUHAMMAD KHARIN ANNUAR BIN SAIRAN

Thesis submitted in partial fulfilment of the requirements
for the award of the degree of
Bachelor of Chemical Engineering (Pure)

Faculty of Chemical & Natural Resources Engineering
UNIVERSITI MALAYSIA PAHANG

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LIST OF ABBREVIATIONS

CMS-Gd-DTPA	Gadolinium diethylenetriaminopentaacetic acid-loaded chitosan microspheres
CO	Carbon Monoxide
LSWR	Low Sulphur Wax residue
NO	Nitrogen Oxide
O/W	Oil in water
SPAN-60	Sorbitan Monostearate
SPAN-80	Sorbitan Monooleate
TWEEN-60	Polyoxyethylene sorbitan monostearate
SPAN-80	Sorbitan Monooleate
W/O	Water in oil

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ABSTRACT

The world oil resources are getting low daily. However, the usage still increasing due to the technology advancement nowadays. Yet, the world still did not find any suitable replacement for this resource which can give high energy at affordable cost, also it must be easy to use by all people. The most efficient resource of energy that can be replacing oil is nuclear power. Nuclear power has it all, efficient, clean, long lasting, but the downside is not every country has ability to build this technology and it is considered as a highly dangerous source of energy as it produces not only explosion but also radiation.

Then this study was conducted to give more time for oil energy era before it become completely extinct. More time for the world to find an efficient source of energy that can be used by the people like this oil energy. The basic of this study is to create a combination of oil and water as an emulsion fuel. Oil and water are immiscible due to polar molecule having in the water. They need some element that can combine and stabilize them together and that element is the emulsifier. Emulsifier functioning as a binding element for the diesel and water to combine, the emulsifier used in this study are Span-80 and LSWR.

The materials used in this study were Diesel oil, water, Span-80 and LSWR. This study consists of two parts, finding suitable ratio and analyzing characterization. For finding suitable ratio, 20:80, 30:70 and 40:60 of water in oil ratio with 1%, 1.5% and 2% emulsifier percentage each, were used. By using a propeller the oil were agitated with the emulsifier for about 5 minutes at 2000 rpm, then the water slowly poured into the solution and agitated more for 10 minutes. The emulsion fuel then putted into a measuring cylinder and take the stability data at 3, 6, 24, 48 and 120 hours. For analyzing characterization, the water droplets size was checked with microscope 10x lens, viscometer to check shear rate, shear stress, viscosity.

From the study, Span-80 emulsifier is more stable than LSWR. Based from data for 20:80 water in oil and using 1.5% emulsifier. For SPAN-80 about 73.5% of emulsion fuel, maintain its state after 120 hours. The rest, 1.5% turned into oil and 25% turned into oil in water layer. Differently for LSWR about 80.6% of the emulsion fuel, maintain its state after 120 hr. However, almost 38 mL from 40 mL of water was dispersed at the bottom layer. Meaning the LSWR has high ability to hold most of the oil but not the water.

ABSTRAK

Sumber-sumber minyak dunia semakin berkurang setiap hari. Namun, penggunaannya masih meningkat disebabkan oleh kemajuan teknologi pada masa kini. Tambahan pula dunia masih tidak menemui sebarang penggantian sesuai untuk sumber ini yang boleh memberi tenaga yang tinggi pada kos yang berpatutan, ia juga mestilah mudah untuk digunakan oleh semua orang. Sumber tenaga yang paling cekap yang boleh menggantikan minyak adalah kuasa nuklear. Kuasa nuklear mempunyai segala-galanya, cekap, bersih, tahan lama, tetapi malangnya tidak setiap negara mempunyai keupayaan untuk membina teknologi ini dan ia dianggap sebagai sumber tenaga yang sangat berbahaya kerana ia bukan sahaja menghasilkan letupan malahan radiasi.

Kemudian kajian ini telah dijalankan untuk memberikan lebih banyak masa untuk era tenaga minyak sebelum ia menjadi benar-benar pupus. Memberikan lebih banyak masa untuk dunia untuk mencari sumber tenaga yang cekap yang boleh digunakan oleh orang ramai seperti sumber tenaga minyak. Asas kajian ini adalah untuk mewujudkan satu gabungan minyak dan air sebagai bahan bakar emulsi. Minyak dan air tidak boleh bercampur antara satu sama lain kerana air mempunyai molekul kutub. Mereka memerlukan sesuatu elemen yang boleh menggabungkan dan menstabilkan mereka bersama-sama dan elemen itu adalah pengemulsi. Pengemulsi berfungsi sebagai elemen yang mengikat diesel dan air, pengemulsi yang digunakan dalam kajian ini adalah Span-80 dan LSWR.

Bahan-bahan yang digunakan dalam kajian ini ialah minyak diesel, air, Span-80 dan LSWR. Kajian ini terdiri daripada dua bahagian, mencari nisbah yang sesuai dan menganalisis pencirian. Untuk mencari nisbah yang sesuai, 20:80, 30:70 dan 40:60 air dalam nisbah minyak dengan 1%, 1.5% dan 2% peratusan pengemulsi masing-masing, telah digunakan. Dengan menggunakan pemutar, minyak telah diadun dengan pengemulsi selama kira-kira 5 minit pada 2000 pusingan seminit, kemudian air perlahan-lahan dituangkan ke dalam campuran dan diadun lagi selama 10 minit. Seterusnya, bahan api emulsi dituang ke dalam silinder penyukat dan data kestabilan pada 3, 6, 24, 48 dan 120 jam diambil. Untuk menganalisis pencirian, saiz titisan air diperiksa dengan mikroskop kanta 10x, viscometer digunakan untuk mengkaji kadar ricih, tegasan ricih, kelikatan dan dengan menggunakan tensiometer pula untuk menganalisis ketegangan permukaan dan ketegangan antara permukaan. Kemudian bahan api emulsi yang paling stabil dibandingkan dengan bahan api konvensional.

Dari kajian ini, didapati pengemulsi Span-80 adalah lebih stabil daripada LSWR. Berdasarkan daripada data untuk 20:80 air dalam minyak dan menggunakan 1.5% pengemulsi. Untuk SPAN-80 kira-kira 73.5% daripada bahan bakar emulsi, mengekalkan keadaan selepas 120 jam. Selebihnya, 1.5% bertukar menjadi minyak dan 25% bertukar menjadi lapisan minyak dalam air. Berlainan bagi LSWR kira-kira 80.6% daripada bahan bakar cecair, mengekalkan keadaannya selepas 120 jam. Walau bagaimanapun, hampir 38 mL daripada 40 mL air terpisah ke lapisan bawah. Ini bermakna, LSWR mempunyai keupayaan yang tinggi untuk mengekalkan kebanyakan minyak tetapi tidak air.

1 INTRODUCTION

1.1 Motivation and statement of problem

The most effective source of power nowadays is oil fuel power which extracted from petroleum or also known as fossil fuel. This source of power is proven efficient, easy to find and use also comes in affordable price. It is also an important source of power because almost all technologies either old or recently created are using this type of energy to be functioning. As it is our strength, it is also our weaknesses as we highly depend on the fossil fuel. Fossil fuel is not a source that can be generated by technologies, it can only produced by nature. However, nature requires million of years to produce fossil fuel. As the time goes by, it will be completely depleted. To overcome this dire situation, researchers all over the world are focusing on finding new type of energy that is efficient and feasible, which still in questions, except for nuclear power. Still, nuclear power technology is not accessible to many countries and it also comes with great risk. This is the reason this study was conducted, to prolong the fossil fuel era to give more time for the world to find an efficient source of energy that can be used like oil fuel energy. The aim of this study is to develop a new type of fuel, emulsion fuel. Emulsion fuel is a combination of conventional fuel with water. This kind of fuel will reduce the consumption of oil and at the same time will give more energy. Emulsion fuel is also giving a cleaner combustion than the conventional fuel. Emulsion fuel needs an element to mix and stabilize the water and oil together, that element is emulsifier. Emulsifier will act like an adhesive to combine the water and oil. The emulsifiers we use in this are SPAN-80 and LSWR.

1.2 Objectives

The following are the objectives of this research:

i) To find the most stable emulsifier, water in oil (w/o) ratio and emulsifier percentage.
ii) Analyzing characterization of the emulsion fuel.
iii) To analyze the difference of the combustion between emulsion fuel and conventional oil.

1.3 Scope of this research

The following are the scope of this research:

i) To find either SPAN-80 or LSWR is the most stable emulsifier by conducting stability test with different water in oil ratio and emulsifier percentage

ii) To find the emulsion fuel characterization by using viscometer to find the shear stress, shear rate, viscosity, tensiometer to analyze the surface tension and interfacial tension, and by using microscope with 10x lens to check the water droplets size.

iii) Using gas burner to analyze the difference between conventional fuel and emulsion fuel created.

1.4 Main contribution of this work

The following are the contributions of this research:

i) Produce a better combustion type of fuel, emulsion fuel provide better combustion hence more power than conventional fuel.

ii) Roughly can save a lot of oil fuel and extend the source life.

iii) Environmental friendly, as better combustion provide cleaner combustion. Thus, reduce the NO and CO produce.

2 LITERATURE REVIEW

2.1 Low Sulphur Wax Residue (LSWR)

LSWR is a side product produced in the crude oil refinery. The crude oil come with an amount of water in it and been removes for corrosion protection in the pipeline. This LSWR, asphaltene and resin in crude oil are believed as the stabilizer for the water in the crude oil. From M. A. Manan, A. R. A. Razak and A.T. Sulai, LSWR is the lowest and the last fraction of refinery products of crude oil. This residual material produced at a temperature of about 3600°C and filtering on. In both room temperature and operating temperature, it is a solid because its pour point is in between 48 to 51°C.

Studies of chemical composition and physical properties of the material balance show that the LSWR suitable and safe for use as a fuel source because it complies with the permitted range of specifications. However, the problems are the pour point and high wax content requires a suitable method for handling LSWR as a fuel.

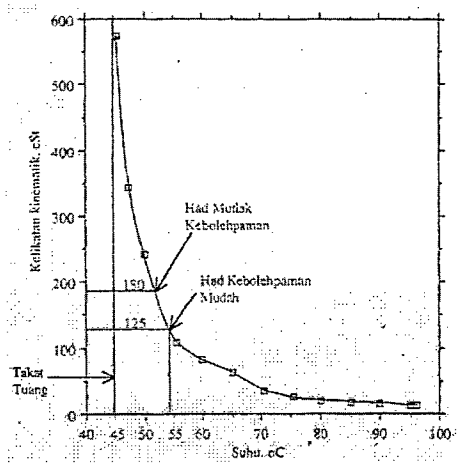

Figure 2-1.1: kinematic viscosity, cSt VS temperature. (Source: LSWR Minyak Tapis Blend di Loji Penapisan Kerteh)