UNIVERSITI TEKNOLOGI MARA

PRODUCTION OF LIQUID FUELS FROM THERMAL CRACKING OF PALM OIL IN THE PRESENCE OF NATURAL GRANITE AS A THERMAL CRACKING AGENT

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the results of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

The search for alternatives to petroleum based fuels has led to the development of fuels from various sources, including renewable feedstocks such as vegetable oils. Cracking of vegetable oils is one of the invented processes to improve the yield of liquid fuels. However, the current study more concentrated on the catalytic cracking since the reaction would give high conversion with high yield of liquid fuels product. The use of this method on the industrial scale is limited by the high cost of catalyst. Therefore, to solve this problem, the natural granite was used as a thermal cracking agent since the availability of natural granite in market is more economically compare the used of catalysts. The purpose of this research is to study the potential of natural granite as a thermal cracking agent in thermal cracking for the production of liquid fuels from palm oil with physical and chemical properties similar to gasoline and comparing with ASTM specifications. The natural granite was characterized with X-ray Fluorescence (XRF), Thermogravimetric Analyzer (TGA) and Fourier Transform Infra-Red (FTIR) methods to characterize the physical and chemical properties. The thermal cracking of palm oil was conducted in a batch reactor under atmospheric pressure for a 4 hour reaction time with the effect of thermal cracking with and without natural granite, different size (<1 cm, 2-3 cm and > 3 cm) and loading of natural granite (1, 3 and 5 kg). The conversion reached to a maximum value of 60 wt%, 14.4 wt% of total liquid and 6.4 wt% of liquid fuels for olein. The liquid fuels essentially consisted of C_5-C_{18} of hydrocarbons. 3 kg of natural granite considered the best amount with high selectivity of light hydrocarbon. All physical properties of liquid fuels like calorific value, kinematic viscosity, flash point, water content, density, and elemental analysis were comparable with commercial gasoline and can be used as alternative fuels. Analysis of the liquid fuels indicates that thermal cracking of palm oil with natural granite as a thermal cracking agent are promising, cost effectively and more profitable due to energy saving.

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CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The diminishing of fossil fuel supplies and rising of oil prices have become a serious problem recently. In Malaysia, the price of fossil fuels nowadays is increasing drastically that cause many other expenses to increase. The impact of fossil fuel on environment and human health is also a serious concern. Therefore, an alternative, renewable source has to be found to reduce and eventually replace the consumption of fossil fuels. Among alternatives energy namely; biofuels, hydrogen, natural gas and syngas (synthesis gas), biofuels are the most environmentally friendly source of energy. Biofuel is very attractive and promising source due to its low sulfur and nitrogen content (Tamunaidu and Bhatia, 2007). Biofuel is defined as a liquid or gaseous fuel that can be produced from natural vegetable oil or fats and is used as transportation fuel or fuel additive in the vehicles to reduce their emissions (Demirbas, 2007).

It is well known that triglycerides contained in vegetable oil such as palm oil, rapeseed oil, soybean oil and others are easier to be converted into liquid transportation fuels because they are already high-energy liquids that contain low amounts of oxygen. Palm oil is one of the vegetable oils that has the greatest possibility to be used in biofuel production and being the worlds' cheapest edible oil (Siswanto et. al., 2008). As one of the largest palm oil producer and exporter, Malaysia is now looked upon as the pioneer palm biofuel producer. On 16 December 2007, Malaysia opened its first biodiesel plant in the state of Pahang. Plant Biofuels Corporation Sdn. Bhd. (PBC) operated with an annual production capacity of 100,000 metric tonnes of biodiesel.