1 INTRODUCTION

1.0 Motivation and statement of problem
Nowadays, the current scenario of biodiesel production is the shortage and unstable cost of feedstock resulting in uncompetitive price of biodiesel. The main problem for current biodiesel production is high cost. According to statistics, 70% of manufacturing cost of biodiesel is from feedstock (Izah et al, 2013). Biofuel feedstock includes many crops that would otherwise be used for human consumption directly or indirectly as well as animal feed. Diverting these crops to biofuels may lead to more land area devoted to agriculture, increased use of polluting inputs resulting in higher prices. Cellulosic feedstock can also compete for resources such as land, water and fertilizer that could otherwise be devoted to food production. As a result, biofuel production may give rise to price and unstable cost of feedstock.

The dominant factor in the production process of biodiesel is the cost of feedstock while capital costs only contribute about 7% (Sani et al, 2013). Therefore, it is essential to utilize cheap feedstock to reduce the overall production cost. Waste cooking oil, animal fat and non-edible oils are potential substitutes and a pre-treatment process using acid catalyst and glycerol extraction was additionally employed in the current plant. There are many works reliable researches, implementation and useful results come to exist. The alternative feedstock must be technically acceptable, economically competitive, environmentally acceptable and easily available. Researches on biodiesel derives from waste cooking oils, animal fats and non-edible oils are being investigated to alternate vegetable oil as biodiesel feedstock.

Furthermore, the utilisation of waste cooking oil is a key component in reducing biodiesel production costs up to 60% until 90% (Kiakalaieh et al, 2013). It is because waste cooking oil is abundantly available in the local market at cheaper rate as it is not commonly used. Meanwhile, a huge quantity of waste cooking oil can be collected from restaurants and food item industry (Shahid et al, 2012). Besides that, biodiesel may also can be produced from less expensive animal fats such as inedible tallow, pork lard and yellow grease (Dhiraj et al, 2012). Animal tallow generated biodiesel offers a wide ranged of energy, environmental and economic advantage (Nelson et al, 2006)
Transesterification is one of the main solutions that have appeared as effective method for using animal fats in diesel engine. Nevertheless, without deep understanding on the equilibrium of liquid mixing during the reaction, transesterification of the low grade oils could not be realistic.

Besides that, a feedstock need a pretreatment process due to its undesired impurities to avoid reaction hindrance and saponification problem occurs. Pre-treatment is the first step of biofuel process, and its quality and efficiency of pre-treatment directly affect the subsequent steps. Additionally, pre-treatment is a combination of many process. It consists of a size reduction step followed by chemical, biological or physical treatments (Tong et al, 2013). However, these combinations add extra costs to the production and make the pre-treatment process to become too slow. There are several pre-treatments method that usually used in industries such as steam explosion pre-treatment, dilute acid pre-treatment organosolv pre-treatment, and sulfite pre-treatments (Tong et al, 2013). However, organosolv pre-treatment is limited because of the high operation cost and high cost of organic solvent (Zhao et al, 2009). Tong et al, (2013) from university of Florida has study a pre-treatment of lignocellulosic biomass for biofuels. He claimed that although pre-treatment is the first step, it is one of the most expensive parts of the entire bioethanol process (Tong et al, 2013)

On the other hand, there is currently a need to improve the commercial feasibility of biodiesel production in order to make it an alternative to conventional biodiesel process. In brief, extractive reaction is one the reactor intensification techniques in order to overcome the reaction hindrance and saponification problems due to undesired impurities in the feedstock. For this purpose, extraction can only be sustained if the medium consistently appears as two-immiscible liquid and the solute is more soluble in the solvent. Hence, this study is essentially to characterize the solubility mechanism and extraction kinetics of fatty acid ethyl esters (FAEE) from reactive region especially at interface by using aqueous ethanol. Briefly, solvent extraction has been defined as a process for transporting materials from one phase to another phase for the purpose of separating one or more compounds from mixtures (Johnson et al, 1983). In the case of biodiesel extraction, FAEE was separated by aqueous ethanol from cooking oil. Aqueous ethanol solution is used as a solvent because of its solubility in water and glycerol that is deposited on lipase surface may be stripped from active active lipasic
sites into the aqueous phase, therefore improving enzyme activity and shifting the reaction equilibrium to the right (Chesterfield et al., 2013)

1.1 Objectives
The following are the objectives of this research:

i) To characterize extraction kinetics of FAEE from oil phase by using aqueous ethanol

ii) To determine the distribution coefficient of fatty acids ethyl esters (FAEE) between oil phase and aqueous ethanol

1.2 Scope of this research
The following are the scope of this research:

i) Palm oil and ethanol at the ratio of 1:6 at 65°C will be used to extract fatty acids ethyl esters (FAEE) using trans esterification reaction

ii) Ethanol is used as a solvent for this experiment since it is less toxic and more excellent fuel properties compared to methanol

iii) Comparison of the result for different molar ratio of solvent on extractive performance

iv) Analysis of component using gas chromatography

1.3 Main contribution of this work
The following are the contributions of this work:

i) Researches on biodiesel for alternative sources of energy to replace petroleum due to environmental concern

ii) Researches on biodiesel derive from low grade oils as alternative to alternate vegetable oil as biodiesel feedstock to reduce biodiesel production cost

iii) Development of integrated process that combine different steps into one single unit through extractive reactor.

iv) Extractive reaction is one the reactor intensification techniques in order to overcome the reaction hindrance and saponification problems due to undesired impurities in the feedstock

1.4 Organisation of this thesis
The structure of the reminder of the thesis is outlined as follow: