1 INTRODUCTION

This chapter will give the ideas about the significant of the research formulation. This first chapter will cover up the subtopic of background of study or information, problem statement, research objectives, scope of proposed research, expected outcomes and significance of the proposed research.

1.1 Background of Study

Biodiesel fuel is one of the alternative fuels for petroleum-derived diesel. Low grade oils are practically used to overcome the high costs of biodiesel production. Biodiesel is currently synthesized via liquid base catalysed trans-esterification of triglyceride components with alcohols, alongside glycerol as a potentially valuable by-product. The potential alcohols are methanol and ethanol. Methanol is the most favourable due to relatively-low cost and more favourable properties in the process. On the other alcohol, ethanol is relatively less toxic - and can be obtained from biomass, making biodiesel production completely renewable (Oliveira et.al, 2011). In this study, ethanol was employed because it shows more excellent fuel properties although it is expensive.

Extractive reaction was used as the method to run the experiment as it is one of the alternatives for more cost effectiveness of the biodiesel production by using low grade oils. This process consists of chemical reaction and liquid-liquid extraction in the same unit achieving such synergistic effect, that the increase of selectivity, conversion, productivity, and purity of final product (Rinaldi et.al, 2007). Liquid-liquid extraction (LLE) is a separation process that takes advantage of the relative solubility of solutes in immiscible solvents (Thomopoulos, 1971). Liquid phases emerged during the biodiesel synthesis reaction change dynamically. Initially, two immiscible liquids appear: rich triglyceride and rich alcohol. Then, depending to the initial amount of excess ethanol or excess triglycerides, the transition phases would be two or single due to the virtual solvent characteristics of FAEE during the biodiesel reaction. The fatty acid esters and glycerol, obtained after the complete trans-esterification reaction are again immiscible. To increase the immiscibility of two liquid phases another solvent which is hydrated ethanol was added. Ethanol was used as solvent because it is a promising technique for refining edible oils, including palm oil, without significant losses of natural antioxidants.
When the extraction system was employed, the denser phase is rich in triglycerides settles at the bottom of the less dense phase which contains ethanol.

Components used in this work were analysed by using gas chromatography that included biodiesel, triglycerides and ethanol to form the ternary diagram for each component. In order to carry a sample through the chromatograph, a carrier gas was used. The choice of carrier gas was dictated both by the nature of the sample and by the type of detector to be used (Med, 1968).

The determination of liquid-liquid equilibrium data (LLE) for the system was important to delineate compositions of component in different phases in the region below bimodal curves. To overcome the lack of phase equilibria information concerning systems from the trans-esterification reaction with ethanol, in this work, liquid–liquid equilibria data, tie-lines and phase boundaries, was measured for the ternary system triglycerides + FAEE + ethanol at temperature 40°C. For the tie-line determination, compositions in the two phase region were selected keeping the molar relation between ethanol and triglycerides constant and changing the FAEE proportion. According to the phase rule, at a fixed temperature and pressure, only one component can independently change its composition. The mixture composition is determined identifying in the bimodal curves measured, the point which represents the composition of the specified component (Oliveira et.al, 2011).

1.2 Motivation and Problem Statement
Biodiesel is nowadays seen as one of the most worthy alternatives to conventional fossil fuels. It is generally accepted that the available fossil fuel reserves will only last for a few more decades. In addition, most of the accessible petroleum fuel comes from politically unstable countries raising the uncertainty of its availability and price (Hallock, 2004). The use of renewable energy sources of biodiesel can also decrease greenhouse gases and emissions of other air contaminants contributing to reduce the global warming problem (Shahid & Jamal, 2008). Nowadays, a major challenge to face in the field of biodiesel production is how to overcome the high costs associated to conventional feedstock (Morales et.al,2011). One way to overcome drawback is using low grade feedstock, so that most of the efforts applied in biodiesel research are focused on looking for new raw materials fulfilling the requirements. The low grade feedstock is
also used in biodiesel production in order to overcome the high costs of production associated to conventional feedstock.

Therefore, this study is one alternative to improve current process not economical for low grade feedstock and to provide equilibrium data for biodiesel synthesis system using low grade feedstock, for intensified reactor such as liquid-liquid reactor. Currently, most of the researchers have been done the researches on the liquid-liquid equilibria in order to provide equilibrium data for biodiesel synthesis system using low grade feedstock. For example, they use phase equilibrium of ternary systems with biodiesel, glycerol, and alcohol to provide the equilibrium data (Negi et.al, 2006).

1.3 Research Objective

The objective of this research is to construct the McCabe-Thiele and the ternary diagram of triolein and ethyl oleate under various alcohol compositions.

1.4 Scope of Research

Scope of study is very crucial and one of the important parts in this research. The scopes of this study are:

1. Ethanol was used as a solvent for this process since it is more excellent fuel compared to methanol.

2. Palm oil was used as the easy resource of triglycerides.

3. Biodiesel (FAEE) was produced through trans-esterification reaction.

4. Analysis of components was conducted by using gas chromatography.