CHAPTER I
INTRODUCTION

Global demand for liquid hydrocarbons will continue to grow annually by 1.2% on average and the greatest oil demand will come from the transportation sector (Lukoil, 2013). Consumption of liquid hydrocarbons will keep on increasing in developing countries where the transportation industry is undergoing rapid growth, especially, growth in the number of cars as well as the development of sea, air and railway transportation. The use of fossil fuels in combustion engines has increased greenhouse gases (GHG), ozone depletion and environmental pollution related impacts.

Because of this fact, biofuels derived from renewable resources such as vegetable oils and agricultural feedstock have been received much attention as an alternative fuel which offers a benefit in terms of cleaner exhaust emissions.

Biofuels can be classified based on their production technology: first generation, second generation, third generation and fourth generation biofuel. First generation biofuel is biofuel which is made from sugar, starch, vegetable oil or animal fat using conventional technology. Second generation biofuel is made from non-food crops using advanced technology. It refers to lingocellulosic material including cereal straw, forest residue, bagasse, and purpose-grown energy crop such as vegetative grass and short rotation forest. It is anticipated that second generation biofuel will not complete with food crop anymore. Biofuel produced from algae is considered as the third generation biofuel and sometimes is called oilgae. Biofuel production from algae is low cost and high yield since algae require only sun light, water and CO_2 during the process of photosynthesis in order to convert to lipid or fatty acid. Finally, bio hydrogen is the fourth generation biofuel.

Nowadays, there are many plants which are grown for the newly alternative resource fuels such as sunflower, rape seed, jatropha, canola, palm, camellia oleilifera, algae etc. Among them, palm oil is one of the most valuable economic crops in South East Asia. This is because of the origin of palm oil; it grows well in different regions of tropical countries. Even more, palm oil is a highly efficient, high yielding source of food and non-food. With sufficient supply, therefore, palm oil is a potential source for biofuel production.

Biofuel production technologies have been developed for many years. Among them, transesterification method is the most common biodiesel production method which reduces the viscosity of vegetable oils. However, biodiesel also has many adverse effects fuel from production process. They are old weather limitations due to relatively higher cloud point and pour point, and increasing nitrogen oxides (NO_x) in the exhaust emissions. In addition, biodiesel is formed by the transesterification reaction of triglycerides with alcohols in the presence of a catalyst and produces glycerol as a co-product. Glycerol requires energy intensive processes to purify or convert to a value-added product, which could cause not only emission from additional process, but also impact to overall GHGs emission (Arpornpong *et al.,* 2014)

As an alternative approach, ethanol produced from agricultural feed stocks is a renewable energy source which can be made from very common crops such as sugar cane and corn. Therefore, ethanol–diesel blends, or E-diesel, are intensively studied for diesel engines without modification. However, ethanol–diesel blends are limited by the fact that they are immiscible over a wide range of temperatures (Singh, 2013). To overcome this problem, surface active agents or surfactants can be used as emulsifiers to stabilize the miscibility of ethanol and diesel.

Because of the disadvantages of the tranesterification process and ethanol blending process, microemulsification of vegetable oils is considered as an alternative method to avoid the process of tranesterification which generates a large volume of wastewater from purification of biodiesel and requires certain energy for glycerol purification. Microemulsions are amphiphile stabilized transparent, iso-tropic and thermodynamically stable dispersions of otherwise immiscible liquid phase and oil. In addition, the microemulsification helps to overcome the immiscibility of ethanol and diesel. Microemulsion-based biofuel is a promising technology, which could fulfill both environmental and economic competitiveness. The benefit of this technique is not only to reduce vegetable oil viscosity, but it also satisfies ethanol-diesel fuel homogeneity or prevents phase separation. In all cases, cost-effective and eco-friendly perspectives are the key challenges to satisfy future biodiesel technologies.

The carbon label for community products has been rising as an approach to improve the product by reducing the used energy, wastes as well as greenhouse gases emissions in a system. Many countries promote their manufactory to apply the concept of GHG accounting. Due to the fact that materials used in the process should be produced from biorenewable sources.

Bio-based surfactant is prepared by the long-chain fatty acids found in seed oil in the form of triacylglycerols (TAGs) for the lipophile. Typically, fatty acyl groups obtained from TAGs are converted into free fatty acids (FFA) or fatty acid methyl ester (FAME) or ethyl esters (FAEE) via hydrolysis and transesterification process (Desmetballestra group, 2008). Feedstock enriched in medium-chain saturates include palm, palm kernel particularly palm stearin, a palmitic acyl-rich byproduct from the purification and fractionation of palm kernel oil. Other potentially valuable sources of fatty acyl groups for surfactants and detergents are inexpensive feedstock such as tallow, used cooking oil, algal oils and oils from jatropha and soapnut.

The greenhouse gas emissions of the system are usually calculated by a tool for quantitative environmental assessment of materials, energy waste flows as well as services called Life Cycle Assessment (LCA). LCA is a methodology for evaluating the environmental loads of processes and products (goods and services) during their life cycle from cradle to gate or cradle to grave.

The goal of this research is to conduct the Life Cycle Assessment of microemulsion biofuel production. The scenarios with different appropriate green materials are evaluated to optimize substantial low environmental impacts of microemulsion based biofuels production process using LCA software package SimaPro version 7.1.The green materials utilized in the formulation are fatty acid methyl ester (FAME) as surfactant and bioethanol as polar phase.