CHAPTER I

INTRODUCTION

1.1 Motivation

Today, governmental agencies and research institutes all over the world are increasingly investigating ways to produce alternative renewable energy to substitute the exhausting petroleum fuels. Biodiesel is an example of renewable and biodegradable energy that is receiving increased attention as an alternative fuel for diesel engine. It has almost no sulfur or aromatic compounds, and has higher cetane number, compared with petroleum diesel. The most widely accepted method to produce biodiesel is by transesterification of oil or fat which gives the product that has properties closest to that of petroleum diesel. Transesterification is the reaction between vegetable oil and alcohol to produce alkyl monoesters of fatty acid (biodiesel) and glycerol as byproducts. The biodiesel produced can be used in any unmodified diesel engines in neat form, or mixed with petroleum diesel fuel.

Biodiesel production by transesterification can be product either by catalytic or non catalytic means. Conventional method uses catalysts including acids (e.g. sulfuric acids or hydrochloric acid), alkali (e.g. sodium hydroxides or potassium hydroxides), or enzyme such as Lipase. Acid catalyzed transesterification typically requires a long time to complete; while alkali catalyzed reactions have a disadvantage in that soap might be produced when alkali reacts with free fatty acids in the oil. Furthermore in both cases, extensive washing is required to remove these catalysts from the biodiesel product, causing a large amount of wastewater. Enzymes catalyzed reaction is a more environmentally friendly method, however the high cost of enzymes makes the process unattractive for industrial scale.

Saka and Kusdiana (2001a) proposed a method of biodiesel production via non-catalytic transesterification of vegetable oils in supercritical methanol. The reaction was found to be complete in a very short time compared with the catalytic processes. Furthermore, purification of the products is much simpler and the process is more environmentally friendly. However supercritical methanol reaction required

temperatures of 350-400°C and pressures of 45-65 MPa. Such high temperatures and pressure leads to high production costs and energy consumption.

One approach to bring down the cost of production would be to use inexpensive raw material. In Thailand, palm oil is the most suitable raw material for production of biodiesel in large scale due to its availability. Purified palm oil however is too expensive (26 baht per liter) to be economically feasible. Palm fatty acid, a by-product of palm oil refinery, on the other hand, is one of the most attractive raw materials due to its low cost of about 13 baht per liter (Buraphamankong Company). Furthermore, it is generally obtained in a purified form during the refining process of crude oil. Fatty acids react with methanol (or other alcohol) producing biodiesel by the reaction called alkyl esterification. Like transesterification, this reaction can be carried out either catalytically or non-catalytically (under supercritical condition). In catalytic process however, the alkali cannot be applied directly due to the competing saponification reaction of palm fatty acids with alkali. For this reason, acid catalyzed process must be used but it generally requires long reaction time. Alternatively, a two step method has been proposed, in which acid catalyzed esterification is initially carried out, followed by esterification with alcohol in an alkali catalyst to complete the reaction.

Fatty acids alkyl esterification can also be carried out in noncatalyitic supercritical conditions. Under such conditions, conversion of fatty acids to biodiesel can be achieved in one step. Nevertheless, a major concern with this method is that water that is produced during the reaction could cause the hydrolysis of methyl ester, and thus lowering the production yield of biodiesel. In this study, the esterification of palm fatty acids in supercritical methanol will be investigated and the specific objectives are:

1.2 Objectives

1. To investigate the effect of operating conditions for supercritical methyl esterification of palm fatty acids on yield of methyl ester in a batch reactor.
2. To investigate the effect of water on yield of methyl ester produced by supercritical methyl esterification.

3. To compare the yield of methyl ester produced by supercritical methyl esterification with other methods.

1.3 Working Scope

1. Determine the effect of reaction temperatures (250-300 °C) and reaction time (10-80 min) on the yield of biodiesel produced by supercritical methanol esterification.
2. Determine the effect of molar ratio of palm fatty acid and methanol (1:1-1:12) on the biodiesel yield.
3. Determine the effect of water on conversion of biodiesel (water/fatty acid ratio between 0-30 v/v %) at selected reaction temperature.

1.4 Expected benefits

1. This investigation provides the suitable conditions for the production of biodiesel by supercritical methyl esterification of palm fatty acids, which is an available inexpensive raw material.