CHAPTER 1
INTRODUCTION

1.1 Background and problem statement

As energy demands increase and fossil fuel reserves are limited, research is directed towards alternative renewable fuels. A potential diesel fuel substitute is biodiesel, consisting of ester compounds of fatty acids and produced by the transesterification reaction of triglyceride of vegetable oils with short-chain alcohol. The most commonly used vegetable oils to produce biodiesel are soybean oil and rapeseed oil. Biodiesel has already entered the fuel market and its main advantages are:

1. It is biodegradable and non-toxic, assuring safe handling and transportation.
2. It does not contain sulphur or aromatic compounds and thus it contributes to reduction of the diesel engine exhaust emission levels.
3. It comes from renewable sources.
4. It can be produced domestically, reducing a country's dependency on foreign fuel.
5. Small modifications of diesel engines can allow them perform very efficiently when fuelled with biodiesel- diesel blends or even pure biodiesel.

The perspectives for its expansion in the fuel market mainly depend on its price, and, apart from the margins for reduction of oil and alcohol price, production processes are considered with a view to reduce the production cost.

Transesterification of vegetable oils with simple alcohol has long been a preferred method for producing biodiesel fuel [1, 2]. Generally speaking, there are two methods of transesterification reaction. One is the method using a catalyst and the other is without the help of a catalyst. The former method has a long story of development and now biodiesel fuel produced by this method is in the market in some countries such as North America, Japan and some west European countries.

However, there are at least two problems associated with this process; the process is relatively time consuming and purification of the product for catalyst and

saponified products are necessary. The first problem is due to the two phase nature of vegetable oil/alcohol mixture requires vigorous stirring to proceed in the transesterification reaction. This conventional process still requires a high production cost and energy. The overall process, thus, includes transesterification reaction, recovery of unreacted alcohol, purification of ester compounds from catalyst and seperation of glycerine as a co-product from saponified products.

The latter method involves uncatalyzed transesterification of vegetable oil in supercritical methanol as recently reported by Saka [3]. The supercritical state of methanol is believed to solve the two phase nature of oil /methanol mixture to form a single phase due to a decrease in dielectric constant of methanol in supercritical state. As a result, the reaction was found to be complete in a very short time within 2-4 minutes, as described in their previous work [3, 4]. In addition, because of non-catalytic process, the purification of products after transesterification reaction is much simpler and environmentally friendly, compared with the conventional commercial method in which all the catalyst and saponified products have to be removed for biodiesel fuel.

1.2 Objectives to the study

1. To study a fundamental on the transesterification of the palm oil and rice-bran oil in supercritical ethanol. This includes the variable conditions which provide appropriate products.
2. To study kinetics of transesterification of palm oil and rice-bran oil to biodiesel fuel under supercritical ethanol conditions.

1.3 Scope and limitation of the study

1. Study the effect of molar ratio of palm oil and rice-bran oil to ethanol by varying between 1:10-1:50 (palm oil or rice-bran oil:ethanol) under supercritical conditions.
2. Study the effect of reaction time by varying 30 seconds to 360 seconds under supercritical ethanol conditions.
3. Study the effect of reaction temperature by varying 250°C to 350°C under supercritical ethanol conditions.

4. Evaluate kinetic parameters and the kinetics of transesterification reaction of palm oil and rice-bran oil under supercritical ethanol conditions.

1.4 Expected outcomes

1. Information of suitable molar ratio of palm oil and rice-bran oil to ethanol under supercritical conditions.
2. Information of suitable reaction time and reaction temperature of transesterification reaction under supercritical ethanol conditions.
3. Information of kinetics of transesterification reaction of palm oil and rice-bran oil under supercritical ethanol conditions.