CHAPTER I
INTRODUCTION

As a resource, petroleum-based diesel fuels are limited and environmental problems that occur from using petroleum as a source of energy are becoming a greater concern, since diesel engines emit a great amount of NO_x, CO, and particulate matter (PM) that cause air pollution problems leading to the greenhouse effect which is the most serious environmental problem all over the world. Another problem nowadays is the increasing of crude oil prices due to the continuously increasing demand for petroleum-based diesel fuel. Researchers all over the world are trying to find alternative fuels in order to replace petroleum-based diesel fuel. One of the most promising approaches is the conversion of vegetable oil, which primarily contains triglycerides and free fatty acid, into biodiesel.

Biodiesel, which is considered to be a possible substitute of conventional diesel fuel, is biodegradable, nontoxic, renewable, and has low emissions of PM, CO, NO_x, sulfur and hydrocarbons as compared to conventional diesel fuel. Biodiesel which is derived from vegetable oil can be used as conventional diesel fuels in diesel engines because its properties are very close to petroleum-based diesel fuels. For example, biodiesel has the proper viscosity, a high flash point, high cetane number, and no engine modifications are required. There are many processes which can be used to produce biodiesel, such as pyrolysis, supercritical transesterification and transesterification. The most commonly used method is transesterification.

Transesterification is a reaction where vegetable oil or fat reacts with alcohol by using a catalyst to form esters and glycerol. The vegetable oils typically are mixtures of triglycerides from various types of fatty acids. The vegetable oils react with alcohol by using a catalyst in order to change the triglycerides and free fatty acid to alkyl esters and glycerol. Alkyl esters are well known as biodiesel. The type of alkyl ester depends on the type of alcohol used and the type of free fatty acid in vegetable oils. Methanol is one type of alcohol that is favored to be used in this process because it gives a proper viscosity and boiling point and a high cetane number.

Many researchers use transesterification to produce biodiesel by using a homogeneous catalyst. A catalyst used in this process can be either basic or acidic such as sodium hydroxide and sulfuric acid, respectively, but a basic catalyst (sodium hydroxide or potassium hydroxide) is often preferred because the reaction rate is more rapid than an acid catalyst. Even though a homogeneous catalyst is preferred, it has many problems, leading to the reduction of biodiesel yield. For example, hydrolysis and saponification are side reactions of transesterification which produce soap (an undesired product). Consequently, it is necessary to separate the catalyst from the product and a large amount of waste water is produced in order to separate and clean the catalyst and the products.

A heterogeneous catalyst is a new choice and has been receiving the most attention for replacing the homogeneous catalyst in the transesterification process. It offers good separation, product purification and a reduction of environmental pollution.

This work is focused on the production of biodiesel from refined palm oil by using heterogeneous catalysts. Two types of heterogeneous catalysts, KOH/Al_2O_3 and KOH/NaY, are prepared by impregnation and are applied to determine the optimum conditions for biodiesel production. Several factors which may influence the quality of the produced biodiesel were investigated, including the reaction time, wt.% loading of the catalyst on the support, molar ratio of methanol to oil, amount of catalyst, stirrer speed, and reaction temperature.