CHAPTER I
INTRODUCTION

Due to the increase in crude oil prices, limited resource of petroleum-based diesel fuels and environmental concerns, a search for alternative fuels have gained significant attention over the years. Among different possible resources, diesel fuels derived from triglycerides of vegetable oils and animal fats present a promising alternative to substitute petroleum-based diesel fuels.

A number of studies have shown that triglycerides of vegetable oils can be used as diesel fuels (Fukuda *et al.*, 2001). The main advantages of using vegetable oils as diesel fuels are their availability and renewability. However, the direct use of vegetable oils in diesel engine can lead to a number of problems such as poor fuel atomization, poor cold engine start-up, oil ring stickening, gum and other deposit formation. Consequently, considerable efforts have been made to develop alternative diesel fuels that have the properties and performance as the petroleum-based diesel fuels. There are four major ways which have been studied extensively i.e. pyrolysis, dilution and blending, microemulsification and transesterification (Fangrui *et al.*, 1999). The most commonly used method is the transesterification.

Transesterification, also called alcoholysis, is the reaction of a fat or oil with an alcohol to form esters and glycerol (Fangrui *et al.*, 1999). This process has been widely used to reduce the viscosity of vegetable oils (triglycerides). In transesterification, vegetable oil that consists mainly of triglycerides will react with alcohol to form mixture of alkyl esters and glycerol. The alkyl esters product from this process is termed biodiesel which has become more attractive recently because of its environmental and economic benefits.

Biodiesel produced from vegetable oils can be used as an alternative to diesel fuels because the characteristics of biodiesel are close to petroleum-based diesel fuels. Several works have shown that biodiesel produced from various vegetable oils have viscosity close to petroleum-based diesel fuel. Their volumetric heating values are a little lower, but they have high cetane and flash points (Fukuda

et al., 2001). Consequently, biodiesel is a strong candidate to replace ordinary diesel fuels if the need arises.

Nowadays, fatty acid methyl esters (FAME), known as biodiesel, have received the most attention. FAME can be produced by transesterification of vegetable oil with methanol. They have proper viscosity and boiling point and high cetane number (Gryglewicz, 1999).

In many countries, different vegetable oils are used as a raw material for making biodiesel. For example, soybean oil in the United States, rapeseed and sunflower oils in Europe and palm oil in Malaysia are being considered (Srivastava and Prasad, 2000). In Thailand wherein coconut and palm oil are produced abundantly, they can be potential raw material for making biodiesel.

Transesterification reaction can be catalyzed by both acidic catalysts and basic catalysts. In general, homogeneous catalysts such as minerals acids, metal hydroxide and metal alkoxide are usually used in transesterification reaction. However, the replacement of homogeneous catalysts by heterogeneous catalysts would have several advantages such as easy catalyst separation and reduction of environmental pollutants (Gorzawski and Hoelderich, 1999).

A number of studies on the transesterification have shown that the use of homogeneous catalyst yields higher alkyl esters than that of heterogeneous catalyst. However, there are prospects that the technology of production of alkyl esters will be simplified when heterogeneous catalysts are used instead.

In this work, the production of biodiesel by using heterogeneous catalysts was investigated. Six types of catalyst (ZrO_2, ZnO, SO_4^{2-}/SnO_2, SO_4^{2-}/ZrO_2, KNO_3/KL zeolite, and KNO_3/ZrO_2) were prepared and applied for the transesterification of two types of vegetable oil, which are crude palm kernel oil and crude coconut oil. In addition, the dependencies of the methyl esters content upon the reaction time, and amount of catalysts used was also investigated.