CHAPTER I
INTRODUCTION

One of the most vital problems in the world today is the continuing sharp increase of crude oil prices, which has a direct effect on many fields, especially transportation. Because of this, the price of goods becomes higher and directly affects our lives. Finding alternative energy is one of many ways to solve this serious problem. Biodiesel is a promising substitute for conventional diesel fuel because its properties are quite similar to diesel fuel. Moreover, the continued increase in the consumption of petroleum has led to an increase in air pollution and has accelerated global warming due to the increase in atmospheric CO_2. If biodiesel were to be used as an alternative fuel, the production of CO_2 would not increase because the CO_2 emitted from biodiesel would be recovered through the production of biomass (the feedstock of biodiesel) (Park *et al.*, 2008). Furthermore, biodiesel contains no sulfuric compounds, which would lead to zero SO_x production.

Biodiesel is produced by the transesterification of the triglycerides of refined/edible oils with methanol in the presence of homogeneous catalysts. In the conventional method of biodiesel production, the reaction occurs in a batch reactor. The batch process includes a two-phase liquid reaction that results in long residence time and low yields. Consequently, the batch reactors need to be run at high impeller intensity, high temperature, and high pressure to obtain reasonable reaction rates and yields (Mittlebach and Remschmidt, 2004). Moreover, removal of the homogeneous catalysts is technically difficult and a large amount of wastewater is produced to separate and clean the catalyst and the products (Xie *et al.*, 2007). The other main drawback in biodiesel production is the high production cost, compared with the cost of diesel obtained from petroleum (Di Serio *et al.*, 2006).

One technique for dealing with these problems is the replacement of the homogeneous catalysts with heterogeneous catalysts, which affords easy catalyst separation, reduction of environmental pollutants, and regeneration of the catalyst, which can reduce the cost of production. Another technique for solving these problems is improving the process technology of biodiesel production. Using heterogeneous catalysts contained in a fixed-bed reactor can improve the system because of the combination of heterogeneous catalysts and a fixed-bed reactor makes it more suitable for use in very large-scale industrial applications.

The main purpose of this research is to study biodiesel production in a fixed-bed reactor with two different types of solid catalysts—potassium hydroxide supported on zirconia and potassium hydroxide supported on mordenite zeolite. In addition, reaction time and catalyst particle size are varied for finding the optimum conditions. The leaching of active components and the regeneration of catalysts are studied. The biodiesel analysis and the characterization of the catalysts are done to explain the obtained results.