CHAPTER I
INTRODUCTION

In the recent years, the world's energy demand, derived from petroleum, mineral coal, and natural gas, is increasing at an exponential rate. The main reason that caused the fast diminishing of energy resources is due to a rapidly increasing of population and a growth of industrialization. In order to solve these problems, researchers are trying to find new alternative energy sources to substitute the fossil fuel. Therefore, biomass is increasingly gaining international attention as a source of renewable energy.

Biodiesel, a mixture of fatty acid methyl esters (FAMEs), has been developed as one of the most promising alternative fuel for fossil fuel regarding to the limited resources of fossil fuels and the environmental concerns. It has high biodegradability, low CO, SO_x, NO_x, and particulate matter (PM) contents, renewability, and lack of aromatic compounds as compared to conventional diesel fuel. On the other hand, biodiesel can be used in diesel engines without engine modification because its characteristics are similar to those of petroleum-based diesel fuels. The production of biodiesel is performed by transesterification reaction of triglycerides using alcohol in the presence of a catalyst.

Transesterification or alcoholysis, is a reaction of a fat or oil reacts with an alcohol by using a catalyst to form esters and glycerol. Many types of alcohol can be used such as methanol, ethanol, propanol, and butanol. The most common used is methanol because it gives a proper viscosity and boiling point and a high cetane number. In the transesterification of vegetable oils, triglyceride reacts with methanol producing glycerol and a mixture of fatty acid methyl esters (biodiesel).

In the transesterification process, biodiesel is usually prepared in the presence of homogeneous base or acid catalysts. The acid-catalyzed process often uses hydrochloric acid or sulfuric acid as a catalyst; however, a high molar ratio of methanol to oil is needed, and the reaction time is very long. So, the base catalysts are preferred to be used instead of the acid catalysts because the catalytic activity of a base is higher than that of an acid and acid catalysts are more corrosive.

However, in this conventional homogeneous method, the removal of these catalysts is very difficult, and a large amount of wastewater is produced to separate and clean the catalyst and the products. Therefore, conventional homogeneous catalysts are expected to be replaced by environmentally friendly heterogeneous catalysts. The replacement of homogeneous catalysts by heterogeneous catalysts would have various advantages such as the easy catalyst separation from the reaction mixture, product purification, and the reduction of environment pollutants.

In this work, transesterification was carried out using CaO–ZnO as heterogeneous basic catalyst. The effects of reaction parameters, such as molar ratio of methanol to oil, reaction time, amount of catalyst, and reaction temperature, were optimized for the production of biodiesel. In addition, effects of %loading of Ca on ZnO support, calcination temperature, and catalyst preparation on the biodiesel yield were also studied.