CHAPTER I
INTRODUCTION

Nowadays, the world's total energy output is mainly generated from fossil fuels and experts have warned about the depletion of this actual source in the near future. The main cause is increasing of the population and a growth of industrialization. Besides, the increasing environmental impact care has imposed restrictions on fuel combustion emissions. In order to solve these problems, researchers are trying to find new alternative energy sources to substitute the fossil fuel. Therefore, the use of biodiesel as a replacement of fossil fuel is becoming increasingly.

Biodiesel, a renewable fuel with similar combustion properties to fossil diesel, is normally produced by transesterification of highly refined oils with short-chain alcohols. Biodiesel can significantly decrease the exhaust emission of CO, SO_x, and unburned hydrocarbons from motor vehicles. Biodiesel is environmentally beneficial and a promising alternative to fossil diesel. On the other hand, biodiesel has good properties: for example, low volatility, flammability, good transport and storage properties, and high cetane number.

Transesterification or alcoholysis is the reaction process by mean of which triglyceride molecules present in animal fats or vegetable oil react with an alcohol in the presence of a catalyst to form ester and glycerol. The catalyst presence is necessary to increase the reaction rate and the transesterification reaction yield. Catalyst mainly used can be classified into homogeneous catalysts and heterogeneous catalysts. Currently, homogeneous catalyst applications is widely used due to their simple usage and less time required for oil conversion dominate the biodiesel industry. The widely used alkaline catalysts, NaOH and KOH, are easily soluble in methanol. However, homogeneous catalysts have some disadvantages, including the facts that they cannot be reused, they produce large amounts of waste water and separation of biodiesel from glycerol is more difficult. Therefore, conventional homogeneous catalysts are expected to be replaced by environmentally friendly heterogeneous catalysts. Heterogeneous catalysts act in different phase from the reaction mixture, usually as a solid. Heterogeneous catalysts can be classified into solid base catalysts and solid acid catalysts. In general, solid base catalysts are more active than solid acid catalysts requiring relatively shorter reaction times and lower reaction temperature. However, it is very sensitive to the purity of the reactants. It is well known that the moisture and high FFA content of crude vegetable oils are important parameters during catalyzed transesterification reactions. The presence of FFA leads to soap formation and subsequently lower yield of biodiesel. The solid acid catalysts have several advantages over solid base catalysts such as the reaction is less affected by the presence of water and free fatty acids (FFA). The main advantage of solid acid catalysts is its ability to carry out the esterification of free fatty acids.

In this work, esterification of oleic acid was carried out using a solid acid catalyst derived from lignin. Effects of sulfonation temperature and sulfonation time during catalyst preparation on the biodiesel yield were also studied. The effects of reaction parameters, such as molar ratio of methanol to oil, reaction time, amount of catalyst, reaction time and reaction temperature were optimized for the production of biodiesel via esterification.