# CHAPTER I
# INTRODUCTION

Nowadays, the renewable alternative energy sources, especially biofuels, have important roles to prevent shortages of fuels in the future. Even though we have fossil fuel: petroleum, mineral coal and natural gas, that have been used as main energy source in many countries, the management of energy resources have to be considered, as well as producing and developing other alternative energies to avoid the shortage in the future. Biofuels are the fuels that mainly derived from the biomass, materials from dead organisms of plant, such as cellulose and vegetable oils. The most widely spread types of biofuels these days are ethanol and biodiesel.

Biodiesel, one of the renewable alternative energy, is studied extensively today since it is clean and safe, and its combustion property is close to petroleum diesel fuels. Biodiesel or fatty acid methyl esters (FAMEs) are synthesized by transesterification of vegetable or animal oil with a short-chain alcohol in the presence of a catalyst. Suitable catalysts for transesterification are basic catalysts such as NaOH and KOH. Since, they can be operated with lower methanol to oil molar ratio, lower loading concentration, lower reaction temperature, and shorter reaction time than acid catalysts (Di Serio *et al.*, 2005 and Lotero *et al.*, 2005). However, soap productions, caused by the reaction of free fatty acids (FFAs) in the vegetable oil and basic catalysts, could affect to the biodiesel yields. Therefore, purified feedstock oil is needed to avoid this problem. Alternatively, as for feedstock with high level of FFAs, many acidic catalysts have been studied. Lotero *et al.* (2005) studied the acidic catalysts used for esterification of FFAs and short-chain alcohol, simultaneously catalyze transesterification.

Normally, the most commonly studied catalysts for transesterification are homogeneous basic catalysts, some of them were compared by Vicente *et al.* (2004). They are more active than heterogeneous catalysts. However, the drawback of homogeneous catalysts is the separation of the catalysts after the reactions is very difficult. It results in large amount of waste water in biodiesel production; therefore,

heterogeneous catalysts have advantages cover that problem. It can be separated easily and the waste from the process has been decreased (Ye *et al.*, 2013).

The solid acid catalysts can perform esterification effectively, for example, the sulfonated carbonized vegetable oil asphalts (Shu *et al.*, 2010). It has lower corrosion property than homogeneous catalysts and lower cost than basic catalysts. In the past few years, the sulfonated carbon catalyst as solid acid catalysts exhibited better activities than many of the other catalysts. There are many interesting reagents with suitable condition, besides sulfuric acid. It strongly depends on sulfonation conditions, as reported by acid density. Some pure or mixed reagents with high acid density, gave higher activity for esterification at moderate conditions for shorter time compound to biodiesel. (Liu *et al.*, 2013 and Zhang *et al.*, 2010)

Oleic acid is used in this experiment since it presents in the context of vegetable oil. It is the main unsaturated fatty acid that composes in the most widely used oil in the world of palm oil, about 37 wt%. Corncobs are available in Thailand and are currently being used as animal feed. It composes of three main composition; cellulose, hemicelluloses, and lignin. The cellulose and hemicelluloses are used as a raw material to produce biobutanol. Wastes from hydrolysis process in biobutanol production are derived as lignin. This residue is used as a starting material in this work. After that, the pretreated corncob is activated by sulfonation process, using sulfuric acid or p-toluenesulfonic acid as activating acid. Then, the conditions of sulfonation process: type and amount of reagent, ratio of acid, time, and temperature, have to be optimized and compared with previous work (Namwong, 2014). The catalysts properties: morphology, functional group, surface area, pore size, internal structure, bulk composition, types of acid site, acid site concentration, and sulfur content, are studied to relate with the biodiesel yields.