

## CHAPTER I

### INTRODUCTION

Biodiesel is recognized as an ideal alternative diesel fuel due to its environmental benefits and its origin from renewable resources including vegetable oils or animal fats. Most biodiesel is currently produced by transesterification of triglycerides with methanol. For every 9 kg of biodiesel produced, about 1 kg. of glycerol is formed as a by-product. To convert the crude glycerol into value-added products, such as catalytic synthesis of propylene glycol from glycerol, is interesting in green chemistry.

The catalytic dehydroxylation of glycerol to propanediol can be carried out in the presence of metallic catalysts and hydrogen. A previous study, Sitthisa (2007) has demonstrated the effectiveness of Cu/Al<sub>2</sub>O<sub>3</sub>. The results showed that 100% glycerol conversion and 90% propylene glycol selectivity were obtained. However, the conversion decreased drastically after 6 h. Swangkotchakorn (2008) introduced ZnO into Cu/Al<sub>2</sub>O<sub>3</sub> and found that the addition of ZnO could prolong the stability of the catalyst. Chirddilok (2009) found that Cu-ZnO/Al<sub>2</sub>O<sub>3</sub> showed superior catalytic activity to Cu/Al<sub>2</sub>O<sub>3</sub> and Cu/ZnO catalysts. Panyad (2011) concluded that the Cu-ZnO/Al<sub>2</sub>O<sub>3</sub> catalyst prepared by the IWI method exhibited the highest catalytic activity and stability as compared to the ones prepared by the SG and COP methods. The causes of catalyst deactivation were the combination of coke formation and sintering of active copper metals. Auttanat (2012) reported that the catalytic dehydroxylation of glycerol to propylene glycol over Cu-ZnO/ Al<sub>2</sub>O<sub>3</sub> using the refined glycerol as feedstock gave the higher catalytic activity than the yellow, technical, and crude grade glycerol. The ICP-EOS results indicated that the catalyst deactivation was caused by the deposition of alkaline contaminated in the feedstocks. The higher amount of impurity (especially Na and K) led to the lower catalytic activity.

In Yuan *et al.* (2009) work, the hydrotalcite, MgO, Al<sub>2</sub>O<sub>3</sub>, H-ZSM5 and H-Beta supported Pt catalysts were prepared and tested for hydrogenolysis of glycerol to propylene glycol. It was found that solid base (hydrotalcite and MgO) supported Pt catalysts exhibited the predominant activity and higher 1,2-PDO selectivity than

that of solid acid ( $\text{Al}_2\text{O}_3$ , H-ZSM5 and H-Beta). Characterization results revealed that the alkaline strength of the catalyst contributed obviously to its activity for glycerol hydrogenolysis. At the same time, solid base supported catalysts also possess advantages in environmental friendly, easiness in separation, and recycle.

In the present study, the catalytic dehydroxylation of glycerol to propylene glycol will be conducted over the  $\text{Al}_2\text{O}_3$ , ASA, MgO, and HT (hydrotalcite) supported Cu-ZnO catalysts prepared by incipient wetness impregnation method. The main purpose is to investigate the effects of catalyst supports on the performance and stability of the Cu-ZnO. Moreover, the catalyst regeneration was studied.