CHAPTER I
INTRODUCTION

One of the most commonly found problems in the energy fuels is the reduction of fossil fuel and its increasing price. Researchers try to solve this problem by developing alternative energy to replace fossil fuel consumption. Biodiesel is one such fuel synthesized by using vegetable oils, animal fats or recycled restaurant grease by transesterification reaction. It is a renewable fuel that is non-toxic, biodegradable and environmentally friendly. In the biodiesel production, every 9 kilograms of biodiesel produced, about 1 kilogram of a crude glycerol by-product is formed. As the biodiesel production is increasing rapidly, the crude glycerol has been generated in a great quantity, causing market prices to fall. For this reason, it is essential to find a new technology for converting glycerol into valuable chemicals to make biodiesel production a cost effective process.

Dehydroxylation of glycerol to propylene glycol is one of the potential solutions to this problem. Propylene glycol ($CH_3CHOHCH_2OH$), also named as 1,2 propanediol, is a major commodity chemical that has a number of applications in various fields. For example, it can be used as raw material for the synthesis of unsaturated polyester resins, functional fluids (antifreeze, de-icing, and heat transfer), pharmaceuticals, foods, cosmetics, liquid detergents, tobacco humectants, flavors and fragrances, personal care, paints and animal feed (Chuang-Wei Chiu *et al.*, 2006).

The catalytic dehydroxylation of glycerol to propylene glycol can be carried out in the present of metallic catalyst and hydrogen. A previous study (Sitthisa, 2007) has demonstrated the effectiveness of Cu/Al_2O_3 catalyst. The results showed that 100% glycerol conversion and 90% propylene glycol selectivity were obtained. However, the conversion decreased rapidly after 6 h. Swangkotchakorn (2008) introduced ZnO into Cu/Al_2O_3 catalyst and found that the addition of ZnO could prolong the stability of the catalyst by reducing the metal-support interaction to form aluminum copper. Chirddilok (2009) found that the $CuZnO/Al_2O_3$catalyst showed superior catalytic activity to Cu/Al_2O_3 and Cu/ZnO catalysts. Panyad (2011) concluded that the $Cu–ZnO/Al_2O_3$ 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) studied the catalytic conversion of glycerol to propylene glycol over $CuZnO/Al_2O_3$ catalyst. The results showed that using refined glycerol as feedstock gave the higher catalytic activity than technical grade glycerol. The ICP-EOS results indicated that the catalyst deactivation caused by the deposition of alkaline contaminated in the feedstocks. The higher amount of impurity (especially Na and K) the lower catalytic activity. Wongpraphairoat (2013) reported that impregnated $CuZnO/Al_2O_3$ catalyst exhibited the highest performance in terms of glycerol conversion due to high surface area of alumina support. However impregnated CuZnO/MgO catalyst exhibited the highest performance in terms of stability. Recently, Paengsri (2014) found that co-precipitated CuZnO/MgO catalyst presented higher catalytic activity than that of impregnated catalyst. Nevertheless, the result indicated that the amount of precipitated Mg become lower than expected metal loading. This is probably due to pH value of mixed metal solution at 10.5 is not proper for precipitation of Mg.

In the present study, the catalytic dehydroxylation of glycerol to propylene glycol will be conducted over the CuZnO catalyst supported on $MgO\text{-}Al_2O_3$ mixed oxide supports. $MgO\text{-}Al_2O_3$ mixed oxide supports were prepared by co-precipitation (COP) method and $CuZnO/MgO\text{-}Al_2O_3$ catalysts were prepared by incipient wetness impregnation (IWI) method. The purpose of this work is to investigate the effect of mixed oxide support in $CuZnO/MgO\text{-}Al_2O_3$ to the catalytic activity of refined glycerol, yellow grade glycerol, and NaOH containing glycerol feedstock.