

CHAPTER I

INTRODUCTION

Light olefins such as ethylene and propylene are widely used in petrochemical industries. Ethylene and propylene are basic petrochemicals used in the production of everyday used items such as polymers, paints, and antifreeze. Generally, light olefins are mainly produced by the oxidative dehydrogenation of alkane (such as ethane and propane), the steam cracking of paraffinic hydrocarbon (e.g. naphtha), and the fluid catalytic cracking (heavier oils, such as heavy gas oil or vacuum gas oil). The consumption of light olefins has been growing continuously, and will continue to rise. For example, during 2005-2010, ethylene demand growth is expected to increase to about 4.3% per year. Propylene demand growth during the same period would rise to 4.8% per year. (CHEMICAL MARKET ASSOCIATES, INC., 2005). Furthermore, fossil crude oil used as a raw material for both petroleum and petrochemical industries has been more and more expensive and scarce. Therefore, alternative sources for the production of light olefins become more and more interesting.

Moreover, the amount of waste tire is increasing, and the disposal of waste tire also causes environmental and economic problems. There are several technologies to solve these problems including retreading of scrap tire, reclaiming, grinding, and being derived to fuel by thermal technologies; for example, incineration, gasification, and pyrolysis. Especially, the pyrolysis process, which is the thermal decomposition of organic materials to lower molecular weight compounds in the absence of oxygen, has a high potential to transform waste tire into useful products. The pyrolysis oil can be used as a fuel, a source of chemicals, and a petroleum refinery feedstock. The pyrolysis gas can be used as a fuel gas whereas the solid residue can be used as a solid fuel or low grade carbon black. Waste tire also can be used to produce light olefins by pyrolysis. From the characterization of gases obtained from the pyrolysis of tire, they consist of 41 % vol light olefins (ethylene and propylene) (Díez *et al.*, 2004). Waste tire pyrolysis has been widely studied for years (Williams *et al.*, 1990; Rodriguez *et al.*, 2001; Barbooti *et al.*, 2004; Murillo *et*

al., 2006; Aylón *et al.*, 2008). Different variables that could affect the pyrolysis products have been studied.

In addition, the catalytic pyrolysis of waste tires is also interesting. The catalysts have some important roles on the quality and quantity of pyrolysis products. There are many series of catalysts used in the catalytic pyrolysis, depending on the properties of catalysts such as activity, pore size, and selectivity. One of the most interesting series of catalysts used in catalytic pyrolysis is bifunctional catalysts because they can increase the gas yield (comprising light olefins) due to its high activity and selectivity for cracking and the dehydrogenation of light hydrocarbons (Choosuton, 2007).

Mordenite is an acid catalyst used for cracking, isomerization, and alkylation (Auerbach, 2003). And, Ruthenium (Ru) is the most active metal for the hydroconversions of hydrocarbons and cracking reactions (Akhmedov *et al.*, 2000). Ru supported catalyst can decrease saturates in the derived oils, but increase the gaseous product yield (Nguyễn *et al.*, 2009). So, Ru supported HMOR catalysts are a suitable cracking catalysts for improving the light olefins productions. Furthermore, there are many researchers having studied the catalytic pyrolysis of waste tire over Ru/HMOR. Choosuton (2007) investigated the effect of metal supported on different zeolites (Beta, USY, HMOR, and KL). He concluded that Ru/HMOR can produce a high yield of light olefins (ethylene and propylene). Likewise, Kittikom (2008) studied the effect of Ru/HMOR and Ru/HZM-5 on pyrolysis products. He found that the Ru/HMOR gave a high yield of gaseous product due to its high acidity for cracking reaction. Hence, Ru/HMOR is a good catalyst, which can enhance the production of light olefins.

The purpose of this work was to further develop the Ru/HMOR to be an industrial pyrolysis catalyst. The effect of ratio of pellet to reactor diameter on pyrolysis products was examined. Also, the deactivation of catalysts on pyrolysis products was investigated. The used tire pyrolysis was carried out in a bench-scale autoclave reactor with the heating rate of 10°C/min from room temperature to the final temperature of 500°C in the atmospheric pressure. Other parameters; holding time, the pyrolysis temperature, the catalytic temperature, N₂ flow rate, the amount

of sample and catalysts were fixed at 90 min, 500°C, 300°C, 30 ml/min, 30 g and 7.5 g, respectively.