



CHAPTER I INTRODUCTION

Nowadays, the demand of car usage increases every year, causing the increases of discarded waste tire and fuel usage. In addition, the problem in fuel production is the insufficient fuel resources. And, the cause of waste tire on its difficult decomposition in environment is that it has more complex structures (polymer, steel, fabric, vulcanization and add some additives to protect degradation). Common ways to reuse are retreading and reclaiming, but they have limitations. Then, it seems that the method to solve the problems of insufficient fuel resources is by converting the large amount of waste tire, which is hard to decompose, to fuels and chemical feedstocks.

There are many techniques for converting waste tire to fuels, such as incineration, gasification, and pyrolysis. This present work focuses on pyrolysis, which is the thermal decomposition process in an oxygen-free atmosphere. The product of this process consists of 10 %wt of gas, 40 %wt of liquid, and 50 %wt of solid, (Rodriguez *et al.*, 2001). Oil and gas can be used as fuels or chemical feedstocks. But these products are still not good enough for being used in an engine and as some high-grade chemical feedstocks. Then, there are many researches studying for the improvement of product quality. Solid is carbon that is able to be used as additive carbon and reinforcement.

Many types of pyrolysis assisting techniques are microwave, ultrasonic, super critical sonic depolymerization, and using a special catalyst (pure and bifunctional). Although there are many researchers improving the quality of product obtained from pyrolysis by changing operating conditions such as pyrolysis temperature, heating rate, and designed reactor/condenser, using a catalyst is the best way to enhance the quality of pyrolysis product because it can produce product with high quantities and selectivity.

The research on pyrolysis waste tire without a catalyst by Rodriguez *et al.*, (2001) revealed that 500°C is the optimum temperature for completing the pyrolysis of tire. The results showed 45 %wt of solid, 38 %wt of oil, and 17 %wt of gas. Similarly, in 2004, Laresgoiti *et al.*, also found that a large amount of aromatic

compounds were produced at 500°C. An example of research related to improving pyrolysis by using a catalyst is Williams and Brindle (2002), which Y-zeolite was used. The results showed that a high amount of aromatic compounds was produced, leading the enhancement of the octane number of gasoline. A year later, a report showed a Y-zeolite (CBV-400) gave a high amount of single ring aromatics (benzene, toluene and xylene), because it has larger pores size and higher acidity than ZSM-5 (Williams and Brindle, 2002). Similarly, Williams (2003) found the higher catalyst per tire ratio gave the higher light naphtha (<160°C), and found that heating rate affected to the yield of aromatic compounds, olefins, and coke.

There are many researchers continuously improving the pyrolysis by using bifunctional catalysts such as Arribas and Martinez (2002), which Pt supported on USY zeolite was used. The result showed that the catalyst can increase the yield of octane number via coupling hydrogenation and the ring opening of aromatic compounds. Roldan *et al.*, (2005) used Pt/USY to get the higher selective isomerization of light naphtha. Also, Boxiong *et al.*, (2006) found that cracking activity depended on the acid site quantity. The result indicated that the increasing amount of alumina led to the increase of cracking activity. Choosuton (2007) used some noble metals (Pt, Pd and Ru) loaded on a zeolite, and it was found that the effect of loaded metals increased the amount of cooking gas and polar aromatics in the oil fraction, and reduced the gas oil fraction. Lee and Rhee (1998) reported that Pd-Pt bimetallic interaction brought about the increase in the amount of electron-deficient metal sites, which improved the sulfur tolerance by reducing irreversible electrophilic sulfur adsorption and thereby reducing sulfur-induced coke formation. Massa *et al.*, (2006) found that the methods to prepared catalysts (co-impregnation, impregnation, co-precipitation) affected to the metal content and metal dispersion on the catalysts.

As above, Pt and Pd enhance the quantity and quality of pyrolysis products by various pathways; for examples, isomerization, dehydrogenation, and hydrogen transfer reaction. However, Pt can be deactivated easily. Furthermore, Pd loading was found to prevent Pt from deactivation. Thus, the objective this research was then to study the changes of both quantitative and qualitative properties of products from

waste tire pyrolysis using Pt and Pd bimetallic catalysts on Y zeolite prepared from several preparation methods with various metal ratios.