CHAPTER I
INTRODUCTION

Nowadays, with the increase in the petroleum fuel consumption and the inadequate of conventional fuel, fuels from wastes or alternative fuels are used for substituting petroleum-based fuels. The fuels from wastes can be produced by several sources such as wood, tar sand bitumen, biomass, and especially from waste tires. Because the structure of tire is designed to struggle to degradation, the production of fuels from waste tires becomes interesting. Moreover, a large quantity of waste tires is generated in the world due to the evolution of vehicle technology, which has been causing serious environmental problems.

Pyrolysis of waste tires is a suitable option since it does not only produce petroleum-based fuel substitutes, but also solves the environmental crisis. Pyrolysis is the thermal degradation process of the tire under the oxygen-free condition. The pyrolysis products of waste tire can be categorized into three phases at room temperature, i.e., gas product, liquid oil, and solid residue (char or ash) (Chang, 1996). The tire pyrolysis oil has a high calorific value of around 41-44 MJ kg^{-1}. Thus, it can be used as replacements for conventional fuels (Williams, 1997), and char can be also useful either as a smokeless fuel, carbon black, or activated charcoal (Williams *et al.*, 1992). The pyrolysis technique can crack the high molecular weight of rubber and other organic compounds in waste tires. The variety of high value products are obtained such as cooking gas (ethylene and propylene), mixed C_4, and mono-aromatics (benzene, toluene and xylenes) and etc. Moreover, sulfur elements, which were used for crosslinking the polymer chains of rubber (Williams *et al.*, 1990), are also cracked in the pyrolysis process. Through pyrolysis, sulfur atoms are present as polar-aromatics in the tire-derived oil. Many researchers reported that the bifunctional catalysts were used for reducing polar–aromatic compounds in the heavy gas oil and gasoline ranges (Dũng *et al.*, 2009). As well known, the hydrogenation functionality of noble metals makes them the potential catalysts for deep HDS via the hydrogenation (HYD) pathways (Ishihara *et al.*, 2005). In addition, noble metals supported on an acidic support can increase the activity on hydrogenation of aromatic compounds, and improve the deep hydrodesulfurization.

From a previous work, noble metals were used to optimize the high value products from the pyrolysis of waste tires, especially mono-aromatics. The mono-aromatics such as benzene, toluene, and xylenes are very versatile chemical feedstocks used to produce many commercial products. Noble metals supported on acid zeolite catalysts, especially Pd and Ru supported on HMOR and HBeta were reported as potential catalysts to produce the high valuable products as olefins, mixed C_4, and mono-aromatics from waste tire pyrolysis (Choosuton *et al.*, 2007). In case of non-noble metals, Ni and Fe are active catalysts for several industrial processes. Ni catalysts have been used in hydrotreating process, and Fe catalysts have been mostly used in Fischer-Tropsch synthesis (Pour *et al.*, 2008) and selective catalytic reduction (SCR) (He *et al.*, 2009). Due to the high prices of noble metal catalysts, the objective of this research is to use non-noble metal catalysts as substitutes of noble metal catalysts. The non-noble metals (Ni and Fe) supported on acid zeolites (HMOR and HBeta) catalysts are used in this research because Ni and Fe catalysts have high activity in isomerization, cracking, and the ring opening of hydrocarbons. Moreover, Ni and Fe are elements in the same group as Pd and Ru noble metals, which is the VIIIB group (http://www.chemtopics.com/elements/8b/8b.htm), aiming to produce high valuable products similar to the noble metals.

Within the above background, the effects of noble metals (Pd and Ru) and non-noble metals (Ni and Fe) supported on HMOR and HBeta zeolites on the quality and quantity of oil products and solid residue were investigated. The effect to coke formation on catalysts was also studied in this work. Moreover, the purpose of this work was to compare the performance of noble and non-noble catalysts on the pyrolysis of waste tires.