CHAPTER I
INTRODUCTION

Pyrolysis is one of the interesting alternatives to deal with rubbers and polymers by converting them to energy and fine chemicals. Pyrolysis processes involve several reactions such as thermal degradation, hydrogenation, cracking, and aromatization. Main objective of pyrolysis process is to convert large molecules to lower molecular-weight molecules in the absence of oxygen, and pyrolysis is well known for low emissions to the environment. There are many reports in pyrolysis with various substances such as plastics, polyolefins, and other rubber compounds. Tire is one of interesting substances in pyrolysis. Waste tire can cause the environmental problems because it is hard to degrade. Annually, the amount of waste tire is rapidly increasing resulting from the increase demand of automobiles. Main products obtained from waste tire pyrolysis are gas, liquid, and char. However, the products obtained from waste tire pyrolysis contain high molecular-weight compounds. The high molecular-weight compounds can be improved by using catalysts. Catalysts are also used to modify the composition and yield of products to highly valuable compounds.

A zeolite is an interesting catalyst and used as a commercial catalyst in petrochemical industry. Zeolites have been proven to be an efficient catalyst for catalytic waste tire pyrolysis by several researchers such as Shen *et al.* (2007). They studied the effect of the pore size and Si/Al ratio of zeolites in waste tire pyrolysis. It was reported that the large pore size promoted hydrocarbons to enter the pore which led to the formation of aromatic hydrocarbons because of catalytic cracking reaction. For the effect of Si/Al ratio, they reported that lower Si/Al ratio resulted in high activity and an increase in the yield of aromatic hydrocarbons. The efficiency of zeolites in waste tire pyrolysis is due to zeolite properties such as pore structure and acidity. The pore structure of zeolite has the effect on shape selectivity in cracking reaction. For the acidity, it has an effect on the carbon-carbon bond scission due to the acid strength of each zeolite.

Bifunctional catalysts have been introduced for the improvement in waste tire pyrolysis. Generally, noble metals are often used in catalytic cracking reaction because they have high activity for hydrogenation reaction. The metal clusters of noble metals supported on zeolites are formed by the reduction reaction of balancing charge. The formations of metal cluster are usually stable and well-dispersed. Moreover, the hydrogenation reaction can be carried out mostly by using Group VIII metals. There were several reports demonstrating that Ag-modified zeolites showed high activity in many catalytic reactions such as the photocatalytic degradation, the methane activation, and the selective catalytic reduction of NO. Ding *et al.* (2008) studied the methane activation over Ag-modified ZSM-5 zeolite. The results showed that the isolated Ag^+ cations exhibited a positive effect to methane activation. The amount of charge transfer when methane interacted with Ag-ZSM-5 was much higher than it interacted with H-ZSM-5. Furthermore, the barrier of C-H bond breaking over H-ZSM-5 was higher than over Ag-ZSM-5 zeolite. The authors explained that the interaction between methane and Ag-ZSM-5 was stronger than between methane and H-ZSM-5. Moreover, the effects of acidity and the pore size of support were the important factors. Wong *et al.* (2008) reported that Y zeolite had larger pore size than ZSM-5; therefore, AgY exhibited good performance in the catalytic oxidation of butyl acetate more than AgZSM-5. They explained that the AgY had the larger pores which had less resistance for the diffusion of reactant and products. They also found that at low temperatures there was no conversion of butyl acetate when using AgZSM-5 as the catalyst. They explained that water vapor formation could block the micropores of Ag/zeolite, and consequently prevent the oxidation reaction at low temperatures. Furthermore, the authors compared their work with the other work reported, and they found that silver-loaded zeolites were better in oxidation performance than the other work. It was concluded that silver-loaded zeolites had the potential to be used as effective oxidation catalysts like noble metals over butyl acetate.

As mentioned above, silver has activity like some noble metals in catalytic reactions. So, it is interesting to use silver in cracking reactions. The objectives of this research are to analyze the effect of silver loading on four commercial zeolites (BETA, KL, HMOR and Y zeolites), and to investigate the effect of structure and their properties of the study catalysts on waste tire pyrolysis products.