CHAPTER I
INTRODUCTION

Nowadays, the growth of automotive and transportation industries, which consume an enormous amount of rubber tires, are very rapid. These tires are mainly composed of natural rubber, synthetic rubber, steel cord and some chemical substances. However, the main component is rubber which makes tires tough and durable and also difficult to dispose. One of the most commonly found problems is the waste tires generated from automotive industries. About 85% of waste tires are automobile tires, and the remainders are truck tires. Most of these tires are usually dumped in the landfills or left in the open areas which can cause serious environment problems and dangerous situations in case of fire. Moreover, they can also be the breeding ground for some insects. Waste tires can be classified as a whole tire, a slit tire, a shredded or chopped tire, as ground or as crumbed rubber products. Whole tires can be used as children's playgrounds and athletic equipments, artificial reefs, and highway retaining walls. Utilization of cut tires includes floor mats, gaskets, wheel chocks, rail road crossing mats, blasting mats, and manhole collars. They can also be an excellent raw material for the production of many creative and marketable products ranging from neck tires to saddle bags. Shredded tires are utilized for the repairing a damaged area and stabilizing soil from leaching. Among the different alternatives for waste tire recycling such as reclaiming, retreating, grinding, incineration, biodegradation, etc., pyrolysis has been proposed as a viable recycling technology.

Pyrolysis of waste tire is an oxygen-free thermal degradation process to produce oil, gas, char, and residual steel product, which have the potential to be recycled to valuable products. Firstly, the derived oil has a higher heating value, and can be used directly as fuels or added to petroleum refinery feed stock. They may also be an important source for refined chemicals since they contain high concentrations of benzene, toluene, xylene and limonene. The solid char can be used as smokeless fuel, carbon black or low-grade activated carbon. Finally, the derived gas contains high concentrations of methane, ethane, butadiene and other hydrocarbon gases with sufficient calorific values, therefore, it may provide energy required by pyrolysis process. The fraction yields and the compositions of pyrolysis product depend on the reaction conditions and the experimental system.

Thermal degradation of rubbers has been investigated by many authors. The maximum degradation rates were reported in the temperature range of 375°C for NR, 445°C for SBR and 465°C for BR (Seidelt *et al.*, 2006). It has been concluded that thermal degradation of tire material starts at approximately 200 °C and finishes at around 500 °C. The yields obtained in the tire pyrolysis process depend on the specific operating conditions of the system used such as temperature, pressure, heating rate, particle size, etc. However, in general three main fractions are obtained: solid residue, gas fraction, and liquid fraction. The general trend is an increase of the yields to liquid and gas as the temperature increases. At high temperatures, the liquid yield exceeds a maximum followed by a subsequent decrease in the yield and an increase in the gas fraction due to the cracking of the liquids.

In the catalytic pyrolysis of waste tire process, catalysts play the most important role on the pyrolysis product yield and distribution. There are many series of catalyst used in the catalytic pyrolysis process, depending on properties of catalysts such as activity, pore size and selectivity. One of the most interesting series of catalyst use in catalytic pyrolysis is bifunctional catalysts because they can reduce polyaromatics hydrocarbon in the oil due to its high activity and selectivity for hydrogenation and ring opening of aromatic hydrocarbons (Choosuton, 2007).

The purposes of this research are to investigate the effects of temperature and residence time to the quality and quantity of gases and other products obtaining from tires pyrolysis. Moreover, the bifunctional catalysts: Ruthenium supported on mordenite (Ru/MOR) and ZSM-5 (Ru/ZSM-5) was synthesized with various amounts of Ru loading in order to investigate the effects of Ru amount loading on the quantity and quality of pyrolysis products. The pyrolysis was carried out in a bench-scale autoclave reactor at room temperature to the final temperature with 10 °C/min heating rate in the atmospheric pressure. Other parameters, particle size, holding time, reduction temperature and the amount of sample will be fixed to at 8-18 mesh, 90 min, 400^0C and 30 g, respectively.