CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The pyrolysis of waste tire was studied in a semi-batch reactor under inert atmosphere. The reaction was performed thermally and catalytically from room temperature to 500°C with heating rate of 10°C/min and held at 500°C for 1 hour. The product was obtained from thermal and catalytic pyrolysis represented in brownish-yellow color, and the gaseous product mainly consisted of methane, ethane, C_4-, propane, C_5- hydrocarbons and other hydrocarbons such as ethylene, propylene, C_6- to C_8- hydrocarbons. The pyrolysis solid residues were in the similar dimensions and shape for all samples.

Non-catalytic pyrolysis of waste tire was performed for investigating the effect of heating rate. The gas yield was found to decrease with increasing the heating rate. On the other hand, the liquid yield slightly increased, and for the solid yield there were no significant differences. At various heating rates, liquid products were produced in narrow carbon number distribution.

ITQ and mordenite zeolite catalysts were used for catalytic pyrolysis of waste tire in order to study the influence of catalysts on product distribution. ITQ-21 and ITQ-24 were synthesized by hydrothermal and microwave processes, and characterized by XRD, SEM, TEM, and BET. The results showed that the surface area and pore volume of ITQ-24 were higher than ITQ-21. On the other hand, the pore size diameter of ITQ-24 was smaller than ITQ-21.

The influence of catalyst-to-tire ratio was examined with fixing the total weight of sample at 1 gram. Mordenite was inspected at the catalyst-to-tire ratio of 0.10, 0.25, and 0.50. The results showed that the influence of the amount of catalysts was to reduce the yield of liquid with a consequent increase in the gas yield. The volume percentage of ethylene, propylene and propane increased, and the range of carbon number shifted to become narrower with increasing amounts of catalysts. Moreover, higher catalyst-to-tire ratio could produce higher gasoline and kerosene yields.

A catalyst-to-tire ratio of 0.25 was selected for studying the effect of loaded germanium with fixing the total weight of sample at 1 gram. The results showed that the gas yield increased, but the yield of liquid decreased with an increase in the percentage of germanium up to 3%Ge. Furthermore, the highest amounts of lighter hydrocarbons were produced with the percentage of germanium increasing to 3%Ge. The gasoline and kerosene yields increased with an increasing percentage of germanium. However, the optimum percentage of germanium to produce more valuable lighter products was 3%Ge.

ITQ-loaded catalysts provided lower gas yield but higher liquid yield as compared to the pure mordenite. However, ITQ-loaded catalysts gave higher amount of gasoline than mordenite.

Non-framework germanium might act as metal sites promoting dehydrogenation, but the framework germanium only provided Lewis acid sites.

5.2 Recommendations

For the future work, the reaction should be further investigated in other factors such as flow rate of carrier gas, and residence time in the non-catalytic mode for observation of the production distribution. Besides, the economics of system should be studied for comparison between the traditional process, non-catalytic usage, and the recently developed process (catalyst usage) in order to determine which one is more satisfied for financial aspect.