CHAPTER VIII
CONCLUSIONS AND RECOMMENDATIONS

The pyrolysis of waste tire was operated in a bench-scaled autoclave reactor. The effects of zeolites properties on species of obtained products were investigated. Pore channel affected the contact time of molecules to stay inside the pore. Pore size controlled the size of obtained products. In addition, the acidic properties of supports governed reaction activity, which was higher with using acid supports than using the non-acid support. The highest amount of styrene was produced by using the acid support, HMOR. The high amounts of benzene, toluene, ethylbenzene, and cyclohexane were produced by using HBeta. In addition, HZSM-5 highly produced cyclohexane. The use of catalysts gave the lighter oils, and also reduced sulfur content in oils for all cases.

To study the effect of pore channel and pore size on sulfur species, HBeta, HZSM-5, and HMOR zeolites were selected to use in the work. The results showed that all zeolites resulted in the reduction of sulfur in oils. The straight channel of HMOR gave a better quality of oil, which consisted of more small molecules of sulfur-containing compounds for further desulfurization in the future, than the zigzag channel of HBeta. Additionally, the medium pore of HZSM-5 gaves a slightly-better quality of oil, which has a lower sulfur content, than the larger pore of HBeta. Moreover, the sulfur-containing molecules obtained from HZSM-5 was easier to be further desulfurized than those from HBeta

In order to investigate the effect of Fe- and Co- modified zeolites, 5 wt.% of Fe and Co were loaded on zeolites (HBeta, HMOR, HZSM-5, and KL). The results showed that using Fe supported on zeolites increased light fraction (full range naphtha) at the expense of the heavier fractions in oil. It was attributed to Fe that enhanced the cracking activity of zeolites. Especially, the petrochemicals in oil highly increased with using Fe-loaded catalysts, except 5%Fe/HBeta. It can be ranked as 5%Fe/HMOR > 5%Fe/KL > 5%Fe/HZSM-5 > 5%Fe/HBeta. 5%Fe/HMOR was discovered to be the best catalyst to produce benzene and cyclohexane. Moreover, sulfur content in oils reduced with using Fe-loaded catalysts, and the lowest sulfur in oil was obtained from 5%Fe/HZSM-5. For sulfur

compounds, dibenzothiophenes significantly decrease with using Fe-loaded catalysts. Moreover, the use of Co supported on KL, HMOR, HZSM-5 and HBeta catalysts enhanced the cracking ability of heavy products to lighter ones. The most abundant compounds in oils were mono-aromatics. Mono-aromatics increased with using 5%Co supported KL and HZSM-5, but they decreased with using 5%Co/HMOR and 5%Co/HBeta. Additionally, the valuable hydrocarbons in oils sharply increased with using Co-loaded catalysts, except 5%Co/HBeta. The highest production of valuable petrochemicals was obtained from using 5%Co/KL, followed by 5%Co/HZSM-5, 5%Co/HMOR-5, and then 5%Co/HBeta. 5%Co/KL can produce the highest amount of benzene, toluene and *p*-xylene. 5%Co/HZSM-5 exhibited the potential for *o*-xylene and *m*-xylene production. Moreover, sulfur in oils were reduced with using Co-loaded catalysts, and the lowest sulfur in oil was obtained from using 5%Co/KL. From the results, it can be concluded that using Co- and Fe-loaded catalysts exhibited the same trend on producing petrochemicals; however, using Fe-loaded catalysts exhibited a better petrochemical production than using Co-loaded catalysts.

It is recommended that the further study be conducted on the comparison between Ru- and Fe-modified HMOR zeolites on the petrochemicals and sulfur species obtained from pyrolytic oil in order to be used for commercial scale.