CHAPTER VIII

CONCLUSIONS AND RECOMMENDATIONS

The pyrolysis of scrap tire was performed in a bench-scaled autoclave reactor. The effect of acid density of mesoporous MCM-48 (Si-MCM-48 and Al-MCM-48 with Si/Al ratio of 25, 42, and 82) and the double beds of Si-MCM-48 and zeolites (HY, HBETA, and HZSM-5) were investigated on tire-derived oil, petrochemicals, and desulfurization. The experimental conditions were set with 20-40 mesh of particle size of tires, 30 min of holding time, 30 ml/min of N_2 flow rate, 10 min/°C of heating rate, 500 °C of temperature in pyrolysis zone, 350 °C of temperature in catalytic zone, 30 gram of tire.

To study the effect of acid density of mesoporous MCM-48. The results showed that the large pore size of Si-MCM-48 catalyst decreased large aromatic hydrocarbons in tire-derived oil, whereas Al-MCM-48 catalysts promoted aromatization of olefins and naphthenes to form large aromatic hydrocarbons in tire-derived oil with increasing Brönsted acid sites. Therefore, the effect of large pore size is more pronounced than the effect of acid density in terms of removal of large molecules from the oil. Moreover, all catalyst increased petrochemicals in oils, except Al-MCM-48 (25). It can be ranked as Al-MCM-48 (42) > Si-MCM-48 > Al-MCM-48 (82). The Si-MCM-48 and Al-MCM-48 (42) catalysts sharply enhanced the selectivity of toluene and ethylbenzene. Furthermore, the highest ability to remove sulfur in oil was obtained from Si-MCM-48 whereas the decreasing Si/Al ratio of Al-MCM-48 catalysts enhanced the sulfur removal in oils whereas the decreasing Si/Al ratio of Al-MCM-48 catalysts enhanced the sulfur removal in oils, indicating that the Brönsted acid sites are necessary for sulfur removal ability of catalysts although a large amount of Brönsted acid sites may result in the production of large molecules. In terms of sulfur species, Si-MCM-48 catalyst sharply decreases benzothiophenes and isothiocyanates, whereas thiophenes and benzothiazoles are removed, depending on the acid density of Al-MCM-48.

In order to investigate the double beds of catalysts, Si-MCM-48 as the first layer was fixed but a zeolite as the second layer was varied (HZSM-5, HY, and

HBETA). The effects of zeolites properties; that are, acidity (HBETA and HY) and pore size (HZSM-5 and HBETA), was investigated. The results show that HY and HBETA with the pore size of 7Å used as the catalyst in the upper bed can promote aromatization to form large hydrocarbon in pores so the presence of heavy compounds in oil by using Si-MCM-48/HBETA and Si-MCM-48/HY more greatly than the single bed of Si-MCM-48, whereas HZSM-5 with the pore size of 5Å used as the catalyst in the upper bed can improve the quality of oil in terms of decreasing large aromatic hydrocarbons and increasing petrochemical productions due to its medium pore size that has a less capacity to form large molecules. Therefore, the double layer of Si-MCM-48/HZSM-5 gave the highest concentration of petrochemicals and reduction of large molecules among all catalysts.

It is recommended that the further study be conducted by using zeolites with pore size lower than 5Å used as the catalyst in the upper bed. It is possible that the quality of oil highly improve.