CHAPTER IX
CONCLUSIONS AND RECOMMENDATIONS

In this work, the effects of nickel-promoted catalysts and different zeolite cores of core-shell structure composite materials on the species of waste tire pyrolysis products were investigated. Ni-loaded catalysts have been widely in fluid catalytic cracking (FCC) process, hydrogenation/dehydrogenation and aromatization processes and desulfurization of liquid fuels. Therefore, the Ni-supported catalysts were expected to enhance the formation of petrochemicals and reduce the sulfur content in tire-derived oils. Core-shell composite catalysts have been used in catalytic applications because they combined both advantages of microporous zeolites, and mesoporous molecular sieves. The advantages of these materials are large pore size, and high surface acidity distribution. Therefore, HY/MCM-41 and HBETA/MCM-41 core-shell composites were expected to reduce the formation of polycyclic aromatics and enhance the petrochemical in tire-derived oil. Furthermore, the different zeolite cores were expected to give different petrochemical selectivity.

To investigate the effect of Ni loading on zeolites with different pore sizes, pore channel structures and acid densities, HBETA, HY, HMOR and HZSM-5 zeolites were selected as the catalysts supports. The results showed that pore size of zeolite supports was found to govern the size of hydrocarbons products and sulfur removing ability of Ni catalysts. The introduction of Ni on HZSM-5 zeolite with smaller pore size provided the lighter oil with a lower sulfur content and higher proportion of petrochemicals than Ni/HBETA catalyst. The complicated channel structure of zeolite supports was found to promote the formation of multi-ring aromatics and enhance sulfur removing ability of Ni catalysts. The introduction of Ni on HMOR with 1D pore channel structure produced the lighter oil with higher sulfur content and higher proportion of petrochemicals than Ni/HBETA catalyst. The higher acid density of zeolite supports was found to promote the formation of heavy aromatics and reduce the sulfur removing ability of Ni catalysts. The introduction of Ni on HY zeolite with a higher acid density (lower Si/Al ratio) produced the heavier oil with a higher sulfur content and lower proportion of petrochemicals than Ni/HBETA catalysts. Therefore, for the production of the waste tire-derived oil with high petrochemicals and low sulfur contents by using Ni promoter, the zeolite supports must have a suitable pore size and 1D channel structure that allows hydrocarbons and sulfur compounds can stay inside at enough contact time for forming of valuable petrochemical and sulfur removal of sulfur compounds.

To investigate the effect of different zeolite cores of core-shell composite catalyst, HY and HBETA zeolites were selected as a core and MCM-41 as shell. The core-shell composites were synthesized by growth of MCM-41 layer over the HY and HBETA particles. The result showed that MCM-41 shell thickness of both HBETA/MCM-41 and HY/MCM-41 core-shell composites were varied in the range of 50-100 nm. The both core-shell composite catalyst provide a higher cracking and sulfur removing activities and better petrochemical selectivity than the non-composite catalysts. The role of MCM-41 shell was pre-cracking of bulky molecules into the intermediate cracking products. The role of zeolite core was cracking of intermediate cracked products from MCM-41 shell to produce petrochemicals and lighter hydrocarbons. The synergy of MCM-41 shell and zeolite core also enhanced the formation of petrochemicals. The different zeolite cores were found to govern petrochemicals, HY core enhanced the selectivity of benzene, ethylbenzene and toluene, whereas HBETA core enhanced the selectivity of ethylbenzene. Therefore, the HY/MCM-41 and HBETA/MCM-41 core-shell composites are the promising catalysts for the enhancement of petrochemical production from tire-derived oil.

It is recommended that the further study be varied the proportion of MCM-41 shell and zeolite core in order to obtain the highest catalytic performances. In addition, the growth of MCM-41 over other zeolites is interesting choice in order to investigate the effect of different zeolite cores on the petrochemical production.