CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this thesis, we studied the adsorption of three refractory sulfur compounds (3-methylthiophene, benzothiophene, and dibenzothiophene) in simulated transportation fuels (gasoline and diesel) on NaX and NaY zeolites in both single- and mixed-solute systems. Then we examined the effect of aromatic content in simulated transportation fuels and water content in the zeolite on those sulfur compounds adsorption. Furthermore, the effect of temperature on the desorption of sulfur compounds was also examined. The results indicated that NaX zeolite effectively adsorbed 3-methylthiophene and benzothiophene slightly more than NaY zeolite. For dibenzothiophene, both NaX and NaY zeolites have the same potential to adsorb dibenzothiophene. Moreover, it was observed that benzothiophene and dibenzothiophene are preferentially adsorbed by NaX and NaY zeolites than 3-methylthiophene, especially at low concentration region. For mixed-solute system, benzothiophene is preferentially adsorbed on both zeolites than 3-methylthiophene. As expected, the presence of benzene ring in the structure of thiophene derivatives is an important factor on thiophenic compounds adsorption. π electrons in benzene ring can form bond with adsorption sites of the zeolite easily.

For the effect of aromatic content on the adsorption of sulfur compounds, it was found that the adsorption of those sulfur compounds decreased with increasing percentage of aromatic content in the range studied. This is due to the competing effect between *o*-xylene and the sulfur compound for the adsorption sites on NaX and NaY. Effect of water content in the zeolite studied revealed a general trend that the adsorption of thiophenic compounds decreased along with increasing percentage of water content in the zeolite. This is due to the adsorption sites of zeolites preoccupied by water molecules. For the desorption of thiophenic sulfur compounds, the results demonstrated that the desorption of 3-methylthiophene, benzothiophene, and dibenzothiophene increased with increasing temperature in the range of 45-75 °C. As expected, it was found that 3-methylthiophene, having weak interaction with

zeolite surface, desorbed at the highest amount when compared to benzothiophene and dibenzothiophene.

5.2 Recommendations

Upon the completion of this study, the adsorption of three major thiophenic compounds in transportation fuels using Na-based faujazite zeolite was established. It is interesting to further study towards the modification of faujasite zeolite by loading various metal ions on zeolites. Effect of the amount of exchanged metal in zeolite on sulfur compounds adsorption should be also investigated in details. Heavy metals such as Zn, Ni, and Cu are potential candidates for the modification of the faujasite zeolite. Subsequently, comparison between Na-based faujasite zeolite and zeolite loaded with other metal ions for their surface adsorption capability can be done.

In addition, the continuous process is more interesting for removal of thiophenic sulfur compounds as the vapour phase. This process should be developed to use in the real application.