CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

In this study, surfactant-modified zeolite (SMZ) was prepared by a simple two-step surface modification technique using mixed cationic and anionic surfactants, CTAB and DOWFAX. The resulting SMZ was evaluated for its ability to adsorb heavy metal (cadmium and lead) and organic (toluene) contaminants in both single- and multi-component systems.

The results obtained from the metal adsorption studies demonstrated that SMZ can be used to adsorb toxic heavy metals such as Cd^{2+} and Pb^{2+} and the adsorption could be described by Langmuir isotherm. The amount of metal ions adsorbed on SMZ was quite similar to that of clinoptilolite but the results showed that SMZ could adsorb cadmium more effectively than lead in both single- and mixed-metal systems. In contrast, lead was adsorbed more than cadmium in the case of clinoptilolite. For the adsorption of organic compounds, SMZ proved to be far more effective in toluene adsorption than unmodified clinoptilolite on the same weight basis; this can be attributed to the improved organic partitioning into the surfactant-modified surface using a mixed-bilayer of cationic and anionic surfactants. In the mixed-solute system where heavy metal (cadmium or lead) and toluene were adsorbed simultaneously, the organic adsorption was slightly enhanced in the presence of heavy metal ions. This may be due to the reduced polarity of the palisade layer upon the adsorption of metal ions. The experimental results obtained in this study clearly demonstrated that SMZ can potentially be used for the treatment of mixed wastes where both heavy metal and organic contaminants need to be removed simultaneously.

5.2 Recommendations

This research work focused on the preparation of the surfactant-modified zeolite (SMZ) by surface modification using a cationic surfactant, CTAB, and an

anionic surfactant, DOWFAX 8390 and the evaluation of the adsorption capability of SMZ for heavy metal and organic contaminants in single- and multi-component systems. In the preparation of SMZ, the molar ratio of CTAB and DOWFAX was fixed at 1:10. In this aspect, further study can be done to investigate SMZ prepared at various CTAB:DOWFAX ratios and their adsorption performance. In addition, it would be very interesting to study the use of various types of anionic surfactants in the modification of SMZ. For example, anionic surfactants with different carbon chain lengths and different types of head group could be evaluated.