CHAPTER V

CONCLUSION AND RECOMMENDATION

The following conclusions can be derived from the experimental results.

1. 13X has the highest BET surface area and pore volume while HZSM-5, NaZSM-5, NH_4ZSM-5, and 4A have the decrease values, respectively.

2. The adsorption equilibrium constant decreases as an increase in temperature. Thus, the adsorption is physical adsorption which is an exothermic process.

3. The heat of adsorption is affected by the surface chemistry of each type of adsorbents and it reduces when the adsorption constant becomes large.

4. Binder including in commercial 4A can adsorb some fraction of toluene and o-xylene vapors.

5. For zeolites which have different structures, 13X has higher toluene adsorption equilibrium constants than NaZSM-5 and 4A. The o-xylene adsorption equilibrium constants of commercial 4A, NaZSM-5, and 13X are compatible at low temperature but at high temperature, the equilibrium constants of commercial 4A are lower than that of 13X and NaZSM-5. Synthesized 4A has the lowest adsorption ability for both toluene and o-xylene vapors.

6. The adsorption equilibrium constants of toluene are higher than that of o-xylene for the same zeolite because of their shape and size of molecules.

7. For the different types of cations of ZSM-5, the adsorption equilibrium constants for both toluene and o-xylene vapors of NaZSM-5 are much lower than that of NH_4ZSM-5 and HZSM-5. The equilibrium constants of NH_4ZSM-5 and HZSM-5 are similar.

8. The axial dispersion coefficients in all adsorbents are in the same range and for short bed length, end effects are significant.

9. At high mass transfer rate, the chromatogram is almost symmetrical and sharp, but at low mass transfer rate, the chromatogram becomes broader and has long tail.

10. The overall mass transfer coefficients of toluene through synthesized 4A and commercial 4A and that of o-xylene through commercial 4A and 13X are consistent to the Arrhenius' law clearly.

11. For toluene, the overall mass transfer coefficients of 4A are higher than that of ZSM-5 and 13X while the mass transfer coefficients of ZSM-5 and 13X are in the same range.

12. For o-xylene, the overall mass transfer coefficients of 13X and commercial 4A are higher than that of ZSM-5. The mass transfer coefficients of all types of cations of ZSM-5 are similar and they are lower than that of synthesized 4A.

13. With high values of equilibrium constant, such adsorbents can be used to remove VOCs in a wide range of temperatures, especially in a range of high temperatures.

14. In order to regenerate the adsorbents, heat of adsorption is one of a key parameters of consideration. For instance, the heat of adsorption of both toluene and o-xylene vapors on 13X are low, thus it requires low energy to regenerate.

15. The chromatographic method is suitable for measurement of adsorption equilibrium constant and mass transfer coefficient. An advantage of this method is quick measurement but small errors might occur from the moment analysis of the

chromatograms. Especially for the high ability adsorbent such as 13X which adsorbs toluene strongly, if the bed length is long, the chromatogram will be very broad and will be difficult to analyze the moment. If the bed length is reduced, the chromatogram will become suitable to be analyzed precisely. When the bed length becomes relatively short, some fraction of the adsorbate might flow pass the bed without adsorption. This causes the weighted mean retention time shorter than the actual value.

RECOMMENDATION

1. The mass transfer rate should be studied further by varying the particle sizes of adsorbent in order to determine the controlling step of mass transfer.

2. Study the surface chemistry of adsorbents to explain the difference of heat of adsorption and to find the effects of types of cations on adsorption ability.