CHAPTER IV

SUMMARY CONCLUSIONS AND ENGINNERING SIGNIFICANCE

4.1 Summary

The adsorption study of the surfactant systems were carried out to determine the adsorption isotherms of the surfactants onto positively charged alumina at temperature of 25$\pm$2°C, equilibrium pH of 6.5-7.5,and electrolyte concentration of 0.001 M NaCl. From the adsorption isotherms, the CMCs of the surfactants were estimated to compare with the CMCs that obtained from the CMC measurement by surface tension. The results showed that the CMCs from the adsorption isotherms were similar to the CMCs from surface tension. In addition, the number of EO group affected the area per molecule and the maximum adsorption. It was found that when the number of EO group increased, the area per molecule increased but the maximum adsorption decreased. Furthermore, the area per molecule at surface saturation of surfactants at the water-air interface was found that it was lower than the area per molecule calculated from the maximum adsorption and specific area of alumina. It could be inferred that the molecule of these surfactants is too large to adsorb in the very narrow pores of this alumina. For the adsolubilization study, the experiments were carried out with the surfactant concentration at right below its CMC in order to control the equilibrium concentration in the supernatant not exceed the CMCs to make sure that there has been no micelle in the bulk solution. The results were found that increasing the number of EO group of the surfactants decreased the adsolubilized styrene and increased the adsolubilized ethylcyclohexane. This could be attributed to the higher carbons in EO group causing the higher hydrophobic area of tail group so that the ethylcyclohexane was able to partition increasingly. The admicellar partition coefficient data further supported that styrene partitions into the palisade region and ethylcyclohexane partitions into the core region of admicelles. However, due to the short chain length, ethylcyclohexane could also partition in palisade region (spaces filling organic solutes of core region is not enough. For surfactant desorption studies, the experiment was carried out after polymerization experiment. The results showed that non-polymerizable surfactant could not be fixed strongly onto the solid surface because the non-polymerizable surfactant could not be polymerized to form the polymerized film. Moreover, it was found that the surfactants desorbed from bilayer easier than from monolayer. This attributes to the electrostatic attraction in the monolayer, which is stronger than hydrophobic interaction in the bilayer. In addition, there have been many studies stated that the polymerization can enhance the dispersion stability that is given the ready availability of the adsorbents for the industrial scale application. Thus, this research provides useful information for designing surface modification by the surfactants to enhanced contaminant remediation.

4.2 Conclusions

Based on the results of this research, the following conclusions are made.

1. The CMCs of the surfactants from the adsorption isotherms were similar to the CMCs that obtained from the CMC measurement by surface tension.
2. Increasing the number of EO group of the surfactants increased the area per molecule and decreased the maximum adsorption.
3. Increasing the number of EO group of the surfactants decreased the adsolubilized styrene and increased the adsolubilized ethylcyclohexane.
4. The admicellar partitioning coefficient data further supported that styrene partitions into the palisade region and ethylcyclohexane partitions into the core region of admicelles.

However, due to the short chain length, ethylcyclohexane could partition in palisade region.

5. The non-polymerizable surfactant desorbed from the surfaces easier than polymerized surfactants and the surfactants desorbed from bilayer easier than from monolayer.

4.3 Engineering significance

Surfactant-modified adsorbents can be used in many industrial and commercial processes and environmental engineering applications such as groundwater remediation and wastewater treatment. Solid oxide coated with surfactants appears particularly to be useful by removal of organic compounds by the phenomenon called adsolubilization process.

In field application for groundwater remediation, surfactant-modified adsorrbents can be used in subsurface barriers or landfill liners which effectively prevent organic contaminants expansion in groundwater. For wastewater treatment, surfactant-modified adsorbents can be used for separation process by inducing organic solutes partitioning into surfactants from aqueous phase which is known as admicellar-enhanced chromatography (AEC).

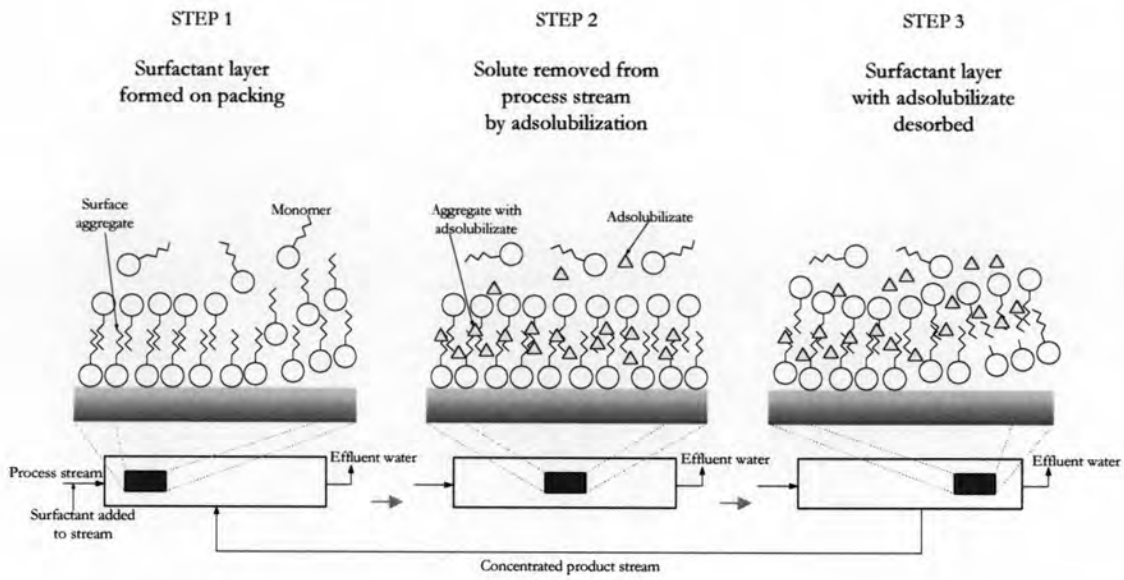

Figure 4.1 The admicellar-enhanced chromatography processes (adapted from Harwell and O'Rear, 1989)

Admicellar-enhanced chromatography (AEC) is a new fixed-bed separation process based on inducing the partition of organic solutes from aqeous phase to surfactant layer in a phenomemon called adsolubilization. In the bed preparation, the concentrated surfactant is feed enter the column to form the admicelles on the packed bed and some surfactant must be continually feed to maintain the surfactant aggregates. If the aqueous solution, which contains dissolved organic solute, is contacted with the prepared bed containing the admicelles, the solutes will partition into these admicelles, and the water stream will be purified. Changing pH of solution causes the surfactant with the organic solutes desorbed from the packing, producing a concentrated solution. The bed can be reused and the process repeated indefinitely. The admicellar-enhanced chromatography process is shown in Figure 4.1.

4.4 Future Studies

The economics of surfactant-modified adsorbents are affected by losses of surfactants. There are many techniques that can work out this problem. From this research and some studies, the polymerization of polymerizable surfactants can fix surfactants strongly onto the solid surface (Esumi, 1993; Attaphong, 2006). The another technique is to use surfactants with twin head groups which exhibit lower losses as compared to single head group surfactants (Rouse et al., 1993). Thus, polymerization using gemini polymerizable surfactants should be effective technique to prevent the surfactant losses in the systems.