

## CHAPTER V

### CONCLUSIONS AND RECOMMENDATIONS

#### 5.1 Conclusions

In this research, we studied the adsorption of two surfactants in both single- and mixed-surfactant systems, using the anionic surfactant (SDS) and the nonionic surfactant (Triton X-100), at various molar ratios of anionic/nonionic surfactant (1:3, 1:1 and 3:1) and at pH 3.5 on the aluminum oxide surface. We then examined the adsolubilization of three organic compounds - benzene, toluene, and ethylbenzene - into the adsorbed surfactant aggregates in each surfactant system. From the adsorption studies, in the single surfactant system, the amount of SDS adsorbed on aluminum oxide is greater than the amount of adsorbed Triton X-100. This is attributed to the electrostatic interactions between the negatively charged head group of the SDS molecules and the positively charged surface of the aluminum oxide. In the mixed surfactant systems, the co-adsorption of the Triton X-100 in the presence of adsorbed SDS is considerably larger than the adsorption density in the pure Triton X-100 system without SDS. Furthermore, the slope of the Triton X-100 isotherm in region II of the mixed adsorption isotherms also increases with increasing SDS content, which implies that increased co-adsorption of Triton X-100 eventually leads to almost all SDS monomers being extracted onto the surface because of the decreased electrostatic repulsion between headgroups of SDS monomers.

From the adsolubilization studies, the results show that the adsolubilization of the three organic compounds - benzene, toluene, and ethylbenzene - is found to depend on the amount of surfactant adsorbed on the aluminum oxide as well as the packing of the surfactant molecules and the physico-chemical properties of the solutes. Benzene solubilized in both single- and mixed-surfactant systems more than the other solutes; toluene and ethylbenzene. This may be due to the difference in the polarity and the structure of the three solutes. Benzene has no attached branching, whereas toluene and ethylbenzene have methyl and ethyl groups, respectively. In the single surfactant systems, all three modal organic solutes adsolubilized in the SDS system to a greater extent than in the Triton X-100 system. This corresponds well

with the amount of surfactant adsorbed on aluminum oxide. In the mixed surfactant systems, synergism was observed in the adsolubilization of the organic compounds at a particular molar ratio of mixed SDS/Triton X-100 (ie., 1:3) which may be attributed to the tighter packing of adsorbed surfactants in the mixed surfactant systems and the physico-chemical properties of the solute.

The partition coefficient ( $K$ ) obtained from the adsolubilization data indicates that benzene favors locations in the admicellar phase (palisade and core layer), as seen from the slope of the partition coefficient that the  $K$  value increases with increasing  $X_{\text{admicelle}}$  whereas toluene prefers to solubilize in both the admicellar (palisade and core layer) and the bulk phase, as seen from the slope of the partition coefficient that the  $K$  value remains relatively constant as  $X_{\text{admicelle}}$  increases. In contrast, ethylbenzene tends to stay in the bulk phase rather than the admicellar phase, as seen from the slope of the partition coefficient that the  $K$  value decreases while  $X_{\text{admicelle}}$  increases. In the admicellar phase, all three organic solutes can be adsolubilized in the core of the admicelle, however, the ability of adsolubilization for each of them may be different depending on their structure such as branching.

## 5.2 Recommendations

In this study, the adsolubilization of organic compounds in mixed anionic-nonionic surfactant admicelles adsorbed on a solid oxide surface was examined. It would be interesting to further study the other properties, such as pH and ionic strength, in both single- and mixed-surfactant systems. In addition, the adsolubilization by admicelles of surfactant mixtures should be investigated in more detail using relevant techniques such as atomic force microscopy (AFM).