

## CHAPTER I

### INTRODUCTION

Contamination of ground water due to chemical releases into the subsurface has become a matter of concern throughout the world because of the health hazards posed by the chemicals (Choori, 1994). The industrial waste water containing numerous dissolved organic contaminants such as chlorinated hydrocarbons, polychlorinated biphenyls and aromatics which are highly toxic and carcinogenic even at trace amounts has obtained from waste disposal sites, chemical spills, and leaking underground storage facilities. Being good solvent, the chlorinated volatile hydrocarbons such as the chloroethanes are often found as contaminants. They are also used as coupling agent for some polymerization reactions.

Considering the time and cost of remediation, the current pump and treat technology is not satisfactory. Hence attention is now focused on the feasibility of surfactant. Surfactant-based separation processes can be effective in the removal of dissolved organics from water (Scamehorn and Harwell, 1989) e.g., polluted wastewater or groundwater. These techniques have the advantage of generally having modest energy requirements and using non-toxic, biodegradable surfactants as the separating agent. When an aqueous solution containing a nonionic surfactant is heated above the cloud point (a lower consolute solution temperature (Yoesting and Scamehorn, 1986)), the solution can separate into two phases (Gullickson, Scamehorn and Harwell, 1989; Rosen, 1989; Frankewich and Hinze, 1994; Akita and Takeuchi, 1996). One phase is concentrated surfactant and is called the coacervate (Franklin and Benson, 1986). The other phase is dilute surfactant,

but at a concentration above the critical micelle concentration (Corti, Minero and Degiorgio, 1984). Since the coacervate phase can be characterized as a concentrated micellar solution, any organic solute in the water tends to solubilize in the micelles of micellar-like aggregates in the coacervate and concentrate in that phase. This aqueous phase/aqueous phase extraction process is known as liquid/coacervate extraction and its effectiveness has been demonstrated for the solute tert-butylphenol in previous work (Gullickson et al., 1989).

One economic constraint in common to many surfactant-based separation processes is the need to recover the surfactant for reusing in the following the operation (Yin, 1994). For example, ionic surfactants can be precipitated. However, nonionic surfactants do not precipitate. If the solute contained in the coacervate is volatile enough, it can be removed by using vacuuming, steam, or gas stripping (Roberts, 1993; Choori, 1994; Hasagawa, 1994), and leave the solute-free surfactant solution for reuse. Although regeneration of the surfactant solution was not studied here, the potential for stripping the coacervate is one of the reasons that the chloroethanes, a volatile toxic pollutant commonly encountered in wastewater or groundwater as the trichloroethylene (TCE), was chosen for the study. Vacuum stripping of TCE from concentrated surfactant solutions (although not coacervate) has been studied in a pilot scale vacuum stripper in the laboratories (Choori, 1994).

An experimental method is described for determining equilibrium constants for the solubilization of organic solutes by aqueous surfactant solutions (Christian, Smith, Tucker and Scamehorn, 1985). One side of an ordinary equilibrium dialysis cell is loaded with a solution containing a surfactant and a solute that is present both as the free monomer and as solubilized form in the micelles (retentate side). The other sides of cell

initially contains distilled water (permeate side). A dialysis method is in fact quite convenient for studying such solubilization equilibria.

In this study, the effect of molecular structure of the chloroethanes on the concentration of surfactant and those solutes in the coacervate and dilute phase was measured under equilibrium conditions. The solubilization constants for those solutes in coacervate phase were also measured under equilibrium conditions.