CHAPTER I

INTRODUCTION

1.1 Introduction

Groundwater contamination is the most intractable form of pollution. One of the most common types of groundwater contamination arises from spills of hydrocarbon fuels and solvents. Gasoline, diesel, and aircraft fuels sometimes spill from rail or tank cars or from pipeline leaks. Another typical contamination of hydrocarbon spill is from leakage of underground storage tanks (Harwell et al., 1999). When the amount of contaminant leaks, the spill liquid can reach the water table. The hydrocarbon that accumulates in a floating lens atop the groundwater due to its less density than water, known as a light non-aqueous phase liquid, or LNAPL. Since the groundwater flows in the subsurface, the contaminated water eventually moved away from the site of the spill, leaving a contaminant plume in the groundwater.

Surfactant-based processes have been widely studied for application in groundwater remediation. Recently, surfactant-modified materials for treating wastes and for landfill liners or subsurface barriers have been introduced to reduce contaminant transport (Sun and Jaffe, 1996; Butler and Hayes, 1998; Sabatini et al., 2000; Cheng and Sabatini, 2001). In all of these applications, surfactant adsorption onto solid surfaces is one of interests. When undesirable, surfactant adsorption can render a design ineffective and significantly increase dosage requirements and thus hinder the economics of the system.

Mixed anionic and cationic surfactants system exhibits the greatest synergism since it can reduce the critical micelle concentration (CMC). The CMC of the mixed surfactants system can be reduced by as much as two to three folds of magnitude as compared to the single surfactant system. Fuangswasdi et al. (Personal Communication) studied the adsorption while varying the mole ratio of anionic to cationic surfactants. They found that by using mixtures of anionic and cationic surfactants, the system reaches the adsorption plateau (region IV) at lower surfactant concentrations as compared to a system with single surfactant. This is an evident of a synergistic behavior. This is based on the fact that the cationic and anionic surfactant would reduce charge repulsion between adjacent adsorbed surfactants, thus allowed a denser surfactant packing at the solid/liquid interface. In addition, Fuangswasdi et al. (Personal Communication) concluded that the mixed surfactants also increase the adsolubilization of organic solutes into surfactant admicelles. For that reason, the adsorption of mixed surfactants phase and adsolubilization of organic solutes on the adsorbent material in column was proposed for this study. It is expected that the results from this present study can be implemented for contaminant remediation, surfactant-enhanced oil recovery as well as subsurface barriers to trap contaminant plume in aquifer media.

1.2 Objectives

The main objective of this research was to investigate adsorption and transport of mixed anionic/cationic surfactants and organic solutes through silica-packed column comparing with a single cationic surfactant system. In order to achieve the main objective, the 4 sub-objectives were designed as follows:

1. To investigate the adsorption and transport of cationic surfactant through the silica-packed column.
2. To study the adsolubilization of styrene and ethylcyclohexane in cationic surfactant adsorbed onto silica-packed column.
3. To study the adsorption and transport of mixed anionic/cationic surfactants through silica -packed column.
4. To study the adsolubilization of styrene and ethylcyclohexane in mixed anionic/cationic surfactants adsorbed onto silica-packed column.

1.3 Hypotheses

Mixed surfactants solutions (anionic/cationic surfactants) can produce maximum adsorption on the adsorbent as a result of synergism. These systems require lower concentration to maintain the bilayer surfactant coverage (lower CMCs) and while producing larger adsolubilization for organic solutes than that of single surfactant system.

1.4 Scope of Study

According to the previous studies conducted in batch experiment, there is a need to simulate the real application condition leading to the study on adsorption behavior and transport of the organic compounds in column. Therefore, this work was carried out in column study. The scopes of work were as follows:

1. The adsorption of a single cationic surfactant; PADD and mixed anionic/cationic surfactants; SDS and PADD through silica-packed column was investigated.

2. The study of adsolubilization and retardation of styrene and ethylcyclohexane in PADD onto silica-packed column was conducted.
3. The adsolubilization and retardation of styrene and ethylcyclohexane in 1:3 mixed SDS/PADD onto silica-packed column was studied.