CHAPTHER 1

INTRODUCTION

1.1 Introduction

The contamination of subsurface soil and water with hazardous substances is a major environmental problem in many countries, especially developing countries. Contaminated environment by hazardous substances may occur by poorly managed landfill, improper storage and transportation, or accidental leakage and spills. Many types of industrial waste contain hazardous substance. Petrochemical industries, spreading around the eastern coast of Thailand, generate numerous organic chemical wastes that may degrade environmental quality under poor management. In Thailand, there are standards to the treatment of wastewater and air pollution from the industrial sector. However, there is no regulation to control pollution in soil, so there is a possibility for soil pollution.

Development of new and improved technologies to remove organic pollutants must not only consider cost and treatment time, but health, safety, and extent of environmental restoration. Principal treatment technologies for cleaning contaminated soil and groundwater being used today include incineration and thermal destruction, volatilization and soil aeration, pump and treatment techniques, soil vapor extraction, air stripping, activated carbon adsorption, bioremediation, solvent extraction, light enhanced air oxidation and soil washing (LaGrega, et al., 2001).

Some organic chemicals which have received a great deal of attention are nonaqueous phase liquids (NAPLs). NAPLs are immiscible (undissolved) hydrocarbons in the subsurface that exhibit different behavior and properties than dissolved contaminant plumes. NAPLs have a tremendous impact on the remediation of contaminated aquifers, as it is very difficult or impossible to remove all of the NAPLs from a hazardous waste site once released to the subsurface (Bedient, et al., 1994). Polycyclic aromatic hydrocarbons (PAHs), hydrocarbon compounds composed of benzene rings, are a kind of NAPLs. They can be found in substances such as petroleum,

crude oil, coal, coal tar pitch, creosote, and roofing tar. PAHs generally have low solubility in water, most likely to stick tightly to particles in soil. Many PAHs have been reasonably identified as probable human carcinogens. Researcher found that the concentration of PAHs in microorganisms is considerably more than the concentration of PAHs in soil or water where those microorganisms live (Agency for Toxic Substances and Disease Registry, 1995).

Because of the hydrophobic nature of the PAH compounds, conventional remedies such as pump-and-treat have proven to be of limited practical value. (Chan, 2002; Conte, 2001; Yeom, 1996) Therefore, significant efforts are being devoted to development of efficacious approaches for the remediation of these contaminated sites. In 1984, the US Environmental Protection Agency (EPA) identified surfactant washing as one of the most promising in situ remediation techniques for contaminated aquifers, spawning a great deal of interest in surfactant-enhanced remediation (SER) processes that has continued up to the present. Overall, SER strategies are commonly characterized by two sequential process stages. The first stage desorbs or otherwise mobilizes PAH compounds at the contaminated site. Once solubilized, the PAH molecules may become available in the second stage for in situ or ex situ (bio) degradation (Grasso, et. al, 2001).

Surfactants have received considerable attention because they can treat organic compounds that are difficult to treat by conventional methods, such as volatile organic compounds (VOCs), chlorinated and nonchlorinated aliphatic solvents, and also PAHs. In addition to this, the actual volume of waste that needs disposal may be less than by the other methods and the surfactant itself is easily removed from the subsurface by an anthropogenic or natural process. Furthermore, possible adverse effects from soil washing are greatly reduced when low toxicity and biodegradable surfactants are used (Abdul and Gibson, 1992).

Surfactants can be introduced into the subsurface either in the conventional solution form or in a foam based fluid (Hayes, 2001). An innovative technology that may be effective for in-situ soil flushing is the use of microbubbles or colloidal gas aphron (CGA) suspensions which are generated from surfactant solutions. CGAs were described as a dispersion of microbubbles (25μm and above in diameter) in water (Roy et al., 1997). Some of the applications of CGAs are flotation of organic contaminants, soil flushing,

and in-situ bioremediation (Kommalapati, 1998; Roy, 1995). CGAs were found to be more efficient than surfactant solutions on the basis of weight of contaminant removed per gram of surfactant. The CGAs have the following properties that are exploited in flotation process (i) large surface area for particle-bubble contact and (ii) no significant coalescence in transportation by pumping (Hashim and Gupta, 1998).

In this experiment, aqueous surfactant solution and colloidal gas aphron generated form surfactant solutions were used to wash PAH from a synthetic soil, pumice. Pumice was used instead of natural soil in order to avoid interference of organic matters in the soil. The PAH used in this experiment is pyrene, the 4-benzene rings PAH. This chemical was chosen because it is typically found in mixed PAH contaminated environment. Furthermore, pyrene has high molecular weight compared to other 2 or 3- benzene rings PAHs. If the surfactant can effectively remove pyrene from the synthetic soil, it should achieve the same or even better remediation with less molecular weight PAHs. BioSolve and BioNonex are the selected surfactants. They have been proven in the laboratory and also in the field as cost effective, environmentally sound answer to soil and groundwater remediation efforts involving a wide range of contaminates. The efficiency of soil flushing using surfactants in the CGA form was compared with that of conventional solution form.

1.2 Objectives

1. To study factor affecting pyrene removal by surfactant-enhanced method
2. To compare the performances of soil flushing by using colloidal gas aphron suspensions, conventional surfactant solutions and water flood in continuous flow column.

1.3 Hypotheses

1. CGA suspensions can be used effectively to remediate PAHs contaminated soil.
2. The performances of CGAs are superior to conventional surfactant solutions and water flood.