CHAPTER I

INTRODUCTION

Activated carbon is a nonpolar adsorbent that is recognized as effective and reliable in removing impurities. It has a tremendous adsorptive capacity, an affinity for a wide variety of dissolved organics and chlorine (Hemphill, 1978; Robert and Anthony, 1986). Consequently, it is very useful in clean-up of streams before emission to the environment by removing dissolved organic pollutants from industrial wastewater or gaseous streams and also used in recovery of some of the organic products.

An advantage of using activated carbon in adsorption application is that it can be reused after a regeneration process. Therefore, regeneration of activated carbon is a major factor in the cost effectiveness in its utilization (Hutchin, 1973; Soffel, 1964).

The standard regeneration method widely used is thermal regeneration (Hutchin, 1973; Slejko, 1985), involving removal of the carbon from the bed and transported to a multihearth furnace or a rotary kiln at 870 - 980 °C where the adsorbed organic are vaporized and carbonized. This process is energy-intensive, labor-intensive and time consuming. Moreover, some inorganic salts can be deposited on carbon or adsorbates that may cause the air pollution during regeneration. Further, the organic adsorbate can not be recovered and up to 30% of the carbon may be burned in the furnace (Soffel, 1964; Yeholskel, 1978).

An in-situ regeneration method has more efficiency than the previous one. The first process is hot gas regeneration (Yeholskel, 1978; Cheremisinoff, 1993), in which a hot gas such as, steam or nitrogen is passed through the bed to desorb the adsorbate by a combination or purging and desorption by heat-up effect. This method is appropriate only for highly volatile adsorbates. The other is solvent regeneration (Sutikno and Himmelstein, 1983; Wankat and Partin, 1980), involving dissolution of the adsorbate into a volatile organic solvent, followed by steam or hot gas to remove residual solvent from carbon that is a major disadvantage of this method because it makes for an energy-intensive.

Biological regeneration (Cheremisinoff, 1993; Chudyk and Snoeylyk, 1984) is also an in-situ regeneration, in which bacteria are introduced into the bed to consume the adsorbed organic. This process is very slow, and has many disadvantages, such as the organic not being recovered, reduction of bed capacity from adsorption of some of the degradation products, the need to induced desorption of the bacteria from the carbon when done, and the frequent inability of bacteria to ingest a mixture of organic.

Surfactant-enhanced carbon regeneration (SECR) is a new in-situ process that utilizes surfactants to remove adsorbed organic from activated carbon in order to regenerate it for reuse (Brant et al., 1989; Yin et al., in press.). In SECR, a concentrated surfactant solution is passed through the spent carbon bed. The organic adsorbate desorbs and is solubilized into micelles, which have surfactant aggregation numbers typically 50-150 molecules, in regenerant solution. After desorption process, residual adsorbed surfactant left on the activated carbon will be removed by water flushing step. Surfactant in regenerant stream will be treated to recover from concentrated solute for reuse again. This method consumes low energy and not the surfactant used can be selected for nontoxic and biodegradable that can be directly discarded to normal sewage systems. The process strategic is illustrated in figure 1.1.

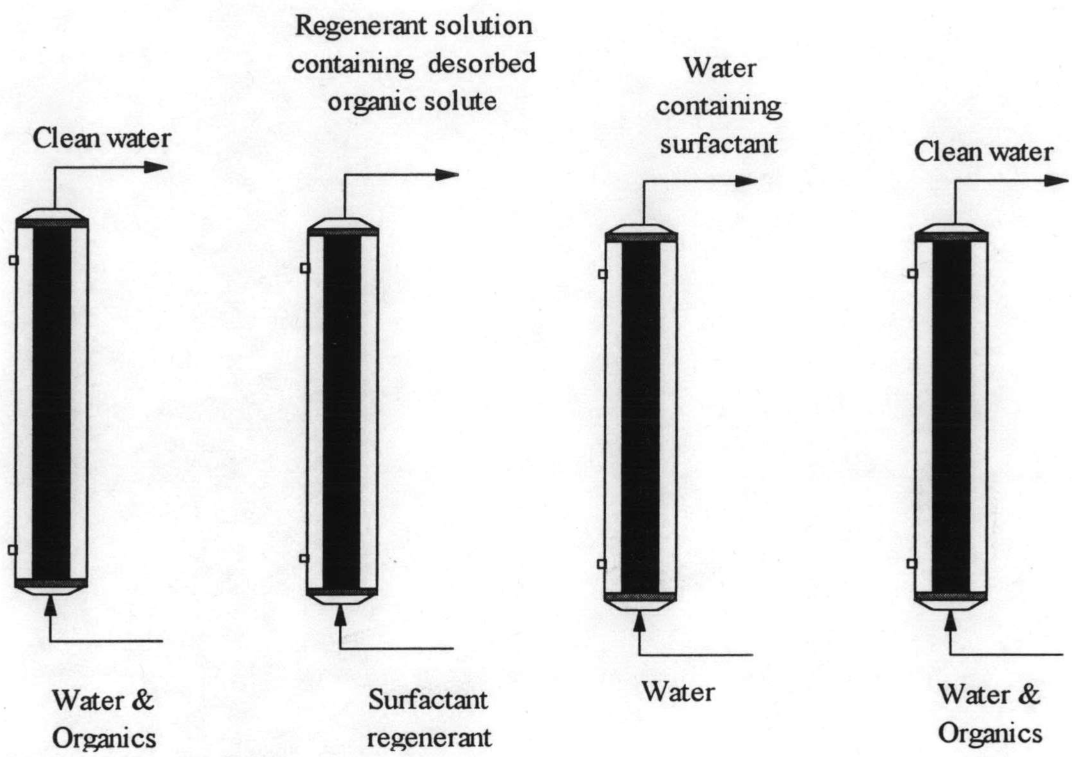

Figure 1.1 Process strategy for surfactant-enhanced carbon regeneration.

Previous studies on SECR application have illustrated the high effective of this technique for removal adsorbed organic from activated carbon bed. Eventhough, the adsorption capacity of carbon after regeneration following by water flush can substantially reduce in applying for liquid phase. The purpose of this study is to investigate the effects of low concentration organic solute loading on the breakthrough curve in subsequent adsorption cycles, and on effective adsorption capacity after regeneration.