# CHAPTER I
# INTRODUCTION

Adsorption process has been widely used as an efficient and economical treatment method to remove various toxic contaminants from industrial waste stream. The process is particularly effective for controlling volatile organic compounds in the emission. In this aspect, activated carbon has extensively been used as the adsorbent in many industrial applications because it can be used to remove a wide variety of organic pollutants from aqueous or gaseous streams. Activated carbon also possesses a tremendous adsorptive capacity, and thus, this nonpolar adsorbent is recognized as being effective and reliable in removing organics at low concentrations (Suffet and McGuire, 1980; Hutchins, 1979; Keller *et al.*, 1987). However, after being used for a period of time, the capacity of activated carbon is exhausted and the activated carbon must be regenerated. There are a number of regeneration methods which are available but the most common technique is thermal regeneration.

Thermal regeneration method requires high temperature that makes this method energy intensive (Suzuki *et al.*, 1978; Moreno-Castilla *et al.*, 1995; Torrents *et al.*, 1997). Moreover, thermal regeneration can cause deterioration of adsorbent which results in a requirement of make up adsorbent and the organic compounds which adsorb on the adsorbent surface can not be recovered. Another common method is chemical regeneration, which requires the use of organic solvents or inorganic chemicals, thus not an environmental friendly technique (Cooney *et al.*, 1983; McLaughlin, 1995; Leng and Pinto, 1996; Kilduff and King, 1997; Rinkus *et al.*, 1997). The other regeneration methods such as bioregeneration (Cheremisinoff, 1993; Chudyk and Snoeylyk, 1984), ultrasound regeneration (Rege *et al.*, 1998; Schueller and Yang, 2001), and supercritical regeneration (Modell *et al.*, 1980; Recasens, 1989) have been known to be far from being commercially viable at the moment since they have some severe drawbacks such as highly time-consuming and high capital and operating costs.

Using surfactant to regenerate activated carbon bed or so-called surfactant-enhances carbon regeneration (SECR) is an alternative in-situ regeneration method (Blakeburn and Scamehorn, 1989; Roberts and Scamehorn, 1989). It consumes low energy and uses nontoxic and biodegradable surfactant which can be directly discarded to normal sewage systems. This regeneration technique contains three main steps, which are flooding the surfactant solution through the activated carbon bed, rinsing of excess surfactant by water and finally, drying the bed with warm air.

Previous work has shown that using sodium dodecyl sulfate (SDS) as a regenerant can effectively remove phenol from granular activated carbon (GAC) in liquid phase application (Sirisithichote, 1996). However, when SDS was introduced for a long time, there was precipitation occurred in the column. The precipitate would cover the surface of the GAC and presumably block the active sites, thus reducing GAC adsorption capacity. It was speculated to be due to the strong adsorption of SDS on GAC. Thamtharai *et al.* (2003) investigated the in-situ regeneration of trichloroethylene (TCE) on GAC in vapor phase application using SDS. The results showed that more than 95% of TCE adsorbed on GAC was removed by using 0.1 M SDS solution. With water flushing at ambient temperature, the adsorption capacity of the regenerated carbon could be recovered but still far below its original capacity. It has been suggested that the surfactant adsorption and desorption is the key issue and should be further investigated. However, it is not easy to study and to fully understand the adsorption and desorption of surfactant on activated carbon due to its heterogeneity. In this aspect, hydrophobic polymeric resin is an ideal candidate for a comparative study since it has similar surface properties to the carbon, yet more homogeneous. Therefore, this research studied the adsorption and desorption of SDS on GAC and hydrophobic polymeric resin XAD-4 under various conditions which involve changes in temperature and salinity. Moreover, sodium octanoate was used in this study in comparison with SDS in order to examine hydrophobicity effect. This study should give a better understanding of the surfactant adsorption on this kind of adsorbents which will aid us in designing suitable conditions to remove residual surfactant on hydrophobic surface.