CHAPTER I

INTRODUCTION

Adsorption processes utilize the concept of contaminant removal by concentration on the surface of a solid material. This method has been in commercial practice for several decades (Mantell, 1951). These processes are currently widely used for volatile organic control in industry. Basing on the physical properties of specifically prepared solid known as adsorbents which attract selectivity and retain chemical compounds on their surface (Beni'tez, 1993).

The most well known adsorbent is the activated carbon due to its ability. The quantity of material adsorbed is proportional to the surface area of the solid and, consequently, adsorbents are usually granular solids with a large surface area per unit mass. The activated carbon, as practised in the industry has been traditionally used to remove objectionable tastes, odors, and organic contaminants which are cause by trace pollutants. Its tremendous adsorptive capacity have expanded its application to the treatment of numerous industrial waste streams.

In many of those industrial applications, recovery and reuse of the removed pollutants have become feasible, since, under these conditions, the process is reversible. This characteristic can convert this rather expensive process in to a source of net profit. In general, any organic compounds which are likely to be a good adsorbate on activated carbon have their molecular weight greater than 45 (Noll, 1992).

Interest in carbon use for air and water pollution control has grown and received increased attention since the early 1970s with the advent of more stringent environmental rules. The limiting step in the use of carbon is the regeneration of the spent carbon. Several alternative regeneration technique for renewing spent carbon to its original adsorptive capacity make use of thermal, biological, chemical, hot-gas or solvent technique (Cheremisinoff, 1993).

Thermal regeneration is the conventional method of regeneration. It involves removal of the carbon out of the bed and sending it to a specialized facility where multihearth or rotary furnaces can be used to volatilize and carbonize adsorbed material (Noll, 1992). Several disadvantages has been found in this process: it caused energy intensive, labor intensive, time consuming. Indeed, there is carbon loss, and no organic adsorbate can be recovered. So an efficient, in-situ, regeneration process is economically more attractive than the commonly employed thermal regeneration method.

Hot-gas regeneration, an in-situ method, is used only when adsorbed organics is highly volatile. By using steam, CO_2 or N_2 pass through the bed to vaporize the adsorbed materials (Scamehorn, 1979).An important disadvantage of this method is an energy intensive process. Due to hot-gas must be performed to desorb a volatile solvent after the process is complete. Moreover, if flammable solvent is used as regenerant, safety considerations need to be considered (Wankat et.al., 1980).

Solvent regeneration process is another in-situ that introduce an appropriate solvent such as acetone, toluene and carboxylic acid to pass through the spent activated carbon and dissolve the adsorbed materials (T. Sutkino and Kenneth J. Himmelstein, 1983).

Another in-situ regeneration method is a biological regeneration. Bacteria are introduced into the bed to consume the adsorbed organics from the activated carbon (Chudyk, 1984). Disadvantage contain the process being very slow, no organic can be recovered, reduction of adsorption capacity, the need to induce desorption of the bacteria when done and finally, the fact that the bacteria often cannot digest a mixture of organics.

In the surfactant enhanced carbon regeneration (SECR) process, a concentrated surfactant solution is passed through the spent activated carbon bed. Then adsorbed organics is removed from the carbon and solubilized in the micelles in the regenerant solution. Recall that SECR depends on solubilizing the target adsorbed organics. Moreover, solubilization is dependent on the presence of micelles, therefore, the concentration of surfactant solution should be greater than CMC (critical micelle concentration). After regeneration is complete, the carbon can contain some residual adsorbed surfactant. It is removed by flushing the water. After the water flush is completely and all of the residual surfactant is removed from the carbon, the bed can be used directly for liquid phase applications or dried before reuse in vapor phase applications.

Toluene, amyl acetate, tert-butyl phenol and phenol are just four organics which have been shown to be essentially completely removed from spent activated carbon with less than 100 pore volumes of regenerant solution (Roberts et.al., 1989; Blakeburn et.al., 1989). The carbon presented no signs of serious degradation upon repeated regeneration.

In this experiment, trichloroethylene (TCE) is selected as the adsorbate. Since it is widely used chlorinated volatile hydrocarbon because of it marvelous solvent properties and nonflammability. It is used as solvent for fats, waxe, resins, oils, rubber paints, vanishes, cellulose esters and ether. It is also used as solvent dyeing, dry cleaning, refrigerant and heat-exchange liquid, fumigant, cleaning and drying electronic parts, diluent in paints and adhesives, textile processing, chemical intermediate, aerospace operations . Due to highly volatile and highly solubility in surfactant solution, TCE is chosen for this study. And Sodium Dodecyl Sulfate (SDS), a biogradable surfactant, is used as the regenerant solution.