CHAPTER I
INTRODUCTION

Activated carbon has been extensively used as an efficient adsorbent to remove organic compounds from water and gases streams by means of adsorption process. In normal applications, packed-bed carbon adsorbers are widely used in cleaning up streams prior emission to environment or recovery of valuable organic compounds. In process services, activated carbon gradually adsorbs organic compounds from the streams resulting in progressive degradation of its ability to remove additional incoming organic compounds from the streams. Eventually, its adsorption capacity is consumed as reaching the breakthrough concentration of the effluent gas stream. At this point, the spent activated carbon must either be replaced or be regenerated to restore its adsorptive capability.

Many chemical engineers believe that the operating costs of activated carbon adsorption are high. This is due to the predominant industrial practice of using activated carbon only once or with thermal regeneration. Current regeneration methods of spent activated carbon are thermal regeneration including steam regeneration, hot inert gas regeneration, thermal regeneration, and thermal reactivation. These regeneration methods are energy intensive. Some of these methods are unable to serve on site resulting in extra cost for unloading the spent carbon and transportation to regeneration site. Moreover, during the regeneration, some part of the activated carbon is destroyed or even decomposed if the regenerating temperature is too high.

Therefore, other alternative regeneration methods have been searched with attempt to decrease the regeneration cost and develop for practical use in industry. These methods are chemical regeneration, solvent regeneration, supercritical extraction, and microwave regeneration. However, they have not reached industrial applications. Regeneration of spent activated carbon for gas phase application using surfactant is one of the promising alternative methods. Two predominant properties namely lowering interfacial tension and solubilization of surfactant cause desorption of the organic compounds from the activated carbon surface. The desorbed organic compounds are migrated out from the activated carbon pore into the bulk solution by the stream of surfactant solution. Then, the organic compounds solubilize in to the core or parlisade layer of the micelles of surfactant.

The ultimate goal of this research work was to find suitable conditions for regeneration of activated carbon and a polymeric adsorbent using surfactant in order to restore its adsorption capacity for volatile organic compound. In the first part, the packed bed adsorber was designed and built to investigate the adsorption of a volatile organic compound using trichloroethelene (TCE) as a model pollutant and to study the regeneration of TCE-saturated granular activated carbon (GAC) and polymeric adsorbent using an anionic surfactant, sodium dodecyl sulfate (SDS). In the second part, effects of various system parameters on the regeneration performance and adsorption capacity of the regenerated GAC and polymeric adsorbent were examined. These parameters included surfactant concentration in regenerant solution, regenerant flow rate, water flushing, and water flow rate in flushing step. In the third part, the adsorption and desorption of SDS on GAC at different temperatures were studied. In addition, the effect of flushing water temperature was examined.