CHAPTER I
INTRODUCTION

Many industrial processes, such as petroleum refining and gas manufacturing plants are major sources of mixed wastes, which contain both toxic organics and heavy metal contaminants. Toxic organics commonly found in mixed wastes are polyaromatics hydrocarbons (PAHs) and BTX (Benzene, Toluene and Xylene) which are carcinogenic substances. Heavy metals, such as lead, cadmium and chromium, are toxic priority pollutants which can cause serious diseases. Conventional techniques such as chemical precipitation, adsorption ion exchange, electrochemical methods, membrane separation, solvent extraction and biological methods have been used to treat particular waste species separately. But there is no readily available economical technology to simultaneously treat toxic organic and heavy metal contaminants.

In our laboratory, we have conducted research on the treatment of mixed wastes containing both toxic organic and heavy metal contaminants by using surfactant-modified zeolite (SMZ) based on a naturally occurring zeolite-clinoptilolite. Clinoptilolite is an abundant and versatile material, which possesses high cation exchange capacity and high surface area. Unfortunately, due to its inorganic nature, clinoptilolite has low organic adsorption capacity. Surface modification using surfactant can enhance its adsorption capacity for toxic organic compounds.

Charge-balancing cations present on the surface of very fine-grained clinoptilolite can be replaced by high-molecular-weight quaternary amines such as cetyltrimethylammoniumbromide (CTAB). Consequently, this converts the clinoptilolite surface to become strongly hydrophobic. The modified-zeolite surface can be further used to anchor a metal ligand, such as palmitic acid (PA), through hydrophobic interactions to form a surfactant modified-zeolite (SMZ). Metals can sorb onto SMZ by the formation of a metal complex. In addition, the organic moiety of the SMZ also provides adsorption sites for organic compounds. Thus, these SMZ can potentially be used to treat mixed wastes containing both heavy metals and toxic organic compounds.

This study focused on the preparation of surfactant-modified zeolite (SMZ) through a simple two-step surface modification technique. The adsorption characteristics of surfactant-modified zeolite (SMZ) for heavy metal and organic contaminant were studied. Batch liquid adsorption experiments were carried out to examine adsorption characteristics of SMZ. Effects of heavy metal concentration, organic contaminant concentration and pH on the adsorption were examined. The possible regeneration and reuse of surfactant-modified zeolite after becoming saturated with heavy metal and organic contaminant was also investigated. Alteration of pH was applied to regenerate surfactant-modified zeolite when saturated with heavy metals and air purging was used for regeneration of organic-contaminant saturated SMZ.