CHAPTER I
INTRODUCTION

Wastewater generated from chemical and petrochemical industries is a major source of organic and heavy metal pollutants. Typical toxic organics include hydrocarbon solvents, chlorinated compounds, polychlorinated biphenyls (PCBs), etc. Hydrocarbon solvents such as benzene, toluene and xylene are generally found in various waste streams, which seriously affect all living elements in the environment because of their toxicity. Heavy metals such as lead, cadmium and chromium are toxic priority pollutants, which are the cause of serious diseases. There are both internal requirements and external environmental regulations placed on producing high-purity water that is free of detectable hydrocarbons and heavy metals contamination. Therefore, the removal of hydrocarbons and heavy metals from contaminated water is critical to many manufacturing industries. Conventional techniques such as chemical precipitation, adsorption/ion exchange, electrochemical methods, membrane separation, solvent extraction, oxidation and biological methods have been used to treat particular waste species. However, there is no economical technology to effectively treat toxic organic and heavy metal contaminants simultaneously. In this aspect, adsorption techniques have increasingly been used as a simple, economical and efficient treatment technique. For several years, various natural adsorbents such as clay minerals, activated carbon and zeolite have been used as economical adsorbents to remove heavy metals and hydrocarbons from contaminated wastewater.

In our laboratory, surfactant-modified zeolite (SMZ) adsorbent based on a naturally occurring zeolite-clinoptilolite has been developed and used to remove both toxic organics and heavy metal contaminants from mixed wastes. Clinoptilolite is an abundant and versatile material, which possesses high cation exchange capacities and high internal and external surface areas. It is layered aluminosilicates with intrinsic negative layer charge. Positively charged inorganic counterions neutralize the zeolite's negative charge, but these cations can be replaced by primary amine or quaternary ammonium cations such as cetyltrimetylammoniumbromide (CTAB), thus causing the clinoptilolite surface to become strongly hydrophobic. The modified-zeolite surface can be further used to anchor metal ligand such as palmitic acid (PA) through hydrophobic interactions to form a surfactant-modified zeolite (SMZ). The metal is expected to sorb onto SMZ through the formation of a metal complex. In addition, the organic region of the SMZ also provides an adsorption region for organic compounds. Thus, these SMZ can potentially be used to treat mixed wastes containing both heavy metals and toxic organic compounds.

This research work focused on the preparation of surfactant-modified zeolite (SMZ) and the adsorption characteristics of surfactant-modified zeolite (SMZ) for heavy metal and organic contaminants. The study investigated the adsorption capacity of SMZ for both contaminants as a function of metal ligand loading. SMZ were first prepared with various surfactant/metal ligand loadings. Batch liquid adsorption experiments were then carried out to examine the adsorption characteristics of SMZ for heavy metal and organic contaminants in single and mixed systems. In addition, SMZ saturated with heavy metal and organic contaminants was regenerated for reuse with the adsorption efficiency compared to its original capacity.