CHAPTER I
INTRODUCTION

Wastewaters from a number of industries are found to contain a mixture of both heavy metals and organic contaminants, known as generally "mixed wastes". Heavy metals such as lead, cadmium, and chromium are toxic priority pollutants which cause not only environmental problems but also human threats from serious diseases. Organic contaminants normally found in mixed wastes are aromatic hydrocarbons (e.g., benzene, toluene) and polyaromatic hydrocarbons (e.g., naphthalene, phennanthrene) which are irritants and carcinogenic. Concerns over this problem have led to the development of alternative technologies as conventional techniques such as precipitation, distillation, extraction, and ion-exchange are neither effective nor economical for this kind of wastes. The obvious disadvantage of precipitation technique is the production of sludge that must be treated and disposed at high cost. The distillation technique requires a great deal of energy for the removal of organic compounds. Ion-exchange technique is a reversible process suitable for heavy metal removal but cannot remove organic compounds effectively. Apparently, there is no effective and economical technique readily available to remove both heavy metal and organic compound. In this aspect, an adsorption technique may potentially be used for a simultaneous treatment of mixed wastes containing both heavy metal and organic compound.

In our laboratory, we have evaluated surfactant-modified zeolite (SMZ) based on a naturally occurring zeolite – clinoptilolite – to adsorb heavy metal and organic contaminants. Clinoptilolite is aluminosilicate mineral that has high cation exchange capacity and high surface area. It is neutralized by positively charged inorganic counterions, but these counterions can be replaced by primary amine or quaternary ammonium cation such as cetyl trimetyl ammonium bromide (CTAB). The presence of surfactant imparts hydrophobic property to the clinoptilolite surface. The modified-zeolite can be further used to anchor metal ligand or anion surfactant such as hexadecyl diphenyloxide disulfonate disodium (DOWFAX 8390) through hydrophobic interactions to form a surfactant-modified zeolite (SMZ). The disulfonate functional group on the surface of SMZ can adsorb heavy metal ions

whereas, the organic region of SMZ also provides adsorption site for the organic compounds. Thus, the resulting SMZ can potentially be used to simultaneously remove both heavy metal ions and organic contaminants.

This study focused on the preparation of surfactant-modified zeolite (SMZ) using mixed cationic and anionic surfactants and the adsorption characteristics of SMZ for heavy metal and organic contaminants. In the first part of the study, SMZ was prepared by adsorbing CTAB and DOWFAX 8390 on clinoptilolite surface. The resulting SMZ was then characterized for the surface functional group by FTIR, EA and Zeta meter. In the second part, batch liquid adsorption experiments were carried out to evaluate the adsorption capacity of SMZ in both single- and multi-solute systems. Model heavy metals used in the study were Cd^{2+} and Pb^{2+} whereas toluene was used as a model organic contaminant.