CHAPTER I

INTRODUCTION

1.1 State of the problem

The industrial activities in Thailand have been increased rapidly at present such as electronic and computer industry, paper and pulp industry, petroleum industry, glass industry and silver jewelry industry. These industries are important for the economy of the country but they also cause environmental problems such as water pollution. The contamination of heavy metals (e.g. Hg, Ag, Pb, Cd, Zn and Ni) in water is one of the problems concerned.

Heavy metals in water are harmful towards human life, animals and plants. Several methods have been used to remove them from wastewater, such as chemical precipitation, coagulation, ion exchange, solvent extraction and adsorption on various adsorbents [1-3]. Among these methods, adsorption is an efficient method and widely used method for removal of metals from effluent. In recent years, various adsorbents have been investigated, e.g. activated carbon, silica gel, zeolites and clay minerals [4].

In the present, clay minerals have gained a lot of interest because of its unique features e.g. ion exchange mechanism, thermal stability, harmlessness to the environment, low cost and laminate structure. Clay minerals have charges on the surface, resulting in swelling ability and intercalation. These properties are suitable for extraction of heavy metal ions and for surface modification. The hydroxyl groups on surface could be used to remove metal ions in water via ion exchange mechanism [1, 5-6]. However, inherent disadvantages of these materials when applied as adsorbents for heavy metal are their low loading capacity, relatively weak metal ion binding

constants and low selectivity towards the type of metals. To overcome these disadvantages, the modification of surface with metal chelating groups was proposed [4-5]. There are different methods for modification of clays with organic molecules such as ion exchange, impregnation, intercalation and grafting. The organo-clays were demonstrated to be good adsorbents for toxic metals e.g. Cr, Pb, Cd, Hg and Zn [2, 5, 7-10].

In this thesis, hectorite was modified with 2-(3-(2-aminoethylthio)propylthio) ethanamine (AEPE) via reaction with hydroxyl groups on hectorite surface. This ligand contains both sulfur and nitrogen donor atoms in the molecule, that can be used efficiently to remove mercury(II) and silver(I) ions in water.

1.2 Objectives of the thesis

The objectives of this work are to synthesize the hectorite modified with the chelating ligand 2-(3-(2-aminoethylthio)propylthio)ethanamine and to study the suitable conditions for extraction of mercury(II) and silver(I) ions in aqueous solutions by the modified hectorite (AEPE-hectorite) using batch method. Finally, the AEPE-hectorite was applied to real water sample.

1.3 Scope of the thesis

At the beginning of this thesis, a chelating ligand (AEPE) was synthesized and then characterized by nuclear magnetic resonance technique (NMR). The ligand was used for the functionalization of hectorite. The modified hectorite was characterized by X-ray diffraction spectroscopy (XRD), Fourier transforms infrared spectroscopy (FTIR), thermo gravimetric analysis (TGA), surface area analysis and elemental

analysis (EA/CHN). Finally, the modified hectorite was used to extract mercury(II) and silver(I) ions in aqueous solutions by batch method.

In batch system, the effect of pH of metal ion solution, extraction time, adsorbent dose, ionic strength and interfering ions and the adsorption isotherms of AEPE-hectorite for both metal ions were investigated. Thereafter, the adsorbent was applied to extract mercury(II) and silver(I) ions in real water samples. The concentrations of the metal ions in solutions were determined by flame atomic absorption spectrometer (FAAS) and cold vapor atomic absorption spectrometer (CVAAS).

1.4 The benefits of this thesis

To obtain a novel organo-hectorite which could be used for removal of mercury(II) and silver(I) ions in water with a good efficiency.