CHAPTER V
CONCLUSIONS AND RECOMMENDATIONS

Porous clay heterostructure (PCH) derived from Na-bentonite clay has been synthesized by a surfactant directed assembly of silica species within the clay galleries. After the modification, PCHs has been functionalized with the 3-mercap topropyltrimethoxysilane and *N,N*-dimethyldecylamine through co-condensation reaction to improve the hydrophobicity on the porous structures for finding a new application of these porous clay for heavy metal and organics pollutant adsorbents, respectively. From the analysis of N_2 adsorption-desorption data, the surface areas of PCH, MP-PCH and DM-PCH increase significantly from pristine clay. The results shown that PCH, MP-PCH and DM-PCH had surface areas of 549.7, 488.7 and 459.9 m^2/g, average pore diameter of 3.16 , 3.28 and 3.31 nm and pore volume of 0.45, 0.48 and 0.56 cc/g, respectively. Moreover, the shape of the N_2 adsorption-desorption isotherms of these products are very similar which belong to a type IV BET isotherm, and also indicated that the framework pore sizes are in the supermicropore to small mesopore region. The adsorption capacity of these functionalized porous clays was investigated using ICP-OES and HPLC for MP-PCH and DM-PCH, respectively.

For the investigation of adsorption properties, MP-PCH was used to be the heavy metal adsorbents to adsorb Mn, Ni, Cu, Cd and Pb. According to ICP-OES results, the MP-PCHs show the ability to adsorb these metals from the solution because the concentration of metal in solution after treatment decreases when comparing with initial concentration. For comparing the metal absorption ability with purified bentonite and PCH, the ability of MP-PCH was better than PCH and purified bentonite, respectively. Moreover, the increasing of MPTMS content in PCH can improve the adsorption ability of the MP-PCH. The effect of pH and contact time were also studied to finding the suitable condition for adsorption process. An increase in metal ion uptake was observed as the pH value increases from 3 to 7 and the suitable pH values to adsorption is pH 7 for all heavy metals. The adsorption increased with increasing contact time, and the equilibrium was attained after shaking for 24 h. At suitable condition, pH 7 and contact time for 24 hr, the

adsorption capacity of MP-PCH was 0.22, 0.24, 0.50 , 0.48 and 0.11mmol/g for Cd, Cu, Mn, Ni and Pb, respectively.

In the case of organics pollutant, DM-PCH was used to be the adsorbent to adsorb 4-chloroguiacal and 2,6-dinitrophenol. The effect of concentration of organics solution and contact time were also studied. From the HPLC data, the capacity was high at 0.2 mM for both organic solutions and the suitable contact time was 24 hr, the adsorption capacity of DM-PCH was 3.6 and 1.4 mM/g for 4-chloroguiacal or 2,6-dinitrophenol, respectively. They point out the potential of these PCHs for utilizing as the heavy metal and organic pollutant adsorbents in wastewater treatment.

Recommendations

To investigate the adsorption properties of MP-PCH, all heavy metals that used in this work have 2 valence. In the further study, heavy metal solution should be concerned on other valency because mixed heavy metals with different valence are usually found in natural wastewater and the properties of the adsorbent can be changed. PCH should be functionalized with varied the functional group content and should be studied on the thermal properties.