CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

5.1.1 The effect of surface modification on heavy metals and ionic dyes adsorption capacities

Mercapto functional groups grafted on SCP (MP-SCP) had highest adsorption capacities of Cu(II), Cd(II) and Pb(II) at pH 5 about 13, 6 and 5 mg/g, respectively. Chemical bonding between mercapto groups and hydrophobicity comparable with the pistine SCP and amino functional groups grafted SCP (AM-SCP) were suggested to be the support factor for adsorption of heavy metals.

Amino functional groups grafted on SCP (AM-SCP) had highest adsorption capacities of acid blue (AB) at pH 5 about 50 mg/g. Electrostatic attraction between negative charge of AB and surface functional groups were suggested to be the most important factor for adsorption of AB, comparing with van der waals force for MP-SCP and hydrogen bonding of pristine SCP.

Mercapto functional groups grafted on SCP (MP-SCP) had highest adsorption capacity of methylene blue (MB) at pH 9 about 90 mg/g. Van der Waals interaction and electrostatic attraction between negative charge of MB and surface functional groups were suggested to be an important factor for adsorption of MB.

From obtained data, Freundlich isotherm can be fitted to the data with very high correlation coefficients, except MB adsorption isotherms.

5.1.2 The effect of pH on heavy metals and ionic dyes adsorption capacities

At pH 5, the adsorption capacities SCP, AM-SCP and MP-SCP of Cu(II), Pb(II) and Cd(II) were higher than at pH 3. At low pH, effect of positive hydronium ion and hydroxo complex might cause the decrease of positive Cu(II), Pb(II) and Cd(II) adsorption capacities as well as increasing of water solubility of heavy metals.

The adsorption capacities of AB on all of adsorbents at pH 5 and 7 were higher than at pH 9, especially for SCP and AM-SCP. At low pH, the electrostatic interaction of negative charged of AB and the positive charged of adsorbents surface was suggested to play the important role for adsorption mechanism, except for MP-SCP, which did not affect by pH changing significantly, due to van der Waals interaction.

The adsorption capacities of MB on all of adsorbents at pH 9 were higher than at pH 7 and pH 5. The electrostatic interaction force of the MB and the adsorbents surface is likely to be raised when the pH increases.

5.1.3 The effect of surface functional groups on selective adsorption of heavy metal and ionic dyes on superparamagnetic particles surfaces.

The presence of heavy metals (Cu(II), Cd(II) and Pb(II)) did not affect to adsorption capacity ionic dyes (AB and MB) significantly for all adsorbents, because of low surface competition of heavy metals and ionic dyes. Adsorbed heavy metals and ionic dyes were not equivalent to the active functional groups on the surfaces; hence, the active site still remained for the other pollutants to be adsorbed on the same surface.

5.1.4 The effects of magnetic field on separation of superparamagnetic particles

Adding magnetic filed at 3500 gauss could enhance sedimentation efficiency of SCP, AM-SCP and MP-SCP. The separation efficiency SCP, AM-SCP and MP-SCP were highest at pH 2. However, separation efficiencies of MP-SCP at every pH were slightly higher than SCP, due to its hydrophobicity. The effect of positive charge might be concluded the positive charge intensity of particles that can enhance the Lorentz force can increase the sedimentation of the particles by magnetic filed. Moreover, removal efficiency of all particles were over 99% until the amount of particle was higher than 0.01 g per 100ml. It was found that the adsorption of Cu(II), Cd(II), Pb(II), AB and MP on the surfaces did not affected to the sedimentation efficiency of SCP, AM-SCP and MP-SCP particles from synthetic wastewater.

Synthesized SCPs are favorable for use as adsorbent for removal ionic dyes and heavy metals (especially for Cu(II)), because of relatively high adsorption efficiency. Moreover, separation of SCPs from wastewater can easily be enhanced and controlled by adding low energy magnetic field.

5.2 Recommendations

1) Study effects of other co-existing compounds and electrolytes which might affect to selective adsorption efficiency and mechanism in real textile wastewater.

2) Compare the adsorption efficiency and pollutants selectivity with commercial activated carbon.

3) Study the application parameters for SCPs separation such as retention time, shape of reactor , etc. for evaluate the possibility to apply SCPs in real wastewater treatment unit.