CHAPTER V

CONCLUSION

The optimum parameter affected the synthesis and properties of HPMSP doped mesoporous silica was evaluated. The synthesis parameters studied were type of silica precursor and the amounts of surfactant. The crystalline silica with narrow pore size distribution of the modified materials was occurred when using TEOS or calcined mesoporous silica as silica precursors. The characterization of all synthesized silica by FT-IR technique and elemental analysis confirmed the presence of surfactant and HPMSP molecules inside the silica. The SEM results revealed the regular morphology of all spherical silica particles with some aggregates. The particle size distribution determined by the Malvern laser diffraction technique was mainly dependent on the amounts of CTAB used for the synthesis of materials. The study of materials' physical properties and their Cu(II) extraction capacity both by batch and column experiments indicated that the most effective sorbent was obtained with the mole ratio of CTAB/TEOS equal to 0.18. The Cu(II) extractability of this silica obtained from batch method was found to be 0.2080 mol/kg. The experimental data of Cu(II) sorption determined by column experiment followed the Langmuir isotherm model and the Cu(II) capacity was found to be 0.1764 mol/kg. The desorption of the retained Cu(II) was completely achieved using 1 MNO_3 as an desorption agent. The reusability of this material were also demonstrated with satisfactory results.

This kind of sorbent was also applied to the extraction of other metal ions including Fe(III), Mn(II) and Zn(II) using both batch and column method. The determination of various parameters had shown that the optimum pH values for quantitative sorption of all metal ions studied should be in the range of 3-6. The metal extractability of the silica was enhanced significantly by the presence of $NaNO_3$ in metal solution. The extraction of metal from the mixture solution of the three metal ions studied indicated the selectivity of this HPMSP modified silica towards the Fe(III) ions. The profile of the adsorption isotherm of the latter metal ion gave also best fit for the Langmuir model. The maximum capacity of this HPMSP modified sorbent to the extraction of Fe(III) as determined by SPE column method was found to be 0.1825 mol/kg. The study of kinetic extraction exhibited the rapidity of the extraction process of the silica. The removal of various metal ions from different

industrial wastewater samples demonstrated the successful application of this HPMSP doped mesoporous silica as an effective sorbent.

Suggestions for future work

1. The synthesis of HPMSP doped mesoporous silica using various types of silica precursor.
2. The investigation of the metal extractability of HPMSP doped mesoporous silica using online method.
3. The investigation of the structure of organic molecules in mesoporous silica.