CHAPTER 4

CONCLUSIONS

The adsorption of lead(II), cadmium(II), copper(II) and chromium(III) ions in aqueous solution by non-modified and modified seaweed, *Sargassum polyceratium* were investigated in batch system at room temperature. Factors affecting the adsorption process such as biomass particle size, pH of solution and contact time were studied. The optimum condition of each parameter was selected by consideration in maximum amount of adsorbed metal.

4.1 Adsorption of lead(II), copper(II), cadmium(II) and chromium(III) on non-modified seaweed

The adsorption of Pb(II), Cu(II), Cd(II) and Cr(II) ions in aqueous solutions on the dried biomass of *Sargassum polyceratium* was studied. In this experiment, the adsorption equilibrium level was determined under three parameters, biomass particle size, pH of solution and shaking time. Biomass particle of the smallest size gave the maximum metals adsorbed. The amount of adsorbed metals increased with increasing shaking time until 60 minutes. The suitable particle size and shaking time for adsorption of all metals were 0.21-0.36 mm and 60 minutes, respectively. The optimum pH of solutions for Pb(II), Cu(II), Cd(II) and Cr(III) ions were 3.5, 4.5, 4.0 and 3.0 at the initial metal concentrations of 30, 7, 5 and 12 mg/l, respectively.

In order to create a model of the adsorption behaviors of the sorbent, the adsorption isotherms were studied. Both Langmuir and Freundlich adsorption models were suitable for describing the short – term adsorption of Pb(II), Cu(II), Cd(II) and Cr(III) by non-modified seaweed as can be seen from the constant of regression coefficient.

4.2 Adsorption of lead(II), copper(II), cadmium(II) and chromium(III) on modified seaweed.

The dried seaweed in the particle size ranging from 0.21 to 0.36 mm was modified by crosslink-xanthate method. The adsorption of Pb(II), Cu(II), Cd(II) and Cr(III) from aqueous solutions on modified seaweed was tested under adsorption conditions on these two parameters, pH of solution and shaking time. The optimum pH values of Pb(II), Cu(II) Cd(II) and Cr(III) solutions were 3.5 , 3.5 ,3.5 and 3.0, respectively. The suitable shaking time of adsorption was 60 minutes for all metals.

The results obtained show that the adsorption of metals on the modified seaweed respect Frenndlich adsorption isotherm in the same way as Langmuir. Freundlich adsorption model was suitable for describing the adsorption of Pb(II), Cu(II), Cd(II) and Cr(III) and Langmuir adsorption model was suitable for describing the adsorption of Pb(II), Cu(II) and Cd(II).

4.3 Effect of other metals on non-modified and modified seaweed

Both modified and non-modified seaweed could remove more than one metallic species simultaneously. It seems promising to us as adsorbent for the removal of overall metal ions from aqueous samples as well as the commercial resins which adsorption procedure and could be used in the wastewater treatment plant effective ion catcher instead of expensive resin.

4.4 The reduction of lead(II), copper(II), cadmium(II) and chromium(III) in wastewater using the proposed procedure.

The optimized conditions were applied to the removal of Pb(II), Cu(II), Cd(II) and Cr(III) in wastewater from industrial estate in Lumphun and Nakon-pathom. Non-modified and modified seaweed had an efficiency for removing Pb(II), Cu(II), Cd(II) and Cr(III) in wastewater. Modified seaweed represented a greater adsorption than that of the non-modified seaweed. The amount of adsorbed metals by non-modified seaweed were 0.36, 0.37, 0.90 and 0.89 mg/g for Pb (II), Cu(II), Cd(II) and Cr(III) and the corresponding uptake by modified seaweed were 0.53, 2.49, 1.82 and 6.47 mg/g, respectively. The effective pH ranges of the adsorption of all metals were from pH 3 to 5. It is seen that the modified seaweed is more efficient adsorbent for metal ions than the non-modified one. This adsorbent was suitable for removal of heavy metal in wastewater.

The relevancy of the research work in Thailand

This research work described use of the seaweed growing in Thailand in the species of *Sargassum polyceratium* as a biosorbent to adsorb some heavy metal ions such as lead, copper, cadmium and chromium. This species of seaweed has not been yet reported to be used as an economic plant and can be generally found along sea-coat in Thailand. Additionally, the seaweed was modified with crosslink-xanthate method in order to increase its adsorption efficiency. Therefore, this research work is responsible for evaluation of non-useful plant to become an economic plant. The latter work was adopted to develop the suitably modified seaweed and used as a domestic biosorbent for the heavy metals adsorption procedures instead of an expensive imported resin. In term of economic point of view, the used of the modified seaweed for treament of heavy metals is not only reduce the cost for the imported resins, but also increase the country incomes from the exported biosorbent material. This would be able to help the Thai Government to improve the economy of Thailand in the near future.