CHAPTER SIX

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Inactivated biomass of *Sargassum baccularia*, a macro marine brown algae has shown tremendous potential to remove heavy metals from aqueous solutions. By chemically modifying it using PVA as the immobilization matrix, the immobilised beads were packed and used in a laboratory scale fixed bed column to remove copper ions at various conditions. A Two Parameter mathematical model was also successfully applied to characterise the respective breakthrough curves of this biosorption system in the column. A systematic approach has been carried out that will provide bench data for further study and possible exploitation for commercial usage in the treatment of industrial waste.

To further enhance the application of *S. baccularia* as a potential biosorbent in a continuous process, various immobilising agents need to be studied. At the time of writing, preliminary studies into the chemical effects of boric acid and sodium phosphate (Chen and Lin, 1994) to cross link and cure PVA reduced the adsorption capacity of the biosorbent. Possible damage to the various functional groups may have occurred resulting in lower metal uptake.

The immobilisation method of Chen and Lin (1994) is also toxic and hazardous to living cells should the need arise to use live cells as biosorbents or biocatalysts. Hence, other alternatives that are both superior and economical must be explored. Recent studies into immobilization chemistry using PVA as the matrix suggest two possible routes to bypass the above chemical process. One is to employ a high concentration of sodium nitrate as opposed to boric acid to cross link PVA. This method also removes the need for phosphate to cure the beads. Another alternative is to use iterative freezing and thawing of PVA beads using liquid nitrogen. The latter is independent of chemical process. The above mentioned alternatives are worth investigating to enhance the immobilization process while not affecting the adsorption potential of the biosorbent.

The present study has only focussed on single component adsorption using copper as the model ion. Nevertheless, single component ions are rarely encountered in industrial applications. Thus, laboratory studies should include multicomponent adsorption. A systematic study into multicomponent adsorption using *S. baccularia* would enable researchers to identify the affinity of the biosorbent towards other metallic ions and the corresponding effects of others ions to the biosorbent. Application of multicomponent adsorption isotherm can then be employed and data from the respective isotherms can be used for mathematical modelling both in batch and continuous systems.

While the present modelling strategy employed an analytical mathematical model to characterise the breakthrough curve for this biosorption system, further studies into batch or fixed bed modelling need to be quantified. Such models require transformation of partial differential equations to ordinary differential equations.