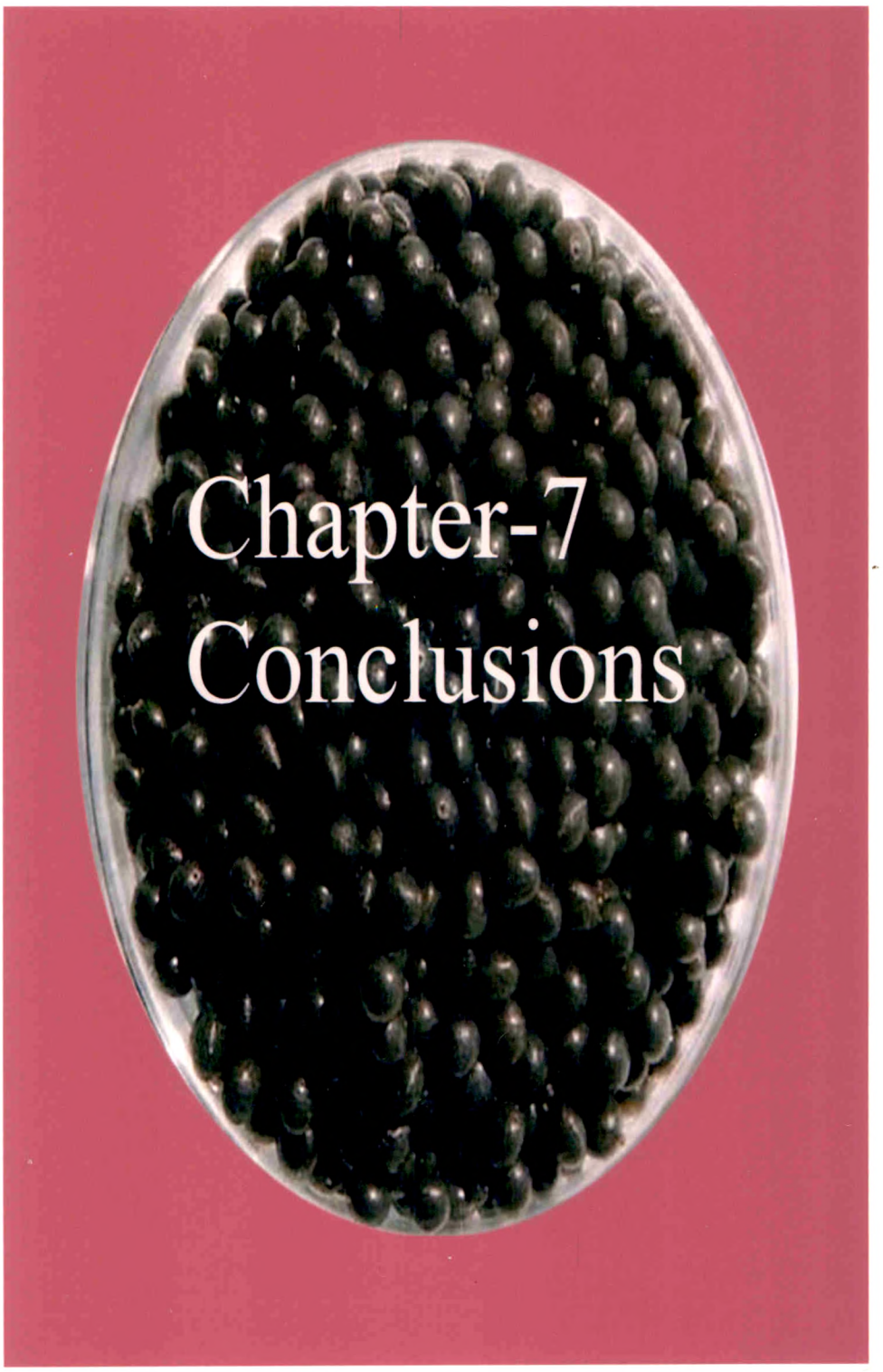

Chapter-7
Conclusions

Conclusions

The present study was undertaken for the evaluation of adsorption capacity and the mechanism involved in the process of biosorption on fungal surface. Various conclusions have been drawn from batch and column process used for biosorption.

The electroplating effluent was found to be highly acidic (pH 2.5) in nature and having high concentration of Cr(VI) (117 mg/l) and Zn(II) (94.8 mg/l) ions which showed its toxic nature. The process of biosorption was used for the removal of heavy metals from electroplating industrial effluent. Different parameters which affected the process of biosorption were optimized and found that the particle size of 100 μm biosorbed the heavy metal ions to maximum extent which revealed that the biosorption decreased with increase in particle size. This was due to the increase in overall mass transfer coefficient with increase in surface area as a result of decrease in particle size.

Immobilization of biosorbent particles was carried out in calcium alginate matrix to increase its strength and its easy use in continuous flow mode. The optimum biomass concentration in immobilized beads was found to be 5% (w/v) which resulted in optimum biosorption. During biosorption process change in pH resulted in the high variability of biosorption capacity due to a change in chemical speciation of heavy metal ions and ionization of functional groups. The optimum pH for Cr(VI) and Zn(II) removal was observed to be 1.5 and 7.5 which revealed that the process of biosorption can be made metal selective by varying the pH of the system.

The study of Freundlich and Langmuir isotherms revealed that the immobilized biosorbents were having higher biosorption capacity than non-immobilized biosorbents. The NaOH treated biosorbents performed better than other biosorbents for the biosorption of Cr(VI) and Zn(II) ions. The treatment of biosorbents with 0.1 N NaOH resulted into the exposure of much more active binding sites by unmasking some of the cellular groups to improve the adsorption capacity. The biosorbent dose showed a synergistic effect with respect to adsorption capacity till the saturation of active binding sites present on the

biosorbent surface were occupied by heavy metal ions. The biosorbent dose of 1 gm was observed to be optimum for the removal of heavy metal ions in the present electroplating industrial effluent.

On the basis of parameter optimization studies for experimental design and fitness of correlation equation, optimal conditions for chromium adsorption were found to be pH 1.5, biosorbent dose 1gm, contact time 1hour and metal ion concentration 100mg/l where as for zinc adsorption these were found to be pH 7.5, biosorbent dose 1gm, contact time 1hour and metal ion concentration 100mg/l for different fungal biosorbents.

The studies on rate kinetics showed that the immobilized biosorbents followed Pseudo-second order rate kinetics to a higher extent as compared to non-immobilized biosorbents which revealed the role of intra-particle diffusion process. The process was found to be very rapid as the biosorption process reached to the state of equilibrium with in 45 minutes. The value of separation factor (R_L) for all the biosorbents ranged from 0 to 1 which supported the favorability of the chromium and zinc adsorption.

Freundlich, Langmuir and Thomas models applied to the equilibrium data inferred that biosorption of chromium and zinc by the biosorbents was physio-sorption as well as chemisorption. These models revealed the reversible nature of biosorption process and this aspect was used for the process of desorption. The desorption of metal ions from the surface of biosorbents was carried out with the help of 0.1 M H_2SO_4 which showed its high efficiency (<90%) upto five cycles. So, the process of desorption made the biosorption process more economical and efficient.

The thermodynamic studies helped in the estimation of free energy change (ΔG) of the process and it was revealed that the biosorption of heavy metal ions was favourable in nature as it was shown by spontaneity of biosorption process (negative values of free energy). The biosorbents showed a preference for chromium over zinc in a two metal system at acidic pH while zinc was adsorbed more as compared to chromium in basic medium. The maximum adsorption of chromium (VI) at pH 1.5 was due to the presence of positive charge on the