Chelation and permeation of heavy metals using affinity membranes from cellulose acetate–chitosan blends

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ABSTRACT

Affinity membranes have attracted the attention of membrane researchers especially in the field of wastewater treatment specifically in removing heavy metals by chelation from aqueous solutions. In the present work, several membranes are made from either cellulose di-acetate (CA) or CA together with chitosan (CS) solutions, the CS prepared in our lab from shrimp shells or from ready-made shrimp or crab shells. The variables investigated included type and ratio of solvents forming the casting solutions, mass ratio of CA to CS in the casting solution, type of CS (shrimp or crab shells), and initial concentration of Cu(II) ions. The membranes were fabricated by casting on a glass plate of a casting assembly using a surgical blade by the phase inversion technique. The permeation and adsorption capacity of each membrane were examined in a plexiglass two compartment diffusion cell in which the membrane was placed between the two compartments to separate the copper ion solution from an equal volume of distilled water. The two compartments were stirred either magnetically or mechanically. The results were presented as concentration–time curves and \( \ln \left( \frac{C_o}{C_t} \right) \) vs. time from which the overall mass transfer coefficient was computed in each case. It was found that the presence of CS obtained from shrimps acted as a better affinity membrane in high CA to CS ratios as well as high concentration of Cu(II) ions, and that crab CS has a poor affinity to Cu(II) ions compared to that obtained from shrimps. It was also realized that the composition of the casting solution markedly affected the properties of the fabricated affinity membrane. In addition, scanning electron microscopic examination revealed the morphology of the membrane surfaces (upper, lower, and cross-section). It is worth mentioning that membrane thickness has a profound effect on both permeability and extent of chelation of the heavy metal examined.

Keywords: Affinity membrane; CS; Cellulose di-acetate; Cu(II) ions; Heavy metals; Wastewater

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