

## Optimization of Chitosan Membrane Production Parameters for Zinc Ion Adsorption

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**Abstract :** Chitosan materials from different sources of raw materials were characterized in order to determine optimal preparation conditions and parameters for membrane production. The membrane parameters such as molecular weight, viscosity, and degree of deacetylation were used to evaluate the membrane performance for zinc ion adsorption. The molecular weight of the chitosan was found to influence the viscosity of the chitosan/acetic acid solution. An increase in molecular weight (60000-400000 kg.kmol<sup>-1</sup>) of the chitosan resulted in a higher viscosity (0.05-0.65 Pa.s) of the chitosan/acetic acid solution. The effect of the degree of deacetylation on the viscosity is not significant. The effect of the membrane production parameters (chitosan- and acetic acid concentration) on the viscosity is mainly determined by the chitosan concentration. For higher chitosan concentrations, a membrane with a better adsorption capacity was obtained. The membrane adsorption capacity increases from 20-130 mg Zn per gram of wet membrane for an increase in chitosan concentration from 2-7 mass %. Chitosan concentrations below 2 and above 7.5 mass % produced membranes that lack good mechanical properties. The optimum manufacturing conditions including chitosan concentration, acetic acid concentration, sodium hydroxide concentration and crosslinking for chitosan membranes within the workable range were defined by the criteria of adsorption capacity and flux. The adsorption increases (50-120 mg.g<sup>-1</sup>) as the acetic acid concentration increases (1-7 mass %). The sodium hydroxide concentration seems not to have a large effect on the adsorption characteristics of the membrane however, a maximum was reached at a concentration of 5 mass %. The adsorption capacity per gram of wet membrane strongly increases with the chitosan concentration in the acetic acid solution but remains constant per gram of dry chitosan. The optimum solution for membrane production consists of 7 mass % chitosan and 4 mass % acetic acid in de-ionised water. The sodium hydroxide concentration for phase inversion is at optimum at 5 mass %. The optimum cross-linking time was determined to be 6 hours (Percentage crosslinking of 18%). As the cross-linking time increases the adsorption of the zinc decreases (150-50 mg.g<sup>-1</sup>) in the time range of 0 to 12 hours. After a crosslinking time of 12 hours, the adsorption capacity remains constant. This trend is comparable to the effect on flux through the membrane. The flux decreases (10-3 L.m<sup>-2</sup>.hr<sup>-1</sup>) with an increase in crosslinking time range of 0 to 12 hours and reaches a constant minimum after 12 hours.

**Keywords :** chitosan, membrane, waste water, heavy metal ions, adsorption

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