A modified coating method for preparing a mono-valent perm-selective cation exchange membrane: I. The evolution of membrane property corresponding to different preparing stages

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ABSTRACT

In this work, enlightened by the preparation of the Tokuyama BP-1 bipolar membrane, a modified coating method is attempted to prepare the mono-valent perm-selective cation exchange membrane (CEM). That is, a surface-roughening step is introduced into conventional coating technology to increase the contacting area and strengthen the interaction between modification layer and base membrane. Furthermore, a post-quaternization is carried out after the formation of the cross-linked chitosan layer to weaken the effect of the electrostatic repulsion among the cationic charged macromolecules on the compactness of the modification layer. The SEM images and the diffusion experiments of solute confirm the formation of a dense and smooth cationic modification layer. The electrodialysis experiments of the CEMs corresponding to different preparing stages with respect to H+/Zn^{2+} system and Na^{+}/Mg^{2+} system show that the mono-valent perm-selectivity can be endowed successfully to the ordinary CEM. For example, the separation ability of the CEM modified by the cross-linked quaternized chitosan to protons and Zn^{2+} in solution of 2.5 g/L ZnSO_{4} in 0.25 M H_{2}SO_{4} increases almost 10 times. However, a remarkable increase of the electrical resistance and decrease of limiting current density is also observed after CEM modification.

Keywords: Mono-valent perm-selectivity; Cation exchange membrane; Electrodialysis; Surface modification; Chitosan

1. Introduction

It is well known that the electrodialysis technology specializes in the common desalination and concentration of electrolyte solutions by means of the alternative arrangement of ion exchange membranes. Therein, the relevant applications, such as the comprehensive utilization of sea-water, waste-water treatment, and hydrometallurgy, thirst for the cation exchange membranes with high proton leakage or selectivity to mono-valent cations [1]. At present, there are several approaches, including the selection of the membrane material [2–4], the alteration of the membrane morphology [5], and the modification of the membrane surface [6,7], to be able to adjust the affinity of the cations with the membrane or/and their migration speeds in the membrane phase. In view of the perfect properties of the current cation exchange membrane (CEM) and the

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