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Development of Hollow Fiber Ion Exchange Membrane Having High Ion Permeability (Ⅱ)

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Summary

The goal of this study is to prepare novel hollow fiber (HF) type ion exchange membranes (IEMs) from poly (vinyl alcohol) (PVA)-based polyelectrolytes. In a previous study, polysulfone (PSF) with graft chains of poly (sodium *p*-styrenesulfonate) (PSF-*g*-PSSS) were synthesized, and flat sheet PSF-based cation-exchange membranes (CEMs) were prepared from the graft copolymers. We measured the ionic transport properties of the obtained CEMs to evaluate the relationship between the transport properties and the preparation conditions. In this study, hydrophilic HF type IEMs were prepared from an aqueous solution of PVA-based poly (vinyl alcohol-*co*-2-acrylamido-2-methylpropane sulfonic acid) (AP-2) and PVA/poly (diallyldimethyl-ammoniumchloride) (PDADMAC) by gel fiber spinning method. The membranes were cross-linked by annealing, and further cross-linked by immersing them in glutaraldehyde (GA) solutions with various concentrations. To investigate the effect of the GA concentration on the ion permselectivity and selectivity for electrolytes, permeation experiments were performed in a Donnan dialysis system consisting of a HF membrane and two aqueous solutions containing a driving electrolyte and a model recovery ion.

The water uptake (*WU*) of the HF membranes decreased as GA concentration increased because the amount of hydroxyl groups decreased by acetalization reaction in the membrane, and depended on the GA concentration.

From the results of ion exchange capacity (*IEC*) for the HF membranes, measured value was lower as compared with the theoretical value and that of commercial IEMs.

Ion permeation experiments in Donann dialysis showed that ion flux (*J*) was decreased with increasing GA concentrations. The value of *J* and ion permeability (*P*) showed constant value independent of GA concentrations. As a result, selectivity coefficient (α) increased as GA concentrations increased. The flux of HF membranes was almost equal to or greater than that of the commercial IEMs, Neosepta® AMX and CMX (ASTOM Corp., Japan). The selectivity coefficient of the HF membranes was lower than the commercial IEMs. The prepared HF membranes were annealed at 160 °C. By increasing the annealing temperature, the degree of crystallinity of the PVA-based HF membranes will increase. In addition, the aggregation of charge groups in the HF membranes will lead to high selectivity. The results in this work indicate that HF type IEMs prepared from PVA-based polymers will have potential application in removal of trace ions in the wastewater and ground water by a Donnan dialysis process.