Synthesis of Ion-exchange Spacer for Electrodialyzer

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INTRODUCTION

A polyolefin spacer net was used to distribute a feed solution in an electrodialyzer, and it was revealed that the electric resistance of the electrodialyzer was reduced by using an ion-exchange spacer[1].

In this study, we attempted to synthesize the ion-exchange spacer more simply than by the known method.

EXPERIMENTAL

Synthesis of ion-exchange spacer

Styrene, divinylbenzene and 2,2'-azobis(isobutyronitrile) at a weight ratio of 9:1:0.2 was mixed by agitation for 2 hours.

A conventional spacer made of polyvinyl chloride was placed into the mixed solution for 24 hours, and polymerized at 85°C for 2 hours.

The cation-exchange spacer was produced as follows: the polymerized spacer was placed into a 10% dichloromethane solution of 10% chlorosulfonic acid for 2 hours.

The anion-exchange spacer was produced as follows: the polymerized spacer was chloromethylated with chloromethylmethyl ether and zinc chloride for 48 hours.

After drying, the spacer was placed into a 30% ethanol solution of N,N,N',N'-tetramethyl-1,6-hexanediamine for 24 hours.

The synthesized cation- and anion-exchange spacers are shown in Figure 1.

Mesurement of electric resistance

To investigate the influence of the cation-exchange spacer on the electric resistance of an electrodialyzer, the experimental apparatus shown in Figure 2 was used.

The apparatus consisted of 3 compartments filled with spacers (TEST-CELL) and 2 electrode compartments.

The dimensions of the TEST-CELL were 4×2×0.7cm. The linear velocity of the feed solution, that is, the aqueous solution of NaCl, was 6cm/s, and the concentration of the solution was in the range of 0.005-0.03M.

RESULTS

Ion-exchange capacity

The ion-exchange capacity of the cation-exchange spacers was in the range of 0.36-2.34meq/g and that of the anion-exchange spacers was in the range of the 0.31-1.07meq/g.

Influence of cation-exchange spacer on electric resistance of the TEST-CELL

The relationship between the concentration of the feed solution (C_{Cl}) and the specific resistance of the TEST-CELL is shown in Figure 3. The specific resistance of the TEST-CELL filled with the cation-exchange spacer was lower than that of the cell filled with conventional spacers, and the amount of reduction was pronounced at low C_{Cl}.

Reference

1. E. Korngold, L. Aronov, O. Kedem, *J. Membrane Sci.*, **138**, p.165 (1998)

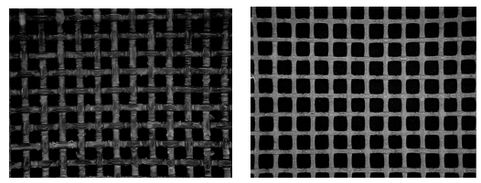

Figure 1 cation- and anion-exchange spacers

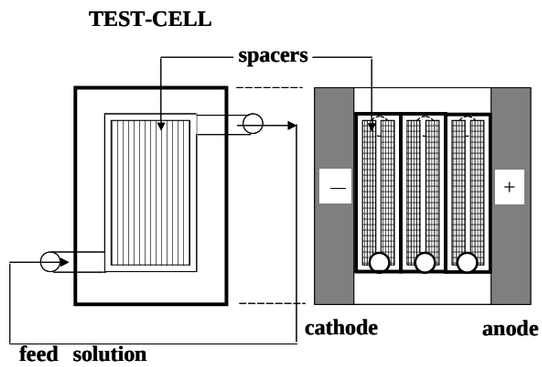

Figure 2 The experimental apparatus

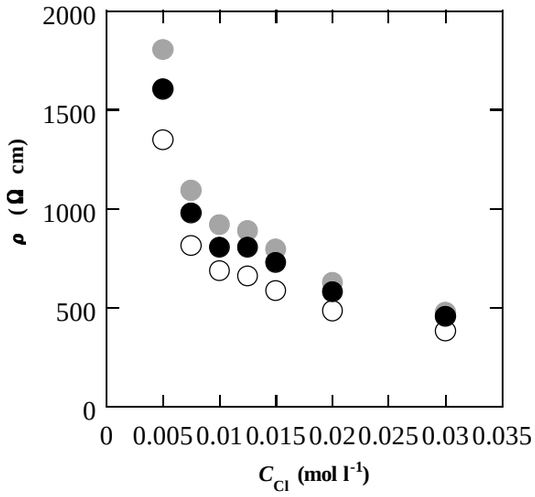

Figure 3 Relationship between C_{Cl} and the specific resistance of the TEST-CELL

○: filled with the cation-exchange spacers
●: filled with the conventional spacers
●: without spacer