Title:

Effects of membrane resistance and transport number of anion exchange membranes on desalination performances of membrane capacitive deionization

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Abstract:

1. Introduction

Membrane capacitive deionization (MCDI), a desalination technology for brackish water, is attracting attention as one of the solutions to the recent global water shortage. In MCDI, a cation exchange membrane and an anion exchange membrane are placed on the anode and cathode surfaces of an electric double-layer capacitor, respectively, and brackish water is used as the electrolyte solution to electrostatically adsorb and desalinate ions when a voltage is applied. However, it is not clear what kind of membranes are suitable for MCDI. In this study, we measured the membrane resistance (R) and anion transport number (t_-) of various anion exchange membranes to investigate the effect of each on the desalination performance of MCDI.

2. Methods

Anion exchange membranes were prepared by dispersity ion-exchange resins in polysulfone. R was measured using a LCR meter, and t_- was estimated from the concentration membrane potential. In the desalination experiments, NEOSEPTA CMX (ASTOM Co., Ltd.) was used as the cation exchange membrane.

3. Results and discussion

The relationship between membrane resistances and salt adsorption rate (SAR) for membranes with anion transport numbers between 0.97 and 1.00 is shown in Fig.1(a). The SAR tended to increase with decreasing membrane resistance. Also, the relationship between the anion transport numbers and SAR is shown in Fig.1(b) for membranes with membrane resistances between 0 and 10 Ω-cm^2. The SAR tends to increase when a membrane with a large anion transport number is used. The use of a membrane with a large anion transport number is thought to have prevented cations from permeating through the membrane, which may have resulted in a larger SAR.

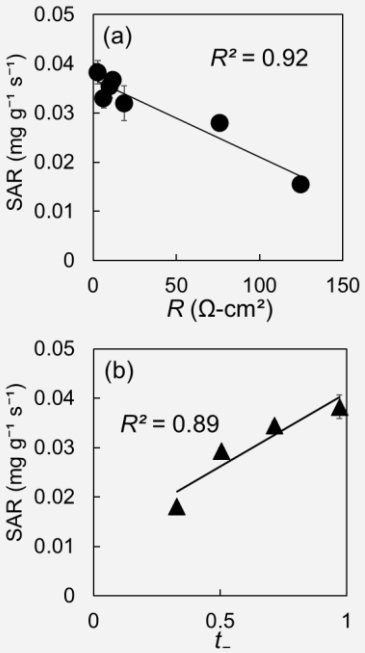

Fig.1 Relationships between R and SAR (a), t_- and SAR (b).