Measurement of effective diffusion coefficients for commercial ion exchange membranes

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Reverse electrodialysis cell stack (REDCS) generates electricity by recovering the free energy of mixing between sea and fresh water by using ion exchange membranes (IEMs). The ion transport to relax the concentration difference is harnessed to yield electric energy. The thermodynamic efficiency of REDCS mainly depends on the effective ion diffusion coefficient of IEMs as the ion mole flux is directly converted to electric current. We quantified effective ion diffusion coefficients of commercial Selemion® IEMs for NaCl solution. Experiments were conducted for 4 cation exchange membranes (CEMs: CMV, CSO, HSF, CMD) and 4 anion exchange membranes (AEMs: AMV, DSV, ASV, AMT). For each pair of a CEM and an AEM, the rate of complementary NaCl diffusion was measured by monitoring electrical conductivity. Measurements were made for various salt concentration difference in the range of 15 g/L to 55 g/L. The complementary diffusion showed non-fickian behaviors, and the effective diffusion coefficient linearly increased with an increase in salt concentration difference.