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Impact of solution composition on the resistance of ion exchange membranes

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Abstract:

Resistance to ion transport in ion exchange membranes (IEMs) is detrimental to the performance of IEM-based processes. In this work we measured the resistance of representative IEMs, i.e. one cation (CEM) and one anion (AEM) exchange membrane, in 15 single-salt solutions using electrochemical impedance spectroscopy. Resistance was sensitive to solute identity only in the case of the CEM for which it depended on the counter-ion identity; the resistance of the CEM was mostly insensitive to the co-ion identity, and the resistance of the AEM was mostly insensitive to both the counter-ion and co-ion identity. For all solutes, membrane resistance decreased sharply with increasing solution concentration below 0.1 M, and remained approximately constant above 0.1 M. An empirical mathematical model comprising a concentration-dependent term and a concentration-independent term successfully described membrane resistance as a function of solution concentration. The model builds on that previously proposed by Galama et al (JMS 467 (2014), 279-291). We found that for both membranes, the concentration-dependent and concentration-independent terms of the resistance increased with