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Selectivity coefficients of ion exchange membranes and method of their determination

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To improve the performance of electro dialysis, it is crucial to investigate innovative approaches and techniques aimed at better characterizing membrane properties and predicting the desalination process. Selectivity serves as a useful tool for examining ion transport through ion exchange membranes, enabling the prediction of ion concentration reduction rates during desalination. Current research focuses on determining selectivity coefficients between monovalent and divalent inorganic ions using both homogeneous and heterogeneous membranes. The primary objectives were to validate the proposed method's applicability and assess the selectivity coefficients of different membranes.

A series of desalination batch experiments was conducted using a laboratory electro dialysis module with ten cell pairs. The feed solution consisted of a mixture of selected ions in various ratios. A constant voltage of 1V/cp was maintained across the membrane stack. To examine the validity range of the selectivity coefficients to be determined, different experimental conditions were tested, including temperature, voltage, ion concentrations, and the presence of organic non-dissociating compounds. Samples of the feed were collected during each batch and analysed to determine ion concentrations.

The evaluation indicated that the proposed method is applicable to both homogeneous and heterogeneous ion exchange membranes, and that the determined coefficients are valid across a broad spectrum of operating conditions. It was found that Ralex® heterogeneous membranes exhibit insignificant selectivity between mono- and divalent ions, whereas CEMs demonstrate even higher selectivity for divalent ions. The monovalent selectivity of Selemion ASVM membranes was confirmed; however, it was shown that fumasep® FAB-PK-130 membranes with hydroxyl-blocking properties possess significantly higher selectivity coefficients (Cl^-/SO_4^{2-}).

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