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Study of the Transport of Multivalent Metal Cations Through Cation-Exchange Membranes by Electrochemical Impedance Spectroscopy

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Abstract : In the present work, Electrochemical Impedance Spectrocopy (EIS) is applied to study the transport of different metal cations through a cation-exchange membrane. This technique enables the identification of the ionic-transport characteristics and to distinguish between different transport mechanisms occurring at different current density ranges. The impedance spectra are dependent on the applied dc current density, on the type of cation and on the concentration. When the applied dc current density increases, the diameter of the impedance spectra loops increases because all the components of membrane system resistance increase. The diameter of the impedance plots decreases in the order of Na(I), Ni(II) and Cr(III) due to the increased interactions between the negatively charged sulfonic groups of the membrane and the cations with greater charge. Nyquist plots are shifted towards lower values of the real impedance, and its diameter decreases with the increase of concentration due to the decrease of the solution resistance.

Keywords : ion-exchange membranes, Electrochemical Impedance Spectrocopy, multivalent metal cations, membrane system
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