Uphill Transport across a Charged Membrane in Multi-component Ion System

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Summary

The transport of ions against their concentration gradient, which is called uphill transport, has been studied by many authors. It is very important for industrial application, such as the recovery of heavy metals from industrial waste water and sea water, and for artificial kidney. This phenomenon was simulated by the theory based on the Donnan equilibrium and Nernst-Planck's equation of ion flux. The theory shows that ion flux is functions of the ion concentration of external solution, membrane charge density, ion mobility and the valence of ions.

This phenomenon was examined by negatively charged membranes, which were Selemion CMV, mixtures of poly(vinyl alcohol)(PVA) and poly(styrene sulfuric acid)(PSSA), and positively charged one, which was a mixture of PVA and poly (allyl amine)(PAAm) in the 1-1 and 2-1-electrolyte systems. The theoretical prediction agreed well with experimental results.

Although ion transport across ion-exchange membranes has formerly been explained as active transport by proton jump mechanism and across lactonized polymer membranes by ring opening/closing reactions, we will describe such transport in terms of coupled transport across a strong and weak acid ion exchange membrane. This theory can predict ion transport phenomena in the systems incorporating polycations and polyanions on one side. In these systems, uphill transport of multivalent ion occur more easily than in the ion system without these polyions. These predictions are applicable for medical fields such as artificial kidney. The extration of phosphoric acid from the blood was discussed using polycation-negatively charged membrane system.