New Separation Methods of Mosaic Membrane Systems

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Summary

New separation methods using mosaic membrane systems, (1) neutralization dialysis, (2) coupling of electron transport with ion transport, and (3) selective transport of non-electrolyte, were investigated and reported in this paper.

(1) Neutralization dialysis is an effective deionization method, cations are exchanged with proton across a cation-exchange membrane, anions are exchanged with hydroxide ion across an anion-exchange membrane, and the deionization and neutralization occur simultaneously in the deionization compartment. Tap water was deionized to be a pure water with a specific resistance of ca. 10 MΩ·cm and very little silica and humic acid. Very weak acids and bases were also removed by this method.
(2) Electron transport is readily coupled to ion transport in a mosaic membrane with electron-transport regions and ion-exchange regions. Electrons and ions are transported by the driving forces of the redox potential gradient or the concentration gradient and the coupling efficiency was improved by the increase of the salt concentration and the redox chain reaction. Electrons were also transported efficiently in this system by the visual light irradiation.
(3) Organic solutes are selectively transported by the combination of a membrane transport and a specific reaction of the organic solute with an inorganic ion. Sugars were selectively transported across an anion-exchange membrane via their complex-formation reaction with borate ion to be anion complexes. The transport was facilitated across the borate ion type membrane by the high distribution of sugars to the membrane and the diffusion rates decreased with increasing attractive interaction between sugars and the borate ion.

These new methods have simple transport mechanisms using simple mosaic membrane systems with conventional ion-exchange membranes and will be applied in many fields.