

Study on Acid - Base Production Utilizing Water Splitting Properties of Bipolar Membrane

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Summary

Bipolar membrane(BPM) inducing effective water splitting should be low resistance and high permselective in each cation and anion layer. The requirements may be satisfied by using commercial cation and anion exchange membranes. In this study, the preparation of BPM was carried out and some membrane characteristics were investigated.

A novel bipolar membrane was prepared by forming polypyrrole from pyrrole monomer in presence of Fe^{3+} at the interface between commercial cation and anion exchange membranes. The BPM was fixed at the central portion of electro dialysis cell composed of four compartments. Both compartments in contact with BPM were filled by KCl solutions which have various concentrations from 10^{-2} M to 1 M. Pt electrodes were separated from KCl solution by cation exchange membrane or anion exchange membrane and 0.5 M Na_2SO_4 solution were inserted into the electrode chambers. On the system prepared thus, first of all, current - voltage curve was measured under constant current supply. As a result, the current - voltage relation indicated Ohmic change against positive current, while the curve gave abrupt change of voltage against negative current. The increased current seemed to be attributed to the proton and hydroxyl ions which were produced inside bipolar membrane. According to the theory by introduced by Mafe et al., the phenomena were interpreted due to the increased rate constant of water dissociation in bipolar membrane.

On the other hand, the water splitting was also verified from pH changes in KCl solution when dc current was supplied through a pair of Pt electrodes from anion exchange layer to cation exchange layer of BPM. When the positive current was applied to the same system, the water splitting did not take place, however. Concentrations of proton or hydroxyl ions calculated from pH values were changed linearly against times and each fluxes were obtained from the slope of the relations. Furthermore, current efficiency was estimated by the ratio of flux to added current. It was noticed that the current efficiency is closely related to donnan salts in bipolar membrane.