Study on Acid - Base Production Utilizing Water Splitting Properties of Bipolar Membrane(2)

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Summary

Based on our concept making the bipolar membrane(BPM) described in preceding report[3], 4 different BPMs were prepared. In the present cases, pyrrole, 3-methylthiophene, aniline and Nafion solution were employed as the adhesion agents between cation and anion exchange membranes. Two identical BPMs prepared were inserted to the electrodialytic cell composed of 5-chambers together with cation and anion exchange membranes as indicated in Fig.1.

In this study, a concurrent observation of acid/base production and desalting from salt solution was mainly aimed in the electrodialytic cell system described above. On the observation of water splitting phenomena, pH glass electrode was inserted into one of the compartments in the cell and pH changes were measured against time under various currents. The desalting phenomena in the compartment surrounded by cation and anion exchange membranes was examined through the solution resistance change under the same current conditions as pH change. The experimental conditions on salt concentration and current about 4 different BPMs examined were 0.01 M ~ 1M KCl concentrations and 0.1mA ~ 1mA currents.

For comparison, the obtained results were expressed by current efficiencies in all the BPMs examined. 4 different BPMs showed almost the similar tendencies with respect to the water splitting and desalting phenomena within experimental errors and the average results were given in Figs. 8 and 9. The result indicated that the electrodialytic cell system involving BPMs and the conventional ion exchange membranes possibly can produce acid/base and at the same time the salts can be excluded from the salt solution. The present study led to the possibility for concurrent production of acid/base and fresh water from sea water. However, a definite difference appeared between the current efficiencies of water splitting and desalting. This was interpreted with taking account of Donnan salt effect.

In addition to the pH change and the concentration change, the membrane resistances ware measured about 4 different BPMs and the thickness of interface layers of BPMs were deduced according to H.Strathmann's study. The layers indicated approximately the values between 15 ~ 50 nm.