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Evaluation of Monovalent and Divalent Ions Removal Characteristics Using Membrane Capacitive Deionization (MCDI) Circulation Process

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Extended Abstract

Desalination is a technology that removes salt from water and water treatment technology is becoming more important [1]. The most widely used techniques for desalination are evaporation, ion exchange, reverse osmosis, electrolysis, etc. However, these techniques have problems such as high energy consumption during operation, periodic replacement due to membrane contamination, and deterioration in treatment capacity. An emerging desalination technique that can solve these problems is so-called capacitive deionization (CDI). It is based on ion removal in a solution through adsorption using electrostatic attraction of an electric double-layer. Recently, the membrane capacitive deionization (MCDI) has been studied, which combines an ion exchange membrane (IEM) with an electrode [2]. It combines anion and cation exchange membranes to selectively pass ions through adsorption and desorption in the electrode, exhibiting easy regeneration and maintenance. However, MCDI process should supply the feed water continuously, because the adsorption and desorption need same feed water. There were many tries to increase the yield by operating the process, but the recovery rate does not significantly increased. In this study, an experiment was conducted to evaluate monovalent and divalent ions removal characteristics by MCDI circulation process. The MCDI circulation process were evaluated using concentrated water during desorption by including circulation tank [3]. The target monovalent ions (K^+, Cl^-) and divalent ions (Mg^{2+}, SO_4^{2-}) were used in this experiment; a voltage of 1.2V and a different flow rates were applied to perform 5-min adsorption and desorption cycles. As the experiment progressed, adsorption was performed stably. However, it was found that the more polyvalent ions, the more difficult to desorb ions. It is thought that the ion removal efficiency is low because the electrostatic force attached to the cell is strong. The removal efficiency also affected to the flow rate. If the flow rate is low, the efficiency of adsorption and desorption was better than higher flow rate. A lower flow rates increase the residence time of the MCDI cell. Therefore, the adsorption and desorption were performed well at lower flow rate. If the MCDI circulation process can be used with low power consumption based on high yield, it can be effectively applied to the water treatment process in the future.

References

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