# Application of Synthesized Anion and Cation Exchange Polymers to Membrane Capacitive Deionization(MCDI)

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Capacitive deionization (CDI), the concept of which was first introduced by Caudle et al. in 1966 [1], is an electrically induced alternative approach for extracting salt ions from concentrated saline solutions [2]. In a CDI operation, once the electric potential is reversed, the adsorbed ions on the electrode desorb and move to the bulk solution, while simultaneously the counter ions move from the bulk to the electrode. This phenomenon gives rise to the incomplete regeneration of the electrode, which leads to a reduction of the adsorption capability and eventually causes higher energy consumption and lower operation efficiency. To overcome this weakness, membrane capacitive deionization (MCDI), which is a modified desalination technology of the existing CDI, was introduced. MCDI consists of two electrodes facing each other separated by an insulator or spacer to prevent a short circuit where the cation and anion exchange membranes placed on each porous electrode surface and the current collectors at the very ends of both sides contact directly to the electrodes [3]. This configuration enables the counter-ions to move freely into and out of the ion exchange membranes and porous electrode, while the co-ions is blocked.

In this study, sulfonated poly(phenylene oxide) (SPPO) and aminated polysulfone (APSf) were synthesized for use as a cation exchange polymer and an anion exchange polymer respectively. The resulting ion exchange capacities of SPPO and APSf of 0.93 and 1.0 respectively were almost equivalent to each other. Then the ion exchange polymers were coated onto the surface of commercial carbon electrodes. Membrane capacitive deionization (MCDI) performance using these coated electrodes was tested under various operating conditions such as adsorption/desorption time, feed flow rate, and feed NaCl concentration and compared with capacitive deionization (CDI) under the same conditions. The experimental results indicate that the effluent concentration during desorption becomes higher with increased adsorption time and a lower feed flow rate. Also it was shown that the introduction of both cation and anion exchange polymers was effective in preventing the "co-ion" effect. With MCDI, a salt removal efficiency of 100% was obtained under the conditions of 5 min/1 min adsorption/desorption time and 23 ml/min feed flow rate, while with CDI the salt removal efficiency was less than 40% under the same conditions.

## References

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