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Low energy cost high electrodialysis performance anion-exchange membranes for desalination

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ABSTRACT

Energy consumption (EC) and salt flux (*J*) are the two key parameters of the industrial electrodialysis (ED) devices. Increasing *J* usually increases EC. The challenge of a qualified ED anion-exchange membrane (AEM) is the dilemma of high *J* and low EC. Here we designed a series of poly(aromatic ethers) based AEMs with main-chain type quaternary ammoniums. The characterization results of structure and basic properties tell that the so-made AEMs are homogeneous, dense and defect-free, and show applicable ion exchange capacities (IECs), water uptakes (WUs), area resistances (R_{area}s) and mechanical properties. The results of the ED tests clear that the current efficiency (η) values of the AEMs ED units are higher than 87.4% companying comparable or better EC than that of the commercial AEM TWEDA1 ED unit (*J* = 81.22 mg m^{-2} s^{-1}, EC = 2.13 kWh kg^{-1}) and *J* varying from 79.77 to 80.92 mg m^{-2} s^{-1}. Especially, the ED unit of QPAEK (IEC = 1.14 mmol g^{-1}) has an EC of 2.08 kWh kg^{-1}. The tailored AEMs ED units have good comprehensive ED performances with relatively high *J* and low EC. These results reveal the potential of QPAEs for industrial ED processes.

Keywords: Anion exchange membrane; Poly(arylene ethers); Electrodialysis; Desalination; Low energy consumption

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