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# PROCEEDINGS

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# The effect of unwanted H+ permeation through anion exchange membranes on the electrodialysis process with bipolar membranes

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Electrodialysis with bipolar membranes (EDBM) is a unique electromembrane process capable of generating acids and bases from solutions of their salts. If the performance of this process is to be controlled, the properties of the membranes used play a key role. Experimental comparison of different membrane combinations has shown that, in order to achieve high salt flux, low specific energy consumption, and high product concentrations, it is desirable to use anion exchange membranes (AEM) and cation exchange membranes (CEM) with the ability to block $H^+$ and $OH^-$ ions, respectively [1]. The aim of this study was to experimentally demonstrate the significant impact of undesirable $H^+$ ion transfer through AEM on the EDBM process and to propose and verify possible methods for its optimization. A set of laboratory EDBM tests was conducted, clearly showing that the transport of $H^+$ ions into the diluate from the acid loop increases with increasing acid concentration. This phenomenon significantly reduces current efficiency, lowers the concentration of both products, and may even lead to the practical cessation of diluate desalination. Based on the data obtained, three approaches were proposed to mitigate these negative effects:
(1) operating the process in batch mode, allowing the acid concentration to increase gradually over time so that the associated adverse effects appear as late as possible;
(2) continuous neutralization of the acidic diluate, for example using the produced alkali, particularly in applications, where achieving a certain degree of diluate desalination is essential;
(3) limiting the maximum concentration of the produced acid by dilution with water, in cases where it is more important to reach the desired base concentration or to desalinate the diluate.

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[1] Slovák, F., Kotala, T., & Václavíková, N. (2025). Comparison of different combinations of heterogeneous and homogeneous bipolar and ion exchange membranes in lab-scale electrodialysis stack. *Chemical Engineering Communications*, 212(9), 1332–1340.