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Electrochemical-magnetic method for the recovery of concentrated effluent from water membrane processes

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ABSTRACT

In this study, the electrochemical-magnetic production of chlorine from concentrated effluent (brine) was investigated. The efficiency and effectiveness of this process was evaluated using different experimental settings in an electrochemical-magnetic plant. The magnetic fields were created by a neodymium magnet with a magnetic flux density of 0.8 T. Box–Behnken design and response surface method were used to optimize the process and determine the optimal values of parameters for maximum chlorine production. The results showed that the optimal condition of the chlorine generation was 19.8 mg/L (as free chlorine residual) that was obtained at the NaCl concentration of 16.8 g/L, the electric potential of 6 V, the electrolysis time of 7.5 min and the current density of 20 mA/cm^2. The results showed that the magnetic electrochemical approach leads to higher chlorine production (186 mg/L) than the electrochemical method (137 mg/L). Moreover, the produced active chlorine was optimized based on energy consumption, which was 77 mg/L for the energy consumption of 0.2 kWh/l. The application of magnetic fields in conjunction with electrolysis process presented a promising approach for chlorine production from the concentrated brine effluent of water membrane processes. This can be attributed to the Lorentz force, which acts on charged particles in the presence of a magnetic field, causing them to move in a certain direction. This alternative method has the potential to reduce the cost and environmental impacts associated with chlorine production, making it a suitable option for industrial applications.

Keywords: Electrochemical-magnetic method; Concentrated effluent; Membrane processes; Box–Behnken design; Chlorine production; Lorentz force

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