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Oxygen depolarized cathode in advanced chlor-alkali cell with Pt–Ru nanoparticles as electro-catalyst: effect of process conditions and response surface methodology

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ABSTRACT

The effect of various operating parameters on the cell voltage of an advanced chlor-alkali membrane cell is studied. The optimization and modeling of the electrolysis process are performed through the response surface methodology (RSM) in combination with central composite design (CCD). The electrolysis process is carried out in the filter press advanced chlor-alkali membrane cell by using a half-MEA (Nafion® 115 membrane coated with Pt–Ru/MWCNTs) as the oxygen depolarized cathode and a dimensionally stable anode. Cell temperature, brine concentration, pH and current density are considered as input variables for RSM. The predicted values of cell voltage are found to be in good agreement with experimental values (R^2 = 0.9555 and Adj-R^2 = 0.9165). The optimization process show that the minimum cell voltage is achieved at the optimum conditions: cell temperature 80°C, brine concentration 320 g/L, pH 3.7 and current density 1 kA/m^2. Finally, the current density effect on the cell voltage and caustic current efficiency (CCE) of advanced chlor-alkali cell is studied under optimal conditions. The results show that by increasing the applied current density, the cell voltage is increased and CCE is decreased and reach to 2.27 V and 89.90% at 5 kA/m^2, respectively.

Keywords: Advanced chlor-alkali cell; Oxygen depolarized cathode; Pt–Ru/MWCNT catalyst; 1; Central composite design

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