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Removal of reactive blue and disperse red dyes from synthetic textile effluent by electrocoagulation process using Al–Al and Fe–Fe electrodes: parametric optimization by response surface methodology

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ABSTRACT

This study deals with the treatment of synthetic effluent containing two textile dyes (reactive blue and disperse red 74) by electrocoagulation (EC) using iron electrodes. Then the results are compared with the performance of aluminum electrodes. Response surface methodology using the JMP.11 statistical experimental design was performed to design experiments and to optimize the process. Twenty experiments were conducted to study the effect of four important process parameters: current density (5–25 mA/cm^2), initial pH (4–11), electrolyte concentration (1–5 g/L), and operating time (20–60 min) for the color removal efficiency (CRE) and consumption energy (CE). The parameters for maximum CRE and minimum CE were found with iron electrodes at current density 17.08 mA/cm^2, operating time 20 min, pH 9, and electrolyte concentration 2 g/L, for aluminum at 25 mA/cm^2, pH 4, operating time 60 min, and electrolyte concentration 2.5 g/L. Reactive and disperse dyes treated with iron electrodes shows efficiency in terms of color removal in alkaline solutions, compared with aluminum electrodes, and more efficiency was obtained in acidic solutions. The operating cost was calculated by considering the energy and electrode consumption and evaluated as 83.879 \$/m^3 of treated wastewater for iron electrodes and 126.23 \$/m^3 of treated wastewater for aluminum electrodes. SEM analysis was performed in further study and show the efficiency of the electrocoagulation process in dye removal. The findings of this study show also that chemical analysis and RSM are suitable for investigating the mechanism and optimization of EC as applied to textile effluents.

Keywords: Electrocoagulation process; Iron electrodes; Aluminum electrodes; Removal efficiency; Experimental design

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