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Electro-Fenton Degradation of Erythrosine B Using Carbon Felt as a Cathode: Doehlert Design as an Optimization Technique

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Abstract : This study investigates the oxidation of Erythrosine B (EB) food dye by a homogeneous electro-Fenton process using iron (II) sulfate heptahydrate as a catalyst, carbon felt as cathode, and Ti/RuO2. The treated synthetic wastewater contains 100 mg L^{-1} of EB and has a pH = 3. The effects of three independent variables have been considered for process optimization, such as applied current intensity (0.1 – 0.5 A), iron concentration (1 – 10 mM), and stirring rate (100 – 1000 rpm). Their interactions were investigated considering response surface methodology (RSM) based on Doehlert design as optimization method. EB removal efficiency and energy consumption were considered model responses after 30 minutes of electrolysis. Analysis of variance (ANOVA) revealed that the quadratic model was adequately fitted to the experimental data with R^2 (0.9819), adj-R^2 (0.9276) and low Fisher probability (< 0.0181) for EB removal model, and R^2 (0.9968), adj-R^2 (0.9872) and low Fisher probability (< 0.0014) relative to the energy consumption model reflected a robust statistical significance. The energy consumption model significantly depends on current density, as expected. The foregoing results obtained by RSM led to the following optimal conditions for EB degradation: current intensity of 0.2 A, iron concentration of 9.397 mM, and stirring rate of 500 rpm, which gave a maximum decolorization rate of 98.15 % with a minimum energy consumption of 0.74 kWh m^{-3} at 30 min of electrolysis.

Keywords : electrofenton, erythrosineb, dye, response serface methdology, carbon felt
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