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Optimization of batch electrochemical coagulation for treatment of real textile wastewater using stainless steel electrodes by CCD of RSM

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ABSTRACT

The practicability and application of the batch electrochemical coagulation (ECC) for the treatment of real textile wastewater (TWW) was evaluated using stainless steel (SS) electrodes in sequence. The central composite design using response surface methodology was used to evaluate and optimize the effect of current density, electrolysis time and electrode numbers as independent variables on the color and chemical oxygen demand (COD) removal as the response function. The significance of the independent variables and their interactions was tested by means of analysis of variance (ANOVA) with 95% confidence level showing R^2 value of 91.48% for color and 92.08% for COD. An optimal current density 180 A/m^2, 45 min of electrolysis time and 4 SS electrodes in ECC showed minimal deviations of the observed values giving the predicted value of 93.60% color and 90.21% COD removal efficiency ensuring a satisfactory adjustment of the second-order regression model with the experimental data. Scanning electron microscopy (SEM), energy dispersive X-ray (EDX) and thermo-gravimetric analysis (TGA) characterized the sludge generated after ECC treatment. SEM images showed vicissitudes on the anode plate with large dents and flake deposits. EDX results of post ECC sludge showed high amounts of metals because of electrode dissolution. TGA plots showed the completion of the oxidation process at higher temperature and the residue remained in it. The operating cost was found to be 2.97 Rs./m^3 (Indian Rupee) and the specific energy consumption was 8.1 kWh/m^3 of TWW treated for color and COD removal using 4 SS electrodes.

Keywords: Batch electrochemical coagulation (BECC); Central composite design (CCD); Response surface methodology (RSM); Color and COD removal; Operating cost; Specific energy consumption

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