Modeling Fentonic advanced oxidation process decolorization of Direct Red 16 using artificial neural network technique

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ABSTRACT

The present work has focused on the modeling of C.I. Direct Red 16 (DR16) decolorization using Fentonic reagents in a batch reactor. The reactor was equipped with an air bubbling for mixing and a water-flow coil for temperature regulating. Dye concentration was analyzed by measuring its absorbance at \( \lambda_{\text{max}} = 526 \text{ nm} \). An artificial neural network (ANN) model was developed to predict the behavior of the process. Six operational parameters and decolorization efficiency were employed as inputs and output of the network, respectively. A three layer feed-forward network with back-propagation algorithm was developed. Application of 10 neurons in the hidden layer and 300 iterations for the network calibration prevents overfitting by the model. The K-fold cross-validation method was employed for performance evaluation of the developed ANN model. The results showed high correlation coefficient \( R^2 = 0.9984 \) and low mean square error \( (\text{MSE} = 1.56 \times 10^{-4}) \) for testing data. Sensitivity analysis indicates the order of operational parameters relative importance on the network response as: \( \text{pH} \approx \text{time} > [\text{H}_2\text{O}_2] > [\text{Fe(II)}] > [\text{DR16}] > \text{temperature}. \)

Keywords: Fenton process; Direct Red 16; ANN modeling; Feed forward; Cross-validation; Sensitivity analysis

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