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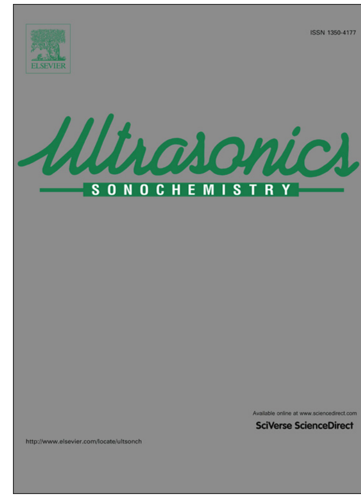

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Sima Porhemmat, Ali Reza Rezvani, Mehrorang Ghaedi, Mohammad Hossein Ahmadi Azqhandi, Ali Akbar Bazrafshan

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Nanocomposites: synthesis, characterization and its application to removal azo dyes using ultrasonic assisted method: modeling and Optimization

Sima Porhemmat[1], Ali Reza Rezvani[1], Mehrorang Ghaedi[2], Mohammad Hossein Ahmadi Azqhandi[3]*, Ali Akbar Bazrafshan[2]

[1] Department of Chemistry, Faculty of Sciences, University of Sistan and Baluchestan, Zahedan, Iran.
[2] Chemistry Department, Yasouj University, Yasouj 75918-74831, Iran.
[3] Applied Chemistry Department, Faculty of Gas and Petroleum (Gachsaran), Yasouj University, Gachsaran, 75918-74831, Iran.

Corresponding author: mhahmadia58@gmail.com, m.ahmadi@yu.ac.ir

Abstract

S-doped and Cu- and Co-doped TiO_2 was synthesized by a sol–gel method and characterized by FE-SEM, XRD, EDX and FTIR. The Co/Cu/S-TiO_2 nanocomposite loaded on the activated carbon as new nanoadsorbent was used for simultaneous removal of methylene blue (MB) and sunset yellow (SY) from aqueous solution by ultrasonic-assisted adsorption method. In this work, central Composite Design (CCD) and adaptive neuro-fuzzy inference system (ANFIS) as a support tool for examining data and making prediction are used to recognize and predict the removal percentage in MB and SY dye solution of different concentrations. The predictive capabilities of CCD and ANFIS are compared in terms of square correlation coefficient (R^2), root mean square error (RMSE), mean absolute error (MAE) and absolute average deviation (AAD) against the empirical data. It is found that the ANFIS model shows the better prediction accuracy than the CCD model.

In addition to, the optimization of ultrasound-assisted simultaneous removal of methylene blue (MB) and sunset yellow (SY) on the Co/Cu/S-TiO_2/AC nanocomposite by response surface methodology (RSM) for the optimization of the process variables, such as MB and SY concentrations, Co/Cu/S-TiO_2/AC nanocomposite dose and sonication time, was investigated.

Various isotherm and kinetic models were used in the experimental data. The results revealed that the langmuir isotherm and pseudo-second-order model had a better correlation than the other models.

Keywords: nanocomposite; RSM; CCD; sol–gel method; optimization; ANFIS; Activated Carbon; Methylene blue; Sunset yellow; Ultrasound-assisted

1. Introduction:

Azo dyes widely used as coloring agents in textile, ink, paint and plastic industries [1-3]. Consumption of azo dyes in textile industries is considerably higher than other classes of dyes. Because, they are easy to apply to the fiber with minimum energy consumption and are available in a wide range of colors anywhere and anytime [4]. McMullan et al. expressed that during the coloration processes a significant amount (20-50 %) of these dyes is lost and is released into the environment for instance colored wastewater [5]. Hence, there is a widespread concern associated with the use of azo dyes in textile industries.

It has been reported that the average dye concentration in waste stream coming from textile industries is 300 mg L^{-1} [6]. Though, concentration more than 1500 mg L^{-1} has been also reported [7]. These dyes in wastewater not only make aesthetic problems but also affect photosynthetic activity of algae, and aquatic plants, light penetration, biological oxygen demand (BOD), and chemical oxygen demand (COD) of water bodies leading towards death of aquatic fauna and flora [8]. Azo dyes and some of their metabolites are also well known to be generally mutagenic and carcinogenic in nature. Furthermore, exposure to high concentration in long time and

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