Optimization of photocatalytic degradation of biochemical oxygen demand from textile industry effluent using copper oxide nanoparticles by response surface methodology

Mohammadi Leili, Mohammadpour Amin, Hosseini Mohammad Reza, Shahsavani Ebrahim, Abbasi Rayeni Reza, Golaki Mohammad, Rahdar Abbas, Pandey Sadanand

Abstract

This study aimed at photocatalytic degradation of biochemical oxygen demand (BOD) from the effluent of the Baluch textile factory in Iranshahr (Iran) using copper oxide nanoparticles (CuONPs). The characteristics of CuONPs were analyzed using a scanning electron microscope (SEM), transmission electron microscope (TEM), X-ray diffraction (XRD) and X-ray fluorescence (XRF). The results showed that the maximum removal efficiency (90.03%) was related to the state in which the intensity of ultraviolet (UV) was at the highest value (30 W). In this study, high values of coefficient of determination (R^2) (99.2%) and adjusted coefficient of determination (adjusted R^2) (98.11%) indicated that the very large share of changes in response variables was determined by independent factors. According to the results of analysis of variance, the order of the effect of the factors used in the study were as follows: pH > UV > time > Copper(II) oxide (CuO) dose. The BOD removal efficiency increased when pH was increased from 3 to 7 and contact time was increased from 10 to 60 min. More than 89% of BOD was removed at pH 7 and contact time 60 min. As such, when nanoparticle dose (from 0.02 to 0.05 g/L and contact time from 10 to 60 min) increased, so that the highest removal efficiency (89%) was reported at a dose of 0.05 g/L nanoparticles and a contact time of 60 min. In general, the Langmuir isotherm had a much better fit (R^2 = 0.991) than the Freundlich (R^2 = 0.9712) and Temkin (R^2 = 0.7545) isotherms.