

## Solar photocatalytic degradation of Reactive Black 5: by-products, bio-toxicity, and kinetic study

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### ABSTRACT

Reactive Black 5 (RB5) dyes are a dye widely used in textile industries. The photocatalytic oxidative degradation of aqueous solutions of RB5 dye was solar photo catalytically treated by employing the pumice modified with zinc oxide (ZnO) and nano zero-valent iron (nZVI) advanced oxidation systems in a batch reactor. The effects of samples pH (3–11), kinetic reaction, total organic carbon (TOC), and chemical oxygen demand (COD) removal, by-products, and bio-toxicity were evaluated. Characterization of the pumice, ZnO, and nZVI samples were performed by scanning electron microscopy, X-ray diffraction, X-ray fluorescence, UV-vis spectrophotometer, and Brunauer–Emmett–Teller measurements. The highest photocatalytic activity for the degradation of RB5 was obtained for the ZnO and nZVI, 99% and 90% efficiency in 120 min, respectively. The results indicate that with increasing pH (3–9) increased the rate of RB5 degradation. The gas chromatography-mass spectrometry analyses results indicate that degradation of RB5, first the ring structure is opened, and then by subsequent reactions with hydroxyl radical (OH<sup>•</sup>), these substances become more stable turning to mineral materials. These results show that the photocatalytic with solar light has high efficiency in RB5 removal and as well as the effluent mineralization (TOC = 90% and COD = 81%) has low toxicity in the environment.

*Keywords:* Photocatalytic degradation; Solar energy; Pumice; RB5 dye; ZnO; nZVI

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