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Solar photocatalytic oxidation of an azo dye with immobilized $TiO_2/S_2O_8^{2-}$ in a component parabolic collector–reactor

Leila Ghalamchi, Mohammad Hossein Rasoulifard*, Mir Saeed Seyed Dorraji, Rahmat Pourata

Applied Chemistry Research Laboratory, Department of Chemistry, Faculty of Science, University of Zanjan, Zanjan, Iran, Tel. +982433052591; Fax: +982433052477; emails: m_h_rasoulifard@znu.ac.ir (M.H. Rasoulifard), ghalamchi_leila@yahoo.com (L. Ghalamchi), dorraji@znu.ac.ir (M.S.S. Dorraji), r_pourata@yahoo.com (R. Pourata)

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ABSTRACT

Empirical modeling study of a new solar reactor for photocatalytic oxidation of wastewater containing toxic compounds is presented. The solar/$TiO_2/S_2O_8^{2-}$ treatment was mediated by a component parabolic collector (CPC) in functional condition (batch photoreactor). Field emission scanning electron microscopy analysis demonstrated favorable immobilization of TiO_2 on the outer surface of the glass tube, which was located in the focal path of CPC to measure the experimental reaction in enhancing the radiation intensity. A central composite design with a response surface methodology was applied to assess the relationships between operating variables and to evaluate the individual and main effects of several operating parameters (i.e., dye and persulfate concentration and reaction time) on treatment efficiency. In the best reaction conditions, 98.5% decolorization of DR23 was carried out with 21.1 mg L^{-1} of dye, 1.25 mM of $S_2O_8^{2-}$ in a reaction time of 90 min. Use of CPC photoreactor provides conditions for environmentally friendly wastewater treatment and enhances remarkable decolorization as compared with the commercial photocatalytic process under UV radiation which is mediated with persulfate.

Keywords: Advanced oxidation; Solar energy; Modeling; Nanoparticles; Photocatalysis

* Corresponding author.