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Optimization of operational parameters in photocatalytic degradation of methylene blue using zeolitic imidazolate framework-11 nanostructure

Fateme Houshyar[a], Mohsen Mehdipour Ghazi[a,*], Narjes Keramati[b]

[a]*Department of Chemical, Petroleum and Gas Engineering, Semnan University, Semnan 35131-19111, Iran, emails: mohsenmehdipour@semnan.ac.ir (M. Mehdipour Ghazi), fatemehoushyar@semnan.ac.ir (F. Houshyar)*
[b]*Department of Nanotechnology, Faculty of New Sciences and Technologies, Semnan University, Semnan 35131-19111, Iran, email: narjeskeramati@semnan.ac.ir*

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ABSTRACT

In this research, synthesis, characterization, and photocatalytic degradation of zeolitic imidazolate framework-11 was investigated. This framework was synthesized through a solvothermal method using the polar solvent, methanol. The characterization analysis included X-ray diffraction analysis, energy-dispersive X-ray spectroscopy, field emission scanning electron microscopy, Brunauer–Emmett–Teller, Fourier-transform infrared spectroscopy, and contact angle measurement; which have been discussed to characterize the as-synthesized nanostructure zeolitic imidazolate framework-11 (ZIF-11). As a result of diffuse reflectance spectroscopy analysis, ZIF-11 was recognized as photoactive with a band gap of 5 eV. The contact angle in the synthesized photocatalyst was 166° showing that it is hydrophobic. Evaluating the effect of operational factors including pH, photocatalyst dosage, and aeration pump flow rate in the photodegradation process was done by performing 22 experiments via Design-Expert software through the response surface method. The most and least effective parameters were identified as pH and aeration pump with contribution percentages of 33.82 and 2.57, respectively. A quadratic theoretical model with a *P*-value of less than 0.0001 for the photodegradation process was obtained. The optimal degradation percentage of methylene blue as organic waste, in minimum aeration pump level, pH equal to 10, and 0.2 g of the photocatalyst was observed to be 83.88% under UV light irradiation in 30 min. The value obtained for *R*-squared in this model was 0.9996, which would validate the accuracy and adequacy.

Keywords: Solvothermal; Photocatalyst; Methylene blue; Zeolitic imidazolate framework-11 (ZIF-11)

* Corresponding author.