

Photochemical Degradation of Methylene Blue and Rhodamine B under Heterogeneous Photo-Fenton System using $\text{Cu}^{\text{II}}\text{Fe}^{\text{II}}_{1-x}\text{Fe}^{\text{III}}_2\text{O}_4$ Ferrites

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Heterogeneous photo-Fenton system, on the basis of its better degradation performance under wide pH range, is applied as one of the best techniques in the wastewater treatment. Here we reported the synthesis of iron(II)-doped copper ferrite ($\text{Cu}^{\text{II}}\text{Fe}^{\text{II}}_{1-x}\text{Fe}^{\text{III}}_2\text{O}_4$) nanoparticles by a simple co-precipitation method using CuSO_4 , FeCl_3 and $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2$ as precursor materials and NaOH as precipitating agent. The nanoparticles were calcined at 400°C for 4 hours and subsequently characterized by using X-ray diffractometry (XRD), scanning electron microscopy (SEM) combined with energy dispersive spectroscopy (EDS), and diffuse reflectance spectroscopy (DRS). The photocatalytic reactions were carried out under visible light inside a (Specord S600) diode-array UV-visible spectrophotometer for the continuous measurement of absorbances during the catalysis.

SEM revealed the structural change from the spherical-like particles into needle-like fine particles as the consequence of the increasing ratio of copper(II) in the ferrites. Besides, the optical band gap energies decreased from 2.02 to 1.25 eV. Based on the photocatalytic experiments, NP-3 ($\text{Cu}^{\text{II}}_{0.4}\text{Fe}^{\text{II}}_{0.6}\text{Fe}^{\text{III}}_2\text{O}_4$) delivered the highest degradation efficiency in the case of Methylene blue and Rhodamine B. During the treatment of Methylene blue, the optimized effect of NP-3 concentration, hydrogen peroxide concentration, and pH were observed to be 400 mg/l, 1.76×10^{-1} M, and 7, respectively. Similarly, for the Rhodamine B decomposition, the optimized effect of NP-3 concentration, hydrogen peroxide concentration, and pH were observed to be 500 mg/l, 8.88×10^{-2} M, and 7.5-8, respectively. Under similar catalytic conditions, higher degradation efficiency in terms of apparent kinetic constant was achieved for Rhodamine B as compared to Methylene blue. On the basis of this study NP-3 can be successfully applied in the heterogeneous photo-Fenton system for removal of hazardous pollutants.

The results of these experiments with heterogeneous photo-Fenton catalysts provided useful pieces of information for development of hybrid systems based on the combination of this method with other advanced oxidation procedures such as non-thermal plasma (NTP) process.

This work was supported by the Széchenyi 2020 program of the Hungarian Ministry for Innovation and Technology under the GINOP-2.3.2-15-2016-00016 project and by the National Research, Development and Innovation Office of Hungary in the frame of bilateral Hungarian-French S&T Cooperation Program (project code 2019-2.1.11-TÉT-2019-00033).