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Integrated Fenton-like and photocatalytic system for metronidazole degradation in water using $FeNi_3/SiO_2/CuS$ magnetic nanocomposite

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ABSTRACTS

In the present study, the adsorption mechanism and capacity of $FeNi_3/SiO_2/CuS$ magnetic nanocomposite, as a catalyst, for metronidazole (MTZ) antibiotic degradation were investigated. The degradation reaction was performed using an integrated treatment system comprised of Fenton-like and UV-photocatalytic processes. Various material analyses such as field-emission scanning electron microscope, Fourier-transform infrared spectroscopy, transmission electron microscopy, energy-dispersive X-ray analysis, X-ray diffraction, and vibrating-sample magnetometer were employed to prove the successful synthesis of the used catalyst and to gather information about its surface and structural properties. The characterization results showed that the nanocomposite used in this study was superparamagnetic (20 emu/g) and its crystal size was 26 and its particle size was about 64 nm. In addition, the effects of pH 3, 5, 7, 9, and 11, catalyst dosage $FeNi_3/SiO_2/CuS$ 0.005–0.1 g/L, initial metronidazole concentration 10–30 mg/L, contact time 5–200 min, and hydrogen peroxide content 50–200 mg/L, were studied. The $FeNi_3/SiO_2/CuS$ in the proposed treatment system was operated with MTZ degradation efficiency reach to 100% during the first 60 min of the degradation process. After the sixth cycle of regeneration processes, the $FeNi_3/SiO_2/CuS$ lost only 5% of its degradation ability (from 100% to 96.83%). The degradation efficiency of the chemical oxygen demand (COD) parameter was tested which is remarkably enhanced to ~74% during degradation time of 200 min. Also, the analysis of COD on real wastewater at this time showed a reduction of about 65.8% during this process under optimal reaction conditions. The adsorption followed a pseudo-first-order kinetic equation ($R^2 \geq 0.9$). Taking the results of this study, the $FeNi_3/SiO_2/CuS$ shows a potential application as a catalyst for MTZ degradation using photocatalytic combined with a Fenton-like treatment system.

Keywords: Metronidazole; Degradation; $FeNi_3/SiO_2/CuS$; Characterization; Kinetic

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