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Investigation of the removal of sulfamethoxazole drug waste from aqueous solutions under the effect of zinc oxide/montmorillonite nanocomposite by photocatalytic ozonation process

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ABSTRACT

In this study, the synergistic effect of photocatalysis and ozonation processes to degrade the sulfamethoxazole (SMX), one antibiotic pharmaceutical compound, has been studied through the influence of main operational variables such as zinc oxide/montmorillonite (ZnO/MMT) dosage, SMX initial concentration, ozone flow rate, pH and the addition of organic and inorganic scavengers. Synthesized ZnO nanoparticles were immobilized on the montmorillonite surface to prepare ZnO/MMT catalyst as a photocatalyst. The catalyst was characterized by X-ray fluorescence, X-ray diffraction, scanning electron microscope, high-resolution transmission electron microscope and N_2 adsorption/desorption. The highest SMX degradation efficiency (80.84% for 30 min of reaction time) was obtained for the photocatalytic ozonation process compared to adsorption, single ozonation, catalytic ozonation, and photolysis. ZnO/MMT was more effective photocatalyst according to ZnO, indicating its usability as a promising photocatalyst for the removal of organic contaminants in aqueous solutions. The reduced degradation efficiency with the addition of organic and inorganic scavengers showed the important role of the photoproduced radicals and holes as well as direct ozonation in SMX degradation. A mechanism is also proposed for photocatalytic ozonation degradation by using the gas chromatography-mass spectroscopy (GC-MS) analysis method. Finally, several by-products were identified by GC-MS analysis, which allowed to depict a possible mechanism for the sulfamethoxazole degradation.

Keywords: Photocatalytic ozonation; Zinc oxide/montmorillonite nanocomposite; Sulfamethoxazole; Hydroxyl radical; Antibiotic

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