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Catalytic destruction of 2,4-D in aqueous environment using transition metal-doped ZnO nanoparticles under ultrasonic waves, UV and visible light

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ABSTRACT

This study investigated the performance of photocatalytic and sonocatalytic processes using zinc oxide nanoparticles doped with copper and cerium for the degradation of 2,4-dichlorophenoxyacetic acid (2,4-D) as a commonly used herbicide in wheat and barley cultivation. The doped metal nanoparticles were synthesized by the thermal solvent method using zinc nitrate precursor and metal salts. The synthesized nanoparticles were characterized using scanning electron microscopy, X-ray diffraction, Fourier-transform infrared spectroscopy, atomic force microscopy, dynamic light scattering and zeta potential analyses. According to the results, the Ce.ZnO nanoparticles, in the presence of visible light, yielded the highest removal efficiency (87%) in removing herbicide. Therefore, in this study, the Ce.ZnO nanoparticles were used as the most effective nanoparticles in the next experiments. The results indicated that the photocatalytic process had the highest herbicide removal efficiency at neutral solution pH. Moreover, raising Ce.ZnO nanoparticle dose increased the photocatalytic removal efficiency of the herbicide. It was found that the photocatalytic efficiency increased with raising contact time. In contrast, increasing the initial 2,4-D concentration caused the efficiency to decline. It can be concluded that the Ce.ZnO nanoparticles, in the presence of visible light, can be efficiently utilized for the removal of 2,4-D herbicide from aqueous solutions.

Keywords: Zinc oxide; Contaminants; Herbicides; Intermediate metals

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