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Photocatalytic degradation of water disinfection by-products using zirconium doped zinc oxide nanoparticles

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ABSTRACT

The aim of this study was to investigate the photocatalytic decomposition of disinfection by-products using zinc oxide nanoparticles doped with zirconium (Zr:ZnO NPs). Zr:ZnO NPs were synthesized through mild hydrothermal method. The characterization of Zr:ZnO NPs was performed using X-ray diffraction, SEM, Fourier-transform infrared spectroscopy, dynamic light scattering, and zeta potential. Photodegradation of trihalomethanes was investigated as a disinfection by-product of chlorinated water under sunlight and UV light illumination. The optimum conditions for removal of trihalomethanes under UV irradiation was 2 h contact time, 1% Zr:ZnO NPs and nanoparticles dosage of 1.5 g/L so that the removal percentages for bromoform, bromomethane chloride, dichlorobromomethane, and total trihalomethane were 79.25%, 96.5%, 65% and 52%, respectively. No chloroform was degraded under this condition. The optimum conditions under sunlight illumination occurred at 2 h contact time, 1.5% Zr:ZnO NPs and nanoparticles dosage of 2.0 g/L occurred so that the removal percentages for chloroform, bromoform, bromomethane chloride, dichlorobromomethane, and total trihalomethane were 20%, 88.5%, 99.75%, 65%, and 67%, respectively. Investigation of the photocatalytic properties of the samples showed the positive presence of a metal as dopant to improve the photocatalytic properties of the samples, so that Zr:ZnO showed 42% higher efficiency compared with bare ZnO in photocatalytic decomposition of trihalomethanes.

Keywords: Zr:ZnO nanoparticles; Photocatalyst; Disinfection by-products; Hydrothermal; Characterization

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