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Solar detoxification of water polluted with fungicide residues using ZnO-coated magnetic particles

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Abstract

ZnO (zincite) coated magnetic particles were successfully prepared and characterized by different techniques (XRD, FE-SEM, EDX, and FTIR). The photocatalytic efficiency of the magnetic particles was assessed by their ability to degrade six fungicides in water exposed to solar irradiation. Magnetic particles composed of a silica undercoat beneath a ZnO coating (MSZPs) were more efficient than magnetic particles loaded with ZnO alone (MZPs) for catalysing the removal of these fungicides. The optimum mass ratio of SiO_2 to ZnO was about 1:2 because of almost complete coverage by ZnO surface coverage and the high photocatalytic degradation rates obtained for the studied fungicides, which was comparable to that obtained with ZnO nanopowder. However, in contrast to ZnO nanopowder, the photodissolution of Zn using MSZPs was low, with Zn^{2+} concentration at the end of the experiment (0.75 mg L^{-1}) below legally permitted levels in drinking water. In addition, the effect of initial concentration of fungicides was studied in order to know maximum degradation efficiency. Finally, the photodegradation activity of MSZPs was increased by the addition of $Na_2S_2O_8$ (250 mg L^{-1}). Therefore, the tandem MSZPs/$Na_2S_2O_8$ provides an interesting method to degrade some organic pollutants in water.

Keywords: Fungicides; magnetic particles; photocatalytic oxidation; ZnO nanopowder.

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