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Reclamationof water polluted with insecticide residues using ZnO as catalyst under natural sunlight for irrigation reuse

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Topic: The elements and the Periodic Table for sustainable chemistry

Abstract

In recent years, environmental concern has led to use of technologies that could be called "environmental cleanup". This research focuses on the application of solar photocatalysisusingZnO to remove residues of 4 insecticides, widely used on different crops in the Region of Murcia, in polluted water for its reuse as irrigation water. Pirimicarb, imidachloprid, thiamethoxam and methoxyfenoxideare the target insecticides in this work. Photocatalysis process has been optimized for the degradation of these compounds using natural sunlight during months of highest radiation. The target compounds underwent a liquid-liquidextraction (LLE) and subsequent separation and detection by HPLC/MS^2, according to the method described by Fenoll*et al.* [1]. Obtained data were adjusted to a pseudo-first-order kinetics. Up to 350 mg L^{-1} of ZnO, the reaction rate for each insecticideincreases with the catalyst loading and then remains constant, as shown in Figure 1.

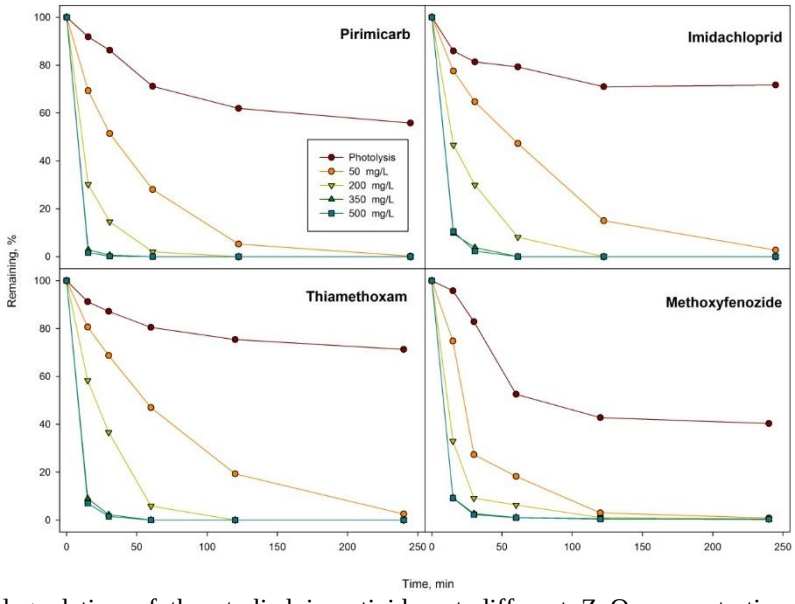

Figure 1. Photodegradation of the studied insecticides at different ZnO concentrations under natural sunlight. Photolysis curves representphotolytic degradation in absence of catalyst.

After 15 minutes of photoreaction, percentage remaining of all pesticides is down than 10 % using 350 mg L^{-1} of ZnO. This amount defines the optimum loadingto degrade these insecticides at circum-neutral pH because they were successfully degraded after 240 minutes. Redissolution and toxicity of Zn^{2+} is one of the disadvantage of using ZnO. Thus, concentration of dissolved Zn^{2+} can be reduced by adjusting the pH of the water to an approximate value of 9.5 after photocatalytic process. At this pH, zinc forms an insoluble hydroxide in water and can be eliminated by sedimentation with subsequent filtration [2].Therefore,the use ofZnO as photocatalyst under sunlight irradiation constitutes an effective method for detoxification of water polluted with the studied insecticides.

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