IMMOBILIZED TIO_2 ON GLASS SPHERES APPLIED TO HETEROGENEOUS PHOTOCATALYSIS TO REMOVE BENZODIAZEPINE DRUGS FROM WATER

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ABSTRACT

Benzodiazepine drugs are considered as potential emerging contaminants found in different aqueous matrices at concentration ranges including surface water and drinking water, with reported ecotoxicity. However, there are very few studies about their removal from water using photocatalysis as the treatment method. Currently, there is a growing interest in new materials, which can be applied in sustainable technologies for water purification and wastewater treatment. Heterogeneous photocatalysis (HP) is an attractive treatment method based on semiconductor catalysts, such as titanium dioxide (TiO_2) which is capable of partially absorbing sunlight photons to degrade a great variety of organic substances. When immobilized in a supporting material, additional benefits are achieved. The aim of this study was to apply a simple protocol for impregnation of commercial TiO_2 (P25) on borosilicate glass spheres and evaluate its efficiency in photocatalytic degradation in water of three benzodiazepine drugs widely used in the modern society: bromazepam, clonazepam and diazepam. The assays were conducted in a lab-scale Compound Parabolic Concentrator (CPC) reactor using radiation from a lamp simulating the solar spectrum. Scanning electron microscopy (SEM) images were collected before and after the photocatalytic treatment. The immobilized TiO_2 catalyst showed very stable coating and remained mostly unchanged after the treatment. Under simulated solar radiation at 45 W/m^2 (within the UVA range), after 180 min of light exposure, immobilized TiO_2 was able to degrade 98, 76 and 88% of bromazepam, clonazepam and diazepam, respectively. The efficiency of the immobilized TiO_2 on glass spheres was higher than the photolysis (photodegradation) with the same exposure time. Immobilized TiO_2 obtained through the procedure here described has an excellent potential to be used in water/wastewater treatment and HP-based remediation of contaminated sites.

KEYWORDS:
Benzodiazepine drugs; Aqueous matrices; Immobilized TiO_2; Heterogeneous photocatalysis.

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