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# Photocatalysis as a potential tertiary treatment of urban wastewater: new photocatalytic materials

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**Abstract** Heterogeneous UV-photocatalytic process has been studied as tertiary treatment of real municipal wastewater. Wastewater photocatalytic treatment was carried out using several materials previously developed as photocatalysts: volcanic ashes and nanostructured titania supported over volcanic ashes. Both material activities in particles were compared with Degussa $TiO_2$ (powder). Photocatalyst amount influence was studied by varying it between 2 and 10 g $L^{-1}$. Wastewater decontamination process was evaluated measuring the chemical oxygen demand evolution with phototreatment time in order to choose the best photocatalytic material and its optimal operation concentration. Moreover, the photocatalytic results obtained were compared with those obtained from photolysis and adsorption studies in wastewater using the same operation conditions. In addition, analyses of main wastewater parameters were made in order to evaluate the complete water decontamination process. Possibility of using photocatalysts in particles shows the main advantage of continuous photocatalyst separation from the water effluent once the decontamination process has finished. Good photocatalytic activities were observed, and it allows to conclude that heterogeneous photocatalysis is an effective method for municipal wastewater treatment, achieving water disinfection and phosphates removal.

**Keywords** Advanced oxidation processes (AOPs) · Heterogeneous photocatalysis · Volcanic ashes · Chemical oxygen demand (COD) · $TiO_2$

## Introduction

Advanced oxidation technology (AOT) has provided innovative, highly cost-effective, catalyzed chemical oxidation processes for treatment of contaminated soil, sludge and wastewater. Advanced oxidation process (AOP) has recently emerged as a powerful alternative technique for polluted water treatment.

AOPs can be broadly defined as aqueous phase oxidation methods based primarily on the intermediacy of hydroxyl radicals, $HO^{\bullet}$, in the mechanism leading to the destruction of the target compounds (Litter and Quici 2010; Lydakis-Simantiris et al. 2010; Robert and Malato 2001). The hydroxyl radical may be generated photochemically or by other kind of energy, and it has high effectiveness for the oxidation of organic matter (Kositzi et al. 2004; Wu et al. 2010).

Currently, the heterogeneous photocatalysis is one of the most important AOPs, because it allows degradation, and even the mineralization, of a wide variety of organic compounds. Heterogeneous photocatalysis is based on the oxidation of polluting compounds that can be found in air or in water by means of a reaction occurring on a semiconductor catalytic surface activated by light with a specific wavelength.

$TiO_2$-based photocatalysts appear as the most used in the heterogeneous photocatalysis. $TiO_2$ is stable to strong acids and bases, photochemically stable, commercially

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