Photocatalytic degradation of chloramphenicol and tartrazine using Ag/TiO₂ nanoparticles

Akbar Jodat*, Asghar Jodat

Laboratory of Chemistry, Shahindezh Branch, Islamic Azad University, Shahindezh, Iran
Tel. +98 4824221022; Fax: +98 4824229092; email: akbarjodat@gmail.com

Received 9 January 2013; Accepted 30 March 2013

ABSTRACT

Photocatalytic degradation of chloramphenicol (CAP) and tartrazine (TAZ) was studied in the aqueous suspensions of silver-modified TiO₂ (Ag/TiO₂) nanoparticles under ultraviolet (UV) light irradiation. Ag/TiO₂ nanoparticles were prepared with chemical reduction method and characterized by X-ray diffraction (XRD), scanning electron micrographs (SEM), energy dispersive X-ray micro analysis (EDX), transmission electron microscope (TEM), and X-ray photoelectron spectroscopy (XPS) techniques. XPS measurement indicates that Ag mainly exists in the Ag⁰ state on the TiO₂ nanoparticles surface. The effects of the operational parameters, such as silver concentration, photocatalyst loading, initial substrate concentration, light intensity, and calcination temperature were evaluated. It was found that the photocatalytic efficiency of TiO₂ nanoparticles for the degradation of CAP and TAZ can be significantly improved by depositing an optimum amount of Ag nanoparticles. By comparing the removal efficiency of CAP and TAZ at the similar conditions, it was observed that the photodegradation rate of TAZ was faster than that of CAP. Total organic carbon (TOC) removal was measured at optimum conditions to quantify the mineralization of the pollutants. Above 84 and 89% mineralization of CAP and TAZ was observed using 120 min irradiation.

Keywords: Photocatalytic degradation; Chloramphenicol; Tartrazine; Ag–TiO₂ nanoparticles; Chemical reduction

1. Introduction

Environmental pollution is the area of concern which inevitably requires deeper attention. Currently, due to industrial growth, the environmental pollution has been steadily escalated reaching to a critical level in the developing countries. In this regard, the discharge of effluents containing high concentrations of dyes and pharmacy wastewater pollutants has exacerbated the problem of environmental pollution. Dyes as water pollutants are nonbiodegradable and releasing them into the environment poses a significant threat to the surrounding ecosystems. Tartrazine (TAZ), one of them, although used as a cosmetic, drug, and food coloring dye, is considered highly toxic for humans due to its high solubility which is found in high amounts in industrial effluents [1–4]. Recently, a lot of studies have concentrated on the degradation of pharmacy wastewater pollutants. Pharmaceuticals including antibiotics are present in...