Photocatalytic degradation of 4-chlorophenol using a Ag/TiO2/Fe3O4 composite under UV-A irradiation

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ABSTRACT

4-Chlorophenol (4-CP), widely used in the production of dyes, drugs, and fungicides is a water pollutant. It can be found in surface water, soil, ecosystems, and the human body. 4-CP is a non-degradable pollutant when subjected to traditional water treatment techniques. The development of advanced oxidation processes provided alternative methods that could potentially be applied to the decomposition of non-degradable compounds; 4-CP could then be removed from water supplies by processes such as photocatalytic degradation. However, the anatase TiO2 typically used in such procedures has a large band gap of 3.2 eV which is only activated by ultraviolet (UV) radiation. In this study, a Ag/TiO2/Fe3O4 composite was synthesized from Ag, TiO2, and Fe3O4 owing to the enhanced photocatalytic activity and catalyst recoverability conferred by Ag and Fe3O4, respectively. The catalyst was characterized by X-ray diffraction, X-ray fluorescence, UV–visible spectrophotometry, scanning electron microscopy, transmission electron microscopy, diffuse reflectance spectroscopy, and energy dispersive spectroscopy. The catalyst surface appeared to be composed of small, spherical or ovoid particles with dimensions smaller than 50 nm. The synthesized catalyst showed much higher activity for the photodegradation of 4-CP than Degussa P25 TiO2 and Ag/TiO2 under UV-A irradiation. The Langmuir–Hinshelwood kinetic mechanism was used to compare the photocatalytic activities of Degussa P25 TiO2, Ag/TiO2, and Ag/TiO2/Fe3O4.

Keywords: 4-Chlorophenol; Ag/TiO2/Fe3O4; Photocatalytic degradation; Langmuir–Hinshelwood