(157)

Photocatalytic Degradation of Rhodamine B under UV Light Catalyzed by Alpha Titanium Phosphate and Metal Modified Titanium Phosphate

Jayasinghe K.W.P.V.*, Palliyaguru L., Jayaweera P.M.

Department of Chemistry, University of Sri Jayewardenepura, Nugegoda, Sri Lanka
**pasinduviduranga123@gmail.com*

Abstract

Wastewater management is a crucial issue in most emergent nations with ever-growing global industrialization. From textiles to food, mankind uses dyes and pigments which pose a threat to the environment due to organic non-biodegradable dyes contained in wastewater. Rhodamine B (RhB) is a conventional colorant in many industries producing a large amount of dye effluent, thus becoming a serious threat to the environment as well as human health. Additionally, RhB is dangerous even at extremely low quantities, making treatment of the RhB effluent more essential. Even though TiO_2 is considered as the best photocatalyst to remove many organic pollutants, acceptable alternatives are needed due to being uneconomical in large-scale usage. Synthesis of titanium bismonohydrogen orthophosphate (α-TiP) can be achieved by refluxing ilmenite with phosphoric acid via a previously reported novel method. Solid state reactions of α-TiP and oxides of Co and Cu at 800° C result in various metal titanium phosphates (M-TiP) with unique colors. XRD, FTIR, and Diffuse reflectance UV-vis techniques were used for characterization of the obtained solids. Bandgap of α-TiP changed with the modification of different transition metal cations lowering bandgap from 4.01eV (α-TiP) to 3.57 eV (Cu-TiP). Aqueous RhB degradation under UV irradiation was used to investigate the photocatalytic abilities of these catalysts. For that 0.2 g sample of catalyst was added to a solution that contained 200 mL of a 5 mg L^{-1} Rh B which was kept for 15 mins in dark to reach adsorption-desorption equilibrium before exposing the sample to UV irradiation for 3 h. A clear enhancement of photocatalytic activity was observed from using Co-TiP as the catalyst, which only took around 80 min to remove almost all Rh B contained in the sample compared to α-TiP which took close to 3 h to become colorless. It was in alignment with spectrometer results where a clear reduction of intensity can be seen in wavelength at 552 nm. Photocatalytic activities of these catalysts decreased in the following order: Co-TiP>α-TiP>Cu-TiP. The Co-modified TiP showed degradation of 99.5% after 3 h of UV irradiation and pseudo first-order kinetics were followed by the degradation.

Keywords: Titanium Phosphate, Photocatalyst, Rhodamine B, Wastewater management