Remediation of anionic dye simulated wastewater using TiO2 as a photocatalyst under various light irradiation wavelength

Abstract

Heterogeneous photocatalytic process employing UV/TiO2 batch photo-reactor system was demonstrated to be effective in the photodegradation of C.I. Reactive Black 5 anionic dye. Various artificial lamps (UV-A, UV-B, UV-C and solar irradiation) were used to activate the TiO2-P25 Degussa photocatalyst. UV-C was found to be the best in degrading RB5 with 100% efficiency at the 25th min with an R2 = 0.9786 according to the first order reaction kinetic model. The effectiveness of UV-C is due to the shorter penetration capability with higher energy photon, so there was more electron-hole pairs available for the target compound. Photodegradation with UV-B was also similarly effective while UV-A and solar irradiations were least effective. Increasing the initial dye concentration reduced the degradation rate due to the inner photon filtering effect by the dye molecules. Since RB5 is anionic dye, by increasing the pH of the system, the degradation rate was reduced to 99.65% in 1 h at pH10. This is due to the electrostatic attraction between the dye molecules and the negatively charged TiO2 particles. Photocatalytic degradation was found to be affected by the pollutant concentration and solution pH which were explored and described in detail in this article