

ENHANCED PHOTOCATALYTIC DEGRADATION OF ORGANIC POLLUTANTS USING Fe₂O₃-TiO₂ COMPOSITES

R. M. N. L. Rathnayake^a and M. A. C. M. Haniffa^{a*}

^aDepartment of Chemical Sciences, Faculty of Applied Sciences, South Eastern University of Sri Lanka, Sammanthurai, Sri Lanka.

*mmmhaniffa@seu.ac.lk

Abstract

This study presents the synthesis and evaluation of Fe₂O₃-TiO₂ composites for the photocatalytic degradation of organic pollutants, using methylene blue (MB) as a model dye under ultraviolet (UV) light irradiation. The composites were prepared via a simple, cost-effective sol-gel method, ensuring uniform mixing and controlled particle properties. Structural and functional group characterization was performed using X-ray diffraction (XRD) and Fourier-transform infrared spectroscopy (FTIR). XRD confirmed the presence of anatase-phase TiO₂ and hematite-phase Fe₂O₃, while FTIR spectra indicated characteristic Ti-O and Fe-O bonds, suggesting strong interfacial interactions. Photocatalytic performance was systematically evaluated by varying pH (3, 6.09, 11), initial MB concentration (5, 10, 15 ppm), and catalyst dosage (0.5, 1.0, 1.5 g L⁻¹). The highest degradation efficiency (90.28%) was achieved at pH 11, 10 ppm dye concentration, and 1 g L⁻¹ catalyst dosage. Kinetic analysis revealed that the degradation followed pseudo-first-order kinetics, with a rate constant of 0.0198 min⁻¹. Control experiments confirmed that significant degradation occurred only when both UV light and the catalyst were present, verifying true photocatalytic activity. The enhanced performance is attributed to Fe₂O₃-induced charge separation, which reduces electron-hole recombination in TiO₂, promoting reactive oxygen species generation. The results indicate that Fe₂O₃-TiO₂ composites are efficient, stable, and potentially reusable catalysts, suitable for textile wastewater treatment and adaptable for broader environmental applications.

Keywords: Fe₂O₃-TiO₂, Photocatalysis, Methylene Blue, UV Light, Wastewater Treatment