Degradation of dyes by TiO$_2$-loaded Graphene oxide (TiO$_2$-GO) materials under visible light illumination

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Abstract

Water pollution poses a threat to the sustainability of the Earth's ecosystem. In particular, the textile industry has been shown to discharge effluents containing compounds that are toxic to plant and animal life in aqueous environments. The dye materials in the effluent are broken down into various toxic substances, such as amines and cyanides under anaerobic condition. Therefore, removal of these toxic compounds is vital. In this regard, several studies are focusing on developing catalysts that can effectively remove these pollutants from the contaminated water. This study mainly focusses on degradation of a model dye, methyl orange (MO) by TiO$_2$ loaded Graphene oxide (GO) materials. TiO$_2$was loaded on the GO material using two different methods, such as mechanical-mixing and impregnation methods. 1, 2, 5, 10, and 20 % loadings of TiO$_2$ was made on the GO material, and the resultant materials were characterized by powder XRD method, which indicated the formation of amorphous TiO$_2$ over GO material. The synthesized materials were used to degrade a model dye, MO in the presence of visible light. Interestingly, 2 % TiO$_2$ loaded on GO using both mechanical-mixing and impregnation was found to be highly efficient in degrading methyl orange. In addition, a decrease in the rate of degradation was observed with increasing TiO$_2$ loading, whereas only adsorption of dye was attained with bare GO. The high degradation efficiency with the 2 % TiO$_2$ loaded GO material may be attributed to the good dispersion of the active TiO$_2$ nanoparticles on to GO.

Keywords: Titanium dioxide, Graphene oxide, Dye, Degradation, Visible light