

Enhanced decolourization of methyl orange by immobilized TiO₂/chitosan-montmorillonite

ABSTRACT

Many attempts have been made to improve the photocatalytic performance of immobilized photocatalysts for large-scale applications by modification of the photocatalyst properties. In this work, immobilized bilayer photocatalyst composed of titanium dioxide (TiO₂) and chitosan–montmorillonite (CS–MT) were prepared in a layer-by-layer arrangement supported on glass substrate. This arrangement allows a simultaneous occurrence of adsorption and photocatalysis processes of pollutants, whereby each layer could be independently modified and controlled to acquire the desired degree of occurring processes. It was found that the addition of MT clay within the CS composite sub-layer improved the mechanical strength of CS, reduced its swelling and shifted its absorption threshold to higher wavelengths. In addition, the band gap energy of the photocatalyst was also reduced to 2.93 eV. The immobilized TiO₂/CS–MT exhibited methyl orange (MO) decolourization rate of 0.071 min⁻¹ under light irradiation, which is better than the single TiO₂ due to the synergistic processes of adsorption by CS–MT and photocatalysis by TiO₂ layer. The MO dye took 6 h to achieve complete mineralization and produced sulfate and nitrate ions as the by-products. Furthermore, the immobilized TiO₂/CS–MT could be reused for at least ten cycles of application without significant loss of its activity.

Keyword: Bilayer; Chitosan; Immobilization; Methyl orange; Montmorillonite; Titanium dioxide