Insight into the synergistic photocatalytic-adsorptive removal of methyl orange dye using TiO2/chitosan based photocatalyst

ABSTRACT

The removal of methyl orange (MO) dye has been studied using TiO2/chitosan-montmorillonite (TiO2/Cs–MT) bilayer photocatalyst which also functions as an adsorbent. The dye removal experiments were conducted in the dark and under UV–Vis light irradiation via adsorption and photocatalysis-adsorption processes, respectively. The adsorption modelings were employed on the dark experimental data and compared with the immobilized and suspended Cs–Mt counterparts. It was found that the bilayer photocatalyst closely followed the adsorption properties of immobilized Cs–Mt which obeyed the pseudo-second-order kinetic and film diffusion models. Fluorescent analysis revealed that the charge separation was enhanced in the presence of Cs–Mt as a sub-layer of TiO2. Under light irradiation, the photocatalytic activity of TiO2/Cs–MT corresponded to its adsorption counterpart trend and was optimized at pH 6.5 and 20 mg L−1 of MO dye solution. High removal efficiency and synergism of MO by TiO2/Cs–MT over TiO2 single layer were observed throughout the 10 cycles of application due to contribution of adsorption of Cs–Mt sub-layer and photocatalysis by TiO2 top layer.

Keyword: Chitosan; Methyl orange; TiO2