

New insights into the photocatalytic endocrine disruptors dimethyl phthalate esters degradation by UV/MWCNTs-TiO₂ nanocomposites

ABSTRACT

Dimethyl phthalate esters (DMPEs) are considered to be endocrine disruptors and environmentally hazardous materials in plastic industries wastewater because of its low solubility and accumulated persistent toxicity. In the present study, MWCNTs/TiO₂ nanocomposites were fabricated by modified sol-gel technique using titanium isopropoxide as titanium oxide sources and purified MWCNTs, to degrade DMPEs through photocatalysis using UV irradiation. The effect of MWCNTs loading (3–15 wt %) on TiO₂ and the photocatalytic performance of DMPEs in aqueous solution by UV/MWCNTs/TiO₂ nanocomposites were investigated. For experiments conducted with the same illumination time, the photodegradation of DMPEs was enhanced with increasing the MWCNTs contents from 3 to 10 wt % and then decreased with a further enhancement to 15 wt %. Basically, the presence of MWCNTs in the nanocomposites can lead to the decrease in the relative amount of TiO₂ in the photocatalyst and then to the decrease of the photogenerated carriers. This is because the same amount of photocatalyst was added for the photoreaction, and hence, the photodegradation of DMPEs decreases especially for the nanocomposites containing MWCNTs exceed than 10 wt %. The presence of functional group (COOH) on the MWCNTs surface would help the achievement of direct chemical bonding between MWCNTs and the TiO₂ nanoparticles, resulting in the synergistic effect of MWCNTs and TiO₂ where the flow of photogenerated electrons in the space charge region to the MWCNTs surface. A method based on high-performance liquid chromatography (HPLC) was developed to study the degraded DMPEs samples produced after exposure to UV light.

Keyword: Photocatalysis; Dimethyl phthalate esters; MWCNTs/TiO₂nanocomposites