Photocatalytic Degradation of Recalcitrant POME Waste by using Silver Doped Titania: Photokinetics and Scavenging Studies

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ABSTRACT

The current paper reports on the photo-degradation of palm oil mill effluent over silver-modified titania (Ag/TiO\textsubscript{2}) under visible light irradiation. TiO\textsubscript{2}-based photocatalysts with 0.25–5.0 wt\% of Ag metal loadings were prepared by impregnating TiO\textsubscript{2} with chemically-reduced Ag nanoparticles from the AgNO\textsubscript{3} solution. The XRD characterization suggests that anatase was the predominant phase for all the as-synthesized photocatalysts. In addition, UV–Vis DRS confirmed that the Ag inclusion has extended the absorbance of photocatalysts to the visible light region. Moreover, the band gap energy of TiO\textsubscript{2} was successively reduced to 2.69 eV (5.0 wt\% Ag/TiO\textsubscript{2}), a drop from 3.1 eV (bare TiO\textsubscript{2}). Consequently, the POME degradation efficiency jumped 300–15.03\% by photoreaction over 1.0 g/L of 0.25 wt\% Ag/TiO\textsubscript{2} compared to the bare TiO\textsubscript{2}. The optimum loading of Ag was found to be 0.5 wt\%, with corresponding degradation of 19.73\%, and can be enhanced further to 26.77\% with the optimum catalyst loading of 1.5 g/L. Moreover, scavenging study confirmed that the primary reactive species for POME degradation in the current system was OH\textsuperscript{•} free radicals. In recycling test, the degradation efficiency of 0.5 wt\% Ag/TiO\textsubscript{2} dropped to 11\% and 13\% for second and third cycle, respectively, due to leaching of Ag metal as proven by ICP-MS, post-reaction.

KEYWORDS: Photocatalysis; POME; Scavenger; Silver; Titania

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