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_2) under visible light irradiation. TiO_2-based photocatalysts with 0.25–5.0 wt% of Ag metal loadings were prepared by impregnating TiO_2 with chemically-reduced Ag nanoparticles from the $AgNO_3$ 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_2 was successively reduced to 2.69 eV (5.0 wt% Ag/TiO_2), a drop from 3.1 eV (bare TiO_2). Consequently, the POME degradation efficiency jumped 300–15.03% by photoreaction over 1.0 g/L of 0.25 wt% Ag/TiO_2 compared to the bare TiO_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 $OH^{\bullet}$ free radicals. In recycling test, the degradation efficiency of 0.5 wt% Ag/TiO_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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