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Research article

Restoration of liquid effluent from oil palm agroindustry in Malaysia using UV/TiO₂ and UV/ZnO photocatalytic systems: A comparative study



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ABSTRACT

In this study, we have employed a photocatalytic method to restore the liquid effluent from a palm oil mill in Malaysia. Specifically, the performance of both TiO₂ and ZnO was compared for the photocatalytic polishing of palm oil mill effluent (POME). The ZnO photocatalyst has irregular shape, bigger in particle size but smaller BET specific surface area (9.71 m²/g) compared to the spherical TiO₂ photocatalysts (11.34 m²/g). Both scavenging study and post-reaction FTIR analysis suggest that the degradation of organic pollutant in the TiO₂ system has occurred in the bulk solution. In contrast, it is necessary for organic pollutant to adsorb onto the surface of ZnO photocatalyst, before the degradation took place. In addition, the reactivity of both photocatalysts differed in terms of mechanisms, photocatalyst loading and also the density of photocatalysts. From the stability test, TiO₂ was found to offer higher stability, as no significant deterioration in activity was observed after three consecutive cycles. On the other hand, ZnO lost around 30% of its activity after the 1st-cycle of photoreaction. The pH studies showed that acidic environment did not improve the photocatalytic degradation of the POME, whilst in the basic environment, the reaction media became cloudy. In addition, longevity study also showed that the TiO₂ was a better photocatalyst compared to the ZnO (74.12%), with more than 80.0% organic removal after 22 h of UV irradiation.