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Photocatalytic restoration of liquid effluent from oil palm agroindustry in Malaysia using tungsten oxides catalyst

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ABSTRACT

In the current work, the photocatalytic treatment of palm oil mill effluent over tungsten oxides photocatalyst under ultraviolet-irradiation was evaluated. Characterization of fresh and used tungsten oxides photocatalyst was accomplished via X-Ray Diffraction, Scanning Electron Microscopy with Energy Dispersive X-Ray Analysis, Ultraviolet–Visible Light Diffuse Reflectance Spectroscopy, and Fourier Transformed-Infrared Spectroscopy. Photocatalytic treatment of palm oil mill effluent was conducted to determine the effects of catalyst loading, longevity, and recyclability of the tungsten oxides photocatalyst, as well as the effect of pH alteration on palm oil mill effluent. During the photocatalytic reaction, the collected liquid sample was tested for chemical oxygen demand, pH, and colour intensity while the gaseous sample was analyzed via gas chromatography. The optimum catalyst loading was 0.5 g/L, corresponds to highest photocatalytic degradation (51.15%) and decolourization (96.21%). The pH alteration on palm oil mill effluent has negligible effect on its photocatalytic degradation with UV/WO_3 system. For longevity study, the optimum reaction time was 16 h, which achieved 84.70% photocatalytic degradation and 98.28% photocatalytic decolourization. From the recyclability study, it can be concluded that the tungsten oxides photocatalyst is suitable for photocatalytic decolourization of palm oil mill effluent, but not suitable for photocatalytic degradation. In addition, analysis of the gaseous product showed that the photocatalytic treatment has successfully degraded the organic pollutants in the liquid effluent into methane and carbon dioxide.