# Evaluating $MnO_2$ as a Transparent Photocatalytic Alternative to $TiO_2$: A Comparative Study of PET Particulate Degradation and Real-Time Spectral Monitoring of Aromatic Byproducts via UV-Vis Spectroscopy

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This study evaluates the feasibility of $MnO_2$ as a transparent, cost-effective alternative to $TiO_2$, the industry standard, in photocatalytic remediation and degradation of PET microplastics. The research investigates if $MnO_2$ can facilitate the cleavage of stable ester bonds into aromatic intermediates in basic conditions, while providing a clearer optical path for real-time absorbance monitoring than current standards. PET plastics were treated with 395nm UV-A light, as well as $H_2O_2$, and either acetic acid or NaOH depending on their designated pH environment. $H_2O_2$ facilitates the production of hydroxyl radicals, while alkali-enhanced environments weakened ester bonds, both expediting catalytic breakdown. Degradation was monitored via UV-Vis spectroscopy (380–400nm) to track the release of aromatic byproducts. High-pH environments across the board showed successful acceleration of polymer chain scission. Initial data analysis demonstrated extremely high absorbance for Basic $TiO_2$ reactors, however this can be identified as a false signature caused by Mie scattering from its colloidal suspension. Conversely, basic $MnO_2$ reactors successfully generated potential signatures of measurable degradation intermediates, like terephthalic acid, while also maintaining solution clarity to monitor these aromatic monomer releases through absorbance spectra. Its catalytic reactions with $H_2O_2$ also showed potential for catalytic micromotors in recovery of microplastics as well. $MnO_2$ establishes high viability as a monitorable, cost-effective photocatalyst for PET chemical degradation and remediation through recovery efficiency. By providing spectral transparency, $MnO_2$ provides a scalable, environmentally sustainable solution to global microplastic remediation overall.

**Awards Won:**