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Evaluation of photocatalytic performance based on nanomaterials as an effective advanced oxidation process (AOPs) in oil pollution treatment

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Refinery wastewaters are significant contributors to water pollution due to their non-biodegradable and toxic nature. Phenolic compounds, classified as priority pollutants by the US EPA, are particularly problematic. Photocatalytic techniques based on nanomaterials, like titanium dioxide (TiO_2) nanostructures, have emerged as effective and versatile solutions for wastewater treatment. TiO_2 nanoparticles offer advantages such as increased surface area, enhanced reaction rates, non-toxicity, biocompatibility, and ease of preparation, making them popular in photocatalysis [1]. They exhibit high photocatalytic activity under ultraviolet light, ensuring efficient degradation even in low light conditions. Importantly, TiO_2 can undergo oxidation state changes without decomposing, making it a desirable catalyst for complete mineralization, serving as an alternative to chemical oxidation [2]. The specific surface area of TiO_2 allows photocatalysis to proceed unaffected by the presence of other molecules, such as water [3].

This article investigates the effective parameters in the purification of p-nitrophenol, a hazardous phenolic compound, using TiO_2 nanoparticles in the photocatalytic method. The study reveals that within the studied range, lamp power and pH positively influence the purification efficiency, while pollutant concentration negatively affects it. Increasing the amount of TiO_2 nanoparticles initially improves efficiency, but further increases lead to decreased process efficiency due to increased turbidity. In summary, this study demonstrates the effectiveness of TiO_2 nanoparticles in the photocatalytic purification of phenolic compounds. It highlights the positive impact of lamp power and pH, along with the negative influence of pollutant concentration on the efficiency of the photocatalytic process. Moreover, the findings emphasize the importance of controlling nanoparticle concentration to avoid diminishing process efficiency caused by turbidity. Overall, this research contributes to the understanding of the photocatalytic method's potential for wastewater treatment and optimization.

Keywords: Photocatalyst, p-nitrophenol, TiO_2

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