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Chemical and biological treatments to clean oily wastewater: optimization of the photocatalytic process using experimental design

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ABSTRACT

The remediation efficiency of oil containing wastewater was evaluated employing an integrated photocatalytic and biological treatment. Both the photocatalytic and biological treatments were carried out in batch reactors using TiO_2 as the photocatalyst. The effects of TiO_2 concentration, pH, and reaction time were optimized by the experimental design, achieving 90.0% of oil removal in 30 min of reaction time at pH = 5.0, with a reaction rate constant of 0.027 min^{-1} ($R^2 = 0.71$). For biological treatment, we used the bacteria *Pseudomonas aeruginosa* in biofilms. The biological treatment alone achieved 66.5% of oil removal in just 45 min of treatment, with a reaction rate constant of 0.018 min^{-1} ($R^2 = 0.99$). To augment the process efficiency, we integrated both the chemical and biological treatments, achieving 99.0% of oil and 78.6% total organic carbon (TOC mg L^{-1}) removal. The concept of experimental design adopted to optimize the photocatalytic process saved time and generated adequate estimates of the experimental variables, which were validated by the reaction kinetics.

Keywords: Biodegradability; Oily wastewater; Photocatalysis; *Pseudomonas aeruginosa*; TiO_2

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