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ÁREA: Photocatalysis and Advanced Oxidative Processes (POAS)

Evaluation of $BiVO_4$ as a photocatalyst in the photocatalysis process of effluent generated in biodiesel production

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Resumo-Abstract

In recent years, Brazil has excelled in the production of biodiesel, diversifying its energy matrix. Law No. 11.097/2005 establishes a gradual increase in the percentage of biodiesel in diesel, from 2% to 12%. Biodiesel is obtained by transesterifying triglycerides from vegetable oils or animal fats with methanol or ethanol, generating esters and glycerin. Purification involves washing, resulting in effluents that need to be treated and reused. With this, it is possible to reduce the amount of waste and minimize environmental impacts, making the process more sustainable and efficient [1]. To treat these effluents, advanced oxidative processes such as heterogeneous photocatalysis are highly effective, using solid catalysts activated by UV light to decompose organic and inorganic pollutants present. Bismuth vanadate ($BiVO_4$) stands out for its high photocatalytic efficiency, especially when activated by UV light, making it an effective and promising alternative for mitigating the negative impacts associated with environmental pollution. The aim of this study is to use heterogeneous photocatalysis with $BiVO_4$ and UV radiation to promote the efficient and sustainable degradation of contaminated effluents generated in biodiesel production, with a view to environmental protection. The photocatalyst was synthesized via the hydrothermal method using ammonium metavanadate and bismuth nitrate, after which the powder was calcined at 400oC. The biodiesel was obtained via methyl transesterification with sodium hydroxide (NaOH), and soybean oil heated to 60°C under stirring for 1 hour. After 24 hours, the glycerin was separated and the biodiesel washed until the residual water reached pH 7. The photolysis and photocatalysis experiments were conducted using an 80W mercury lamp in a jacketed reaction cell. The pH of the samples was kept neutral and the concentrations of $BiVO_4$ varied between 500 and 1000 ppm. Aliquots of 5 mL were taken throughout the experiment and centrifuged to determine pH, conductivity and temperature and UV-Vis in the 200 to 800 nm range, the analyses were carried out and quickly returned to the reaction medium. Representative samples from the initial and final times were preserved for Total Organic Carbon (TOC) analysis in order to gauge the efficiency of the degradation processes. The study compared the effectiveness of photocatalysis with $BiVO_4$ and photolysis in the treatment of biodiesel effluents. Photocatalysis with 500 ppm of $BiVO_4$ at neutral pH proved to be the most efficient, with a degradation rate of 30%, while the sample with 1000 ppm and photolysis performed less well. These results indicate that photocatalysis with 500 ppm is a promising solution for treating effluents, with the potential to be applied in industrial processes, helping to reduce environmental impacts.

Keywords: Advanced oxidative processes, $BiVO_4$, Environmental sustainability.

References

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