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Evaluation of $BiVO_4$ as a photocatalyst in the process of photocatalysis of effluent from the craft beer industry

Emilly L. S. Xavier[1*], Luciele T. da Silva[1], Alessandra R. de Oliveira[1], Suely S. L. de Castro[1], Keurison F. Magalhães[1]

[1]Laboratory of Electrochemistry and Analytical Chemistry - LEQA, Rio Grande do Norte State University (UERN), Mossoró-RN, 59.610-210, Brazil.
*E-mail: emillylohanna@alu.uern.br**

Resumo-Abstract

In 2019, Brazil recorded a 36% increase in the production of brewery effluents, the improper disposal of which can cause serious environmental damage [1] . To tackle this problem, new treatment methods, such as Advanced Oxidative Processes (AOPs), are being studied, with an emphasis on heterogeneous photocatalysis, which uses semiconductors activated by UV-Vis light [2]. Among the photocatalysts investigated, Bismuth Vanadate ($BiVO_4$) stands out for its photocatalytic properties and high efficiency under sunlight [3]. The aim of this work is to implement heterogeneous photocatalysis with $BiVO_4$ and UV-Vis radiation to promote the effective degradation of this type of effluent. The photocatalyst was synthesized via the hydrothermal method using ammonium metavanadate and bismuth nitrate, after which the powder was calcined at 400ºC. At the brewery located in the city of Mossoró-RN, 5L of effluent was collected, filtered to remove coarse material and stored for physical-chemical analysis such as pH, conductivity and temperature. The photolysis and photocatalysis experiments were carried out using an 80W mercury lamp in a jacketed reaction cell, under agitation and a cooling system.The concentration of $BiVO_4$ varied between 250, 500 and 1000 ppm and the pH of the samples was kept at 7.5 mL aliquots were taken throughout the experiment and centrifuged to determine pH, conductivity and temperature, 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 initial samples from the photocatalysis test with 1000 ppm and photolysis had a pH of 5.72 and 6.71, and conductivity of 78.7 µS and 69.6 µS respectively. After the process, the final samples showed pH of 6.58 and 7.31 and conductivity of 679 µS and 81.5 µS respectively.The TOC results obtained in the tests that showed superior performance, both in photolysis and photocatalysis, reveal that in the photolysis tests there was a reduction of 4.2% and in the 1000 ppm photocatalysis there was a significant reduction of 21.1% in the final concentration, demonstrating the action of the photocatalyst in degrading the organic molecules present in the effluent. The results were very promising, demonstrating the effectiveness of the method employed. This suggests that there is potential for further studies with the aim of optimizing the process even further.

Keywords: Craft beers, $BiVO_4$, heterogeneous photocatalysis.

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