ASEC 2023 The 4th International Electronic Conference on Applied Sciences

Efficiency of a Magnetic Multi-Core Shell Catalyst in the Degradation of Paracetamol and Sulfamethoxazole: A Catalytic Wet Peroxide Oxidation Approach

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With the populational rise in the last decades, the potable water available has been a common concern. In this scenario, pharmaceuticals, mostly excreted in sewers, are not treated by conventional wastewater treatment plants. This study explores the synthesis of a magnetic multi-core shell catalyst and its efficiency in the degradation of paracetamol (PCM) and sulfamethoxazole (SMX) by catalytic wet peroxide oxidation (CWPO). The catalysts were synthesized in a two-step process. The core was initially synthesized via a coprecipitation methodology, followed by the sol-gel synthesis of the niobium pentoxide shell. The tests were conducted with three different matrixes, two in single components ([SMX] =10 ppm or [PCM] =100 ppm) and one in multi-component ([SMX] = 10 ppm and [PCM] = 100 ppm). The liquid-phase oxidation reactions were carried out at 80 °C, pH 3.5, and stirring at 300 rpm and a catalysts concentration of 2.5 g L-1. Results showed that the catalyst maintained its magnetic property, accelerating the removal process from the matrix and resisting the CWPO process, not showing leaching. In single-component matrices, the degradation of PCM and SMX led to the removal of approximately 90.9% of PCM and 22.8% of SMX within 4 hours. However, in the case of multi-components, 88.7% of PCM and 80.1% of SMX were removed within the same time frame, indicating a potential synergy between the catalyst and the pollutants. In conclusion, the degradation of the pharmaceuticals by the new catalyst developed proved to have a high degradation rate and low toxicity.

Keywords: CWPO; pharmaceuticals; wastewater treatment; environmental catalysis.