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Combining the power of H_2O_2-based processes with heterogeneous photocatalysis for the degradation of sulfamerazine

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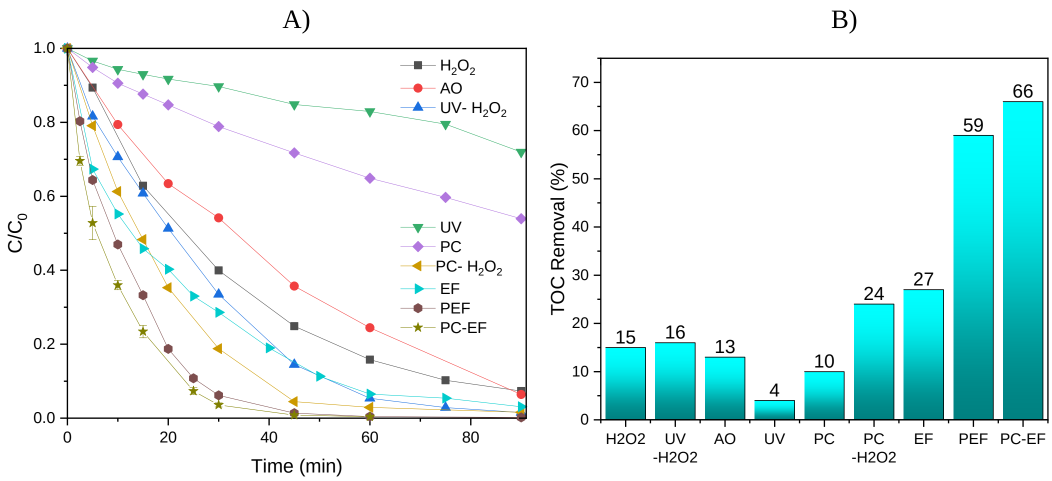
This study aims at the degradation of the antibiotic known as sulfamerazine under multiple processes, particularly focusing on the hybrid heterogeneous photocatalysis/photoelectro-Fenton process, employing cellulose-based gas diffusion electrodes for H_2O_2 electrogeneration and $TiO_2/KNbO_3/g\text{-}C_3N_4$ ternary photocatalyst. Regarding the sulfamerazine degradation tests, the hybrid heterogeneous photocatalysis/photoelectro-Fenton process (PC-EF) exhibited the highest efficiency between the degradation processes studied, probably due to the synergistic effect obtained towards the creation of new mechanisms of active radical generation. As such, the hybrid process was able to complete degrade the sulfamerazine in the system after 45 min, with 66% mineralization after 1.5 h (Figure 1). Upon examining the junction of heterogeneous photocatalysis and H_2O_2 electrogeneration (PC-H_2O_2), it is noticeable that the mineralization of the SFMZ obtained was comparable to the EF process, with an even higher k_{app} value. Consequently, the PC-H_2O_2 process emerges as a potentially substitutive approach to the electro-Fenton process, offering advantages in post-treatment scenarios due to the absence of iron in the solution and the facile separation of the photocatalyst via simple filtration. Thus, considering the quite inexpensive nature of the photocatalyst employed and facile separation from the reactional system, the combination of heterogeneous photocatalysis and H_2O_2-based processes can be seen as a very interesting alternative for the degradation of toxic organic pollutants in aqueous media.

Figure 1 – A) Results for the sulfamerazine degradation experiments (0.05M K_2SO_4, pH = 3, V = 0.25 L, C_{SFMZ} = 50 mg L^{-1}, j = 25 mA cm^{-2}, Photocatalyst dosage = 0. 3 g L^{-1}, 11 W UV-lamp); B) TOC results for the degradation tests (*AO = Anodic Oxidation, PC = Heterogeneous Photocatalysis, UV = UV Photolysis, PC-H_2O_2 = Heterogeneous Photocatalysis/H_2O_2 generation, EF = Electro-Fenton, PEF = Photoelectro-Fenton, and PC-EF = Heterogeneous Photocatalysis/Electro-Fenton*)



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