World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:19, No:06, 2025

Visible Light-Driven Photocatalytic Degradation of Amphotericin B and Naproxen Using Carbon Quantum Dots Embedded in MIL-88B(Fe)

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Abstract : A novel photocatalytic adsorbent has been synthesized, comprising carbon dots (CD) embedded within a metal-organic framework (MOF) referred to as MIL-88B(Fe). This composite was prepared using a solvothermal technique, which is effective for producing advanced hybrid materials. The resulting CD@MIL-88B(Fe) was characterized through a variety of X-ray-based microscopic and spectroscopic methods, including electrochemical impedance spectroscopy, UV-Vis spectroscopy, Fourier-transform infrared spectroscopy (FT-IR), diffuse reflectance spectroscopy (DRS), thermogravimetric analysis (TGA), and photoluminescence (PL) analysis. The synthesized adsorbent exhibited remarkable photocatalytic activity in the removal of amphotericin B (AmB) and naproxen (Nap) from aqueous solutions under visible light irradiation, achieving removal efficiencies of up to 92% for AmB and 90% for Nap, with a relative standard deviation (RSD) of approximately 5%. The study also investigated various parameters influencing the degradation process of these pharmaceuticals. Optimal conditions were identified, including pH values of 3 for AmB and 4 for Nap, a catalyst concentration of 0.2 g. L^{-1}, and hydrogen peroxide concentrations ranging from 40 to 50 mM. Furthermore, reactive oxidative species such as hydroxyl radicals (·OH) and superoxide anions ($\cdot O_2$) were detected through the use of various scavengers. Adsorption isotherm and kinetic studies revealed that the synthesized photocatalyst demonstrates dual functionality: it acts as an effective adsorbent with maximum adsorption capacities of 42.5 mg. g^{-1} for AmB and 121.5 mg. g^{-1} for Nap while also serving as a photocatalytic agent for the removal of these pharmaceutical contaminants.

Keywords : metal-organic frameworks, fenton-like degradation, CD@MIL-88B(Fe), Amphotericin B, Naproxen, heterogenous photocatalysts
Conference Title : ICC 2025 : International Conference on Chemistry
Conference Location : San Francisco, United States
Conference Dates : June 12-13, 2025