

Heterogeneous Photocatalytic Degradation of Ibuprofen in Ultrapure Water, Municipal and Pharmaceutical Industry Wastewaters Using a TiO₂/UV-LED System

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Abstract : Degradation and mineralization of ibuprofen (IBU) were investigated using Ultraviolet (UV) Light Emitting Diodes (LEDs) in TiO₂ photocatalysis. Samples of ultrapure water (UP) and a secondary treated effluent of a municipal wastewater treatment plant (WWTP), both spiked with IBU, as well as a highly concentrated IBU (230 mgL⁻¹) pharmaceutical industry wastewater (PIWW), were tested in the TiO₂/UV-LED system. Three operating parameters, namely, pH, catalyst load and number of LEDs were optimized. The process efficiency was evaluated in terms of IBU removal using high performance liquid chromatography (HPLC) and ultra-high performance liquid chromatography coupled to tandem mass spectrometry (UHPLC-MS/MS). Additionally, the mineralization was investigated by determining the dissolved organic carbon (DOC) content. The chemical structures of transformation products were proposed based on the data obtained using liquid chromatography with a high resolution mass spectrometer ion trap/time-of-flight (LC-MS-IT-TOF). A possible pathway of IBU degradation was accordingly proposed. Bioassays were performed using the marine bacterium *Vibrio fischeri* to evaluate the potential acute toxicity of original and treated wastewaters. TiO₂ heterogeneous photocatalysis was efficient to remove IBU from UP and from PIWW, and less efficient in treating the wastewater from the municipal WWTP. The acute toxicity decreased by ca. 40% after treatment, regardless of the studied matrix.

Keywords : acute toxicity, Ibuprofen, UV-LEDs, wastewaters

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