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Maya Amasha, Abbas Baalbaki, Antoine Ghauch

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A comparative study of the common persulfate activation techniques for the complete degradation of an NSAID: The case of Ketoprofen

Maya Amasha, Abbas Baalbaki, Antoine Ghauch[*1]

[1]American University of Beirut | Faculty of Arts and Sciences | Department of Chemistry
P.O. Box 11-0236 Riad El Solh – 1107-2020 Beirut – Lebanon

Abstract

This work assessed the treatment of ketoprofen (KTP) using persulfate (PS) based Advanced Oxidation Process (AOP) activated thermally, chemically (Fe^{2+}) or by UV. KTP degradation was optimized by manipulating several experimental parameters to achieve efficient KTP and its byproducts removal. Parameters included: PS concentration, Fe^{2+} concentration, temperature, pH, dissolved ions e.g. Cl^-, HCO_3^-, and humic acids (HA). Results showed that: (i) KTP degraded significantly in UV only systems in contrary to thermal and chemical systems where KTP was resistant in PS free solutions; (ii) KTP degradation extent increased with the increase in $[PS]_0$ while it was highly dependent on the $[Fe^{2+}]_0$:$[PS]_0$ molar ratio; (iii) The activation energy (E_A) calculated in thermal activation experiments was found to be 157.02 (±8.9) KJ mol^{-1}; (iv) The highest % reaction stoichiometric efficiency calculated only in thermal systems reached 38%; (v) Sequential KTP additions showed that the UV system was the most sustainable, followed by the thermal system while the chemical system was the least sustainable. (vi) KTP dissolved in a non-treated waste water matrix was best removed along with present coliforms in UV system. KTP transformation products were identified by HPLC/MS and a degradation reaction pathway was suggested. This study led to the conclusion that UV/PS systems are the most economically efficient among the three investigated PS-based systems.

Keywords: Ketoprofen, Persulfate, Heat, UV, Fe^{2+}, degradation.

[1] Corresponding Author: e mail antoine.ghauch@aub.edu.lb Phone: +961 1350 000 Fax: +961 1 365 217