DEGRADATION AND MINERALIZATION OF BISPHENOL A BY THE PHOTO FENTON PROCESS

M. Navarro-Jordà, M. Graells, M. Pérez-Moya
Escola Universitaria d'Enginyeria Tècnica Industrial de Barcelona, Universitat Politècnica de Catalunya, BARCELONATECH
tel. +34 93 4137275, e-mail: montserrat.perez-moya@upc.edu; EUETIB, C/Comte d'Urgell 187, 08036-Barcelona, Spain.

Environmental Technology and Risk Analysis: Advanced Techniques for Effluent Treatment

Bisphenol A (BPA; 2,2-bis (4-hydroxyphenyl) propane) is an industrial organic chemical basically used in the plastics industry as a monomer for producing epoxy resins and polycarbonates [1,2]. It is also a well-known endocrine disruptor agent that contaminates surface waters even at low concentration [3].

Unfortunately, BPA cannot be entirely removed from water solutions by conventional treatments. Additionally, in some cases, such treatments can lead to a series of by-products with higher endocrine disrupting effect [4].

Advanced Oxidation Processes (AOPs), among them the Fenton and photo-Fenton processes, are efficient methods for BPA photodegradation [1]. However, they are energy-intensive processes and their cost is ought to be improved by reducing the reaction time as well as the consumption of reagents.

In this work, the Fenton and the photo-Fenton degradation of BPA (0,5 L, 30 mg L^{-1}) was addressed. The process efficiency was evaluated under different H_2O_2 and Fe(II) initial concentrations (2,37-6,41 mM H_2O_2 and $1{,}42\cdot10^{-2}$-$3{,}92\cdot10^{-2}$ mM iron salt), while other variables were fixed (pH=3, 25ºC, UV light source). The treatment performance was assessed for a series of assays from a factorial design and was quantified in terms of the decay rate of total organic carbon (TOC) and the total conversion attained, according to a pseudo first order kinetics [5-6].

Given the initial conditions, the analytical expression for the TOC evolution is:

$$[TOC] = [TOC]^{\infty} + \left([TOC]^{o} - [TOC]^{\infty}\right)\cdot e^{-kt} \qquad \text{(eq. 1)}$$

which can be expressed in terms of conversion (ξ) by the following equation:

$$\xi = \xi^{max}\left(1 - e^{-kt}\right) \text{ being } \xi^{max} = \frac{[TOC]^{o} - [TOC]^{\infty}}{[TOC]^{o}} \qquad \text{(eq. 2)}$$

Hence, the performance of the mineralization may be characterized by determining the two parameters of the model, ξ^{max} (or $[TOC]^{\infty}$) and k, which can be obtained by fitting the model to the experimental data under the least squares criterion. The results were plot k in front to identify different clusters and the conditions which produces higher mineralization rates

References:

[1] H. Katsumata, S. Kawabe, S. Kaneca, T. Suzuki, K. Oht. Degradation of bisphenol A in water by the photo-Fenton reaction. Journal of Photochemistry and Photobiology A: Chemistry 162 (2004). 297–305.
[2] M.J. Zhan, X. Yang, Q.M. Xian, L.R. Kong, Environmental Contamination and Toxicology, 76 (2006) 105–112.
[3] G. Levy, I. Lutz, A. Krüger, W. Kloas, Environmental Research, 94 (2004) 102–111.
[4] P.E. Stackelberg, E.T. Furlong, M.T. Meyer, S.D. Zaugg, A.K. Henderson, D.B. Reissman, Science of the Total Environment, 329 (2004) 99–113.
[5] M. Pérez-Moya, H. D.Mansilla, M. Graells, Journal of Chemical Technology and Biotechnology, 86 (2011) 826.
[6] J.A. de Lima Perini, M. Pérez-Moya, R. F. Pupo Nogueira, Journal of Photochemistry and Photobiology A: Chemistry, 259 (2013) 53– 58.

Acknowledgements:

Financial support from the Spanish "Ministerio de Economía y Competitividad" and the European Regional Development Fund (both funding the research Projects EHMAN, DPI2009-09386 and SIGERA, DPI2012-37154-C02-01) is fully appreciated.