

Accepted Manuscript

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PII: S1385-8947(16)31122-6
DOI: <http://dx.doi.org/10.1016/j.cej.2016.08.048>
Reference: CEJ 15614

To appear in: *Chemical Engineering Journal*

Received Date: 13 April 2016
Revised Date: 6 August 2016
Accepted Date: 9 August 2016



Please cite this article as: A.J. Expósito, J.M. Monteagudo, I. Díaz, A. Durán, Photo-fenton degradation of a beverage industrial effluent: intensification with persulfate and the study of radicals, *Chemical Engineering Journal* (2016), doi: <http://dx.doi.org/10.1016/j.cej.2016.08.048>

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PHOTO-FENTON DEGRADATION OF A BEVERAGE INDUSTRIAL EFFLUENT: INTENSIFICATION WITH PERSULFATE AND THE STUDY OF RADICALS

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ABSTRACT

An industrial wastewater effluent from the beverage industry has been treated in a pilot plant using a photo-Fenton process, which was intensified with persulfate. Under optimal conditions in a photo-Fenton process, 53% mineralization was achieved after two hours. The remaining Total Organic Carbon (TOC) was mainly composed of acetate and formate, whose decarboxylation was limited via hydroxyl radical reactions. Thus, persulfate (PS) was added to the system after 2 hours to obtain a more efficient decarboxylation by sulfate radicals (SR, $\text{SO}_4^{\bullet-}$). Different conditions were studied to activate PS (UV-C, thermal, Fe(II) and H_2O_2). The hydroxyl radical concentration in the solution was also measured, which supports the results in the sulfate-radical-based process.

The combined treatment with UV-C irradiation and thermally activated persulfate enhanced the mineralization efficiency. Under the best conditions, 76 % mineralization was achieved in 4 hours: photo-Fenton reaction (UV-C/Fe(II)/ H_2O_2) was achieved in the first two hours and UV-C/Fe(II)/ H_2O_2 /PS/thermal in the second two hours (65°C) (pH = 2.9, $[\text{H}_2\text{O}_2]$ = 4000 mg/L; $[\text{Fe(II)}]$ = 375 mg/L). Strong inhibition of the oxidation of Fe(III)-oxalic complexes in the last stage of the treatment is not probable because its removal by precipitation does not improve the mineralization rate. Thus, the low reactivity of acetic acid and the formation of oxalic acid are responsible for the slow mineralization at the end of the process. The formation of undesirable chlorinated oxidation products is also improbable.

Keywords: industrial wastewater; persulfate; photo-Fenton; radical measurement

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