Influence of Hydrogen Peroxide Dosage on the photo-Fenton Process

F. Audino[(1)], R. Belles Canals[(1)], M. Pérez-Moya[(1)]

[(1)] Universitat Politècnica de Catalunya, Department of Chemical Engineering
Campus Diagonal-Besòs Eduard Maristany, 16, 08019 – Barcelona, Spain
francesca.audino@upc.edu

1. Introduction – The present work aims at studying the role of H_2O_2 dosage strategy in the performance of the photo-Fenton process. The relationship between the online measurements of dissolved oxygen (DO) concentration and the efficiency of the photo-Fenton process, performed under different H_2O_2 dosage protocols, was also investigated as a possible monitoring tool that can allow future automation of the process, as stated by [1].

2. Experimental - Photo-Fenton assays were performed in batch mode with recirculation in a 15-L pilot plant composed by an annular photoreactor (irradiated volume of 1.5 L) and a glass reservoir. Four peristaltic pumps allow reactants dosage, and a PLC connected to a SCADA ensures data acquisition (pH, T, redox potential, DO, and conductivity) and management. Paracetamol (PCT) was selected as model contaminant and its initial concentrations was set to 40 mg/L PCT. Initial concentration of Fe(II) was fixed to 7.5 mg L^{-1}, based on the results of a preliminary study [2] investigating the most efficient Fenton reagents load. Conversely, the initial amount of H_2O_2 was varied between 2 and 4 mL, the amount to be dosed between 7 and 38 mL and the dosage interval time between 48 and 165 min.
Measurements of Total Organic Carbon (TOC), PCT, H_2O_2 and iron species were performed to follow process evolution.

3. Results and Discussion – The ratio between the amount of H_2O_2 consumed at a generic time t and the total amount of TOC mineralized (Efficiency = $H_2O_2^{consumed,\ t}$ /TOC^t-TOC^{t0}), has been used as an index of the process efficiency and has been compared with the DO evolution recorded during the experiments.

a) **b)**

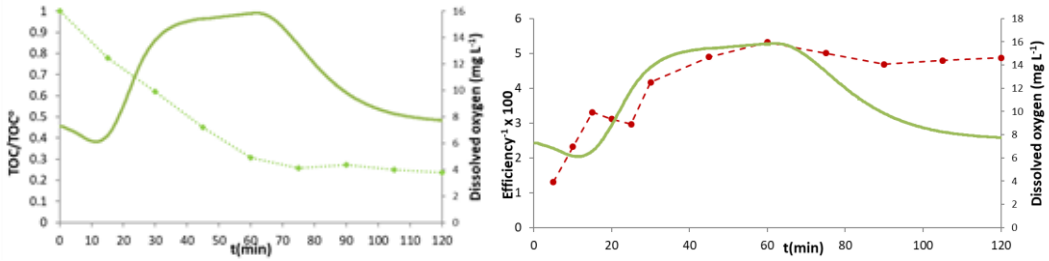

Image I. a) Normalized TOC (dotted green line) and dissolved oxygen concentration (solid green line) and **b)** Efficiency^{-1} (dashed red line) and dissolved oxygen concentration (solid green line) evolution in case of using a total H_2O_2 concentration of 378 mg L^{-1}.

The experiment performed adding an initial amount of H_2O_2 of 4 mL and then 5 mL from 0 to 5 min, and 8 mL from 5 to 60 min (corresponding to a total H_2O_2 concentration of 378 mg L^{-1}), showed one of the best performance in terms of achieved level of TOC mineralization (almost 80%). Image I shows the TOC and Efficiency^{-1} against the DO evolution obtained in this case. As can be observed, the initial decrease in the DO concentration corresponds to an increase of the process efficiency while the DO increase corresponds to a decrease of the process efficiency showing an inefficient use of the oxidant.

4. Conclusions – The results of the present study confirm the possibility to use the DO online measures as a monitoring tool also when a continuous dosage protocol is performed with the future possibility to be used as a tool for the automation of the process.

5. References

[1] L. Santos Juanes et al., *Applied Catalysis B: Environmental*, **104**, (2011) p. 316–323
[2] F. Audino et al., *15th International Conference on Environmental Science and Technology Rhodes, Greece, 31 August to 2 September 2017*