

The use of UV-A LED radiation in the treatment of agro-industrial effluents by photo-Fenton and UV/Peroxymonosulphate/Fe oxidation processes

Carlos Amor, J.R. Fernandes, Marco S. Lucas, José A. Peres*

*Centro de Química de Vila Real, UTAD - Universidade de Trás-os-Montes e Alto Douro,
5000-801 Vila Real, Portugal*

**(+351) 259 350 227, jperes@utad.pt.*

1. Introduction – Agroindustrial processing inevitably generate large amounts of solid by-products and liquid effluents of environmental concern to water resources if released without a suitable treatment. Generated wastewater requires efficient treatment before discharge into watercourses [1]. Advanced Oxidation Processes (AOPs) are emerging as potential wastewater treatment technologies showing to be attractive for polluting content degradation and consequent COD and TOC removal, biodegradability improvement as well as odour and colour abatement [2]. This work presents the application of photo-Fenton and UV/oxymonosulphate/Fe oxidation processes using UV-A LED system as photon source for the treatment of elderberry wastewater treatment.

2. Experimental - Batch experiments were performed using 500 mL of elderberry wastewater. Initially, the desired dosage of oxidant (hydrogen peroxide (H₂O₂) or peroxymonosulphate (PMS)) was added to the effluent. Then, the pH was adjusted to a value around 3.0. Finally, the assays started with metal addition (Fe) and simultaneously when radiation was switched-on. Samples were withdrawn at periodic interval for TOC analysis.

3. Results and Discussion - Using 50 mg/L of Fe (II) in Fenton's reagent achieved 30% of TOC removal with 33 mM of H₂O₂ consumption. Comparing the same operational conditions with UV-A LED radiation (photo-Fenton) it was observed an increasing on TOC removal (there was obtained 99%) in 90 minutes, with around 70 mM of H₂O₂ consumption. On the other hand, experiments in UV-A LED/PMS/Fe(II) process achieved 68% of TOC removal with 50 mg/L of Fe(II). The catalytic cycle Fe(III)/Fe(II) in photo-Fenton process, accelerated by the photo-reduction of Fe(III)-complexes, was higher than UV/PMS/Fe(II) process, thus resulting in higher removal efficiencies.

4. Conclusions – Photo-Fenton process demonstrated to be a feasible technology for elderberry wastewater treatment, with almost completely degradation of the organic matter (99% of TOC removal). Oxidation processes driven by UV-A LED radiation in combination with Fe (II) was significantly photo-activated, leading to the improvement on TOC removal. Thus, UV-A LED system can be an alternative to conventional UV lamps.

Acknowledgements - This work is funded by INTERACT project, no. NORTE-01-0145-FEDER-000017, co-financed by the European Regional Development Fund (ERDF) through NORTE 2020 (North Regional Operational Program 2014/2020) and Fundação para a Ciência e a Tecnologia (FCT) for the financial support provided to CQVR through PEst-C/QUI/UI0616/2014.

5. References

- [1] I.J. Seabra, M.E.M. Braga, M.T. Batista, H.C. de Sousa, *The Journal of Supercritical Fluids*, **54** (2), (2010) p.145.
- [2] D. Krzemińska, E. Neczaj, G. Borowski, *Journal of Ecological Engineering*, **16** (2), (2015) p.61.