Treatment of winery wastewater by an EDDS-photo-Fenton process. Assessment of UV-C, UV-A and solar radiation

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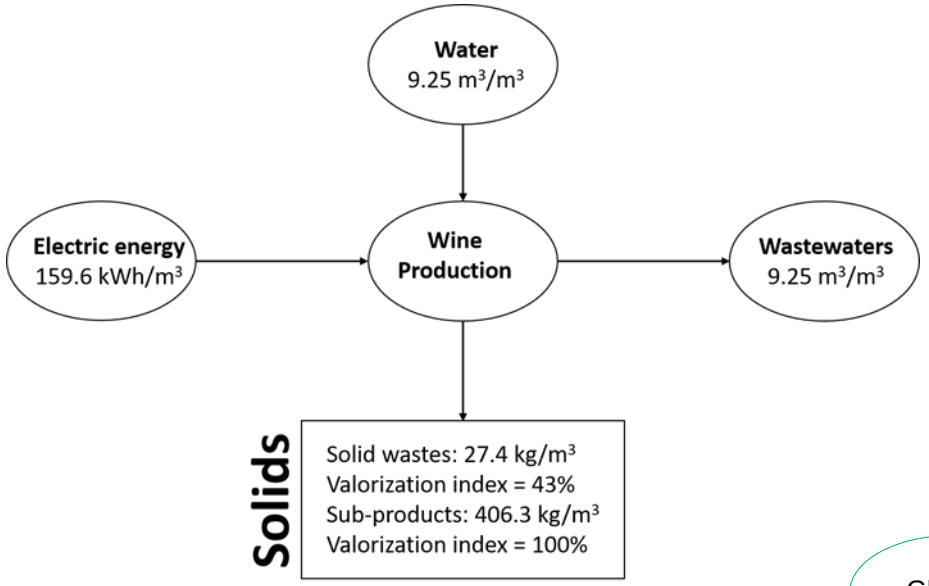
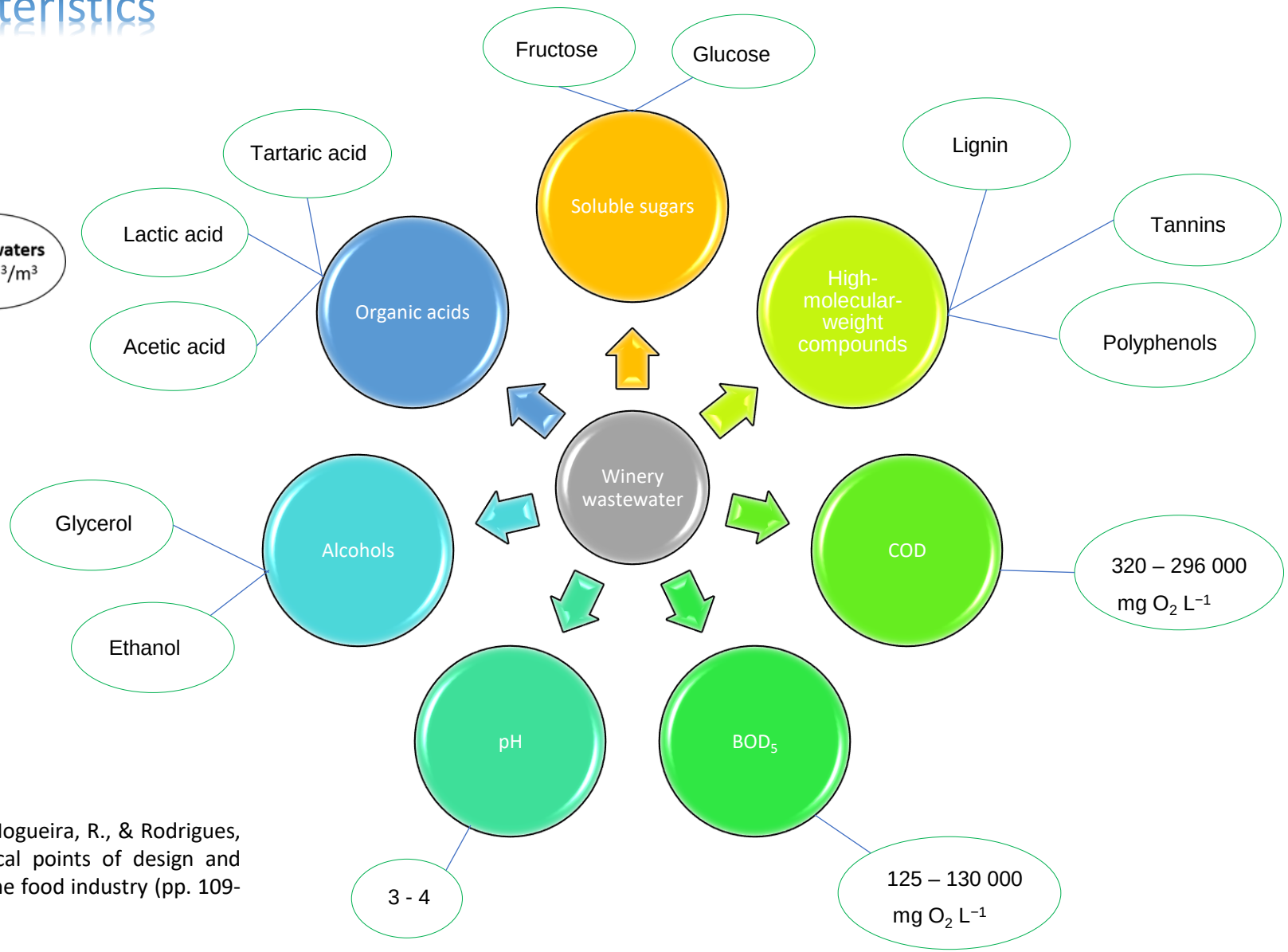
Winery wastewater main characteristics

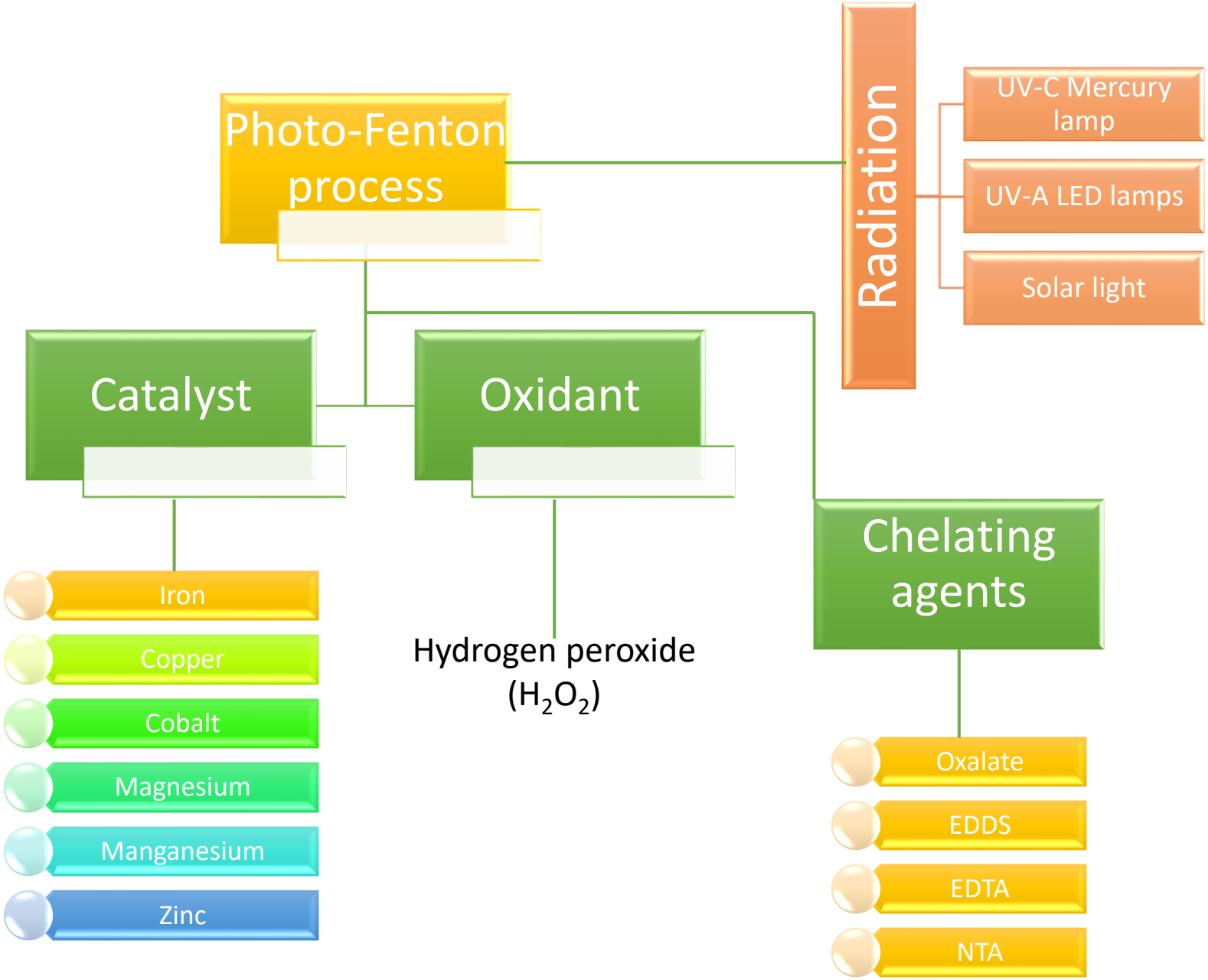


Mass balance applied to ACPB winery representing specific values, i.e., values per cubic meter of produced wine. Losses of water by evaporation were neglected [1].



[1] Brito, A. G., Peixoto, J., Oliveira, J. M., Oliveira, J. A., Costa, C., Nogueira, R., & Rodrigues, A. (2007). Brewery and winery wastewater treatment: some focal points of design and operation. In Utilization of by-products and treatment of waste in the food industry (pp. 109-131). Springer, Boston, MA.

Introduction



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Enhanced decolorization of Orange G in a Fe(II)-EDDS activated persulfate process by accelerating the regeneration of ferrous iron with hydroxylamine

Donghui Han [a], Jinquan Wan [a,c,d,*], Yongwen Ma [a,c,d], Yan Wang [a], Mingzhi Huang [b], Yangmei Chen [e], Dongya Li [a], Zeyu Guan [a], Ying Li [a]

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Degradation of ethylbenzene in aqueous solution by sodium percarbonate activated with EDDS–Fe(III) complex

Hang Cui [a], Xiaogang Gu [a], Shuguang Lu [a,*], Xiaori Fu [a], Xiang Zhang [a], George Y. Fu [b], Zhaofu Qiu [a], Qian Sui [a]

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Treatment of winery wastewater by sulphate radicals: HSO_5^-/transition metal/UV-A LEDs

Jorge Rodríguez-Chueca [a], Carlos Amor [a], Tânia Silva [a], Dionysios D. Dionysiou [b], Gianluca Li Puma [c], Marco S. Lucas [a,c,*], José A. Peres [a]

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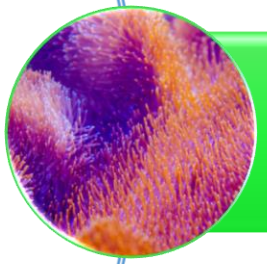
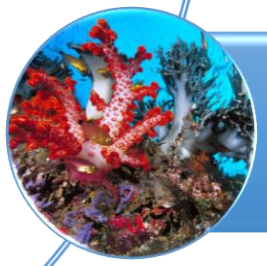
Objectives

The aim of this work is

(1) Study the impact of EDDS on Fe^{2+} regeneration in photo-Fenton process



(2) Study the effects of EDDS and HA on hydroxyl radical production in photo-Fenton process



(3) Study the impact of radiation type in organic matter removal

Winery wastewater characterization

Main chemical characteristics of winery wastewater (WW)

Parameters	Portuguese Law Decree nº 236/98	WW
pH	6.0-9.0	4.0
Biochemical Oxygen Demand - BOD_5 (mg O_2/L)	40	550
Chemical Oxygen Demand - COD (mg O_2/L)	150	2145
Biodegradability – BOD_5/COD		0.26
Total Organic Carbon – TOC (mg C/L)		400
Turbidity (NTU)		296
Total suspended solids – TSS (mg/L)	60	750
Electrical conductivity (µS/cm)		62.5
Total polyphenols (mg gallic acid/L)	0.5	22.6
Iron (mg/L)	2.0	0.05
Aluminium (mg/L)	10.0	
Cobalt (mg/L)		0.00
Manganese (mg/L)	2.0	
Potassium (mg/L)		20.5
Calcium (mg/L)		1.07
Magnesium (mg/L)		0.51
Sodium (mg/L)		0.19

Winery wastewater used in this work

Winery wastewater collection and storage

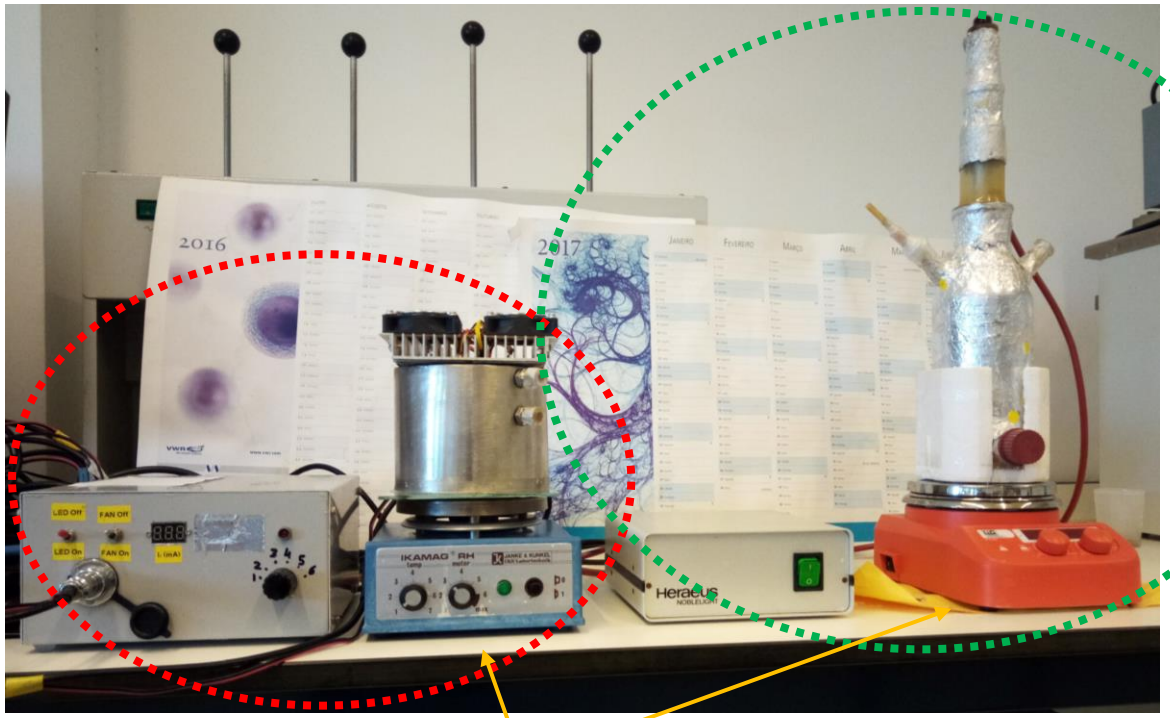
Storage in small containers

Conservation at -40ºC

Equipment used in photo-Fenton process

UV-A LED reactor

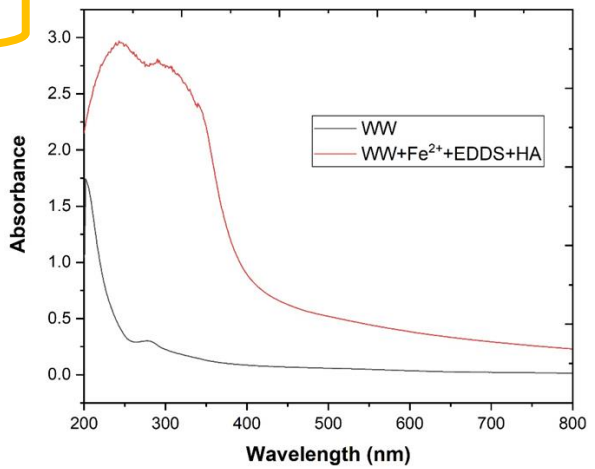
UV-C mercury lamp reactor



Magnetic agitators

Solar reactor

Silver coated panel

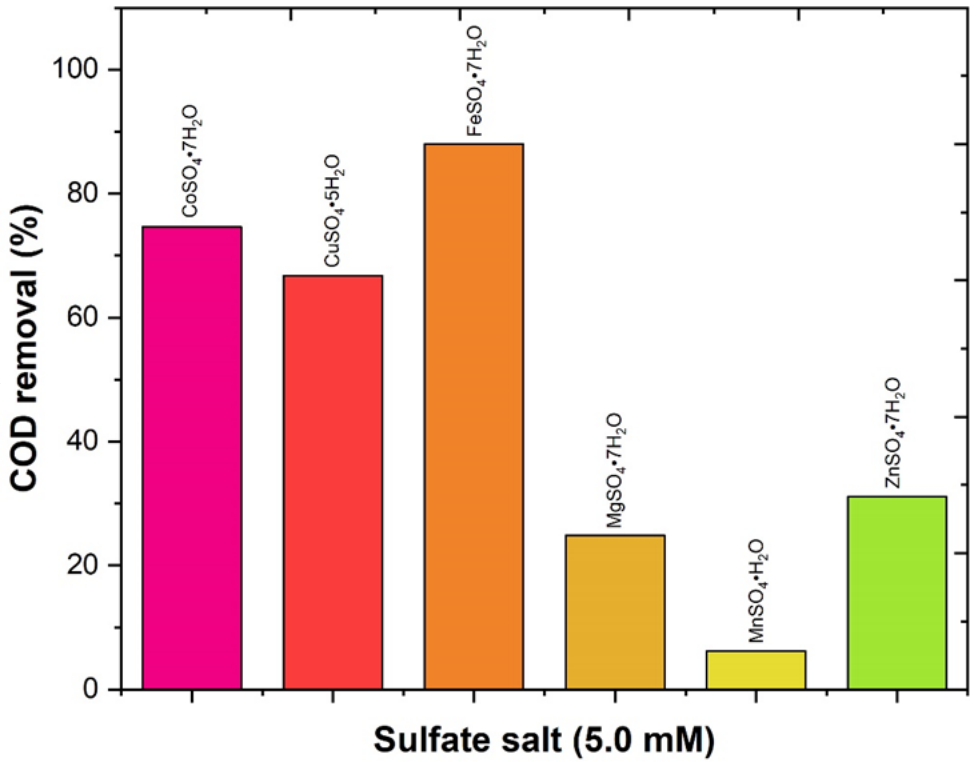


UV absorption spectra corresponding to WW and WW+Fe^{2+}+EDDS+HA.

Results and discussion

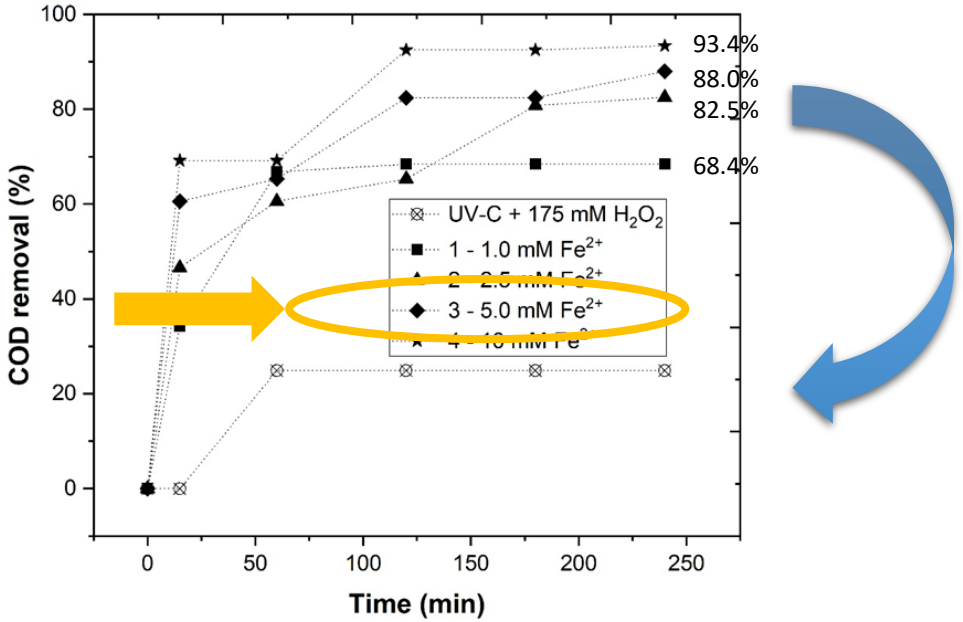
- (1) Variation of $[H_2O_2]$
- (2) Variation of $[Fe^{2+}]$
- (3) Variation of catalyst type
- (4) Variation of the EDDS dosage
- (5) Variation of the HA dosage
- (6) Variation of radiation type vs pH

Effect of catalyst type



Influence of different sulfate salts in the removal of COD.

Effect of catalyst concentration



Evolution of COD removal through the photo-Fenton experiments, using different catalyst dosages

$HO^{\bullet} + H_2O_2 \rightarrow H_2O + HO_2^{\bullet}$	Eq. 1
$HO_2^{\bullet} + HO^{\bullet} \rightarrow H_2O + O_2$	Eq. 2

$Fe^{2+} + H_2O_2 \rightarrow Fe^{3+} + HO^{\bullet} + HO^{-}$	Eq. 3
$Fe^{3+} + H_2O_2 \rightarrow Fe^{2+} + HO_2^{\bullet} + H^{+}$	Eq. 4

Results and discussion

- (1) Variation of $[H_2O_2]$
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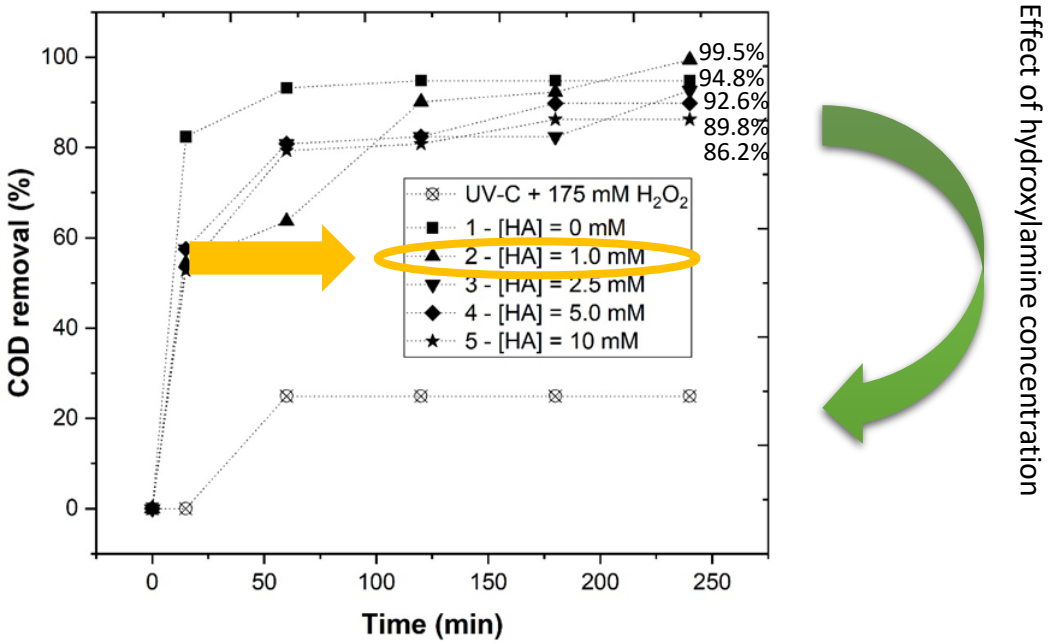
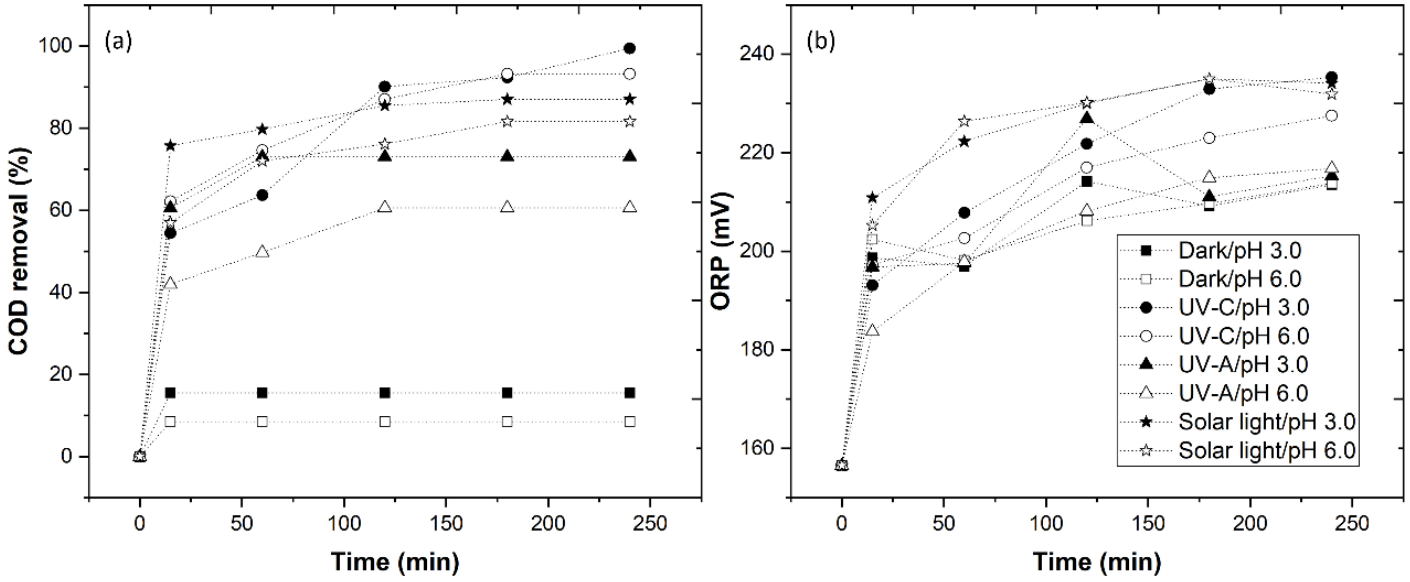


Effect of hydroxylamine concentration

Effect of radiation type



Evolution of the (a) COD removal, (b) ORP value through the photo-Fenton experiments, under the influence of different UV sources at pH 3.0 and 6.0.

Evolution of COD removal through the photo-Fenton experiments, using different HA concentration.

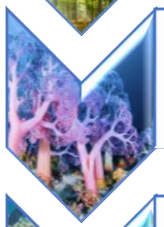
Conclusion

Based in the results it is concluded

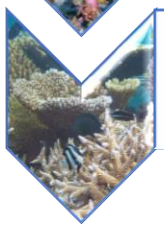
- 1. The application of 175 mM H_2O_2 achieves a high COD removal (82.5%), high $HO^{\bullet}$ radical production (240.3 mV) and low metal leaching (1.79 mg Fe/L)

- 2. The type of catalyst has a great influence in the organic matter removal, and that the Fe^{2+} is concluded to be the most efficient catalyst

- 3. The radicals generation are greatly promoted with the addition of hydroxylamine and the molar ratio of EDDS-Fe/HA system (1/5/1) achieves higher COD removal (99.4%)



- 4. With application of the Fe^{2+}-EDDS/HA system it is concluded that the photo-Fenton process at pH 6.0 achieves similar COD reductions regarding pH 3.0.



- 5. The solar radiation achieves similar COD removal than UV-A radiation and is concluded to be a viable alternative.

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Thank you for your attention