ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

New progress in emergent pollutants degradation by UV photo assisted Fenton process

Laura Esquius
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Institut des Sciences et Ingénierie
Chimiques, GGEC, EPFL, Bât. CH, 1015
Lausanne, Switzerland
Prof. César Pulgarin

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Introduction

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Advanced Oxidation Processes (AOPs)

- Competitive water treatment technologies for the degradation of those organic micropollutants which are not removed by biological treatments

- Techniques characterized by the generation of ***radicals***, such as the hydroxyl radical ($^{\bullet}OH$)

Photo-Fenton

The main reaction is the one involving the formation of *hydroxyl radicals* from the interaction between ferrous ions and hydrogen peroxide with UV light:

$$Fe(II) + H_2O_2 \rightarrow Fe(III) + OH^- + \mathbf{HO^{\bullet}}$$

Introduction

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Photo-Fenton
at neutral pH

At neutral pH, *pH~7* → hydroxy complexes precipitate.

In presence of dissolved organic matter (DOM) → polydentate ligands, can complex with ferric ions.

$$Fe^{III}(L)_n + h\nu \rightarrow Fe^{II}(L)_{n-1} + L^{\bullet}_{ox}$$

- Keep the iron *soluble.*

- Have *higher molar absorption* coefficients in the near-UV and visible regions than do the aquo complexes.

- Undergo via LMCT to the production of Fe^{2+} and a ligand radical.

→ This *radical* can then react with O_2 leading to the formation of a sequence of oxidants ($O_2^{-\circ}/HO_2^{\circ}$, H_2O_2, $^{\circ}OH$).

Objective

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- Evaluation of the effect of reagents and water parameters such as oxygen and carbonates in photo-Fenton to achieve 80% of micropollutants degradation

Results and discussions

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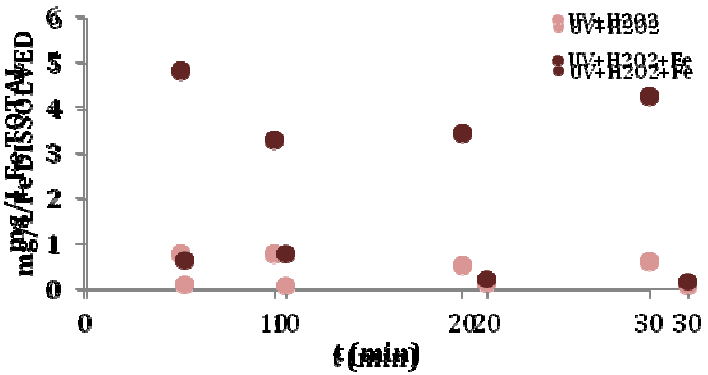
Effect of the differents components of photo-Fenton reagents

	UV	UV + H_2O_2 (10 mg/L)	UV + H_2O_2 (10 mg/L) + Fe (5mg/L)
Pollutants degradation (30 min)	80 %	96 %	95 %

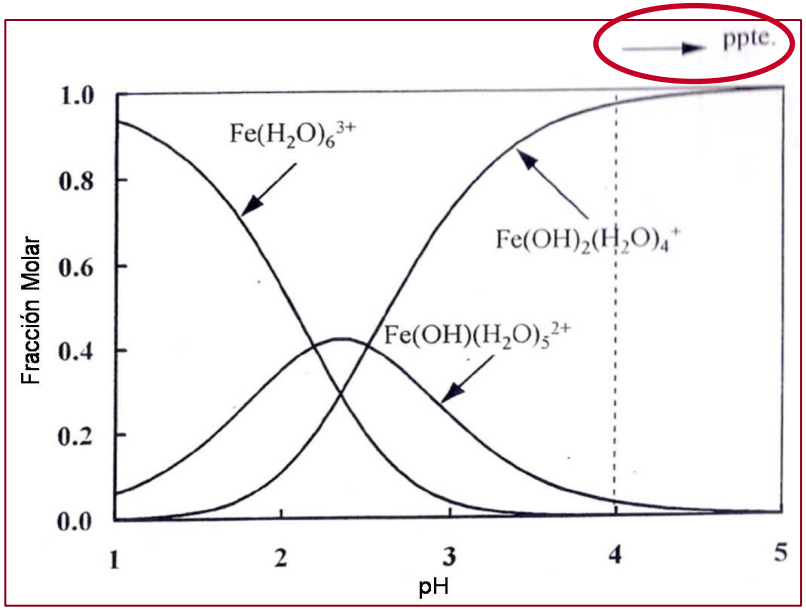
Results and discussions

Iron evolution



Fe^{2+} ⇌ Fe^{3+}

pH = 6 - 7



Barona, J. F. Morales, D.F.; González, L.F. [a]; Pulgarín C.; Benítez, L.N. *Decontamination and disinfection of water by photo-fenton process under conditions close to natural. Assessment of their potential application to obtain drinking water*. (Colombia, 2012)

Results and discussions

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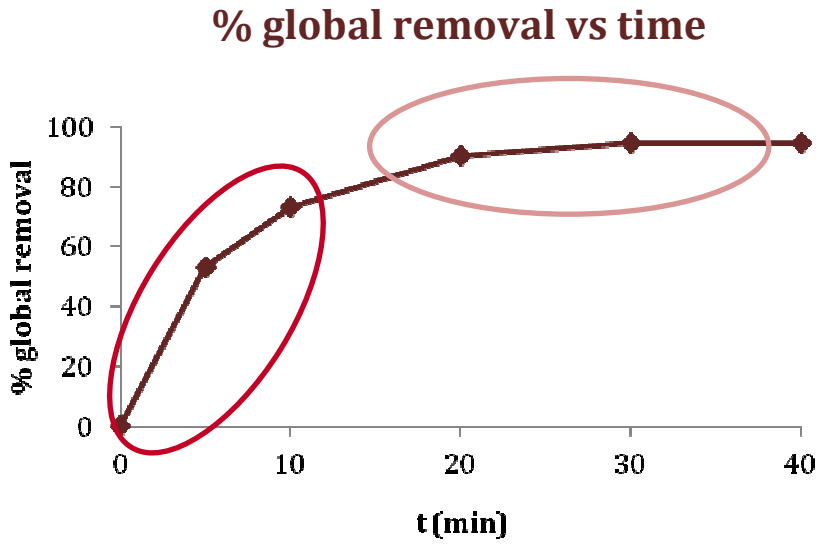
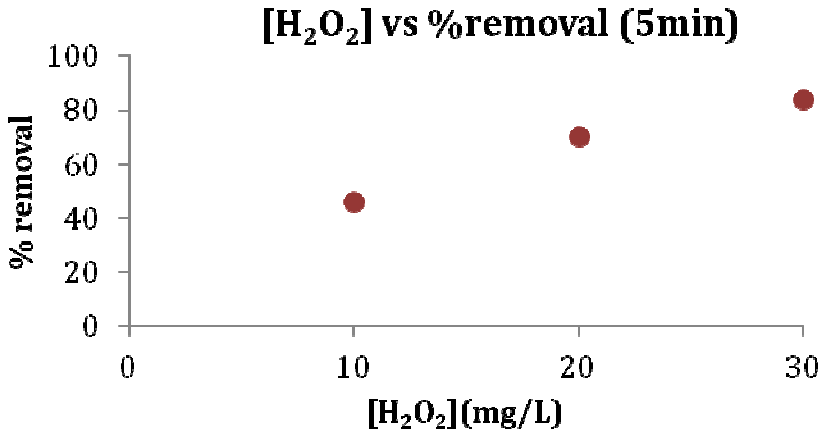


Results and discussions

Hydrogen peroxide concentration



UV

+

20 mg/L H_2O_2

10 min

Removal > 80%

Results and discussions

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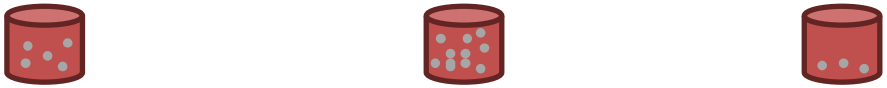
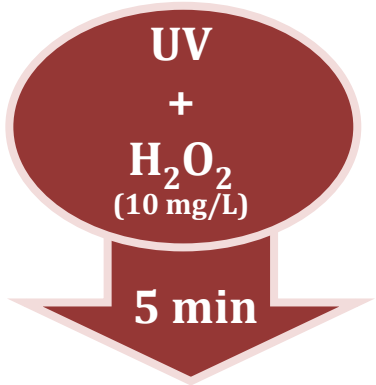
Different water conditions



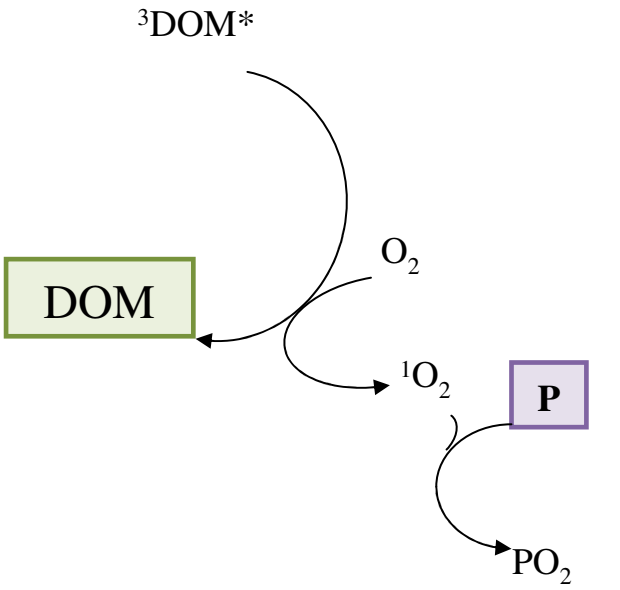
	A	B	C
Time	9 a.m	11 a.m	1 p.m
pH	6	7.75	6.74
Transmittance (%)	-	57	66
Inorganic Carbon (mg/L)	30.16	69.13	17.84
Total Organic Carbon (mg/L)	5	12.67	5.57
Fe total (mg/L)	0.6	-	2
Fe dissolved (mg/L)	0.1	-	0

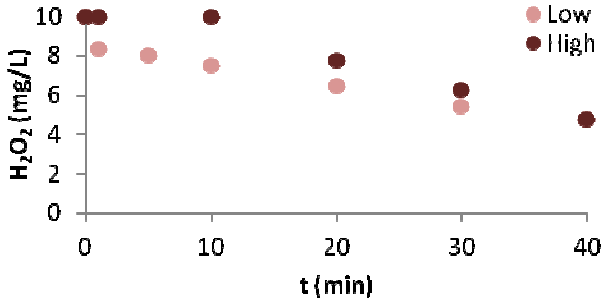


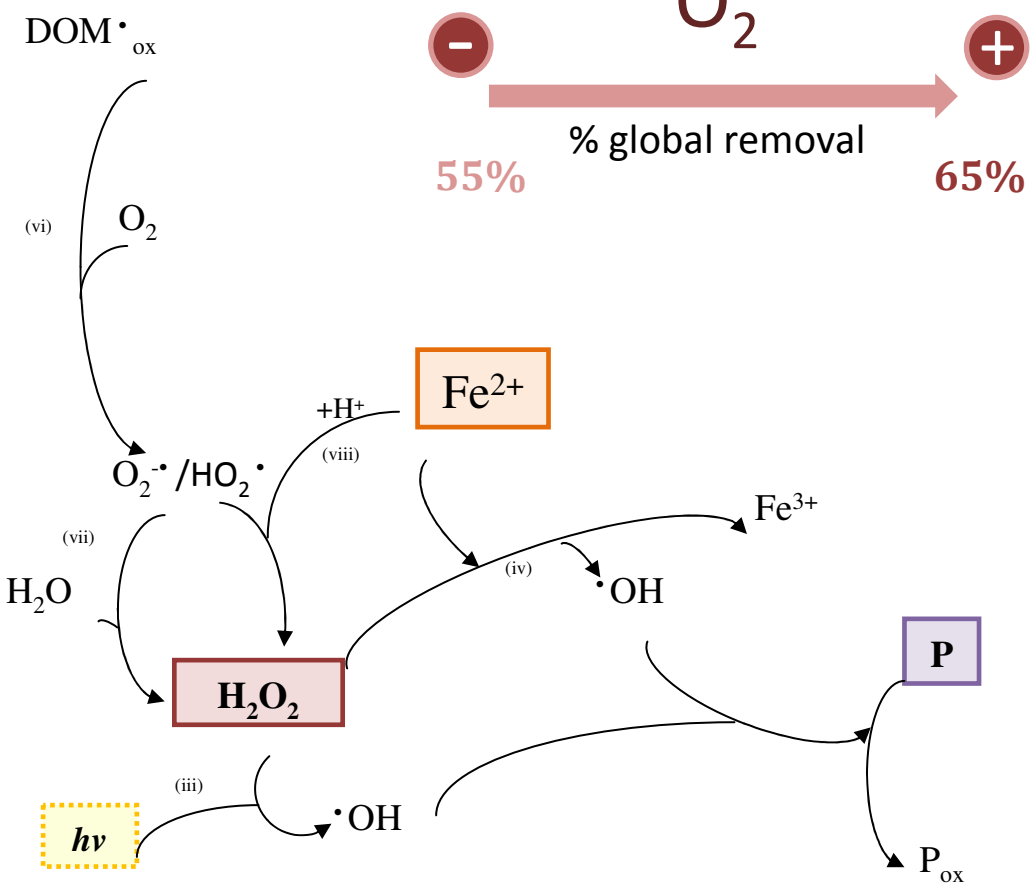
% global removal	88	59	46

Results and discussions

The influence of oxygen





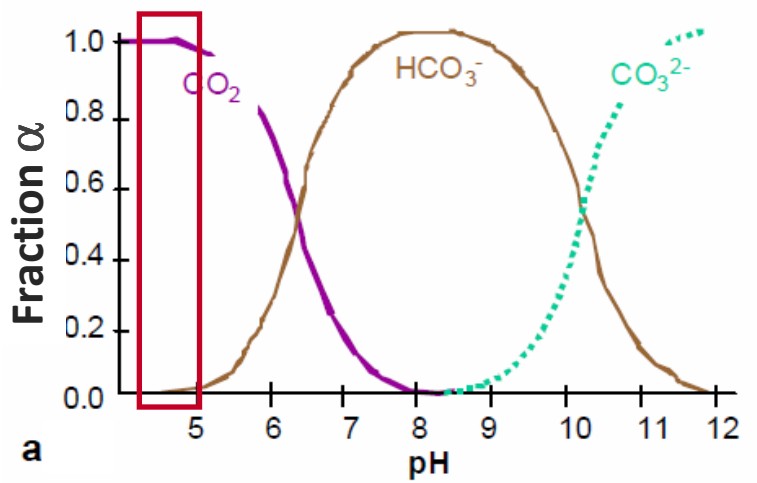


Ref.: N. De la Cruz, J. Giménez, S. Esplugas, D. Grandjean, L.F. de Alencastro, C. Pulgarín *Degradation of 32 emergent contaminants by UV and neutral photo-fenton in domestic wastewater effluent previosly treated by activated sludge*, (2012).

Results and discussions

The influence of carbonates

pH = 4.6 – 5



carbonate

S% global removal

65% 46%

✓ Carbonates are *hydroxyl radical* $HO^{\bullet}$ scavengers, competing the pollutants degradation.

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Conclusions

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- ✓ Iron is necessary but the addition working at neutral pH is inefficient
- ✓ UV + H_2O_2 (20 mg/L) ⟶ 10 min ⟶ global removal > 80%
- ✓ H_2O_2 increase the removal in the most economical way
- ✓ The presence of oxygen encourage the degradation
- ✓ Carbonates are hydroxyl radical $HO^{\bullet}$ scavengers

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Thank you for your attention

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