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Investigation of variables affecting UV-LED photocatalytic degradation of antibiotics ciprofloxacin and sulfamethoxazole

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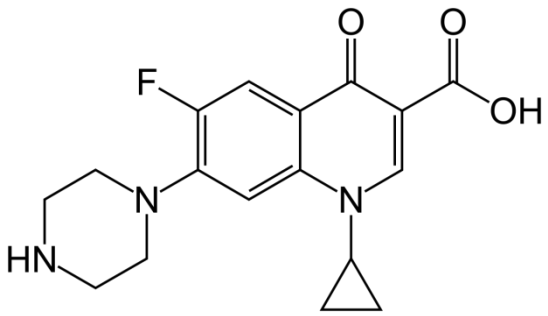
Introduction

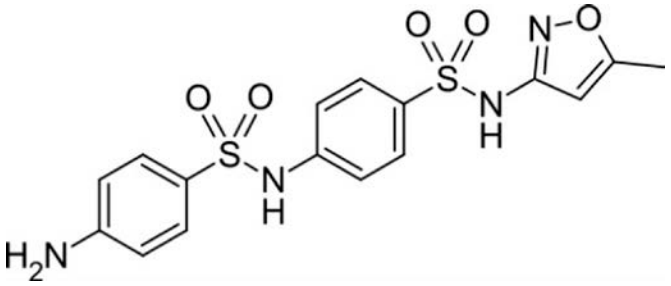
Raising awareness about micropollutants in waterbodies

Micropollutants are resistent to conventional WWTP (slow biodegradation)

Ciprofloxacin (CIP)



Sulfamethoxazole (SMX)



Antibiotics in the EU Watchlist of contaminants of emerging concern

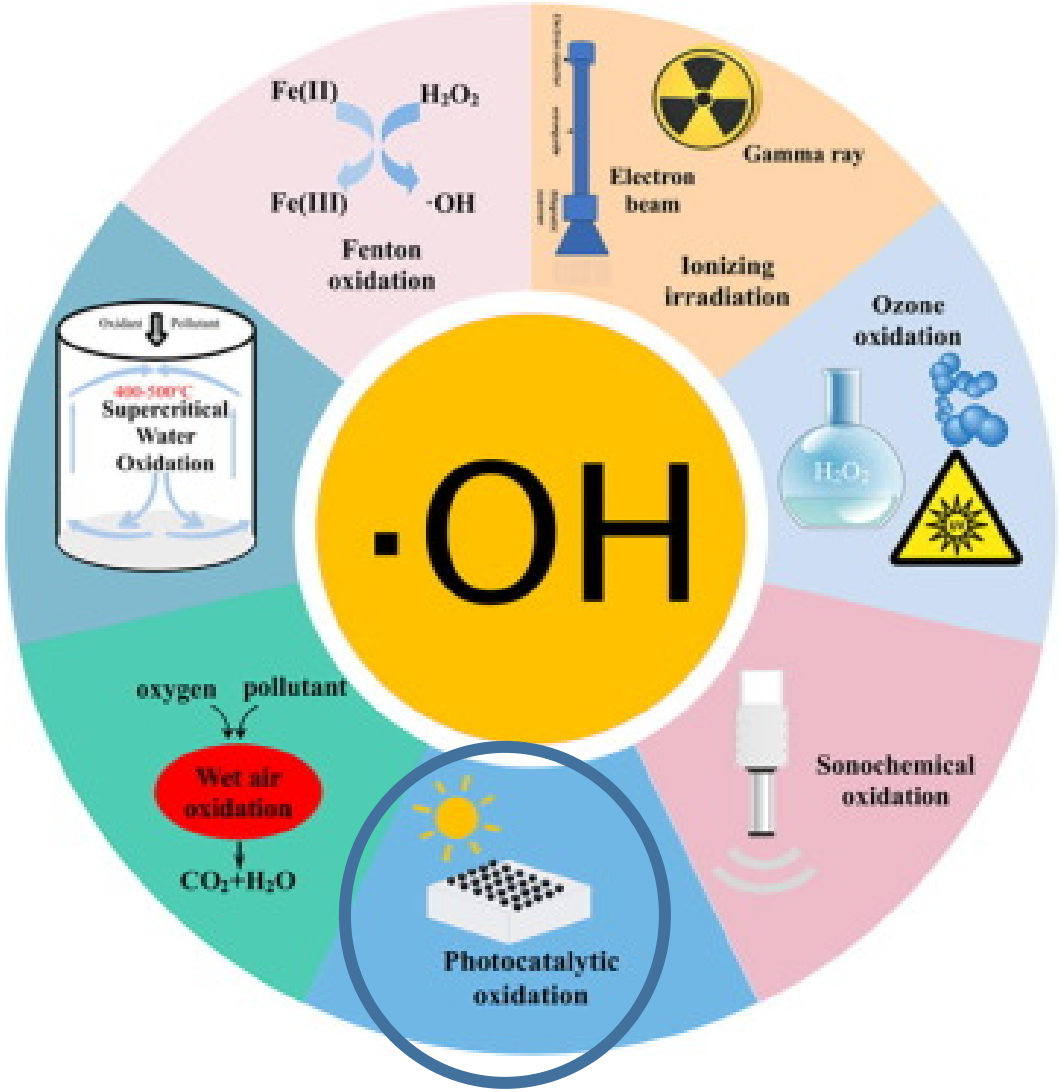
Introduction

Micropollutants are toxic even at very low concentrations

Antibiotics in the environment may lead to superbacteria

Solution?

Advanced Oxidation Processes!



Photocatalysis

PROS:

- No need of additional chemicals
- Large scientific interest on TiO_2
- Typically follows pseudo 1st order kinetics

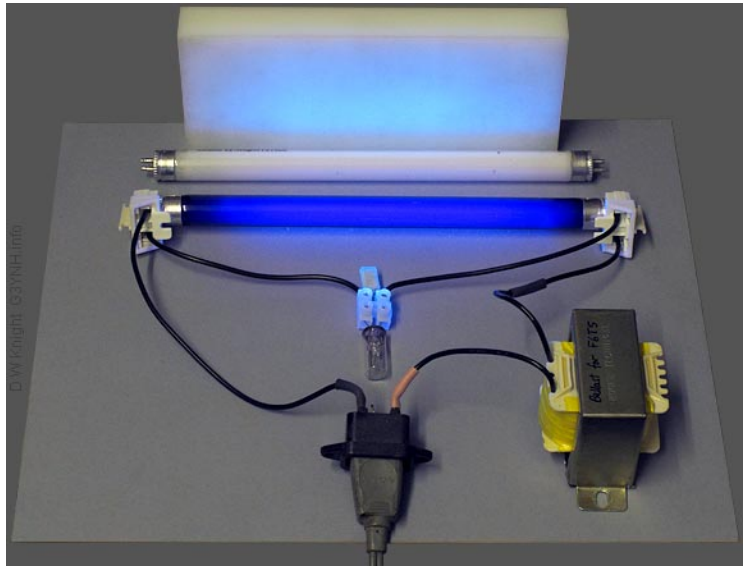
CONS:

- High sensitivity: it depends on a large amount of variables
- Low photonic efficiency
- Practically no large-scale applications so far

UV-LEDs

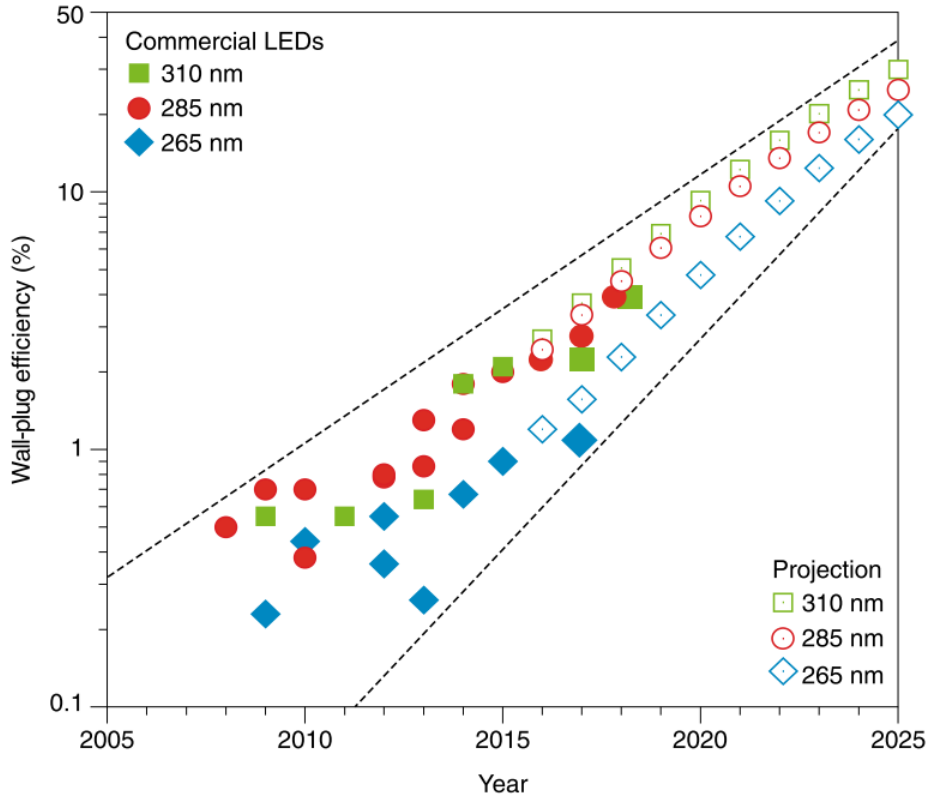
- They open up new horizons for photoreactor design
- More design flexibility than Hg lamps
- Unique features: controlled periodic illumination and wavelength tailoring

VS



UV-LEDs

Wall-Plug efficiency of UV-LEDs increases exponentially with time (Kneissl et al., 2019)

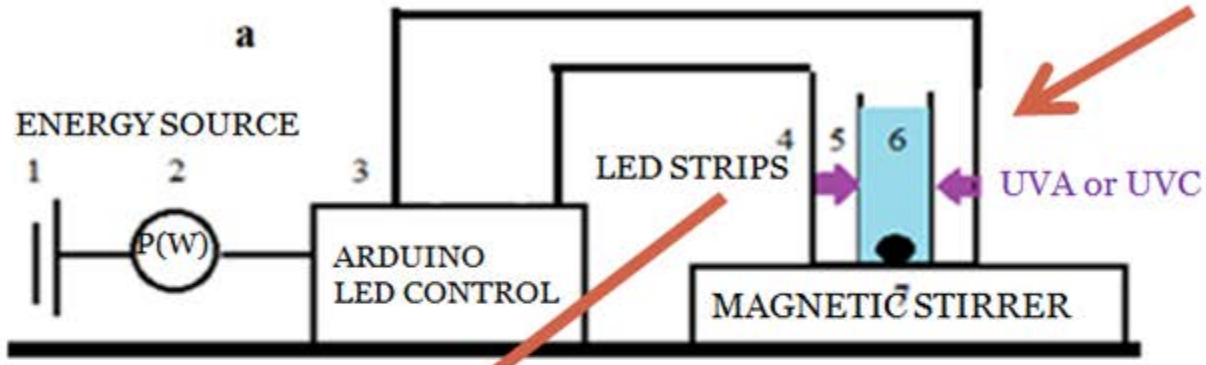


Objective

Considering the significant number of variables which influence photocatalytic processes, this study evaluates degradation of two antibiotics (CIP and SMX) under different circumstances to further understand this process and contribute to finding optimization possibilities

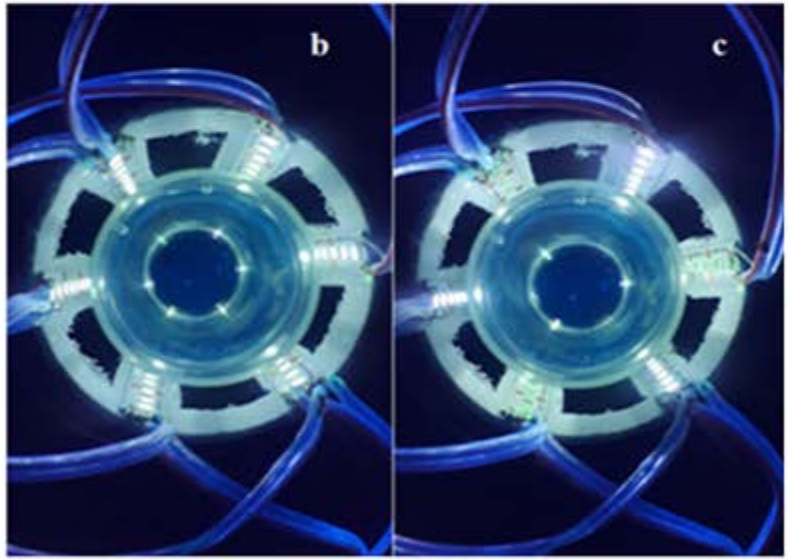
Methodology

Experimental set-up



REACTOR (with or without catalyst)

Photoreactor upview with 6 (b) and 3 (c) LED strips around



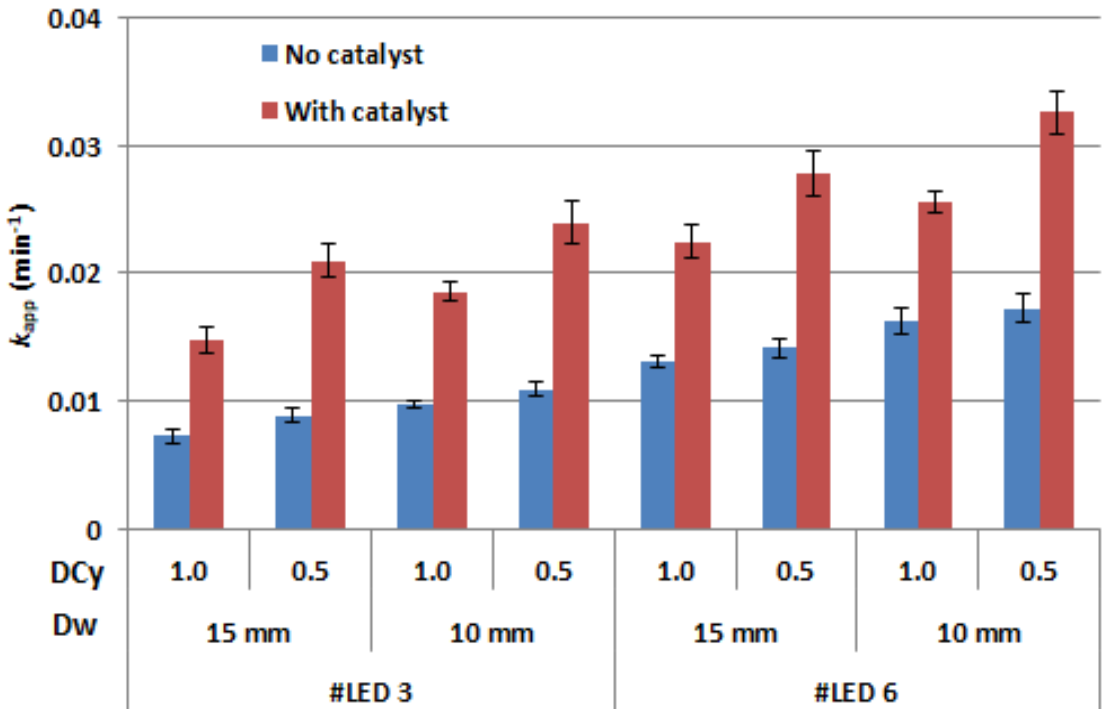
Initial concentration: 10 mg/L

Solutions prepared in MilliQ water

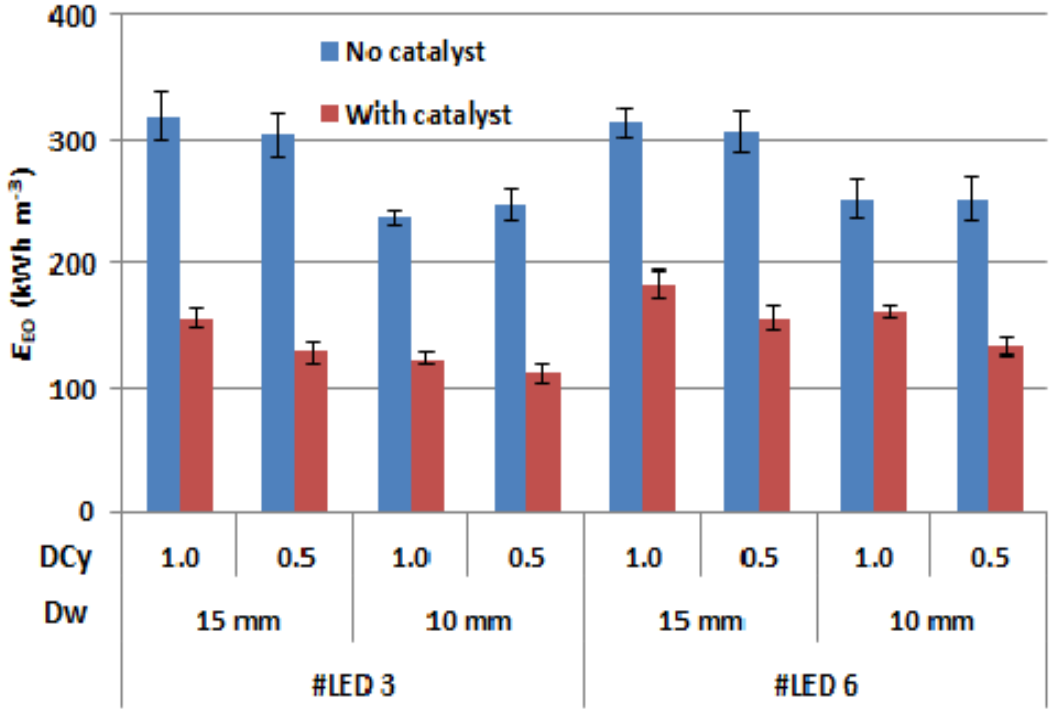
Results and Discussion

1st step: CIP, UVA, #LEDs and D_w

Kinetics



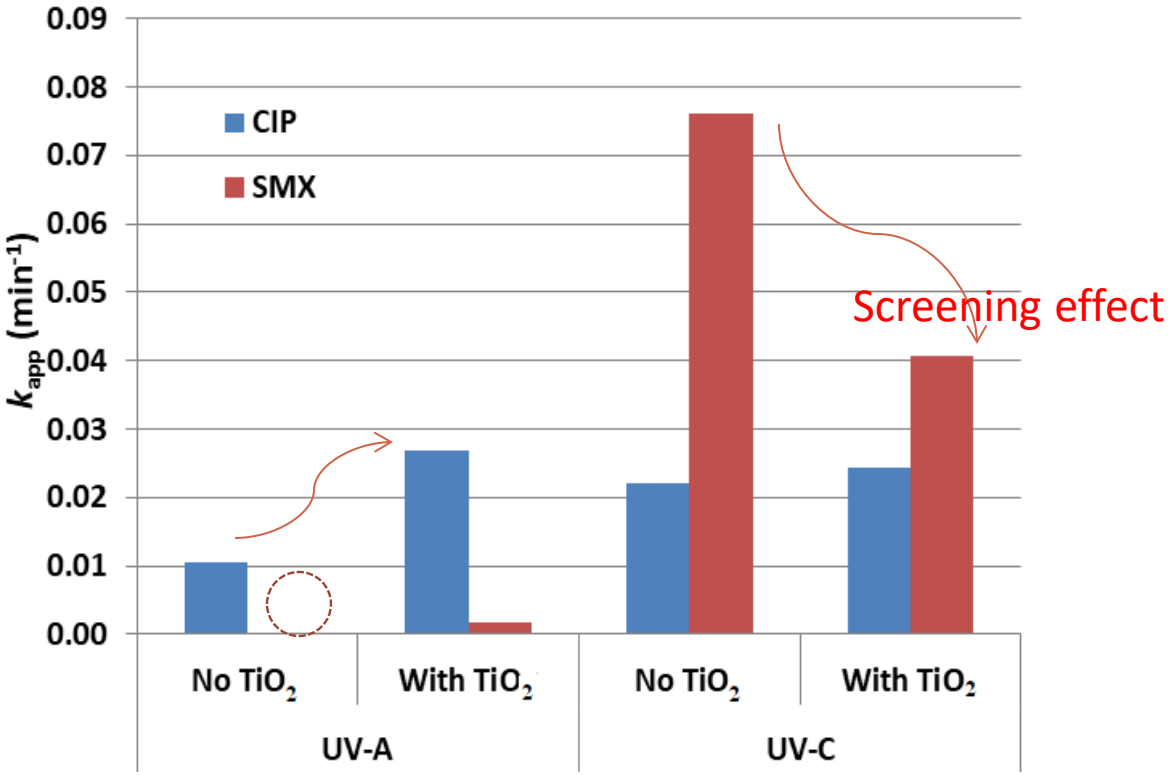
Energy consumption



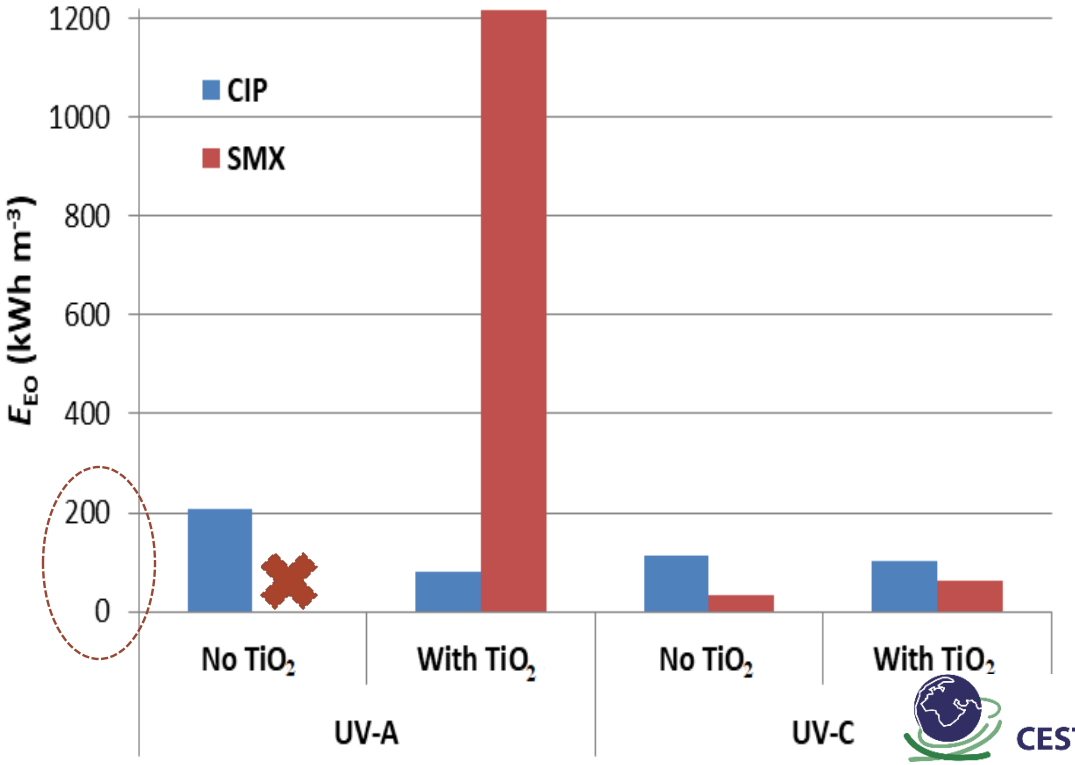
Results and Discussion

2nd step: SMX & CIP, Wavelength

Kinetics



Energy consumption



Conclusion

A large number of variables can have an impact on pollutant degradation by UV-LED photocatalysis and each target compound has different reactivity towards multiple degradation routes.

Light screening can be an issue, specially for lower wavelengths

More data evaluating degradation of pollutants under realistic conditions exploring the new design possibilities of UV-LED are fundamental for more sustainable water treatment processes.

While photocatalysis' E_{EO} values are still unfeasible, they should decrease exponentially in the next few years thanks to advances in LED technology

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Actions

Thank you for your attention!

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