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Evaluation of UV/persulfate process for the treatment of alachlor polluted water

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Introduction

- UV/persulfate ($S_2O_8^{2-}$) process is an innovative alternative to typical advanced oxidation processes (AOPs).
- Generation of sulfate radicals ($SO_4^{\bullet-}$) with excellent degradation efficiency for persistent organic pollutants in aquatic environments.[1]
- In comparison to $HO^{\bullet}$, sulfate radicals (redox potential 2.5-3.1 V) have higher selectivity, pH independence and longer half-life.
- $SO_4^{\bullet-}$ has lower reactivity with natural organic matter (NOM) relative to $HO^{\bullet}$, which allows its efficient application for organic contaminants removal in aquatic environment rich in NOM. [2]
- Activation of $S_2O_8^{2-}$ under UV irradiation:

$$S_2O_8^{2-} + h\nu \rightarrow 2SO_4^{\bullet-}$$

- The Water Framework Directive (WFD) (2000/60/EC) stimulates the development of innovative, more cost effective water treatment technologies for priority pollutants control.

Experimental

- Photodegradation experiments were carried out in laboratory conditions using photochemical reactor with a quartz reaction vessel equipped in the centre with an low Hg lamp emitting monochromatic radiation at 253.7 nm.
- GC/MS system (*Agilent Technologies* 7890B/5977A) was used for the alachlor analysis.
- The following reagents were used: alachlor (*Pestanal® Sigma- Aldrich)* and potassium persulfate (*Sigma-Aldrich*).
- The laboratory investigation applied in synthetic water matrices (ultrapure water from a LABCONCO ((*WaterPro RO/PS Station*, USA) system), which were spiked with an aqueous solution of alachlor (100 µg/L).
- Synthetic matrix was also prepared to contain humic acids (*Fluka*) (5 mg C/L DOC).

The main objective of this study was to evaluate the possibility of UV/$S_2O_8^{2-}$ process application for treatment of alachlor polluted water and in the presence of humic acids. Alachlor, a commonly used herbicide in agriculture has been classified as the carcinogen of B2 group by the Environmental Protection Agency (EPA) and one of priority pollutants by WFD.

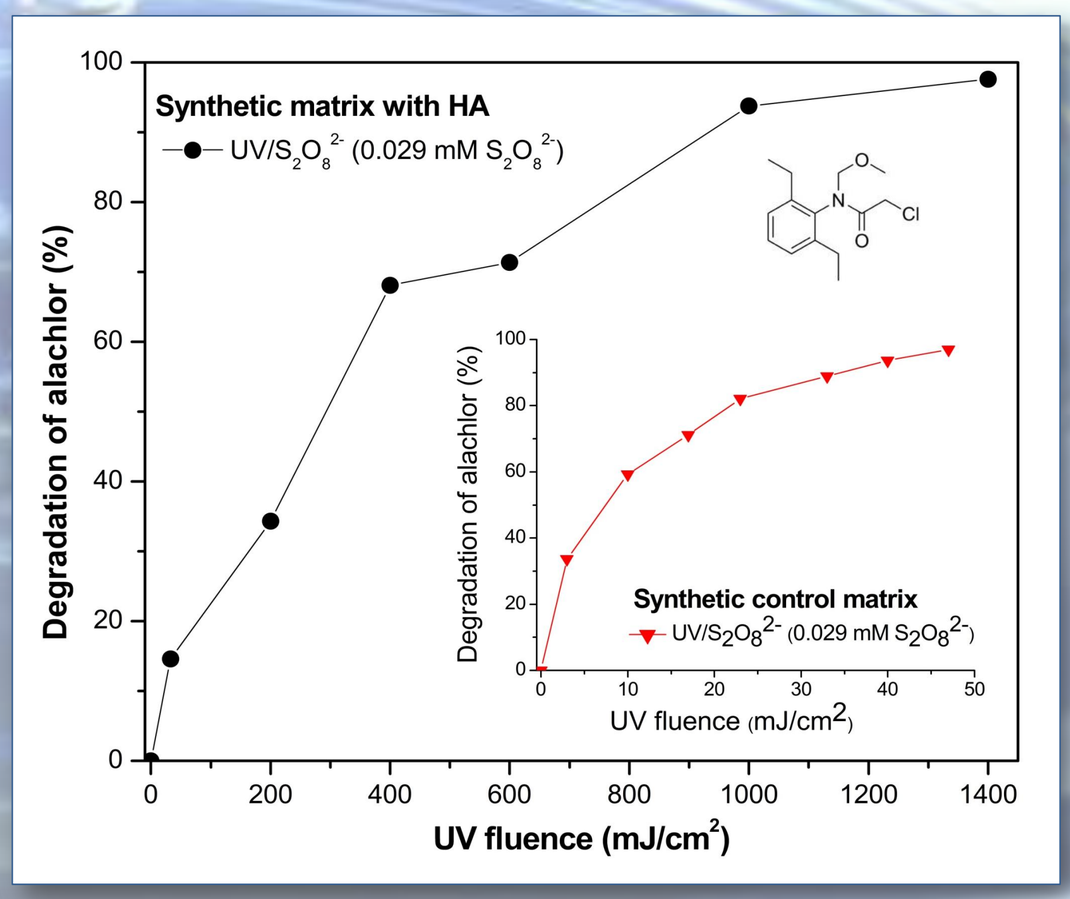

Figure 1. *Degradation of alachlor in synthetic water matrix by UV/$S_2O_8^{2-}$ process*

Results and discussion

- Almost complete degradation of alachlor (up to 97%) in ultrapure water by UV/$S_2O_8^{2-}$ process.
- The presence of humic acids in synthetic matrix requires application of higher UV fluence (about 30 times) to achieve a same efficacy as in synthetic control matrix (Fig. 1).
- Humic acids as a model of NOM commonly present in natural waters can act as scavengers of the free radicals or absorb the UV light, reducing the efficiency of the oxidative degradation of organic pollutants.

Conclusion

A new perspective UV/$S_2O_8^{2-}$ advanced oxidation process, has been proven to be effective in degrading alachlor from the synthetic water. The presence of natural organic matter has influence on performance of UV/$S_2O_8^{2-}$ process, requiring the optimization of the applied reagent and UV dose.

Literature

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2. Dewil R., Mantzavinos D., Poulios I., Rodrigo M.A., *J Environ Manage* **195** (2017) 93-99.

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