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Advanced Reduction Processes (ARPs) for the degradation of man-made compounds: A UV-C/Sulfite Approach

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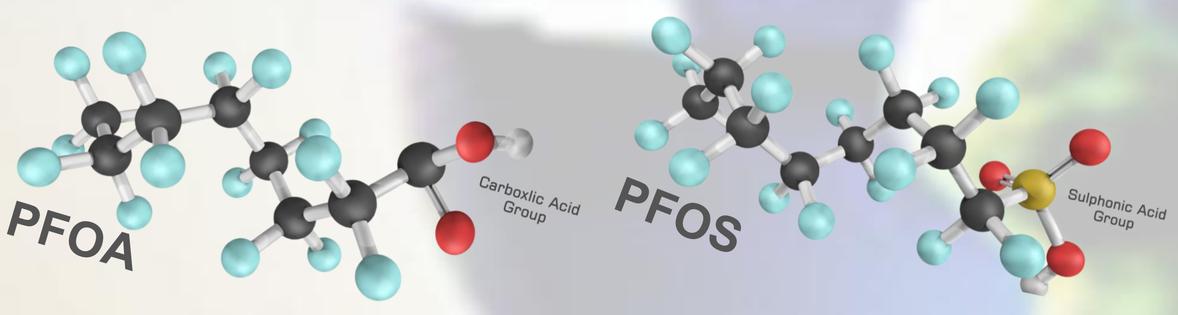
INTRODUCTION

Advanced Reduction Processes (ARPs) represent a promising remediation strategy for the degradation of persistent per- and polyfluoroalkyl substances (PFAS) in water. These processes generate highly reactive hydrated electrons (e^-_{aq}), which can cleave resilient bonds [1].

PFAS, such as perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), contain carbon-fluorine (C-F) bonds that render them, resistant to conventional treatment. They have been detected in water samples globally, at concentrations ranging from 0.002 to 187 ng L^{-1} for PFOS and from 0.001 to 1371 ng L^{-1} for PFOA [2].

Given the widespread detection of these contaminants in water systems, this study evaluates the efficacy of the UV-C/sulfite ARP for the decomposition of PFOS and PFOA in aqueous solutions.



METHOD

- Reduction experiments were conducted in an immersion well reactor, using a low-pressure mercury UV lamp.
- Aqueous solutions containing 0.5 mg L^{-1} of PFOS and PFOA, simultaneously, and 5 or 10 mM sulfite were prepared and irradiated.
- To evaluate the efficiency of the UV-C/sulfite process, the concentrations of PFOS and PFOA were quantified by a Bruker UHPLC/MS-microTOF II system.

CONCLUSION

- ✓ The degradation efficiency was strongly dependent on the sulfite concentration.
- ✓ Near-complete removal of PFOA (>99%) achieved at optimal conditions within 210 minutes.
- ✓ UV-C/sulfite process was more effective for PFOA.
- ✓ The preliminary experiments highlight UV/sulfite ARPs as a promising and efficient technology for PFAS remediation in contaminated water.

RESULTS

- ➢ The removal rates were affected significantly by the initial sulfite concentration.
- ➢ The higher tested concentration of sulfite (10 mM) was able to remove around 99% of PFOA, and about 40% of PFOS.
- ➢ Higher reduction percentages of PFOA, in comparison to PFOS, were observed in both initial concentrations of sulfite.

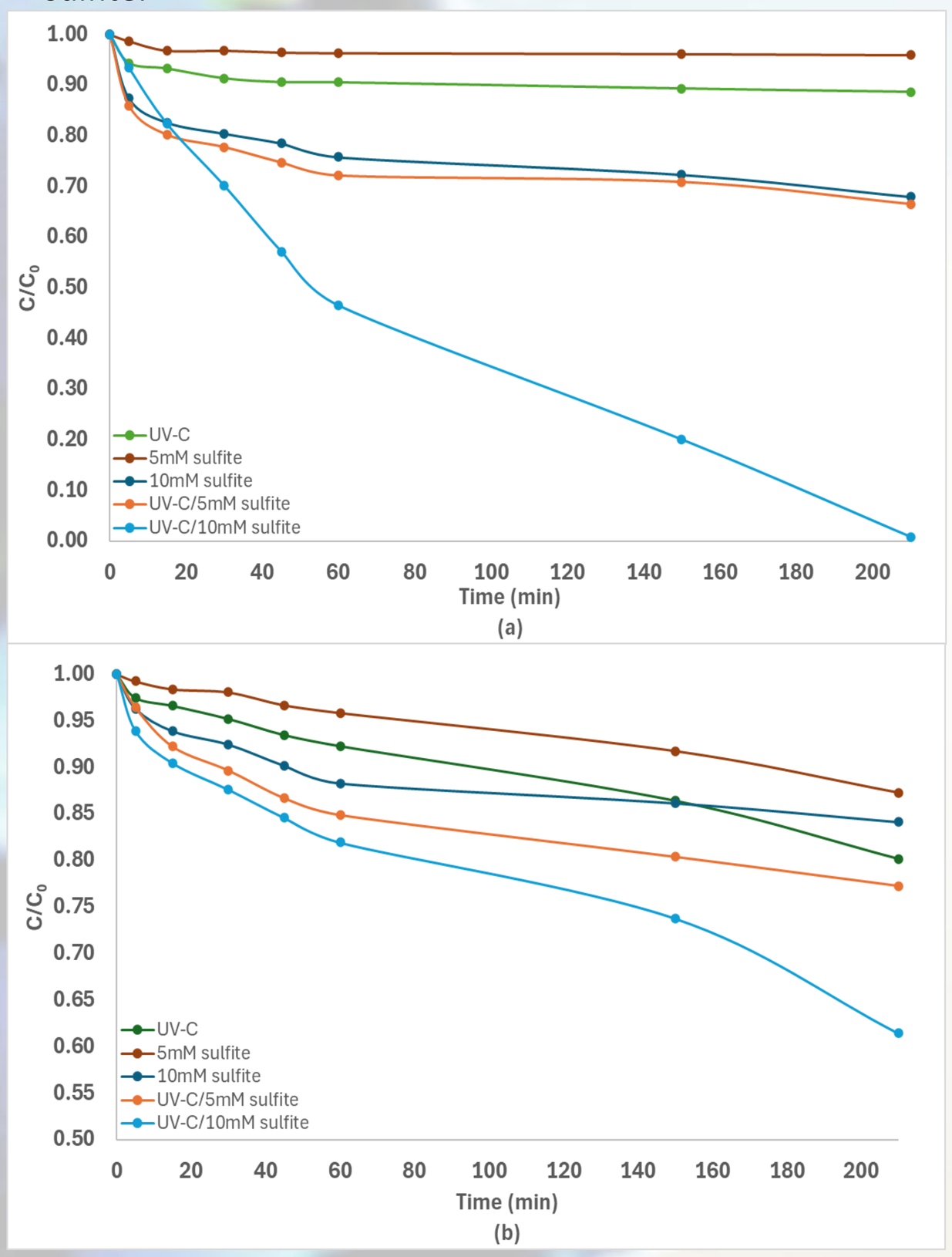


Figure 1: Reduction of PFAS mixture (a) PFOA and (b) PFOS, using different processes.

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[1] Fennell, B. D.; Mezyk, S. P.; McKay, G. Critical Review of UV-Advanced Reduction Processes for the Treatment of Chemical Contaminants in Water. *ACS Environ. Au* **2022**, *2* (3), 178–205.

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