

Removal of Organic Contaminants via Electro-Activated Biochar Suspensions

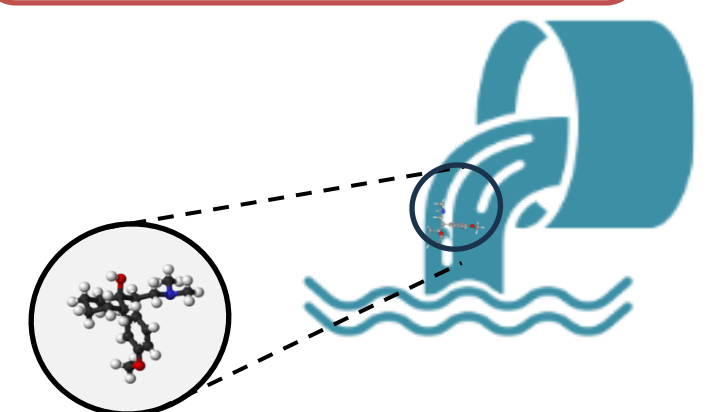
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INTRODUCTION



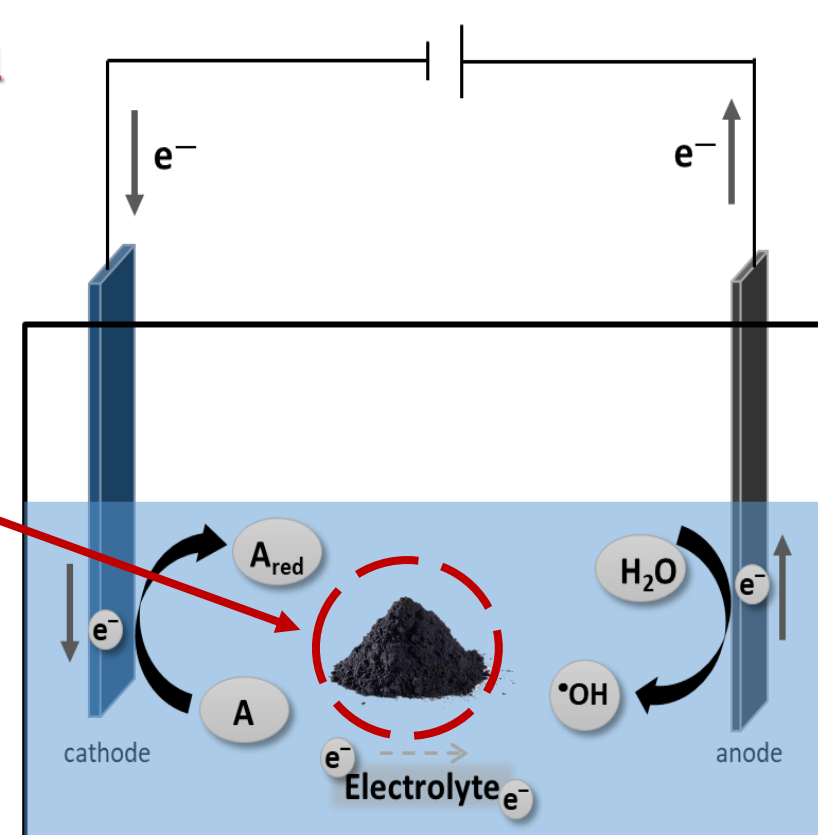
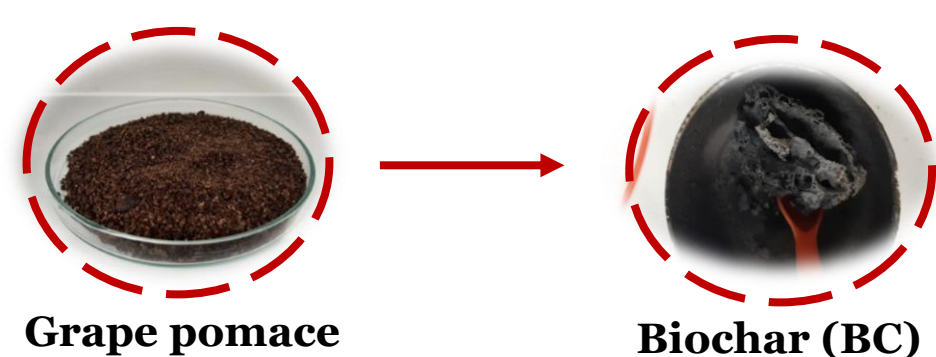
Surface water and wastewater in which VFX can be found due to ineffective removal



- Venlafaxine (VFX), a common antidepressant, is classified as a **Contaminant of Emerging Concern (CEC)** due to its environmental persistence and potential risks.
- VFX is listed on the **EU Watch List** (Decision 2022/1307) and **must be monitored** under Directive (EU) 2024/3019.
- Traditional water and wastewater methods are **ineffective at fully removing** VFX and other CECs and degradation by-products.
- Complete elimination of VFX requires the development and adoption of **innovative treatment solutions**.

METHOD

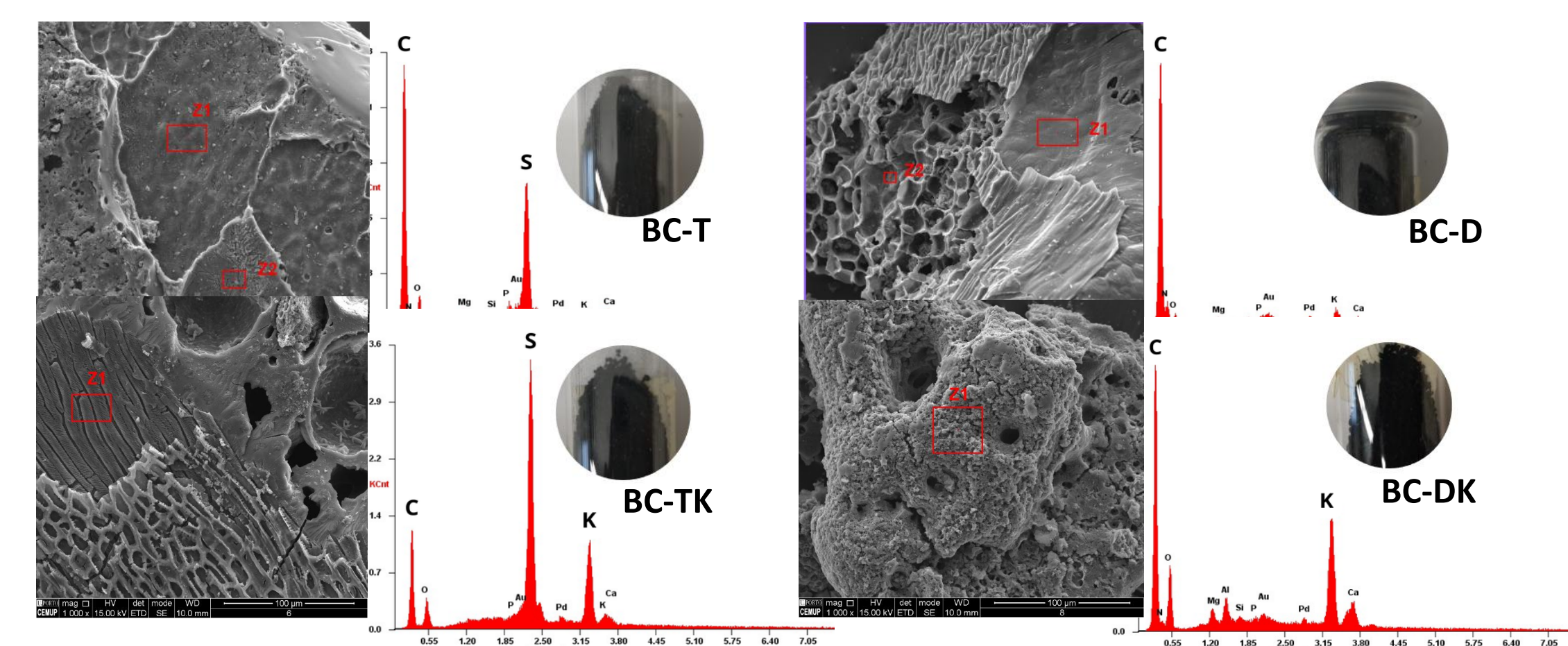
Electrochemical advanced oxidation processes (EAOPs)



- EAOPs generate reactive **oxy species** to degrade and **mineralize VFX**.
- **Salts** present in water act as **electrolytes** and allow operating under mild conditions with fixed electrodes.
- **Carbon electrocatalyst** from produced from wine industry waste enhance efficiency and VFX removal.

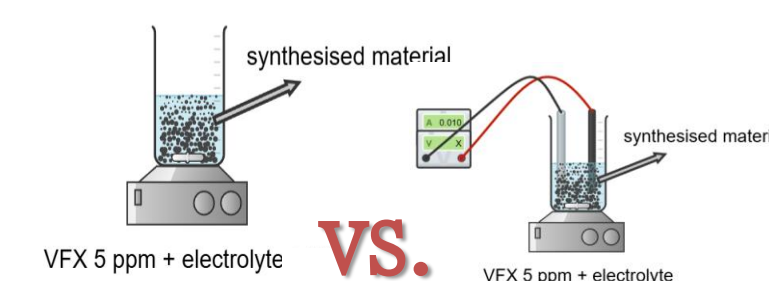
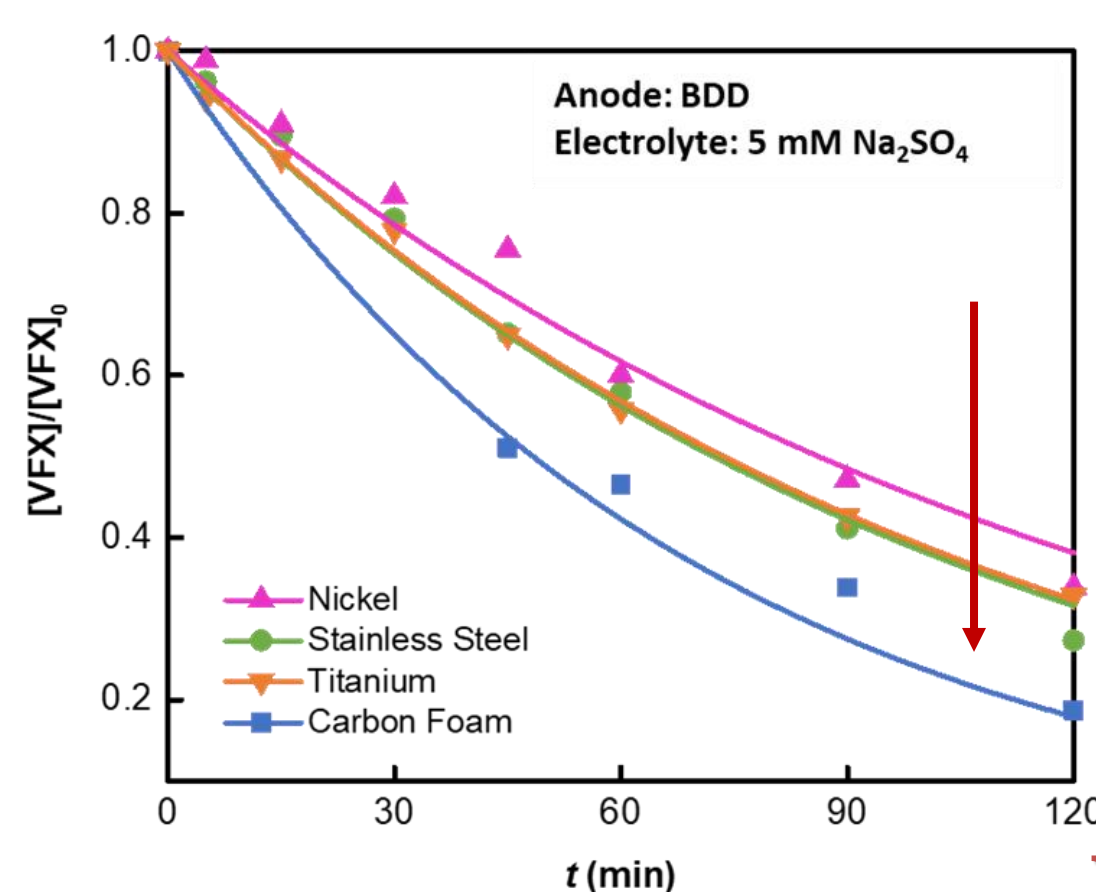
Biochar characterization

- **BC** synthesised via **one-pot** simple technique.
- Modifications were applied using thiourea (**BC-T**) and dicyandiamide (**BC-D**) as precursors.
- Potassium hydroxide (KOH) for activation, yielding **BC-TK** and **BC-DK**.
- **SEM imaging and EDX** analyses revealed that each treatment produced different structural and chemical features in the biochar matrix.



RESULTS & DISCUSSION

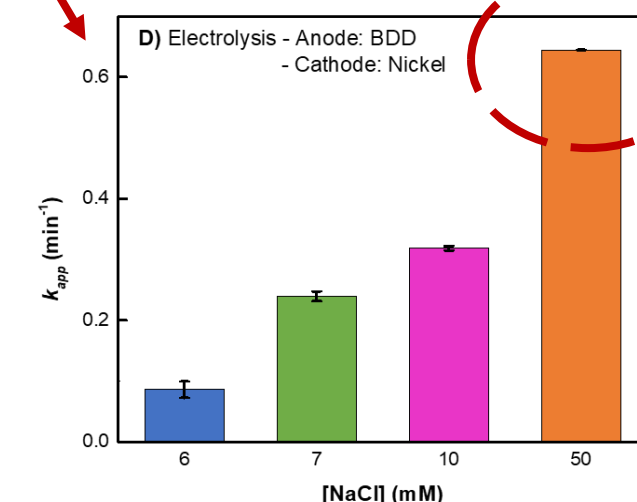
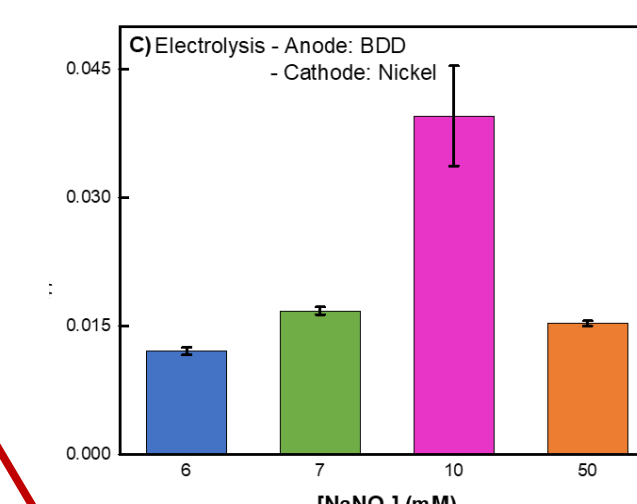
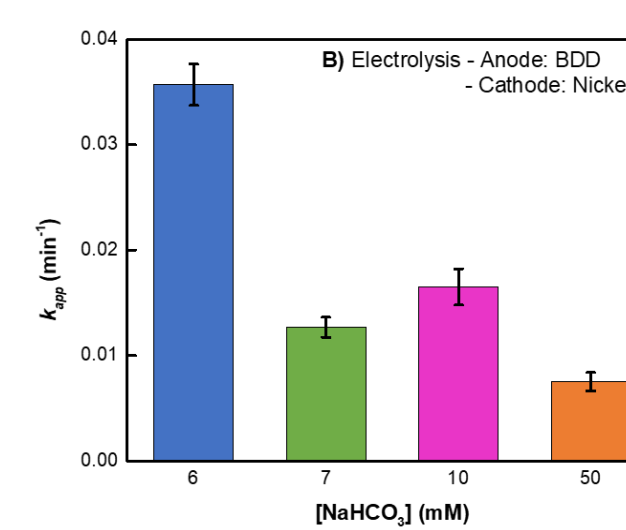
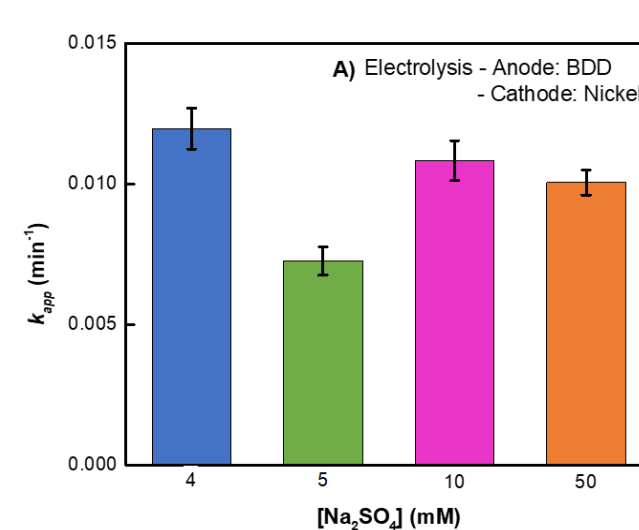
Cathode effect in electrolysis



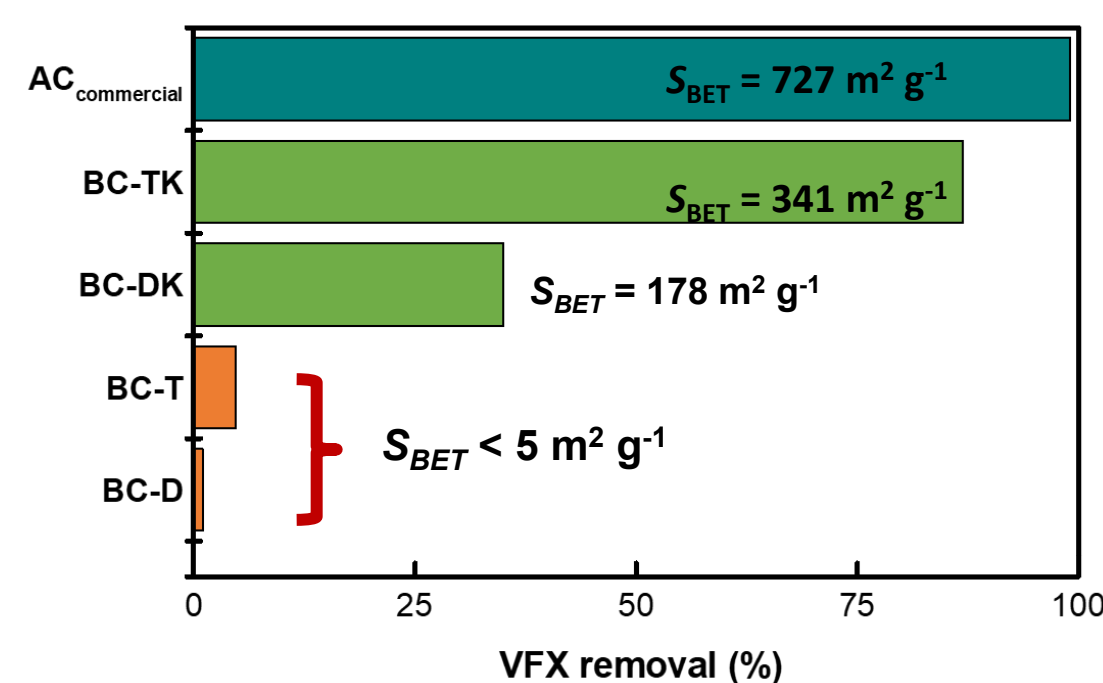
- **Boron-doped diamond** was fixed as anode
- Cathodic impact was assessed in electrolytic conditions
- **Best combination** with carbon foam

Electrolyte effect in electrolysis

- Various **sodium-based salts** were tested
- **NaCl** demonstrated the **highest** electrochemical activity.

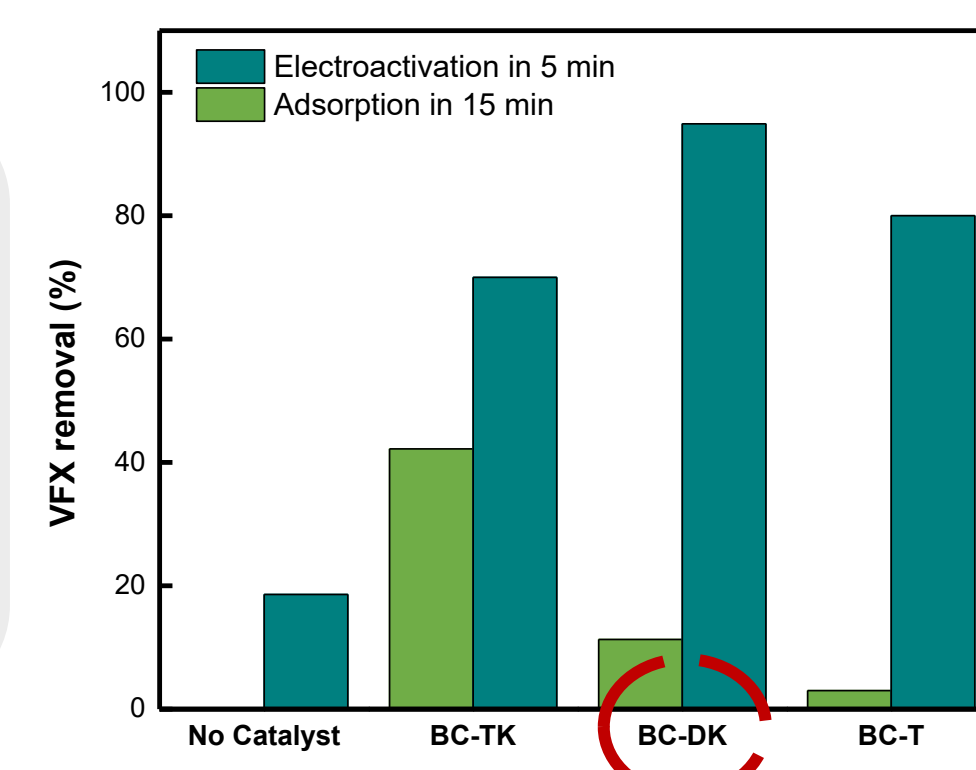


Adsorption vs. Electrocatalysis



- **Adsorption** tests demonstrated that BC-TK and BC-DK (higher S_{BET}) achieved **higher VFX** compared to non-activated ones;
- **BC-TK** showed a removal **comparable** with a commercial activated carbon

- Control tests confirmed the **effectiveness** of electroactivation
- **BC-TK** and **BC-DK** removed **80% and 95% of VFX in 5 minutes**, respectively
- Electroactivated biochars showed **superior VFX removal** compared to regular adsorption



CONCLUSIONS

- ✓ One-pot synthesis of carbon-based catalyst was achieved, adding **value to otherwise discharged waste**;
- ✓ **BC-DK achieved higher removal of VFX of 95% in only 5 minutes**, reducing the removal time to one third of when no catalyst is added;
- ✓ The implementation of a **new technology combined with carbon-based catalysts** enhanced the efficiency of water and wastewater treatment.

ACKNOWLEDGEMENTS

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