ELIMINATION OF SULFAMETHOXAZOLE BY ACTIVATED PERSULFATE WITH NETTLE BIOCHAR

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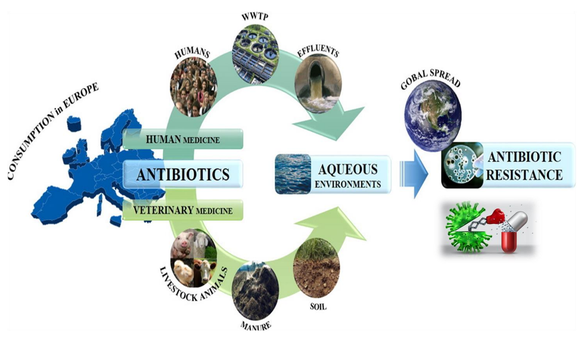
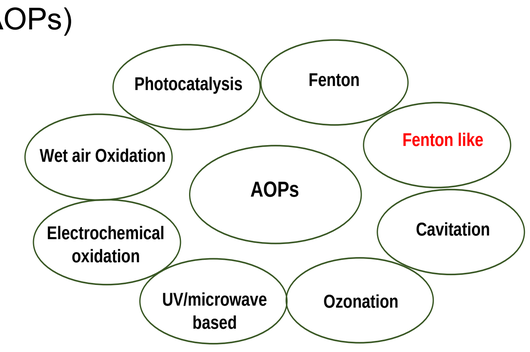
INTRODUCTION

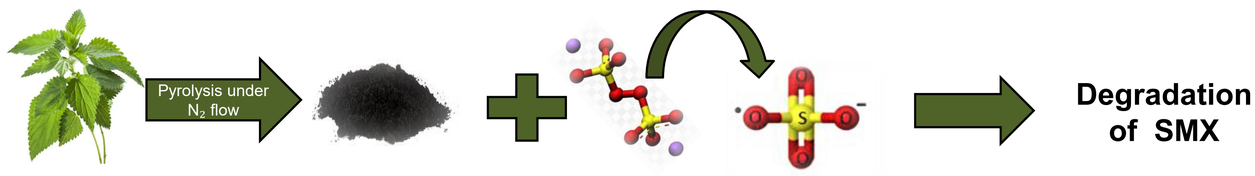


Possible solution→ advanced oxidation processes (AOPs)

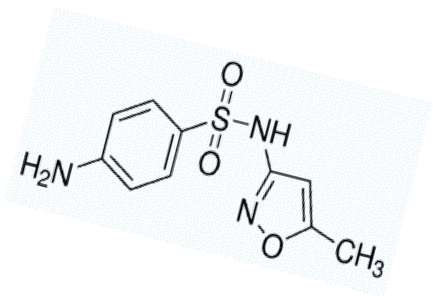


Aim of the study

The main purpose of this project was the development of nettle biochar catalyst/sodium persulfate process for the removal of antibiotic Sulfamethoxazole (SMX) from several water matrices. SMX is a representative pharmaceutical of the antibiotics family typically found in environmental samples at relevant concentrations from ng/L to mg/L [1]



EXPERIMENTAL



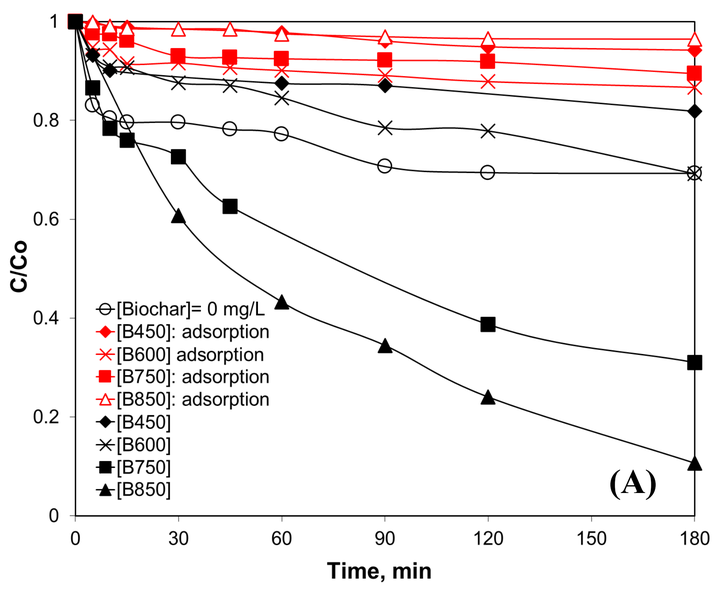
Materials.

- Antibiotic: sulfamethoxazole (SMX)
- Catalyst: material nettle biochar (B(T℃))
- Oxidant: Sodium persulfate (SPS)
- Water matrix:
  - Ultrapure water (UPW)
  - Wastewater (WW) containing ca 4.5 mg/L organic carbon and inorganics
  - Bottle Water (BW) containing mainly ca 250 mg/L $NaHCO_3$
  - 10 mg/L of humic acid (HA) to simulate the organic content of WW

Experiment conditions

- Reactant mixture volume: 60 mL
- Constant temperature at 25 °C
- Atmospheric pressure
- HPLC: Alliance 2695, Waters

RESULTS



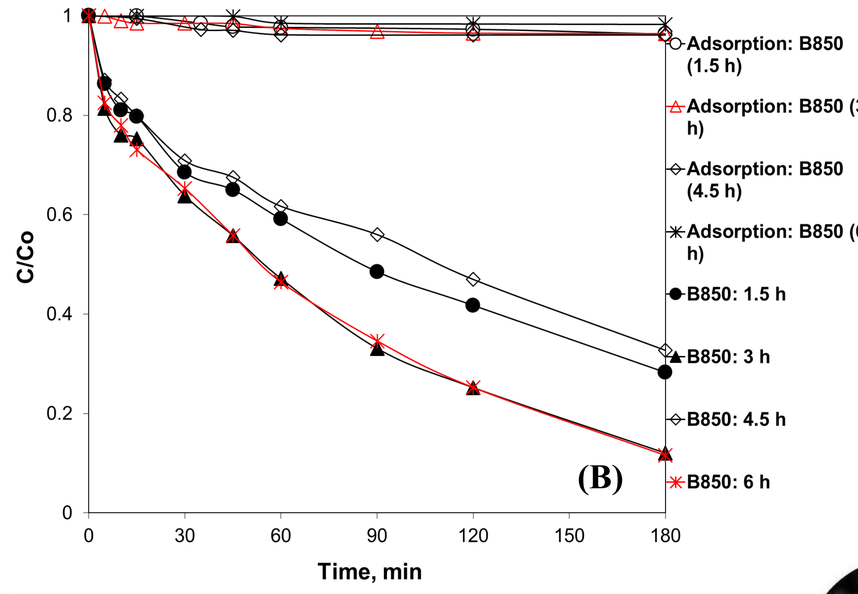


Figure 1. Evaluation of the activity of nettle biochar in (A) various pyrolysis temperatures with residence time 3 h and (B) several residence time at 850 ℃. Experimental conditions: [SMX]= 500 μg/L, [BT(℃)] = 500 mg/L and [SPS]= 500 mg/L in Ultrapure water (UPW).

- **Fig. 1A** shows that B850 sample exhibited the greatest efficiency of the tested samples with 90% SMX removal at 180 min.
- **Fig. 1B** shows that B850: 6 h and B850: 3 h sample exhibit the same degradation rate of SMX. Thus, all the following experiments were carried out with B850: 3h.

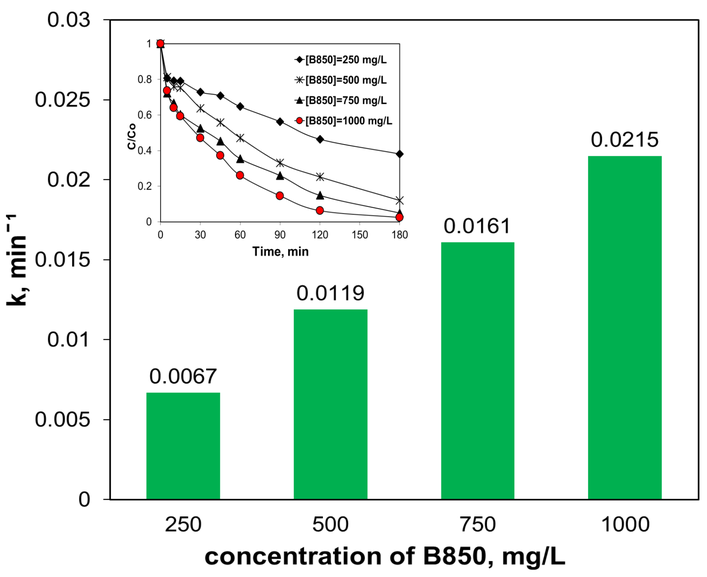


Figure 2: Effect of B850 concentration on the kinetics of [SMX]= 500 μg/L in UPW with [SPS]= 500 mg/L and inherent pH. Inset graph: concentration profiles of SMX degradation in UPW with several concentration of B850

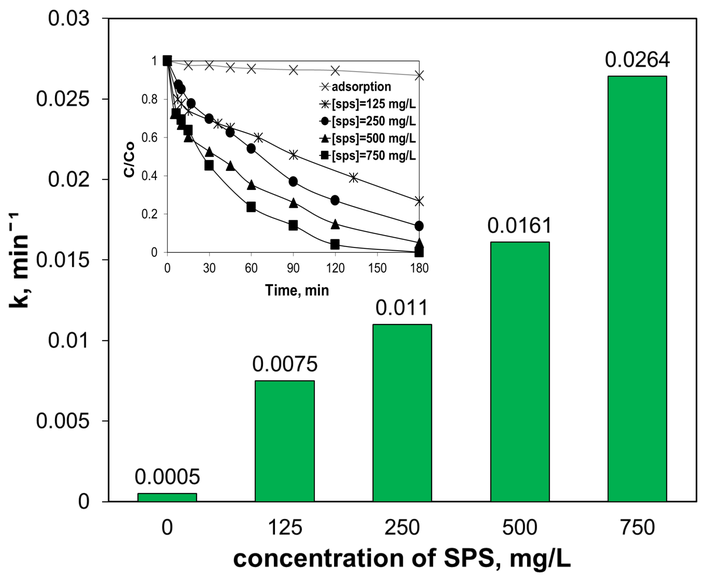


Figure 3: Effect of SPS concentration on the kinetics of [SMX]= 500 μg/L in UPW with [B850]= 750 mg/L and inherent pH≈8.5. Inset graph concentration profiles of SMX degradation in UPW with several concentration of SPS and adsorption.

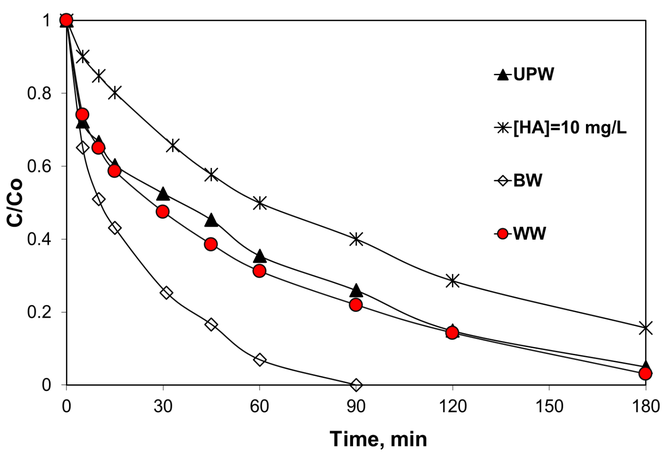


Figure 4: Effect of water matrix on 500 μg/L SMX degradation with [B850]= 750 mg/L and [SPS]= 500 mg/L.

- **Fig. 2** shows that the degradation rate enhances with enhancing B850 concentration because the number of active sites that are available for reaction is increased.
- **Fig. 3** display that increasing the persulfate concentration expectedly accelerated the degradation rate of SMX, while the removal due to adsorption was insignificant [2,3].
- **Fig. 4** shows that BW appears to favor SMX decomposition; it can be accomplished 100% SMX conversion at 90 min. Also, experiments in UPW and WW give nearly identical SMX degradation while 10 mg/L HA slow down the conversion of SMX [2].

CONCLUSIONS

✓Nettle biochars pyrolyzed at 750 ℃ and 850 ℃ were able to activate persulfate for the degradation of SMX in UPW. B850 sample showed the greatest performance.
✓The optimal residence time at 850 ℃ is 3 h.
✓The degradation rate of SMX in WW is slightly enhanced compared in UPW while in bottle water is remarkable faster than in UPW.

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