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Modified biochars from basil agro-wastes for environmental photo-remediation

Maria Pedro Gouveia, Ana Rita Alves, Sónia Figueiredo, Cristina Delerue-Matos, Antón Puga

REQUIMTE/LAQV, Instituto Superior de Engenharia do Porto, Instituto Politécnico do Porto, Porto, Portugal

Agri-food Waste Management for Sustainable bio-economy through Higher Education curricula and upskilling

AGRIMA

INTRODUCTION

Pharmaceutical contamination in aquatic environments and wastewater treatment plants (WWTPs) has become a critical concern due to its potential environmental impacts. Addressing this issue is a priority within the EU, with goals set for effective treatment solutions by 2045. [1].

Biochar produced from agricultural wastes, particularly basil residues, presents a sustainable solution owing to its remarkable adsorption properties [2]. To enhance reusability, Advanced Oxidation Processes (AOPs) are employed to regenerate biochar [3].

All biochars used (**B1, B2, B3, B4**) were incorporated with a photosensitive compound, Titanium (IV), enabling photo-degradation of pharmaceuticals: Fluoxetine (**FLX**) and Trazodone (**TRZ**).

Widely used antidepressants

MATERIALS & METHODS

BIOCHAR PRODUCED BY BASIL WASTE

Adsorption tests

- **Pharmaceutical compounds tested:** FLX and TRZ (5 mg/L);
- **Volume of pollutant:** 200 mL
- **Biochar mass:** ≈ 1 g
- Room temperature (25°C);
- pH range: [2.27 ; 5.80];
- Constant stirring (200 rpm);
- **Duration**: 4 hours.

↓ Filtration of solution

↓ Analysis by HPLC

Pharmaceutical degradation

Figure 1 Modified biochar used as a catalyst in photodegradation.

- **Pharmaceutical compounds tested:** FLX and TRZ (5 mg/L);
- **Volume of pollutant:** 100 mL
- **Biochar mass:** ≈ 0.5g
- Room temperature (25°C);
- pH range: [1.9 ; 2.35];
- Constant stirring (100 rpm);
- **Duration**: 4 hours;
- Assembly with 4 UV lamps.

↓ Filtration of solution

↓ Analysis by HPLC

RESULTS & DISCUSSION

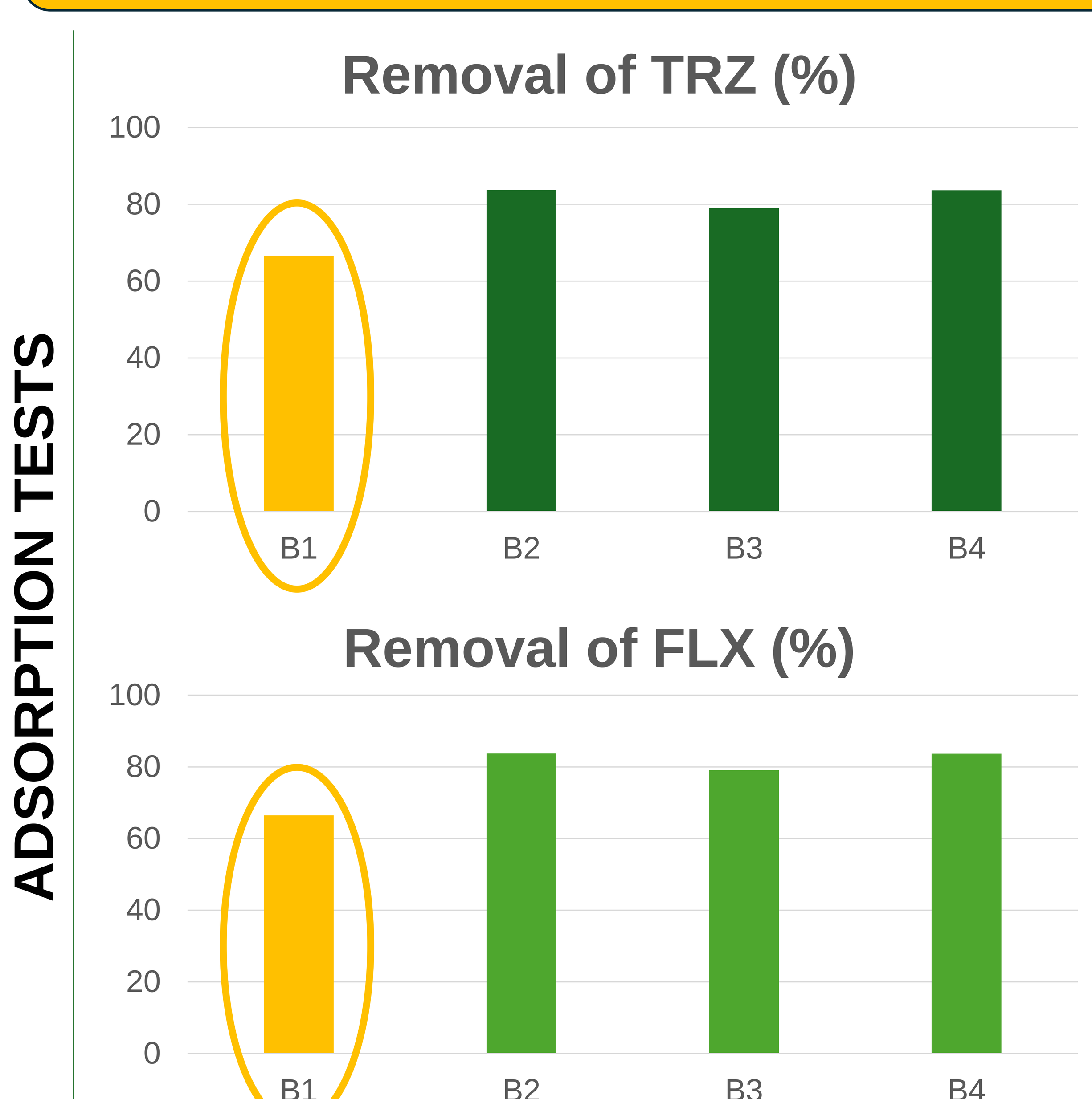
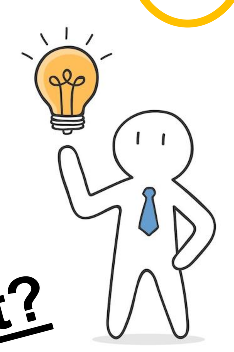


Figure 2: Adsorption of pharmaceutical compounds using four diferent biochars in 4 hour trials.

B1: Low adsorption



Useful as a photocatalyst?

BIOCHAR SAMPLES

B1: Titanium (IV) oxide sulfate sulfuric acid (in ethanol)

B2: Titanium (IV) butoxide (in water)

B3: Titanium (IV) oxide sulfate sulfuric acid (in water)

B4: Titanium (IV) isopropoxide (in water)

DEGRADATION TESTS

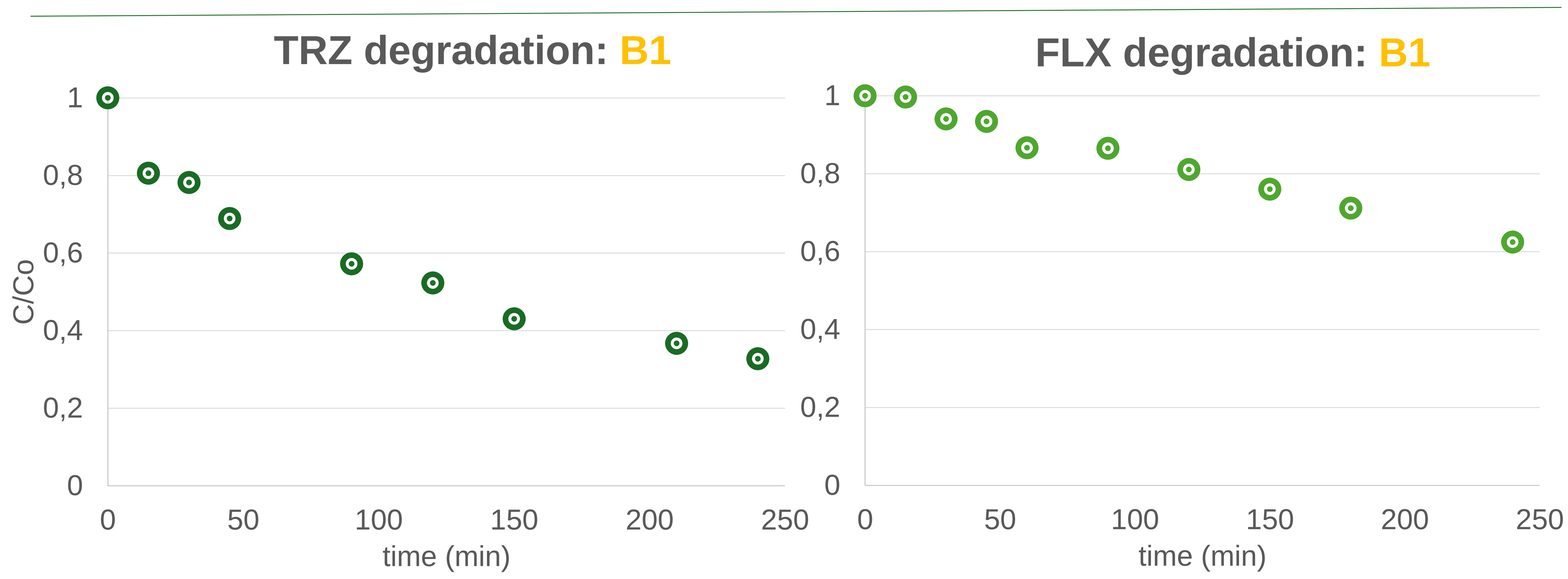


Figure 3: Degradation of pharmaceutical compounds using B1 as a catalyst over a 4-hour experiment.

CONCLUSIONS

Basil-derived biochar modified with titanium achieved over 65% adsorption of fluoxetine and trazodone across four different modifications; the least adsorptive material showed additional photocatalytic activity under UV light, reaching ~50% degradation of fluoxetine and ~70% of trazodone, highlighting its potential for combined adsorption–photocatalysis in sustainable water remediation.

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