FEASIBILITY STUDY OF BIOCHAR/TITANIUM DIOXIDE COMPOSITES IN HETEROGENOUS PHOTOCATALYTIC DEGRADATION

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INTRODUCTION

Biochar, a carbon-rich material derived from biomass pyrolysis, has shown promise in environmental and technological applications (Cao et al., 2011). Photocatalysis, used for degrading organic contaminants in wastewater and air purification, has been extensively studied (Marwah et al., 2023). Recent research focuses on biochar/TiO2 composites to boost photocatalytic efficiency (Mausomi et al., 2021). These composites enhance photodegradation through a synergistic effect, where the carbonaceous structure acts as an electron sink, extending charge carrier recombination time (Baca et al., 2020). This method significantly improves organic contaminant degradation efficiency and material stability (Bhavani et al., 2022). In this study, a biochar/TiO2 composite catalyst was prepared via the sol-gel method and tested for its ability to degrade ibuprofen.

EXPERIMENTAL ACTIVITY

Materials Synthesis

- Biochar (BC) (biomass-vineyard branch residues): by pyrolisis under inert atmosphere (350 ºC at rate 10 ºC/min for 90 min.)
- Synthetic TiO_2: sol-gel method (Titanium (IV) isopropoxide)
- TiO_2/BC (calcinatin method – N_2 for 4h at 450ºC): difference ratio 1:1.01, 1:1.05, 1:1, 1:1.5

Materials Characterization

- X-Ray diffraction (XRD)
- Brunauer Emmett Teller (BET) specific surface area
- Fourier transform infrared (FTIR)
- X-ray photoelectron spectroscopy (XPS)
- Transmission electron microscope (TEM)
- Scanning electron microscope (SEM)

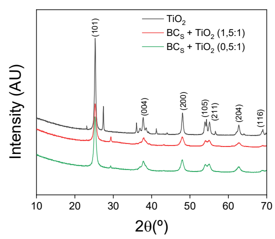

Figure 1. XRD spectrum.

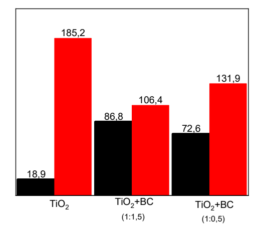

Figure 2. Specific surface (red) and pore size (black)

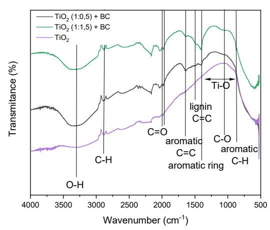

Figure 3. Transmission spectrum.

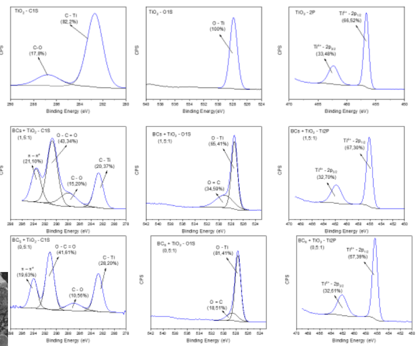

Figure 4. XPS spectrum.

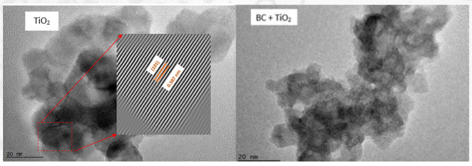

Figure 5. TEM image.

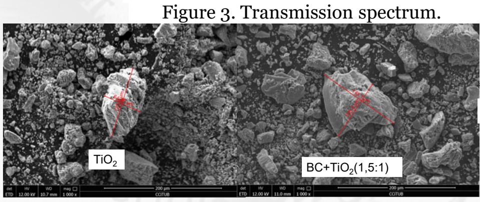

Figure 6. SEM image.

PHOTOCATALYTIC EVALUATION

Experimental conditions and analytical methods

- Pollutant concentration: 5 mg.L-1 of ibuprofen (IBP)
- Photocatalyst concentration: 0.5 g.L-1
- Total volume: 100 ml of 5 mg.L-1
- Solar light simulator of 765 W.m-2 for 4 hours.
- Aliquots were extracted at 10-minute
- Analytical methods : HPLC and NPOC

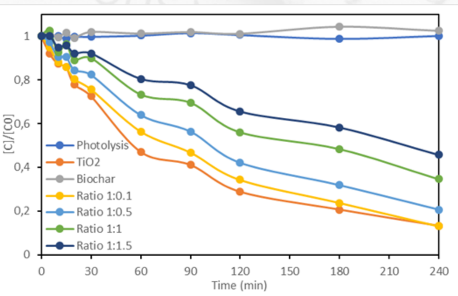

Figure 7. Ibuprofen degradation for different ratios of TiO2:biochar.

Table 1. NPOC values

Sample	NPOC
IBP	3,1
TiO2 + BC (1:0,5)	4,1
TiO2 + BC (1:0,5) + IBP initial	6,8
TiO2 + BC (1:0,5) + IBP final	6,6

COCLUSIONS

- The best results have been achieved with ratios 1:0.1 and 1:0.5, showing degradations of 87% and 79%, respectively.
- The NPOC has not difference between initial and final treatment, due to the increase in the molecules complexity of intermediates generated.
- The presence of TiO_2 in the BC is confirmed by XRD-spectrum and the transmitance-spectrum.
- The surface area is lower and the biochar structure is not crystalline.

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