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P.II.1 — Hydrothermal-to-pyrolytic reconstruction of sewage sludge and garden waste-derived Fe-coupled biochar for peracetic acid activation toward sulfamethoxazole degradation

Hao Dong[1], Jorge Bedia[1*], Elena Díaz[1], Ángel F. Mohedano[1]

1: Department of Chemical Engineering, Faculty of Sciences, Universidad Autónoma de Madrid, Campus Cantoblanco, 28049 Madrid, Spain

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Poster Presentations #27

P.II.1 — Hydrothermal-to-pyrolytic reconstruction of sewage sludge and garden waste-derived Fe-coupled biochar for peracetic acid activation toward sulfamethoxazole degradation

Hao Dong[1], Jorge Bedia[1], Elena Díaz[1], Ángel F. Mohedano[1]*

[1] Department of Chemical Engineering, Faculty of Sciences, Universidad Autónoma de Madrid, Campus Cantoblanco, 28049 Madrid, Spain

**Correspondence: jorge.bedia@uam.es*

Keywords: *Fe-coupled biochar; Hydrothermal carbonization; Pyrolysis*

Valorization of sewage sludge and garden and park waste (GPW) into functional carbonaceous materials is a promising route for coupling waste management with advanced water treatment. In this work, Fe-coupled biochars were prepared through a hydrothermal-to-pyrolytic reconstruction strategy. Sewage sludge and GPW were converted by hydrothermal carbonization at 240 °C for 1 h, with $FeCl_3{\cdot}6H_2O$ introduced as an Fe precursor under fixed input conditions. The as-recovered Fe-assisted hydrochars were subsequently pyrolyzed at 800 °C for 2 h under N_2 to preserve the real Fe-containing precursor state and promote structural reconstruction.

The non-Fe hydrothermal systems showed comparable feedstock-based yields of 53.3–54.0%, while Fe-assisted systems reached 48.4–56.8%, indicating feedstock-dependent redistribution of organic and inorganic fractions. Pyrolysis yields ranged from 39.2 to 52.0%, giving overall biochar yields of 21.2–29.5%. Elemental and ash analyses showed that sludge supplied mineral-rich matrices, whereas GPW contributed biomass-derived carbon. Textural characterization revealed that hydrochar precursors had very low BET surface areas (approximately 11 $m^2\ g^{-1}$), whereas SL+GPW-Fe/BC exhibited a markedly reconstructed porous structure with a BET surface area of approximately 430 $m^2\ g^{-1}$ and a pore volume of 0.352 $cm^3\ g^{-1}$. XRD and Raman analyses indicated the formation of Fe-related crystalline phases and defect-rich carbon domains after pyrolysis, while FTIR and SEM-EDS confirmed retained mineral-associated functionalities and heterogeneous C/O/Si/Al/P/S/Fe distributions. ICP further confirmed strong Fe enrichment in Fe-assisted biochars.

Pre-adsorption tests with sulfamethoxazole (SMX) identified 0.10 g L^{-1} catalyst dosage and 30 min pre-equilibration as suitable conditions for subsequent oxidation experiments. Overall, hydrothermal-to-pyrolytic reconstruction generated porous Fe-coupled carbon/mineral interfaces that provide a promising structural basis for future peracetic acid activation toward SMX degradation.

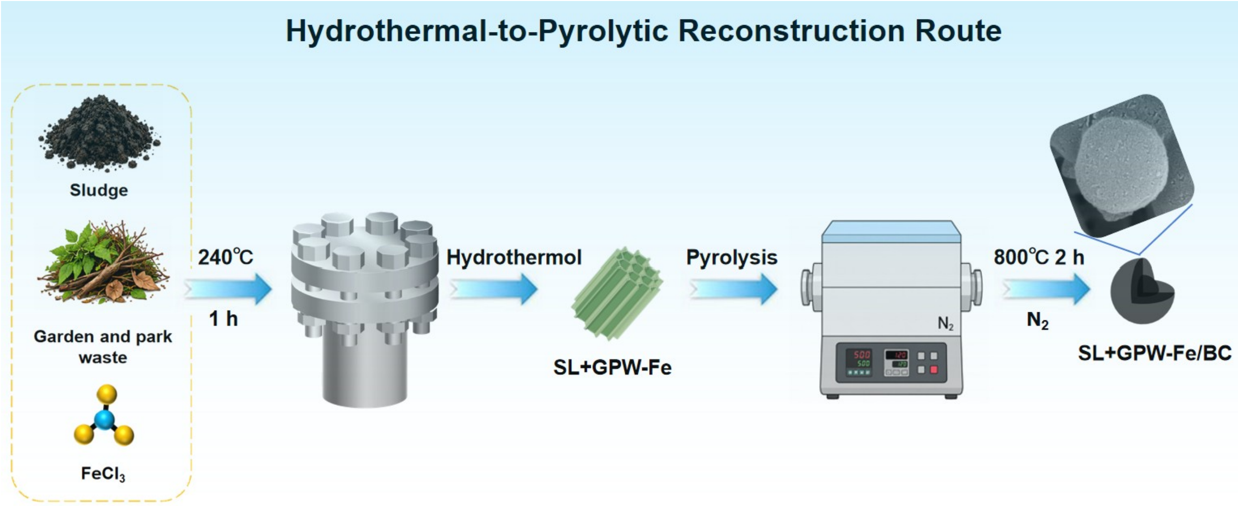

Figure 1. Material preparation process