

From bone waste to environmental remediation: hydroxyapatite-based materials for metal immobilization

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Introduction

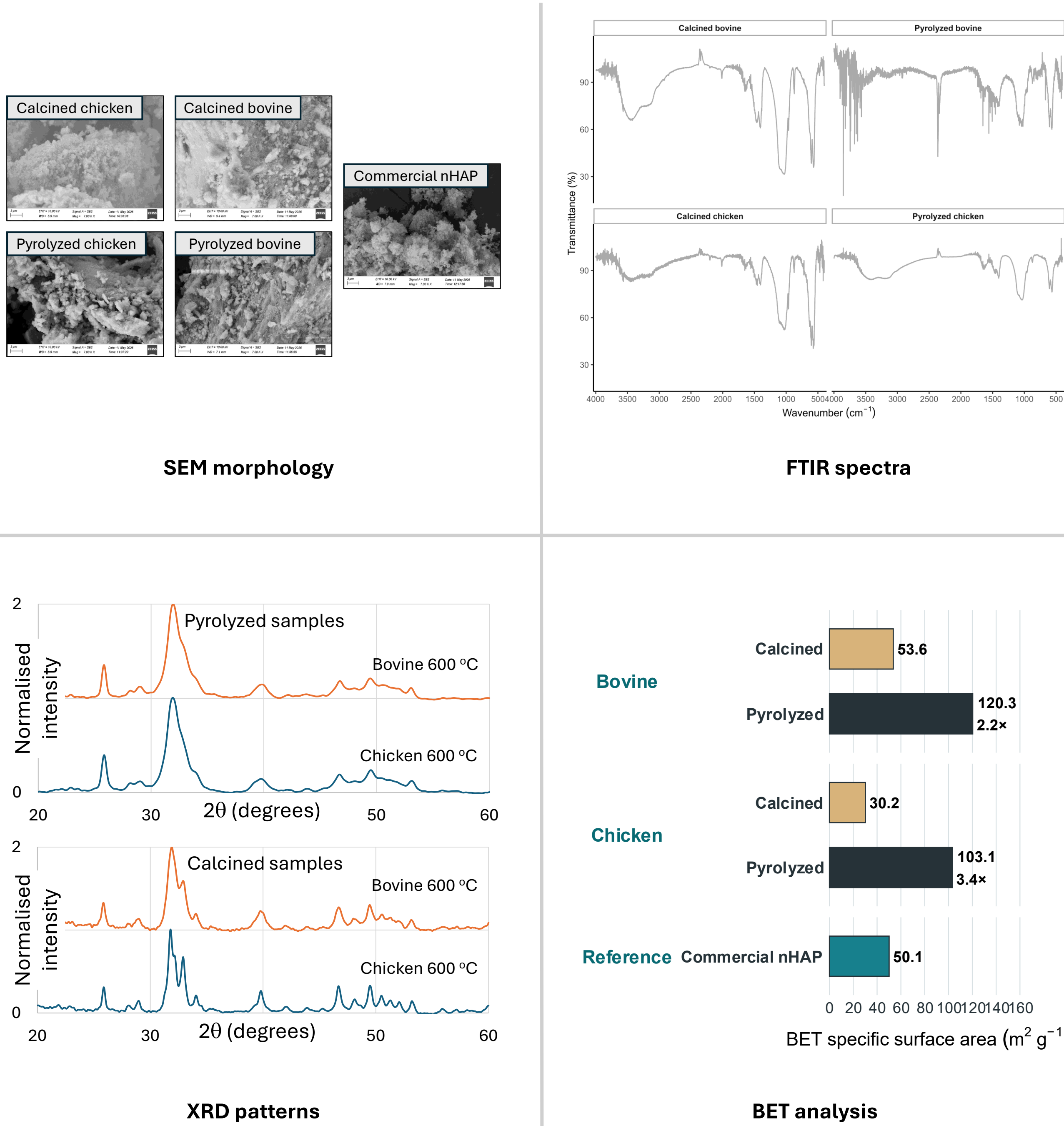
Bone-derived hydroxyapatite links waste valorization to the removal of potentially toxic metals (Pb, Cd and Zn), which pose risks to ecosystems and human health. We compared calcined and pyrolyzed chicken- and bovine-bone materials with commercial nHAP through aqueous adsorption screening to identify promising candidates for soil immobilization.

Materials and methods

- Materials:** calcined and pyrolyzed chicken and bovine bones; commercial nHAP as reference.
- Characterization:** SEM, BET, XRD and FTIR.
- Aqueous screening:** Pb, Cd and Zn batch adsorption; residual metals quantified by ICP.

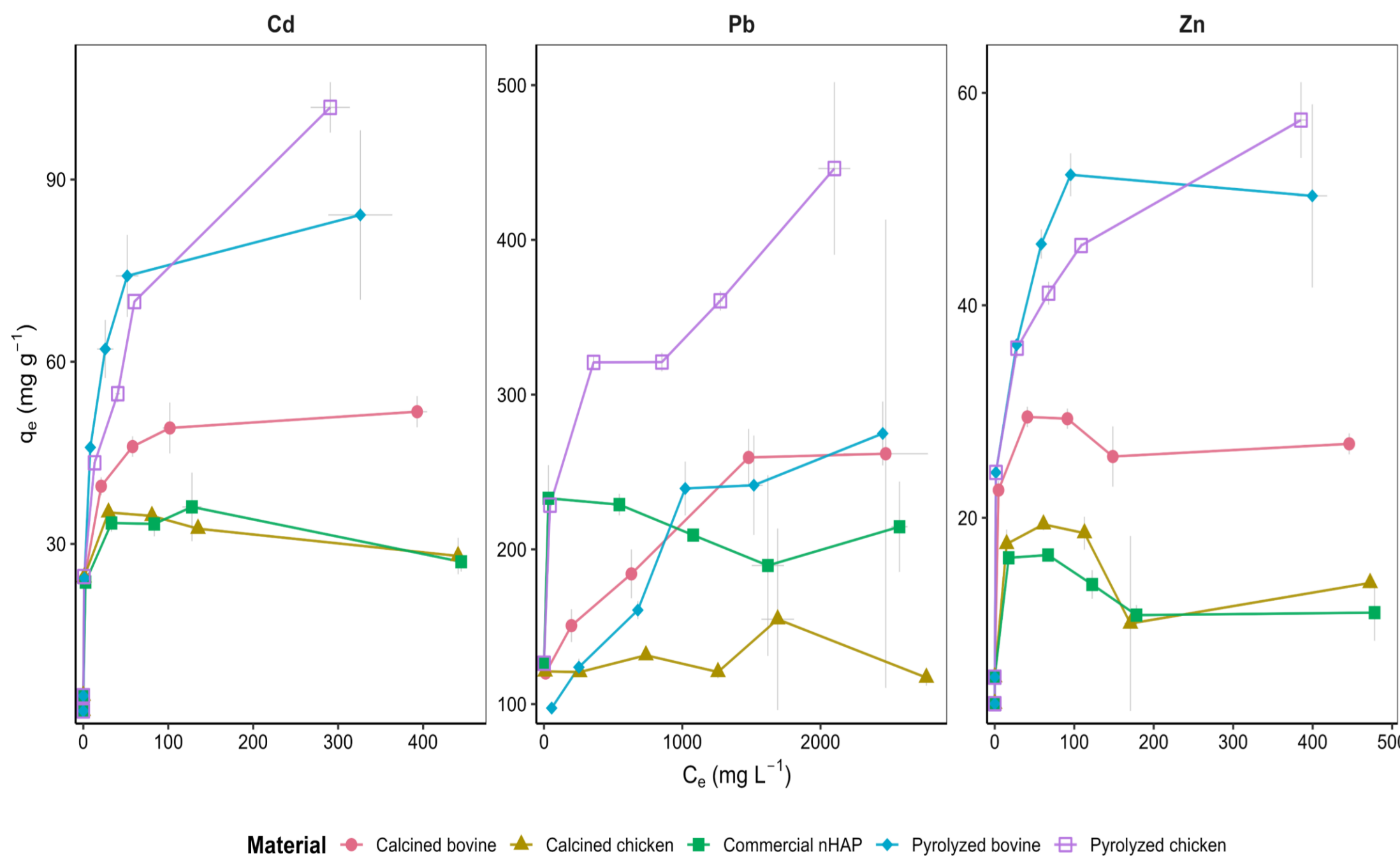
Results and discussion

Material characterization

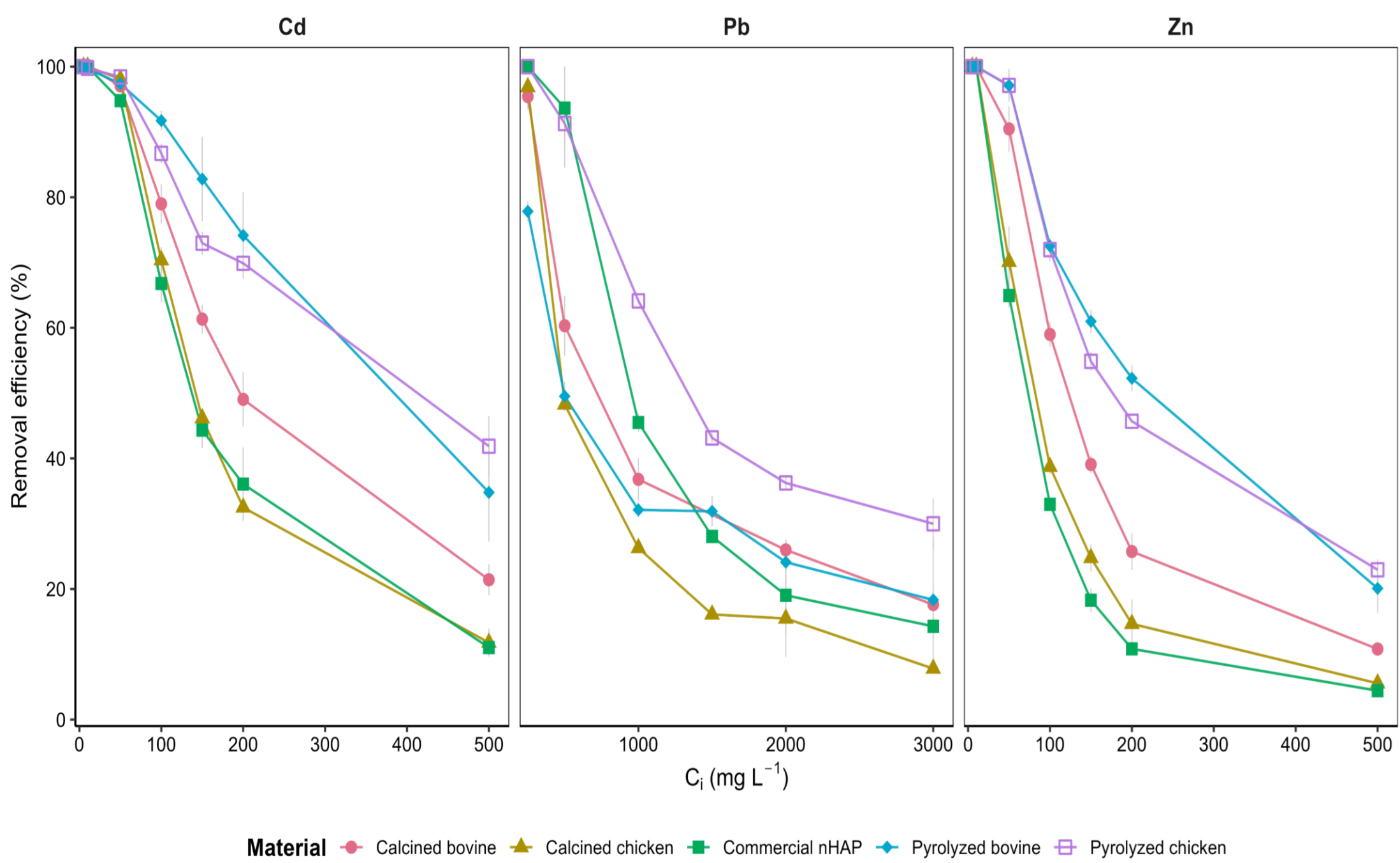


- Calcined materials formed nanoscale aggregates; pyrolyzed samples showed larger, irregular plate-like structures.
- Calcination presents enhanced phosphate bands; pyrolysis preserved carbonaceous residues and oxygen-containing surface groups.
- Comparable peak positions confirmed hydroxyapatite as the principal crystalline phase in all materials.
- Pyrolysis increased surface area and reduced mean pore diameter.

Batch adsorption test



Adsorption isotherms



Removal efficiency

- Pyrolyzed materials showed the highest adsorption capacities, with chicken bone char performing best overall.
- Removal efficiency decreased with increasing concentration, while metal affinity followed the order Pb > Cd > Zn.

Conclusions

