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Development of corn starch/alginate hydrogel beads for metal ion removal: effect of crosslinking and composition

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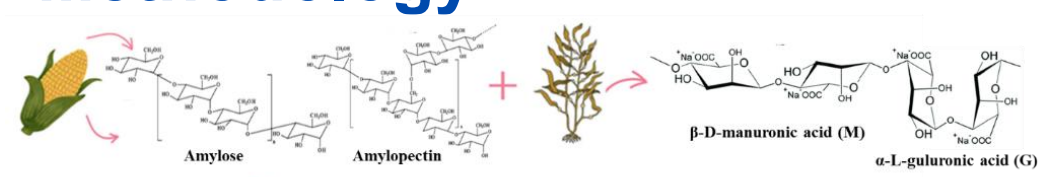
Introduction

The development of biodegradable polymeric adsorbents has emerged as a promising strategy for the sustainable removal of potentially toxic metal ions from contaminated water[1]. Corn starch and sodium alginate are attractive materials due to their abundance, biodegradability, and hydroxyl and carboxyl functional groups capable of interacting with metal ions. Combining ionic gelation with citric acid crosslinking enables the formation of stable hydrogel networks with tunable swelling behavior and adsorption properties. However, factors such as polymer composition, crosslinker concentration, and reaction time can significantly influence the structural characteristics and accessibility of adsorption sites. Understanding these relationships is essential for optimizing adsorption efficiency, selectivity, and reusability in multicomponent aqueous systems.

Objectives

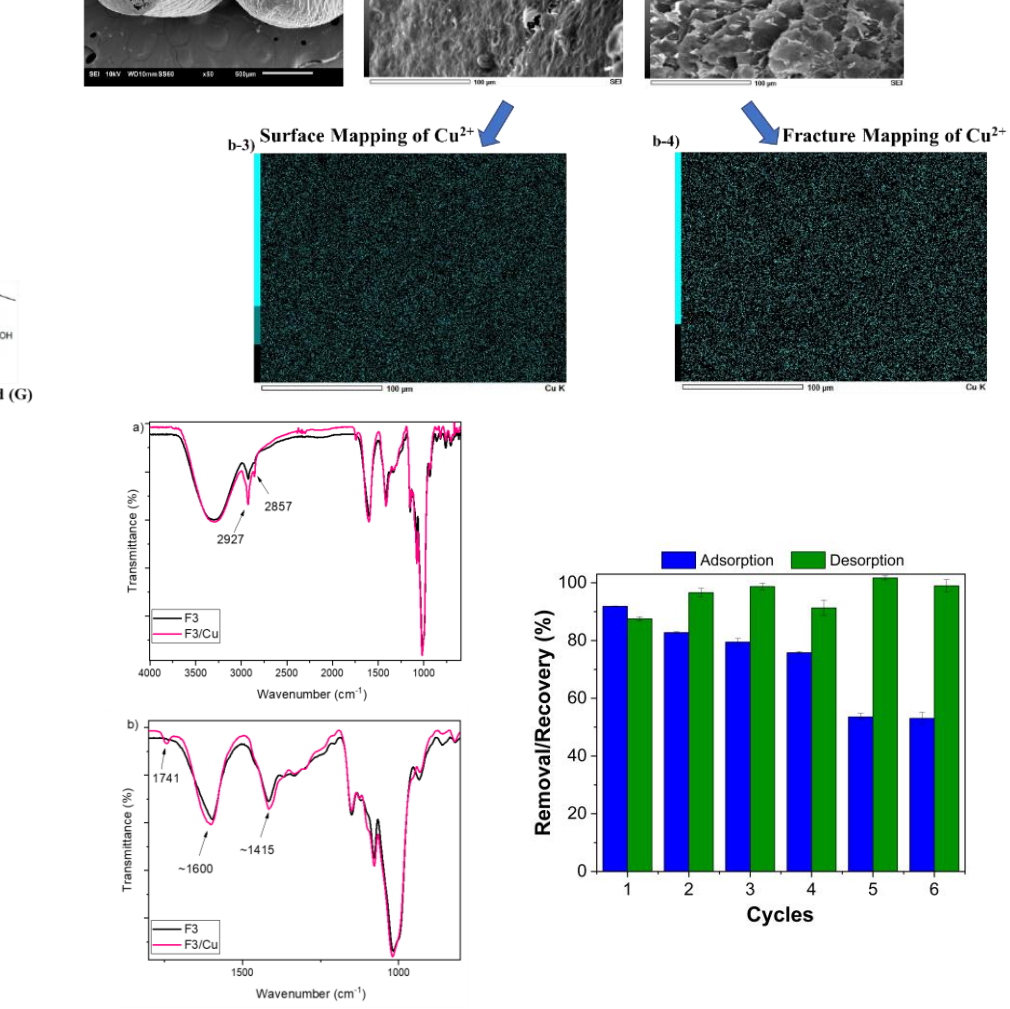
We developed biodegradable corn starch/sodium alginate hydrogel beads crosslinked with citric acid at different formulation conditions to investigate their swelling behavior and adsorption performance for potentially toxic metal ion removal from contaminated water.

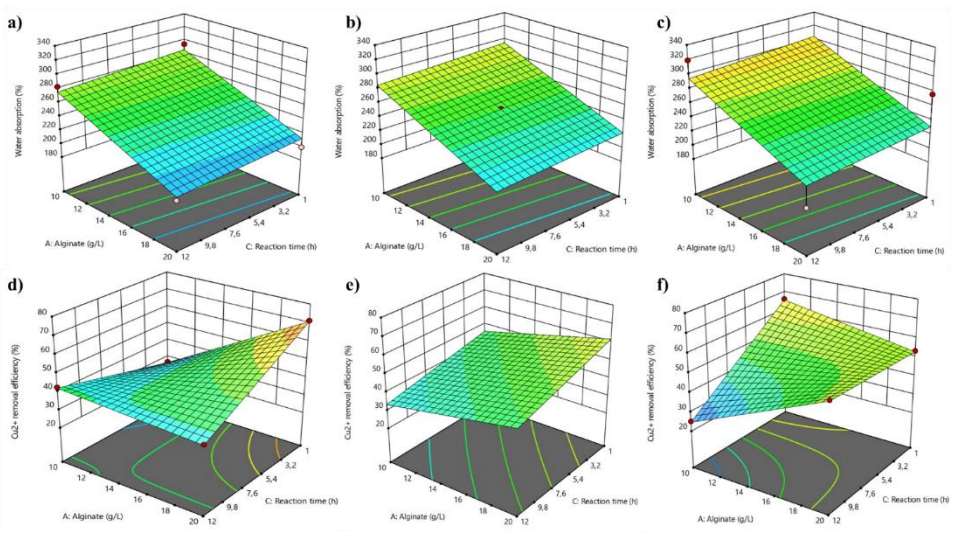
Methodology





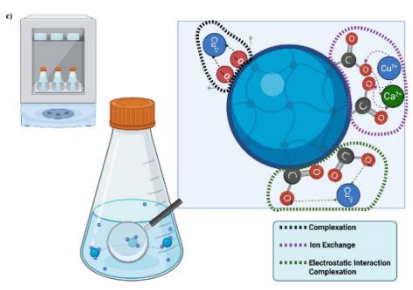
Results and Discussion





Conclusions

- Starch/alginate hydrogel beads exhibited good efficiency in Cu^{2+} removal.
- Alginate concentration was the main factor influencing water uptake.
- The optimized formulation achieved 71.3% Cu^{2+} removal.
- The maximum Cu^{2+} adsorption capacity reached 0.704 mmol/g.
- Hydroxyl and carboxyl groups contributed to Cu^{2+} adsorption.
- The beads showed desorption efficiencies above 90% and good reusability.



References

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GONÇALVES, Lucas R.; FERREIRA, Rafaela R.; SOUZA, Alana G.; BARBOSA, Rennan F. S.; DA COSTA, Talles B.; ROSA, Derval S. Polymer Bulletin, v. 82, n. 10, p. 4479–4503, 2025. DOI: 10.1007/s00289-025-05715-5.

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