Optimization of Phosphate and Nitrate Ions Adsorption Using LDH-Alginate Composite Beads: A Response Surface Methodology Approach

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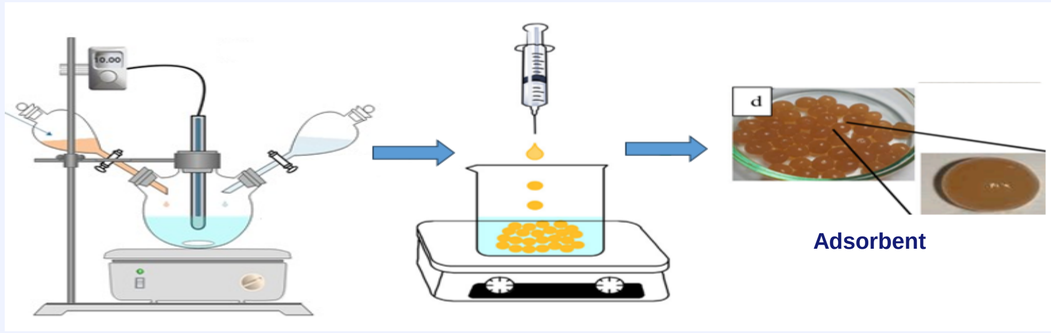
Introduction

Phosphate and nitrate are commonly used industrial and agricultural nutrients that are of great anxiety because of their ubiquitous existence in water and wastewater sources and association with harmful health effects. Herein, we aimed to fabricate a novel and environmental-friendly alginate encapsulated LDH beads and applied for the adsorption of phosphate and nitrate ions from water

Objective

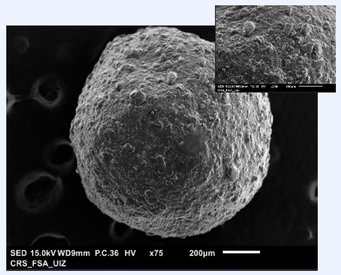
Optimization of the phosphate and nitrate adsorption process using LDH-Alginate composite beads by applying response surface methodology (RSM).

Adsorbent synthesis

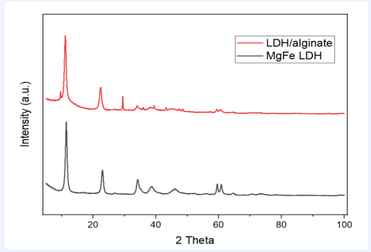


Results & Discussion

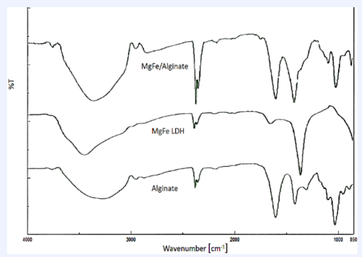
• Characterization of the adsorbent



SEM



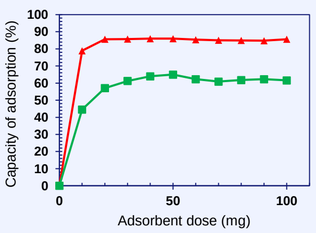
X-Ray diffraction

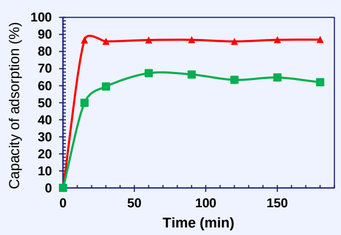


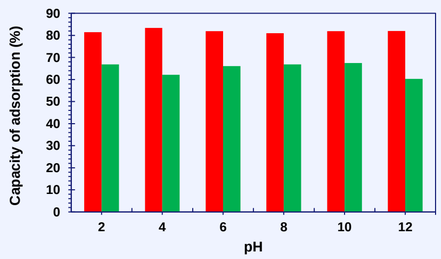
FT-IR

SEM images, FT-IR spectra, and X-ray diffraction patterns confirmed the successful integration of LDH with alginate, demonstrating a robust and effective composite material

• Adsorption study



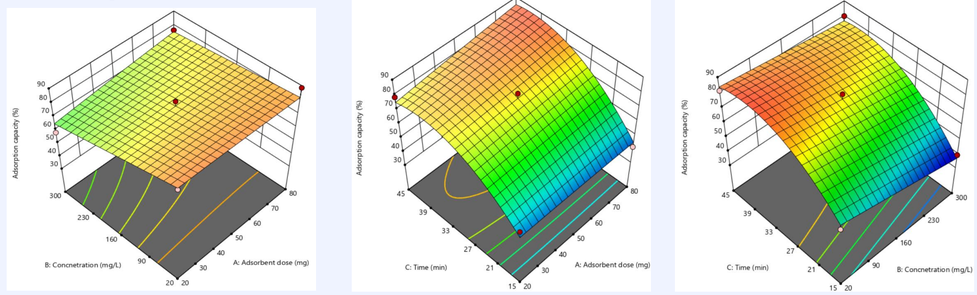




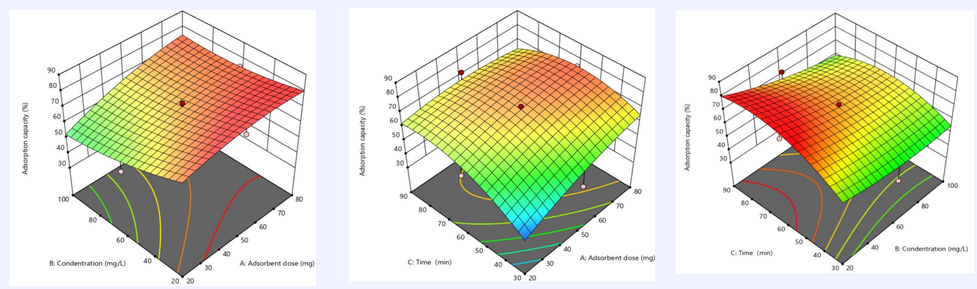
The removal efficiency was evaluated considering various influencing factors such as adsorbent dosage, solution pH, and contact time. MgFe-LDH/Alginate beads demonstrated a significantly higher adsorption capacity for phosphate ions (86%) compared to nitrate ions (67%).

• RSM optimization

% Phosphate



% Nitarte



These results demonstrate that the response surface methodology (RSM) is a powerful method for optimizing the operational conditions of the adsorption process to remove phosphate (89% with m=20mg, Ci=130 mg/L and tc= 45 min) and nitrate (76% with m=60mg, Ci=20 mg/L and tc=90 min)

Conclusion

- ✓ **MgFe-LDH/Alginate beads exhibited a significantly higher adsorption capacity for phosphate ions compared to nitrate ions.**
- ✓ **This optimization process confirmed the potential of MgFe-LDH/Alginate beads as an effective adsorbent for treating water contaminated with phosphate and nitrate ions.**

The environmentally friendly nature of the alginate-encapsulated LDH beads underscores their compatibility with green chemistry, aiming to reduce the environmental impact associated with traditional adsorbents.

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