COLLEGE OF ENGINEERING
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

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Research Horizons Day

Porous magnetic NiLa-LDOs/Fe_3O_4 for improved phosphate adsorption and antibacterial activity in secondary effluent

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Introduction

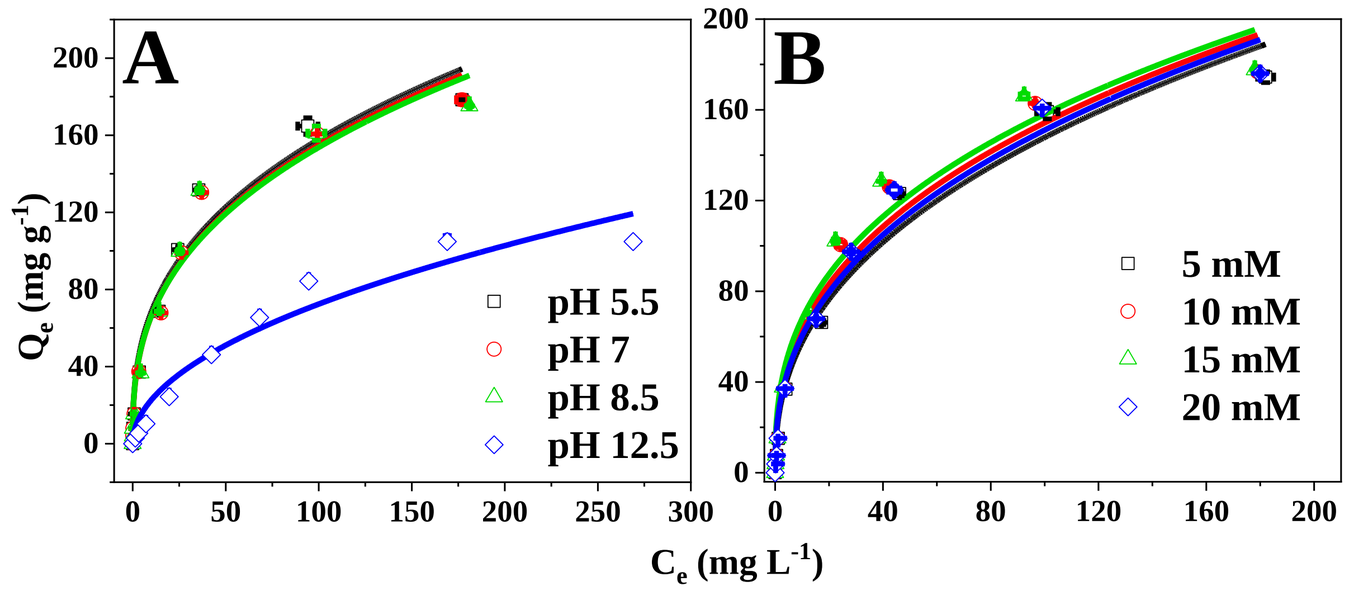
- Excessive discharge of phosphate (nutrients), which one of the main sources is secondary effluent from wastewater treatment plant, is the major cause of eutrophication.
- Layered double hydroxides (LDHs) and their calcination derivatives layered double oxides (LDOs) are promising adsorbents. LDHs are brucite-like layers denoted as $M^{2+}_{1-x}M^{3+}_{x}(OH)_2A^{n-}_{x/n}.mH_2O$, in which M^{2+} and M^{3+} are the di valent and trivalent cations, respectively, x is the molar ratio of $\frac{M^{3+}}{M^{3+}+M^{2+}}$ and A^{n-} are the intercalated anions. The high surface area, low cost, highly tunable interior architecture and outstanding anion-exchange ability render LDHs potential adsorbents for both inorganic and organic contaminants.
- Magnetic porous NiLa-LDOs/Fe_3O_4 were synthesized via low temperature co-precipitation with dispersed Fe_3O_4 nanoparticles and egg white solution, and subsequently employed for the adsorption of phosphate. The low-cost and simple egg white treatment helped enhance the porosity and surface area of LDOs considerably, and thus the adsorption capacity. The antibacterial property toward *E. coli* of the material was also tested.

Materials and methods

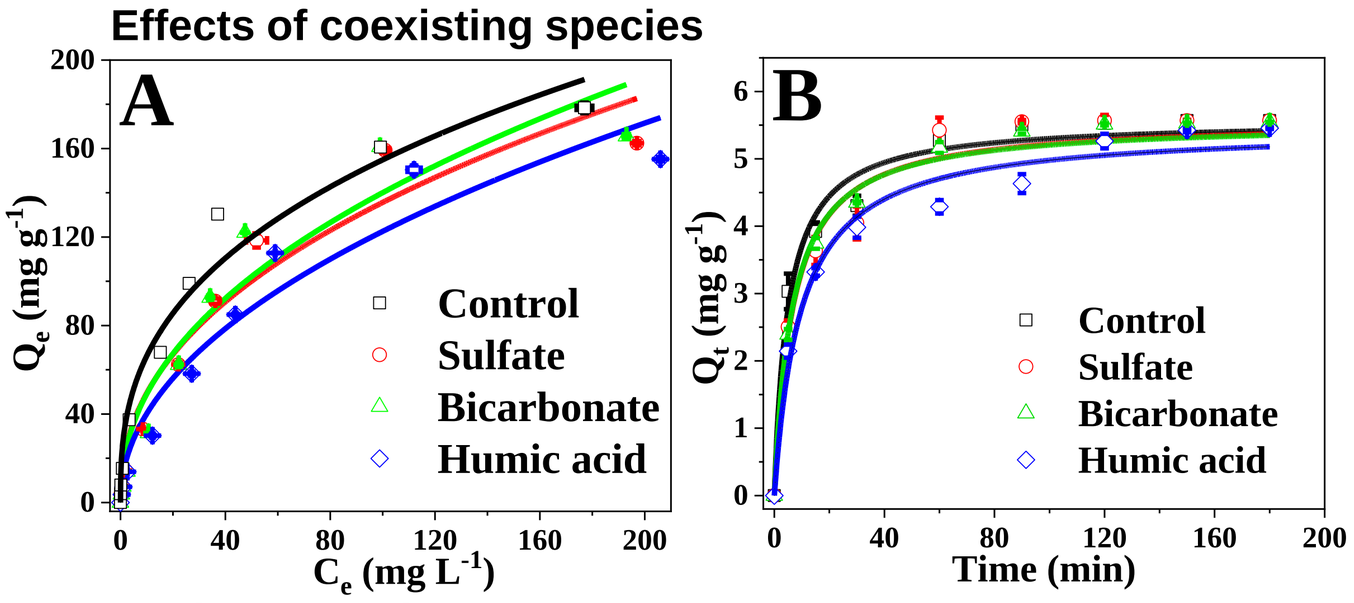
- Fe_3O_4 nanoparticles were prepared using $FeCl_3$, EDTA, ethylene glycol, Na_2CO_3.
- Co-precipitation method of $NiCl_2$ and $LaCl_3$ on Fe_3O_4 nanoparticles and egg-white template was performed (at 80°C, pH 10) to obtain NiLa-LDHs/Fe_3O_4, which was then calcined at 500°C for one hour to obtain NiLa-LDOs/Fe_3O_4.
- Batch adsorption and antibacterial tests (50 mg adsorbent and 40 mL phosphate solution) were performed in a shaking water bath (at 60 rpm, 25°C).

Results

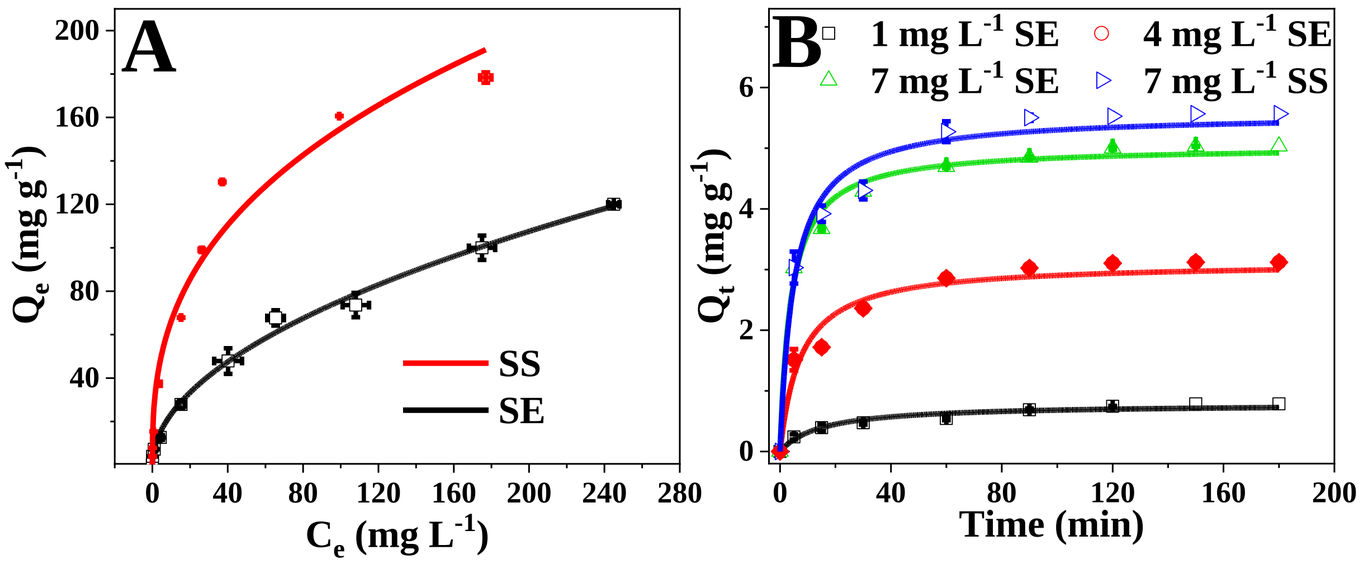
Effects of pH and ionic strength



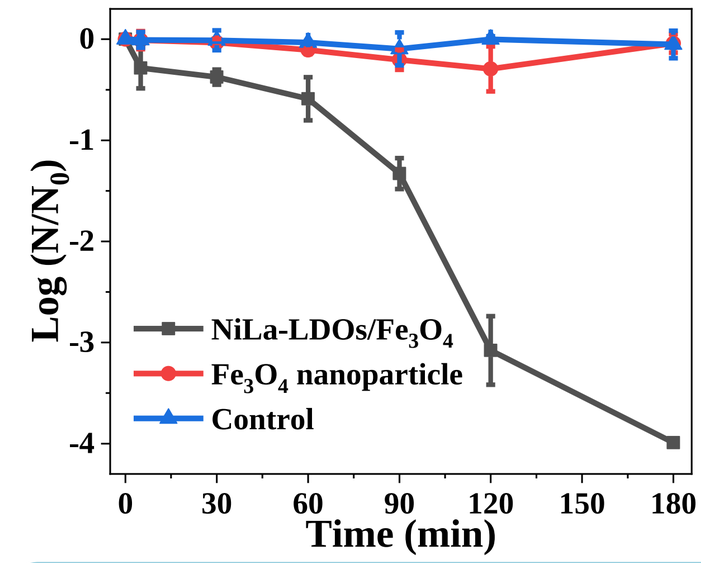
Effects of coexisting species



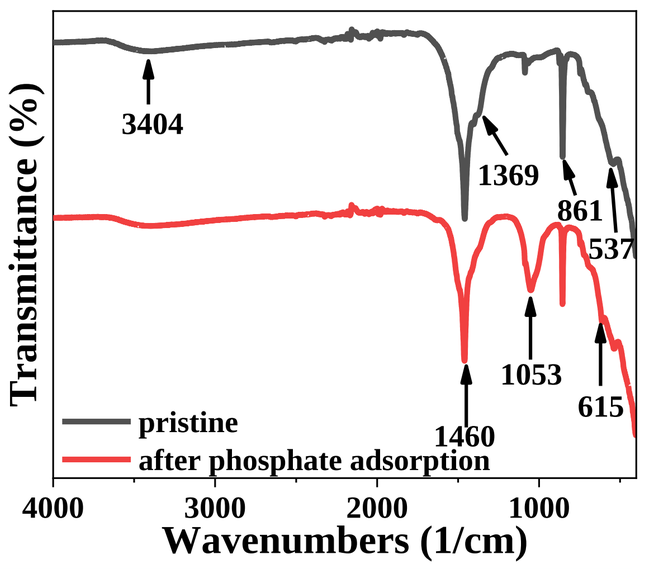
Testing on real wastewater



E. coli antibacterial activity



FTIR analysis



Conclusions

- The porous magnetic NiLa-LDOs/Fe_3O_4 performed well in phosphate removal and antibacterial activity tests, making it a compelling solution for secondary effluent management.

Acknowledgements

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