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Co-removal potential of heavy metals and dyes from wastewater by simultaneous adsorption with biomass residue formed from microbial treatment of lacquer residue

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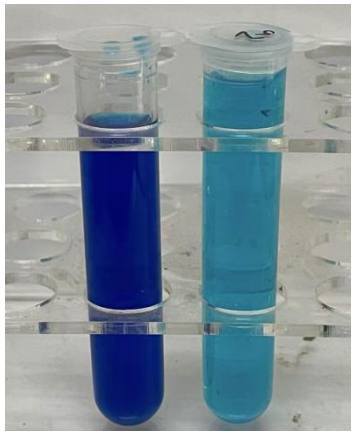
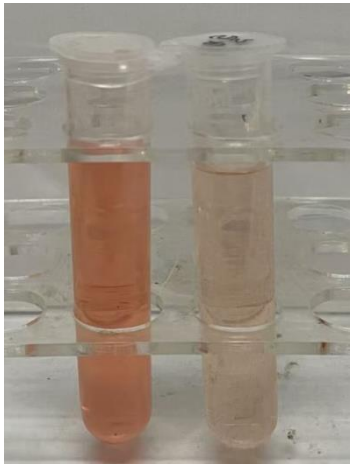
Research Summary

This study aims to explored whether the lacquer residue biomass (LBM) can be used as a valuable adsorbent material for the simultaneous removal of heavy metals and dyes in Pb^{2+}-MB/CR composite systems, thus realizing the purpose of treating waste of waste.



- To explore the simultaneous adsorption characteristics of Pb^{2+} and MB or CR by LBM in the Pb^{2+}-MB/CR composite systems through adsorption kinetics, isothermal adsorption, and adsorption thermodynamics experiments.
- To reveal effects of different environmental conditions or coexisting ions in adsorption systems on simultaneous removal of heavy metals and dyes by LBM through changing pH, ionic strength, LBM dosage, temperature, or coexisting anions/cations type.
- To explore the potential for regeneration and recycling of LBM after adsorption in the Pb^{2+}-MB/CR composite systems through the desorption experiments of LBM.
- To understand the simultaneous adsorption mechanisms of Pb^{2+} and MB or CR by LBM in the Pb^{2+}-MB/CR composite systems through scanning electron microscopy, X-ray diffraction, and Fourier transform infrared spectroscopy to analysis the surface features of LBM before and after adsorption.



Conclusions

- The adsorption kinetics of Pb^{2+} and MB or CR by LBM in the Pb^{2+}-MB/CR composite systems can be effectively characterized by the pseudo-second-order kinetic model (R^2>0.97). The maximum actual adsorption capacity for Pb^{2+}, MB and CR was 14.89 mg/g，3.16mg/g，2.86 mg/g, respectively.

- The adsorption removal of Pb^{2+} and MB increases with the pH and decreases as the ionic strength increases, while the removal rate of CR shows an opposite trend. The different coexisting cations and anions have a limited effect on the simultaneous adsorption removal of Pb^{2+}, MB, and CR in the Pb^{2+}-CR composite system.

- In the Pb^{2+}-MB composite system, the adsorption of Pb^{2+} and MB by LBM is antagonistic; However, in the Pb^{2+}-CR composite system, the adsorption of Pb^{2+} and CR by LBM is synergistic.

- In the Pb^{2+}-MB/CR composite systems, the desorption rates of LBM-adsorbed Pb^{2+}, CR and MB were lower than 12.96%, 7.16%, and higher than 68.4%, respectively. Which indicated that the optimal resource utilization pathway of LBM in both systems was as a disposable absorbent.

- The simultaneous adsorption of Pb^{2+} and MB or CR by LBM in the Pb^{2+}-MB/CR composite systems are controlled by complex interactions involving hydrogen bonding, complexations, π–π bonding interactions, and electrostatic interactions.

Innovation points

- **LBM was found to be a novel disposable adsorbent material for simultaneous removal of heavy metals and dyes in Pb^{2+}-MB/CR composite systems, which indicated LBM could realized resource utilization used as adsorption material by the patway of treating waste with waste.**



Innovation points

- **The various inorganic and organic components of LBM contribute to simultaneous adsorption and removal of Pb^{2+} and MB or CR in the Pb^{2+}-MB/CR composite systems.**
- **The interactions between LBM and Pb^{2+} and MB or CR in the Pb^{2+}-MB/CR composite systems are mainly hydrogen bond interaction, complexation, π-π bond interaction and electrostatic interaction.**

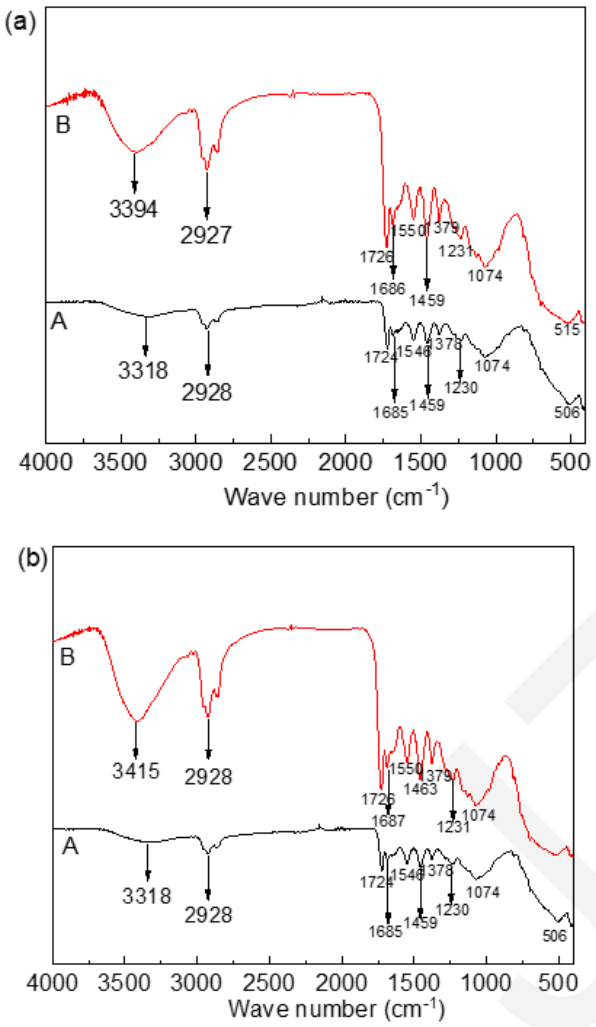


Fig. 5 FTIR characteristics of LBM in Pb^{2+}-MB (a) and Pb^{2+}-CR (b) composite systems (A: before adsorption; B: after adsorption)

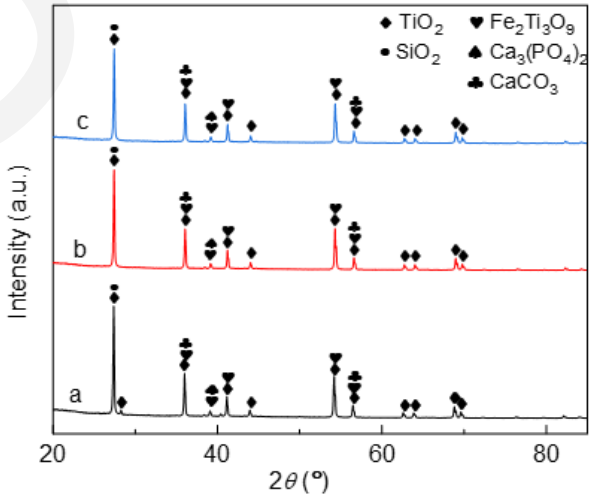


Fig. 4 XRD characteristics of LBM in the Pb^{2+}-MB/CR composite systems before and after adsorption (a: before adsorption; b: after adsorption of Pb^{2+}-MB; c: after adsorption of Pb^{2+}-CR)