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Novel and Efficient Method for Lead Ions Biosorption from Aqua Solution by Artemia Cysts

Somayyeh Ziaei [a], Hossein Ahmadzadeh[a*], Zarrin Es'haghi,[b]

[a]*Department of Chemistry, Faculty of Science, FerdowsiUniversity of Mashhad,9177948974Mashhad, Iran*

[b]*Department of Chemistry, Payame Noor University, 19395-4697 Tehran, Iran*

[*] *E-mail: h.ahmadzadeh@um.ac.ir*

Introduction

The eco-friendliness and affordability of biosorption as a water treatment method to eliminate hazardous heavy metal ions, has stimulatedthe interest of many scholars that explore this arena [1], [2].

The study proposes Artemia cysts (A.C.) as a new and efficient biosorbent for the elimination of lead ion contaminants which can continuously produce new and multifold cysts as a sorbent in every cycle. Cyst of Artemia is composed of multiple layers covered with a porous surface and numerous functional groups that are capable of vigorous encapsulation of lead ions[3], [4].

Experimental

$$q_e = \frac{(C_0 - C_e)V}{W} \qquad (1)$$

In this study, the effect of some essential parameters such as initial pH, shaking time and concentration of Pb ions were optimized. For batch sorption experiments, 50.0 mg of A.C. was introduced into an Erlenmeyer flask containing 50 mL solution with 50 mgL^{-1} lead (II) ions. The pH of solution was adjusted by adding a small amount of diluted HNO_3 or NaOH. The glass flasks were transferred to an incubator shaker under a constant shaking speed of 150 rpm for 2 hours at 25 °C and then the sorbent was filtered. Finally, the residual lead concentrations were calculated using the flame atomic absorption spectrophotometer.

Result and Discussion

Characterization of the Artemia cyst:

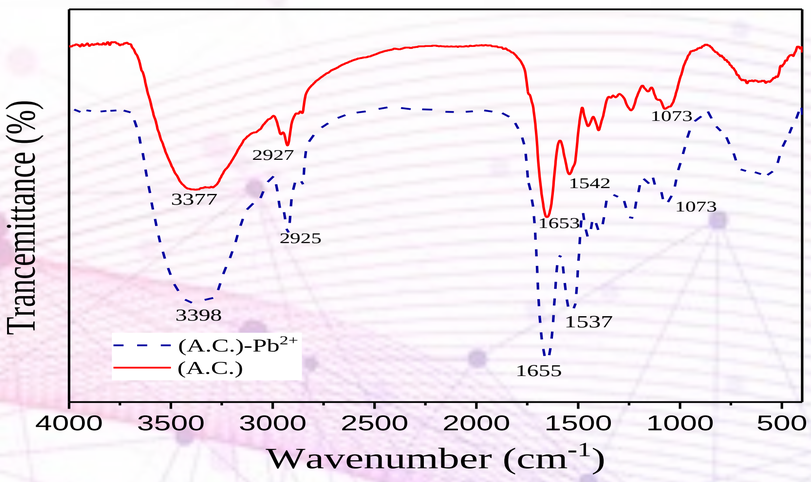


Fig. 1. FT-IR spectra of the A.C. after and before Pb ions uptake

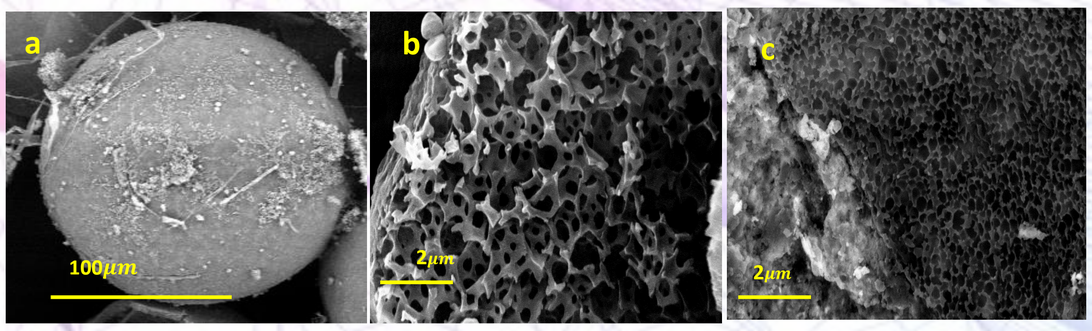


Fig. 2. SEM images before uptake of lead ions for (a) cyst of *Artemia;* (b) pore structures of the inner porous of cysts; and SEM images after uptake lead ions for (c)

Fig. 3. (a) pH effects on Pb(II) uptake (conditions: 0.5 g L^{-1} sorbent, initial lead (II) concentration of 50 mg L^{-1} at 25ºC); **(b)** Pb^{2+} species distribution at different pH values

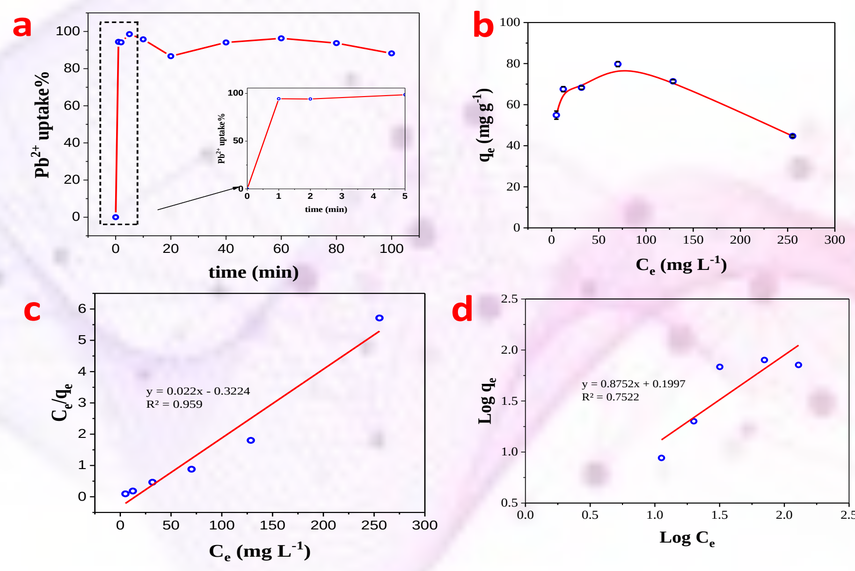
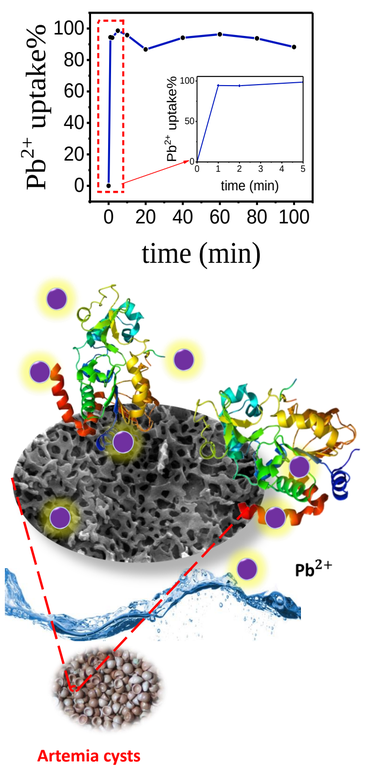


Fig. 4. (a) Biosorption rate at different time intervals, (b) Biosorption isotherm, (c) Langmuir isotherm and (d) Freundlich isotherm

Conclusion

- ✓ Maximum uptake 94.40% at pH 5.8 in less than 1 min with 50mg.$L^{-1}$of initial concentration of lead ions.
- ✓ Kinetics models well fitted by Langmuir isotherm.
- ✓ Efficient and straightforward performance of Artemia cysts in purifying contaminated water with lead ions.
- ✓ Novel method integrates merits of simplicity, time-optimization and affordability in addition to the reusability, good biodegradability, low cost, high efficiency and the possibility of metal recovery.



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