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Effect of competitive interferences on the biosorption of lead ions using Artemia Cysts

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Introduction

Water being an existential element that sustains life on earth. Even trace amounts of heavy metal contaminating water impose a detrimental threat to human health[1]. Various biomaterials, have been examined as sorbents to remove heavy metal ions[2]. Most biosorbents would be saturated with high salt ion concentrations, resulting in loss of chemical stability. Therefor, researchers are persistently investigating the potential use of adsorbents with sufficient capacity for intended ion adsorption in the presence of other competitive ions. Selectivity is argued as one of the essential parameters for successful adsorbent process[3]. In this study, we propose Artemia cyst as a robust lead ions biosorbent in the presence of high concentration of common available ions at optimum experimental condition.

Experimental

The competing experiments were performed by adding Na^{+}, Mg^{2+}, and Ca^{2+}ions at different concentrations to the initial 50 mgL^{-1} Pb (II) at 25 °C, with 50.0 mg sorbent at pH = 5.8. The contents of each flask were transferred to an incubator shaker for 2 hours. For the rate of Pb (II) sorption process on A.C. , 0.5 g of A.C. was added into a 500 mL solution containing 50 $mgL^{-1}$of lead ions. Mechanical stirring was used to attain full mixing, and 0.5 mL of the solution was sampled at a specific time. Finally, the residual lead concentrations were calculated using the flame atomic absorption spectrophotometer (FAAS).

Result and Discussion

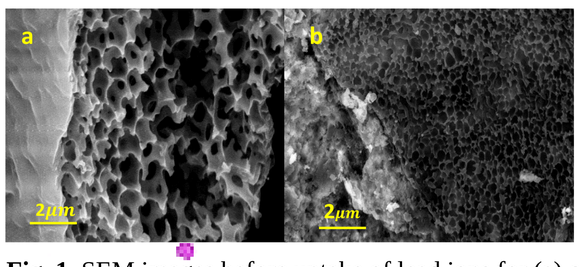

Fig. 1. SEM images before uptake of lead ions for (a) cyst of *Artemia;* (b) after uptake lead ions

Fig.1 show the chorion layer and outer cuticular membrane of cyst with 3D hierarchical morphology structure while size ranges of pores are widespread.

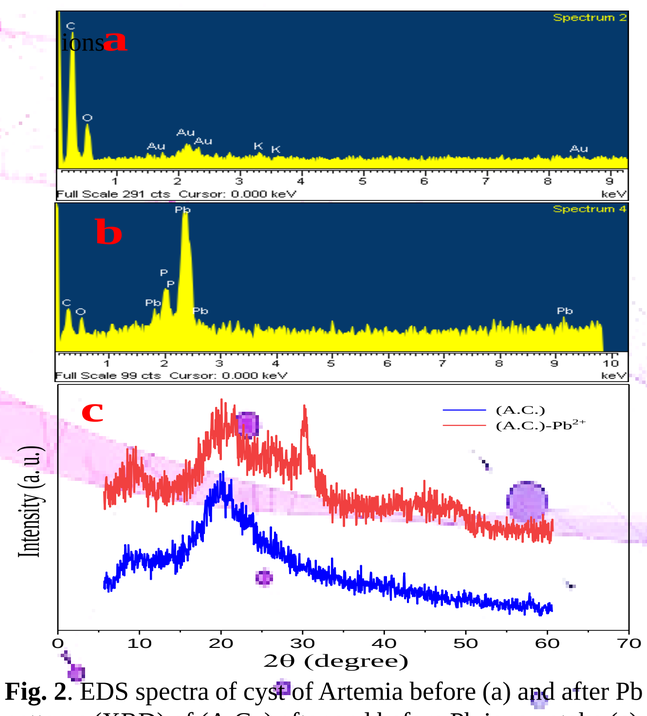

Fig. 2. EDS spectra of cyst of Artemia before (a) and after Pb ions uptake (b) X-ray diffraction patterns (XRD) of (A.C.) after and before Pb ions uptake (c)

Fig.2.c. shows the noisy pattern and broad peak of cysts that suggest an amorphous structure . After lead uptake, the new distinct peaks at 2θ values of 25.76 and 30.21 are observed

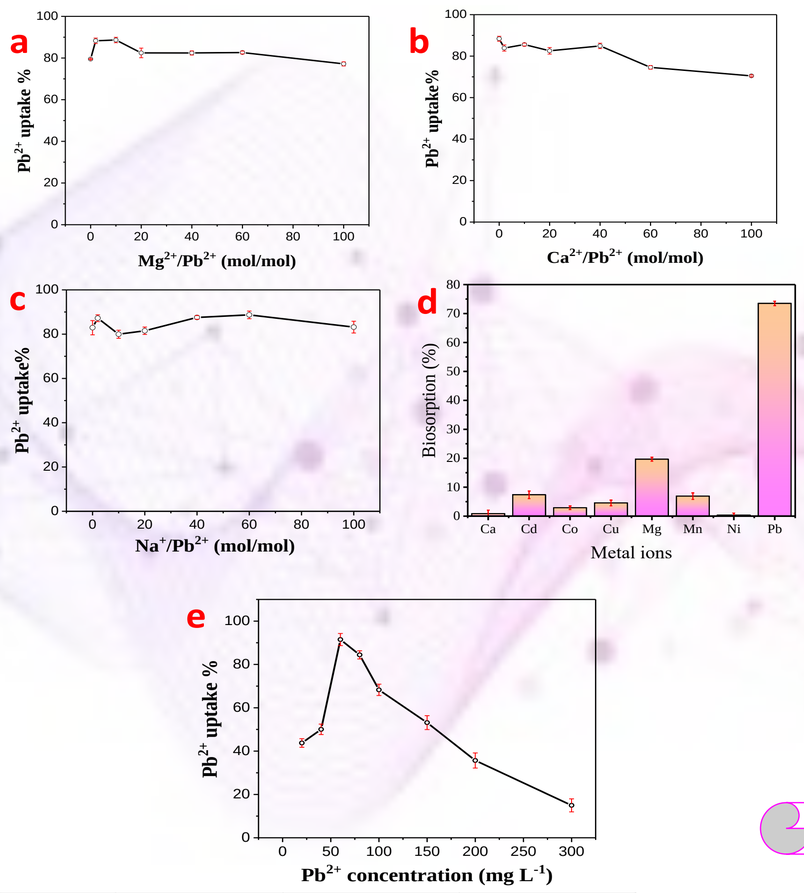

Fig. 3. (a–c) Biosorption selectivity evaluation for the effects of Mg, Ca and Na ions on lead ions uptake by A.C. respectively.
(d) Competing cations effect for Pb (II) biosorption (Pb(II) concentration 1mg L^{-1}, competing ion concentration was 20.0 mg L^{-1})
(e) Effect of initial Pb ions concentration on uptake by A.C.

T(K)	ΔG° (kJ.mol^{-1})	ΔH° (kJ.mol^{-1})	ΔS° (J.mol^{-1}.K^{-1})
298	-3.24	-28.74	-86.133
313	-1.46		
333	-0.22		

Table 1. Thermodynamic parameters for the biosorption of lead ions on A.C.

Conclusion

- ✓ Artemia cysts revealed impressive selectivity and applicability in the presence of common available ions in their natural environment and several divers metal ions presented in wastewater samples at elevated levels.
- ✓ Artemia cyst were demonstrated having faintly lower biosorption (73.5%) when compared to single ion biosorption (94.40%).
- ✓ Thermodynamic parameter showed this processes exothermic and spontaneous.

selectivity distribution ratio, Kd (mLg^{-1}) $K_d = \frac{(C_0 - C_e)}{C_e} \times \frac{V}{M}$

References

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