Assessment of efficiency *Allium sativum* L. used in the bioremediation of metals cadmium (II) and Nickel (II) in aqueous solution

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Abstract

In the last years various materials have been tested in search of better biosorventes. In this work was carried out an experimental study to evaluate the efficiency of the garlic, *Allium sativum*, as biosorbent. Synthetic samples containing cadmium and nickel were treated with adsorbent and analyzed by Inductively Coupled Plasma - Optical Emission Spectrometry (ICP-OES). The results showed that garlic is a reasonable adsorbent for cadmium and unsuitable for nickel.

Introduction

Garlic, whose botanical name is "*Allium sativum* L." is a condiment often used in culinary[1]. It has also been used for other purposes, its bulb, for example, has properties beneficial to health[2].

For this study, were used samples previously dried in an oven for 72 hours at 40°C with a particle size of 125 mesh and aqueous solutions of cadmium nitrate and nickel nitrate at a concentration of 2.0 mg L^{-1}. Adsorbent (2.0 g) and solutions were mixed and subjected to constant agitation for 30 min at 200 rpm with pH control (6.0) and temperature (25°C). The solutions were filtered with cellulose nitrate filter paper 0.7 µm and analyzed by ICP-OES.

Results and discussion

After the analyzes were calculated the amount of adsorbed metal (Q_{eq}) and the percentage of metal removed from the solution (% *R*). Table 1 presents the results for the solutions I (cadmium nitrate), II (nickel nitrate) and III (cadmium nitrate and nickel nitrate).

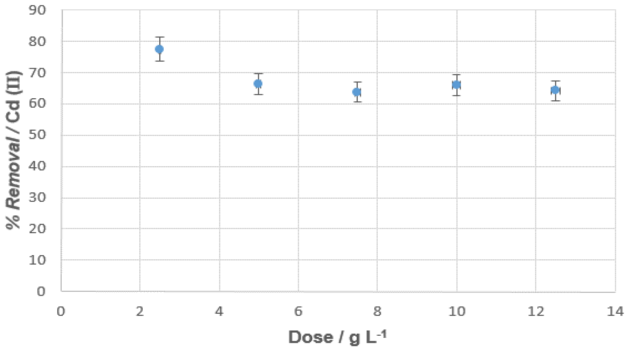
Table 1. Quantity metal removed from the solution.

	Q_{eq} (mg g^{-1})		% *R*	
	Cd^{2+}	Ni^{2+}	Cd^{2+}	Ni^{2+}
I	0.355 ± 0.009	-	29.91 ± 0.31	-
II	-	0.059 ± 0.011	-	5.69 ± 1.05
III	0.326 ± 0.001	0.053 ± 0.008	28.44 ± 1.89	5.00 ± 0.86

[pH = 6,0; t = 25°C; stirring time = 30 min]

The biosorption order obtained ($Cd^{2+} > Ni^{2+}$) was consistent with the properties of the metal ions studied[3]. It was noticed that the adsorbent presented itself as more appropriate for cadmium, which led to an assay to assess the variation of adsorbent dose for a fixed concentration of the metal (C_o = 2.41 mg L^{-1}). In this study, the dose of biosorbent was defined as the amount of garlic in contact with a volume of 1.0 L of cadmium solution. It was varied the amount of biosorbent of 2.5 to 12.5 g L^{-1} (Figure 1).

Figure 1. Removal percentage of the cadmium in function of varying the dose of *A. sativum*.



[C_o = 2,41 mg L^{-1}; pH = 6,0; t = 25°C; stirring time = 50 min]

The curve analysis allows to realize that increasing the dosage of adsorbent above 2.5 g L^{-1} does not improve the ability to remove cadmium from aqueous solution.

Conclusions

Garlic is not feasible for nickel removal in aqueous solution, but can be used for the removal of cadmium. We can say that there is no significant difference in adsorption when the two metals are treated separately or jointly. In study of the biosorbent dosage, it was found that the removal of cadmium decreases with the increasing dose, reaching equilibrium and making it practically constant at 5.0 g L^{-1}.

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