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Adsorption of Hexavalent Chromium from Acidic Solutions using Coriander Leaves Powder

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ABSTRACT

Discharges of industrial effluents containing hazardous heavy metals are increasingly polluting our environment. It is therefore essential to propose the best suited treatment method to eliminate and/or recover them. This work aimed at investigating the potential of coriander leaves powder as abundant and low cost biosorbent to remove hexavalent chromium from acidic solutions. Effects pH, contact time, biosorbent dose, initial Cr(VI) concentration were studied. The kinetics study showed that the maximum adsorption (100%) was reached after 120 min at pH 2. The results of this study showed that the coriander leaves powder is an efficient sorbent for the removal of Cr(VI) and is more economical when compared with commercial adsorbents.

1 Introduction

Hexavalent chromium is a hazardous toxic metal ion which is highly present in wastewater and industrial effluents generated from diverse industries such as electroplating, textiles, leather tanning, paints, and cosmetics. Several conventional methods are proposed to remove hexavalent chromium from aqueous solutions such as chemical precipitation [1] solvent extraction [2], biological treatment [3] coagulation and precipitation [4]. However, these methods aren't all satisfying and generate a supplementary harm to the environment. In this work we suggest a biosorption process using agricultural wastes such as coriander leaves for removing toxic heavy metal ions from contaminated solutions. These natural materials are non-toxic and offer a cost-effective alternative with a high-efficiency which has already shown its success in the field.

2 Experimental

2.1 Preparation of the adsorbent

Coriander leaves were washed with distilled water to remove dust and dirt. Then, it was dried and exposed to sunlight for weeks. After drying, coriander has been crushed into powder and sieved. A powder have been obtained (100 µm) and stored in sterilized containers.

2.2 Preparation of adsorbate solution

Stock solution of hexavalent chromium (100 $mg.L^{-1}$) was prepared by dissolving a required amount of $K_2Cr_2O_7$ ((purities >98%) was purchased from Sigma-Aldrich (Germany)) in double deionized water.

2.3 Adsorption experiments

Adsorption studies were carried out in batch mode by stirring out different amounts of adsorbent in 50 ml of metallic solution at different experimental conditions. The mixture was then filtered through a Whatman No. 41 filter paper and the final concentration of the metal ion was determined by atomic absorption spectrometry (AAS).

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3 Results and discussion

Effect of stirring time

Kinetic adsorptions were carried out at different initial concentrations of chromium 10 mg.L^{-1} and 50 mg.L^{-1} for contact times ranging from 5 min to 300 min at room temperature. An amount of 0.5 g adsorbent was added to 50 ml of chromium solution.

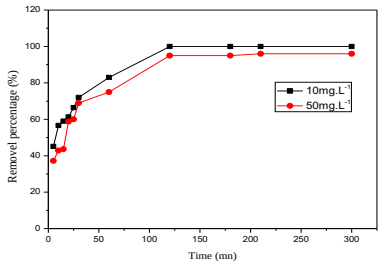

Figure1: Effect of the initial concentration of Cr(VI) and contact time on the adsorption process. [Cr(VI)] = 10 or 50 mg.L^{-1}, pH= 2, adsorbent dose= 0.5g

Figure1 shows that the efficiency and adsorption capacity of chromium increased gradually with increasing adsorption time and reached 100% of chromium adsorption at pH= 2 after 120 min of stirring when the Cr(VI) initial concentration is 10 mg.L^{-1}.

Effect of pH

The effect of pH on the adsorption of hexavalent chromium was studied. The pH was adjusted by adding an appropriate amount of dilute solutions of 0.1 M HCl and 0.1 M NaOH.

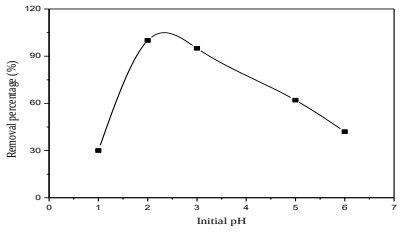

Figure2: Effect of pH on the adsorption process. [Cr(VI)] = 10 mg.L^{-1}, adsorbent dose= 0.5g.

The results given in figure 2 show that the adsorption of Cr(VI) ions is maximal at pH= 2.

Effect of biosorbent dose

Three varying amounts (0.25g, 0.5g and 1g) of the biosorbent were tested over 120 minutes. The results show that the removal efficiency of Cr(VI) ions increases when the biosorbent amount increases (fig.2). The best adsorption is obtained with 1g of adsorbent.

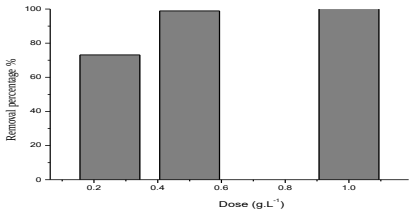

Figure3: Effect of the adsorbent amount on the adsorption process. [Cr(VI)] =10 mg.L^{-1} , pH= 2 , adsorbent dose= 0.25g, 0.5g,1g.

Effect of electrolyte addition

The effect of various electrolytes such as $NaNO_3$ and NaCl on the adsorption of hexavalent chromium was investigated. An amount of 0.5 g adsorbent was added to 50 ml of chromium solution. The results show that the electrolytes have a competitive effect on the adsorption process. It was found that the adsorption of Cr(VI) ions was affected by the presence of NaCl or $NaNO_3$.

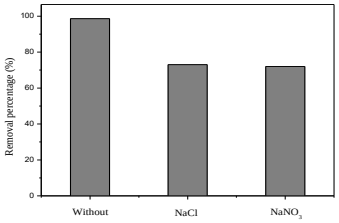

Figure4: Effect of various electrolytes on the adsorption process. [Cr(VI)] = 10 g, adsorbent dose= 0.5g, [$NaNO_3$]= [NaCl]=10^{-2}M

4 Conclusion

Coriander leaves powder is an efficient natural adsorbent for Cr(VI) ions. The maximum adsorbed quantity of Cr(VI) is 100% at optimal condition.

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References

[1] A. K. Golder, A. K. Chanda, A. N. Samanta, S. Ray, Removal of hexavalent chromium by electrochemical reduction–precipitation: investigation of process performance and reaction stoichiometry, Sep. Purif. Technol., 76 (3) (2011) 345-350. http://dx.doi.org/10.1016/j.seppur.2010.11.002

[2] A. Kokare, V. Suryavanshi, S. Zanje, G. Kore, D. Waghmode, M. Anuse, Development of a rapid and reliable liquid–liquid extractive method for the effective removal of chromium(VI) from electroplating waste water and tannery effluents, Russian J. Inorg. Chem., 62 (2017) 527-538. http://dx.doi.org/10.1134/S003602361704009X

[3] B. Dhal, H. N. Thatoi, N. N. Das, B. D. Pandey, Chemical and microbial remediation of hexavalent chromium from contaminated soil and mining/metallurgical solid waste: A review. J. Hazard Mater., 250 (2013) 272-291. http://dx.doi.org/10.1016/j.jhazmat.2013.01.048

[4] K. Cheballah, A. Sahmoune, K. Messaoud, N. Drouiche, H. Lounici, Simultaneous removel of hexavalent chromium and COD from industrial wastewater by bipolar electrocoagulation, Chem. Eng. Process: Process Intensification, 96 (2015) 94-99. http://dx.doi.org/10.1016/j.cep.2015.08.007

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