RJC

RASĀYAN J. Chem.
Vol. 7 | No.4 |375-379 | October-December | 2014
ISSN: 0974-1496 | e-ISSN: 0976-0083 | CODEN: RJCABP
http://www.rasayanjournal.com
http://www.rasayanjournal.co.in

ADSORPTION CHARACTERISTICS OF *AILANTHUS EXCELSA* BARK AS A ADSORBENT FOR RETRIEVAL OF Pb(II) AND Co(II) FROM AQUEOUS SOLUTIONS

V.H. Waghmare* and U.E. Chaudhari
Department of Chemistry, Mahatma Fule Arts, Commerce and Sitaramji Chaudhari Science Mahavidyalya Warud, Dist. Amravati (MS) India
*E-mail: uechaudhari@gmail.com

ABSTRACT
In this investigation an attempt has been made to remove Pb(II) and Co(II) from aqueous solution by using Ailanthus Excelsa **B**ark as an inexpensive adsorbent. Various parameters such as Adsorbent dosages ,P^H and Contact time having and impact of adsorption efficiency were studied. Equilibrium contact time was found to be 360 minutes for both Pb(II) and Co(II). The removal efficiency for Pb and Co at these contact time was 85.43% and 84.71% respectively. The adsorption data were modeled by using both Langmuir and Freundlich adsorption isotherm.
Keywords: Adsorption, Ailanthus Excelsa Bark, Lead and Cobalt removal, Adsorption isotherm.

INTRODUCTION

Rapid industrialization and urbanization has resulted in the deterioration of water, air, and land quality. Natural waters are contaminated with various heavy metals arising from mining wastes and industrial discharges. The tremendous increase in the use of heavy metals over the past few decades has resulted in an increased flux of metallic substances into the environment. The heavy metals are of special concern because they are non-degradable and therefore persistent. These metals are toxic both in their chemically combined forms and in the elemental form. Development of modern industry causes increasingly serious pollution in the environment. The effective removal of heavy metal ions from water is among the most important issues for many industrialized countries.[1]

Cobalt, a natural element present in certain ores of the Earth's crust, is essential to life in trace amounts. It exists in the form of various salts. Pure cobalt is an odorless, steely-gray, shiny, hard metal. Everyone is exposed to low levels of Cobalt in air, water and food. An average of 2 gdm^{-3} in drinking water has been estimated[2].

It is important to remove Cobalt from wastewater due to its known toxicity. The effects of acute Cobalt poisoning in humans are very serious, among them are asthma-like allergy, damage to the heart, causing heart failure, damage to the thyroid and liver. Cobalt may also cause mutations (genetic changes) in living cells[3]. Adsorption is one of the methods commonly used to remove heavy metal ions from various aqueous solutions with relatively low metal ion concentrations[4].

Environmental concerns have motivated many physico-chemical methods for heavy metal removal from aqueous solution. Exposure to Lead for instance, is widely recognized as a major risk factor for several human diseases, and the structure of industrial ecological systems have made exposure to Lead unavoidable for most people alive today.[5]

Nowadays, with the exponential increase in population, measures for controlling heavy metal emissions into the environment are essential. Lead causes many serious disorders like, anemia, kidney disease, nervous disorders, and even death. At present Lead pollution is considered a worldwide problem because this metal is commonly detected in several industrial wastewaters[6].

The removal of poisonous Pb (II) from wastewater by different low-cost abundant adsorbents was investigated. Rice Husks, Maize cobs and sawdust, were used as different adsorbent. Natural materials that are available in large quantities or certain waste from agricultural operations may have potential to be used as low cost adsorbents.[7]From the eco-toxicological point of view Pb, Cd, Cu, Co etc. are the dangerous metals, therefore removal of these heavy metals from aqueous water is a prime importance.[8]

EXPERIMENTAL

Preparation of Adsorbent

Ailanthus Excelsa Bark was collected from a local farm. It was cut in to small segment and dried in sunlight until almost all the moisture evaporated. Then it was ground to get desired particle size of 100 to 200 micron. It was then soaked 2 hours in 0.1M NaOH solution to remove the lignin content. Excess alkalinity was then removed by neutralizing with 0.1 N HCl. The *Ailanthus Excelsa Bark* was then washed several times with distilled water till the washings are free from color and turbidity. The washed bark was then dried in oven at 200^0 C for 24 hrs and stored in desiccators for the further study.

Preparation of solutions

The stock solution of Pb(II) and Co(II) were prepared by dissolving $Pb(NO_3)_2$ and $Co(NO_3)_2.6H_2O$. respectively in double distilled water. The analytical grade salt used for analysis. The desired solution were obtained by diluting the stock solution in double distilled water.

RESULTS AND DISCUSSION

Effect of pH

The pH of the metal solution was key parameter for adsorption of Pb(II) and Co(II). Optimization of pH was done at pH range 2-6.According to Fig.1 with increasing pH in the range of 4.0 to 6.0 metal uptake on adsorbent also increases. At higher pH the effect of competition from H^+ ions deceases and metal ions get adsorbed on the surface of adsorbent, resulting an increase in the metal uptake. The optimum pH of 4.5 was chosen for adsorption of Pb(II) and pH of Co(II) 4.0 respectively.

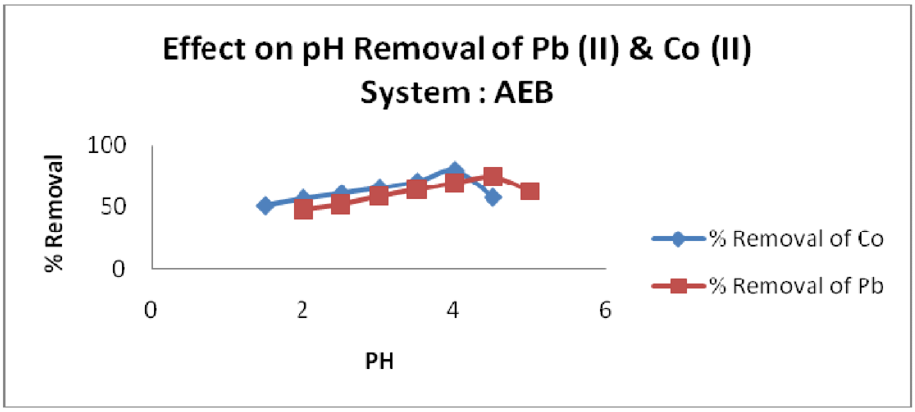

Fig.-1 : Effect of pH

Effect of Contact Time

The effect on contact time on the uptake of the studied cations on to the adsorbent is shown in Fig.2.this was achieved by varying the contact time from 30 to 360 minutes. Equilibrium contact time was found to be 360 minutes for Pb(II) and Co(II). The removal efficiency for Pb and Co at these contact time was 85.43% and 84.71% respectively.

Effect of Adsorbent Dosages

The effect of adsorbent dosages on removal of Pb(II) and Co(II) has been presented in Fig 3.the experiments were carried out by varying the adsorbent dosages from 200mg to 1gm/L. The adsorption capacity of adsorbent increases with increasing the adsorbent dosages. This is due to availability of more functional groups and surface area at higher dosages. In case of Pb(II) and Co(II) maximum removal was attained at 1.0 g/L of adsorbent weight.

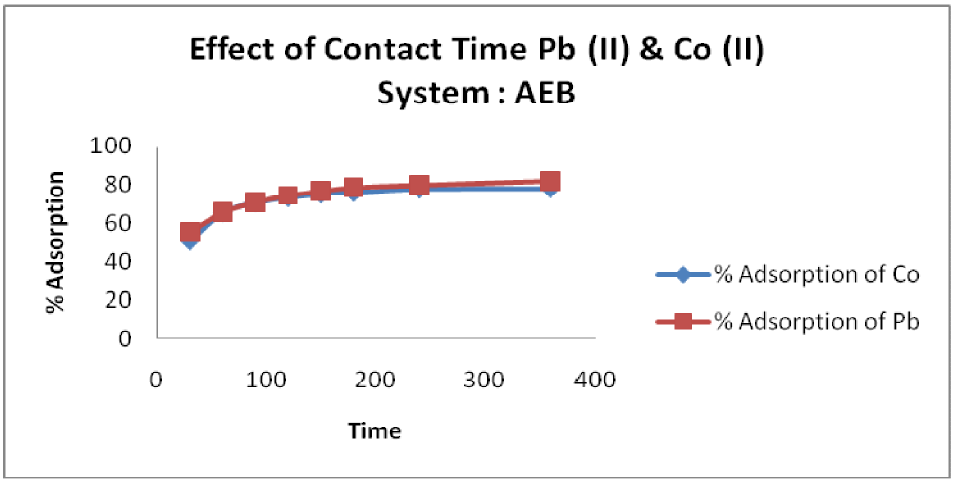

Fig.-2 : Effect of Contact Time

Adsorption Isotherms

Equilibrium adsorption isotherm equations are used to describe the experimental adsorption data. The parameters obtained from the different models provide important information on the sorption mechanisms and the surface properties and affinities of the adsorbent. The most widely accepted surface adsorption models for single-solute systems are the Langmuir and Freundlich models. The correlation with the amount of adsorption and the liquid-phase concentration was tested with the Langmuir and Freundlich isotherm equations. Linear regression is frequently used to determine the best-fitting isotherm, and the applicability of isotherm equations is compared by judging the Correlation coefficients.

Adsorption Isotherms Models

Freundlich Isotherm

The Freundlich isotherm is an empirical equations used to describe the heterogeneous adsorptions data. The sorption data of Pb(II) and Co(II) onto Ailanthus Excels Bark was also fitted to Freundlich isotherm in the following linear form -

$$\log qe = \log Kf + 1/n \log Ce \qquad (1)$$

Where, *qe* is the amount of metal ions adsorbed per gram of adsorbent (mg/g). Ce is the equilibrium concentration of metal ions in solution (mg/L). *Kf* and *1/n* are Freundlich constants, indicating the Adsorption Capacity and Adsorption Intensity respectively.Straight line were obtained by plotting logqe against logCe, which show that sorption of Pb(II) and Co(II) ions obeys Freundlich isotherm well. K_f and *1/n* values were calculated from intercept and slop of the plot respectively and presented in Table 1. The Correlation coefficient R^2=0.923 for Pb(II) 0.995 for Co(II), indicating that adsorption of Pb (II) and Co(II) ions on AEB follows the Freundlich isotherm. The value of 'r' indicated the type of the isotherm to be unfavorable if (r >1), linear if (r =1) and favorable for (0< r <1). As the value of 'r' lies between 0 to 1 shows favorable adsorptions. This confirmed that the bark used is favorable for adsorption of Pb (II) and Co(II) ion under the condition used in this work.

Langmuir Isotherm

The Langmuir isotherm is valid for sorption of a solute from a liquid solution as monolayer adsorption on a surface containing a finite number of identical sites. Langmuir isotherm model assumes uniform energies of adsorption onto the surface without transmigration of adsorbate in the plane of the surface. The Linear form of Langmuir equation is-

$$1 / qe = 1/ b\, Q_0 \times 1/Ce + 1/Q_0 \quad (2)$$

Q_0 and *b is* Langmuir constants related to the adsorption capacity and energy of sorption respectively. A plot of *qe* versus *C*e should indicate a straight line of slope 1/ b Q_0 and an intercept of 1/ Q_0. The values of *Qo* and b and Correlation Co-efficient obtained from the Langmuir model are shown in Table 1. The Correlation Co-efficient R^2>0.997 and 0.998 suggests that adsorption of Pb(II) and Mn(II) ions onto AEB follows the Langmuir isotherm. The maximum monolayer adsorptions capacity Q_0 obtained from the Langmuir is 18.181 and 9.803 mg/g. In order to observed whether the adsorption is favorable or not, a dimensionless parameter 'r' obtained from Langmuir isotherm is, $r = (1+ b \times Cm)^{-1}$

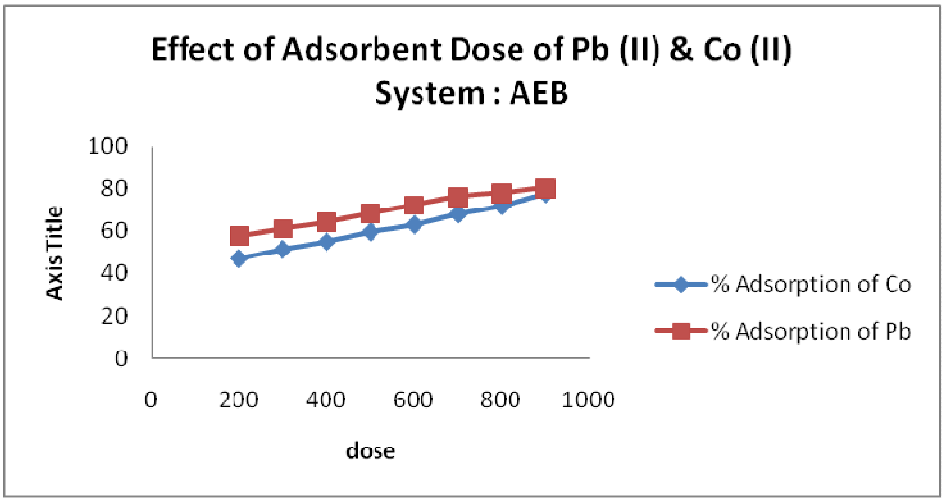

Fig.-3 : Effect of Adsorbent Dosages

Table-1: Isothermal Constants

Metal Ions	Freundlich Constants			Langmuir Constants		
	K	1/n	R^2	Q_0	b	R^2
Pb(II)	4.898	1.169	0.923	18.181	0.0194	0.994
Co(II)	7.413	0.769	0.995	9.803	0.077	0.998

CONCLUSIONS

1. The current investigation shows that *Ailanthus Excelsa* Bark is very effective adsorbent in retrieval of Pb(II) and Co(II) ions aqueous solutions.
2. The adsorption of Pb(II) and Co(II) ions are dependent on pH, Adsorbent dosages, Contact time.
3. In adsorption isotherm analysis Freundlich and Langmuir isotherm model well described the adsorption of both the Metal Ions Pb(II) and Co(II).
4. Hence, this Adsorbent can be used as a low cost adsorbent in the treatment of wastewater containing Pb(II) and Co(II) toxic ions.
5. The result show that in very short time, a good amount of the toxic Metal Ions can be Adsorb by the *Ailanthus Excelsa* Bark.

ACKNOWLEDGEMENTS

The authors are thankful to Dr. D. V. Atkare ,Principal Mahatma Fule Mahavidyalaya Warud for providing the necessary facilities for this investigations.

REFERENCES

1. Shaymaa H. Khazaal , *Eng. &Tech. Journal*, **29**, 9,(2011).
2. S. Rengaraj, Seung-Hyeo Moon, *Water Research*, **36**,1783(2002).
3. Evans T. Musapatika, Ruella Singh, Krishnie Moodley, Charles Nzila, Maurice S. Onyango and Aoyi Ochieng , *African Journal of Biotechnology*, **11**, 39, 9407 (2012).
4. Zahra Naseem, *Pak. J. Anal. Environ. Chem*., **13(1)**,1(2012).
5. D.Sai Seetha Rama Raju,V.Nageswara Rao, P.Rajendra Prasad, N.Chitti Babu, *International Journal Of Engineering Science & Advanced Technology,* **2(6)**, 1577 (2012).
6. Kafia M. Shareef Surchi, *International Journal of Chemistry,* **3(3)**, 3(2011).
7. N. T. Abdel-Ghani, M. Hefny, G. A. F. El-Chaghaby, *Int. J. Environ. Sci. Tech*., **4(1)**, 67 (2007).
8. Uma M. K. Nagpal And Hassan Rezaei, *Current Worlod Enviorment.* **5(2)**, 243 (2010).

[RJC-1175/2014]