International Journal of Advanced Science and Research
ISSN: 2455-4227, Impact Factor: RJIF 5.12
www.allsciencejournal.com
Volume 1; Issue 12; December 2016; Page No. 08-11

Studies on the adsorption characteristics of Hevea Brasiliensis seed coat charcoal on Cu (II) & Zn (II) Ions

D. Abilasha, L. Lisy

Nanjil College of Arts & Science, Nedungode, Kaliakkavilai, Tamil Nadu, India

Abstract

The present study was focused on the variety of Heva Brasiliensis seed coat, as an alternative adsorbent for the removal of Cu (II) and Zn (II) ions from aqueous phase. Both adsorption experiments were conducted by using Hevea Bresiliensis seed coat charcoal. Batch adsorption study used 100 ml solution containing heavy metals ion of varying concentration shaking and filtering were carried prior to measuring final residual heavy metals remaining in solution.

Batch experiments were conducted at room temperature 30°C to determine the factors affecting adsorption of Cu (II) and Zn (II) ions. The adsorption process is affected by various parameters such as contact time, solution pH, adsorbent does and initial concentration. The experimental data was tested using Langmuir and freundlich equations. The data was fitted well to both Langmuir and freundlich isotherms. The data was fitted Hevea Bresiliensis seed coat activated carbon charcoal could be used as low cost adsorbents and easily available in larger quantities especially for the removal of metal ions such as $Cu^{2+}$and Zn^{2+} ions.

Keywords: Hevea Bresiliensis seed coat charcoal, initial concentration, adsorbent, etc.

1. Introduction

Charcoal known as excellent adsorbent, is well known for it wide application. Its main use today is in the treatment of solution (or effluents) for the removal of noxious constituent's or colouring matters by sorption [1]. Charcoal is presently used as a raw material for active carbon. Time dependent study of metal ions adsorption on solids provides valuable information on the adsorption process and its mechanism. Rate of metal ions adsorption porous is dependent on a number of factors such as agitation of the solution, the state of metal ions in solution, concentration of metal ions and temperature. Temperature is the parameter generally ignored in most adsorption studies [2].

Furthermore, the release of heavy metals by industrial activities into the environment is one of the main concerns of researchers in recent years. The sources of metal contamination in the environment are metal, mining, steel industry, tannery, paint manufacturing, battery manufacturing and alloy processing industries. The heavy metals unlike other organic pollutants are not biodegradable and results into hazardous and products. It has been reported that at lower concentration heavy metals do not pose any threat to human health however at higher concentration they tend to get accumulated in human tissues [3]. If, excessive intake of copper by humans may lead to severe mucosal irritation, hepatic and renal damage, central nervous system irritation, etc. [4]. Copper and Zinc can be removed by ion – exchange, membrane separation reverse osmosis, solvent extraction,[5] and various methods involved coagulation, chemical oxidation, electrochemical and adsorption techniques have been used for removal of such metals, dyes etc. Among these methods, the adsorption onto activated carbon has been found to be superior compared to other techniques.

All the methods one generally expensive. Therefore it is important to reason for low – cost method which is effective and economic [6]. However commercially available activated carbons are still considered costly. This is due to the use of non-renewable and relatively expensive starting material such as coal, which is unjustified in pollution control applications. Therefore, in recent year, this has prompted a growing research interest in the production of activated carbon from renewable and cheaper precursors which are mainly industrial and agricultural by-products, especially for application concerning waste water treatment. Researchers have studied the production of activated carbon from rubber seed coat, pine wood, sawdust, etc. [6].

Hevea Brasiliensis or known commonly as rubber tree is the main source of natural rubber. Rubber seed coat, a waste agricultural by-product, is utilized in Malaysia as fuel and manure. To produce a value added product from rubber seed coat, it is proposed to convert it to activated carbon. Rangaraj *et al*. (2002) reported that activated carbon prepared from rubber seed coat is 2.25 timer move efficient compared to commercial activated carbon. Recently, a review on various types of low – cost adsorbents from agricultural waste materials for removing heavy metal ions has been published [7]. This paper presents a studies on the adsorption characteristics of hevea brasiliensis seed coat charcoal on Cu (II) & Zn (II) ions.

2. Materials & methods

2.1 Materials Required

Standard Copper Sulphate Solution
Standard Zinc Sulphate Solution
EDTA Solution
Fast Sulphon Black-T indicator
Eriochrome Black-T indicator
Distilled Water
Hevea Brasiliensis seed coat Charcoal.

2.2 Preparation of Plant Charcoals (Adsorbent)

Hevea Brasiliensis seed coat collected from Kadayal and Kaliyal, K.K District in the month of May. The collected plant were first washed with tap water then rinsed with deionised water and sun dried materials were then grinded with electric grinder. After been grinding the plant particles were sieved. The sieved particles were converted into charcoal by adding concentrated sulphuric acid [8]. Then the charcoal was washed with several times using deionised water, until the filtrate solution pH becomes neutral and then dried in a hot air oven at 80°C for 2 hours. The obtained charcoal was crushed in a mechanical grinder. Finally the fine powder was stored in a glass bottle to be used later without any pretreatment [9].

2.3 Procedure

Hevea Brasiliensis seed coat charcoal, were collected and dried on exposure to sun light, crushed and powdered and roasted using earthen ware and then powdered. Then these samples were dried at 70°C using petridish in an oven for one hour, and then cooled. This was used as adsorbent [10].

(i) Standardisation of EDTA Using Copper Sulphate

1 Litter of 0.1N Std. Copper Sulphate solution was prepared. 10ml of Std. Copper Sulphate solution was pipetted out into a conical flask. A burette was filled with EDTA solution. 2 drops of Fast sulphon black-T indicator was poured into the conical flask and was titrated against EDTA taken in the burette. Appearance of dark green colour will be the end point. From this the normality of EDTA was calculated [11].

2.4 Experiment for Concentrations

A standard solution of Copper sulphate was prepared. From this different concentrations of Copper sulphate solutions (i.e.,) 0.1N, 0.08N, 0.06N, 0.04N, 0.02N, were prepared in the previously washed and dried corning bottles numbered 1, 2, 3, 4, 5 respectively by the proper dilution of distilled water and respective metal ions. A known amount of adsorbent (lg) was accurately weighed and added to each of these bottles.

The bottles were stoppered well and shaken using mechanical shaker for one hour. After the adsorption equilibrium was established, the solutions in the bottles were filtered through whatt man no: 1 filter paper. 10 ml of the filtered solutions were pipette out from each bottles in a conical flask and titrated against the standard EDTA solutions using Fast sulphon Black-T as indicator. The experiment were carried out at room temperature (30+1ºC) under batch, mode [12]. The value of percentage removal and amount adsorbed (Kannan & Rajakumar, 2003) were calculated using the following relationships.

Percentage removal of $CuSO_4$ = 100 [C_i – C_e /C_i]

Amount of $CuSO_4$ adsorbed (Cad) = C_i – C_e

Where, C_i and C_e are initial and equilibrium (final) concentration of toxic metal ions (ppm), respectively.

(ii) Standardisation of EDTA Using Zinc Sulphate

1 Liter of 0.1N Std. Zinc sulphate solutions was prepared.10ml of Std. Zinc sulphate solution was pitette out into a concial flask. A burette was filled with EDTA solution. 2 drops of Eriochrome Black-T indicator was poured into the conical flask and was titrated against EDTA taken in the bruette. Appearance of blue colour will be the end point. From this the normality of EDTA was calculated.

2.5 Experiment for Concentrations

A standard solution of Zinc sulphate was prepared. From this different concentrations of Zinc sulphate solutions (i.e.,) 0.1N, 0.08N, 0.06N, 0.04N, 0.02N, were prepared in the previously washed and dried corning bottles numbered 1, 2, 3, 4, 5 respectively by the proper dilution of distilled water and respective metal ions. A known amount of adsorbent (lg) was accurately weighed and added to each of these bottles. The bottles were stoppered well and shaken using mechanical shaker for one hour. After the adsorption equilibrium was established, the solutions in the bottles were filtered through Whattman no: 1 filter paper. 10ml of the filtered solutions were pipette out from each bottle in a conical flask and titrated against the standard EDTA solutions using Eriochrome Black-T as indicator. The experiments were carried out at room temperature under batch mode [13]. The value of percentage removal and amount adsorbed (Kannan & Rajakumar, 2003) [15] were calculated using the following relationships.

Percentage removal of $ZnSO_4$ = 100 [C_i – C_e /C_i]

Amount of $ZnSO_4$ adsorbed (C_{ad}) = C_i – C_e

Where, C_i and C_e are initial and equilibrium (final) concentration of toxic metal ions (ppm), respectively.

3. Result and Discussion

3.1. Adsorption of Cu (II) ions on Rubber seed coat charcoal from aqueous solution

Absorption isotherm of Cu (II) ions adsorbed on activated rubber charcoal at room temperature. An adsorption isotherm describe the relationship between the amount of adsorbate that is adsorbed on the adsorbent and concentration of adsorbate in the solution at equilibrium of constant temperature [14]. In this study, the two most common isotherm models are used, such as the Langmuir & Freundlich models. Both of these models used to describe the nature of adsorption on Hevea Brasiliensis seed coat charcoal at different concentraction. The percentage of removal decreased with increase in concentration, due to the limited number of available active sites on the surface of Hevea Brasiliensis seed coat charcoal toxic metal ion [Cu (II)] [15].

Table 1: Percentage adsorption & removel of Cu (II) & Zn (II) ions

C_i	Cu(II) ion		Zn(II) ion	
	Percentage Adsorption	**Percentage Removal**	**Percentage Adsorption**	**Percentage Removal**
0.1	0.0012	1.2	0.0116	11.6
0.08	0.0010	1.25	0.0066	8.25
0.06	0.0016	2.67	0.0034	5.6
0.04	0.0014	3.5	0.0018	4.4
0.02	0.0010	5	0.0006	3

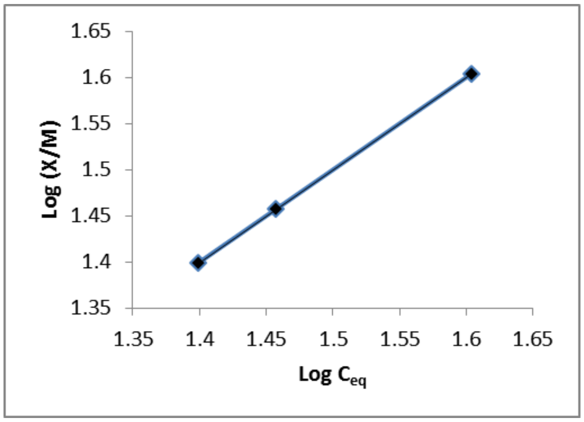

Fig 1: Freundlich isotherm plot of copper adsorption at room temperature

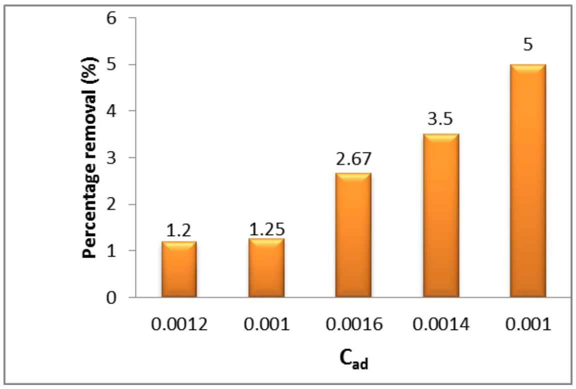

Fig 2: Percentage removal of copper Sulphate of various concentration using Hevea Bresiliensis seed coat char coal

3.2. Adsorption of Zn (II) ions on Rubber seed coat charcoal from aqueous solution

Adsorption isotherm of Zn (II) ions adsorbed on rubber seed coat charcoal at room temperature. The distribution of metal ion between liquid and solid phases is generally described by using the Langmuir & Freundlich adsorption isotherm models [16]. Experimental data were fitted with freundlich & Langmuir isotherms by carrying out the correlation analysis. In this experiment when Zinc concentration was higher, the percentage of removal of metal by the adsorbent also increases due to higher probability of collision between Zn (II) ions and adsorbent surface.

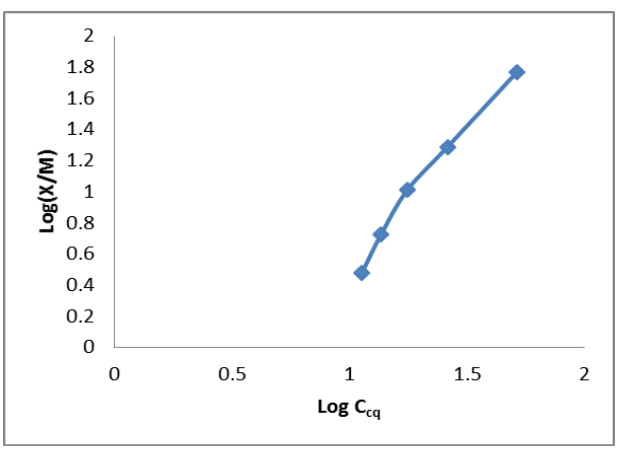

Fig 3: Frueundlich isotherm plot of Zinc adsorption at room temperature

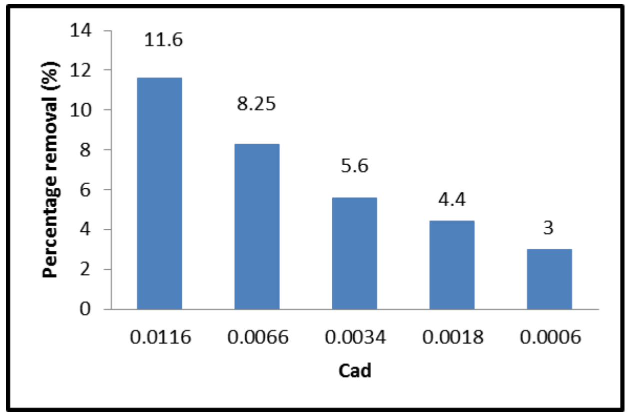

Fig 4: Percentage removal Zinc Sulphate of various concentration using Hevea Brasilienss Seed Coat Charcoal

4. Conclusion

The results and discussion and presented in this paper conclude that the percentage of adsorption was found to be high for Zn (II) ion tham Cu (II) ions at initial concentration. Thus it can be concluded. Adsorbate species are found to adsorb strongly on the substance of Hevea Brasiliensis seed coat charcoal. Kinetic data may be useful for environmental technologists in designing Cu^{2+} & Zn^{2+} containing waste water. Hevea Brasiliensis seed coat charcoal posses the maximum adsorption capacity and hence, it is an effective adsorbent for the removal of Copper toxic metal ions like Cu^{2+} & Zn^{2+} from an aqueous solution. Here Langmuir & Freundlich isotherm models were used to interpret the adsorption phenomenon of the adsorbate. This study won't affect the environment. It is eco-friendly and Hevea Brasiliensis seed coat charcoal can be alterative low cost adsorbent to remove metal ions from solution and it is used to treat industrial and house hold waste water.

5. Reference

1. Rahman MA, Asadullah M, Haque MM, Motin MA, Sultam MB, Azad MAK. Preparation and characterization of activated Charcoal as an adsorbent, J. Surface Sci. Technol. 2006; 22(3-4):133-140.
2. Qadeer Riaz. Adsorption of ruthenium ions an activated Charcoal; influence of temperature on the Kinetics of the adsorption process, J. Zhejiang Univ SCI. 2005; 6B(5):353-356.
3. Bhat Irshad UI Haq1, Elias Nursafura B, khanam Zakia. Adsorption studies of Cr (VI) and Fe (II) Aqua solutions using Rubber Tree Leaves as an Adsorbent, Int. Res. J. Environmental Sci. 2003; 2(12):52-56.
4. Larous S, Meniai AH, Lehocine MB. Experimatal study of the removal of copper from aqueous solutions by adsorption using sawdust, Desalination 2005; 185:483-490.
5. Quek SY, Wase DAJ, Forster CF. The use of sag waste for the sorption of lead and copper. Water SA24, 1998, 251-256.
6. Hameed BH, Daud FBM. Adsorption studies of basic dye an activated carbon derived from agricultural waste; Hevea Brasiliensis sees coat, Chemical Engineering Journal. 2008; 139:48-55.
7. Sud D, Mahajan G, Kauy MP. Agricultural waste material as potential adsorbent for sequestering heavy

metal ions from aqueous solutions a review. Bioresous Technol, 2008; 99:6017-6027.
8. Kadirvelu K, Nama Sivayam C, Activated carbon from coconut coirpith as metal adsorbent: adsorption of Cd (II) from aquous solution, Advances in Environ. Res. 2003; 7:471-478.
9. Helen Kalavathy M, Lima Rose Miranta. Comparism of copper adsorption from aqueous solution using modified and unmodified Hevea Brasiliensis saw dust, Desalination 2010; 255:165-174.
10. Tan IAW, Hameed BH, Ahmad AL. Equilibrium and Kinetic studies on basic dye adsorption by oil palm frbre activated carbon, Chem. Eng. J. 2007; 127:111-119.
11. Vogal. Quantitative Analysis.
12. Kannan N, Veemaraj T. Detoxification of toxic metal ions by sorption onto activated carbon from Hevea Brasiliensis bark-A Comparactive study, Global NEST Journal, 2010; 12(2):197-205.
13. Dr. Balamurugan, Lab Manual for physical Chemistry.
14. Wan Ngah Ws, Hanafiah MAKM. Adsorption of copper on rubber leaf powder: kinetic, equilibrium and thermodynamic studies: Biochem Eng J. 2007; 39:521-530.
15. Kannan N, Raja Kumar A. Suitability of various indigenously prepared activated carbons for the adsorption of mercury (ii) ions, Toxicol. Env. Chem. 2003; 84(140):78-19.
16. Langmuir I. The constitution and fundamental properties of solids and liquids, J. Am. Chem. Soc. 1916; 38:2221-2295.