International Journal of Research in Engineering, Science and Management
Volume-2, Issue-8, August-2019
www.ijresm.com | ISSN (Online): 2581-5792

Adsorption of Chromium (III), Nickel (II), Lead (II) And Mercury (II) Ions from Aqueous Solution by Activated Carbon Prepared from Gloriosa Superba Seed Shell

J. Kavitha[1], M. Manjuladevi[2], C. Chelladurai[3], N. Jeevitha[4], P. Siva Kumar[5], R. Kumaresan[6]
[1,3,4,5,6]*Assistant Professor, Dept. of Chemistry and Physics, Jai Shriram Engineering College, Tiruppur, India*
[2]*Assistant Professor, Department of Chemistry, SNS College of Technology, Coimbatore, India*

***Abstract*: Carbon prepared from plant waste, i.e. glorisa superba (Kanveli vidhai) collected from nearby Dindugal and Dharapuram area was used as an adsorbent for the removal of heavy metals Cr (III), Ni (II), Pb (II) and Hg (II) from the textile waste water. The gloriosa superba seed shell was converted into activated carbon by the acid treatment process. The influence of some characterization has been studied. Various parameters are ph, moisture content, ion exchange capacity, decolorizing power, determination of surface area apparent density particle size, volatile matter, matter soluble and matter soluble in acid. The purpose of this work was to evaluate the characterization of activated carbon prepared from plant waste.**

***Keywords*: Activated Carbon, Adsorption, Gloriosa Superba seed shell, Heavy metal.**

1. Introduction

The increased attention on the harmful effects of heavy metal ions on human health and the environment over the past few decades has lead to a concomitant focus on improved water quality. Since industrial effluents in particular are a major contributor to heavy metal contamination the removal of such metals from these effluents has been a priority in the tightening and enforcement of environmental regulations traditional methods for the recovery 0f heavy metals from industrial waste streams are precipitation, ion exchange, electrolysis, adsorption on activated carbon. Most of the methods are extremely expensive or inefficient; especially for a large amount of solution at relatively low concentration adsorption is now recognized as an efficient and economic method to remove metal ions from aqueous solutions. The presence of copper, zinc, cadmium, lead, mercury, nickel and other metals has a potentially damaging effect on human physiology and other biological systems when the tolerance levels are exceeded.

The permissible limits (Mg/l) of the metals in waste water are given the following table.

Table 1
Permissible limits of metals in drinking water (ISI, 1992).

METALS	LIMITS (Mg/l)	
	EPA	INDIAN STANDARD
Chromium (iv)	0.050	0.050
Lead (ii)	0.050	0.100
Mercury(ii)	---	0.010
Nickel (ii)	1.0	3.0

2. Experimental Methods

A. Adsorbent

Glorisa superba was collected from nearby dindugal and dharapuram at Tamil Nadu in India. The collected material was sun dried. The dried shell was chopped into pieces and acid treatment was carried out. To one part of the material and 2:1 parts of sulpuric acid was added and stirred and left for one hour. The carbonized material was washed with distilled water to remove the force acid. After washing the material, it was soaking in 1% sodium bicarbonate solution and allowed to stand for 6 hours to remove the acid. Then the material is washed with distilled water until the pH of the carbon reached 6.5 ± 2 and dried in hot air over 105 ^{0}Celsius. The dried material was ground and sieved to get different particles sizes ranging from 125 to 250 micrometer, 250-500 micrometer and 500-750 micrometer. The adsorbent was stored in air tight container and characterized.

B. Characterization of prepared activated carbon

1) Decolorizing powder (Indian Standards Institute, 1997)

About 0.5 grams of carbon material is transferred to a 100ml conical flask.1ml of methylene blue solution (0.15% w/v) was added from a burette and shaken for 10 minutes. Addition of methylene blue solution and shaking is continued till the blue color is persisted for at least for 10 minutes.

Decolourising powder of carbon is expressed in terms of milligrams of methylene blue adsorbed by 1g of carbon.

Decolorizing power (mg/g) =1.5x V/m V=volume of methylene blue solution consumed m=mass of the material taken for the test (g)

2) pH of the adsorbent

The carbon (adsorbent) was placed in a 1-liter beaker (5g carbon) 150 ml of freshly boiled and cooled water (pH 7.0) was added and heated to boiling point. After digesting for 10 minutes, the solution was filtered hot, rejecting the first 10ml of the filtrate. The remaining filtrate was cooled at room temperature and pH was measured using a pH meter.

3) Moisture content of the adsorbent

About 5 gm of the carbon was weighed in a silica crucible. The dish was placed in an electric oven maintained at 110 ± 5 ^{0}C for about 5 hrs. The dish was covered, cooled in a desiccator's. Heating, cooling and weighing was repeated at 30 minutes interval until the difference between the two consecutive weighing was less than 5 mg.

$$Moisture\ content\ (\%) = \frac{100 - (M - X)}{M}$$

Where M = Mass of the material taken for the test (g).
X = Mass of the material taken for drying (g).

4) Ash content

About 1 gm of carbon was weighed accurately into a crucible. The crucible and its contents were placed in an electric oven at 110 ± 5 ºC and heated for about 5 hrs. The crucible was removed from the oven and the contents were ignited in an electric oven at a temperature of

250 ºC for about 30 minutes. The process of heating and cooling was repeated until the difference between two consecutive weighing was less than 5 mg.

$$Ash\ \%\ by\ mass\ = \frac{100 \times M_1}{M_2(100 - X)}$$

Where, M_1 = Mass of ash (g)
M_2 = Mass of the material taken for test (g)
X = % of moisture content present in the material taken.

5) Ion exchange capacity

About 0.5 gm of carbon was weighed and taken in a beaker and a sufficient amount of distilled water was added to cover the carbon. The slurry was carefully transferred to the burette. The column was never allowed to drain completely and the level of the liquid was maintained at about I cm above the carbon bed.

100 ml of a solution of 0.25 M sodium sulphate was allowed to drip into column at a rate of 2 ml/min and the effluent was collected in a 500 ml in conical flasks. When all the solution has passed through the column. The effluent was titrated with standard 0.1 N sodium hydroxide solution using phenolphthalein indicator. The ion exchange capacity of the bed in milli equivalents / g is given by the sodium hydroxide solution v is the volume in ml and W is the weight of carbon.

Table 2
Physico-chemical characterization of gloriosa superba hull activated carbon

pH 1 % solution	7.49
Moisture content	1.6
Ash content	9 %
Decolorizing power (mg/g)	57.5
Ion exchange capacity	0.0243
Apparent density (g/l)	0.58
Particle size (µm)	125-250
Water soluble matter (%)	2.716
Acid soluble matter (%)	6.2

3. Conclusion

From the overall results of the characterization study it can be concluded that carbon obtained from gloriosa superba hull might be an appropriate adsorbent for heavy metal adsorption. Treatment of waste matters with GSH carbon may be suitable for heavy metal such as Ni, Hg, Cr & Lead removal. The results for the characterization of the prepared activated carbon are discussed in this paper. The test for characterization include pH, Moisture, Ash content, decolorizing power, Ion exchange capacity, Apparent density & matter soluble in acid and water of activated carbon towards heavy metal removal.

References

[1] Abdel-Halim, S. H., Shehata, A. M. A., EI-Shahat, M. F., 2003. Removal of lead ions from industrial waste water by different types of natural materials. Water Res. 37, 1678–1683.
[2] Namasivayam. C. and Arasi. D. J. S. E. (1997), "Removal of Congo Red from aqueous solution by mixed adsorbents; fly ash and coal water research; 24, 45-50.
[3] Ahluwalia, S.S., Goyal, D., 2005. Removal of heavy metals by waste tea leaves from aqueous solution. Eng. Life Sci. 5, 158–162.
[4] Amarasinghe, B. M. W. P. K, Williams, R.A., 2007. Tea waste as a low cost adsorbent for the removal of Cu and Pb from waste water. Chem. Eng. J. 132, 299–309.
[5] Aydin, H., Bulut, Y., Yerlikaya, C., 2008. Removal of copper (II) from aqueous solution by adsorption onto low-cost adsorbents. J. Environ. Manage. 87, 37–45.
[6] Farajzadeh, M. A., Monji, A. B., 2004. Adsorption characteristics of wheat bran towards heavy metal cations. Sep. Purif. Technol. 138, 197–207.
[7] Goel, J., Kadirvelu, K., Rajagopal, C., Garg, V.K., 2005. Removal of Pb (II) by adsorption using treated granular activated carbon: batch and column studies. J. Hazard. Mater. B125, 211–220.
[8] Sabriye, D., Ali, C., 2006. Pb (II) and Cd(II) removal from aqueous solutions by olive cake. J. Hazard. Mater. 138, 409–415.
[9] N. Kannan, J. Balamurugan, Removal of lead ions by adsorption onto coconut shell and dates nut carbons—a comparative study, Indian J. Environ. Prot. 25 (9) (2005) 816–823.
N. Kannan, S.M. Devi, Studies on removal of copper(II) and lead(II) ions by adsorption on commercial activated carbon, Indian J. Environ. Prot. 25(2005) 28–37.
[10] G. Issabayeva, M. K. Aroua, N. M. N. Sulaiman, Removal of lead from aqueous solutions on palm shell activated carbon, Bioresour. Technol. 97 (18) (2006) 2350–2355.