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Adsorption of Copper from Aqueous Solution Using Mango Seed Powder

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ABSTRACT
The objective of the study was the removal of copper metal ions from aqueous solution using mango seed powder as low cost adsorbent. The influences of contact time, adsorbent doses & temperature were studied in batch experiments at room temperature. The results showed that with increase in the contact time percent removal of copper increases. The adsorption was rapid during first 45 minutes & equilibrium was reached in 90 minutes. The results also showed that with increase in the adsorbent doses & temperature percent removal of copper increases. Thus mango seeds have the potential to be applied as alternative low-cost biosorbent in the remediation of heavy metal contamination in waste water.
Keywords: Adsorbent, copper ions, heavy metals, Waste water

I. INTRODUCTION

Adsorption techniques for wastewater treatment have become popular in recent years due to their efficiency in the removal of pollutants. As a result of industrial activities and technological development, the amount of heavy metal ions discharged into streams and rivers by industrial and municipal wastewater have been increasing pollution. Certain heavy metals such as iron (Fe), copper (Cu), zinc (Zn) and manganese (Mn) are required by humans for normal biological functioning. However, heavy metals such as mercury, lead, cadmium are toxic to organisms. Increased use of metals and chemicals in process has resulted in generation of large quantities of effluent that contains high level of toxic heavy metal and their presence poses environmental-disposal problems so adsorption processes are generally used. Mango seeds are a low-cost agriculture waste which could be used for adsorption of heavy metals in wastewater. Hence to find an inexpensive and an effective adsorbent to replace commercial methods in removing heavy metals from aqueous effluent mango seed powder can be used as an adsorbent.

II. EXPERIMENTAL PROCEDURE

2.1 Preparation of adsorbent:-

Mango seeds are obtained from agricultural waste. These mango seeds were dried under sunlight for a few days and then in oven at 80 ºC . The dried seeds were crushed and blended to powder form using a blender.

Fig. 1 Preparation of adsorbent

2.2 Preparation of copper ions solution:-

Cu(II) ion was used as the adsorbate in this study. A stock solution was prepared by dissolving accurately weight amount of copper sulphate in distilled water.

2.3 Batch experiments:

Batch experiments were carried out at room temperature by shaking a mixture of 1 g of mango seeds powder and 100 mL of Cu(II) solution of known concentration with the help of mechanical stirrer for 1 hour. After agitation, the powder was removed by filtration using filter paper. The concentration of Cu(II) in the filtrates was determined.

Fig. 2 Experimental runs

2.4 Effect of contact time:

The effect of contact time was investigated by agitating 1 g of mango seeds powder in 100 mL of Cu(II) solution over time periods of 15 minutes at constant agitation speed. The procedure was repeated for samples of same concentration for over time period 30, 45, 60, 75 and 90 minutes.

2.5 Effect of adsorption doses:

The effect of adsorption doses was studied by agitating 1, 2, 3, & 4gm of mango seeds powder in different sample solutions for same time periods & temperature.

2.6 Effect of adsorption temperature:

The effect of adsorption temperature was studied by agitating 1 g of mango seeds powder in 100 mL of Cu(II) solution for temperature of 50 ^{0}C at constant agitation speed & time. The procedure was repeated for samples of same concentration for the temperature of 60, 70 & 80 ^{0}C.

III. RESULTS & DISCUSSION

3.1 Effect of contact time

Increasein the contact time of adsorbent in the given solution at constant doses and temperature results in the increase in percent removal of copper ions from the solution.

Sr. no.	Time (min.)	% Removal
1	15	55.55
2	30	58.72
3	45	61.90
4	60	61.90
5	75	61.90
6	90	65.90

Table 1: Contact time vs % Removal

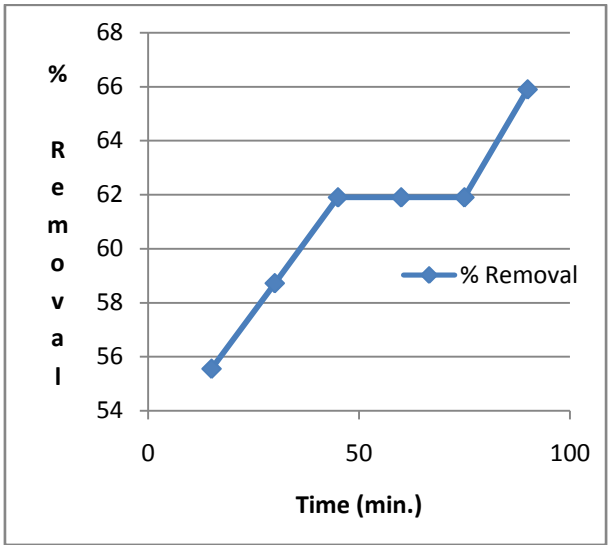

Fig. 3 Relation between Contact time & % Removal

3.2 Effect of adsorption doses

Increase in the adsorption doses in the given solution at constant time and temperature results in the increase in percent removal of copper ions from the solution.

Sr. no.	Concentration (gm)	% Removal
1	1	49.20
2	2	58.72
3	3	68.02
4	4	68.25

Table 2: Concentration vs % Removal

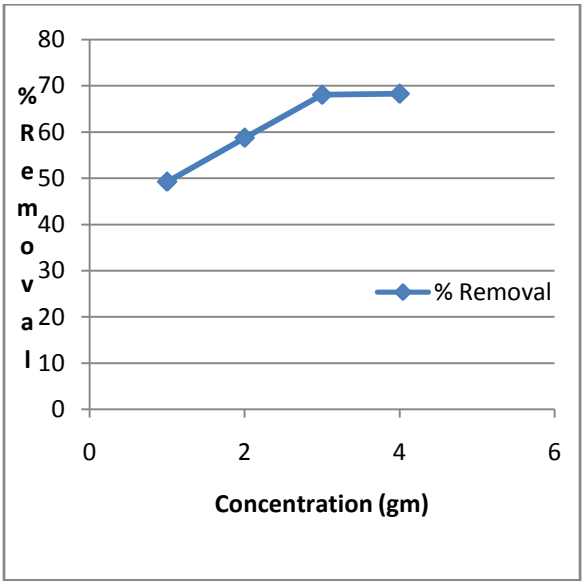

Fig. 4 Relation between Concentration & % Removal

3.2 Effect of adsorption temperature

Increase in the temperature of adsorption at constant doses and time results in increase in the percent removal of copper ions from the solution.

Sr. no.	Temperature(^{0}C)	% Removal
1	50	37.0
2	60	43.3
3	70	49.6
4	80	55.9

Table 3: Temperature vs % Removal

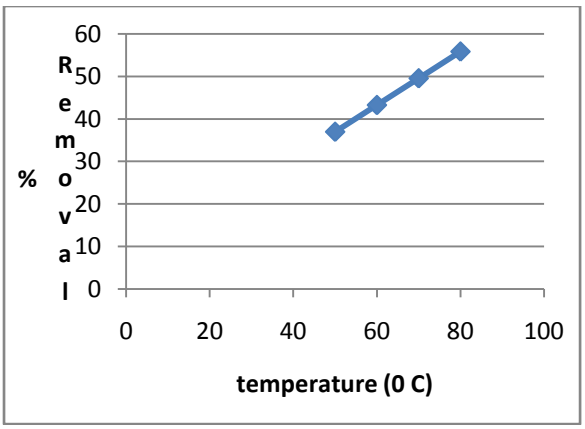

Fig. 5 Relation between Temperature & % Removal

IV. CONCLUSION

The results of the study indicated that with increase in the contact time percent removal of copper increases. The adsorption was rapid during initial period of time & equilibrium was reached in 90 minutes. The results also showed that with increase in the adsorbent doses & temperature percent removal of copper increases. Thus it can be concluded that mango seeds can be considered as an alternative biomass for the removal of Cu(II) ions since it is effective, low cost, abundant and can be obtained locally. Thus reducing heavy metals from waste water environmental pollution can be lowered.

REFRENCES

[1] Feng, N., Guo, X., and Liang, S., (2008). Adsorption study of copper (II) by chemically modified orange peel. *Journal of Hazardous Materials*, 164, 1286-1292

[2] Murugan, T., A., Valliappan, R., (2010), Removal of dyes from aqueous solution by adsorption on biomass mango (Magifera indica) leaves. E-Journal of Chemistry, 7(3), 669-676

[3] Patel, H.J. and Vashi, R.T., (2009). Comparative study of Methylene Blue dye removal from its aqueous solution using guava and mango leaf powder as low cost adsorbent. International Journal of Human Geography and Enviromental Studies, 1,1.

[4] Butt, H-J, Graf, K., and Kappl, M., (2003). Adsorption. In: Physics and chemistry of interfaces. (pp177-202). Germany: Wiley-VCH.

[5] Myers, D., (1999). Adsorption. In: Surfaces, interfaces, and colloids: principles and applications. 2nd Edition. (pp 179-213). New York: John Wiley & Sons.

[6] Empari, K.,(n.d.). Mango. Department of Agriculture Sarawak. URL: http://www.doa.sarawak.gov.my/abs_comm_manggo.htm#production. Assessed on 25thJanuary 2011.

[7] Copper Development Association, (2010). Copper facts. URL: http://www.copper.org/education/c-facts/c-electronics.html. Assessed on 20th January 2011.

[8] Wikipedia, (2011). Adsorption. URL: http://en.wikipedia.org/wiki/Adsorption. Accessed on 23th January 2011.

[9] Ahluwalia, S.S. and Goyal, D., (2005). Microbial and plant derived biomass for removal of heavy metals from wastewater. Bioresource Technology, 98, 2243-2257.

[10] Ajmal, M., Rao, R.A.K., Anwar, S., Ahmad, J., and Ahmad, R., (2002). Adsorption studies on rice husk: removal and recovery of Cd(II) from wastewater. Bioresource Technology, 86, 147-149.

[11] http://eprints.utar.edu.my/83/1/CE-0805723-2011.pdf

[12] Al-Subu, M.M., Salim, R., Braik, H., and Swaileh, K.M., (2001). Removal of dissolved copper from polluted water using plant leaves: II Effects of copper concentration , plant leaves, competiting ions and other factors. Revista Internacional de Contaminación ambiental, 17(3), 123-127.