International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

A Study of the Extraction of Cu (II) and Cd (II) Heavy Metals from Waste Water by Bio-adsorbent

Vandana Mathur[1], Neeta Kanoongo[2], Shiella Tikku[3], Anita Kothari[4]

[1, 2, 3, 4]Department of Chemistry, S.P.C. Government College, Ajmer, Rajasthan, 305001, India
Corresponding author: *vandanamathurdr[at]gmail.com*
9414284877

Abstract: ***Heavy metals are introduced into fresh water by various industries and are easily digested by fish and other aquatic organisms. Low concentrations can be toxic because heavy metals can undergo bioconcentration. Toxic heavy metals of particular concern in industrial wastewater treatment include zinc, copper, nickel, mercury, cadmium, lead and chromium. The purpose of this study was to determine the potential of peanut shells to remove cadmium and copper from contaminated water. Batch method was used: parameters such as pH, contact time and initial metal concentration were studied.***

Keywords: heavy metal, peanut shell, extraction, batch method.

1. Introduction

Advances in science and technology have led to tremendous improvements in many areas of development, while also contributing to environmental degradation worldwide, which has increased the demand for new technologies for proper pre-disposal treatment facilities [1, 2]. Traditional methods such as chemical precipitation, coagulation, ion exchange, solvent extraction and filtration, evaporation and membrane processes have been used to remove toxic heavy metals from water systems [3]. Heavy metal adsorption on conventional adsorbents such as activated carbon is widely used in many applications as an effective adsorbent, and activated carbon produced from carbonization of organic matter is the most widely used adsorbent. However, the high cost of the activation process limits its use in wastewater treatment applications [4].

Along with industrial by-products and natural materials, agricultural waste is a rich source of inexpensive adsorbents. Due to their abundance, agricultural wastes such as peanut shells, rice husks, wheat bran and sawdust offer several economic values [5]. The use of peanut shell charcoal for Cu (II) adsorption from wastewater was studied by Periasamy and Namasivayam [6].

The objective of this work is to study the adsorption behaviour of some low-cost adsorbents such as peanut husk with respect to Cu2+ and Cd2+ ions. The batch method was employed: parameters such as pH, contact time, and initial metal concentration, were studied.

2. Literature Review

Agricultural solid wastes are relatively cheap and are available in huge quantities. They can be used as an adsorbent due to their physico-chemical properties. The utilization of these wastes can play a significant role in national economy. Waste materials that have been successfully used to manufacture activated carbon in the recent past include waste wood [7], coir pith [8], orange peel [9] coffee husk [10] pine cone [11], coconut tree [12].

3. Material and Methods

Preparation of adsorbent: Peanut husks were collected from the local market, washed thoroughly to remove dust using distilled water, dried in an oven at 100 °C for 18 h, ground using a laboratory mill, sieved to 0.5–0.8 mm, and rinsed using 0.1 N HCl. Then the pH was adjusted with 0.1 N HCl at values (6–7). Finally, PHC was dried and stored in an oven at 80 °C till it reached constant density and humidity [13].

Chemical and reagents: Stock solutions of copper chloride and cadmium chloride of 400 mg/l were used as adsorbate, and solutions of various concentrations were obtained by diluting the stock solution with distilled water. Copper and Cadmium concentrations were determined by spectrophotometer. All the chemicals used were of analytical grade reagent and all experiments were carried out in 500 ml glass bottles at the laboratory ambient temperature of 27± 2 °C.

Methodology: Batch adsorption experiments were carried out by shaking a series of bottles containing various amounts of the adsorbents used and heavy metal ions separately at optimum pH. For the investigation of solution temperature, contact time, adsorbent dosage, and pH batch studies were carried out. Designated adsorbents were added into 150 ml conical flask with a stopper, containing 100 ml of test solution and then carried out the batch adsorption at the desired contact time, pH and adsorbent dose.

4. Result and Discussion

Effect of pH: The pH was varied from 2 to 12 for Cu (II) and Cd(II) and the pH of the solutions was adjusted to different values using suitable buffers. The pH of the solution has a significant impact on the uptake of heavy metals since it determines the surface charge of the adsorbent and the degree of ionization and speciation of the adsorbate [14].The removal efficiency was calculated at constant Schiff base weight, biomass and concentration of metal ion. Maximum absorption takes place at pH 10 and 8 in Cu (II) and Cd (II) respectively.

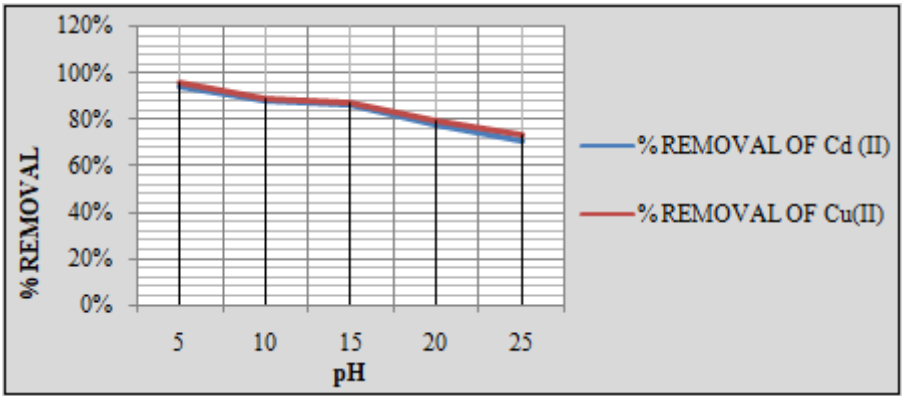

Figure 1: Effect of pH

Effect of initial concentration of metal ion: Effect of initial metal ion concentration on % removal of Cu (II) and Cd (II) metal ion by bio adsorbent from industrial effluent was investigated. Effect of metal ion concentration is calculated at constant pH, biomass and weight of bio adsorbent.

Maximum % removal of heavy metal takes places at minimum concentration .The results are shown in Fig. 2 which indicate that the percentage removal decreases with the increase in initial metal ion concentration. This is because there were no more adsorption sites on the adsorption surface of the adsorbent material.

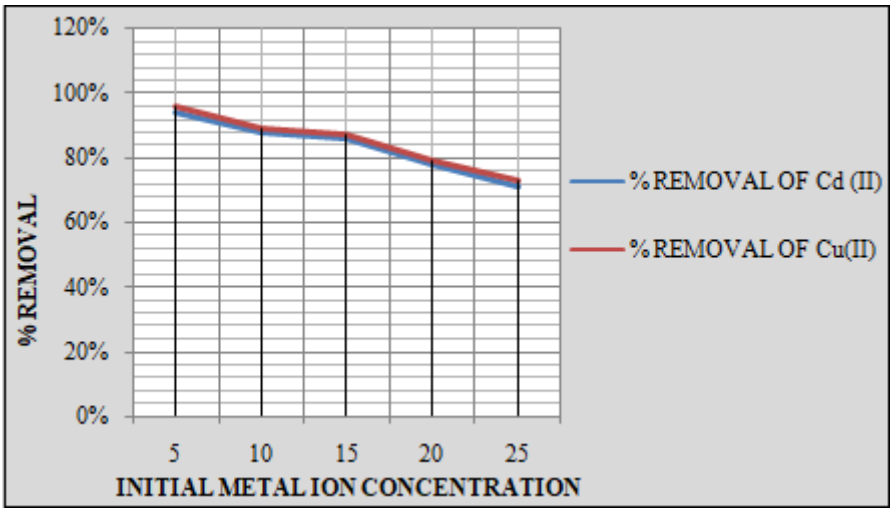

Figure 2: Effect of Initial Metal Ion Concentration

Effect of contact time: The effect of contact time on the removal efficiency of different adsorbents for copper and zinc ions was studied: the results are shown in Fig. 3.The rate of uptake of metal ions was quite rapid; Equilibrium was reached for copper and Cadmium removal within 15 and 20 min respectively. This is in agreement with the results obtained by Sharma et al. [15].

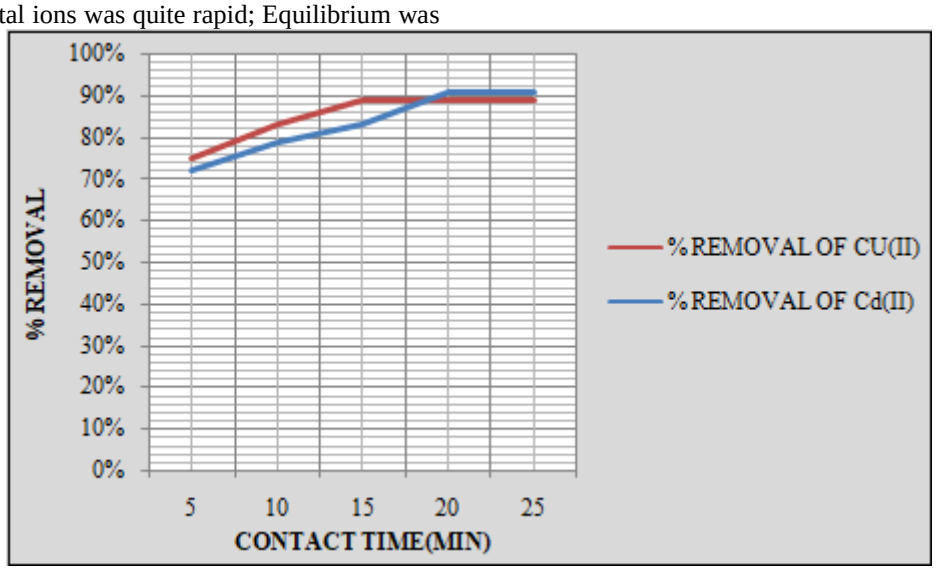

Figure 3: Effect of Contact Time

5. Conclusion

Cost effective adsorbents peanut shell charcoal is effectively removed Cu^{2+} and Cd^{2+}ionsfrom aqueous solution. The batch method was used; Parameters such as pH, contact time, and metal dosage concentration checked at room temperature 27±2°C. The optimal pH value corresponds to the maximum copper and cadmium removal adsorption is 8-10.The graph of initial metal ion concentration versus the percentage removal concludes that the effective percentage removal of Cu(II) and Cd(II)decreases as concentration of heavy metal increases from 5 to 25 ppm. The graph of contact time versus the percentage removal of heavy metal ion concluded that maximum percentage removal of Cu(II) and Cd(II) takes place at 15 and 20 min respectively. So, from all graphs it is concluded that peanut shell charcoal is rapid and cost-effective approach for removal of heavy metal ion from waste water.

6. Future Scope

The future research can be done by investigating the thermodynamics, isotherms and other kinetic theorems in adsorption process.

References

[1] Chandra R, Gupta M, Pandey A, Monitoring of river Ram Ganga: Physico-chemical characteristic at Bareilly. Recent research in science and technology 3, 2011.
[2] Rane NM, Sapkal RS, Sapkal VS, Patil MB, Shewale SP, Use of naturally available low cost adsorbents for removal of Cr (VI) from waste water. International *Journal of Chemical Sciences and Applications* 1: 65-69, 2010.
[3] Panayotova M, Velikov B. Influence of zeolite transformation in a homoionic form on the removal of some heavy metal ions from wastewater. *J Environ Sci Health A Toxic Hazard Subst Environ Eng*;38(3):545–54, 2003.
[4] Amarasinghe BMWPK, Williams RA., Tea waste as a low cost adsorbent for the removal of Cu and Pb from *wastewater. ChemEngJ*;132(1–3):299–309, 2007.
[5] Igwe JC, Abia AA., Adsorption kinetics and intraparticulate diffusivities for bioremediation of Co(II), Fe(II) and Cu(II) ions from waste water using modified and unmodified maize cob. *Int J PhysSci*;2(5):119–27, 2007.
[6] Periasamy K, Namasivayam C. Removal of copper (II) by adsorption onto peanut hull carbon from water and copper plating industry wastewater. *Chemosphere*;32(4):769–89, 1996.
[7] Acharya, J., Sahu, J.N., Sahoo, B.K., Mohanty, C.R., Meikap, B.C. Removal of chromium (VI) from wastewater by activated carbon developed from Tamarind wood activated with zincchloride. *Chem. Eng. J.* 150, 25–39,., 2009.
[8] Namasivayam, C., Kavitha, D.,. Removal of Congo red from water by adsorption onto activated carbon prepared from coir pith, an agricultural solid waste. *Dyes Pigments* 54, 47–58, 2002.
[9] Khaled, A., El Nemr, A., Ei-Sikaily, A., Abdelwahab, A.,. Treatment of artificial textile dye effluent containing direct yellow12 by orange peel carbon. *Desalination* 238, 210–232, 2009.
[10] Ahmad, M.A., Rahman, N.K.,. Equilibrium, kinetics and thermodynamic of Remazol Brilliant Orange 3R dye adsorptionon coffee husk-based activated carbon. *Chem. Eng. J.* 170, 154–161, 2011.
[11] Gecgel, U., Kolancilar, H.,. Adsorption of Remazol brilliant blueR on activated carbon prepared from a pine cone. *Nat. Prod. Res*.26, 659–664, 2012.
[12] Senthilkumaar, S., Kalaamani, P., Subburaam, C.V.,. Liquidphase adsorption of crystal violet onto activated carbons derived from male flowers of coconut tree. *J. Hazard. Mater.* 136, 800–808, 2006.
[13] Ricordel S, Taha S, Cisse I, Dorange G. Heavy metals removal by adsorption onto peanut husks carbon: Characterization, kinetic study and modeling. *Sep PurifTechnol*; 24(3):389–401, 2001.
[14] Cho H, Oh D, Kim K. A study on removal characteristics ofheavy metals from aqueous solution by fly ash. *J Hazard Mater;*127(1-3):187–95, 2005.
[15] Sharma YC, Uma USN, Weng CH. Studies on an economically viable remediation of chromium rich waters and wastewaters byPTPS fly ash. *Colloids Surf A PhysicochemEng Aspects*;317(1-3):222–8, 2008.