# Adsorption Of Copper From Aqueous Solution By Using Banana Peels Powder

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**Abstract:**.

Adsorption is a recognized method for the removal of heavy metals in low concentration from wastewater containing heavy metals. The high cost of activate carbon limits its use in adsorption. Many varieties of low-cost adsorbents have been developed and tested to remove heavy metal ions. However, the adsorption efficiency depends on the type of adsorbents. Bio sorption of heavy metals from aqueous solutions is a relatively new process that has been proven very promising for the removal of heavy metal from wastewater.The main objective of this study is to evaluate the feasibility of using the Banana Peels powder for removal of copper, optimize of the different operating parameters such as pH, adsorbent dose, contact time, and initial copper concentration were studied , to find the equillibrium values ,in order to get maximum efficiency study the comparison of adsorption capacity of locally available adsorbent

**Index Terms:**Adsorption, Adsorbent, Atomic adsorption spectrophotometer, Batch study, Copper removal, Banana Peels.

## I. INTRODUCTION

Eco-toxicity on living organism has become a prime concern from the last few decades. Massive urbanization are continuously releasing waste and wastewater to the ecosystem and, causing pollution to environment and eventually toxicity to living being. The industrial effluents which contain different derivatives of heavy metals such as Cd, Pb, Ni, Cr, As, Cu, Fe etc. are continuously discharging to the ecosystem and producing a significant toxic impacton aquatic environment. Among the heavy metals, copper is the major available type of heavy metal in the aquatic environment. Copper in the blood system may generate reactive free oxygen species and damage the protein, lipids and DNA . The excess copper compound in the body may also affects on aging, schizophrenia, mental illness, Indian childhood cirrhosis, Wilson's and Alzheimer's diseases . Copper has damaged the marine ecosystem and damaged the gills, liver, kidneys, the nervous system and changing sexual life of fishes . Recent awareness of toxicity originated from water and wastewater are attending the interest for environmental scientist and researcher. The sustainable removal of heavy metals from water and wastewater has become a major challenge for scientists. Over the last few decades, several methods have been devised for the treatment and removal of heavy metals. The commonly used procedures for removing metal ions from aqueous streams include chemical precipitation, Chemical reduction, Xanthate process, Cementation, Solvent Extraction, Electro deposition, Reverse osmosis, Electro dialysis, Ion exchange, Donna dialysis may require working with corrosive chemicals, increase the volume of waste sludge, used a trial and error approach, high cost of electrodes has inspired researchers to investigate effective treatment process called Adsorption and to find suitable low cost adsorbents.

## II.MATERIALS AND METHODOLOGY

### A. Preparation of adsorbent

Musa Acuminata is an evergreen tropical tree in the flowering plant family Musaceae, native to India and Indonesia. peels were locally collected from Banana Peels tree located in Shahapur. Peels of the fruit was removed .The peels were separated from the Banana Peels fruits by eating and peels was washed with the distilled water. The peels were dried in shade and stored at 25C. The dried peels was ground and screened to uniform powder by using 90 microns sieve. Thus Banana peels powder is stored in an air tight container for further usage.

**Fig.1.Banana peelsFig.2.Banana peels Powder**

**Fig.4. Copper Fig.5. Reaction of Cu with $HNO_3$**

**Fig.6.Preparation of Copper solution Fig.7.Batch study**

**B. Reagents and equipment's**

Prepare a series of standard metal solutions in the optimum concentration range by appropriate dilution of the following stock metal solutions with water containing 1.5ml conc. ($HNO_3$)/l. Thoroughly, dry reagents before use. In general use reagents of the highest purity.

Copper

Dissolve 1.00g copper metal in 15ml of 1+1 $HNO_3$ and dilute to 1000ml with water;

1.00ml = 1.000mg Cu

Air, cleaned and dried through a suitable filter to remove oil, water and other foreign substances ,use metal free water for preparing all reagents and calibration standards and as dilution water. Acetylene standard commercial grade acetone.

**C. Batch Adsorption study**

Batch experiments were carried out in 250mL glass jar with 250 mL test solution at room temperature (29±2oC). The jar, along with known volume of test solution of fixed concentration at neutral pH, was shaken in Jar test apparatus at 100 rpm to study the equilibration time for maximum adsorption of copper. The effect of pH on copper was studied by adjusting the pH of test solution using 1N Hcl or 1N NaOH on fixed quantity of adsorbent. At the end of the desired contact time, the samples were filtered using Whattman no. 42 filter paper and the filtrate was analyzed for residual copper concentration by Atomic Absorption spectrophotometer: Model No. AA-200, PERKIN described in the standard methods of examination of water and wastewater. The batch study was performed to determine the optimum condition and to study the effect of pH, adsorbent dose, contact time and initial copper concentration on the test solution.

**D. Data modeling**

The efficiency and copper adsorption capacity from the residual copper concentration was calculated by the following equations.
The percent removal efficiency of the copper was calculated as

$$\% \text{ Removal} = \frac{Ci-Ce}{Ci} x100 \qquad (1)$$

Where, Ci is the initial copper concentration (mg.L-1), Ce is the equilibrium concentration of copper solution (mg.L-1).

$$\text{Adsorption capacity (qe)} = \frac{(Ci-Ce)*V}{m} \qquad (2)$$

Where, Ci is the initial copper concentration (mg.L-1), Ce is the equilibrium concentration of copper solution (mg.L-1), V is the volume of solution used in the batch (lit.), m is mass of adsorbent (g), qe is adsorption capacity (mg of copper removed/ g of adsorbent).

## III.RESULTS AND FINDINGS

**A. Effect of Adsorbent dose on percentage copper removal**

One of the parameters that strongly affect the adsorption process in an aqueous solution is the adsorbent dose. This is an important parameter, because it determines the capacity of an adsorbent for a given initial concentration of the adsorbate .More specifically, the increase rate of this parameter was high for higher adsorbent doses, due to the greater availability of active sites on the surface of the materials, and low for lower adsorbent doses, due to the progressive saturation of these active sites. However, the amount of Cu (II) adsorbed per adsorbent mass unit decreased considerably as the adsorbent dose increased. This can be attributed to adsorption sites remaining unsaturated during the adsorption reaction. In addition, it could also be noticed that the majority of the tested materials, steady state was reached for an adsorbent dose value 0.1g/l Therefore, the optimum adsorbent dose of 0.1 g/L.

**B.Effect of adsorption capacity on removal efficiency of copper**

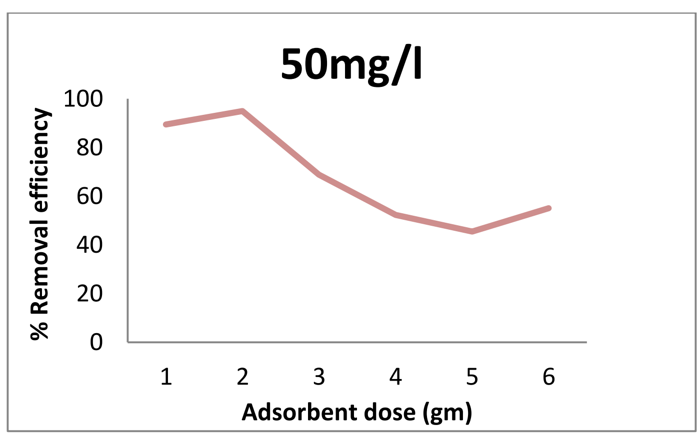
The mechanism of metal adsorption from an aqueous solution is particularly dependent on the adsorption capacity in the solution. According to the results increasing the initial Cu concentration caused an increase in the amount of Cu adsorbed per adsorbent mass unit. This was due to the increase in the driving force for mass transfer, which is the concentration gradient. In addition, a decrease in the Cu removal could be noticed as the initial Cu concentration in the solution increased, due to the saturation of the active sites in the solution.

**C.Effect of pH on percentage copper removal**

The pH of an aqueous solution is one of most important controlling parameters in the heavy metal adsorption process . It affects the surface charge of the adsorbent and the degree of ionization and speciation of the heavy metal in the solution. This study was carried out in a pH range 2-11 since copper starts to precipitate above pH 7. The optimum Cu (II) uptake of95.64%, by Banana Peels respectively, was observed at pH 7.

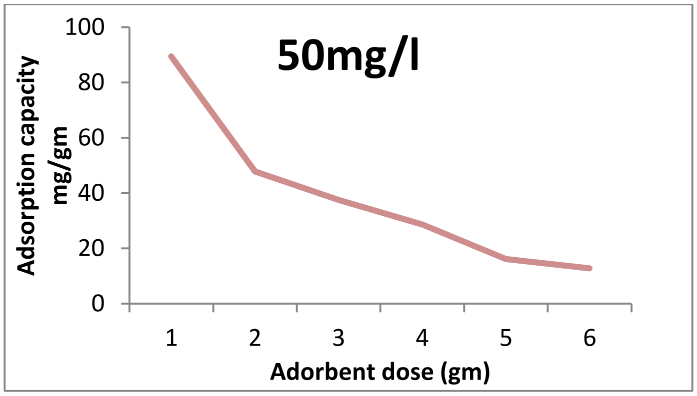
**D.Effect of Contact Time on percentage copper removal**

By increasing contact time, an increase in both the amount of Cu(II)adsorbed per adsorbent mass unit and the Cu removal was obtained. In most cases, the quick initial rate of adsorption during the first few minutes of contact was followed by a slower one, until equilibrium state was reached. This was due to the existence of abundant vacant active Banana Peels sites, whereas as adsorption continued a progressive saturation of these active sites with time.




**Graph A Effect of Adsorbent dose on percentage copper**

**removal**




**Graph B Effect of adsorption capacity on removal efficiency of copper**

| Sr. No | Samples mg/l | Adsorbent dose gm | Removal efficiency % | Adsorption capacity mg/gm |
|---|---|---|---|---|
| 1 | 50 | 0.05 | 89.4 | 89.42 |
| 2 | 50 | 0.1 | 95.64 | 47.82 |
| 3 | 50 | 0.2 | 68.8 | 37.5 |
| 4 | 50 | 0.4 | 52.3 | 28.6 |
| 5 | 50 | 0.8 | 45.5 | 16.1 |
| 6 | 50 | 1.6 | 55 | 12.8 |

**Table –I Test results for Ph =7, Contact time =3hrs ,Initial Metal Concentration=50mg/l.**

## IV.CONCLUSIONS AND FUTURE SCOPE.

Copper concentration were found to have predominant effect on the adsorption efficiency of Banana Peels peel powder.The uptake of copper ions is possible between pH of 2.0 and 10; however pH of 7.0 gives maximum copper removal for Banana Peels powder.The removal efficiency at pH=7 is about 95.64% . Which are also encouraging and might be improved by optimizing the operating parameters at the pH=7.The percentage of copper removal was found to be a function of adsorbent dose and contact time at a given initial solute concentration In case of effect of adsorbent dose, equilibrium dosage of 0.1g was found for Banana Peels powder after that there is no any significant change on copper removal efficiency with increase in dose. While the maximum efficiency was found to be 95.64%.The increase in copper concentration from 10 to 50mg/L the percentage of copper removal was decreased from 95.64-78.5 % and curve gradually attains equilibrium after 180 min for Banana Peelspeel powder. As there was no significant increase in percentage of copperremoval after 180 min so equilibrium time.

### FUTURE SCOPE

Suitable as low cost adsorbents; column study will show better results for selected adsorbents; desorption study possible for regeneration of adsorbents.

## V.REFERENCES


[1]Pandey P L, Kankal S B, Jadhav M V Adsrptive “Removal of copper from Aqueous solution by using Syzgiumcumini L” International Journal of Scientific and Research Publications, Volume 4, 1 ISSN 2250-3153.

[2] Brewer GJ, “Iron and copper toxicity in diseases of aging, particularly atherosclerosis andAlzheimer's disease”, Exp. Biol. Med., vol. 232, 2007, pp. 323-35.

[3] Faller P, “Copper and zinc binding to amyloid-beta: coordination, dynamics, aggregation, reactivity and metal-ion transfer”, Chembiochem., vol.10, 2009, pp 2837-45.

[4] Haureau C, and Faller P, “Abeta-mediated ROS production by Cu ions: structural insights, mechanisms and relevance to Alzheimer's disease”, Biochimie., vol. 91, 2009, pp.1212-7.

[5] Van Genderen EJ, Ryan AC, Tomasso JR and Klaine SJ, “Evaluation of acute copper toxicity to larval fathead minnows (Pimephalespromelas) in soft surface waters”, Environ. Toxicol. Chem., vol. 24, 2005, pp. 408-14.

[6] Flemming CA and Trevors JT, “Copper toxicity and chemistry in the environment: a review”, Water, Air, & Soil Pollution., vol. 44, 1989, pp. 143-158.

[7] Gao H, Liu Y, Zeng G, Xu W, Li T and Xia W, “Characterization of Cr(VI) removal from aqueous solutions by a surplus agricultural waste-Rice straw”, J. Hazard. Mater., vol.150,2008, pp.446-452.

[8] Basha S, Murthy ZVP and Jha B, “Biosorption of hexavalent chromium by chemically modified seaweed, Cystoseiraindica”, Chem. Eng. J., vol.137, 2008, pp.480-488.

[9] Mohan D, Pittman Jr. CU, Bricka M, Smith F, Yancey B, Muhammad J, Steele PH, Alexandre-Franco MF, Gomez-Serrano V and Gong H, “Sorption of arsenic,cadmium, and lead by chars produced from fast pyrolysis of wood and bark during bio-oil production”, J. Colloid Interface Sci., vol.310, 2007, pp.57-73.

[10] Malkoc E and Nuhoglu Y, “Potential of tea factory waste for chromium(VI) removal from aqueous solutions: Thermodynamic and kinetic studies”, Sep. Purif. Technol., vol.54,2007, pp.291-298.

[11] Garg UK, Kaur MP, Garg VK and Suda D, “Removal of hexavalent chromium from aqueous solution by agricultural waste biomass”,J.Hazard.Mater.,vol.140,2007,pp.60-68.

[12] American Public Health Association (APHA) Standard Methods for Estimation of Water and Wastewater, 22nd edition, American Water Works Association, Water environment Federation, Washington (2012).

[13] Indian Standard Institute (ISI), Drinking Water Specification (2012 Revised).

[14] World Health Organization (WHO), Guidelines for Drinking Water Quality. Health Criteria and other Supporting Infor-mation, 1, WHO, Geneva, (2004).

[15] Indian Council of Medical Research (ICMR) Manual of Standards of Quality for Drinking Water Supplies (1975).

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