**REMOVAL OF COPPER FROM AQUEOUS SOLUTIONS BY USING SUGAR CANE BAGASSE**

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**ABSRACT**

Adsorption behaviour of copper from waste water has been investigated in this paper using Bagasse. Copper is highly toxic metal ion and considered as a priority pollutant released from various chemical industries like electroplating mixing activities, smelting, battery manufacture, etc. Effluents have been excessively released into the environment due to rapid industrialization and have created a global concern. Therefore they must be removed before discharge. In the present paper, the experimental results carried out in batch adsorption process using treated Bagasse with synthetic samples prepared in laboratory were presented. The various parameters such as solution pH, initial copper concentration, temperature and adsorbent dosage on the adsorption of Cu were studied and presented. It was found that the adsorption data were fitted well by Langmuir isotherm. The Langmuir adsorption capacity was estimated as 4.75 mg/g for Bagasse. The maximum removal of Copper is above 93% was observed at pH of 5 for Bagasse in 100 ppm Copper solution.

**Key Words:** Copper, Bagasse, Low Cost Adsorbent, Adsorption

**INTRODUCTION**

Environmental contamination by toxic meter is of great concern because of health risks on humans and animals. Among the toxic metal ions chromium is one of the common contaminants which gains importance due to its high toxic nature even at very low concentration. Water pollution by chromium is of considerable concern, as this metal has found widespread use in electroplating, leather tanning, metal finishing. The conventional methods used to remove Cu from aqueous effluents include chemical precipitation, ion exchange, electroflotation, membrane separation, reverse osmosis, electro dialysis, solvent extraction, etc. However, these approaches have proved to be costlier and difficult to implement. Adsorption is one of the physico-chemical treatment process found to be effective in removing heavy metals from aqueous solutions. Adsorbents can be considered as cheap or low cost if it is abundant in nature, requires little processing and is by product of waste material from industrial or agricultural operations may have potential has inexpensive adsorbents. Plant wastes are in expensive as they have no or low economic value. The aim of the present investigation is to detect the performance of bagasse on Copper removal from aqueous solutions by varying Copper concentration, pH and adsorbent dosage. Langmuir and Freundlich isotherms were applied to fit the experimental data.

**MATERIALS AND METHODS**

All the chemicals used in this study were of analytical grade and were proceed from SD. Fine Chem. Ltd.

The adsorbent was selected for removal of Copper by bagasse. The adsorbent were grounded and wasted with deionised water. The adsorbents were dried at room temperature (32 ±1°C) till a constant weight of the adsorbents was achieved (after 20 hrs). Adsorption is an effective and versatile method for removing Copper.

**Preparation of adsorbent:**

*Adsorbent:* Adsorbent collected from the Chittor Coop., Sugars, and Chittor.

Firstly the adsorbent was washed and dried at room temperature to avoid the release of color by adsorbent into the aqueous solution. The activation
of adsorbents are carried out by treating it with concentrated sulphuric acid (0.1N) and is kept in an oven maintained at a temperature range of 150°C for 24hr. Again is washed with distilled water to remove the free acid.

**Batch experiments:**

A stock solution of Cu is prepared by dissolving 2.68 grams of 99.99% copper chloride dihydrate in distilled water and solution made up to 1000ml. This solution is diluted as required to obtain the standard solutions containing 50 mg/L – 500 mg/L of Copper. The pH is adjusted in the range of 2-10 by adding 0.1N H₂SO₄ and 0.1N NaOH solutions and measured by a pH meter (ELICO, LI 613).

The batch experiments are carried out in 250ml borosil conical flasks by shaking a pre-weighed amount of the saw dust with 100ml of the aqueous Copper solutions of known concentration and pH value. The metal solutions were agitated in a rotary shaken at 120 rpm for a desired time. The samples were withdrawn from the shaken at the predetermined time intervals and adsorbent was separated by filtration. Copper concentration in the filtrate was estimated using AAS. The experiments were carried out by varying the copper concentration in the solution (50mg/L-500mg/L), pH 5. The adsorbent dosage 0.2-1gr/100ml for contact time is 6hrs, with initial metal concentration of 100mg/L at room temperature 30 ±20°C and solution pH 5.

The samples were collected at different time intervals 15 min to 5 hrs and the adsorbent was separated by filtered using filter paper.

\[
\text{% removal of copper = } (C_{\text{int}} - C_{\text{fin}}) \times 100 / C_{\text{int}}
\]

Where \(C_{\text{int}}\) and \(C_{\text{fin}}\) are the initial and final copper concentrations, respectively.

**RESULT AND DISCUSSION**

**Effect of PH**

Effect of solution pH on removal of Cu was studied using Bagasse as adsorbent. Fig. 1 shows the effect of pH on the batch adsorption of 100 mg/l Cu at 32°C and adsorbent dosage 0.2 gr/100 ml. It is obvious that the increasing pH from 2 to 10 percentage removal is decreased from 65% to 59%. It was observed that the maximum percentage of removal of Cu was at pH 5. Almost above 65% of Cu removal was observed at this pH at 100 mg/l Cu concentration.

**Effect of contact time**

The effect of contact time on Cu adsorption bagasse is investigated to study the Cu percentage removal. Fig. 2 shows the percentage removal of Cu for different initial concentration ranging from 50 mg/l to 500 mg/l at pH 6. The time is one of the most important factors for the adsorption of Cu on adsorbent. It was observed that, while increasing the Copper concentration from 50 mg/l to 500 mg/l, the percentage removal decreases from 81 to 60% after completion of 2 hrs contact time.

Hence the Equilibrium time obtained is 210 min for the Cu adsorption on bagasse. It is obvious that increase in contact time from 30 min to 100 min enhanced significantly the percent removal of Cu. The initial rapid adsorption gives away a very slow approach to equilibrium. The nature of adsorbent and its available sorption sites affected the time needed to reach the equilibrium.
Effect of Adsorbent dose

The effect of adsorbent dosage on the adsorption of Cu process is shown in Fig.3. Removal of Cu increases with increasing of adsorbent dosage. The percentage removal increases from 85% to 93% by increasing the adsorbent dosage from 2 – 10 gm/l. Fig.4. for a constant initial Cu concentration of 200 mg/L in the solution. The increase in Cu removal with increasing adsorbent amount is due to the increasing surface area and adsorption sites available for adsorption. Fig.4 shows However; the adsorption capacity is decreases from 4 to 0.995 mg/gr by increasing the adsorbent amount from 2 to 10 grams /lit.

Effect of initial concentration:

In the present study, the removal of Cu by using bagasse at different initial concentrations of Copper (50 -500 mg/l) at fixed dosage 2 gr/lit and contact time 5 hrs. The results show that with increase in Cu concentration from 50-500 mg/l(Fig.5), the Percent removal decreases from 81 to 60% and adsorption capacity increases(Fig.5)

Adsorption Isotherms

Langmuir and Freundlich isotherms

The adsorption isotherm plot between Ce/qe verses Ce. From Fig.6 shows the Langmuir constant qm, which is a measure of the monolayer adsorption capacity of bagasse is obtained 4.75 mg/gr. The Langmuir constant b, is found to be 0.009. The high value of regression correlation coefficient (R²=0.978) is obtained. The dimensionless parameter R_L, which is a measure of adsorption favorability is found to be 0.5(0< R_L<1) which confirms the favorable adsorption process for Cr(VI) removal using mixing and bagasse. R_L, also known as the separation factor, given by

\[ R_L = \frac{1}{1 + bC_e} \]

The value of R_L lies between 0 and 1 for a favorable adsorption, while R_L > 1 represents an unfavorable adsorption, and R_L = 1 represents the linear adsorption, while the adsorption operation is irreversible \( R_L = 0 \).
The Langmuir and Freundlich equations are given in equations are

\[ \frac{C_e}{q_e} = \frac{1}{q_m} + \left( \frac{1}{q_m} \right) C_e \]

\[ \ln q_e = \ln K_f + \left( \frac{1}{n} \right) \ln C_e \]

Freundlich isotherm is analyzed based on adsorption copper by using the same equilibrium data of mixing of bagasse. Freundlich constants, \( K_f \) and \( n \) are obtained by plotting the graph between \( \log q_e \) versus \( \log C_e \) (Fig. 7). The values of \( K_f \) and \( n \) are 0.0087 and 1.424 respectively. It is found that, from the regression correlation coefficient of Freundlich Isotherm is more suitable than the Langmuir isotherm model as given in Table 1.

**Table 1:**

<table>
<thead>
<tr>
<th>Constant</th>
<th>Correlation coefficient ( R^2 )</th>
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<tr>
<td>( q_m )</td>
<td>0.009</td>
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**Table 2:**

<table>
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<tr>
<th>Constant</th>
<th>Correlation coefficient ( R^2 )</th>
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<tbody>
<tr>
<td>( K_f )</td>
<td>0.0087</td>
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**CONCLUSION**

Following conclusions are drawn from the above discussed results:

1. Adsorbent prepared from bagasse could be used for the removal of Cu from aqueous solutions
2. The equilibrium time the adsorption of Cu on the adsorbate prepared from bagasse in the present study from aqueous solution is found to be 2 hrs
3. The adsorption isotherm data of Cu on bagasse with best modeled by both Langmuir and Freundlich isotherm.
4. Adsorption of Cu on mixing of bagasse yielded maximum adsorption capacity is 4.75 mg/gr.
5. Removal of Cu increases with increasing of adsorbent dosage at pH 5
6. Removal of Cu decreases with increasing of the initial concentration and also with pH, However Adsorption capacity is increasing with increasing the initial concentration of Copper.
7. Adsorption capacity is decreases with increasing the adsorbent amount.

REFERENCES


