INVESTIGATING EFFECTS ON CHROMIUM ADSORPTION FROM AQUEOUS SOLUTION BY HENNA POWDER AND CORN COB POWDER

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Abstract

Heavy metal is one of the major environmental and ecological problems in the world. The presence of heavy metal in water and waste water causes toxic effects to the living beings and the environment. Compared to other heavy metals chromium is very toxic. Due to a large number of industries, Chromium contamination exceeds the tolerance limits. Many methods are used to remove the chromium from effluent. Adsorption is one of the cost-effective method, being widely used for the removal of heavy metals from industrial and commercial waste water. The Initial concentration of chromium present in waste water is 4366.544 mg/l. Many of the natural adsorbent are available to remove the heavy metals. This project illustrate the removal of Total Chromium (Cr) from synthetic waste water replicating electro plating industry Effluent by using natural adsorbents like corn cob and Henna leaves. The experiment results carried out in batch adsorption process with varying adsorbent dosage, contact time and pH by using corn cob and Henna leaves for removal of chromium. The results are to be validated by using different isotherms.

Keywords: *Chromium, Henna leaves, Corncob, Adsorption method, Synthetic waste water, Electroplating industry*

Introduction

Water pollution by chromium is of considerable concern, The challenge of water in the 21st century is one of both quantity and quality. The World Water Development report revealed that nearly half of the global population will be living in regions of high water stress by 2030.This projection is particularly daunting considering that in 2000, 508 million people inhabited water-stressed or water-scarce regions indicating that the percentage of the world population affected by water-scarcity could rises from 8% to 47% in a mere three decades. The global population is expanding by 80 million people annually, increasing the demand for freshwater by about 64 billion year. We struggle with the basic need of water for our day to day life is the one type of problem, the another mode of problem is good quality of water for compensating lack of nutrients in drinking water. Freshwater bodies have limited capacity to process the pollutant charges of the effluents from expanding urban, industrial and agricultural uses. Water quality degradation can be a major cause of water scarcity. 83% of the world's populations are using improved drinking-water sources, but 1.1 billion people are still without access to safe drinking-water. We use most of water source for drinking, domestic and industrial purposes. Result of these inadequate uses of water from various sources causes salinity, mixing of contaminants by industrialization.

Chromium may enter the natural water by weathering of Cr-containing rock, direct discharge from industrial operation, leaching of soil, among others. In the aquatic environment Cr may suffer reduction, oxidation, sorption, desorption, dissolution and precipitation (Uplabdhi tyagi et al., 2018). The health hazardes associated with exposure to chromium are dependents on its oxidation states. When inhaled, chromium compounds are respiratory track irritants and can cause pulmonary sensitization. Chronic inhalation of Cr(VI) compounds increase the risk of lung, nasal and sinus caner. Severe dermatitis and usually painless skin ulcers can result from contact with Cr (VI) compounds. Long-term exposure to copper dust can irritate your nose, mouth and eyes and cause headaches, dizziness, nausea and diarrhea., there are several method's for removal of heavy metal. These techniques include chemical precipitation ion exchange, membrane filtration, coagulation-flocculation, adsorption and floatation. Among these techniques adsorption is the most cost effective method (Nassar et al., 2006). In this study to evaluate the potential of corn cob powder & henna powder as adsorbent for the removal of total chromium from synthetic waste water replicating electroplating industry waste water.

Material Collection

Among the various adsorbent available for the removal of chromium from electroplating industrial wastewater, natural adsorbents such as corn cob and henna leaves are chosen for the experiment. To find the removal efficiency of an each adsorbent, laboratory studies has to be done, they include the preparation of adsorbents and characterization of adsorbents and waste water prepared synthetically The following things describes the materials adopted to meet the objective of this work was presented in this chapter.

Selection of Adsorbents

Many researchers have utilized low cost, eco-friendly and highly efficient adsorbents for removal of heavy metals from effluents. Among these recently investigated adsorbent materials (Corn cob, Henna leaves) have attracted particular attention because these waste represent unused resources and hence these can be used as adsorbents for removing heavy metals.

Figure 1 Henna Leaves

Figure 2 Corn Cob


Figure 3 Preparation of Corn Cob Powder

Preparation of Henna Powder

Henna leaves used in the present study was purchased from the local market in sivaganga, Tamil Nadu. The henna leaves were washed thoroughly with distilled water in order to remove the soil clinging to it. The sample was dried in the presence of sunlight for 5 to 6 days.


Figure 4 Henna Powder Figure 5 Dried Henna Leaves

Preparation of Synthetic Waste Water

The waste water used in this Experiment was synthetically prepared in the laboratory. To replicate the waste water characteristics from an electroplating industry the heavy metal concentration chromium concentration where alone replicated and the remaining heavy metals are not considered in this study.

Results and Discussion

Characterization of Adsorbents

Proximate analysis was done in order to determine moisture content, ash content, and volatile matter in the adsorbents. It was observed that lower the ash content the better the overall activity of the adsorbents (yahya et al., 2020).

Table 1 Proximate Analysis of Prepared Adsorbents

S.No	Characteristics	Henna Powder	Corn Cob Powder
1	Moisture Content	11.2%	14%
2	Ash Content	2.00%	4.00 %
3	Volatile Matter	43.17%	77.10%

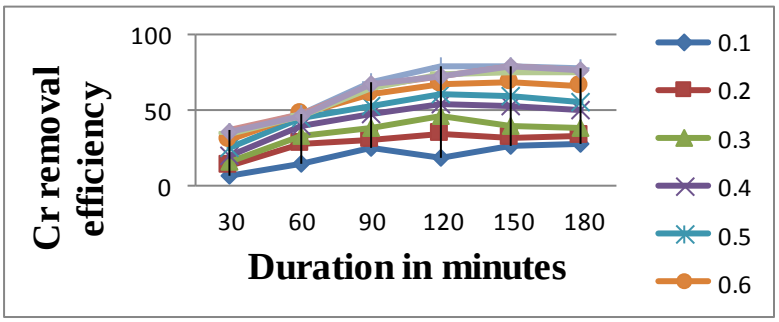

Figure 6 Removal Efficiency of Chromium by Corn Cob

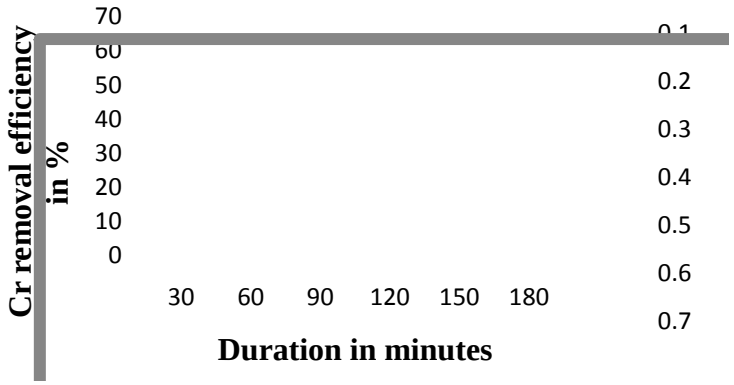

Figure 7 Removal efficiency of chromium by henna powder

Comparative Analysis of Corn Cob and Henna Powder

Comparison for Chromium

For the removal of chromium from the synthetic waste water corn cob and henna powder is used separately. The removal efficiency and equilibrium time is compared. The maximum removal efficiency are 79.54% and 59.32% at equilibrium time are 120min and 150 min for corn cob and henna powder respectively

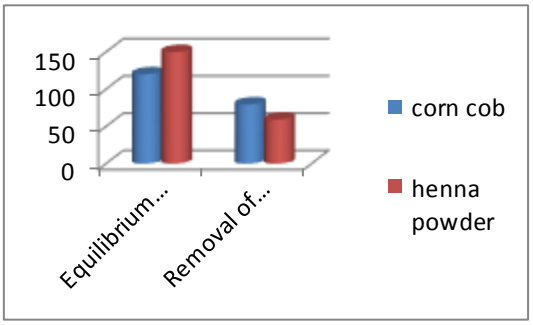

Figure 8 Comparison of Chromium Removal Efficiency by Corncob and Henna Powder

Freundlich Isotherms

This study was carried out to determine whether the adsorption of chromium on corn cob and henna powder follows multi-layer adsorption or not (Freundlich; 1906). The data was plotted with log Ce as X axis and log (X/m) as Y axis this plot is used to determine the factors affecting the Freundlich constants ie the rate at which the adsorption of chromium on corn cob and henna powder is taking place and the adsorption capacity of corn cob and henna powder are determined

Table 2 Freundlich Isotherm

S.No	Adsorbents	R2	Kf(mg/g)	1/N
1	Chromium removed by corn cob	0.982	176.66	-0.044
2	Chromium removed by henna powder	0.983	96.38	-0.05

Langmuir Isotherms

This study was carried out to derive the relationship between the adsorbent and adsorb ate at constant temperature through the model described by Langmuir. Langmuir model demonstrates the adsorption of chromium on corn cob and henna powder as monolayer and the surface of corn cob and henna powder as homogenous (Azizi, 2012;Palanisamy, 2009; Mouni, 2018

Table 3 Langmuir Isotherm

S.No	Adsorbents	R2	a	b
1	Chromium removed by corn cob	0.67	28.87	2.58
2	Chromium removed by henna powder	0.77	11.5	0.47

Comparison of Corn Cob and Henna Powder for the Removal of Chromium

For the removal of chromium from the waste water the natural adsorbents such as corn cob and henna powder is used separately. The adsorption capacity for corn cob and henna powder at the dosage of 0.7g/l and 0.8g/l are 9.6mg/g and 6.2mg/g respectively. From the result the adsorption capacity for corn cob is high for the removal of chromium.

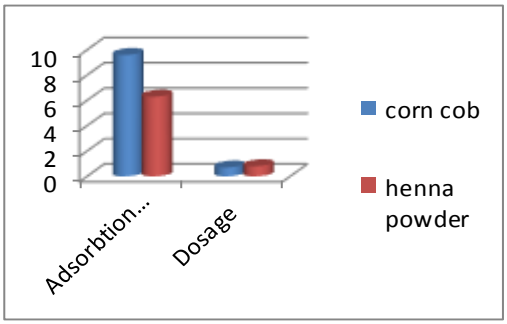

Figure 9 Comparison of Removal of Chromium from the Waste Water the Natural Adsorbents of Corn Cob and Henna Powder

Conclusion

The feasibility of employing corn cob and henna powder for removal of copper and henna powder with activation and solvent was investigated in this study. Apart from activating agent and solvent, the influence of various operational parameters like Effect of contact time, adsorbent dosage, were also examined in this study. The results obtained were listed below, proximate analysis studies were carried out to investigate about the corn cob and henna powder as adsorbents for this study. The ash content and volatile matter of the corn cob and henna powder are reduced, due to reduction in ash content the capacity of adsorption is increased. Isotherm studies were carried out to investigate the mechanism which governs the Adsorption of chromium on corn cob and henna powder. In this work the chromium adsorbed per unit mass of corn cob and henna powder and equilibrium concentration chromium at constant temperature was formulated based on two isotherm model, Langmuir and Fruendlich. Further in this study. From isotherm study, it is determined that, Freundlich intensity of the adsorption capacity of chromium on corn cob is 9.6mg/g and for the chromium on henna powder is 6.3mg/g . From the isotherm study, according to the removal efficiency it is determined that , the removal of chromium the corn cob is more effective than henna powder Based on R2 value it is concluded that adsorption of chromium on corn cob and henna powder follows multi-layer adsorption i.e. it follows Freundlich isotherm rather than Langmuir isotherm.

References

1. A. Kannan and S. Thambidurai, (2008), “Removal of Hexavlent chromium from Aqueous solution using activated carbon derived from palymra palm fruit seed”.
2. Vinesh V. Rakholiya and S. A. Puranik (2012) “COD reduction using modifying industrial effluent treatment flow sheet and low cost adsorbent as a part of cleaner production” Advances in Applied Science Research, 2012, 3 (3)..
3. T. Shanthi and V. M. Selvarajan (2012), “Removal of Cr (VI) and Cu (II) Ions from Aqueous Solution by Carbon Prepared from Henna Leaves” Journal of Chemistry Volume 2013.
4. Dada, A., Olalekan, A., Olatunya, A., DADA, (2012) “Langmuir, Freundlich, Temkin and Dubinin–Radushkevich Isotherms Studies of Equilibrium Sorption of Zn2+ Unto Phosphoric Acid Modified Rice Husk” *(IOSR-JAC) Volume 3, Issue 1(Nov. – Dec. 2012),*.
5. R.S.Mane, V.N.Bhusari, “Removal of Colour (dyes) from textile effluent by adsorption using Orange and Banana peel” (IJERA) Vol. 2, Issue 3, 2012.
6. C. Pragathiswaran, S. Sibi and P. Sivanesan “Comparison studies of various adsorption isotherms for aloevera adsorbent” IJRPC 2013.
7. KKIU Arunakumara, Buddhi Charana Walpola and Min-Ho Yoon “Banana Peel: A Green Solution for Metal Removal from Contaminated Waters”, Vol. 32, No. 2, 2016.