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Adsorption of heavy metal ions from ultramarine blue industrial effluents by low cost adsorbents

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Abstract- *In this study the usefulness of agricultural wastes have been investigated after their chemical treatment for the removal of cadmium, zinc, copper and lead from aqueous solutions using column adsorption. The result shows that a flow rate of 2ml/min and a bed height of 10 cm are most feasible. It is known that cellulosic material can be obtained and employed as economic adsorbents and their performance can be affected up on chemical treatment. Agricultural wastes like rice husk, sugarcane bagasse, and wheat bran shows good adsorption capacities for toxic metal ions like cadmium, copper, zinc and lead. This process is useful for wastewater treatment.*

Key words:Adsorption, Toxic metal ions, Waste water, Treatment, Agricultural waste.

1.Introduction

Excessive release of heavy metal ions in industrial effluent has created a major global concern. In such effluents cadmium, zinc, copper and lead are often detected in industrial waste waters, which originate from pigment manufacture printing and photographic industries etc.[1-2]

Looking to the hazardous effects of heavy metals on human health due to its accumulation, it is advised to remove these heavy metal ions before discharge of such industrial effluent. This urgent need of removal of such hazardous metal ion by suitable adsorbents create an interest to go for research activities which can help to find the cheaper adsorbents to replace costly waste water treatment procedure such as chemical precipitation, ion exchange, electro flotation, membrane separation, reverse osmosis, electro dialysis, solvent extraction etc.[3] are attracting attention of scientists.

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Adsorbents available in nature can be considered as low cost if it is abundant in nature, such plant wastes are inexpensive. Many adsorption studies have been focused on untreated plant waste materials.[4] The application of untreated plant wastes as adsorbents can also bring several unwanted yields like low adsorption, high chemical oxygen demand (COD) and biological chemical demand (BOD) and total organic solid (TOC).[5] Therefore before application of plant waste material as adsorbent a chemical treatment is suggested[6-7].

2. Materials and methods

(i) Rice husk:- Pretreatment of rice husk exhibited higher adsorption capacities on heavy metal ions than unmodified rice husk. The rice husk treated with sodium hydroxide, sodium carbonate and epichlorohydrin enhanced the adsorption capacity of cadmium[8].

(ii) Wheat bran:- By-products obtained from wheat milling industries, is allowed to interact with strong sulphuric acid which is dehydrating agent brings structural changes on surface area of this adsorbents, which results in imparts better binding capacity to adsorb copper ions.[9]

(iii) Sugarganebagasse:-This adsorbent material is treated with sodium bicarbonate and hydrochloric acid with 0.1M of both which facilitated adsorption capacity of cd(II) and pb(II) gradually[10].

Table 1:- (Aqueous medium)

Comparison of the adsorption efficiencies of toxic metal ions on untreated and chemically modified adsorbents.

S.No.	Adsorbent	Modifying agent	Heavy metals	Adsorption before treatment Q max (mg g^{-}	Adsorption after treatment Q max mg g-
1.	Rice husk	Water washed sodium hydroxide (0.1 m) sodium bicarbonate (0.1m)	Cd (II)	5.42	7.68

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		and epichlorohydrine(0.1 m)	Zn(II) Cd (II)	NA 3.46	NA 6.26
2.	Sugarcane bagasse	Sodium bicarbonate (0.1m) Hydrochloric acid (0.1m)	Cu (II) Pb (II)	7.46 8.32	9.26 11.42
3.	Wheat bran	Sulphuric acid (0.1m)	Cu (II)	10.62	21.26

Stock solution of 1gm/l of metal ions were prepared from the salts-

Cu $(NO_3)_2$. $4H_2O$, Zn $(NO_3)_2.6H_2O$, Cd $(NO_3)_2.4H_2O$ and Pb $(NO_3)_2$ analytical grade.

Actually 25ml of 1ppm of each metal ion solution is used for this study. For this 0.01 gm of adsorbents are put into each 25 ml of 1ppm solution of cadmium cd2+

Copper (Cu^{2+}), lead (Pb^{2+}) and Zinc (Zn^{2+}) respectively as per illustration shown table 1. Also a comparative study is explored to differentiate adsorption capacity in the single component model system of batch and column condition at pH 5.0, room temperature (25± 5°C).

Table 2.

Metallic ion Q (mg)

Single compound solution	Batch	Column
Pb^{2+}	1.95	24.22
Cd^{2+}	2.26	20.22
Cu^{2+}	4.23	40.23
Zn^{2+}	0.253	12.26

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4.Column regeneration:-

Stock solution of pb^{2+}, zn^{2+}, cd^{2+} and cu^{2+} were passed through the polyethylenecolumn using the condition as found for single component solution. Accordingly effluents are used and an aliquot of 10ml were collected and the ions concentration were determined.

5. Result and discussions:-

A significant change in adsorption efficiency of modified adsorbent is observed. The maximum difference is observed in wheat bran adsorbent for copper (Cu2+) ion which becomes from 10.62 to 21.62 which is approx more than its double value of adsorptioncapacity. While rice husk is treated with epichlorohydrin for adsorption of Cd(II) showsagainthe efficiency is approx doubled. In other cases taken in this study the efficiency of adsorption is quite improved because of chemical treatment. (Table 1.)

It was found that the adsorption capacity of the column perform better than that of the batch system. The gradient concentration decreases with time in batch experiments while it is increasing in column system attributed the increased capacity.

6. Conclusion:-If a flow rate of 2ml/min and a bed height of 10 cm, the adsorbent efficiency for the adsorption of metal ion cadmium (2+) rice husk and copper (2+) wheat bran gets doubled.

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