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ORIGINAL RESEARCH ARTICLE

Heavy Metals Removal from an Aqueous Solution by Low cost Natural waste

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ABSTRACT

Heavy metals - Chromium (Cr) and Lead (Pb) are released into natural waters by industrial and domestic wastewater discharges. These can be toxic to aquatic life and cause natural water to be unsuitable as potable water sources. To remove these toxic metals from the natural water resources, researchers have tried many methods. Among them, Activated Carbon is used as adsorbent for the removal of pollutants present in water and wastewater however it is costlier process hence here we tried a low cost technology using the natural available resources such as various fallen tree leaves as an absorbent. *Terminelia cadappa* leave is analyzed whether they are having the capacity of effective adsorbent for the removal of Cr and Pb from the wastewater by experiments and various observations were made for the effect of contact time, pH, metal concentration and adsorbent doses in solution. Also a comparative study is been made through isotherm characteristics of removal efficiency of heavy metals from aqueous solution.

Key words: *Terminelia cadappa* , Chromium, Lead, Wastewater and Adsorbent.

1. INTRODUCTION

Pollution is an undesirable change in the Physical, Chemical and Biological characteristics of Air, Land and Water. Heavy metals such as Antimony (Sb), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg) and Zinc (Zn) having toxic effects on man and ecological environment which are present in various types of wastewater. Adsorption of heavy metals has been analyzed w.r. to be a number of adsorbents. To develop inexpensive and effective metal ion adsorbents, natural wastes such as coconut shelles, coal char, pine barks, agricultural wastes etc have been investigated. In this study, a fallen tree leaf of Terminelia Cadappa (TC-Batham leaves) is chosen as biomass.

The sago waste has the maximum sorption capacity of lead (46.6 mg/g) than for copper (12.4 mg/g) as reported by Quek *et al.* [1]. Samanta *et al.* [2] reported that chromate removal capacity of rice straw is good in an agitated and a packed bed column under varying processes and design parameters Rao *et al.* [3] applied bagasses for removal of chromium, nickel, copper and lead from aqueous solution. Gupta and Singh [4] studied the suitability of impregnated fly ash and rice husk for the removal of cadmium from aqueous solution. The order of Cd (II) removal capacity of these absorbents was reported as IFA>FA>RH). Rice husk ask has been used as an adsorbent for the removal of Cr(VI) from solution in a batch experiment by Bansal and Sharma [5] who reported that favourable conditions are an equilibrium time of 4 hr, pH of 2 and RHA dose of 4 g/100ml. Lead removal at pH 6.5 was reported to be 96.6% at initial concentration of 40 mg/l, temperature of 20°C using wheat bran by Singh *et al.* [6].

The present study deals with an alternate process for the removal of heavy metal ions by using leaf powder of batham leaves a commonly found plant. Most leaf powder can serve as potent metal sequestering biosorbent. Because of this economical and efficient techniques, based on leaf powder, can be developed for adsorption of heavy metals.

2. MATERIALS AND METHODS

Preparation of Biomass

After collecting required quantity of Batham leaves, it was dried in sunlight for three days and

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places it in a jute bag and keeps it in a room temperature for four days. It was then powdered and sieved 300 µm in size for use. The powder is washed twice with distilled water to remove unwanted materials, followed by washing with 0.1 NHNO_3 solutions, which is diluted with distilled water and heated it for 10 minutes. Finally the biomass is washed with distilled water until all the colour of the biomass in removed.

Preparation of stock solution

The solution of Chromium is prepared by dissolving 1.0g of $K_2Cr_20_7$ in 1 lit distilled water. The concentration of prepared solution is 1000 ppm. The solution of lead was prepared by diluting to 1000ml by dissolving 0.1598g of (PbNO3)2 in a minimum amount of 1+1 HNO3 and add 10ml of concentrated HNO_3.

Biosorption studies

0.5g biomass powder was contacted with 100ml metal ion solution in a conical flask by placing it in a mechanical shaker. Sample were taken out at specific duration of time and centrifuged at 1000rpm for 15min. The supernatant liquid was separated for low residual Cr (V1) and Lead (Pb) ions and analyzed by spectrophotometer and Atomic Absorption spectrophotometer.

3. RESULTS AND DISCUSSION

Metal removal as a function of time

(**Fig 1 & 2**) indicate the uptake of metal ions vs. contact time for different leaf dose (1.0, 1.5 and 2.0g/l at pH7). The removal of Cr(V1) ranges between 51-81% at 30-150 min at concentration 100ppm. Fig 1 shows the rate of Cr(V1)binding with leaf powder is more at initial stages and further gradually increase and remains constant. Fig 2 shows the removal of Pb ranges between 42-75% at 30-150min at concentration 100ppm and constant pH7. The rate of Pb binding with leaf powder is more at initial stages increases and remains constant.

Effect of biomass dose on adsorption

(**Fig 3 & 4**) show the relationship between percentage removal and dose variation ranges from 0.2, 0.4, 0.6, 0.8, 1.0, 1.2, 1.4, 1.6, 1.8 and 2.0g at pH7 for contact time of two hours. Fig.3 shows the removal of Cr(VI) range between 32-81 percent at 120 minutes for the concentration of 100ppm. Fig 4 shows the removal of Pb range between 40-84% at 120min. The rate of Cr(VI) and Pb binding with leaf powder is increases gradually and varies in minimum percentage when the dosage of biomass increases with concentration and pH remains constant.

Effect of pH on adsorption

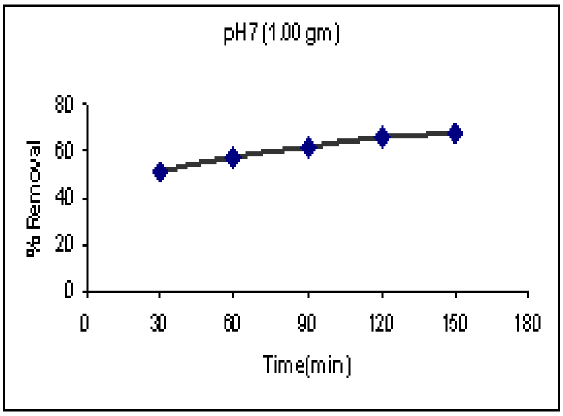
(**Fig 5**) results in Cr (VI) an increase in 10-80 percent removal with increase in pH of the medium was observed for the metal ion to a pH1-7. There was decrease in percent removal above this pH. An optimum pH of 6.5 for the adsorption of Cr was found using Terminelia cadappa. (**Fig 6**) in Pb, on increasing the pH from 1.0-7.0 of the medium the sorption capacity increased from 11-82%.The result suggests that the absorption is mainly due to ionic attraction between biomass and metal ions.

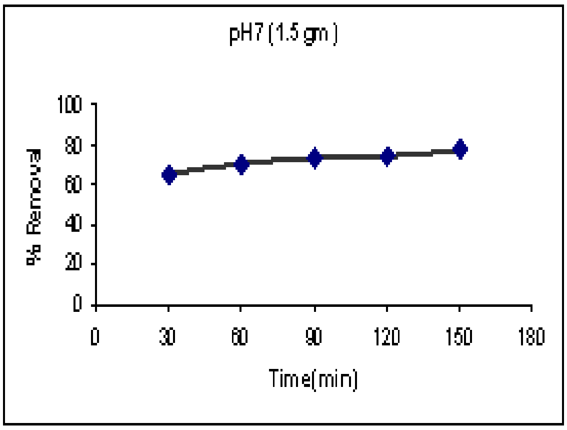
Adsorption Isotherm

Langmuir and Freundlich sorption isotherms are the most widely used models to describe the equilibrium behavior of adsorption uptake. The Freundlich model was desired empirically, while the Langmuir adsorption isotherm was developed from rational considerations. The experimental dates for the adsorption of Cr (VI) and Pb on the Batham bares are arrived from (**Fig 7 & 8**) are formed to be fit with both isotherms.

Table 1: **Comparison of Isotherm characteristics for Cr (V1) and Pb with Batham leaf**

Metal ion	Langmuir Isotherm	Freundlich Isotherm
Cr(VI)	Ce(x/m)=-3.535×10^3 + (1/-0.0064)ce	Logx/m=-0.346+0.0073ce
Pb	Ce(x/m)=-0.0005+0.0194ce	Logx/m=1.6193-0.3841ce.





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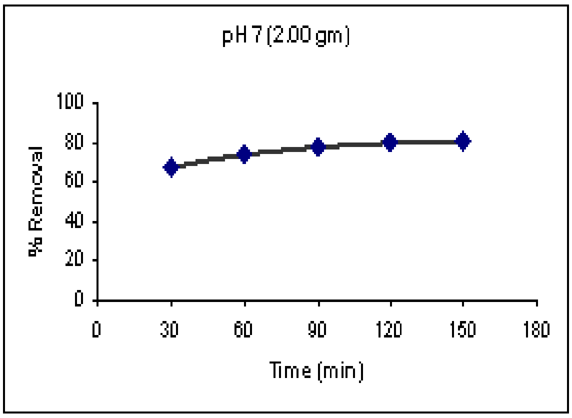

Fig 1: Effect of contact time on percentage removal of Cr(VI) by TC Leaves at pH 7 (1.0, 1.5 and 2 gram)

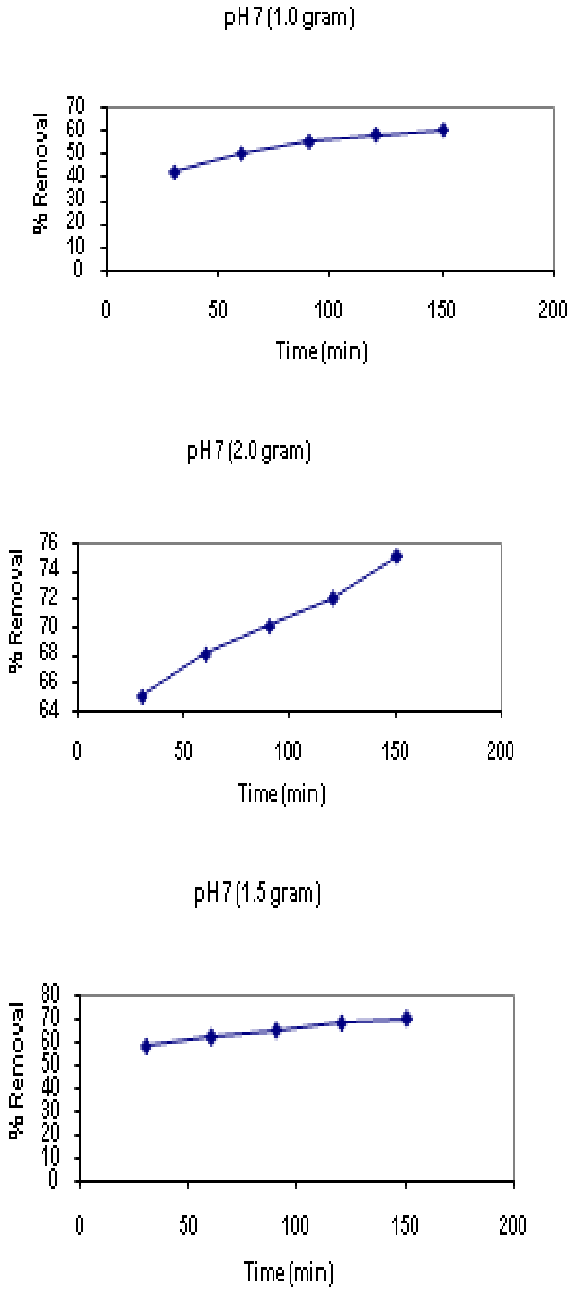

Fig. 2 Effect of contact time on percent removal of Pb (II) by TC leaves at pH 7 (1.0, 1.5 and 2g)

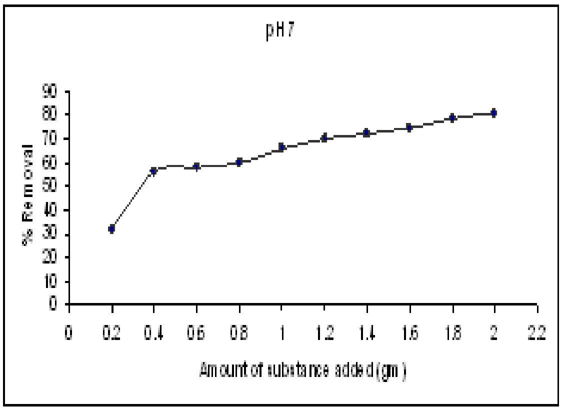

Fig 3: Effect of Biomass dose at neutral pH on percent removal of Cr(VI) by TC leaves

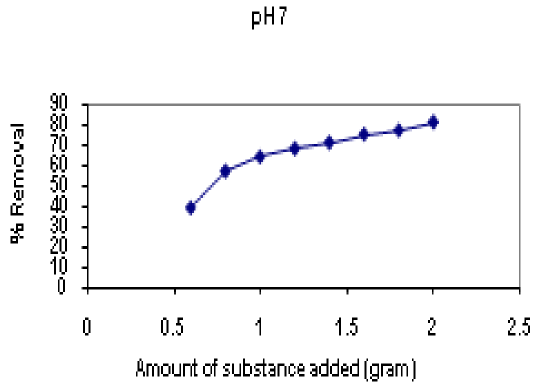

Fig 4: Effect of biomass dose at Neutral pH on percent removal of Pb (II) by TC leaves

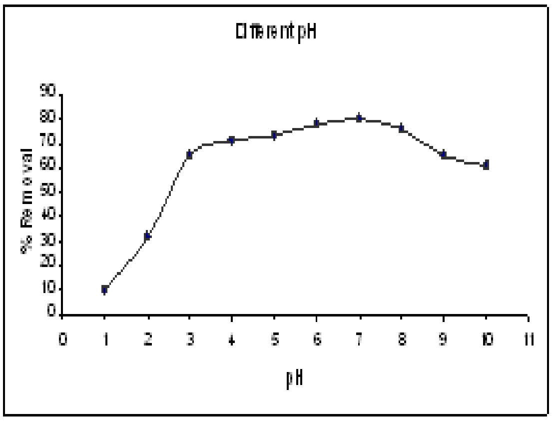

Fig 5: Effect of pH on percent removal of Cr (VI) by TC leaves

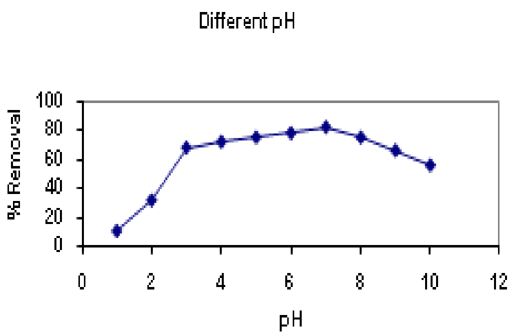

Fig 6: Effect of pH on percent removal of Pb (II) by TC leaves

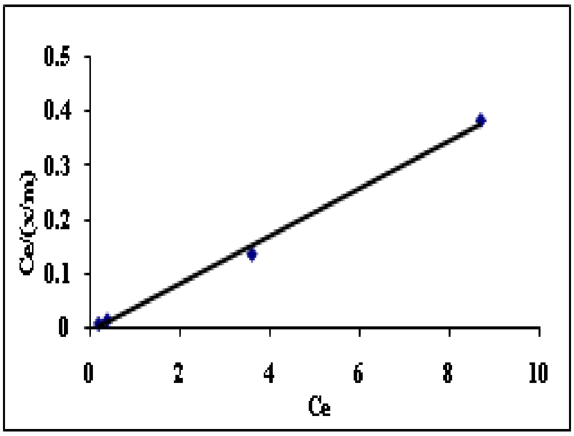

Fig 7: Linearized Langmuir Isotherm for the adsorption of Cr (VI) by TC Leaves

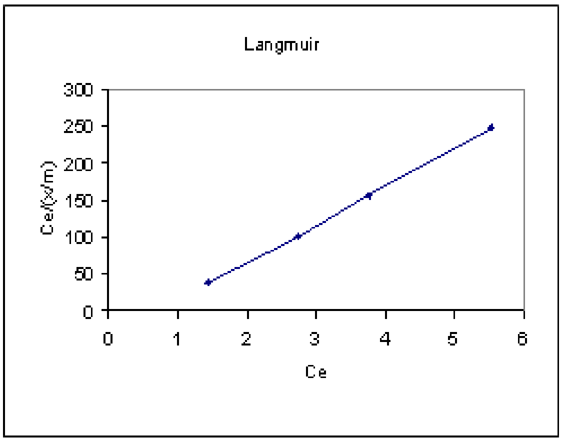

Fig 8: Linearized Langmuir Isotherm for the adsorption of Pb (II) by Batham Leaves

Table 2: Isotherm characteristics by TC (Batham Leaves) system

Initial concentration	Initial O.D	Final O.D	CE	X	g	x/m	Ce/[x/m]	Log Ce	Log X/M
20	0.694	0.602	8.674	11.331	0.500	22.661	0.383	0.938	1.355
30	1.021	0.300	3.584	26.412	1.000	26.412	0.136	0.554	1.422
40	1.322	0.045	0.370	39.631	1.500	26.421	0.014	-0.432	1.422
50	1.569	0.030	0.178	49.722	2.000	25.213	0.007	-0.749	1.401

Table 3: Isotherm Characteristics by BLP System

Initial Concentration	Initial O.D	Final O.D	Ce	x	m gram	x/m	Ce / (x/m)	Log Ce	Log x/m
20	0.126	0.018	1.428	18.572	0.5	37.141	38.452	0.155	1.574
30	0.212	0.058	2.736	27.264	1.0	27.262	100.37	0.437	1.432
40	0.287	0.108	3.763	36.237	1.5	24.165	155.754	0.575	1.384
50	0.351	0.194	5.527	44.473	2.0	22.244	248.523	0.742	1.354

4. CONCLUSION

Terminelia cadappa (TC- Batham leaves) have been studied as an adsorbent for Cr (VI) & Pb under various parameters. If the contact time between the solution containing the heavy metal and the biomass is more the efficiency of removal of heavy metals will be high, also, depends on the amount of biomass added to the solution and pH of the solution. This study revealed that the adsorption capacity of Cr (VI) and Pb were 81% and 82% respectively using Batham tree leaf. The equilibrium characteristics of adsorb ate uptake has been verified through Langmuir and Freundlich adsorption isotherm model.

REFERENCES

1. Quek N., Bansal T.K. and Sharma H.R. (1997) Chromium Removal by adsorption on Rice Husk. Indian Journal of Environmental Protection,12(3) : 198-201.
2. Samanta, N., Govind, L., Gopalasamy,V. G. (2000) Biosorption and its application in removal of heavy metals from wastewater, Nature Environment and Pollution Technology, 5: 337 - 342.
3. Rao J., Kannan N and Balamurugan J. (2003) Removal of Lead ions by Adsorption on to coconut shell and dates nut carbons-A Comparative study. Indian J. Environmental Protection, 25(9):816-823.
4. Gupta S and Singh, M (2004) Removal of Chromium (VI) by different adsorbents. A comparative study. Indian Journal Environmental Protection. 18(9):679-682.
5. Bansal K.K and Sharma S.H. (1992) Removal of Lead from wastewater using Agricultural by product Wheat bran. Indian journal of Environmental Protection. 25(5):390-396.
6. Singh N, Srinivasan K and Ramadevi A. (2005) Removal of Lead in aqueous medium by Tamarind nut carbon. Indian journal of Environmental Protection. 25(5):421-428.

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