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Adsorptive Removal of Heavy Metals from 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 unhealthful metals from the natural water resources researchers have tried several ways among them activated carbon is employed as adsorbent for the removal of pollutants gift in water and waste matter, but it's costlier method, thus here we tend to tried a coffee price technology exploitation the natural accessible resources like varied fallen tree leaves as associate absorbent. AegleMarmelos (AM)-Vilvam leaves leave is analyzed whether or not they are having the capability of imp active adsorbent for the removal of Cr and Pb from the waste water by experiments and numerous observations were created for the effect of contact time, pH, metal concentration and adsorbent doses in answer conjointly a comparative study is been created through isotherm characteristics of removal potency of heavy metals from solution.

Keywords: *Adsorbent, AegleMarmelos, Cr, Pb, waste water*

INTRODUCTION

Pollution is an undesirable amendment within the Physical, Chemical and Biological characteristics of Air, Land and Water. Significant metals like Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg) and Zinc (Zn) having venomous effects on man and ecological atmosphere that are gift in varied styles of waste water. Adsorption of heavy metals has been analyzed with reference to be a number of adsorbents. To develop inexpensive and effective metal ion adsorbents, natural wastes such as coconut shells, coal char, pine barks, agricultural wastes etc. have been investigated. In this study, a fallen tree leaf of AegleMarmelos (AM-Vilvam leaves) is chosen as biomass. 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 (1992) [5] who reported that favorable conditions are an equilibrium time of 4hr, 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. (2005) [6]. Samanta et al. (2000) [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. (2003) [3] applied bagasse for removal of chromium, nickel, copper and lead from aqueous solution. Gupta & Singh (2004) studied the suitability of impregnated fly ash and rice husk for the removal of cadmium from aqueous solution [4]. The order of Cd(II) removal capacity of these absorbents was reported as IFA>FA>RH). Present study deals with an alternate process for the removal of heavy metal ions by using leaf powder of vilvam leaves a commonly found plant. Most leaf powder can serve as potent metal sequestering bio sorbent. Because of this

economical and efficient techniques, based on leaf powder, can be developed for adsorption of heavy metals.

MATERIALS AND METHODS

Preparation of Biomass

After collecting required quantity of vilvam leaves, it was dried in sunlight for three days and places it in a jute bag and keeps it in a room temperature for four days. It was then powdered and sieved 300μ 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 color 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 1lit. distilled water. The concentration of prepared solution is 1000 ppm. The solutions of lead were 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.

Bio sorption Studies

A conical flask is placed in mechanical shaker with 0.5g biomass powder with 100ml metal ion solution and sample taken out the 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.

RESULT AND DISCUSSION

Metal removal as a function of time

Fig. 1 and 2 indicate the uptake of metal ions vs. contact time for different leaf dose (1.0, 1.5 and 2.0g/l at pH7). Fig. 1 shows the removal of Cr(V1) ranges between 22-69% at 30-150 min at concentration 100ppm. 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(II) ranges between 48-80% at 30-150min at concentration 100ppm and constant pH7. The rate of Pb(II) binding with leaf powder is more at initial stages increases and remains constant.

Effect of biomass dose on adsorption

Biomass dose proportion removal and different dose 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 2 hours shows in the Fig. 3 and Fig. 4. Fig. 3 shows the removal of Cr(VI) range between 8−65 percent at 120 minutes for the concentration of 100ppm. Fig. 4 shows the removal of Pb range between 30−79% at 120 min. 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 10−44% 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 7 for the adsorption of Cr was found using Aeglemarmelos. Fig. 6 in Pb, on increasing the pH from 1.0 - 7.0 of the medium the sorption capacity increased from 8−80%.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 sorption of Cr (VI) and Pb on the vilvam leaves are arrived from Fig. 7 and Fig. 8 are shaped to be match with both isotherms.

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

Metal ion	Langmuir Isotherm	Freundlich Isotherm
Cr(VI)	Ce(x/m)=0.0085 +0.035Ce	Logx/m=0.2089+0.4527Ce
Pb(II)	Ce(x/m)=-10.212x10^{3}+24.509Ce	Logx/m=0.155-0.046Ce

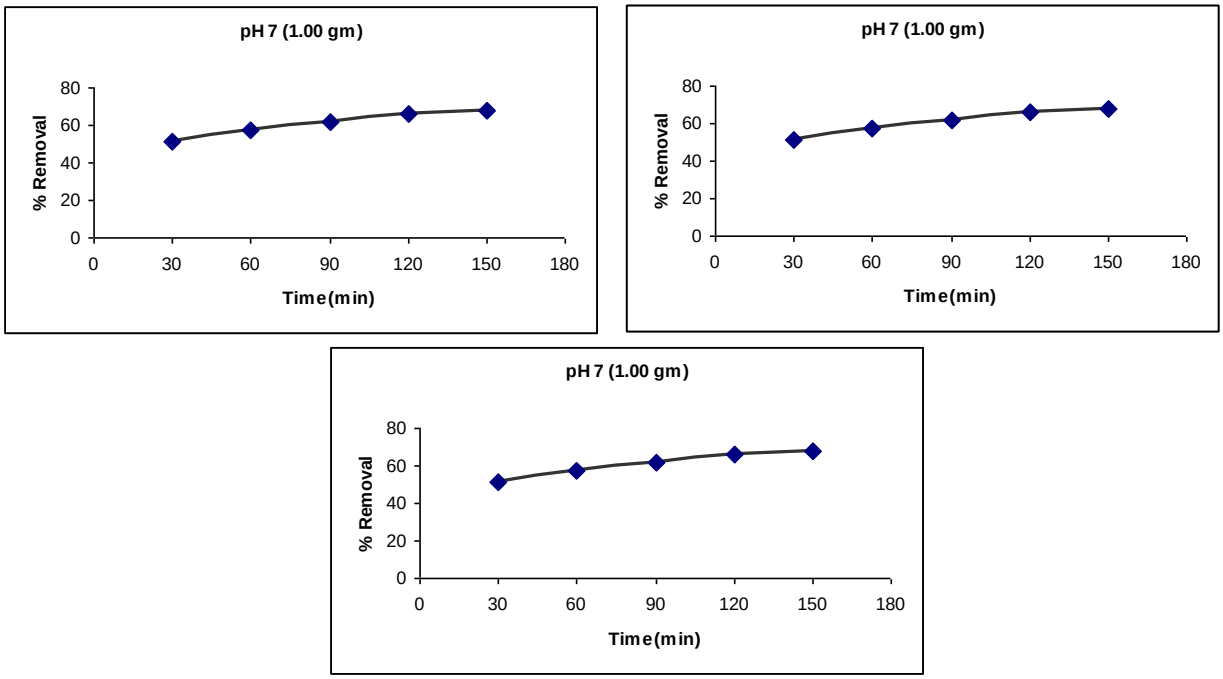

Figure 1: *Effect of contact time on percentage removal of Cr (VI) by AM Leaves at pH 7 (1.0, 1.5 and 2 gram).*

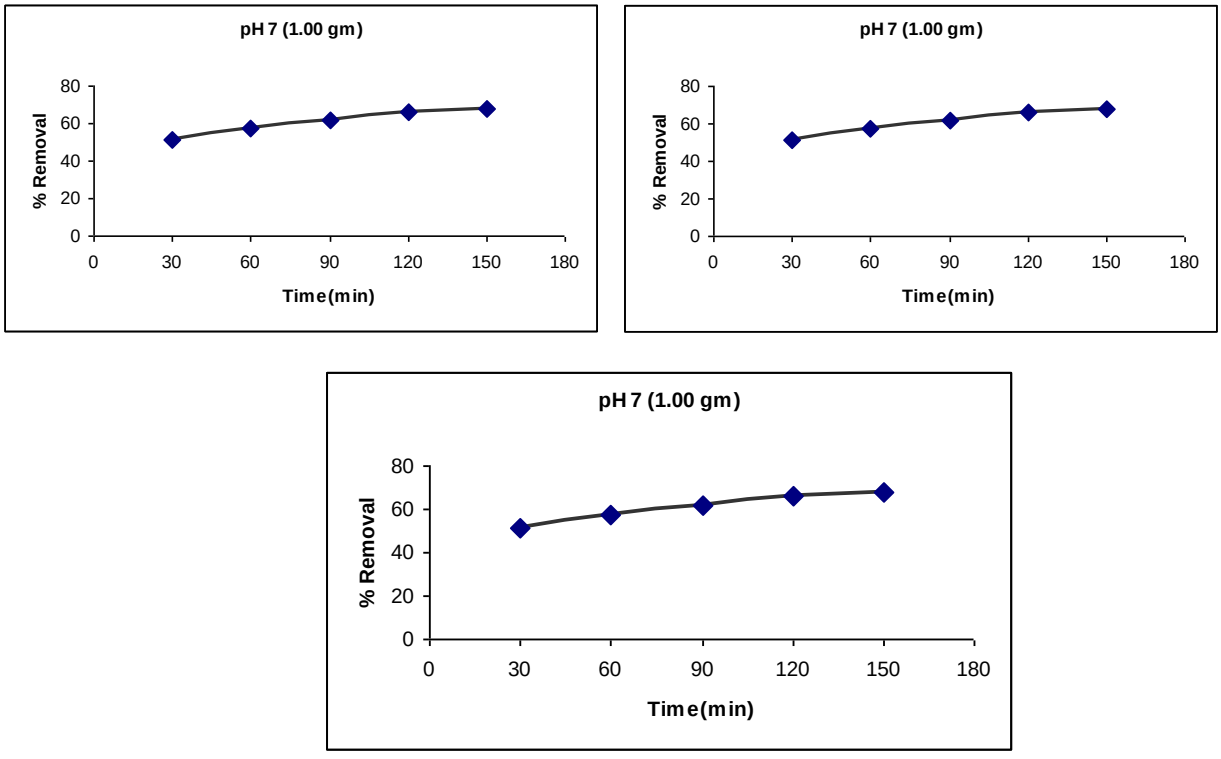

Figure 2: *Effect of contact time on percent removal of Pb (II) by AM leaves at pH 7.*

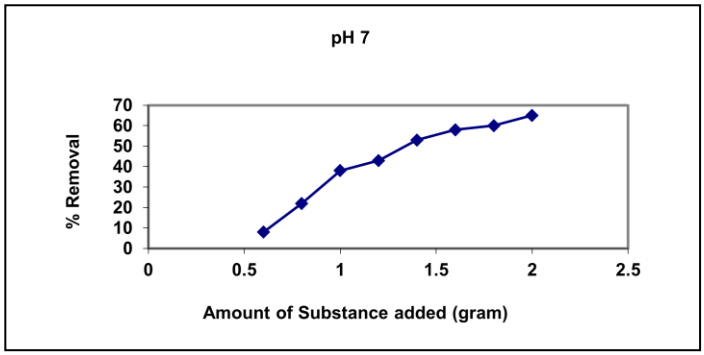

Figure 3: *Effect of biomass dose at neutral pH on percent removal of Cr(VI) by AM leaves.*

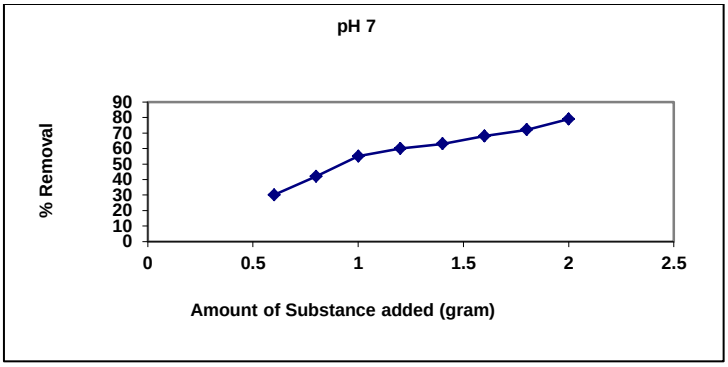

Figure 4: *Effect of biomass dose at Neutral pH on percent removal of Pb (II) by AM leaves.*

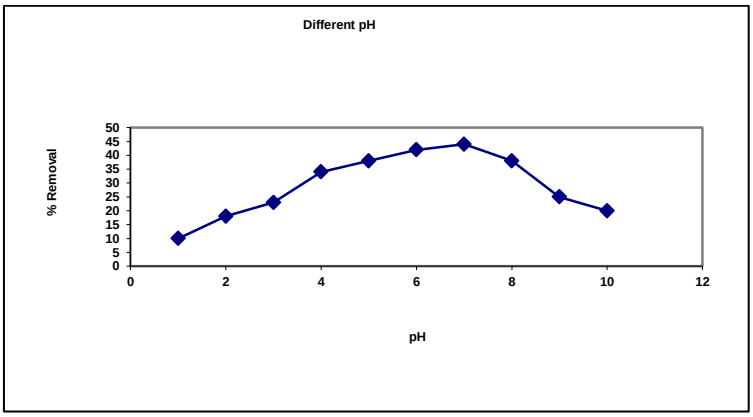

Figure 5: *Effect of pH on percent removal of Cr(VI) by AM leaves.*

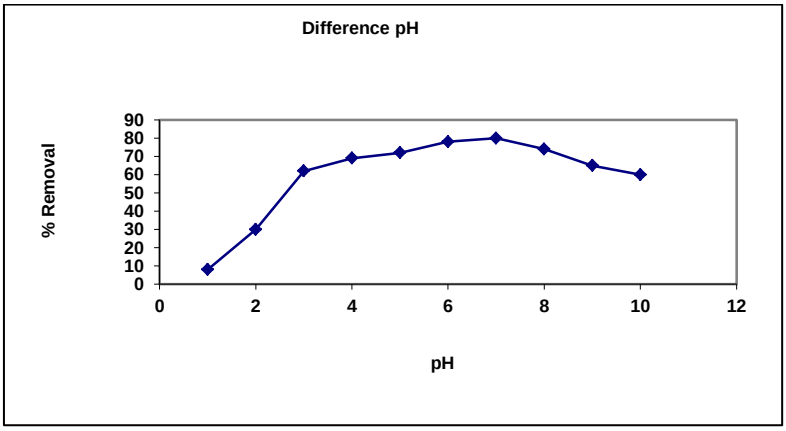

Figure 6: *Effect of pH on percent removal of Pb (II) by AM leaves.*

Table 2: *Isotherm characteristics by AM (Vilvam Leaves) system.*

Initial Concentration	Initial O. D	Final O. D	CE	X	g	x/m	Ce/ [x/m]	Log Ce	Log X/M
20	0.152	0.019	1.250	18.750	0.50	37.500	33.333	-0.096	1.574
30	0.262	0.017	0.658	29.342	1.00	29.342	22.425	-0.182	1.536
40	1.517	0.070	0.465	39.535	1.50	26.356	17.643	-0.332	1.467
50	1.925	0.062	0.322	49.678	2.00	24.839	12.963	-0.492	1.395

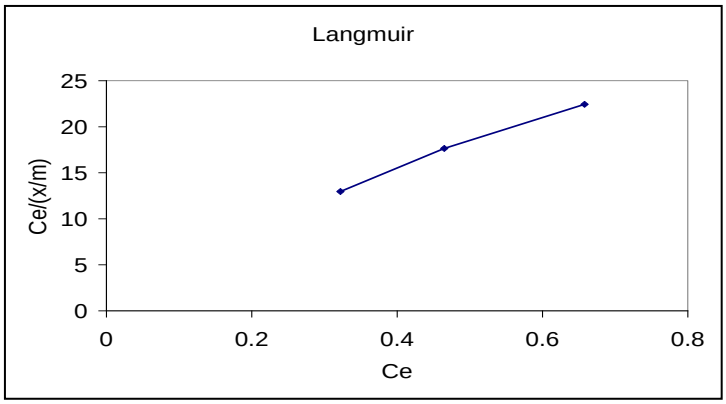

Figure 7: *Linearized Langmuir Isotherm for the adsorption of Cr (VI) by AM leaves.*

Table 3: *Isotherm characteristics by VLP system.*

Initial Concentration	Initial O. D	Final O. D	Ce	x	m gram	x/m	Ce / (x/m)	Log Ce	Log x/m
20	0.515	0.399	7.747	12.253	0.500	24.506	0.316	0.889	1.389
30	1.112	0.539	4.847	25.153	1.000	25.153	0.192	0.685	1.400
40	1.523	0.268	1.759	38.241	1.500	25.494	0.069	0.245	1.419
50	1.926	0.041	0.215	49.785	2.000	24.892	0.008	0.667	1.396

m – Mass of substance added, VLPS – Vilvam Leaf Powder System

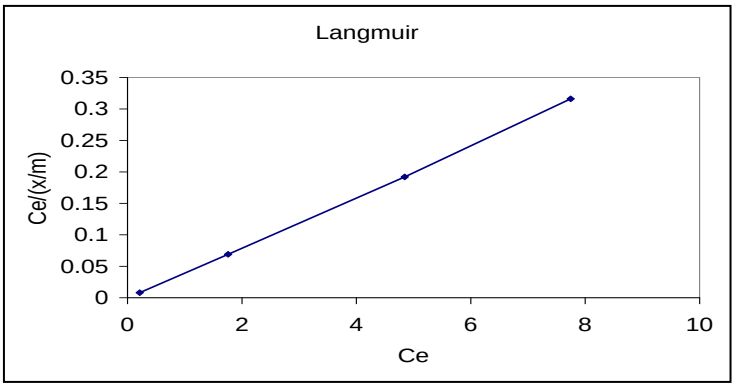

Figure 8: *Linearized Langmuir Isotherm for the adsorption of Pb (II) by Vilvam leaves.*

CONCLUSION

AegleMarmelos (AM- Vilvam leaves) have been studied as an adsorbent for Cr (VI) and Pb(II) under various parameters. If the contact time between the solution containing the metal and also the biomass is a lot of the potency of removal of heavy metals are going to be high, also, depends on the number of biomass add the pH solution. This study disclosed that the sorption capability of Cr(VI) and Pb(II) were 65% and 79% several exploitation AegleMarmelos 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., Sharma H. R. (1997), "Chromium Removal by adsorption on Rice Husk", *Indian Journal of Environmental Protection*, Volume 12, Issue 3, pp. 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*, Volume 5, pp. 337−342.
3. Rao J., Kannan N, Balamurugan J. (2003), "Removal of Lead ions by Adsorption on to coconut shell and dates nut carbons-A Comparative study", *Indian J. Environmental Protection*, Volume 25, Issue 9, pp. 816−823.
4. Gupta S, Singh, M (2004), "Removal of Chromium (VI) by different adsorbents. A comparative study", *Indian Journal Environmental Protection*, Volume 18, Issue 9, pp. 679−682.
5. Bansal T. K., Sharma H. R. (1992), "Chromium Removal by adsorption on Rice Husk", *Indian Journal of Environmental Protection*, Volume 12, Issue 3, pp. 198−201.
6. Singh.K.K, Singh N.L., Hasan S.H. (2005), "Removal of Lead from wastewater using Agricultural by product Wheatbran", *Indian journal of Environmental Protection*, Volume 25, Issue 5, pp. 390−396.
7. Gopalasamy V. G. et al., (2006), "Biosorption and its application in removal of heavy metals from wastewater", *Nature Environment and Pollution Technology*, Volume 5, pp. 337−342.
8. Baisakh et al., (2002), "Removal of Heavy metals through Low cost adsorbents", *A review journal of the IPHE, India*, Volume 4, pp. 24−26.