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Adsorption of Chromium (VI) from Aqueous Solution by Using *Mangifera indica* Bark Dust

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Abstract:

Water is the most natural resource and it is essential for all forms of life. Without water man can't surviv. Due to population explosion, urbanization and industrialization the water is getting polluted day by day unlike in the past, When natural resources are considered to be abundant, the present situation is completely different. Outdated technologies by the industries cause a lot of waste. These wastes enter into the water and soil systems directly or indirectly through various processes. It is a responsibility of any individual and environmental scientist to address this problem to control and take this problem at grass root to find an economical solution. The present study deals with the removal of chromium (VI) by adsorption process by using a waste and ecofriendly material such as *Mangifera indica*. The experiments are conducted by batch process. Experiments are conducted with respect contact time, concentration and adsorbent dosage. The optimum contact time found is equal . The optimum dosage is equal to 0.8gms. The percentage removal is ranging between 93% - 95%.

Keywords: *Manjifera indica*, chromium, bioadsorbent, contact time, adsorption

1.0 Introduction:

Water is the most vital element among the natural resources, and is crucial for the survival of all living organisms. An increased use of metals and chemicals in the process industries has resulted in the generation of large quantities of aqueous effluents that contain high levels of heavy metals, thereby creating serious environmental disposal problems (Antunes et al., 2003). Also exponential growth of the world's population over the past 20 years has resulted in environmental build up of waste products, of which heavy metals are of particular concern (Appel and Ma, 2002). The pollution from industrial and urban waste effuelents and from agro chemicals in some water bodies and rivers has reached alarming level. There are numerous ill effects of pollution, each type of pollutant having different effects, on human and animal health and ecology.

Chromium has been considered as one of the top 16th toxic pollutants and because of its carcinogenic and teratogenic characteristics on the public, it has become a serious health concern. The toxicity of chromium compounds depends on the oxidation state of the metal.it is toxic to micro-organisms , plants , animals and humans(6-9). The conventional methods utilized to remove Cr (VI) from wastewaters include reduction follwed by chemical precipitation, ion exchange, electrochemical precipitation, solvent extraction, and reverse osmosis. Most of these techniques have some disadvantages such as complicated treatment process, high cost, and energy intensive(11-17). Recently attention has been drawn towards the development of alternative methods like bioadsorption which uses biological materials as adsorbents. Bioadsorption plays an important role in elimination of metal ions from aqueous solutions in water pollution control . The major advantages of the bioadsorption technology are its effectiveness in reducing the concentration of heavy metal ions to very low levels and the use of inexpensive bioadsorbent materials.

2.0 Methods and Materials:

2.1 Selection of Adsorbent:

Mangifera indica commonly known as Mango belongs to the family Anacardiaceae. *Mangifera indica* (Anacardiaceae) grows in the tropical and subtropical regions and its parts are used commonly in folk medicine for a wide variety of conditions (Coe

& Anderson, 1996). Taking all these factors into consideration *Mangifera indica* bark dust is selected as an adsorbent. The present work, examines the possibility of using a well-known physicochemical method like adsorption for the removal of chromium from the water. The initial screening studies have been carried by introducing a known amount of adsorbent into the aqueous solution of chromium. *Mangifera indica* bark dust was used as adsorbents for controlling chromium in water. The adsorption experiments are carried out with respect to Contact time between adsorbate and adsorbent with respect to effect of Chromium concentration, with respect to effect of adsorbent dosage.

2.2 Preparation of Cr (VI) solution:

A stock solution of Cr (VI) (0.35g/100ml) was prepared by dissolving appropriate quantity of AR grade $K_2Cr_2O_7$ in 100 ml of distilled water from Millipore purification unit. The stock solution was further diluted with distilled water to desired concentration for obtaining the test solutions. The initial metal ion concentrations ranged from 10 mg to 85 mg were prepared. Final residual metal (Cr (III) and Cr (VI)) concentration after adsorption was directly measured with spectrophotometer.

2.3 Effect of mango bark dust contact time:

The initial (before adsorption) and final (after adsorption) concentration is determined at regular intervals of time i.e. 2, 5, 10, 20 and 30 minutes. The results are given in fig 1.

2.4 Effect of initial chromium concentration:

Different concentrations of aqueous solution of chromium are mixed with a fixed amount of adsorbent. The experiments are carried out with contact time is fixed depending upon contact time experiments. The results are given in fig 2.

2.4 Effects of Manjifera bark dust dosages:

Definite concentration of aqueous solution of chromium is made up to pass through different amounts of adsorbent dosages i.e. 0.2 gms, 0.4 gms, 0.6 gms and 0.8 gms respectively. The experiments are carried out with the contact time of one hour is maintained.

3.0 Results and Discussion:

3.1 Variation of contact time between Chromium and Mango bark dust

Volume of Chromium solution: 100 ml
Amount of mango bark dust: 1.0 gms
Concentration of Cr: 85 mg/l
Surface area: 9.96 cm^2

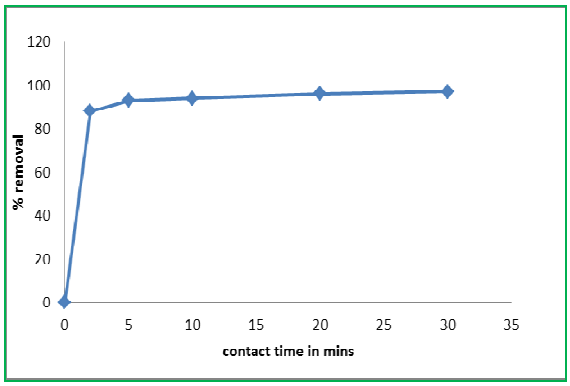

Figure 1: Variation of contact time between Chromium and Mango bark dust

The experimental runs measuring the effect of contact time on the batch adsorption of Cr (VI) and at initial concentration of 85 mg indicated that increase in contact time from 2 to 30 minute enhanced the percent removal of Cr (VI) significantly. The optimum contact time is 25mins. The removal of chromium is increasing with increasing the contact time. Once the equilibrium is achieved the figure becomes parallel to the time axis which can be explained on the basis of reacting the saturation point. The percentage removal of chromium follows a smooth curve which indicates the monoayer coverage and it follows the first order kinetics.

3.2 Variation of initial concentration of Chromium on Mango bark dust

The adsorption data of Cr (VI) at different initial concentrations ranging from 50-200 mg. However, the experimental data were measured at 60 minutes to make sure that full equilibrium was attained.The percentage removal is ranging between 94-99%. The number of chromium molecules present in the higher concentration are more and less mobile compare to the molecules at lower concentration. As the chromium molecules are in contact with the surface for more time the tendency of getting adsorb is more at the higher concentrations.

Volume of Chromium solution: 100 ml
Amount of mango bark dust: 1.0 gms
Surface area: 9.96 cm^2

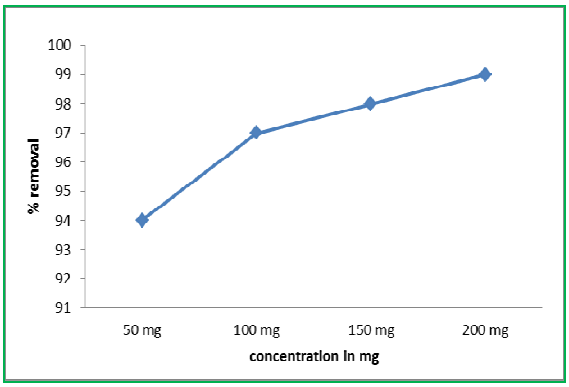

Figure 2: Variation of initial concentration of Chromium

3.3 Variation of Mango bark dust dosages on Chromium

Volume of Chromium solution: 100 ml
Concentration of Cr: 85 mg

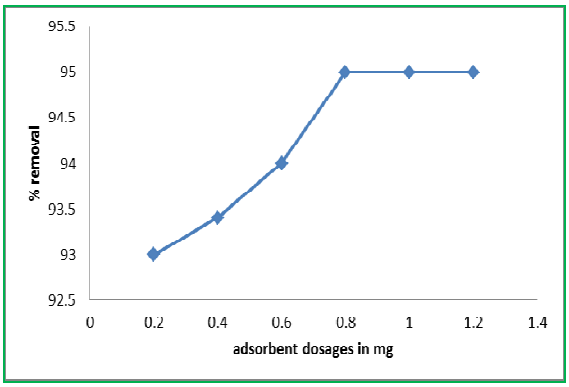

Figure 3: Variation of Mango bark dust dosages

To study the effect of adsorbent dose(g) on the uptake of Cr (VI), experiments were done with 100 ml of 85 mg solutions, while the amount of adsorbent added was varied from (0.2 – 0.8 g). Results in Figure III showed that the percentage removal of Cr (VI) from aqueous solution increased with the adsorbent dose and reached a optimum at 0.8 gm of sorbent. The increase in ion removal was due to the increase in the available sorption surface area.

4.0 Conclusion:

India possesses 4% of total average run-off in the rivers of the world. The water availability of natural run off is only 2,500 m^3/year compared to the other countries. The consumption and demand for water is increasing. The quality of water is deteriorating day by day due to the industrial pollution and human intervention. In order improvise the quality of water, the study is carried out by using *mangifera indica* bark dust. The percentage removal is increased with increase in contact time indicating unimolecular layer formation. It is following first order kinetics. The percentage removal is increased with increasing the adsorbent dosage indicating that large number adsorption sites are provided. It is ecofriendly and bioadsorbent which is efficient in controlling chromium (VI) in water.

References:

1. Alan W (1994). Hazardous elements in soils. Soils and the environment. An introduction. Cambridge University Press, *Cambridge, pp*. 189-210.
2. Al-Asheh S, Duvnjak Z (1999). Sorption of heavy metals by Canola meal. *Water Air Soil Pollut*., 114: 251-276.
3. Acar, F.N., Malkoc, E., 2004. The removal of chromium(VI) from aqueous solutions by Fagus orientalis L. *Bioresource Technol*. 94,13–15.
4. Al-Subu M M (2002). The Interaction effects of cypress *(Cupressus sempervirens*), Cinchona (*Eucalyptus longifolia*) and pine (*Pinus halepensis*) leaves on their efficiencies for lead removal from aqueous solutions. *Adv. Environ. Res., 6*(4): 569-576.
5. Altin O, Ozbelge O H, Dogu T (1999). Effect of pH, flow rate and concentration on the sorption of Pb and Cd on Montmorillonite: I Experimental. *J. Chem. Technol*. *Biotechnol*., 74: 1131-1138.
6. Antunes W M, Luna AS, Henriques C A, Da Costa ACA (2003). An evaluation of copper biosorption by a brown seaweed under optimized conditions. *Electronic J. Biotech., 6(3): 174-184. http//www.ejbiotechnology.info/content/vol6/issue15/full15/index html. ISSN 0717-3458.*
7. Appel C, Ma L (2002). Heavy metals in the environment concentration, pH and surface charge effects on Cd and Pb sorption in three tropical soils. J. *Environ. Qual*., 21(3): 581-589.
8. Bose P, Bose MA, Kumar S (2002). Critical evaluation of treatment strategies involving adsorption and chelation for wastewater containing copper, zinc and cyanide. *Adv. Environ. Res*., 7(1): 179 –195.

9. Brown P, Jetcoat I, Parrisha D, Gilla S, Grahams E (2000). Evaluation of the adsorptive capacity of peanut hull pellets for heavy metals in solution. *Adv. Environ. Res., 4(i):* **19-**29.
10. Cossich ES, Tavares CRG, Ravagnani TMK (2002). Biosorption of chromium (III) by *Sargassum sp* biomass. August 15 (Cited26October,2005). *Availablefrom http//www.ejbiotechnology.info/content /vol5/issue15/full15/index html. ISSN 0717-3458. Elec. J. Biotech*., 5(2): 133-140.
11. Dakiky M, Khamis M, Manassra A, Mereb M (2002). Selective adsorption of chromium (VI) in industrial wastewater using low – cost abundantly available adsorbents. *Adv. Environ. Res*., 6(14): 533-5430.
12. Demirbas E, Kobya M, Senturk E, Ozkan T (2004). Adsorption kinetics for the removal of chromium (VI) from aqueous solutions on the activated carbons prepared from agricultural wastes. *www.wrc.org.za. Water SA* 30(4): 533-539.
13. Deng L, Su Y, Su H, Wang X, Zhu X (2007). Sorption and desorption of lead (II) from wastewater by green algae *Cladophora fascicularis.* Doi: 10.1016/ *j.jhazmat*. 2006.09.009. *J. Haz. Mater*. 143(1-2): 220-225.
14. Doyurum S, Celik A (2006). Pb (II) and Cd (II) removal from aqueous solutions by olive cake. *J. Haz. Mater*., B138: 22-28.
15. Elifantz H, Tel-or E (2002). Heavy metal biosorption by plant biomass of the macrophyte *Ludwigia stolonifera. Water Air Soil Pollut*., 141: 207-218.
16. Canizares-Villanueva, R.O., (2004). Heavy metals removal by the micro algae Sceneunus in crassatulus in continuous cultures. *Bioresource Technology*, **94** (2): 219-222
17. Gholami, F., Mahvi, A.H., Omrani, Gh. A.,Nazmara, Sh., Gashri, A., (2006). Removal of Chromium (VI) from aqueous solution by *ULMUS* leaves, *J Env Iranian Health Sci Eng*, **3** (2): 97-102
18. Malkoc, E. and Y. Nuhoglu, 2005. Investigations of nickel (II) removal from aqueous solutions using tea factory waste, *J. Hazard. Mater*., 127: 120 – 128.
19. Mousumi, Sen., Dastidar, M.G., (2010). Adsorption-Desorption Studies on Cr(VI) Using Non-Living Fungal Biomass. *Asian Journal of Chemistry*, **22(**3):2331-2338.
20. Singh, T.S., Pant, K.K., 2004. Equilibrium, kinetic and thermodynamics studies for adsorption of As(III) on activated alumina. *Sep. Pur. Technol*. 36, 139–147.
21. Deng L, Su Y, Su H, Wang X, Zhu X (2007). Sorption and desorption of lead (II) from wastewater by green algae *Cladophora fascicularis.* Doi: 10.1016/ *j.jhazmat*. 2006.09.009. *J. Haz. Mater*. 143(1-2): 220-225.
22. Doyurum S, Celik A (2006). Pb (II) and Cd (II) removal from aqueous solutions by olive cake*. J. Haz. Mater*., B138: 22-28.