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Natural Polymer Used for Adsorption of Metal Ions from Aqueous Solution

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ABSTRACT

In order to evaluate the problem of hazards on groundwater and to ascertain its suitability for drinking agriculture purposes in Bhandara district of Maharashtra. The quality of groundwater of any area is great importance for human being and irregation.All the groundwater irrespective of their source of origin certain mineral salt and their chemical properties. The kind of concentration of these constituents depends on various geological and physical factors. Since most of these factors are varying from place to place, the groundwater of any region each charactrize by mark difference in their chemical properties since the quality of water is directly or indirectly dependent upon its intended use. There is always a need to classify the water of an area on regional basis. [1]

Adsorption has been proved to be an excellent way to treat industrial waste effluents, offering significant advantages like the low-cost availability, profitability, ease of operation and efficiency comparative to activated carbon. The Tictona Grandis tree bark substrate was found to have good sorption capacity for Nickel. Studies indicate that the sorption of Pb (II) increases with the increase in pH value and contact time, 30minute was found to be optimum. The effect of concentration shows that the Tictona Grandis can remove Pb (II) ions from aqueous solutions, the concentration of metal ions increases adsorption decreases.
Keywords : Tictona Grandis tree bark substrate, Lead metal ion solution, pH meter, Spectrophotometer, Batch method, Lead nitrate, dimethylglyoxime solution, chloroform, separating funnel, shaking machine.

I. INTRODUCTION

Salt of various metals and other potentially dangerous are being discharged in to the aquatic environment, water containing vital concentration of some of the heavy metal ions are harmful to human being, animal as well as aquatic organism. The toxicity of some heavy metal ions even at the trace level has been recognized with respect to public health for many years. Metals such as Mercury, Lead, Cadmium, Copper, Nickel and Chromium are under this category. Many metals have been evaluated as harmful to aquatic life above certain toxicity level. Many industries may have specific waste problem where the particular metal is an integral part of the many manufacturing process. Notable examples are the high zinc waste of viscosity Rayon manufacturing ground wood pulp production and News print production.

Thus, the material which cause pollution of environment are called pollutants. In other words, pollution is harmful solid, liquid or gaseous substance present in such a concentration in the environment, which tends to be injurious for the whole living Biota {2,3}. Contaminants can have different chemical characteristics and in a preliminary classification , they can roughly be divided into organic(E.g. pesticide, Herbicide, phenol, polycyclic, aromatic hydrocarbon) inorganic (E.g. oxide of carbon, oxide of nitrogen) and different cations and metallic (E.g. Cu, Cd , Pb, Ni, Co, Zn, Mn, Cr , Radioactive element and some rare earth) pollutants {4,5}

Pollution of the environment is one of the most horrible ecological crises to which human being are subjected today. It is well known that three basic amenities are needed for living organism. Pollution is usually brought about by the addition of waste products of human activity to the environment {6-7}. When the waste product is not efficiently assimilated, decomposed or otherwise removed by the natural, biological and physical process of the biosphere, adverse effect may result as the pollution they accumulate or get converted into more toxic substances {8-9}.

The major advantages of biosorption technology are its effectiveness in reducing the concentration of heavy metal ions to very low level, use of inexpensive biosorbent material high efficiency minimization of chemical and biological sludge, regeneration of biosorbent on additional nutrient requirement, possibility of metal recovery. Many investigators have studied the feasibility of using low cost agro-based waste material. Many conventional techniques such as chemical precipitation, membrane filtration, electrolysis, ion exchange and adsorption are used for the removal of heavy metal ions but at low concentration. For this reason, low cost adsorbent has been evaluated for the removal of heavy metal from aqueous solution.

TOXIC EFFECT OF LEAD

Lead poisoning occurs when lead builds up in the body, often over months or years. Even small amounts of lead can cause serious health problems. Children younger than 6 years are especially vulnerable to lead poisoning, which can severely affect mental and physical development. At very high levels, lead poisoning can be fatal. Lead-based paint and lead-contaminated dust in older buildings are the most common sources of lead poisoning in children. Other sources include contaminated air, water and soil. Adults who work with batteries, do home renovations or work in auto repair shops also might be exposed to lead. There is treatment for lead poisoning, but taking some simple precautions can help protect you and your family from lead exposure before harm is done. Lead exposure can have serious consequences for the health of children. At high levels of exposure, lead attacks the brain and central nervous system to cause coma, convulsions and even death.

II. METHOD AND MATERIAL

Several researchers describe the use of various tree bark and various agricultural byproduct such as peanut skin, onion skin, paddy husk, paddy straw, embolic leaves, sugarcane bagasse, garlic skin etc., for the removal and recovery of toxic heavy metal ions from mining and industrial waste water. Recently a research has been focus on development of cost effective alternative. Adsorption is one of the physicochemical treatment process found to be effective in removing heavy metals from aqueous solution using low cost adsorbent. Most commonly used adsorbent are untreated plants waste such as teak leaf powder, rubber leaf powder, Papaya wood, newspaper pulp, bagasse fly ash, banana and orange peels, carrot residue reported the use of bark, particularly those of red wood, hemlock and red oak, for selective removal of toxic heavy metal ions from industrial wastage such as mercury and lead battery wastage and mine run off.

Preparation of *Tictona Grandis* tree bark substrate

The barks were dried and finally powdered in an electric grinder machine. 2gm of powder was treated with 5ml of formaldehyde solution and 20ml of 0.25 H_2S0_4. The whole mixture was stirred occasionally for 6hrs and filtered. The residue was washed with distilled water and pH of the filtrate was 4-5 till it was free of H_2S04 and dried in an electric oven in 60^0C, till was moisture free and then powdered. Treatment with formaldehyde in acidic medium polymerize and insolubilizes colored water-soluble organic constituents of tree bark substrate. The bark substrate sample thus prepared were used for further studies.

PREPARATION AND ESTIMATION OF LEAD ION SOLUTION –

Standard $0.96X10^{-5}$ M working solution was prepared by dissolving adequate amount of lead nitrate in one liter of distilled water and 0.005% dithiozone solution in chloroform was prepared. Different volume of standard Lead nitrate solution taken in 250 mL separating funnel. To it 7.5 mL of 0.005% dithiozone solution in chloroform was added by the addition of 17.5mL of chloroform. Sufficient water is added to bring the final volume to about 50mL. The content was shaken for about a minute. The phases were allowed to separate the absorbance was determine against the blank solution in 1.0 cm absorbance cell. Further extraction of the same solution gives zero absorbance indicate the completer extraction of the Lead.

GENERAL PROCEDURE ADOPTED FOR EQUILIBRIUM EXPERIMENT - Equilibrium experiments were conducted by agiting by 1gm of tree bark substrate prepared as above with 100ml metal solution containing the respective metal ion for predetermined time in BOD bottle until equilibrium was reached. The mixture was then filtered through the Whatmann's no 41-filter paper and the solution was analyzed for the respective metal ions. The quantity of metal ions adsorbed on the substrate was calculated by the difference between the initial and final concentration of the metal solution. The Batch experiments were performed for the study of various parameters such as Ph, time, concentration, dosages, temperature and light metal ions. The initial and final metal ion concentration was found out before and after adsorption on bark substrate and percent of metal ion adsorbed or removal was calculated. The results are shown in the form of table and figure.

III. RESULT AND DISCUSSION

The result and discussion are given under relevant paragraph for Pb (II) with the *Tictona Grandis tree* bark substrate.

1) Effect of pH – 1gm of tree bark substrate was agitated with 100 ml solution of Pb (II) at room temperature. The pH of metal solution was varied between 2-9. It can be seen from the data the adsorption of Pb (II) ions gradually increases. The final pH was found to be less than initial pH. In all further investigation with Pb (II) the pH of the metal solution was maintained at 5 in order to prevent the possibility of precipitation of metal hydroxide.

2) Effect of agitation time/ contact time- 100 ml of Pb (II) metal solution was agitated with 1gm of *Tictona Grandis* bark substrate for different time interval varying from 5-120 min. It is evident from the data the metal ion removal from solution occurred within 5 minutes showing that the metal ion adsorption on the substrate is very fast. After contact time of 60 min value remain constant even after 2 hours, hence, 1-hour contact time was fixed for further studies.

3) Effect of Initial Metal ion concentration-100ml of metal ion solution was agitated with 1gm of substrate at pH 5 about 1 hour at 30^0C. It was observed that the metal ion removal from solution decreases with increase in initial metal ion concentration.

4) Effect of Dosage-When different quantities of *Tictona Grandis* tree bark substrate were shaken with fixed concentration of metal solution at Ph 5. It is observed that metal ion removal increases with increasing dosage of the adsorbent.

5) Effect of Temperature- Effect of temperature varies from 30-70^0 c in steps of 10^0c on adsorption has been investigated, it was observed that with the increase in temperature uptake of metal ion decrease hence, all further studies were performed at 30^0C conveniently.

6) Freundlich adsorption Isotherm: Using the data the Freundlich adsorption Isotherm has been

drawn by plotting log x/m Vs Log of Ce,. Where x/m is concentration of Pb adsorb per gram of adsorbent and Ce is residual concentration of the metal ion. The data for the uptake of Pb(II) by *Tictona Grandis* substrate has been analyze in the light of Freundlich adsorption model. The adsorption of Pb(II) on *Tictona Grandis* was also found the confirm the Freundlich adsorption Isotherm at 30^{0}C.The linearized form of the Freundlich equation given as

$$\log\frac{x}{m} = \frac{1}{n}logCe + logKf$$

Where Ce is the equilibrium concentration (mg/L) and x/m is the amount adsorb mg/g, the value of n and K_f at 30^{0}C were determined from the slope of the linear plot of log x/m Vs Ce. Since the value of 1/n is less than, it indicate favorable adsorption. Smaller value of 1/n indicate better adsorption mechanism and formation of relatively stronger bond between adsorbate and adsorbent. The higher nu8merical value of K_f confirmed the significant affinity of Pb(II) ions towards the *Tictona Grandis* tree bark substrate.

IV. CONCLUSION

The use of *Tictona Grandis* tree bark substrate is used for removing of toxic heavy metal ions from industrial wastewater has been thoroughly investigated. The reported results are incorporated in the tabulated from. Idea experimental condition for the best sorption of the heavy metal ions investigated. The determined and optimum experimental condition have been suggested fo0r achieving the maximum efficiency. The results of batch experiment proved that under appropriate experimental condition, substantial quantities of the heavy metal ions in solution could be removal from solution by the modify natural polymeric substances. Similarly the effect of the initial concentration of heavy metal ion on the sorption of various metal ions by the substrate indicate that the sorption of heavy metal ion at low concentration is more. Naturally the sorption of heavy metal ions decreases as the initial concentration of metal ion increases. Similarly the effect of dosage of the bark also proved that the sorption of heavy metal ion increases with increase dosage of bark substrate. It can be seen from the result the bark substrate showed different selectivity for various metal ions. Thus particular metal ion which is best adsorbate by particular bark substrate. It appears that depending upon the particular toxic heavy metal ion present and the respective concentration in wastewater sample, one has to make judicious selection of the bark substrate.

V. REFERENCES

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EFFECT OF pH

Sr.No	Initial pH	Final pH	Initial conc.	Final conc.	Conc. Ad.	% Removal
1	2.5	2.1	11.7	9.1	2.6	22.22222
2	3.5	3	11.7	7.1	4.6	39.31624
3	4.5	4.3	11.7	5	6.7	57.26496
4	5.5	5.1	11.7	2.1	9.6	82.05128
5	6.5	6.1	11.7	2.6	9.1	77.77778
6	7.5	7.1	11.7	3.1	8.6	73.50427
7	8.5	8.2	11.7	3.7	8	68.37607
8	9.5	9.1	11.7	4.2	7.5	64.10256

EFFECT OF AGITATION TIME

Sr.No	Agitation time	Initial conc.	Final conc.	Conc. Ads.	% Removal
1	0	0	0	0	0
2	5	11.7	8.7	3	25.64102564
3	10	11.7	7.4	4.3	36.75213675
4	15	11.7	4.2	7.5	64.1025641
5	30	11.7	1.9	9.8	83.76068376
6	60	11.7	1.9	9.8	83.76068376
7	120	11.7	1.9	9.8	83.76068376
8	240	11.7	1.9	9.8	83.76068376

EFFECT OF INITIAL CONCENTRATION ADSORPTION OF Pb (II)

Sr.No	Initial conc.	Final conc.	Conc. Ads.	% Removal
1	11.7	2.9	8.8	75.21368
2	12.5	3.4	9.1	72.8
3	12.9	3.7	9.2	71.31783
4	13.3	3.9	9.4	70.67669
5	14.7	5	9.7	65.98639
6	16.1	6.2	9.9	61.49068
7	17.7	7.4	10.3	58.19209
8	19.1	8.7	10.4	54.45026
9	21.9	10.9	11	50.22831
10	23.4	11.7	11.7	50

EFFECT OF DOSAGE OF ADSORBENT Pb (II)

Sr.No	Dosage	Initial conc.	Final conc.	Conc. Ads.	% Removal
1	0.5	11.7	7.4	4.3	36.75213675
2	1	11.7	5.6	6.1	52.13675214
3	1.5	11.7	5	6.7	57.26495726
4	2	11.7	4.2	7.5	64.1025641
5	2.5	11.7	3.4	8.3	70.94017094
6	3	11.7	2.6	9.1	77.77777778
7	3.5	11.7	1.9	9.8	83.76068376
8	4	11.7	1.2	10.5	89.74358974
9	4.5	11.7	0.5	11.2	95.72649573

Freundlich adsorption Isotherm

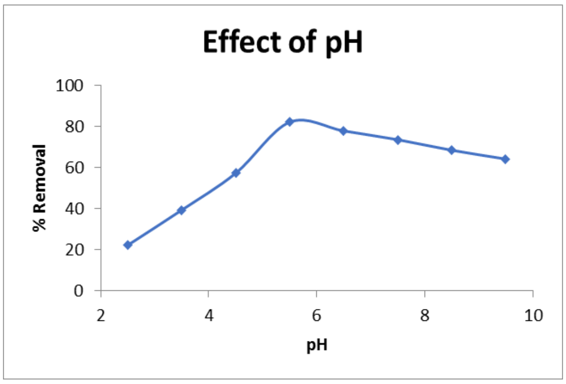
Sr.No	Dosage (m)	Initial conc. (x)	x/m	log x/m	Final conc. (Ce)	log Ce
1	0.5	11.7	23.4	1.369216	7.4	0.869232
2	1	11.7	11.7	1.068186	5.6	0.748188
3	1.5	11.7	7.8	0.892095	5	0.69897
4	2	11.7	5.85	0.767156	4.2	0.623249
5	2.5	11.7	4.68	0.670246	3.4	0.531479
6	3	11.7	3.9	0.591065	2.6	0.414973
7	3.5	11.7	3.342857	0.524118	1.9	0.278754
8	4	11.7	2.925	0.466126	1.2	0.079181
9	4.5	11.7	2.6	0.414973	0.5	-0.30103

EFFECT OF TEMPERATURE OF Pb (II)

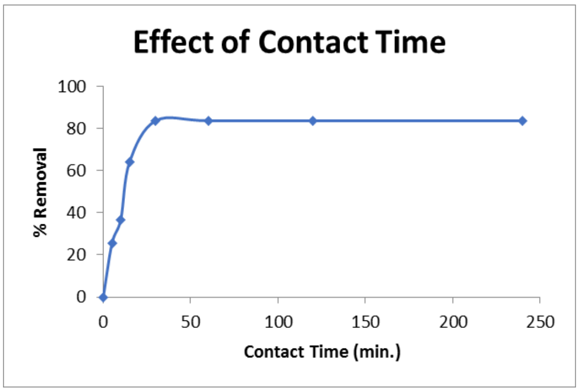
Temp.	Initial conc.	Final conc.	Conc. Ads.	% Removal
30	11.7	1.9	9.8	83.76068
40	11.7	3.9	7.8	66.66667
50	11.7	5.9	5.8	49.57265
60	11.7	7.7	4	34.18803
70	11.7	9.4	2.3	19.65812

Graph:

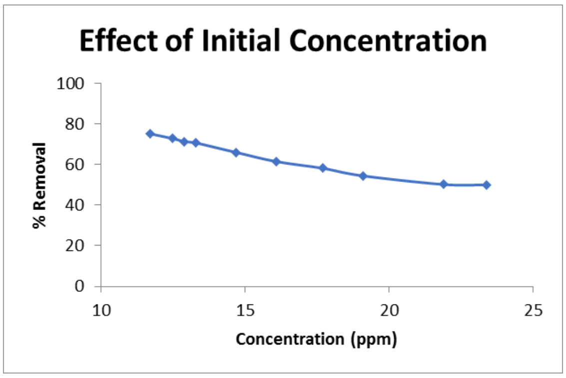
EFFECT OF pH



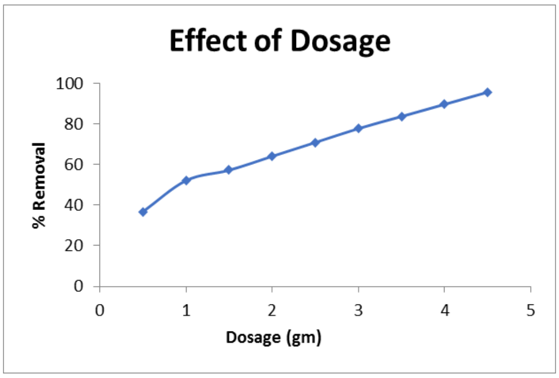
EFFECT OF AGITATION TIME



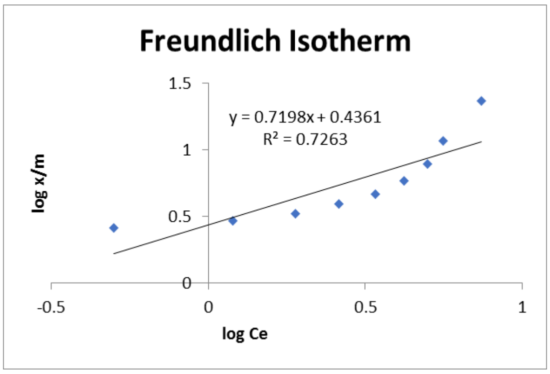
EFFECT OF INITIAL CONENTRATION



EFFECT OF DOSAGE



FREUNDLICH ADSORPTION ISOTHERM



EFFECT OF TEMPERATURE