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TO STUDY THE ADSORPTION OF Cr (VI) FROM AQUEOUS SOLUTION USING LOW COST ADSORBENT

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Abstract-

Excess amount of substance will disturb the balance of nature. Although traces of some heavy metals such as Copper and Cobalt are supposed to play some essential role in nutrition. However excessive amount can induce toxic effect. Several heavy metal ions are known to exert their toxic effect particularly on the rapidly growing tissue such as the gastro-intestinal mucosa.

Bone marrow and some highly specialised cells such as neurons and renal tubular cells.

Adsorption has been proved to be an excellent method to treat industrial waste water. Significant advantages like the low-cost availability. *Techtona-grandis* tree bark substrate was found to have good sorption capacity for the Cr(VI). Studies indicate that sorption of Cr(VI) increases with the increase in pH value and contact time are found to be maximum. The effect of metal ion concentration shows that *Techtona – grandis* tree bark substrate can remove Cr(VI) from aqueous solution as the concentration of light metal increases as the adsorption decreases.

Keyword – *Techtona grandis* tree bark substrate, potassium dichromate solution, pH meter, UV spectrophotometer, Batch experiment, Shaking machine, Diphenyl carbazide solution.

INTRODUCTION –

Due to awareness of the importance of the aquatic organisms, water quality manager concerned with environmental protection have developed methods by which evaluation of the biological effect of polluting substances can be carried out from the safety point of view. It is an urgent need to well define the safe amount of chemicals to can-hold pollution and to protect the aquatic fauna.

However, the safety limits prescribed to many of the heavy metal ions we expected to be modified from time to time in the light of further knowledge of their toxic limit likely to be gained in future.

The discharge limits placed on the toxic metal ions and their effluent concentration one of vital significance in guiding the treatment process to be adopted for a given waste treatment problems.

Several reviews are available on the various techniques applied for waste minimisation and the removal of heavy metal from waste- water. Several methods that have been used for the treatment of waste-water and the removal of toxic metal ion include, Adsorption, Electrochemical, Electrodialysis, Electrolysis, Filtration, Flocculation, Floatation, Ion Exchange, Separation, Neutralisation, Oxidation, Precipitation, Reduction, Reverse Osmosis and Solvent Extraction.

ADSORPTION -

Adsorption is one of the most effective physical process for removal of toxic metal from wate -water. It is a surface phenomenon which may be defined in terms of a unit operation that utilizes surface forces based on the concept of parting a chemical species between a bulk phase and an interface or accumulation of substance near the interface.

The Surface or Solid have residual forces or free valancies thus the surface of a solid has a tendency to attract and to retain molecule of other species with which such surface come in contact. Adsorption is a unique process and offered many advantages over the other processes. Adsorption can be used for treating toxic and hazardous organic and inorganic waste. Recovery of valuable by-product from the waste-water is possible.

METHOD AND METHODOLOGY

Selection of adsorbed for adsorption requires following characteristics-

1) It should be easily available in large quantity.
2) It must be cheap and reusable.
3) It requires more adsorption capacity
4) It requires higher Adsorption rate.
5) It must be biodegradable or decomposable

Preparation of *Techtona grandis* tree bark substrate

1) 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_2S04. 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 polymerise and insolubilizes coloured water soluble organic constituents of tree bark substrate. The bark substrate sample thus prepared were used for further studies.

Preparation and estimation of Cr (VI) Metal ions

Standard solution of 0.001 molar potassium dichromate was prepared by dissolving requisite amount of potassium dichromate in 1 litre of distilled water. 3ml of this solution was then transferred in a beaker and to this add 2ml of sulphuric acid and 1ml of 0.25% of Diphenyl carbazide solution in acetone. The volume was made up to 25 ml with distilled water. A green coloured complex was formed. For estimation of Cr (VI) ions by this methods was obtained by using varying concentration of Cr(VI) ions and measuring absorbance.

General method adopted for Equilibrium Experiment

Equilibrium experiment were conducted by agitating 1 gm of the bark substrate prepared as above with 100ml metal solution, for predetermining time in BOD bottle until the equilibrium was reached. The mixture was then filtered through Whatmann no 41 filter paper and the solution were analysed of metal ions. The quantity of metal ions sorbed on the bark substrate was calculated by the difference between the initial and final concentration of the metal solution. Batch experiment were performed for the study of various parameters.

1)pH

2) Time

3)concentration

4) Dosages

5) Temperature

6) Light metal ions

The initial and final metal ion concentration was found out before and after adsorption and percent of metal adsorbed or removal was calculated.

Result and Discussion

1) Effect of pH -
It was found that metal ion sorption increases with increase in pH of the solution 3-6 and further decreases with increase in pH of the solution.
2) Effect of Agitation time-
It was found that metal ion removal from the solution within 5 minutes. Showing that the metal ion sorption on the substrate is very fast. At about an hour the removal of metal ions recorded the maximum value and the sorption remain same even after contact time of 24 hours.
3) Effect of Temperature – It was found that the percent removal of the metal ion solution to the substrate decrease with the increase in temperature.
4) Effect of Initial metal ion concentration –

It was found that the metal ion removal from the solution, the concentration increases although the sorption of metal ions naturally decreases.

5) Effect of Adsorbent dosage –

It was observed that the effect of dosage of bark substrate for the adsorption increases with the increase in dosage

6) Effect of Light metal ions-

Light metal ions such as Na^{+} Ca^{++}, Mg^{++} have considerable effect by the substrate. It was found that the sorption of metal ions gradually decreases in the presence of increase in concentration of light metal ions.

CONCLUSION –

To sum up, it should be emphasized that, each waste treatment problem should be regarded as a special case demanding a thorough study of the chemistry, technology and economical aspect involved, apart from the nature, concentration and association of heavy metals concerned and the permissible discharge limits which guide the treatment process to be adapted. Further whenever feasible, it is advantageous to integrate the waste treatment in to the process sequenced itself, as in the case of integrated waste treatment system used in plating industry.

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Effect of pH

Sr.no	Initial pH	Final pH	initial conc in ppm	residual conc in ppm	conc adsorbed in ppm	percentage removal
1	3.01	2.03	21.25	7.47	13.78	64.84
2	4.03	3.16	21.25	6.96	14.29	67.24
3	5.1	4.19	21.25	6.36	14.89	70.07
4	6.09	5.03	21.25	5.44	15.81	74.4
5	7.05	6.01	21.25	6.46	14.79	69.6
6	8	7.02	21.25	6.76	14.49	68.18
7	9	7.79	21.25	6.96	14.29	67.24
8	10	8.98	21.25	7.47	11.78	55.43

Effect of contact time

Sr.no	Time in min	initial conc in ppm	residual conc in ppm	conc adsorbed in ppm	percentage removal
1	5	21.25	7.47	13.78	64.87
2	15	21.25	6.96	14.29	67.24
3	30	21.25	5.44	15.81	74.4
4	60	21.25	5.44	15.81	74.4
5	90	21.25	5.44	15.81	74.4
6	120	21.25	5.44	15.81	74.4
7	240	21.25	5.44	15.81	74.4

Effect of Temperature					
Sr.no	Temp in ^{0}C	Initial conc	Residual conc	conc adsorbed	percent removal
1	30	21.25	5.44	15.81	74.4
2	50	21.25	6.43	14.82	69.74
3	70	21.25	9.48	11.77	55.38
4	90	21.25	10.38	10.87	51.15

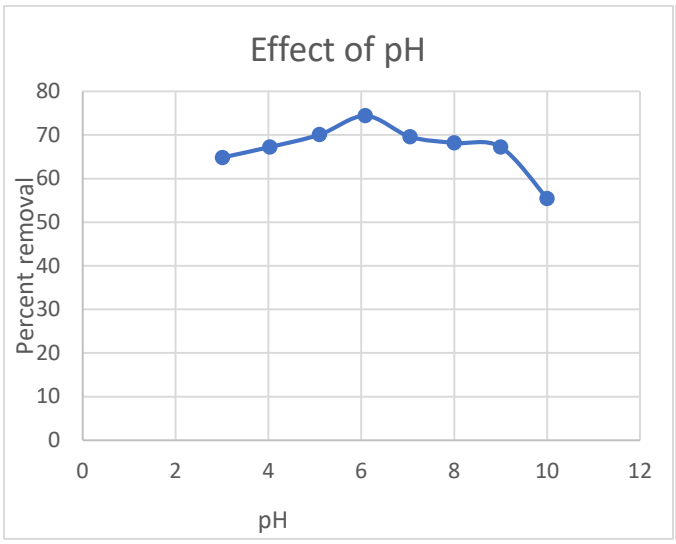
Effect of initial metal ion concentration				
Sr.no	Initial conc in ppm	Residual conc in ppm	Conc adsorbed in ppm	Percent removal
1	21.25	5.44	15.81	74.4
2	25.58	8.5	17.08	66.77
3	30.53	11.52	19.01	62.26
4	33.53	14.34	18.99	56.97
5	30.48	19.37	19.11	49.66
6	40.49	21.67	18.82	46.48
7	48.39	23.27	25.12	45.1
8	43.49	27.35	16.12	37.11
9	50.49	32.95	17.54	34.73

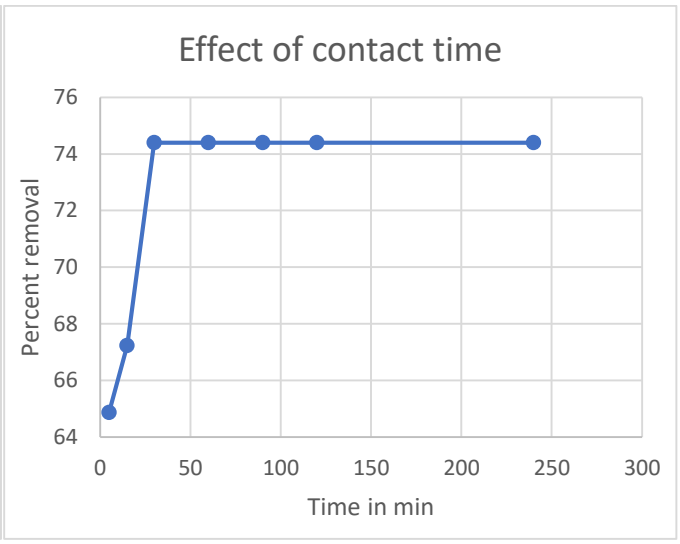
Effect of Dosages					
Sr.no	Substrate dosage in gm	initial conc in ppm	residual conc in ppm	conc adsorbed	percent removal
1	1	21.25	5.44	15.81	74.4
2	2	21.25	5.34	15.91	74.87
3	3	21.25	4.38	16.87	79.39
4	4	21.25	4.25	17	80
5	5	21.25	3.91	17.34	81.6
6	6	21.25	3.37	17.88	84.14
7	7	21.25	3.27	17.98	84.61
8	8	21.25	2.87	18.38	86.49
9	9	21.25	2.5	18.75	88.24
10	10	21.25	2.22	19.03	89.55

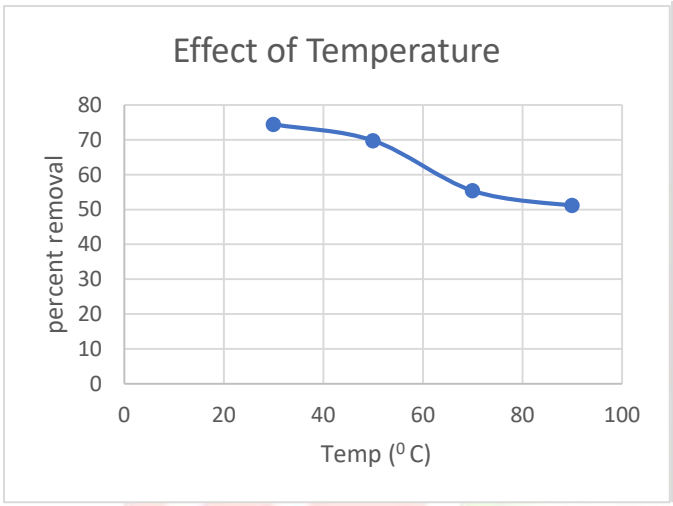
Effect of Light metal ion Na+					
Sr.no	Conc of Na^+ in ppm	Initial conc in ppm	Residual conc in ppm	conc adsorbed in ppm	percent removal
1	25	21.25	11.63	9.62	40.27
2	50	21.25	13.59	7.66	36.04
3	100	21.25	15.18	6.07	28.56

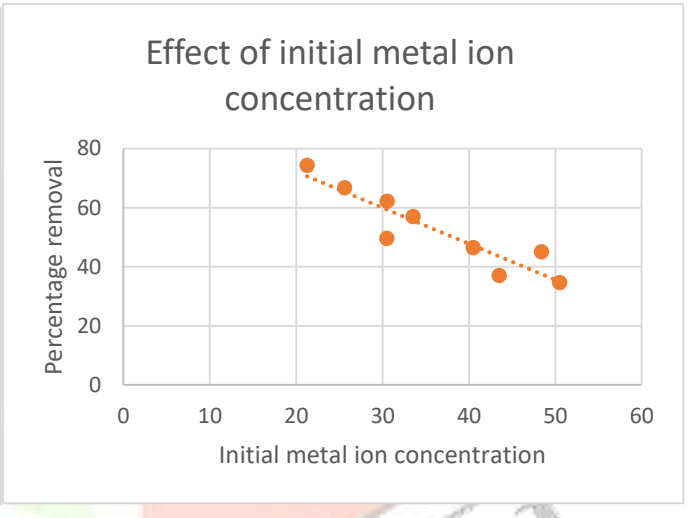
Effect of Light metal ion Ca^{+2}					
Sr.no	Conc of Ca^{+2} in ppm	Initial conc in ppm	Residual conc in ppm	conc adsorbed in ppm	percent removal
1	25	21.25	12.01	9.24	43.48
2	50	21.25	14.31	6.94	32.65
3	100	21.25	15.21	6.04	28.42

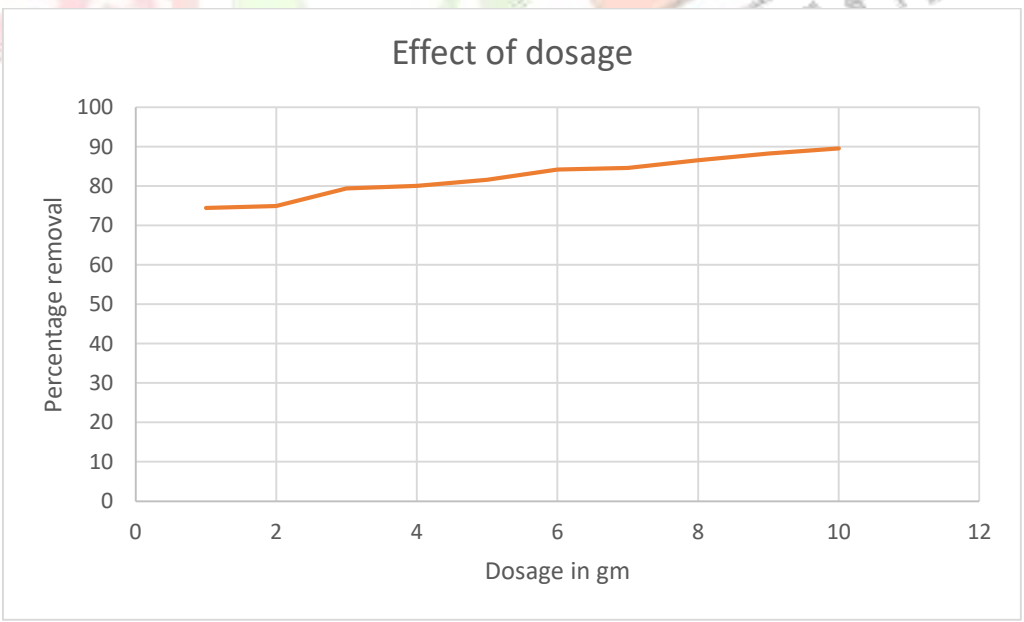
Effect of Light metal ion Mg^{+2}					
Sr.no	Conc of Mg^{+2} in ppm	Initial conc in ppm	Residual conc in ppm	conc adsorbed in ppm	percent removal
1	25	21.25	11.93	9.32	43.85
2	50	21.25	13.89	7.36	34.63
3	100	21.25	14.96	6.29	29.6

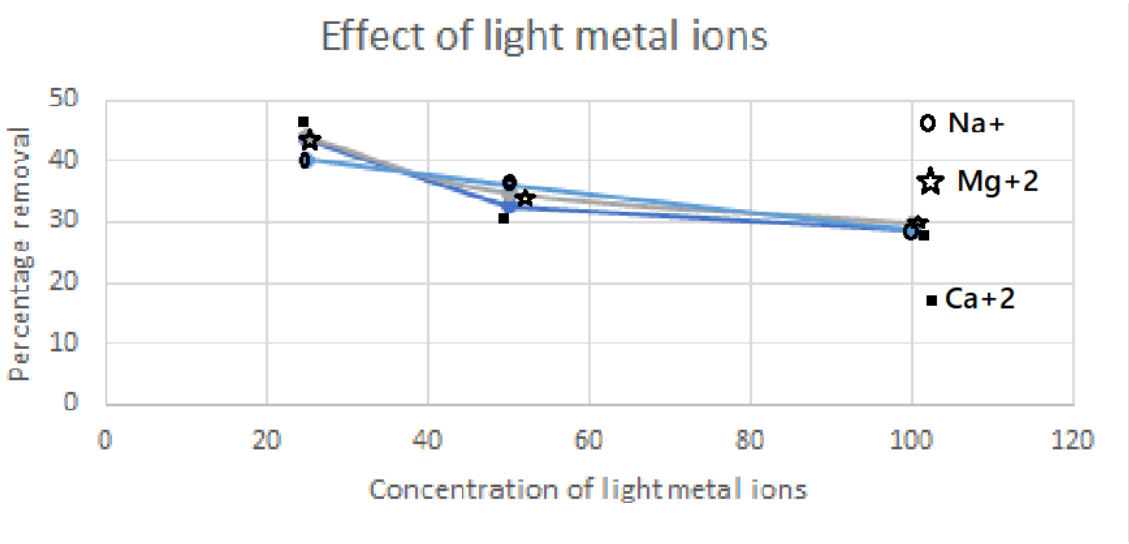

Effect of pH
Percent removal
pH
0
10
20
30
40
50
60
70
80
0
2
4
6
8
10
12


Effect of contact time
Percent removal
Time in min
64
66
68
70
72
74
76
0
50
100
150
200
250
300


Effect of Temperature
percent removal
Temp (0 C)
0
10
20
30
40
50
60
70
80
0
20
40
60
80
100


Effect of initial metal ion concentration
Percentage removal
Initial metal ion concentration
0
20
40
60
80
0
10
20
30
40
50
60


Effect of dosage
Percentage removal
Dosage in gm
0
10
20
30
40
50
60
70
80
90
100
0
2
4
6
8
10
12


Effect of light metal ions
Percentage removal
50
40
30
20
10
0
0
20
40
60
80
100
120
Concentration of light metal ions
Na+
Mg+2
Ca+2