International Journal of Scientific Research in Chemistry (IJSRCH)
© 2020 IJSRCH | Volume 5 | Issue 2 | ISSN : 2456-8457
doi : https://doi.org/10.32628/IJSRCH20523

Adsorption of Co^{2+} from Aqueous Solution Using G Low Cost Adsorbent

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ABSTRACT

Concentration of water supplies with metals is constant area of concern naturally an international. The challenge to remediate hazardous metals containing waste stream from present formal mining operation, industrial sites and ground water is immersed. Adsorption has proved to be an accelerate way to treat industrial waste effluents. The heavy metals renders the water unsuitable for drinking and also higher toxic to human being. Removal of these material is therefore essential. The studies pertaining to the use of inexpensive agro based adsorbents, such as tree bark, saw dust, Corn cob, straw and fly ashes for heavy metals ions has been investigated using Mangifeara indica substrate through batch adsorption studies. Result obtained are quite encouraging, batch adsorption studies have shown that removal of metal ions is dependent upon process parameters like contact time, temperature, metal ions concentration, dosage and pH. The maximum removal of Co2+ to the extent of has been achieved at pH 4 to 6 in 30 min in the concentration range 30 to 90 mg/liter. The use of packed column adsorption has been investigated at the optimum condition, to study the feasibility of the process s for application in small scale industries.

Keywords : Mangifeara Indica , Tree Bark Substrate, Cobalt Nitrate Solution, Column Of 0.2 Mm Diameter, Ph Meter, Ultraviolet Spectrophotometer, Shaking Machine

I. INTRODUCTION

The repaid industrialization and technological development enhanced the concentration of heavy metals posing significant threat to the environment and public health because of their toxicity accumulation the goof chain and persistence in nature. Industrial waste constitutes the major source of various kind of metals pollution in natural water, heavy metal ions are reported as priority pollutants. Shrink to their mobility inn natural water ecosystem and their toxicity. The heavy metal ions are stable and persistent environmental contaminants since they cannot be degraded and destroyed, these metal ions are harmful to aquatic life and water contaminated by toxic metal ions remains a serious health problem. Heavy metals removal from aqueous solution has been traditionally carried out by chemical precipitation. The presence of copper, zinc, cadmium, lead, Mercury, iron, nickel and other metals have potentially damaging effect on human physiology and other biological system. When the tolerance level have been exceed. Heavy metals are elements such as Cu^{2+}, Co^{2+} and Zn^{2+} which is associated with toxicity and naturally components of earth's crust. They cannot be degraded or destroyed to a small extent. They entered in our bodied via food, drinking water and air as a trace elements. This little quality of water which is available for human use, is also getting concentrated because of industrialization, urbanization and population exhaust. Various method of treatment for removal of heavy metals from

industrial waste water have been reported. Among these method precipitation, ion exchange and adsorption are the most common for low concentration of metal ions in waste water.

The adsorption process is highly recommend for effective removal, the process of adsorption implies the presence of an adsorbent solid that binds molecule by physical and attractive forces. It is advisable that adsorbent is available in large quantities, easily re-generable and cheap. Bio sorption is environmental treatment heavy metals from aqueous solution is relatively new process that has been proved that very promising removal of contaminants from aqueous solution as adsorbent. Material derived from low cost agriculture waste was employed effectively for the removal and recovery effectiveness in deducing the concentration of heavy metal ions to very low level. Use of inexpensive biosorbent material, high efficiency minimization of biological sludge, regeneration of biosorbent, no additional nutrients requirement and possibility of metal recovery, for this reason low cost adsorption have been expanded for the removal of heavy metals from aqueous solutions,. The paper present with experimental results on low cost and easily available *Mangifera indica* as adsorbent for the removal of heavy metals Co^{2+} from aqueous solutions. The results are quite encouraging and official removal is possible and is comparable with high cost activated charcoal.

The Co^{2+} metal ions are involved in the synthesis of Vitamin B_{12} that is required for the production of red blood cells and prevention of pernicious anemia make it an essential element for animals. It served as containing in manufacturing of anemia, alcohol and the number of other organic compounds. It is useful for therapeutic agent in the treatment of anemia and cyanide poisoning, salt of cobalt are absorbed well from the gastrointestinal track. However, increase the level of cobalt in food and water do not tend to accumulate within the human body as about 80% of the investigated cobalt is excreted out in urine while about 15% is excreted in faces. It is also excreted through milk and sweet. The usual response of most of the mammals, man to large intake of cobalt including omitting, diarrhea and sensation of warm.

II. MATERIAL AND METHODS

Preparation of Metal ion Solution:

All the chemicals, Cobalt nitrate, used were of analytical grade purchased commercially and used without further purification, the Co^{2+} metal ion solution were prepared from Cobalt nitrate in double distilled water. The glassware used were rinsed with conc. nitric acid and dried at 50°C. The pH of Cobalt nitrate solution was adjusted to 4-5 using buffer solution to prevent hydrolysis.

Preparation of Adsorbent:

Mangifera indica bark were collected and dried at room temperature in air, grinded and sieved through adsorption mesh. 2 gm of *Mangifera indica* bark were mixed with 5 ml of 0.25 N Sulphuric acid and 20 ml of 39% formaldehyde solution. The mixture was continuously agitated for 6 hours using commercial shaking machine. The mixture was then filtered and washed several time with deionized water until the constant pH of filtrate was attained to 5. The residue was dried in an oven at 50°C. The acidified *Mangifera indica* bark substrate was used for final adsorption experiment of the wastewater treatment.

III. RESULT AND DISCUSSION

The result and discussion are given under the relevant paragraph for the removal of Co^{2+} metal ions with the *Mangifera indica* tree bark substrate.

Batch Method

1. Effect of pH

The effect of pH on the adsorption of Co^{2+} on Mangifera indica bark substrate has been found in the range of 4-5 at room temperature at fixed final sorption concentration. In each case 1 gm of substrate

at the desired pH was agitated for 30 minutes. The % Removal found to increase up to certain extent and decrease. This decrease in adsorption may be due to precipitation of metal hydroxide. The data show that the adsorption of Co^{2+} at optimum 4.5 pH

2. Effect of Agitation Time

The adsorption of metal ions by *Mangifera indica* bark substrate for different time intervals was studied. The time of agitation was varied from 5 minutes to 24 hours. It was observed that up to 30 minutes adsorption increases at fast rate and attain saturation due to blockage of sites.

3. Adsorption Dosage

It was observed that the removal of Co^{2+} metal ions increases with increase in the adsorbent doses. In all experimental runs in aqueous solution at their optimum pH value. However, with further increase in adsorbent doses there was no appreciable change in Co^{2+} removal.

Using the data a Freundlich adsorption isotherm has been drawn by plotting log of x/m vs log Ce, where x/m is concentration of Co^{2+} (adsorbed per gm. of adsorbent) and Ce is the residual concentration of metal ions.

4. Effect of Temperature

The adsorption of Co^{2+} metal ions with effect of temperature by modifying bark substrate have been investigated at variable temperature from 30-70°C. The initial concentration of Co^{2+} ions in the solution was kept at 4.5 pH. It was observed that with the increase in temperature the binding of metal ions decrease.

5. Effect of Metal ion Concentration

The adsorption of metal ions on bark substrate were also carried out using various concentrations of metal ions at room temperature using predetermined agitation time of 30 minutes.

The Column Studies on Co^{2+} ions:

The column adsorption studies of Co^{2+} ions on *Mangifera indica* substrate at room temperature was investigated using aqueous solution. The different concentration at the optimum pH value 4.5 is faster and effective adsorption of Co^{2+} ions occur during the initial phase. The adsorption reaches to the optimum value at 40 minutes up to 90 effluent. The subsequent adsorption decreases as a consequence of the progressive saturation of the binding sites. It was observed that the column gets saturated after passing 144 ml of Co^{2+} ion solution.

IV. CONCLUSION

It is emphasize that each waste water treatment problem should be regarded as a special case demanding a thorough study of the chemistry, Technology and economical aspect involved, part from the nature, concentration and association of the heavy metals concerned and the permissible discharge limit which guide the treatment process to be adopted. Further whenever feasible, it is advantageous to integrate the waste treatment into the process sequence itself, as in the case of integrated waste treatment system used in platting industry. The objective of the study is to develop an inexpensive and effective biosorbent that is easily available in large quantities and feasible economically for multiple metal ions in solution.

Table 1 Effect of pH on adsorption of Co(II) using MngiferaIndica bark substrate

Sr. No.	Initial pH	Final pH	Initial Conc. (ppm)	Final Conc. (ppm)	Cond. Adsorbed (ppm)	% Removal of Co(II)
1	2	1.78	22.90	4.23	18.67	81.50
2	3	2.05	22.90	3.82	19.08	83.29
3	4	3.23	22.90	3.31	19.59	85.51
4	5	3.79	22.90	1.88	21.02	91.75
5	6	4.37	22.90	0.96	21.94	95.76
6	7	5.53	22.90	2.70	20.20	88.19
7	8	6.79	22.90	2.31	19.49	85.07
8	9	7.57	22.90	4.43	18.47	88.67

In each case 1 gm of substrate was agitated with 100 ml Co(II) ion solution for 1 hour at 30°C

Table 2 Effect of Contact time on adsorption of Co (II)

Sr. No.	Time of Agitation (min)	Initial Conc. (ppm)	Final Conc. (ppm)	% Removal of Fe(II)
1	5	22.90	7.8	65.93
2	15	22.90	4.60	79.72
3	30	22.90	2.3	89.52
4	45	22.90	1.78	92.2
5	60	22.90	0.86	96.21
6	75	22.90	0.86	96.21
7	90	22.90	0.86	96.21
8	105	22.90	0.86	96.21
9	120	22.90	0.86	96.21

In each case 1 gm of substrate was agitated with 100 ml Co(II) ion solution at pH 6

Table 3 Effect of Dosages of adsorbent on adsorption of Co(II)

Sr. No.	Substrate Dosages (gm)	Initial Conc. (ppm)	Final Conc. (ppm)	Cond. Adsorbed (ppm)	% Removal of Co(II)
1	0.5	22.90	6.58	16.32	71.26
2	1.0	22.90	5.76	17.14	74.82
3	1.5	22.90	4.64	18.26	79.72
4	2.0	22.90	3.41	19.49	85.07
5	2.5	22.90	2.70	20.10	88.19
6	3.0	22.90	2.19	20.71	90.41
7	3.5	22.90	1.78	21.12	92.20
8	4.0	22.90	1.17	21.73	94.87

In each case 100 ml Co(II) ion solution at pH 6 was agitated for 30 1 hr at 30°C

Table 4 Effect of Temperature on adsorption of Co(II) using *Mangifera indica* tree bark substrate

Sr. No.	Temperature (°C)	Initial Conc. (ppm)	Final Conc. (ppm)	Cond. Adsorbed (ppm)	% Removal of Co(II)
1	30	22.90	1.07	21.83	95.32
2	50	22.90	3.72	19.18	83.75
3	70	22.90	6.17	16.73	73.04

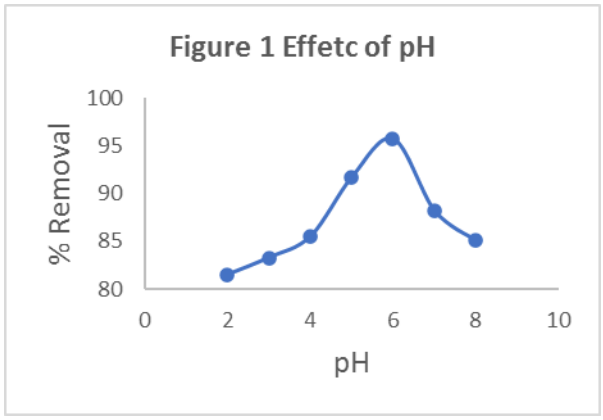
In each case 1 gm of substrate was agitated with 100 ml Co(II) ion solution at pH 6 for 1 hr.

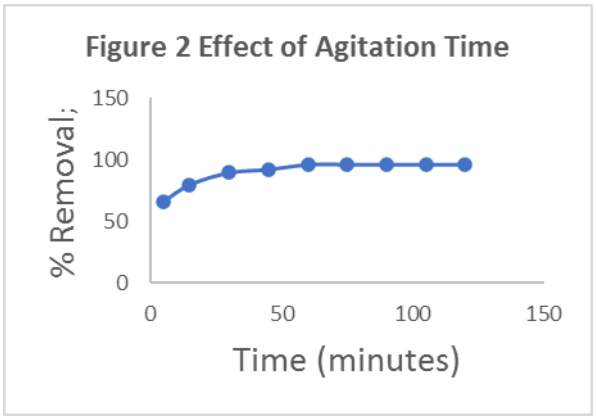
Table 5. Effect of initial metal ion concentration on the adsorption of Co(II) ion using *Mangifera indica* tree bark substrate

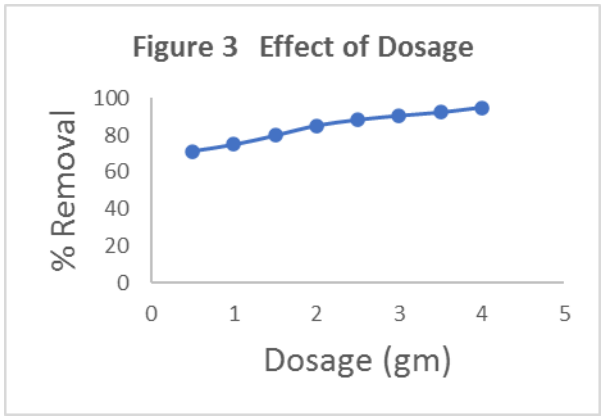
Sr.No	Initial Conc. (ppm	Final Conc. (ppm)	Cond. Adsorbed (ppm)	% Removal of Co(II)
1	22.9	3.21	19.69	85.96
2	22.43	4.91	19.29	79.51
3	36.68	6.07	30.61	83.44
4	54.84	12.9	41.94	76.46
5	69.54	18.52	51.02	73.36
6	70.96	24.54	51.42	67.69
7	79.43	26.17	53.26	67.04
8	83.92	32.09	51.83	61.74

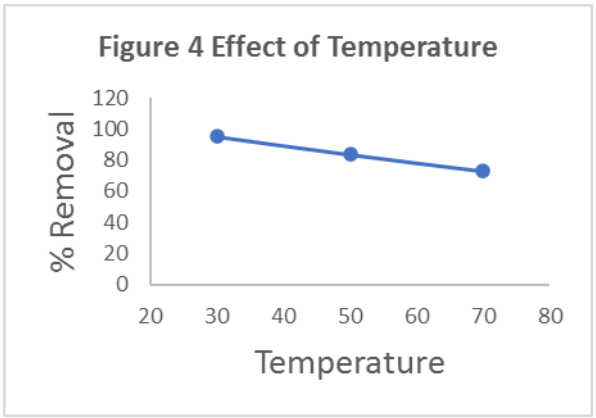
In each case 1 gm of substrate was agitated with 100 ml Co(II) ion solution at pH 6 for 1 hr.

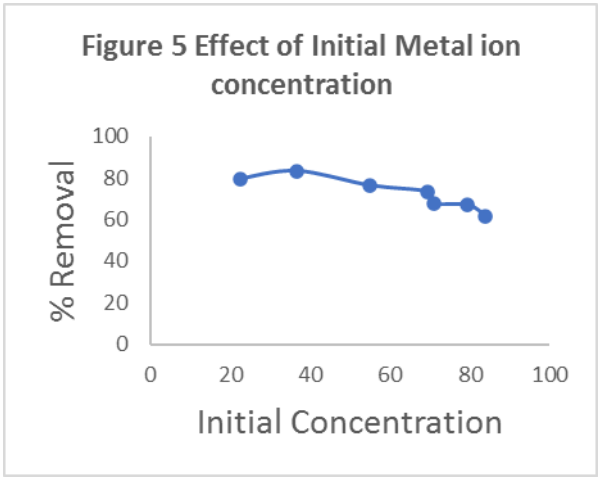
Figures











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Cite this article as :

Gharde B. D., Gharde A.D., "Adsorption of Co2+ from Aqueous Solution Using G Low Cost Adsorbent", International Journal of Scientific Research in Chemistry (IJSRCH), ISSN : 2456-8457, Volume 5 Issue 2, pp. 10-16, March-April 2020.
doi : https://doi.org/10.32628/IJSRCH20523
URL : http://ijsrch.com/IJSRCH20523