© 2017 IJSRST | Volume 3 | Issue 8 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Scavenging of Toxic Metal Ions from Aqueous Solution by Using Column of Modified Magnifera Indica Tree Bark Substrate

Gharde B. D.[1], Gharde A. D. [2]

[1]Department of Chemistry, Science College, Pauni Dist. – Bhandara, Maharashtra, India

[2]Department of Chemistry, N.A. College Umrer Dist. – Nagpur, Maharashtra, India

Corresponding Author Email - bdgharde@gmail.com

ABSTRACT

The uncontrol growth of industrialisation in the world is responsible for change in chemical and biological properties of both surface and ground water which constitute a health hazard. The heavy metal render the water unsuitable for drinking and are highly toxic. Removal of these material is therefore essential.Meagre quantity of water which is available for human use is also getting contaminated because of industrialisation, urbanisation, population exodus.The major contaminants responsible for water pollution is as follows- Inorganic pollutants and toxic metals , sediments , oxygen demanding wastage , radioactive substances, thermal pollutants ,pesticides , farm waste and fertilizers, autoexhaust as water pollutants , organics ,synthetic detergents , disease causing agent , plant nutrient , biological pollutants(Nuisance , organism like algae etc and suspended matter). The salt of various heavy metal and potentially hazardous material are being discharged in increasing amounts into the aquatic environment. Water containing significant concentration of some if the heavy metal ions are toxic 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 Hg, Pb,Cd,Cu,and Cr fall under this category . Many metals have been evaluated as toxic to aquatic life above certain threshold toxicity level . Rapid industrialisation and technological development enhance the concentration of heavy metal poisoning posing a significant threat to the environment and public health because of their toxicity , accumulation in the food chain and persistance in nature . Industrial waste constitute the major source of various kind of metal pollution in natural water. The heavy metals are stable and persistant environmental contaminants . Since they can't be degraded and destroyed . The metal ions are harmful to aquatic life and water contaminated by toxic metal ions remains a serious health problems. The present study aimed at effective management and purification of industrial waste water using cheaper and locally available tree bark for removal of heavy metal and a substitute to conventional . The effect of tree bark on Potassium dichromate , Cobalt chloride ,on the metal contents on industrial waste water was investigated in the pH of 4-6 . It is observed that the process of uptake followed first order adsorption, rate , expression and obey langmuir and frendlich model of adsorotion.

Keywords : Powder of *Magnifera indica* tree bark substrate , Co(II) and Cr(VI) metal ion solution, ultraviolet spectrophotometer, pH meter , Shaking machine , column of 20 mm diameter.

I. INTRODUCTION

Heavy metals generally occur in water in low concentration as a result of metal industries and partly through geological processes but these cause direct toxicity both to human and other living being due to their presence , obey the specified limits1.

Heavy metals in waste water have emerged as focus of environmental remediation effort of industrialisation and urbanisation with new technological advancement. The existing water resources are contaminated by discharging waste water containing organic, colour and heavy metals.2. The term pollution of the environment is one of the most harmful ecological crisis to which human being are subjected today. It is well known that three basic amenities are needed for living organism, air, land or soil and water . Sometimes in the past , these amenities were poor virgin and undisturbed , uncontaminated and basically must impossible for living organism.3.Industrial activities have been releasing large proportion of metals into the environment, as a result of these man and animal are constantly exposed to heavy metals at an alarming rate . The toxicity of some heavy metal ions even at some trace level has been recognised with respect to public health for many years such as Hg, Pb,As, Cu, Co, Zn , Cr etc are considered as toxic metals hence, strength limit have been imposed by the public health authorities regarding their effluent concentration . India has thick forest cover. It is tropical agricultural country and generate a considerable amount of agricultural wastage throughout the years. Agricultural products and byproduct such as tree bark , seed leaves and fruit shell etc have been reported to remove the heavy metals from waste water to below the discharge limits quite efficiently and economically some studies in this direction have been done in our laboratories .Various methods of treatment fir removal of heavy metal from industrial waste water have been reported. .4.Amongst these methods, precipitation, ion exchange , adsorption are the moat common for low concentration of metal ions in waste water. The adsorption process is highly recommended for their effective removal. The process of adsorption implies the presence of an adsorbent solid that bind molecules by physical attractive forces ,ion exchange and chemical binding . It is advisable that the adsorbent is available in large quantities, easily regenerable and cheap. The application of biosorption environmental treatment has become a significant research area. The major advantages of biosorption techniques are its effectiveness in reducing the concentration of heavy metal ions to very low level. 5. Use of inexpensive biosorbent material , high efficiency , minimisation of chemical and biological sludge , regeneration of biosorbent no additional nutrient requirement and possibility of metal recovery. The paper represent with experimental result on low cost and easily available Magnifera indica tree bark substrate as a adsorbent for the removal of heavy metal Co(II) and Cr(VI) from waste water for our exclusive knowlegde this is the first time we are reporting tree bark substrate as adsorbent for the removal of Co(II) and Cr(VI) from waste water from column.6. Many conventitional techniques such as chemical precipitation , membrane filtration , electrolysis, ion exchange , and carbon adsorption are extended for the removal of heavy metals but at low concentration. These techniques fail to certain cases also they are not cost - effective for this reason. Low cost adsorbent have been expanded for the removal of heavy metals from aqueous solution. 7.8.

II. TOXICITIES OF CO(II) AND CR(VI)

A Study was made of toxicity in a field of crop of oats on a sign developed in an area were ultrabasic rock occurs , an area selected fir sampling showed a range of toxicity from the border were plants were normal to the centre were most affected . The total cobalt and chromium contents of soil solution extracted with a centrifuge from soils at field capacity were in order Co>Cr . In the soils solution of Co range from 0.03 to 0.14 pp. And Cr range from 0.01-0.02ppm.

The concentration was found and compared with the known concentration to induce toxicities in oat. Cobalt ion can contribute to loss of appetite, loss of weight and loss of energy.Cr causes skin inflammation, renal failure and cardiovascular issues. Co is involved in vit B12 synthesis that is required for the production if RBC and prevent of pernicious anemia make it an essential element for animal . It serve as catalyst in manufacturing of ammonia , alcohol and number of other organic compound. It is the use of full of therapeutic agent , in the treatment of anemia and cyanide poisoning , salt of cobalt are absorbed well from gastrointestinal tract . However , increase in Co level and put in water do not tend to accumulate within the human body as about 80% of the investigated cobalt is excreted out in urine, and about 15% is excreted in faeces , it is also excreted through milk and sweet. The usual response of most of mammals man to large intake of cobalt including vomiting , diarrhoea sensation of warmth.

III. EXPERIMENTAL

PREPARATION AND ESTIMATION OF COBALT ION SOLUTION - 20ml of cobalt nitrate solution is taken in beaker and 2ml of 2% nitroso R salt was added in it in this 2ml of 1% sodium acetate trihydrate was added and the contents were bind for few minutes. 2ml of 1:1 nitric acid was added to stabilise the orange colour complex the absorbance was measured against the blank . A plot of absorbance vs the concentration was then made .

PREPARATION AND ESTIMATION OF CHROMIUM ION SOLUTION-

The standard solution of 0.0001M potassium dichromate was prepared by dissolving requisite amount of potassium dichromate in 1 litre of distilled water. 3 ml of this solution was then transferred in a beaker and to this added 2ml of 3 M sulphuric acid and 1ml of 0.25% of diphenyl carbazide solution in acetone . The volume was made upto 25 ml with distilled water. A green colour complex was formed and its absorbance measured, Beer's law plot for estimation of Cr(VI) ion by this method was obtained by using varying concentration of Cr(VI) ion solution and measuring the absorbance .

Preparation of adsorbent of Magnifera indica tree bark substrate -Raw material used for preparing adsorbent are collected from plant material . Dried shell of plant Magnifera indica were collected and crushed to small size in an electric grinder. The powder was shifted and 2gm of powder were added to a mixture of 20ml 0.25N sulphuric acid and 39% formaldehyde. It was kept in a water bath at 50degree C for 6 hours and occassionaly stirred. The powder was washed with distilled water for several times for the removal of sulphuric acid and used for removal of metal ions. The treatment of bark with acidic medium polymerise with insolubilize the water listed the soluble organic constituents of bark. In this way the bark substrate was prepared and used for further studies for removal of metals form waste water the general treatment method used. Adsorption is best technique which is a broadly applied to remove metals.

IV. RESULT AND DISCUSSION

Column study - Column studies were made by the optimum condition fixed and maintained . A column of tree bark substrate (10g) was prepared in glass tube of 20mm internal diameter. The metal solution (2-3 litre) was passed from top through this column and collected at the bottom(throwpot volume). The metal content in this solution was analysed by given method . The rate of flow of solution was maintained at 3-4 ml per min. The assembly for column studies was prepared as shown in fig.

The result obtained from these studies are given in table and figure . The result show that after 70-90ml throwpot volume collection the percentage removal decreases . This may be because of the blockage of adsorption site of substrate by metal ion thus it can be seen that Co(II) and Cr(VI) are present in the feed solution are removed by the substrate column to a large extent . The result clearly indicate that by utilizing adequate column of Magnifera indica tree bark it is possible to reduce the toxic heavy metal ion concentration in solution.

V. CONCLUSION

The review presents spectrophotometric analytical methods applied for the determination of some non – steroidal anti – inflammatory drugs coxibs (Celecoxib, Valdecoxib) between 1985 and 2008. Comparing validation parameters of already researched methods, it can be concluded which one of them is more sensitive (low LOD and LOQ values).

Table 1. Adsorption of Co(II) from Cobalt nitrate solution using a packed column of Magnifera indica tree bark substrate

Sr.no	Time in min	Throwpot volume	Initial concentration in ppm	Residual conc. In ppm	Conc. Adsorbed in ppm	Percent removal
1	15	50	35.04	4.66	30.38	86.70
2	30	60	35.04	2.46	30.58	92.98
3	60	70	35.04	1.80	33.24	94.86
4	90	80	35.04	7.52	27.52	78.54
5	120	90	35.04	4.66	30.38	86.70
6	240	100	35.04	3.71	31.33	89.41

Adsorption of Cr(VI) from potassium dichromate solution using a packed column of *Magnifera indica* tree bark substrate

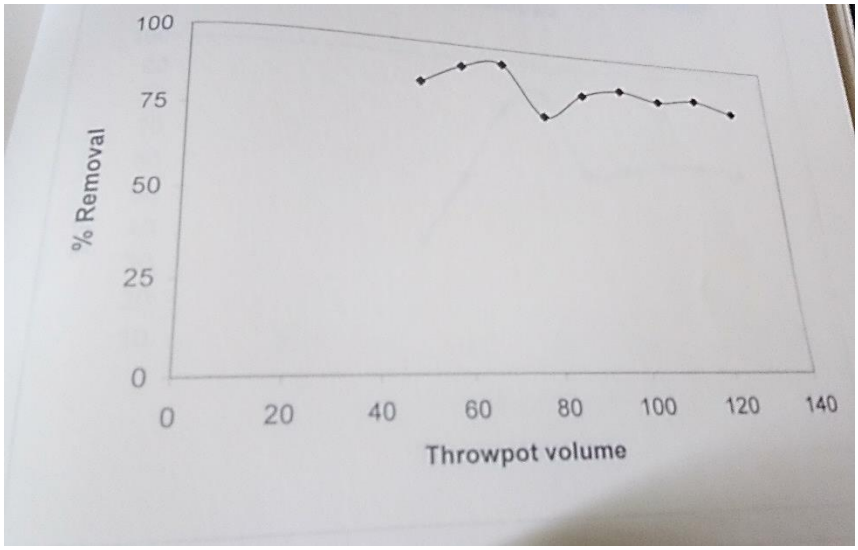
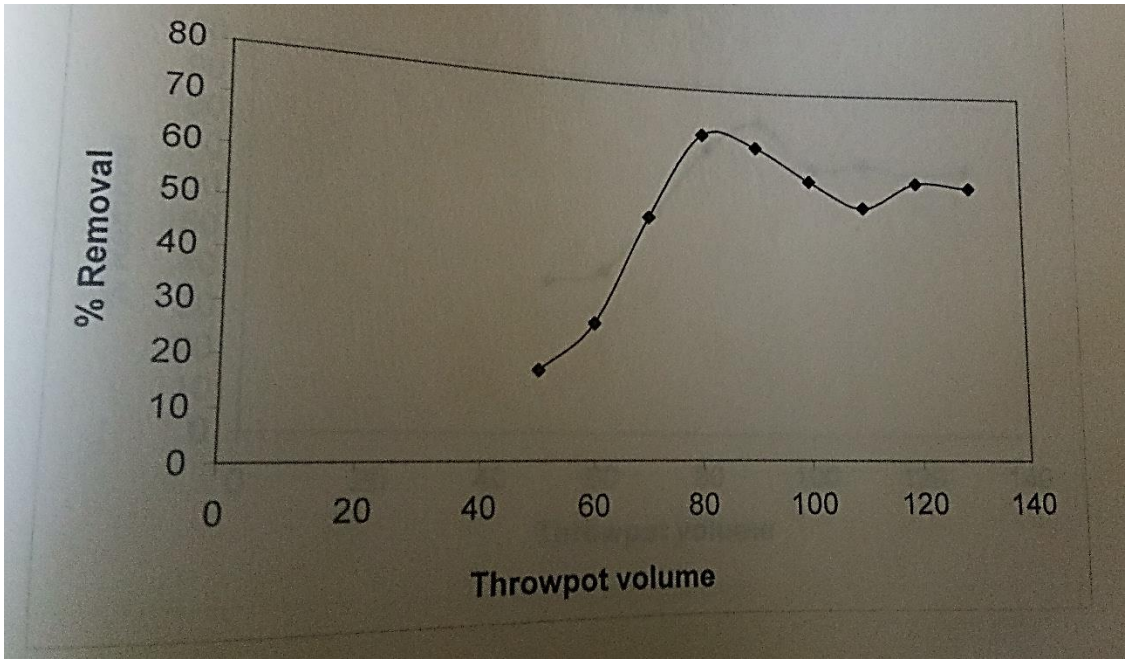


Table 2. Adsorption of Co(II) from Cobalt nitrate solution using packed column of *Magnifera indica* tree bark substrate

Sr.no	Time in min	Initial conc. In ppm	Residual conc. in ppm	Conc adsorbed in ppm	Percent removal
1	15	21.25	17.37	3.88	18.25
2	30	21.25	15.25	6.01	28.28
3	60	21.25	10.34	10.91	51.34
4	90	21.25	6.37	14.88	70.02
5	120	21.25	6.87	14.38	67.67
6	240	21.25	8.37	12.88	60.61

Adsorption of Cr(VI) from potassium dichromate solution using a packed column of *Magnifera indica* tree bark substrate



VI. CONCLUSION

The present investigation clearly show that the magnifera indica tree bark substrate used have considerable capacity to bind toxic heavy metal ions. Formaldehyde modified substrate shows highest removal of Co(II) and Cr(VI) time of 30 minutes. Numerical value of a Frendliech adsorption isotherm for tree bark substrate and activated charcoal indicated that the substrate has more binding capacity compared to activated charcoal. The substrate material are not only cheap , inexpensive and easily available by needs simply processing for effective removal of metal ions without use of any sophisticated use of any equipment or expert attention it could be effective , alternative to conventional adsorbent like activated charcoal are alumina and expensive ion exchange resins . Thus, the method could be utilized for removal of heavy metal ions from industrial effluent after prior

separation of a particular method from other impurities present. Application of these adsorbent to waste water treatment is expected to be economical and efficient. The work is progressed in this direction.

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Cite this Article

Gharde B. D., Gharde A. D., "Scavenging of Toxic Metal Ions from Aqueous Solution by Using Column of Modified Magnifera Indica Tree Bark Substrate", International Journal of Scientific Research in Science and Technology (IJSRST), Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 3 Issue 8, pp. 2013-2018, November-December 2017. Journal URL : http://ijsrst.com/IJSRST1964165