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Use of Column of Ferronia Elephuntum Fruit Shell Substrate for the Adsorption of Fe[Ii] and Mn[Ii] Metal Ion From Aqueous Solution

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ABSTRACT

Meagre quantity of water, which is available for human use is also getting contaminated because of industrialisation, urbanisation and population exhaust. The major contaminants responsible for water pollution are as follows inorganic pollutant and toxic metals, sediments, oxygen demanding wastage , radioactive substances , thermal pollutants , pesticides form wastage and fertilizers auto exhaust as water pollutants , organics , synthetic detergents , diesease causing agents,plant nutrient, biological pollutant and suspended matter . Salt of various heavy metals and other potentially hazardous material are being discharged in increasing amounts into the aquatic environment. Water containing significant concentration of some of the heavy metal ion are toxic to human being , animals as well as aquatic organisms. The toxicity of some heavy metal ions even at the trace level as being recognised with respect to the public health for many years . Metal such as Hg, Pb, Cd, Cu, Cr fall under this categories. Many metals have been evaluated as toxic to aquatic life over certain threshold toxicity level. Exposure to heavy metal toxicity can result from every facet of natural activity such as agriculture , mining, transport energy and industry. Continue release of metal wastage into the environment has been justified on the basis of dilution to undetectable level or to the level below the threshold toxicity level in the receiving water body. 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 renders the water unsuitable for a drinking and are also highly toxic . Removal of these naterials is therefore essential . The studies pertaining to the use of inexpensive agro based adsorbent such as tree bark , saw dust , corncob, straw , flyash and fruit shell etc fir heavy metal removal or gaining a lot of importance . In the present study the removal of Fe[II] and Mn[II] has been investigated using *Ferronia elephuntum* fruit shell substrate through pack column and results are obtained and are quite encouraging. The use of pack column has been investigated at the optimised condition , to study the feasibility of the process for application in small scale industries.

Keywords : *Ferronia elephuntum* fruit shell substrate, column of 2mm diameter ferrous ammonium sulphate solution, Maganese sulphate , Uv spectrophotometer.

I. INTRODUCTION

The toxic heavy metals are released into the environment from a number of industries , such as mining , plating , dyeing, automobile maufacturing and metal processing. The presence of heavy metals processing. The presence of heavy metals in the environment has led to the number of environmental problem in order to meet the water quality standard for most of the countries , the concentration of heavy metals in waste water must be controlled.1. The heavy metal ions are stable and persistant environmental contaminants since they can't be degraded and destroyed. These metal ions are harmful

to aquatic life and water contaminated by toxic metal ions remains a serious health problem.2. So their concentration must be reduced to acceptable level before discharging into environment , otherwise this can cause POAC a threat to public health. The metal of most immediate concern are Zn, Cr, Fe, Ni, Hg, Cd, Pb.3. Substances in considerable access amount will upset the balance of nature . Although traces of some heavy metals such as Cu and Co are supposed to fill some essential role in nutrition , however exccessive amount can induce toxic effect. Several heavy metal ions are known to exert their toxic effects particularly on the rapidly proliferating tissues such as the gastrointestinal mucosa, bone marrow and on highly specialised cell such as neurons and renal tubular cells .4. Several reviews are available on the various techniques applied for waste minimisation and the removal of heavy metals from the waste water. Several methods that have been used for the treatment of waste water and removal of toxic metals include adsorption , biosorption, cementation, chelation, complexation, chlorination ,coagulation, electrochemical , filtration, flocculation , floatation, ion exchange, membrane separation , neutralisation, oxidation , precipitation, reduction, reverse osmosis , solvent extraction. Sometimes two or more techniques have been coupled to achieve enhance efficiency. An ideal method for removing trace metal should be rapid, cheap[in term of the equipment , chemicals , energy requirement, labour input, etc] and capable of being applicable to small, intermediate and large scale level . Furthermore , the method should be able to handle even small volume of liquid or solid enriched in contaminants in concentration level well below the standard established by the regularaties agencies .5. The adsorption is one of the most effective physical process for the removal of toxic metal ions from waste water . It is a surface phenomenon based on the concept of parting a chemical species between a bulk phase and an interphase or accumulation of a substance near the interface the technique is classified as localised , non localised, negative , positive and static dynamic Adsorption based on the strength of binding forces. The surface if solid have residual forces are free valencies. 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 . This phenomenon is termed as adsorption. Adsorption is a technical term , coined to denote the taking up of gases , vapour, liquid by surface or interface , the substance which adsorb another substance is called adsorbent while the substance that get adsorbed on the other is called adsorbate is more commonly reffered to as physical and chemical adsorption. 6. The adsorption process depend upon nature and geometry of heavy metals in the waste water apart form the other impurity Some of the governing factors of adsorption techniques are nature and particle size of the adsorbate , surface and nature of adsorbent, temperature, pressure ,pH , adsorbent doses , initial concentration of adsorbate , adsorption period, pack column , no. Of cycles implied for experimentation, salinity , foreign ion present etc. 7. To provide effective purification an adsorbent should be able to take up and hold molecules of the substances to be removed without disturbing other constituent of the system . Low cost and non conventional adsorbent include agricultural wastage like natural compost , irish peanut , peanut shell , wallnutshell , bone and biomass such as Aspergillus , Tereous, and Mucor remainnus, natural material such as hair and cattails , waste wool , peanut skin , bark ,modified bark , rice hust , barley straw ,straw , low rank coal , human hair , waste tire , rubber and the tea leaved.8. The selection of adsorbent for adsorption require the following characteristics - It must be easily available , It must be cheap and reusable, It require more adsorption capacity , It requires higher adsorption rate , Rate of desorption is late or slow , it must be biodegradable or decomposable. Several workers describe the use of various tree bark and various agriculture byproduct such as peanut skin, onion skin, puddihusk, puddistraw , sugarcane bagasse, green emblica leaves , garlic skin etc for the removal and recovery of toxic heavy metals from mining and industrial waste water .9. Randall and coworker reported the use of

bark , particularly , dose of Red wood , Hemlock , Red oak , for selective removal of heavy metal cations from industrial wastage such as mercury and lead battery wastage and mine run off . The metal seems to be bound to the bark substrate by ion exchange presumbly form the phenolic group in tannin compound , several battery manufacturing , plant in the U. S are reportedly bark filled coulmn process for their wastage treatment . Dara and coworker investigated a number of commonly occuring indian tree bark eg Acasia arabica , Acasia enthocephalus, Soyameda fabrifuga, Magnifera indica, Anthosephalum kadamba, Pterocarpus marsupsium, Terminilia tomantosa and Techtona grandis, and agricultural byproduct such as onion skin and garlic skin for their efficiency in binding heavy metals from waste water and show their potential use in waste water treatment particularly for small industrial unit which can not be afforded for conventional treatment system. This methods are cheap and obiquitous and capable of scavenging discharge limit.10.

II. EXPERIMENTAL

PREPARATION OF METAL ION IN AQUEOUS SOLUTION

All chemicals, ferrous ammonium sulphate, hydroxyl amine hydroxide and pottasium periodate use were for analytical grade, and were used without further purification . The metal ion solution of required concentration of Fe[II] and Mn[II] were prepared from ferrous ammonium sulphate and potassium permagante respectively in distilled water. The pH of ferrous ammonium sulphate and potassium permanganate solution was adjusted to 4c5 using buffer solution to prevent hydrolysis.

PREPARATION OF FRUIT SHELL SUBSTRATE-

Ferronia elephuntum fruit shell were collected and dried at room temperature in the air , further grinded using grinding machine and sieved through a mesh . Adequate mass of the Ferronia elephuntum fruit shell substrate were mixed with 0.25 N sulphuric acid and 39% from aldehyde . The mixture was continuously agited for 6 hrs using commercial shaking machine the mixture was then filtered and washed several times with distilled water with the help of filtrate was attained till pH 5. The residue was dried in an electric oven at 50 degree C . The formaldehyde treated Ferronia elephuntum fruit shell substrate was used as adsorbent for column adsorption method.

III. RESULT AND DISCUSSION

Preparation of column for adsorption-

Column studies were carried out in a column made of Borosil glass of 2mm internal diameter and 15cm length . The two column ere filled with 10gm of dried modified Ferronia elephuntum fruit shell substrate by tapping so that maximum amount of adsorbent was packed without gap for adsorption of Fe[II] and Mn[II] respectively. The metal solution 2-3 litres was passed from the top through this column and collected at the bottom. The metal contents in this solution was analysed by the given methods . The rate of flow of solution was maintained at 3-4 ml/min. The result obtained from the studies show that after 70-90ml throwpot volume collection, the percentage removal decreases. This may be because of this blockage of this adsorption site of substances of the metal ions.The results clearly indicate that the utilizing adequate column of Ferronia elephuntum fruit shell substrate , it is possible tO reduce toxic heavy metal ion concentration in solution.

IV. CONCLUSION

The present study demonstrate that a modified Ferronia elephuntum fruit shell substrate could be used successfully for the removal of Fe[II] and Mn[II] from aqueous solution . The maximum adsorption capacity of formaldehyde modified Ferronia elephuntum fruit shell substrate achieve up-to 80-90% at 45 minutes. Substrate indicate that substrate has more binding capacity comapared to activate a

charcoal . The substrate material are inexpensive and easily available , needs simple processing for effective adsorption of metal ions for effective adsorption of metal ions without use of any sophisticated equipment expert attention . It could be effective , alternative , to conventional adsorbent like activated charcoal . Thus, the method could be utilized for removal of heavy metal ions from industrial effluents after prior separation of particular metal from other impurities present. Finally it is concluded that the adsorbent prepared from the fruit shell material seems to offer inexpensive but effective alternative to the expensive commercial ion exchange resins . Thus adsorbent will certainly go a long way in the tertiary treatment of portable water as well as industrial effluent . The results are encouraging and furtherwork is in progress in their direction.

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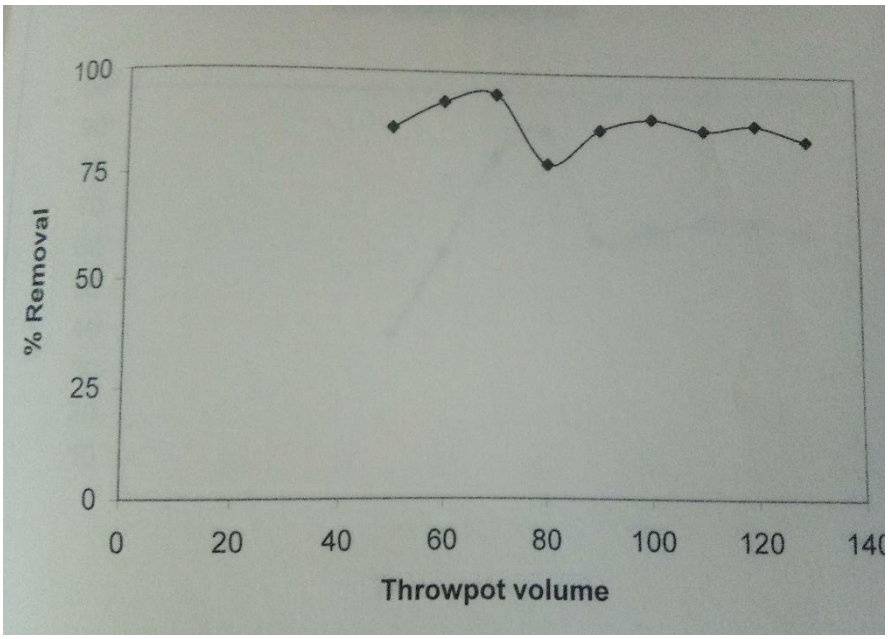
Adsorption of Fe[II] using pack column of Ferronia elephuntum fruit shell substrate

Sr.no	Time in min	Throwpot volume	Initial con. In ppm	Conc. Adsorbed in ppm	% removal
1	15	50	35.04	23.71	67.66
2	30	60	35.04	24.95	71.2
3	60	70	35.04	26.65	76.05
4	90	80	35.04	29.7	84.76
5	120	90	35.04	34	97.03
6	240	100	35.04	28.7	81.9
7	360	110	35.04	27.25	79.48

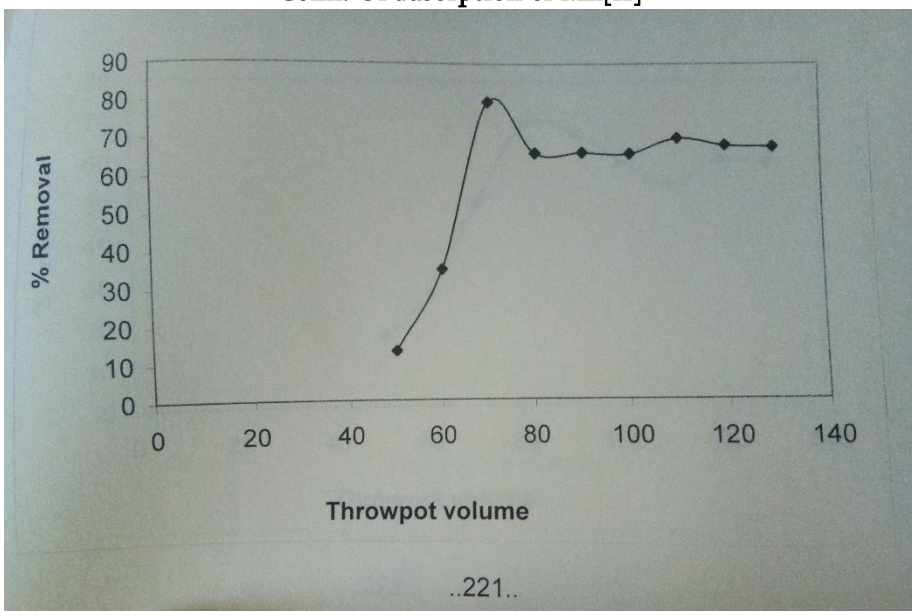
Adsorption of Mn[II] using pack col. Of Ferronia elephuntum fruit shell substrate

Sr.no	Time in min	Throwpot vol	Initial conc. In ppm	Conc adsorbed in ppm	% removal
1	15	50	23.11	8.27	35.78
2	30	60	23.11	10.77	46.61
3	60	70	23.11	12.87	55.69
4	90	80	23.11	18.47	79.93
5	120	90	23.11	19.49	84.34
6	240	100	23.11	16.43	71.09

Colm. Of adsorption of Fe[II]



Colm. Of adsorption of Mn[II]



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