Bulletin of Environment, Pharmacology and Life Sciences Bull. Env. Pharmacol. Life Sci., Vol 9[11] October 2020 : 77-88 ©2020 Academy for Environment and Life Sciences, India Online ISSN 2277-1808 Journal's URL:http://www.bepls.com CODEN: BEPLAD Global Impact Factor 0.876 Universal Impact Factor 0.9804 NAAS Rating 4.95

ORIGINAL ARTICLE



Synthesis and Characterization of Gaurgum Ascorbic Acid Resin (GAAR) for Deletion of Toxic Heavy Metal Ions From Industrial Discharges

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ABSTRACT

Gaurgum based resin containing ascorbic acid as a functional group has been synthesized .The ascorbic acid group has been incorporated by porath's method of functionalisation of polysaccharide .The adsorption behavior of GAAR for heavy metal ions have been study by batch and column experiment .GAAR resin selectively remove heavy metal ions as Zn(II) ,Fe(II) ,Cu(II), Cd(II), and Pb (II), from industrial waste water .The GAAR resin was characterized by FTIR and the effect of various adsorption conditions as effect of pH, treatment time, agitation speed and ion exchange capacity were also investigated .The order of Kd value were determined. The maximum adsorption sequences of these heavy metal ions on GAAR resin were found asCd⁺²> Pb⁺²> Zn⁺²> Fe⁺²> Cu⁺².

KEYWORDS: GAAR resin, Kd value, batch method, ascorbic acid and heavy metal.

Received 23.08.2020

Revised 29.09.2020

Accepted 19.10.2020

INTRODUCTION

Water pollution is a biggest issue not only in India but all over the worldwide. Whole world affected by this hazardous problems. Heavy metal pollution in the environment can originate from natural sources as well as from man-made sources. Volcanoes, earth quake, heavy rain fall, flood, and geological weathering are natural sources of pollution, but the ratio of pollution originate by natural sources is less than human made sources.

Mining and industries effluents are some of the man-made sources of heavy metal pollution. The effluent resulting from different industries like metal processing, tannery, electroplating, textile, paper, pulp, paint etc. This type of effluent contain a heavy toxic metal ions as Cr(II), Hg(II), Ag(I), U(II), As(III), Sn(II), Fe(III), Ni(III), Pb(II) and other radio-active metal ions which are very difficult to detoxify. The quality of surrounding fresh and marine water varies directly with healthy growth, propagation and harvests of both plants and animals. A large measure of sewage, industrial effluents and domestic waste are discharge daily. The presence of heavy metals in aqueous water streams has become a problem due to their harmful effect on human health and on the flora and fauna of receiving water bodies. Electroplating band, metal working industries discharge a large amount of heavy metal ions including Cu(II), Ni(II), Zn(II), ions in their effluents have been organized as a major problem to human health and aquatic life.

The current regulation of waste water and drinking water standards are required contamination of heavy metal reduced up-to few parts per million. Several processing techniques are available to reduce the concentration of heavy metal ions in waste water, including precipitation method, flotation, solvent extraction, adsorption, cementation into iron, membrane processing and electrolytic methods, and ion-exchange method. Adsorption on activated carbon is a well-known method for removing toxic metal ion, but the high cost of activated carbon restricts its use in developing countries, so cheap and effective alternatives for the removal of heavy metals should reduce operating costs, reduce the prices of products, improve competitiveness and benefit the environment. The adsorption abilities of a number of low-cost absorbents like cheap zeolites, cellulose, sewage sludge, agricultural wastes, cellulose, and biomass have been determined for the removal of heavy metal from water[1].

Ion exchange and its principles have wide applications in analytical chemistry ,hydrometallurgy, antibiotic purification, separation of radioisotopes, water treatment and pollution control [2].

Ion exchange removes unwanted ions from solution by transferring them to a solid material (ionexchanger)which accepts them while giving back an equal number of desirable species stored on the ion exchange skelton [3].

Recently, many tactics have been studied for the development of cheaper and more operative absorbent containing natural polymers. Among these polysaccharides like as chitin ⁴⁻⁶ and starch [7-9]. Gaur gum and their derivatives like chiton [10-11] cyclodextrine [12-14] deserve particular attention. These biopolymer represent an interesting and smart alternative as absorbent because of their particular construction, physio-chemical features, chemical permanence, great reactivity and outstanding choosiness to aromatic compounds and metals.

In this study, the adsorption behavior of natural polysaccharide with respect to metal ions have been studied in order to consider its application to purity metal finishing wastewater. That natural polysaccharide guar gum ascorbic acid (GAA) resin, hold excessive potency to eliminate cations weighty metal species from industrialized wastewater [15-18]. Ion exchange capacity of any resin depends upon the functional group which incorporate in resin, pH of the solution and contact time the most functional groups which are used in resin for the removal of metal [19-21] ion from the effluents are ascorbic acid,. The object of the present work is to develop such chemicals preferably using the raw material which are locally available.

MATERIAL AND METHODS

Among natural polymers guar gum is special interest due to its easy availability, cheap in cost and wide application spectrum both in natural as well as modified form. Now we have attempted to develop polysaccharide matrix based ion exchanger with different functional group incorporated in the same. These polysaccharides give hydrophilic base for the synthesizing of chelating resin and are effective, compatible in metal ion separation from industrial effluents.

For esterification of polysaccharides, epichlorohydrin have been used and these derivatives are then treated with functional groups is colorless, mobile liquid having irritating chloroform like odour. Its presented by the formula



Epoxy chloropropane is extremely reactive and usually combines through the epoxy group with a substance containing an active hydrogen atom and is the most preferred coupling agent¹⁹ for derivatives of polysaccharides.

The degree of substitution which shows the number of substituted ring sites. To check the cross- linking. Gaur gum ascorbic acid resin has been synthesized for removal of toxic metal ions from aqueous solution and industrial effluent.

EXPERIMENT'S AND ANALYSIS

Method of synthesis of Guar gum Ascorbic Acid (GAA) resin :

Synthesized of guar gum ascorbic acid resin by the following steps as follow:

Preparation of Epoxy propyl ether of Guar gum

Anquantity of 41gm (0.5mol) of guar gum fine particles was taken in a round bottom flask and it was slurred with dioxane. After it 15ml of 40% sodium hydroxide was added to make it alkaline till pH reached 9-10.The solution was stirred at 60°C for 3hr. Then 9.25 gm(0.1mol) epichlorohydrine was added with continuous stirring .The stirring was further constant for 5hr at 60°C. The product epoxypropyl ether of guar gum powder was filtered under vacuity and splashed with methanol to remove impurities and dried.

Preparation of Guar gum Ascorbic Acid (GAA) resin

Epoxypropyl ether of guar gum was then allowable to react with an amount of 8.8 gm (0.1 mol) of ascorbic acid was added and stirring for 5hr at 60°C and left overnight. The produce was filter under vacuum and splashed with 90% methanol, containing few drops of hydrochloric acid to get rid of inorganic impurities. Finally it was washed with pure methanol. The product guar gum ascorbic acid (GAA) resin was free flowing light yellow powder and yield was 56 gm. The reaction scheme for the synthesis of GAA resin is shown in Fig. 1



Fig: 1. Chemical reaction scheme of the synthesis of Guar gum Ascorbic Acid (GAA) resin

Apparatus were used during work :

Magnetic stirrer

Magnetic stirrer manufactured by Metrex Scientific Pvt. Ltd. was used.

FTIR (Fourier transform infrared spectroscopy)

The structure of newly synthesized resins was characterized by Perkin Elmer model 5000 FTIR spectrometer. The solid samples were tested with KBr pellet method. Infrared spectroscopy exploits the fact that molecules absorb specific frequencies that are characteristic of their structure.

AAS (Atomic Absorption Spectrophotometer)

The concentrations of studied metal ions were measured by Perkin Elmer 2380 atomic absorption spectrophotometer (AAS). Atomic absorption spectrophotometer was used in the quantitative determination of metals ion concentration in traces .The technique is based on the fact that that ground state metals absorb light at specific wavelengths which quantitatively measures the concentrations of elements present in a sample.

pH meter

Digital pH meter model no. 5651, (Electronics corporation of India, ECI) was used in the determination of pH values. The pH measurement of metal ions and buffer solution were carried out by this.

PHYSIOCHEMICAL CHARACTERIZATION OF GAAR RESIN

Physiochemical characterization of newly synthesized resin of guar gum wascarried out. The resins were characterized by the various method:

Determination of total ion exchange capacity of GAA resin

Procedure:-

Back titration procedure was followed for the determination of capacity of GAA resin. An amount of 1.0gm resin was taken in an Erlenmeyer flask and 200 ml of standardized NaOH (0.05N) containing 5ml of 5% NaCl solution was added and was allowed to stand overnight. 25ml of aliquot of supernatant solution was back titrated with standard solution of 0.05N HCl using indicator (phenolphthalein). Ion exchange capacity of the newly synthesized resin was calculated by the formula:

$Q(Meq/g) = \frac{(0.05NXV1) - 8(0.05NXV2)}{4}$

In this formula

V1 = Volume of 0.05N NaOH Solution(ml)

V2 = Volume of 0.05N HCl consumed (ml)

M = Weight of dry resin (gm)

 $Q(Meq/g) = \{(0.05x200) - 8(0.05Nx 14.56)\}/0.92$

- = (10-8(0.728)/0.92
- = (10-5.82)/0.92
- = 4.54

pH titration of GAA resin

Procedure

Firstly guar gum derivatives were converted to H^+ ion form then washed with water to remove excess acid and dried at 55-60 °C overnight. 0.1 gm of the resin was taken from them in different 7 flasks and

decreasing amount of 1 N NaCl solution was added in flasks and increasing amount of 0.1N NaOH was added in each flasks. At last de-ionized water was added in each flask to make volume 25 ml of each. All tightly closed flasks were equilibrated by magnetic stirrer until the final pH value attained by the solution. Measured the pH value of each by digital pH meter and the values were given in below Table. Curve of pH v/s meq of alkali /g of resin plotted for resin.

Flask No.	Volume of 1 N NaOH (ml)	Volume of 0.1N NaCl (ml)	Volume of	рН
			deionized water (ml)	
1	0.0	1.5	23.5	3.42
2	0.3	1.3	23.4	4.48
3	0.6	1.1	23.3	6.54
4	0.9	0.9	23.2	8.21
5	1.2	0.7	23.1	8.34
6	1.5	0.5	23.0	9.00
7	1.9	0.2	22.9	9.11





Fig.2: pH titration curve of Guar gum Ascorbic Acid (GAA) resin.

Effect of pH on Guar gum Ascorbic Acid (GAA) resin

pH is a very important index to determine the exchange capacity of a synthesized resin. With increasing the pH, ion exchange capacity of a resin increase (pH 2-6) after increasing pH above 7, basic environment of absorption of metal ions on resin decreasing gradually. The maximum value of adsorption of metal on GAA resin at pH 6.

Effect of treatment time on Guar gum Ascorbic Acid (GAA) resin

Adsorption of metal ions on Guar gum Ascorbic Acid resin amplified when interaction time was enlarged from 35 to 235 minutes, hence optimalinteraction time for GAA resin was found to be 235 min. Other restrictions such as pH of solution and agitation speed were kept optimal, while heat was kept at 25°C. Greater accessibility of ascorbic acid well-designed groups on the surface of guar gum which are required for contact with metal ions, suggestivelybetter the binding ability and the procedure proceeded fast. The results of conduct time indicate that adsorption % of metal ions better with an increase in contact time before stability is reached.

Effect of agitation speed on Guar gum Ascorbic Acid (GAA) resin

The effect of agitation speed on adsorption of metal ions was studied by variable the speed of agitation from 0 (without shaking) to 200 rpm, while other limitations (like temperature, pH) keeping optimum. The adsorption of metal ions on ion exchange resin normallyenlarged with increasing agitation speed. The adsorption of metal ions on newly synthesized modified GAA resin increased when agitation speed increased from 0 to 160 rpm. These results can be related to the fact that the growth of the agitation speed, Increases the dispersal of metal ions towards the surface of the adsorbents. This also shows that a shaking rate in the range 100-160 rpm is enough to assure that all the surface binding sites are made readily obtainable for metal ions uptake. For convenience, agitation speed of 140 rpm was selected as the ideal speed for newly manufactured modified GAA resin for elimination of metal ions from effluent.

Effect of temperature on Guar gum Ascorbic Acid (GAA) resin

There are many parameters which affect adsorption of metal ions on resin, but temperature is one of the most parameter. With increasing the temperature, the adsorption of metal ion on resin decrease. For GAA resin, temperature of treatment time is between 25° C to 60° C.

IR characterization of Guar gum powder

FTIR spectra of guar gum powder showwide-ranging band in the region 3600-3200cm⁻¹ distinguishing of –OH stretching. The peak at 2950 is attributed to C-H stretching vibration, strong and shrill peak at 1660 cm⁻¹ due to O-H bending and variable peak at 1470-1345cm⁻¹ is due to C-H bending. A solid peak at 1300-900 cm⁻¹ due to C-O vibration. The FTIR spectra of guar gum powder show in Fig. 3



Fig.3.The FTIR spectra of guar gum powder

IR characterization of Guar gum Ascorbic Acid (GAA) resin

The FTIR spectra of guar gum ascorbic acid resin shows peak at 2970 cm⁻¹ is due to C-H stretching vibration. A strong peak in the region 1260-990 cm⁻¹ is due to C-O extending vibration. The peak at 1625-1400cm⁻¹ are attributed to C=C extending in aromatic cores. The GAA resin show stretching vibration at 2500-2900cm⁻¹ due to –OH group in carboxylic acid. Another peak at 1600-1450 cm⁻¹ is recognized to C-H bending. The FTIR bands of Guar gum Ascorbic Acid resin is shown in Fig.4



Fig.4 FTIR spectra of Guar gum Ascorbic Acid (GAA) resin

Distribution coefficient (Kd)

An ion exchanger is an insoluble material (R) that has inorganic functional groups to which counter ions (A) can be bound. In the ion exchange reaction, liquid is contacted with the ion exchanger and ion A and C are exchanged:

$$Z_CRA^{ZA} + Z_AC^{ZA} \longrightarrow Z_ARC^{ZC} + Z_CA^{ZA}$$

Distribution of metals between solution and solid depends on the selectivity of the ion exchange, in certain experimental conditions. Selectivity is important characteristic of an ion exchange, which makes the ion exchanger prefer one counter ion to another, thus selectivity drives the reactions either to the left hand or right hand side, the selectivity coefficient for A/C ion exchange in reaction as show below:

$$K_{C/A} = \frac{[RC]^{ZC}[A]^{ZC}}{[C]^{ZA}[RA]^{ZC}}$$

The selectivity coefficient depends on experimental conditions and the value of the coefficient can vary in the range of a few orders of magnitude.

For trace ion exchange a useful measure for metal distribution is the distribution coefficient [Kd] which is defined by:

$$Kd = \frac{[RC]}{[C]} [ml/g]$$

Under the specific condition ion C is present at trace level than selectivity coefficient is defined as partially coefficient as follow:

$$Kd = \frac{[KC/AQZC]^{1/ZA}}{[A]^{ZC/ZA}}$$

The Kd values are thus independent of trace ion concentration [C] and inversely proportional to $[A]^{ZC/ZA}$. Although in general the experimental conditions, such as metal concentration and pH have a strong effect on the distribution coefficient. The Kd values can be used as a comparative measure of the efficiencies of various exchange and sorbents.

Determination of Kd values for heavy metal ions on GAAR :

Chelation of Zinc(II) ion on Guar gum Ascorbic Acid (GAA) resin

In different glass stoppered conical flask appropriate amount of 0.2 M sodium acetate and 0.2 M acetic acid were added to get the buffers of desired pH i.e 2 to 7. similarly in other glass stoppered conical flask appropriate amount of 0.2 M NH₄OH and 0.1 M NH₄Cl were also added to get the pH 8.0. Amount of 0.070 gm of dry resin and 1ml of 1000 ppm Zn (II) solution was added to each flask. The content were equilibrated by magnetic stirrer for 1 hour and thenfiltered. The filtrates were analyzed by AAS for zinc .The results are given in Table 2.

рН	Absorbance	Concentration (ppm)	Metal ions in filtrate (mg)	Metal ions in resin (mg)	Kd value	% Absorption of metal ion by resin	IEC (mg/g)
2	0.363	8.67	0.3558	0.6442	1061.45	64.42	9.20
3	0.289	6.65	0.2727	0.7273	1562.40	72.73	10.38
4	0.301	5.40	0.2218	0.7782	2058.73	77.82	11.11
5	0.146	3.47	0.1535	0.8465	3484.97	84.65	12.09
6	0.059	1.47	0.0604	0.9396	9131.19	93.96	13.42
7	0.275	6.21	0.2547	0.7453	1714.51	74.53	10.64
8	0.450	10.72	0.4398	0.5602	779.24	56.02	8.35

Table 2: Chelation of Zinc(II) ion on Guar gum Ascorbic Acid (GAA) resin

Chelation of Iron (II) ion on Guar gum Ascorbic Acid (GAA) resin

In different glass stoppered conical flask appropriate amount of 0.2 M sodium acetate and 0.2 M acetic acid were added to get the buffers of desired pH i.e 2 to 7. similarly in other glass stoppered conical flask appropriate amount of 0.2 M NH₄OH and 0.1 M NH₄Cl were also added to get the pH 8.0. Amount of 0.070 gm of dry resin and 1 ml of 1000 ppm Fe(II) solution was added to each flask. The content were equilibrated by magnetic stirrer for 1 hour and then filtered. The filtrates were analyzed by AAS for iron .The results are given in Table 3.

рН	Absorbance	Concentration (ppm)	Metal ions in filtrate (mg)	Metal ions in resin (mg)	Kd value	% Absorption of metal ion by resin	IEC (mg/g)
2	0.270	13.65	0.560	0.44	460.49	44.00	6.28
3	0.213	10.48	0.430	0.57	776.99	57.00	8.14
4	0.194	9.48	0.389	0.611	920.73	61.10	8.72
5	0.137	7.17	0.294	0.706	1406.65	70.60	10.08
6	0.249	11.56	0.474	0.526	872.46	52.60	10.08
7	0.318	15.46	0.634	0.366	338.19	36.60	5.22
8	0.342	15.62	0.641	0.359	328.33	35.90	5.12

Table 3: Chelation of Iron (II) ion on Guar gum Ascorbic Acid (GAA) resin

It was observed that Kd values for Fe(II) on GAA resin increases with pH, with a maximum value at pH 5.0.

Chelation of copper (II) ion on Guar gum Ascorbic (GAA) resin

In different glass stoppered conical flask appropriate amount of 0.2 M sodium acetate and 0.2 M acetic acid were added to get the buffers of desired pH i.e 2 to 7. Similarly in other glass stoppered conical flask appropriate amount of 0.2 M NH₄OH and 0.1 M NH₄Cl were also added to get the pH 8.0. Amount of 0.070 gm of dry resin and 1 ml of 1000 ppm Cu(II) solution was added to each flask .The content were equilibrated by magnetic stirrer for 1 hour and then filtered. The filtrates were analyzed by AAS for copper .Theresults are given in Table 4

рН	Absorbance	Concentration	Metal	Metal	Kd	% Absorption	IEC
		(ppm)	ions in	ions in	value	of metal ion by	(mg/g)
			filtrate	resin		resin	
			(mg)	(mg)			
2	0.512	16.04	0.658	0.342	304.59	34.2	4.88
3	0.388	12.95	0.531	0.469	517.37	46.9	6.69
4	0.260	8.07	0.331	0.669	1184.28	66.9	9.55
5	0.247	7.80	0.320	0.680	1245.42	68.0	9.71
6	0.278	8.63	0.354	0.646	1069.35	64.6	9.22
7	0.334	10.31	0.4230	0.577	799.50	57.7	8.24
8	0.571	17.82	0.731	0.269	215.64	26.9	3.84

 TABLE 4: Kd value of Cu(II) metal ion on Guar gum Ascorbic (GAA) resin

Inference:

It was observed that Kd values for Cu (II) on GAA resin increases with pH, with a maximum value at pH 5.0.

Chelation of lead (II) ion on Guar gum Ascorbic (GAA) resin

In different glass stoppered conical flask appropriate amount of 0.2 M sodium acetate and 0.2 M acetic acid were added to get the buffers of desired pH i.e 2 to 7.Similary in other glass stoppered conical flask appropriate amount of 0.2 M NH₄OH and 0.1 M NH₄Cl were also added to get the pH 8.0. Amount of 0.070 gm of dry resin and 1 ml of 1000 ppm Pb solution was added to each flask . The content were equilibrated by magnetic stirrer for 1 hour and then filtered. The filtrates were analysed by AAS for lead .The results are given in Table 5.

TABLE 5 :Kd value of Pb(II)	metal ion on Guar gum	Ascorbic ((GAA)) resin
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рН	Absorbance	Concentration (ppm)	Metal ions in filtrate (mg)	Metal ions in resin (mg)	Kd value	% Absorption of metal ion by resin	IEC (mg/g)
2	0.487	13.90	0.571	0.429	440.90	42.9	6.12
3	0.142	7.80	0.323	0.677	1239.92	67.7	9.67
4	0.120	4.87	0.201	0.799	2343.79	79.9	11.41
5	0.078	4.07	0.167	0.833	2923.83	83.3	11.89
6	0.178	7.80	0.321	0.679	1243.58	67.9	9.69
7	0.346	10.97	0.453	0.547	712.33	54.7	7.81
8	0.430	12.43	0.515	0.485	557.40	48.5	6.92

Inference:

It was observed that Kd values for Pb(II) on GAA resin increases with pH, with a maximum value at pH 5.0

Chelation of Cadmium (II) ion on Guar gum Ascorbic Acid (GAA) resin

In different glass stoppered conical flask appropriate amount of 0.2 M sodium acetate and 0.2 M acetic acid were added to get the buffers of desired pH i.e 2 to 7.Similary in other glass stoppered conical flask appropriate amount of 0.2 M NH₄OH and 0.1 M NH₄Cl were also added to get the pH 8.0. Amount of 0.070 gm of dry resin and 1 ml of 1000 ppm Cd solution was added to each flask .The content were equilibrated by magnetic stirrer for 1 hour and then filtered. The filtrates were analyzed by AAS for cadmium .The results are given in Table 6

рН	Absorbance	Conc.	Metal ions in filtrate (mg)	Metal ions in	Kd	% Absorption	IEC (mg/g)
		(ppm)	intrate (ing)	resin (ing)	value	resin	(mg/g)
2	0.468	11.70	0.480	0.520	634.92	52.0	7.42
3	0.462	10.51	0.431	0.569	773.41	56.9	8.12
4	0.356	8.78	0.360	0.640	1041.32	64.0	9.14
5	0.213	5.17	0.212	0.788	2177.39	78.8	11.25
6	0.107	3.17	0.130	0.870	3920.68	87.0	12.42
7	0.349	8.34	0.342	0.658	1127.09	65.8	9.39
8	0.478	10.73	0.440	0.560	745.57	56.0	7.99

 TABLE 6: Kd value of Cd(II) metal ion on Guar gum Ascorbic Acid (GAA)resin
 Image: Comparison of Cd(II) metal ion on Guar gum Ascorbic Acid (GAA)resin

Inference:

It was observed that Kd values for Cd (II) on GAA resin increases with pH, with a maximum value at pH 6.0

BINARY SEPERATION

Ion exchange is used for removing metal ions from solutions. Most of ion exchange operation are carried out in column. We have attempted the separation of mixture of inorganic metal ions on resin on the basis of their distribution coefficient values obtained at various pH by batch method.

In the column, a glass tube with 1.6 cm internal diameter .The resin was swelled in DMF. The swollen resin was allowed to settle in order to form a homogeneous layer. The height of column was about 4-5cm and resin about 5.0 gm was used.

PROCEDURE

The column was washed with de ionized water and water was rejected. The mix of two metal ions was poured into the column. The loaded metal ions were eluent quantitatively with different strength of acids. The quantity of individual metal ions were then determined in the eluent by AAS (Atomic Absorption Spectrophotometer).

Separation of mixture of Zn(II) and Cu(II) on Guar gum Ascorbic Acid (GAA) resin

A column was packed with 2.0 gm of swollen resin. The column was equilibrated with NH₄OH –NH₄Cl buffer at pH 9.0. An amount 20 ml of mixture containing 10 ml of Cu(II) and 10 ml of Zn(II) were loaded on the column .The rate of flow was controlled at 2 ml/min. The column was washed with same buffer solution and the sorbet metal ions were eluted with 0.1 N HCl. 5.0 ml of fraction were collected and were analysed for concentration of Cu(II) by AAS. The result were given in Table 7

S.No.	Concentration (ppm)	Absorbance
1	1	0.093
2	2	0.184
3	3	0.285
4	4	0.375
5	5	0.473
6	6	0.581

TABLE 7: Absorbance of standard Zinc solution

The calibration curve show in Fig.5



Fig. 5 Calibration curve for standard solution of Zn(II)

S.No.	Volume of eluent(ml)	Absorbance	Concentration (meq/gm)
1	5	0.00	0.00
2	10	0.02	0.00
3	15	0.02	0.05
4	20	0.05	0.10
5	25	0.08	0.012
6	30	0.012	0.020
7	35	0.029	0.065
8	40	0.057	0.156
9	45	0.058	0.267
10	50	0.061	0.356
11	55	0.014	0.029
12	60	0.008	0.023
13	65	0.004	0.015
14	70	0.001	0.000
15	75	0.00	0.00
16	80	0.00	0.00

TABLE 8: Concentration of Zn(II) in meq/gm

TABLE 9: Absorbance of standard Copper solution

S.No.	Concentration (ppm)	Absorbance
1	1	0.123
2	2	0.241
3	3	0.365
4	4	0.486
5	5	0.608
6	6	0.725

The calibration curve show in Fig.6



Fig. 6 Calibration curve for standard solution of Cu(II)

S. No.	Volume of eluent (ml)	Absorbance	Concentration
			(meq/gm)
1	5	0.00	0.00
2	10	0.02	0.00
3	15	0.02	0.00
4	20	0.05	0.100
5	25	0.08	0.014
6	30	0.012	0.026
7	35	0.029	0.028
8	40	0.057	0.034
9	45	0.058	0.046
10	50	0.061	0.511
11	55	0.074	0.532
12	60	0.089	0.674
13	65	0.124	0.0769
14	70	0.001	0.016
15	75	0.00	0.012
16	80	0.00	0.000

TABLE 10: Concentration of Cu(II) in meq/gm

The column separation of Zn(II) and Cu(II) is given in Fig 7



RESULT AND DISCUSSION

Ion exchange capacity of guar gum ascorbic acid (GAA) resin is found as 4.54 m mol/g of the dry form, this observation show that these resins have high ion exchange capacity.

The molar distribution coefficient 'Kd' and adsorption of metal ions Cu(II), Fe(II), Zn(II), Cd (II), Pb(II) with guar gum ascorbic acid (GAA) resin at the pH of their maximum adsorption follows the following sequence :

Metal ions : Cd⁺²> Pb⁺²> Zn⁺²> Fe⁺²> Cu⁺² Kd value: 3920.68 > 2923.83 > 2853.70 > 1406.65 > 1245.42

CONCLUSION

The synthesized resins of guar gum polysaccharide was very useful and suitable for removal of heavy toxic metal ions from industrial effluents. Removal of such toxic metal ions like Zn(II), Cu(II), Cd(II). Pb(II), Fe(II) by guar gum ascorbic acid (GAA) resin is now extra considered one of the most active and promising techniques due to its biodegradable nature, little cost and rapidness, because most of the resins which prepared by di-viny benzene styrene backbone and petrochemical are hydrophobic, very costly and not as eco-friendly as they were.

The natural polysaccharide resins are hydrophilic backbone and low cost. Polysaccharide based cation ion exchange resin are more effective, efficient and compatible for the separation and concentration of metal ions in solution, recovery of metal ions from industrial waste, mineral, textile and metallurgical industries.

ACKNOWLEDGEMENT

I pay respect against HOD Department of Chemistry, my supervisor and all other teaching staff. I acknowledge all the non teaching staff member of department of chemistry who directly and indirectly help during my research work.

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CITATION OF THIS ARTICLE

S Nagar, A V Singh, S Gaur, J S Rathore. Synthesis and Characterization of Gaurgum Ascorbic Acid Resin (GAAR) for Deletion of Toxic Heavy Metal Ions From Industrial Discharges. Bull. Env. Pharmacol. Life Sci., Vol 9[11] October 2020 : 77-88