

Synthesis, Characterization and Study of ion-exchange properties of terpolymer resin derived from phenyl salicylate- 4,4'-diaminodiphenyl sulphone with formaldehyde (PS4,4'DADPSF-I)

M.B.Dewase¹, R.N.Singru² and M.I.M.Siddique³

Department of Chemistry

¹Sarvodaya Mahavidyalaya Sindewahi, Chandrapur, Maharashtra, India,

²Tai Golwalkar Mahavidyalay, Ramtek, Nagpur, Maharashtra, India,

³Institute of Science Nagpur, Maharashtra, India,

Abstract: *Terpolymer resin (PS4,4'DADPSF-I) synthesized by the condensation phenyl salicylate 4,4'-diaminodiphenyl sulphone with formaldehyde in the presence of acid catalyst and using 1:1:2 molar proportions of the reacting monomers, was proved to be selective chelating ion-exchange copolymer for certain metals. The chelating ion-exchange properties of this copolymer were studied for Fe (III), Cu (II), Ni (II), Co (II), Zn (II), Cd (II) and Pb (II) ions in the form of their metal nitrate solutions. A batch equilibrium method was employed in the study of the selectivity of metal ion uptake involved in the measurements of the distribution of a given metal ion between the copolymer sample and a solution containing the metal ion. The study was carried out over a wide pH range, shaking time and in media of various ionic strengths of different electrolytes. The copolymer showed a higher selectivity for Fe (III), Cu (II), and Ni (II) ions than for Co (II), Zn (II), Cd (II) and Pb (II) ions. Distribution ratios (D) of metal ions were found to be increased by increasing pH of the solutions; hence the resin can be used to recover certain metal ions from waste solutions and used for the purpose of purification of waste water and removal of iron from boiler water. The ion-exchange capacity of metal ions has also been determined experimentally and compare with other commercial resins. The morphology of the copolymer was studied by scanning electron microscopy (SEM); showing amorphous nature of the resin therefore can be used as a selective ion-exchanger for certain metal ions.*

Keywords: Adsorption, degree of polymerization (DP), ion exchangers, metal-polymer complexes, resins, selectivity.

I. INTRODUCTION

Ion-exchange technique can remove traces of ionic impurities from water/process liquors and gives out a product of ultra pure quality in a simple efficient and techno-economically viable manner. Ion exchangers are widely used in analytical chemistry, hydrometallurgy, antibiotic purification and separation of radioisotopes and find large applications in water treatment and pollution control [1, 2]. Various hydroxyl benzoic acid-formaldehyde and 4-hydroxyacetophenone-biuret- formaldehyde copolymers have been reported and found use as ion-exchangers [3-5].

In an earlier communication [6-8] from this department a number of such copolymers have been reported. However, no work has been carried out on the synthesis, characterization and ion-exchange properties of the copolymer resin-IV from 8-hydroxyquinoline5-sulphonic acid, oxamide and formaldehyde. The purpose of present study, is to explore the adsorption behavior of seven metal ions Fe²⁺, Cu²⁺, Ni²⁺, CO²⁺, Zn²⁺, Cd²⁺ and Pb²⁺ on the newly synthesized copolymer resin 8-HQ5-SAOF –IV at different pH values, different concentrations of different electrolytes and at different shaking time intervals. The adsorption behavior of these metal ions is based on the affinity differences towards the chelating resins as functions of pH, electrolyte concentrations and shaking time. The copolymer resin under investigations is found to be cation exchanger having both ion-exchange group and chelating group in the same polymer matrix and the resin can be used selectively for the purpose of purification of waste water. One of the important applications of chelating and functional polymer is its capability to recover metal ions from waste solution. Hence the chelating ion exchange property of the 8-HQ5-SAOF –IV copolymer resin was also reported for specific metal ions. The result of this study will provide a group of functional data for the isolation of trace and ultra trace metal ions from various samples.

Pollution by toxic heavy metals due to their toxicities in relatively low concentration and tendency to bioaccumulation in the ecosystem, agriculture, and human body has received wide spread attention in recent years. Various approaches such as ion-exchange, reverse osmosis, electro dialysis, re-precipitation, and adsorption techniques have been developed for the removal and recovery of the

metal ions from sewage and industrial wastewater. Among these techniques, many research works have focused on metal ions removal by adsorption on chelating polymers, because they are reusable, easily separable, and with higher adsorption capacity and selectivity having physical and chemical stabilities [9, 10].

The present paper has been described the development of a novel ion-exchanger resin process suitable for the desalination of waste water which is high in Fe (II), Ni (II) and Cu (II) ions, to meet effluent discharge specifications. Ion Exchange column of 8-HQ5-SAOF –IV copolymer resin can be used for removal of the iron, nickel and copper metal ions as well as suspended solids in waste water. It can also be used in the removal of iron from boiler water in industries [11]. There are many useful reports on ion-exchange separation methods in chemical processes [12, 13, 14].

II. MATERIALS AND METHODS

Materials

The chemicals used were all of A.R. or chemically pure grade and are procured from the market.

Synthesis of PS4,4'DADPSF -I terpolymer resin

This terpolymer resin was synthesized by condensing a mixture of reacting monomers, phenyl salicylate (2.14 g, 0.1 mol), 4,4'diaminodiphenyl sulphone (2.48 g, 0.1 mol) and formaldehyde (7.4 ml, 0.2 mol) in presence of 2M (200ml) HCl as catalyst by molar ratio of 1:1:2, in a round bottom flask fitted with water condenser and heated in an oil bath at $135^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for seven hours with occasional shaking to ensure thorough mixing. The temperature of electrically heated oil bath was controlled with the help of dimmer stat. The yellow resinous product obtained was immediately removed from the flask as soon as reaction was over and then purified it into beaker containing ice cold water. The product so obtained was further purified by reprecipitation technique. The yield of the terpolymer resin was found to be 80%. The reaction is given as below in Fig. 1.

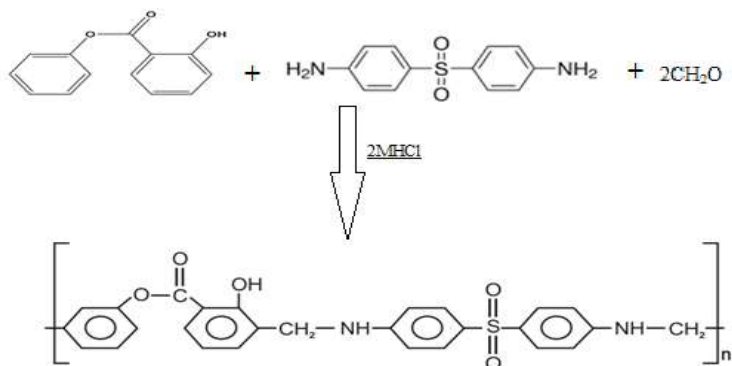


Fig.1: Reaction and Suggested Structure of Representative PS4,4'DADPSF-I Terpolymer Resin

III. ION-EXCHANGE PROPERTIES

Batch equilibrium technique developed by Gregor et al and De Geiso et al were used to study ion exchange properties of 8-HQ5-SAOF –IV copolymer resin. The results of the batch equilibrium study carried out with the copolymer 8-HQ5-SAOF –IV is presented in Fig.3-6. Seven metal ions Fe^{3+} , Cu^{2+} , Ni^{2+} , Co^{2+} , Zn^{2+} , Cd^{2+} and Pb^{2+} in the form of aqueous metal nitrate solution were used. The experiments were repeated for six times and the mean standard deviations were calculated at different concentrations, shaking times and pH of the solutions and have been found to be as follows.

At different concentrations

Metal ions	Fe^{3+}	Cu^{2+}	Ni^{2+}	Co^{2+}	Zn^{2+}	Cd^{2+}	Pb^{2+}
Standard Mean deviation	0.45	0.81	0.89	0.41	0.79	0.70	0.71

At different shaking times

Metal ions	Fe^{3+}	Cu^{2+}	Ni^{2+}	Co^{2+}	Zn^{2+}	Cd^{2+}	Pb^{2+}
Standard Mean deviation	18.24	18.71	21.23	20.34	20.20	25.33	23.87

At different pH of the solutions

Metal ions	Fe^{3+}	Cu^{2+}	Ni^{2+}	Co^{2+}	Zn^{2+}	Cd^{2+}	Pb^{2+}
Standard Mean deviation	483.76	437.41	222.52	162.22	71.52	82.22	95.69

The study was carried out to investigate the following aspects.

1. Determination of metal uptake in the presence of various electrolytes of different concentrations.

- Determination of rate of metal uptake at different shaking time intervals.
- Determination of distribution of metal ion at different pH.

All experiments were carried out with purified and finely powdered resin sample under investigation at room temperature.

Determination of metal uptake in the presence of various electrolytes and different concentration

The copolymer sample (25 mg) was suspended in an electrolyte solution (25 ml) of known concentration. The pH of the suspension was adjusted to the required value by using either 0.1M HNO₃ or 0.1M NaOH. The suspension was stirred for 24 hrs at 30°C. To this suspension 2 ml of 0.1M solution of the metal ion was added and the pH was adjusted to the required value. The mixture was again stirred at 30°C for 24 hrs. The polymer was then filtered off and washed with distilled water. The filtrate and the washing were collected and then the amount of metal ion was estimated by titrating against standard EDTA (ethylene diamine tetra-acetic acid) at the same pH (experimental reading). The same titration has been carried out without polymer (blank reading). The amount of metal ion uptake of the polymer was calculated from the difference between a blank experiment without polymer and the reading in the actual experiments. The experiment was repeated in the presence of several electrolytes [15, 16]. Metal ion, its pH range, buffer used, indicator used and color change are given in Table 1. The metal ion uptake can be determined as,

Metal ion adsorbed (uptake) by resin = (X-Y) Z millimols / gm.

Where,

'Z' ml is the difference between actual experimental reading and blank reading.

'X' mg is metal ion in the 2ml 0.1M metal nitrate solution before uptake.

'Y' mg is metal ion in the 2ml 0.1M metal nitrate solution after uptake.

By using this equation the uptake of various metal ions by resin can be calculated and expressed in terms of millimols per gram of the copolymer.

Table 1
Data of experimental procedure for direct EDTA titration

Metal Ion	pH range	Buffer used	Indicator used	Colour change
Fe(III)	2-3	Dil.HNO ₃ /dil.NaOH	Variamine blue	Blue-Yellow
Cu(II)	9-10	Dil.HNO ₃ /dil.NaOH	Fast sulphone black	Purple-Green
Ni(II)	7-10	Aq.NH ₃ /NH ₄ Cl	Murexite	Yellow-Violet
Co(II)	6	Hexamine	Xylenol orange	Red-Yellow
Zn(II)	10	Aq.NH ₃ /NH ₄ Cl	Salochrom black	Wine Red-Blue
Cd(II)	5	Hexamine	Xylenol orange	Red-Yellow
Pb(II)	6	Hexamine	Xylenol orange	Red-Yellow

Estimation of rate of metal ion uptake as function of time

In order to estimate the time require to reach the state of equilibrium under the given experimental conditions, a series of experiments of the type described above were carried out, in which the metal ion taken up by the chelating resin was determined from time to time at 30°C (in the presence of 25ml of 1M NaNO₃ solution). It was assumed that, under the given conditions, the state of equilibrium was established within 24 hrs [17]. The rate of metal uptake is expressed as percentage of the amount of metal ions taken up after a certain time related to that at the state of equilibrium and it can be defined by the following relationship.

The percent amount of metal ions taken up at different time is defined as.

$$\text{Percentage of amount of metal ion taken up at different time} = \frac{\text{Amount of metal ion adsorbed}}{\text{Amount of metal ion adsorbed at equilibrium}} \times 100$$

Percentage of metal ion adsorbed after 1 hr = (100X) / Y

Where,

'X' mg of metal ion adsorbed after 1 hr and 'Y' mg of metal ion is adsorbed after 25 hrs, then by Using this expression, the amount of metal adsorbed by polymer after specific time intervals was calculated and expressed in terms of percentage metal ion adsorbed. This experiment was performed using 0.1M metal nitrate solution of Fe³⁺, Cu²⁺, Ni²⁺, Co²⁺, Zn²⁺, Cd²⁺ and Pb²⁺.

Evaluation of the distribution of metal ions at different pH

The distribution of each one of the seven metal ions i.e., Cu (II), Ni (II), Co (II), Zn (II), Cd (II), Pb (II), and Fe (II) between the polymer phase and the aqueous phase was determined at 30°C and in the presence of 1M NaNO₃ solution. The experiments were carried out as described above at different pH values. The distribution ratio, D, is defined by the following relationship [18].

$$D = \frac{\text{Amount of metal ion on resin}}{\text{Amount of metal ion in solution}} \times \frac{\text{Volume of solution (ml)}}{\text{Weight of resin (g)}}$$

$$\text{Metal ion adsorbed (uptake) by the resin} = \left(\frac{ZX}{Y} \right) \frac{2}{0.025}$$

Where,

'Z' = is the difference between actual experiment reading and blank reading,

'C' = gm is the amount of metal ion in 2ml 0.1M metal nitrate solution,

'Y' = gm of metal ion in 2ml of metal nitrate solution after uptake.

IV. RESULTS AND DISCUSSION

4.1. Elemental analysis

The results of elemental analysis for carbon, hydrogen, nitrogen and oxygen content are shown in Table 1 used to assign empirical formula and empirical weight for PS4,4'DADPSF -I terpolymer. Composition of terpolymer was assigned on the basis of elemental analysis and was found to be in good agreement with that of calculated values.

Table 1: Elemental analysis data of PS4,4'DADPSF -I terpolymer

Terpolymer resin	% of carbon	% of hydrogen	% of nitrogen	% of sulphur	Empirical formula of repeated unit	Empirical formula weight
PS4,4'DADPSF-I	66.53 66.34	4.72 4.60	5.75 5.19	6.57 6.50	C₂₇H₂₃N₂O₅S	487

4.2. Infra-Red Spectra

The FT-IR spectrum of PS 4,4'DADPSF -I terpolymer has shown in Fig.2. A strong band appeared at 3645cm^{-1} which may be assigned due to free phenolic -OH. A broad and strong band appeared at 3367.2cm^{-1} which may be assigned due to the >NH stretching (sec. amine). A medium and sharp band displayed at 2924.3cm^{-1} may be assigned due to the stretching vibration of aromatic C-H group. A sharp band at 1703.3cm^{-1} indicates the presence of a -C=O stretching group. A sharp band appearing in the region of 1399.25cm^{-1} may be due to -S=O (sulphone) group. A medium band appearing at 1449.26cm^{-1} indicates the presence of -C=C- (aromatic) group. A strong band appeared in the region of 1251cm^{-1} which shows -C-O-C ester (aromatic) stretching. The presence of -C-N amine group due to medium peaks at 1144.2cm^{-1} . The methylene (-CH₂) bridge shows sharp and medium peaks for scissoring bending appeared at 1494.2cm^{-1} . A strong band appeared in the region of 761.3cm^{-1} that represents 1,2,3 trisubstituted strong bending C-H groups [4,19,21,24].

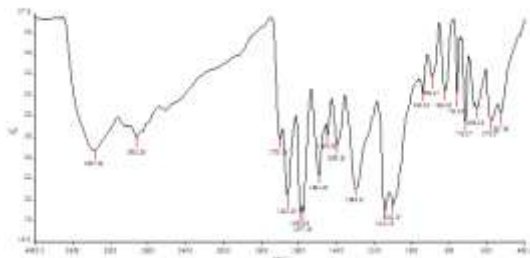


Fig. 3: Infra Red Spectra of PS 4,4'DADPSF-I Terpolymer Resin

4.3. ¹H-NMR spectra

¹H-NMR spectra is presented in Figure 4. The spectrum reveals different patterns of peaks, since each of them possesses a set of protons having different proton environment. The significant singlet signal appearing at the region of 8.05 ppm is due to metaproton of Ar-H. A singlet observed at 7.2 ppm is due to proton of Ar-SH (thiophenol). Amino proton of -CH₂-NH-CH₂- linkage gives singlet that is observed at 6.7 ppm. Amino proton of aromatic amine gives singlet at 6.5 ppm. Methylene proton of -NH-CH₂-CH₂- linkage gives triplet at 4.1 ppm. Singlet is observed at 2.5 ppm due to methylenic proton of Ar-CH₂-NH- linkage.

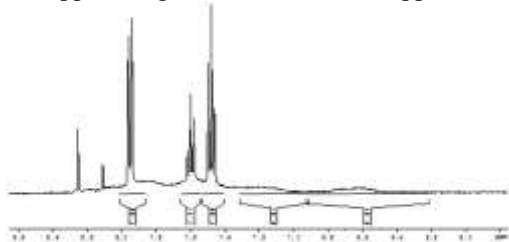


Fig. 4: ¹H NMR Spectra of PS 4,4'DADPSF-I terpolymer Resin

4.4. SEM analysis

The morphology of the reported resin sample PS 4,4'DADPSF-I was investigated by SEM at different magnification Scanning electron micrographs of terpolymer resin has been recorded at 1000X and 2000X magnification. The SEM exhibits spherulites with deep corrugation. At lower magnification the polymer shows spherulites and fridge model in which the crystals are arranged smaller in area with more closely packed structure. This indicates the crystalline nature of the polymer. The spherulites are typical crystalline formation and they grow in high viscous and concentrated solution at high magnification. The spherulites morphology of resin exhibit crystalline structure with deep corrugation which is clearly visible in SEM photographs of resin. These evidences indicate that more or less the resin shows amorphous character with less close packed surface having deep pits. The resin thus possesses amorphous and crystalline nature showing higher exchange capacity for metal ions .

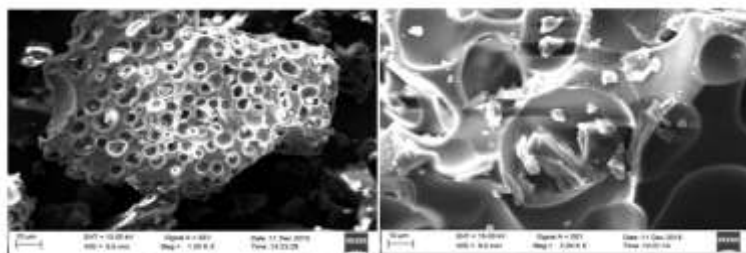


Fig. 5: SEM Micrographs of PS 4,4'DADPSF-I Terpolymer Resin

4.5. Ion-exchange properties

Batch equilibrium technique developed by Gregor et al and De Geiso et al was used to study ion exchange properties of PS4,4'DADPSF -I terpolymer resin. The results of the batch equilibrium study carried out with the terpolymer PS4,4'DADPSF -I have been presented in Fig. 6 to 9.

The ion exchange study was carried out using three experimental variables:

- Electrolyte and its ionic strength
- Uptake time and
- The pH of the aqueous medium

Among these three variables, two were kept constant and only one was varied at a time to evaluate its effect on metal uptake of the copolymer similar to the earlier co-workers [20-22]. The details of experimental procedure are given below.

Effect of electrolyte and its ionic strength on metal uptake

We examined the influence of NO_3^- and SO_4^{2-} at various concentrations on the equilibrium of metal-resin interaction. Fig. 6 and 7 shows that the amount of metal ions taken up by a given amount of copolymer depends on the nature and concentration of the electrolyte present in the solution.

In the presence of nitrate ions, the uptake of Fe(III), Cu(II) and Ni(II) ions increase with increasing concentration of the electrolytes, whereas in the presence of sulphate ions the amount of the above mentioned ions taken up by the copolymer decreases with increasing concentration of the electrolyte [20, 21,22]. Moreover, the uptake of Co (II), Zn (II), Cd (II) and Pb (II) ions increase with decreasing concentration of the sulphate ions. This may be explained on the basis of the stability constants of the complexes with those metal ions [21]. The ratio of physical core structure of the resin is significant in the uptake of different metal ions by the resin polymer. The amount of metal ion uptake by the PS4,4'DADPSF -I terpolymer resin is found to be higher when comparing to the other polymeric resins [22, 23].

Estimation of the rate of metal ion uptake as a function of time

The rate of metal adsorption was determined to find out the shortest period of time for which equilibrium could be carried to while operating as close to equilibrium conditions as possible. Fig. 8 shows the dependence of the rate of metal ion uptake on the nature of the metal. The rate refers to the change in the concentration of the metal ions in the aqueous solution which is in contact with the given polymer. The result shows that the time taken for the uptake of the different metal ions at a given stage depends on the nature of the metal ion under given conditions. It is found that Fe (III) ions require about 3hrs for the establishment of the equilibrium, whereas Cu (II), Ni (II), Co (II) and Zn (II) ions required about 5 or 6 hrs [24]. Thus the rate of metal ions uptake follows the order $\text{Cu (II)} > \text{Ni (II)} > \text{Co (II)} \approx \text{Zn (II)} > \text{Cd (II)} > \text{Pb (II)}$ for all of the copolymers [25]. The rate of metal uptake may depend upon hydrated radii of metal ions. The rate of uptake for the post transition metal ions exhibit other trend for Cd (II), the rate of uptake is in the comparable that of Pb (II) because of difference in 'd' orbital.

Distribution ratios of metal ions at different pH

The effect of pH on the amount of metal ions distributed between two phases can be explained by Fig. 9. The data on the distribution ratio as a function of pH indicate that the relative amount of metal ion taken up by the PS4,4'DADPSF -I copolymer increases with increasing pH of the medium [25].The magnitude of increase, however, is different for different metal cation. The study was carried from pH 1.5 to 6.5 to prevent hydrolysis of metal ions at higher pH. For metal ion Fe^{3+} the highest working pH is 3,

where distribution ratio is medium, since Fe³⁺ forms octahedral complex with electrolyte ligand, showing crowding effect (steric hindrance), which may lower the distribution ratio of Fe³⁺ ions. The value of distribution ratio at particular pH thus depends upon the nature and stability of chelates with particular metal ion. The data of distribution ratio show a random trend in certain cases [26]. This may be due to the amphoteric nature of the PS4,4'DADPSF -I resin.

From the result it reveals that with decrease in atomic number, the ion uptake capacity is increased. In case of Cd (II) and Pb (II) purely electrostatic factors are responsible. The ion uptake capacity of Cd (II) is lower owing to the large size of its hydrated ion than that of Cu (II). The steric influence of the methyl group and hydroxyl group in PS4,4'DADPSF -I resin is probably responsible for their observed low binding capacities for various metal ions. Therefore the polymer under study has more selectivity of Cu²⁺ and Ni²⁺ ions at pH 4.0 to 6.0 then other ions which form rather weak complex. While at pH 3 the copolymer has more selectivity of Fe³⁺ ions. The order of distribution ratio of metal ions measured in pH range 2.5 to 6.5 is found to be Fe (III) > Cu (II) > Ni (II) > Zn (II) > Co (II) > Pb (II) > Cd (II). Thus the results of such type of study are helpful in selecting the optimum pH for a selective uptake of a particular metal cation from a mixture of different metal ions [26].

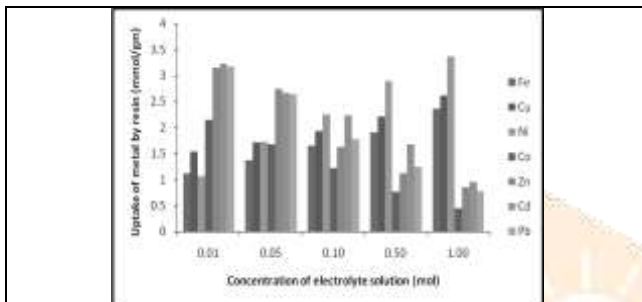


Fig.6 Uptake of several metal ions by PS4,4'DADPSF -I copolymer resin at five different concentrations of electrolyte NaNO3 solution

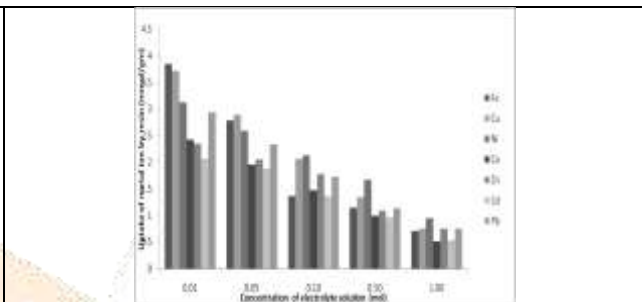


Fig.7 Uptake of several metal ions by 8-PS4,4'DADPSF -I copolymer resin at five different concentrations of electrolyte Na2SO4 solution

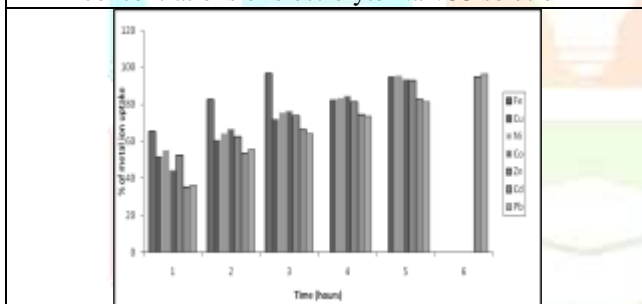


Fig.8 Comparison of the rate of metal ion uptake by PS4,4'DADPSF -I copolymer resin at different pH

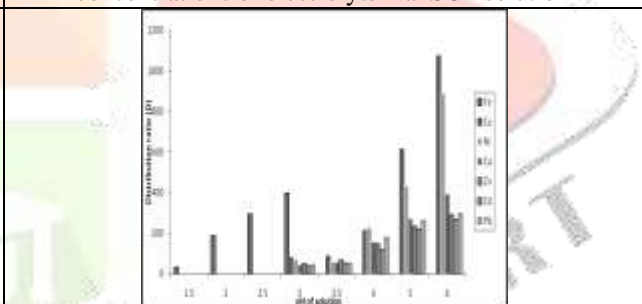


Fig.9 Comparison of the rate of metal ion uptake by PS4,4'DADPSF -I copolymer resin

4.6. Ion-exchange capacity

The term ion exchange capacity is intended to describe the total available exchanged capacity of an exchange resin, as described by the number of functional group on it. Ion exchange capacity was determined by following experimental procedure.

25 mg of resin sample was suspended in 50 ml of double distilled water; to this add 25 ml of 0.5 M sodium acetate solution. The mixture has been stirred for 2 to 5 min. when H⁺ from resin liberated in the solution to form acetic acid and adsorbed sodium ion (Na⁺). Then the solution was filtered and the filtered is titrated with 0.5 M NaOH solution.

The ion-exchange capacity can be calculated by using following equation, in milli mole per gram (mili mol.g⁻¹)

$$\text{Ion-exchange capacity of terpolymer resin} = XY / Z$$

Where, X = molarity of NaOH, Y = volume of NaOH required during titration, Z = Weight of the exchanger

The ion exchange capacity (IEC) is a fundamental and important quantity for the characterization of any ion exchange material. The ion exchange capacity of PS4,4'DADPSF -I terpolymer has been calculated, which was found to be 4.8 mill mol g⁻¹ which indicates that PS4,4'DADPSF -I terpolymer resin is better ion exchanger than commercial phenolic and some polystyrene commercial ion exchangers.

Trade Name	Functional Group	Polymer Matrix	Ion-exchange Capacity (mmol.g ⁻¹)
Amberlite IR-120	-C ₆ H ₄ SO ₃ H	Polystyrene	5.0-5.2
Duolite C-3	-CH ₂ SO ₃ H	Phenolic	2.8-3.0

Amberlite IRC-50	-COOH	Methacrylic	9.5
Duolite ES-63	-OP(O) (OH) ₂	Polystyrene	6.6
Zeocarb-226	-COOH	Acrylic	10.00
Dowex-1	-N(CH ₃) ₃ Cl	Polystyrene	3.5
Amberlite IRA-45	-NR ₂ , -NHR, -NH ₂	Polystyrene	5.6
Dowex-3	-NR ₃ , -NHR, -NH ₂	Polystyrene	5.8
Allassion A WB-3	-NR ₂ , -N ⁺ R ₃	Epoxy-Amine	8.2

For the strongly acidic cation exchange resin such as cross linked polystyrene sulphonic acid resins, the ion exchange capacity is virtually independent of the pH of the solutions. For weak acid cation exchangers, such as those containing carboxylate group, ionizations, occurs only in alkaline solution. Similarly weakly basic cation exchanger does not work above pH-9.

V. NOVELTY OF THE PRESENT STUDY

The copolymer resin under investigations is found to be cation exchanger having both ion-exchange group and chelating group in the same polymer matrix and the resin can be used selectively for the purpose of purification of waste water. One of the important applications of chelating and functional polymer is its capability to recover metal ions from waste solution. Hence the chelating ion exchange property of the PS4,4'DADPSF -I terpolymer resin was also reported for specific metal ions.

The present paper has been described the development of a novel ion-exchanger resin process suitable for the desalination of waste water which is high in Fe (III), Ni (II) and Cu (II) ions, to meet effluent discharge specifications. Ion Exchange column of PS4,4'DADPSF -I terpolymer resin can be used for removal of the iron, nickel and copper metal ions as well as suspended solids in waste water. It can also be used in the removal of iron from boiler water in industries. The resin can also be used for the removal of iron and zinc from brass.

The strength of ion exchange capacities of various resins can be studied by comparing their ion exchange capacities. The ion exchange capacity (IEC) is a fundamental and important quantity for the characterization of any ion exchange material. It is defined as the amount of ion that undergoes exchange in a definite amount of material, under specified experimental conditions. The ion exchange capacity of PS4,4'DADPSF -I terpolymer has been calculated. I. E.C. of PS4,4'DADPSF -I terpolymer resin was found to be 4.8 mmol g⁻¹, indicates that this terpolymer resin is better ion exchanger than commercial phenolic and some polystyrene commercial ion exchangers.

VI. CONCLUSION

A copolymer PS4,4'DADPSF -I based on the condensation reaction in the presence of acid catalyst was prepared. PS4,4'DADPSF -I is a selective chelating ion-exchange copolymer resin for certain metals. The copolymer resin showed a higher selectivity for Fe³⁺, Cu²⁺ and Ni²⁺ ions than for Co²⁺, Zn²⁺, Cd²⁺ and Pb²⁺ ions. The uptake of some metal ions by the resin was carried out by the batch equilibrium technique. The uptake capacities of metal ions by the copolymer resin were pH dependent. From the results of distribution coefficients, it can be observed that Cu (II) has higher value of distribution ratio. Due to considerable difference in the uptake capacities at different pH and media of electrolyte, the rate of metal ion uptake and distribution ratios at equilibrium, it is possible to use for separation of particular metal ions from their admixture.

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