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Anion Exchange Separation of some toxic metal ions like cadmium, mercury,lead, magnesium from other elements by using Dowex IR-45 (Cl^-).

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Abstract : *The exchange behavior of of Ni, Cd, Mn,Zn,Th,Hg,Al,Cu,Mg, Pb,Ca,and Co in aqueous acetone isobutyric acid on Dowex IR-45 Cl (-) form as an ion exchanger has been studied. The values of distribution coefficient have been evaluated and the optimum conditions of metal ions separations determined. The results of few satisfactory binary and tertiary mixture separations are presented.*

I. INTRODUCTION

Carboxylic acids have proved to be useful as the media for the ion exchange separations of the metal ions [1-4]. Cation and anion exchange studied of twenty cations in aqueous cations of formic,oxalic,tartaric acids and citric acids were carried out by Qureshi et al [5]. The distribution coefficients for Ni (II), Hg(II), Cu(II), Ca(II), Al(II), Cd(II), Mn(II) and Bi (II) were found out in aqueous acetone isobutyric acid on Dowex IR-45 Cl (-) form as an ion exchanger. The data are used for working out optimum conditions for the analytical separations of binary and tertiary systems.

II.EXPERIMENTAL

The ion exchanger used for all experiments is strongly basic anion exchange resin in chloride form.The exchanger commercially known as Dowex IR-45 (Cl^-), 20 to 50 mesh in chloride form has physical appearance golden yellow beads . The capacity and moisture content of the resin were 3.6 m eq /g and 20 % respectively.

All BDH chemicals of analytical grade . 0.05 M chlorides of metal ion solutions of Ni (II), Hg(II), Cu(II), Ca(II), Al(II), Cd(II), Mn(II) and Bi (II) were prepared in distilled water. Isobutyric acid in acetone ,water mixtures were prepared and molar strengths of the stock solutions confirmed volumetrically.

III.DETERMINATION OF DISTRIBUTION COEFFICIENTS

The distribution coefficients were determined by equilibrating 1 g of dry resin in the chloride form with 50 ml of the appropriate acetone water acetone isobutyric acid solutions together with 4 ml of the metal ion solution. The flask containing the mixture was stoppered and kept for 24 hrs. The metal ion content was then determined by suitable volumetric methods. The distribution coefficients KD were calculated from the formula.

$$K_D = \frac{\text{M eq metal per g of dry resin}}{\text{M eq. metal per ml solution}}$$

The findings of distribution coefficients in aqueous acetone isobutyric acid medium (1 M) are given below.

Table -1

Sr. no.	Acetone % , v/v -→	0	20	40	60	80
	Metal ion					
1	Ni(II)	1126	1126	1126	1070	1070
2	Cd(II)	1062	1296	1764	2444	4572
3	Mn(II)	540	744	904	1512	3132
4	Zn(II)	1023	1341	1341	2187	3334
5	Th(II)	663	972	1553	2292	4272
6	Hg(II)	2197	2408	4924	2370	12474
7	Al(II)	1413	1752	2124	2935	4674
8	Cu(II)	6507	6507	6507	8712	13122

9	Mg(II)	1203	1422	1728	2646	4674
10	Pb(II)	1927	1927	2097	3672	6507
11	Ca(II)	657	726	766	810	1039
12	Co(II)	920	920	1002	1048	1626

IV.ION EXCHANGE SEPARATIONS OF METAL IONS

The separations were carried out by using pyrex glass chromatographic columns having 50 ml capacity. The column was packed with a small wad of glass wool at the bottom and a slurry 7 ml water soaked resin was passed and allowed to settle by occasional tapping. After passing 20 ml of aqueous acetone IBA mixture at the maximum flow rate , the solution of binary, tertiary mixture of metal ions was added to the column. The effluents fractions at 5,10,30 ml as per requirement were collected and estimated by suitable titration method.

V.RESULTS AND DISCUSSION

It is observed that values of K_D of Ni, Hg, Cu, Ca, Al and Co are very low at all concentrations of acetone, particularly with increase of percentage of acetone at 1 M isobutyric acid , K_D values show increase. These findings indicate that the distribution coefficients are affected by changes in dielectric constants [7,8]. The presence of less polar solvents mixed with water enhances the extent of complete formation.[9,10]. The results of synthetic binary mixtures are reported in table -2.

Table 2 – Quantitative separation of synthetic binary mixtures.

Mixture	First metal ion eluted	Second metal ion eluted	Last metal ion ion eluted
		Cd	Mn
Ni + Cd / Mn	Ni = a	b	b
Hg + Cd / Mn	Hg = a	b	b
Cu + Cd / Mn	Cu = a	b	b
Ca + Cd / Mn	Ca = a	b	b
Al + Cd / Mn	Al = a	b	b
Co + Cd / Mn	Co = a	b	b
Pb + Mg/Mn	Pb=a	b	b

a = 40 % acetone- 1 M isobutyric acid medium.
b = 1 M chloroacetic acid medium.

Since Ni / Hg / Cu / Ca / Al / Co/Pb/Mg show very low values of KD at 40 % acetone + 1 M isobutyric acid medium , these elements are easily eluted by this medium first. Later, the other ions from synthetic mixture (Cd + Mn + Bi) are eluted by 1 M chloroacetic acid.

The various ions were eluted and the fractions of 5 -10 ml were collected and estimated. It was generally observed that the elution started quickly in first 10 ml (Break through Volume BTV). The elution is maximum at 30 -40 ml (Volume at Elution Peak VEP) and the elution is complete at 70 -80 ml (Terminal Elution Volume TEV) , as the flow rate is maintained 1 ml / min.

The recovery of each constituent metal is 90 to 95 %.

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