The behaviour of inorganic anions on papers loaded with anion-exchange resins

In a previous paper we have recorded the R_F values of numerous inorganic anions on Whatman weak anion exchange resin paper using N KCl and N KNO$_3$ as developing solvents[1]. Since many separations are possible we decided to extend this work to other papers loaded with anion-exchange resins which had become commercially

TABLE I

R_F VALUES OF INORGANIC ANIONS ON SEVERAL PAPERS LOADED WITH ANION-EXCHANGE RESINS USING N KNO$_3$ AS SOLVENT

Anion	Whatman weak anion-exchange resin paper	Amberlite WB-2 paper	Amberlite SB-2 paper
Chloride	0.57	0.52	0.66
Bromide	0.35	0.43	0.43
Iodide	0.10	0.24	0.12
Thiocyanate	0.07	0.16	0.10
Chlorate	0.48	0.45	0.49
Bromate	0.74	0.49	0.75
Iodate	0.95	0.33	0.88
Periodate	0.06	0	0.06
Nitrite	0.49	0.41	0.63
Selenite	0.90	0.39	0.89
Selenate	0.82–1	0.36	0.90
Tellurite	0.03–0.40	0	0.03–0.27
Thiosulphate	0.75	0.10	0.83
Chromate	0.18–0.57	0	0–0.17
Molybdate	0.63	0	0.18
Vanadate	0.08	0	0.05
Arsenite	0.84	0.79	0.79
Arsenate	0.89–1	0.48	0.88
Orthophosphate	0.90–1	0.42	0.92
Ferrocyanide	0.50	0	0.43
Ferricyanide	0	0	0

available in the meantime, namely the Amberlite resin papers WB-2 and SB-2 containing about 45 % of Amberlite IRC-50 and Amberlite IRA-400 respectively.

The Amberlite WB-2 paper was first neutralised with HCl, washed and then converted to the nitrate form. All papers were converted to the nitrate form by immersing the papers in 2 N KNO$_3$ for 30 min, washing with distilled water, repeating this process and drying at room temperature.

The solutions of the anions to be chromatographed were approximately 1.5 % to 2 % solutions of the alkali or ammonium salts in distilled water.

As shown in Table I there is little difference between the ion-exchange papers. However, the Amberlite WB-2 paper had a greater tendency to decomposition than the other two papers and yielded dark coloured spots with chromate, vanadate and molybdate.

Table II shows the R_F values with 0.1, 0.5 and 1 N KNO$_3$ on Amberlite SB-2 paper (strong base) and on ordinary cellulose paper. The latter was used to confirm that adsorption on cellulose is small for most ions. As was shown by KERTES AND

TABLE II

R_F VALUES OF INORGANIC ANIONS ON AMBERLITE SB-2 PAPER WITH 0.1 N, 0.5 N AND N KNO$_3$ SOLVENT

Anion	0.1 N KNO$_3$	0.5 N KNO$_3$	1.0 N KNO$_3$	R_F values with N KNO$_3$ on cellulose paper (Whatman No. 1)
Chloride	0.22	0.51	0.66	1
Bromide	0.10	0.33	0.43	1
Iodide	0.03	0.07	0.12	0.84
Thiocyanate	0.02	0.06	0.10	0.81
Chlorate	0.12	0.34	0.49	1
Bromate	0.28	0.60	0.75	1
Iodate	0.60	0.87	0.88	1
Periodate	0	0.05	0.07	1
Nitrite	0.21	0.49	0.63	1
Selenite	0.64	0.86	0.89	0.86
Selenate	0.19	0.80	0.90	1
Tellurite	0–0.25	0–0.25	0.03–0.27	0.34–0.86
Thiosulphate	0.08	0.43	0.83	1
Chromate	0.03	0.06	0–0.17	1
Molybdate	0–0.11	0–0.22	0.18	0–0.72–1
Vanadate	0	0	0.05	0.4–1
Arsenite	0.75	0.78	0.79	0.80
Arsenate	0.61	0.84	0.88	0.91
Orthophosphate	0.66	0.88	0.92	1
Ferrocyanide	0	0.03	0.43	1
Ferricyanide	0	0	0	1

LEDERER[2] the change of R_F value with the change of the normality of the eluting ion should obey an equation of the type:

$$n \log[\text{NO}_3] = \log\left(\frac{1}{R_F} - 1\right) + \text{const.}$$

providing that the anion-exchange equilibrium obeys the law of mass action.

When the results of Table II are plotted graphically (R_M [$= \log (1/R_F - 1)$] values *versus* the logarithm of the nitrate concentration) straight lines are obtained; however, the tangent of the line, which should indicate the valency of the anion, is practically the same for monovalent anions such as Cl$^-$, Br$^-$, I$^-$, SCN$^-$, ClO$_3^-$, BrO$_3^-$, IO$_4^-$ and NO$_2^-$ and for phosphate, arsenate, and arsenite, the values for the tangent being between 0.8 and 1.1. A lower tangent (0.57) for chromate and a higher one (1.76) for thiosulphate seems to indicate that in such solutions the charge on an anion cannot be determined from anion-exchange equilibria.

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Laboratorio di Cromatografia del C.N.R.,   L. OSSICINI
Istituto di Chimica Generale ed Inorganica,
          Rome (Italy)

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