CHEMISTRY LETTERS, pp. 875-876, 1973. Published by the Chemical Society of Japan

ION-EXCHANGE SEPARATION OF SODIUM AND POTASSIUM WITH COUNTER-CURRENT OF ELUENT AND ELECTROMIGRATION

Yoshihiro MORI, Tetsuo OOYASU, and Hiroyuki MATSUDA
Department of Chemistry, Faculty of Science, Shinshu University
3-1-1 Asahi, Matsumoto, Nagano 390

The translation of Na^+ with an eluent on strong electrolyte cation exchanger column is larger than that of K^+, but with electromigration smaller than that of K^+. An effective separation of Na^+ and K^+ may be expected with a simultaneous use of ion-exchange and electromigration. When an electric field[150 v(between electrodes), 3.3 mA] was applied on a strong electrolyte cation exchanger(Diaion PK-228) column(height; 10 cm, diameter; 1 cm) with parallel but reverse direction to the eluent(0.1 N NH_4Cl) flow, Na and K(each 0.5 meq) have been separated perfectly by the elution.

The simultaneous use of ion-exchange and electromigration in the vertical and the horizontal directions, respectively, has been reported already for continuous isotope enrichment.1)2) Now, the separations of sodium and potassium were attempted by a simultaneous use of ion-exchange and electromigration in vertical but reverse directions. It is well known that the potassium affinities for a strong electrolyte cation exchanger from relatively dilute aqueous solutions are higher than the sodium affinities. In consequence, the translation of sodium on the ion-exchange column by eluents is generally larger than that of potassium. The electromigration velocity of potassium is larger than that of sodium in aqueous solutions3) as well as in the strong electrolyte cation exchange resin.4) When the direction of electromigration is opposite to the flow of eluent, the differences in the translation velocities of Na and K on the ion-exchange column are larger than the differences by eluent only, and the separation of K and Na will be attained effectively.

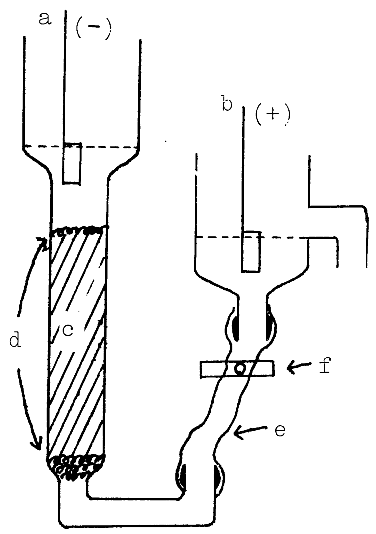

Fig.1 Ion exchange column with electromigration

a,b; platinum electrode
c; ion-exchanger
d; glass wool
e; flexible tube
f; screw cock

An ion exchange column(height; 10 cm, diameter; 1 cm) was made with Diaion PK-228 NH_4-form(100 $\sim$ 150 mesh) (Fig. 1). On the top of the column, 0.5 meq. Na and 0.5 meq. K ions were absorbed from a mixed solution and the column was washed with deionized water. The electric field was not applied in the first experiment with the eluent of 0.1 N NH_4Cl solution(flow rate; 1.2 ml/min) and in the second experiment the electric field[150 v (between electrodes), 3.3 mA] was applied. The effluents were collected with a fraction collector, and the concentration of NH_4 on each fration was determined by a spectrophotometric method.5) The differences of the NH_4 concentrations between the eluent and the effluents were considered to be alkali concentration in the effluents. The elution curves of Na and K ions are shown in Figs. 2-a and -b.

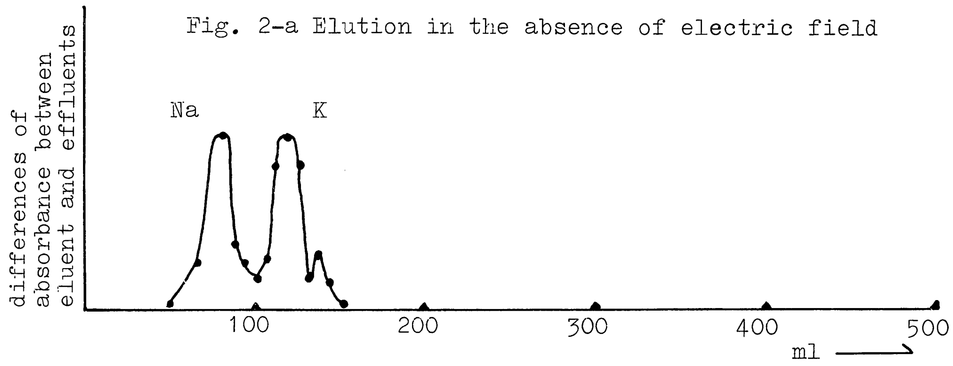

Fig. 2-a Elution in the absence of electric field

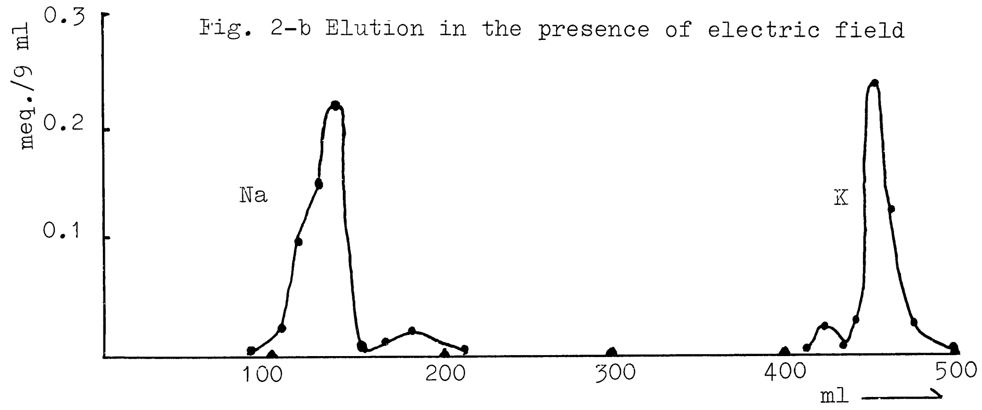

Fig. 2-b Elution in the presence of electric field

Sodium and potassium in the effluent were estimated by flame tests and by the measurements of weight and equivalents of the chlorides after eliminating NH_4 with OH-form strong electrolyte anion exchanger.6) In Fig. 2-a, the distance between the peaks of Na and K is 35 ml in the elution volume, and overlapping of the elution curves is observed. When the electric field was applied(in Fig. 2-b), the corresponding distance is 297 ml, and the two elution curves are completely separated from each other. The separation of Na and K proceed perfectly with a relatively short ion-exchange column. Na and K in effluent were found to be 0.47 meq. and 0.50 meq. respectively.

References

1) H.Kakihana, Y.Mori and T.Hoshino, Bull.Chem.Soc.Japan, 35, 2055(1962).
2) H.Kakihana, Y.Mori and T.Hoshino, J.Atomic Energy Soc.Japan, 6, 65(1964).
3) R.A.Robinson and R.H.Stokes, "Electrolyte Solution" Sec.Ed., Butterworths Publighers London(1959) 463.
4) H.Kakihana and Y.Mori, "Ionkokan Nyumon", Hirokawa Publishers, Hongo,Bunkyo,Tokyo (1969) 74.
5) Y.Morita and Y.Kogure, Nippon Kagaku Zasshi 91, 653(1970).
6) T.Murase, I.Sasaki and H.Kakihana, Nippon Kagaku Zasshi 71, 227(1954).

(Received May 8, 1973)