Chromatographic Behavior of Magnesium and Ethylenediaminetetraacetate Ions, and Their Complex on Sephadex G-15 Column

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Several investigations concerning the chromatographic behavior of inorganic species on columns of Sephadex[1,2] (cross-linked dextran) and Bio-Gel[3] (cross-linked polyacrylamide) have recently been reported. From the fact that in general the chemical species on the Sephadex column were eluted in the order of decreasing molecular weight (or molecular size) the principle of this method has been explained in terms of molecular sieving effect[4] in the gel phase. The elution volume, V_e, of individual species in column operation is characterized by the equation

$$V_e = V_0 + K_d V_i \qquad (1)$$

where V_0 represents the void volume, V_i the internal volume and K_d a fraction of internal volume available for the solute.

In column operation of the equilibrium system such as Mg+EDTA⇌Mg-EDTA, where magnesium and ethylenediaminetetraacetate (EDTA) ions interact rapidly to form magnesium ethylenediaminetetraacetate complex, it is required to characterize the behavior of metal complex in addition to that of metal and ligand ions. The present paper describes briefly the behavior of magnesium and EDTA ions, and their complex eluted on a Sephadex G-15 column ($1.5\phi \times 56.5$ cm) at room temperature with 0.1 M sodium chloride solution as an eluent. Sample solutions for three chemical species were prepared by dissolving magnesium chloride, disodium ethylenediaminetetraacetate and disodium magnesium ethylenediamintetraacetate in 0.1 M sodium chloride solution, respectively.

The observed elution volumes and K_d values (calculated by Eq. (1)) of four species are shown in Table 1, together with those of Blue Dextran (molecular weight=2000000) and tritiated water which were used as standard materials of K_d=0 and 1, respectively. Both magnesium and EDTA ions gave symmetrical elution curves when 0.01 M sample solutions were individually eluted. However, the peak skewing became more remarkable with increase of the sample concentration, which might be ascribed to the nonlinear isotherm. It resembles type III of Brunauer *et al.*[5] but is in contrast with adsorption behavior of calcium ion on cation exchanger.[6]

TABLE 1. ELUTION VOLUMES AND K_d VALUES ON SEPHADEX G-15 COLUMN
(Flow rate: 20—30 ml/hr, Volume of fraction: 1.02 ml)

Chemical species	V_e, ml	K_d
Blue Dextran	35.7	0.00
EDTA ion	45.9	0.22
Magnesium-EDTA complex	50.0	0.31
Magnesium ion	64.3	0.62
Sodium ion	70.4	0.76
Tritiated water	81.6	1.00

The sample composed of equimolar concentrations (0.05 M) of magnesium and EDTA ions gave a more complicated elution profile because of the partial dissociation of magnesium-EDTA complex into two reactants which migrated on the Sephadex column with different velocities. However, a sharp, well-defined elution peak of magnesium-EDTA complex was obtained by differential analysis (complexiometric titration) of three components. The complex showed an elution position of molecular size slightly smaller than free EDTA ion. Graphic representation of their behavior will be presented in the near future.

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