9.2.5.5 Diffusion, Selectivity and Separation

Diffusion Coefficient in the Ion Exchanger (D_{ex})

The diffusion coefficient characterizing the diffusion in the ion-exchange phase

Selectivity Coefficient ($k_{A/B}$)

The equilibrium coefficient obtained by application of the law of mass action to ion exchange and characterizing quantitatively the ability of an ion exchanger to select one of two ions present in the same solution. The ions involved in the exchange should be specified as subscripts.

Examples:

Exchange: Mg^{2+} - Ca^{2+}

$$k_{Mg/Ca} = \frac{[Mg]_S/[Ca]_S}{[Mg]_M/[Ca]_M}$$

Exchange: SO_4^{2+} - Cl^-

$$k_{SO_4/Cl} = \frac{[SO_4]_S/[Cl]_S^2}{[SO_4]_M/[Cl]_M^2}$$

In the above equations subscript S refers to the ion exchanger ("stationary phase") and M to the external solution ("mobile phase"). For exchanges involving counter-ions differing in their charges, the numerical value of $k_{A/B}$ depends on the choice of the concentration scales in the ion exchanger and the external solution (molal scale, molar scale, mole fraction scale, etc.). Concentration units must be clearly stated for an exchange of ions of differing charges.

Corrected Selectivity Coefficient ($k_{A/B}^a$)

This is calculated in a way identical to the selectivity coefficient except that the concentrations in the external solutions are replaced by activities.

Separation Factor ($\alpha_{A/B}$)

The definition of this term is identical to the definition given in sub-chapter 9.2.3.7. In an exchange of counter-ions of equal charge the separation factor is equal to the selectivity coefficient (see *Diffusion Coefficient in the Ion Exchanger*), provided that only one type of ion represents the analytical concentration (e.g., in exchanges of K^+ and Na^+) but not in systems where several individual species are included in the analytical concentrations.