

AN IMPROVED MODEL FOR BINARY SYSTEM ION EXCHANGE EQUILIBRIA

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ABSTRACT

A theoretical model to predict ion exchange equilibrium behaviour in binary systems is described. The equilibrium model is based upon one previously developed by two of the authors for the sorption of gold cyanide and copper cyanide on ion exchange resins in saline solutions.^{1,2} That model applied the principles of statistical thermodynamics as well as the Metropolis Monte Carlo numerical method to consider a range of non-ideal sorption phenomena on the resin phase including selectivity, irreversibility and interaction between sorbed species. All the parameters in the model have some physical meaning and describe only a single characteristic of the ion exchange system. In that model the solution phase is assumed to behave ideally. The present study describes an improvement to the existing model involving the incorporation of the Pitzer electrolyte solution theory^{3,4} to account for non-idealities in the solution phase. Incomplete dissociation of the salts of the system is also considered. The improved model is used to predict the equilibrium behaviour of the binary systems $\text{Na}^+\text{-K}^+$, $\text{K}^+\text{-H}^+$, $\text{Ca}^{2+}\text{-H}^+$, $\text{Ca}^{2+}\text{-K}^+$ and $\text{Ca}^{2+}\text{-Na}^+$ at several solution concentrations and with Cl^- as the non-exchanging anion, and the $\text{Na}^+\text{-H}^+$ system with either Cl^- , F^- , or NO_3^- as the non-exchanging anion. The new model predicts well the equilibrium behaviour of the systems studied. In addition it predicts the equilibrium behaviour of the $\text{Na}^+\text{-H}^+$ binary system in the presence of the range of non-exchanging anions based upon the model parameters determined when Cl^- is the non-exchanging anion.