120e Two-Site Equilibrium Model for Ion Exchange between Multivalent Cations and Zeolite-a in a Molten Salt

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A two-site equilibrium model which previously only accommodated monovalent cations has been extended to include divalent and trivalent cations for ion exchange between zeolite-A and molten chloride salts, a process being considered for concentrating nuclear fission products into high level waste forms. Equilibrium constants were determined by fitting the model to equilibrium data sets for ion exchange between zeolite-A and Cs ternary salt (CsCl-LiCl-KCl), Rb ternary salt (RbCl-LiCl-KCl), Na ternary salt (NaCl-LiCl-KCl), Sr ternary salt ($SrCl_2$-LiCl-KCl), and U ternary salt (UCl_3-LiCl-KCl). The results reveal a good fit between the experimental data sets and the model. The two ion exchange sites, framework sites and occluded sites, demonstrate different relative selectivities for the cations. It was found that Sr^{2+} is the preferred cation in the ion exchange site, and Cs^+ is the preferred cation in the occlusion site. Meanwhile, Li^+ has the highest combined selectivity when both ion exchange and occlusion sites are considered. Interestingly, divalent and trivalent species are more preferred in the ion exchange site than the monovalent species. Further detailed results will be discussed and compared with other models previously reported in the literature.