Chapter 9 Ion Exchange with Clays

A frequent issue in the transport of fluids through soils or rocks is the exchange of ions in the water with ion exchange sites on the clays. A household example of ion exchange is the water softener. Divalent ions such as calcium and iron are undesirable in tap water because it leaves scale in tea pots and water heaters, stains sinks and tubs, and precipitates bath soap to reduce sudsing and leave a bath tub ring. The divalent ions can be removed from tap water by passing it through a bed of ion exchange medium such as polystyrene beads with sulfonate functional groups or zeolites (a silicate mineral). The bed is regenerated by passing a concentrated salt (NaCl) solution through the bed. Ion exchange is an important issue in surfactant flooding because it can change the electrolyte composition of the surfactant solution from the injected concentration and have a significant effect on the oil displacement and surfactant transport properties. Ion exchange is also important in contamination of the soil with inorganic materials such as chromium, lead, mercury, and plutonium.

Assignment 9.1. Ion exchange isotherms

1) Plot f_2^o and f_2^c as a function of the normalized variables, $\frac{r}{c_3^o}$ and $\frac{Kr}{Q_v}$. Use similog plot from 10^{-2} to 10^2.

2)Plot isotherm (iso chloride concentration) of f_2^c versus f_2^o for c_3^o = 0.01, 0.06, and 0.115 eq/liter. Let K=0.012, Q_v =0.03 eq/liter.

Assignment 9.2 Ion Exchange Displacement

Compute the composition route, distance-time diagram, effluent history, and profile for the following cases.

1) I.C.: C_1^o =0.05 N, C_2^o =0.01 N; B.C.: C_1^o =0.03 N, C_2^o =0.01N

2) I.C.: C_1^o =0.03 N. C_2^o =0.01 N; B. C. C_1^o =0.05 N, C_2^o =0.01 N