Release of clay particles from an unconsolidated clay-sand core: experiments and modelling

Marie-Hélène Fauré*, Michel Sardin** and Pierre Vitorge*.

*CEA Saclay DCC/DESD/SESD 91191 Gif-sur-Yvette Cedex FRANCE.

**Laboratoire des Sciences du Génie Chimique, CNRS-ENSIC, BP 451, 54001 Nancy, FRANCE

Abstract

This work identifies the main phenomena that control the peptisation and transport of clay particles in a sand core. Clay can be dispersed into small particles in an aqueous solution of low ionic strength. This property is used to generate clay particles with NaCl concentration varying from 0.5 M to 0.015 M. For this purpose, a chromatographic column is initially packed with a 5 % clay-sand mixture. The monitored decrease of the NaCl concentration of the feed solution allows the control of transport of the particles without plugging the porous medium. In this conditions, it is shown that, in a column of a given length, the amount of clay particles, released into solution and available to transport, depends only on NaCl concentration. Some clay particles are available to migration when the NaCl concentration of the feed concentration is between 0.16 M and 0.05 M (first domain) or between 0.035 M and 0.019 M (second domain). An empirical function, $P_d([NaCl])$, accounts for this particle generation. Transport is mainly dependent on the hydrodynamic characteristics of the porous medium that vary during the elution, probably due to the particle motion inside the column. A phenomenological modelling is derived from these results, coupling the particle generation term, $P_d([NaCl])$, with an adapted nonequilibrium transport solute model. Similarly to the solute, particles were attributed a characteristic time of mass transfer between mobile and immobile water zones. This is sufficient to take into account the kinetic limitations of particles transport. The values of the parameters are determined by independent experiments. Finally, breakthrough curves of clay particles are predicted when a column of a given length is flushed by a salinity gradient of NaCl in various conditions.