Electrolyte Concentration-Permeability Relationships in Sodium Illite-Silt Mixtures

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Abstract: To examine the effects of clay swelling and dispersion on electrolyte concentration-permeability relationships of low clay content soils, flow experiments were conducted on a silt of fixed particle size distribution containing 0, 5, 7 · 5, 10 and 15 per cent clay (sodium illite, 2 μm fraction). Flocculated specimens were sedimented using both slow and rapid procedures. After compression each specimen was permeated successively with electrolyte solutions which caused (1) swelling of the clay fraction (0 · 10 N), and (2) dispersion (0 · 05 N). Absolute permeabilities varied with clay content, sedimentation procedure, compression rate, and electrolyte concentration; however, the form of this variation plotted against through-put volume was similar for all specimens containing electrolyte solutions causing only swelling of the clay. Increasing the hydraulic gradient above a critical value apparently increased the swelling slightly as evidenced by further reductions in permeability. The permeability of mixtures permeated with electrolyte solution causing dispersion of the clay was more complex and depended on clay content, the hydraulic gradients used to introduce the dispersing electrolyte solution and the pre-dispersion gradients to which the specimens had been subjected. Permeability decreases were attributed to the last stages of swelling prior to dispersion and to pore plugging. Increases in permeability were the result of erosion of dispersed particles. Specimens previously subjected to the highest gradients while swelling dispersed more rapidly and had a greater tendency to erode. The effects of predispersion gradients diminished with increasing clay contents. It is concluded that both compositional and mechanical factors play an important role in determining electrolyte concentration-permeability relationships for soils containing active clay minerals.

Clays and Clay Minerals; April 1974 v. 22; no. 2; p. 143-154; DOI: 10.1346/CCMN.1974.0220202

Clay Minerals Society (www.clays.org)