
Effect of Exchangeable Potassium on the Hydraulic Conductivity of Smectite-Sand Mixtures¹

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Abstract: Changes in hydraulic conductivity of smectite-sand mixtures (using four reference smectites) as a function of the concentration (0.01, 0.003, 0.002, 0.001 M Cl⁻ and distilled water) and potassium adsorption ratio (of 2, 4, and 6) of the percolating solution were measured. Swelling and dispersion of the clays were evaluated from the changes in hydraulic conductivity of the mixture and from the clay concentration in the effluent.

The effect of exchangeable potassium percentage (EPP) on the hydraulic conductivity of the smectites depended on the charge density of the clays. The effect of potassium at EPPs <20 on the hydraulic conductivity of smectites having high charge density was negligible. Conversely, the hydraulic conductivity of smectites having low charge density (smectites from Wyoming and Belle Fourche, South Dakota), changed markedly when leached with dilute solutions as the EPP of the clay increased. The dispersive effect of exchangeable potassium on low-charge smectites was similar to that of exchangeable sodium. The low hydration energy of the K⁺ cations, coupled with the strong electrostatic attraction forces between platelets of smectites with high charge density account for the "inefficiency" of K⁺ in dispersing these smectites.

Key Words: Hydraulic conductivity • Potassium • Salinity • Sand • Smectite • Swelling

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