COHERENCE OF CLAY CRYSTALS IN WATER

by

W. W. Emerson

Division of Soils, Commonwealth Scientific and Industrial Research Organization, Glen Osmond, South Australia

ABSTRACT

Dry aggregates of Na-illite or Na-montmorillonite usually disperse spontaneously when immersed in water. The corresponding Ca-clays show only limited swelling. However, the latter, when mechanically shaken up with water, do form dispersed suspensions. It follows that at some initial spacing of the Ca-clay crystals, which is less than that corresponding to a suspension, the wet clay will just disperse when immersed in water. This spacing must also be greater than the maximum spacing attained by initially dry, unsheared clay in water.

The average spacing between crystals has been varied by adding water to dry clay, followed by a uniform remoulding of the clay. The critical water content or spacing at which dispersion begins has been found. For soil illites this water content can be only 5% greater than the maximum water uptake of the dry, unsheared clay. For montmorillonites with a low N_2 surface area, the increase required may be 200% by weight.

In contrast to the 2:1 minerals, Ca-kaolin suspensions flocculate in water. The amount of illite required before a wet, remoulded, kaolin–illite mixture disperses in water has been determined. This amount is equal to that calculated to cover the basal surfaces of the kaolin crystals present.

When a dry clay aggregate is immersed in water, although the clay crystals may not disperse, the aggregate can still break up rapidly into discrete fragments (slaking). This is due to differential swelling and entrapped air. If the clay crystals are sufficiently thin, then the pressures developed by entrapped air can be relieved by bending of the crystals, without causing macroscopic dislocation of the aggregate. Thus an aggregate of coarse-grained crystals showing very little swelling in water, e.g. a ceramic kaolin, rapidly fragments when immersed dry in water, whereas an aggregate of a highly swelling clay with very thin crystals, e.g. a Ca-montmorillonite, remains intact.

The application of these ideas to two soil properties will be discussed. First, the hydraulic conductivity of compacted soils. Second, the stability of soils to sudden wetting with water.

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