

Anisotropic Behavior of Sand Stabilized with Colloidal Silica

Authors : Eleni Maria Pavlopoulou, Vasiliki N. Georgiannou, Filippos C. Chortis

Abstract : The response of M31 sand stabilized with colloidal silica (CS) aqueous gel is investigated in the laboratory. CS is introduced in the water regime, forming a hydrosol. The low viscosity hydrosol thickens in a controllable manner to form a stable, non-toxic gel; the gel fills the pore space, retains the pore water, and supports the grain structure. The role of colloidal silica on subsequent sand behavior is examined with the aid of direct shear, triaxial, and normal compression tests. Under the examined loading modes, while the strength of the treated sand is enhanced, its stiffness may reduce, and its compressibility increase. However, in most geotechnical problems, the loading conditions are complex, involving changes in both stress magnitude and direction. Rotation of principal stresses (σ_1 , σ_2 , σ_3) in varying amounts expressed as angle α , (from $\alpha=0^\circ$ to 90°) in concurrence with increasing shear stress loading is commonly encountered in soil structures such as foundations, embankments, underwater slopes. To assess the influence of anisotropy on the response of sands before and after their stabilization, hollow cylinder tests were performed. The behavior of stabilized sand is compared with the characteristic sand behavior, i.e., a reduction in peak stress ratio associated with a softer stress-strain response with the increasing angle α . The influence of the magnitude of the intermediate principal stress (σ_2) on the mechanical response of treated and untreated sand is also examined.

Keywords : anisotropy, colloidal silica, laboratory tests, sands, soil stabilization

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