Effects of Nanomaterials on the Electro-Osmotic Consolidation of Soft Soils

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Soft soil is characterized by a high water content (w), high void ratio, high compressibility, poor permeability, and low shear strength (S); therefore, it is not suitable as a natural foundation without proper treatment. In this study, axisymmetric electro-osmotic (EO) consolidation of soft soil was carried out, and the change laws of current (I), potential (U), w , water discharge (V), pH, S , and bearing capacity (B) during the EO process were analyzed. The consolidation effect was enhanced by the addition of SiO₂ nanoparticles or Fe₃O₄ nanosolution, and the mechanism of EO consolidation was determined by analyzing the macroscopic properties and microstructure of the soil. The results showed that the I and U in soil decreased with time (t), while the V increased with t . Near the anode, the w and pH were low, but the S and B were high. The soil cracks were centered on the cathode and spread out in a cross pattern that extended to the anode. In addition, ion exchange occurred on the surface of the soil particles and inside the crystal layer, which produced a thinner electrical double layer, lower zeta potential, and lower water absorption capacity of the particles. To improve the consolidation effects, the best concentrations of nano-SiO₂ and nano-Fe₃O₄ were 3‰ and 2‰, respectively.

Keywords: Soft soil, Nanomaterials, Electro-osmosis, Consolidation, Microstructure

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