Effects of Calcium Sulfate on Swelling Potential of an Expansive Clay

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Geotechnical Testing Journal
Vol. 23, Issue.4, 2000

Abstract: The unique chemical features of calcium sulfate are largely manifested by its phase transformation due to the reversible hydration-dehydration reaction. Due to the harsh climatic and environmental conditions in eastern Saudi Arabia, such phase changes add to the potential swelling hazards of local expansive clays. The adsorption of water by expansive soils and the hydration of anhydrite to gypsum are the sources of much damage to foundations throughout the world. This paper attempts to assess the swelling caused by the interaction of calcium sulfate phases, especially gypsum and anhydrite, with expansive clay. Such assessment was primarily based on studying the geotechnical, mineralogical, and volume change characteristics of calcium sulfate-bearing soils. X-ray and thermal analyses were used to estimate the type and amount of minerals during phase transformation of calcium sulfate. The swelling potential was determined using an improved version of the simple odometer and constant-volume tests. The conventional odometer is the device usually used in these tests. However, the size of soil samples, the complete confinement, and the rigidity of the conventional odometer imposes a serious limitation on the application of the laboratory results to actual field problems. Therefore, the authors investigated the use of a large-scale odometer with different mold sizes and shapes on the swelling potential of some mixtures of expansive clay and calcium sulfate phases. In addition, the soil fabric of these mixtures was investigated using scanning electron microscopy to explain the volume change behavior. The results of this investigation indicated that the swelling potential of clay-calcium sulfate mixtures decreased as the percentage of calcium sulfate was increased, and this reduction was more pronounced when gypsum was used. Swelling pressure was observed to be the highest in the conventional odometer and lowest in the large-scale square odometer mold