Geophysical Research Abstracts
Vol. 17, EGU2015-2151, 2015
EGU General Assembly 2015

The Initial Water Content Dependent Swelling Behavior of Clayey Soils

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The variation in water content is known as a main controlling parameter for many physical and mechanical behaviors of clayey soils, particularly soils found in arid and semi-arid regions. Expansive soils found in such regions are naturally subjected to many volume increase and decrease cycles within unsaturated zone during rainy and dry periods, and thus these soils constitute severe hazard to low-rise light buildings and infrastructures constructed in shallow unsaturated depths. Although the relationships between swelling parameters (swelling pressure and swelling percent) and soils' physical - index properties have been investigated in details in previous researches, the continuous effect of water content on swelling mechanisms of soils is not yet sufficiently studied. The water content of unsaturated zone naturally fluctuates with changes in both seasonal climatic conditions and increasing in depths, and therefore, swelling parameters of a soil within unsaturated soils should not be represented with only one single value. For achieving accurate understanding of swelling behavior at field condition, soils should be subjected to swelling tests by considering different initial water content conditions. Considering requirement for further understanding in water content dependent swelling behavior of soils, a research program was aimed to investigate the effect of initial water content on swelling behavior of soil materials. For this purpose, soils having wide range of physical properties such as grain size distributions, mineralogical composition and consistency limits were collected from different locations in Turkey. To minimize the effect of dry unit weight on swelling behavior of soils, samples prepared at same dry unit weight (14.6 kN/m^3) with various initial water contents ranging from 0% to approximately 37% were subjected to swelling tests by using convenient odometer device. Beside these tests, grain size distribution, Atterberg limits and mineralogical composition of samples were also determined. The swelling pressure of selected samples reached up to 250 kPa at zero water content. In addition, swelling parameters of collected clayey soils considerably decrease with increasing initial water content to somewhere between 30% and 37%. For finding the most important physical, index and mineralogical properties to constitute predictive models for swelling parameters of soils and understand the effect of initial water content, simple and multiple regression analyses were performed among appropriate variables. As a result of all analyses, statistically significant linear relationships were obtained between swelling parameters and initial water content values. Furthermore, it can be concluded that initial water content is a crucial controlling parameter for understanding swelling behavior of soils.