World Academy of Science, Engineering and Technology
International Journal of Geotechnical and Geological Engineering
Vol:12, No:12, 2018

# Laboratory Assessment of Electrical Vertical Drains in Composite Soils Using Kaolin and Bentonite Clays

**Authors :** Maher Z. Mohammed, Barry G. Clarke

**Abstract :** As an alternative to stone column in fine grained soils, it is possible to create stiffened columns of soils using electroosmosis (electroosmotic piles). This program of this research is to establish the effectiveness and efficiency of the process in different soils. The aim of this study is to assess the capability of electroosmosis treatment in a range of composite soils. The combined electroosmotic and preloading equipment developed by Nizar and Clarke (2013) was used with an octagonal array of anodes surrounding a single cathode in a nominal 250mm diameter 300mm deep cylinder of soil and 80mm anode to cathode distance. Copper coiled springs were used as electrodes to allow the soil to consolidate either due to an external vertical applied load or electroosmosis. The equipment was modified to allow the temperature to be monitored during the test. Electroosmotic tests were performed on China Clay Grade E kaolin and calcium bentonite (Bentonex CB) mixed with sand fraction C (BS 1881 part 131) at different ratios by weight; (0, 23, 33, 50 and 67%) subjected to applied voltages (5, 10, 15 and 20). The soil slurry was prepared by mixing the dry soil with water to 1.5 times the liquid limit of the soil mixture. The mineralogical and geotechnical properties of the tested soils were measured before the electroosmosis treatment began. In the electroosmosis cell tests, the settlement, expelled water, variation of electrical current and applied voltage, and the generated heat was monitored during the test time for 24 osmotic tests. Water content was measured at the end of each test. The electroosmotic tests are divided into three phases. In Phase 1, 15 kPa was applied to simulate a working platform and produce a uniform soil which had been deposited as a slurry. 50 kPa was used in Phase 3 to simulate a surcharge load. The electroosmotic treatment was only performed during Phase 2 where a constant voltage was applied through the electrodes in addition to the 15 kPa pressure. This phase was stopped when no further water was expelled from the cell, indicating the electroosmotic process had stopped due to either the degradation of the anode or the flow due to the hydraulic gradient exactly balanced the electroosmotic flow resulting in no flow. Control tests for each soil mixture were carried out to assess the behaviour of the soil samples subjected to only an increase of vertical pressure, which is 15kPa in Phase 1 and 50kPa in Phase 3. Analysis of the experimental results from this study showed a significant dewatering effect on the soil slurries. The water discharged by the electroosmotic treatment process decreased as the sand content increased. Soil temperature increased significantly when electrical power was applied and drops when applied DC power turned off or when the electrode degraded. The highest increase in temperature was found in pure clays at higher applied voltage after about 8 hours of electroosmosis test.

**Keywords :** electrokinetic treatment, electrical conductivity, electroosmotic consolidation, electroosmosis permeability ratio
**Conference Title :** ICGMTA 2018 : International Conference on Ground Modification Techniques and Applications
**Conference Location :** Paris, France
**Conference Dates :** December 27-28, 2018