

Abstract

Soils are a heterogeneous medium formed by several phases, this fact hampers its / their study as a medium across which a massic or energy flow circulates there. There are different techniques to study the microstructure of soil, porosimetry of mercury, X-ray dispersion, gas adsorption, ... all of great accuracy but they determine of expensive equipments and complex and, often, they need a destructive pretreatment of the sample.

One of the goals of the work it consist in the design and realization of a probe capable of measuring the resistivity of a sample of soil, previous calibration with samples of the same material to in the same way density and humidity different and with saline solutions of different concentrations, to relate de variation of resistivity with the variation in the contents of water of the sample. It is also intended to study the mechanical behaviour of an expansive material on saturating itself through the probes of measure of the resistivity and the equipment of measure of tensions that the cell includes. Relating like this the variation of the moderate humidity with the increase of tensions that will be produced in the sample on not being able to become deformed.

To carry out the assays an undeformable cell that includes a sensor of load and three sensors of total pressure, which was used to studying the thermohidromechanic behaviour of bentonite, have been used. The equipment of work consists of the cell and the equipment of datum acquisition, a generation of wave functions, an oscilloscope and fives probes of resistivity. The idea of this work is based on the work of J.C. Santamarina [Santamarina et al. (2004)], that after carrying out different you prove that they describe an electrical current modifying the frequency, the intensity, the salinity of the interstitial fluid, and, in general, all parameters, a rank for each parameter establishes that it allows to carry out the measures with a certain reliability in the results.

A test of infiltration in a mixture of bentonite with sand and lead nitrate added with registry of the resistance to different heights of the column of soil has been carried out. They not obtained good worked out with the probes since, due to of excessive duration of the assay, these rusted and the measures where altered. The test was repeated with a mixture of sand with fines of permeability much higher than the bentonite. The duration of the test was two hours, approximately. A test of vertical penetration of the probe was also carried out three times in a column of sand with fines with a static front of saturation. The probe penetrates with a speed of 1cm/min to minimize the alteration that is produced in the soil. In all three cases the behaviour of the curves recorded by the probe is the same one.

In the test of infiltration in sand with fines was obtained the expectable behaviour, a decrease of resistance according to the saturation of the material. It is detected clearly the instance in that the front of saturation enters in touch with the probe. Each curve shows a different rank of variation. Regarding the assay of vertical penetration of the probe, all three curves of resistance measured have identical behaviour, however, it is different of that which it might be expected to find. The resistance reduced in a sudden way until values next to 0 under the front of saturation, and increased afterwards in depth. Regarding the determination of the humidity, the results are not satisfactory, the main problem is that the mixture of sand with fines it collapses on to become saturated, so that the density of material increases, making the resistivity diminish on reducing the porous net, that it is for where the electrical flow circulates. This, together with the effect of polarization of membrane that the clay produce and that it makes increase the resistance-humidity relation does not give good worked out.

At qualitative level, however, the probes are very useful on detecting the interface of the front of saturation and detecting sudden changes in the contents of water. Also, they are very useful, how it is shown in the work of Santamarina, detecting small changes in the structure of saturated soils. In a future line of research the degree of saturation (1) and could be fixed and would be able to calibrate at different densities, so that changes of the porosity could be detected, with a millimetric accuracy.