DENSITY-DEPENDENT HYDROMECHANICAL BEHAVIOUR OF A COMPACTED EXPANSIVE SOIL

Hossein NOWAMOOZ*, Farimah MASROURI

Laboratoire Environnement Géomécanique and Ouvrages, Nancy-Université, Rue du Doyen Marcel Roubault, BP 40, 54501 Vandœuvre-lès-Nancy Cedex, France, Tél.: +(33) 3 83 59 63 09

Clayey soils are widely used in geotechnical engineering for dam cores, barriers in waste landfills and for engineered barriers in nuclear waste storage facilities. In the latter case, the used materials contain a large amount of smectite which is a highly swelling clay. On site, they can be submitted to complex suction/stress/temperature variations that could change dramatically their hydromechanical behavior, meaning their saturated and unsaturated mechanical caracteristics.

To further our knowledge of the coupling between the hydraulic and mechanical behaviour of the swelling soils, this paper presents an experimental study on a swelling bentonite/silt mixture using osmotic odometers. A loading/unloading cycle was applied to samples with different initial dry densities (1.27, 1.48, and 1.55 $Mg.m^{-3}$) at different constant suctions (0, 2, and 8 MPa) (Figure 1).

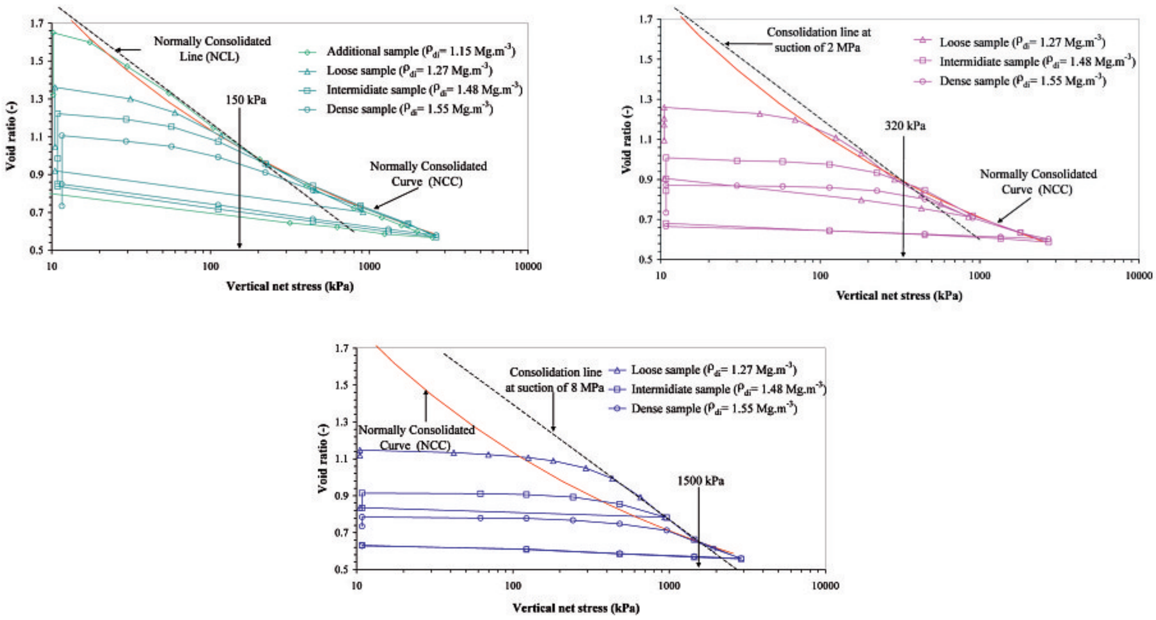

Figure 1: Compressibility curve a) at saturated state b) at suction of 2 MPa and c) at suction of 8 MPa for different initial states.

These experimental results provided a sufficient database to analytically model the mechanical behavior of the swelling soil and define three yielding surfaces (Figure 2):

- the Suction Limit between Micro- and Macrostructure ($s_{m/M}$) and the Suction Limit between Nano- and Microstructure ($s_{n/m}$), which depend completely on the soil fabrics and the diameter separating the nano-, micro-, and macrostructure,
- the Loading Collapse (LC) curve, representing the preconsolidation stress variation as a function of suction,
- the Saturation Curve (SC), representing the variation of the saturation stress (P_{sat}) as a function of suction.

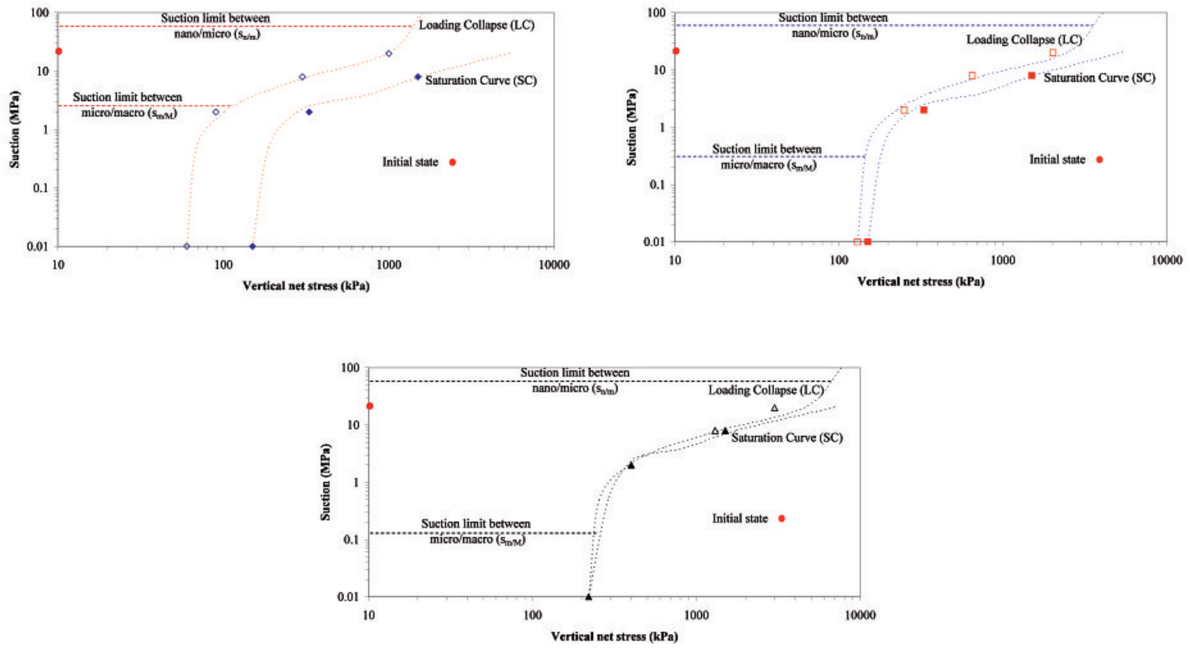

Figure 2: Estimated yielding surfaces for the loose compacted soil with an initial dry density of a)1.27 $Mg.m^{-3}$ **b)** 1.48 $Mg.m^{-3}$ c) 1.55 $Mg.m^{-3}$.

In general, we can state that the increase of compaction pressure unified the LC and SC surfaces and decreased the ($s_{m/M}$) value without modifying the ($s_{n/m}$) value.