STUDY OF THE ORGANIZATION OF A CLAVEY LOAM SOIL MODELLING OF HYDRAULIC CONDUCTIVITY FROM EXPERIMENTAL SOIL WATER PROPERTIES

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The study of reorganizing of undisturbed clayey loam soil samples subjected to a strong initial drying stress is approached indirectly. The method is to relate by a model (MUALEM's model, 1976 ; van GENUCHTEN mathematical procedure, 1980) the relative hydraulic conductivity K_r (θ) to the experimental soil water retention properties θ(h). A comprehensive and quantified draft of the poral space transformation is then suggested based on the evolution of these two associated characteristics.

The approach relies on experiments inspered from recent studies on pure clay water behaviour (TESSIER and all., 1980 ; TESSIER, 1984). The experiments are applied to sets of samples from the bottom of the Versailles soil B horizon, the clayey components (34,6 %) of which are kaolinite, illite and smectite. The water content is mesuared in a large range ofsuction h from saturation up to pF = 6 (pF = $\log_{10}$ h cm of water).

During the first experiment, no preliminary stress is applied to clods and we admit that this soil water characteristic is representative of the natural deshydratation of the medium (fig. 1, first experiment).

The aim of the second experiment is to modify the water behaviour of clods submitting them to an initial energy level :

— the sturated clods are dried op to equilibrium at pF = 6 ;

— the are progressively rewetted to saturation ;

— the same clods are finally submitted to a second drying during which water contents are measured at same pF as in the first experiment (fig. 2, second experiment).

The comparison of he two semi-log graphs θ(h) (fig. 1 and 2) thus obtained in drying conditions shows the result of the second experiment underlined by a marked change of retention properties of samples.

The second part of the paper is devoted to the fitting of the hydraulic conductivity model on these experimental bases. Taking into account in the fitting process the parameter θ_r (residual water content) is of great importance. The estimation of this parameter assimilated here to a particularly and physically identified water content (air entry value into the plasmic fabric, fig. 3, third experiment) allows to verify the previsionnal capacity of the model applied to a very fine textured medium. Reasonable agreement is obtained between K_r (h) measured in situ (LESSARD, 1981) and the K_r (h) computed from the model (fig. 4).

An outline of the reorganization of the poral space is then deduced from the evolution of the two main related characteristics of different physical nature, θ (h) and K_r (θ).

1. - The irreversible evolution of retention or equilibrium properties is marked by an increasing of the concavity of the θ (h) relation coherent with the vanishing tendency of the observed discontinuity between pF = 4 and pF = 4,8. This evolution might reflect the existence of a more continuous pore size distribution at the expense of a finer porosity occuring initially in the plasmic fabric.

2. - The clearly reduced slope of the second $K_r(\theta)$ curve (fig. 5 and 6) in a larger range of water contents is significant. The shape of the curve suggests that hydro-

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dynamic properties are active in a different structure as a result of the formation of a more gradual porosity. Continuity of flow paths plays as a matter of fact a prominent part in these properties. Processes resulting from second experiment have probably improved the thresholds of accessibility from pore size distribution to another.

This draft is compared to results of other authors (TESSIER, 1984 ; PARCEVAUX, 1980) having visually followed the evolution of pure clays or plasmic fabrics macroscopic organization under different stresses. These authors observed more particularly during rewetting from very high suctions that the swelling properties induce shear structure in the solid phase individualizing new types of particles.

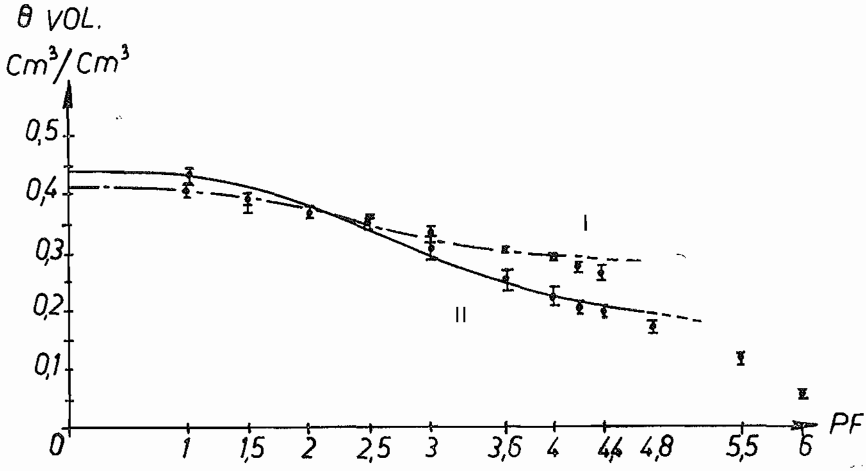

Figure 1 and 2 : Soil water characteristics of undisturbed clods. I. first experiment. II. second experiment. Experimental measurements with associated standard deviation. Fitted curves for θ_r = 0.25 cc/cc (I) and θ_r = 15 cc/cc (II).

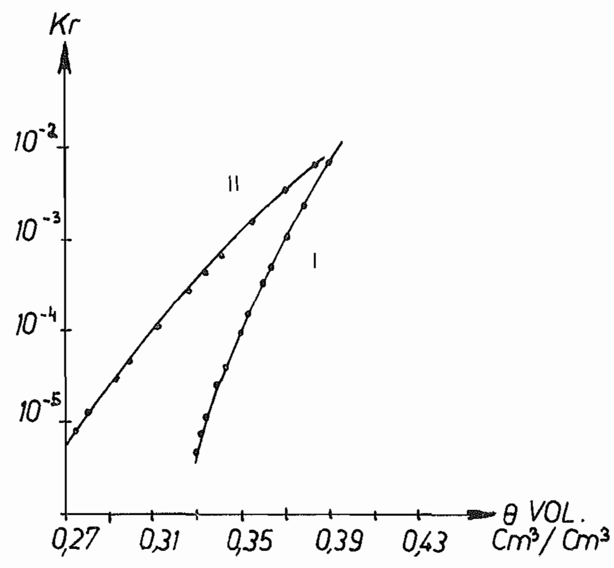

Fig. 5 and 6 : Calculated relative hydraulic conductivity vs water content from the fitted soil water characteristics (VAN GENUCHTEN model) I and II.