

EFFECT OF THE BULK DENSITY ON SOIL SHRINKAGE AND HYDRAULIC PROPERTIES OF THE POROUS MEDIA IN HOMOGENIZED AND STRUCTURED SOILS

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SUMMARY

Soils are three phase porous systems. The relative proportion of these phases (soil matrix, water and air) is influenced by properties like texture, structure, biological activity, weather and soil management. The aim of this work is to show some results that allow the characterisation of the porous media and its function. The water retention curve (WRC), the soil shrinkage (Ss), the saturated water conductivity (ks) and the air conductivity (kl) were measured in disturbed and undisturbed soil samples. The disturbed material was collected at 15 cm depth from a Luvisol (Harste, Göttingen, Germany). In purpose to get uniform bulk densities (1.2 – 1.4 and 1.6 Mg cm⁻³) soil samples were prepared with a Load Frame Device. Vertical and horizontal undisturbed soil samples were collected from the seedbed and plough pans of a Stagnic Luvisol (Ritzerau, Germany). The water retention curve and the soil shrinkage were measured at matric potentials of -10, -20, -30, -60, -150, -300 and -500 hPa. The air conductivity was determined at matric potentials between -60 and -500 hPa with an air permeameter. The saturated water conductivity was measure under instationary conditions. With increasing bulk density the volume of secondary (structural) pores, the air and water conductivity, as well as, the maximal shrinkage (void ratio at saturation minus void ratio at -500 hPa) of the soil decrease. The undisturbed soil samples present the smallest volume of effective porosity (pore volume till -300 hPa). However, the saturated water conductivity and air conductivity is higher in these structured samples than in the homogenized material the highest bulk density (1.6 Mg m⁻³). This circumstance can be explained by differences in the continuity of the porous media between the homogenized and structured material. The presence of a platy structure in the plough pan leads to an anisotropy of the saturated hydraulic conductivity in the horizontal direction ($k_{sh} > k_{sv}$). These results show that the capability of the soil to transmit fluids depends on the bulk density, the structure, as well as, on the continuity of the porous media.

KEY WORDS: porous system, porous function, shrinkage, anisotropy