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Soil Porous System and Soil Hydraulic Functions

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0.1 Soil water retention curve together with saturated and unsaturated hydraulic conductivity are basic soil hydraulic functions used in the solution of transport processes in soils. The models of hydraulic functions were related to the reality of the soil porous system mainly by empirical parameters of soil water retention curve. In order to overcome this shortcoming, the physical description of the soil porous system looks as the way to the advanced forms of hydraulic functions. Pore size distribution function was therefore approximated by lognormal distribution and this form entered into hydraulic functions of monomodal (homogeneous) soils (Pachepsky, Kosugi). However, the majority of soils has the n-modal pore size distribution due to the existing structure and internal architecture of soil constituents. We modified therefore the relevant equations based on lognormal pore size distribution to bi-modal soils. We used the measured data from soil profiles to test the proposed theory. Bi-modal soils are characterized by the existence of matrix and structural domains of capillary pores. The pressure head separating them is not constant and it varies in a broad range of values. The classification of soil pores into various categories with fixed boundaries of pore radii lacks objectivity. The structural porosity is lower than the matrix porosity and their ratio decreases in the B horizon, or with the compaction and loss of soil structure. Parameters of the pore size distribution in the two domains were used for plotting the separate soil water retention curves of matrix and structural domains. Parameters characterizing the unsaturated conductivity function differ substantially when the matrix and structural domains are compared. Our assumption on different configuration of soil porous systems in matrix and structural domains was proved. A simple relationship between the empirical parameters of unsaturated conductivity and the pores tortuosity and connectivity is questionable as well as the simple models of conductivity in the matrix domain. A hypothesis on combination of full profile flow and film flow is formulated. We consider our procedure as the first step in relating the parameters of soil hydraulic functions to the quantified results of micromorphologic studies of the soil porous system.

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