MODELING OF CAPILLARY-POROUS MEDIUM STRUCTURE AND CALCULATION OF DIFFERENTIAL SOIL POROSITY

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Soil structure is modeled by regular or conditionally irregular (fractal) models. Fractal geometry operates with fractal's dimension and the numbers of iterations, characterizing the number of hierarchical levels of structure. A feature of fractal models of the soil structure is the comparison of different levels of structural organization of one system (one soil). In this paper the physical basis for choosing a particular type of soil structure model for modeling are discussed. A method for determining the multifractal dimension of the porous space of soil based on the Harst effect under nonstationary moisture filtration is proposed. The time series (the dependence of the volume flow rate of a liquid upon filtration on time) is a periodic function whose spectrum diverges at low frequencies. Differential porosity for the subsequent calculation of the water retention of the soil is determined on the basis of the multifractal dimension of the soil structure. The method was tested in 2015–2016 with soil samples of various granulometric and aggregate compositions from the Leningrad and Pskov regions and on an artificial soil and soil models. Filtration tests of the soils and the model environments have been carried out with a KF-OOM measuring device. Differential porosity has been calculated from the data on water retention of the soil. Comparison of the values of differential porosity calculated by independent methods shows a high convergence of the results. It will probably allow calculations of the main hydro physical characteristic of the soil (curve line of dehydration) in the future, and possibly also a hysteresis curve of function water retention of the soil from the data on the differential porosity obtained as a result of studies of the multifractal dimension of the soil structure by the filtration method.

Key words: soil physic, fractals, percolation, differential porosity of the soil, calculation of the basic hydro physical characteristics of the soil.