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Modelling the hydraulic conductivity of porous media using physical-statistical model

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Soils and other porous media can be represented by a pattern (net) of more or less cylindrically interconnected channels. The capillary radius, r can represent an elementary capillary formed in between soil particles in one case, and in another case it can represent a mean hydrodynamic radius. When we view a porous medium as a net of interconnected capillaries, we can apply a statistical approach for the description of the liquid or gas flow. A soil phase is included in the porous medium and its configuration is decisive for pore distribution in this medium and hence, it conditions the course of the water retention curve of this medium. In this work method of estimating hydraulic conductivity of porous media based on physical-statistical model proposed by B. Usowicz is presented.

The physical-statistical model considers the pore space as the capillary net. The net of capillary connections is represented by parallel and serial connections of hydraulic resistors in the layer and between the layers, respectively. The polynomial distribution was used in this model to determine probability of the occurrence of a given capillary configuration.

The model was calibrated using measured water retention curve and two values of hydraulic conductivity saturated and unsaturated and model parameters were determined. The model was used for predicting hydraulic conductivity as a function of soil water content K(theta). The model was validated by comparing the measured and predicted K data for various soils and other porous media (e.g. sandstone). A good agreement between measured and predicted data was reasonable as indicated by values R2 (>0.9). It was also confirmed that the random variables used for the calculations and model parameters were chosen and selected correctly.

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