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Determination of water content by TDR during the infiltration outflow column experiment

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Pore system of some soils may not become fully saturated during ponded infiltration due to air entrapment. Varying entrapped air content then determines quasi-saturated water content of soil and can strongly affect soil quasi-saturated hydraulic conductivity. This study shows changes of quasi-saturated volumetric water content in time measured by time domain reflectometry (TDR) during the infiltration outflow experiment conducted on medium sized soil column in the laboratory. Experiments were conducted on a packed sample of fine quartz sand and on undisturbed soil. The undisturbed soil sample (internal diameter 189 mm and 250 mm height) of sandy loam soil was collected at the experimental site Uhlirska (Jizera Mountains, Czech Republic). Recurrent ponded infiltration experiment, conducted on each sample, consisted of three infiltration runs. The same level of ponding was maintained during each infiltration run at the top of the sample. Water drained freely through the perforated plate at the bottom of the sample. First infiltration run was done into naturally dry soil while subsequent runs were conducted into wet soil. The degassed water was used for the third infiltration run. The apparent dielectric constants were monitored at depths 75, 125 and 175 mm bellow the sample surface using the 7.5 cm long TDR probes connected to Campbell Scientific TDR100 reflectometer via multiplexor. Volumetric water contents in each depth were calculated from apparent dielectric constants using Topp's equation. Additionally, the pulse of potassium bromide was applied repeatedly during the quasi-steady state of each infiltration run, while the bromide breakthrough was monitored both in the effluent (by ion selective electrode) and in the sample by TDR (as changes of electric conductivity). Experimental results showed that in case of homogenously packed sand the quasi-steady state flow rates and water contents were nearly the same during all three infiltration runs. The undisturbed sandy loam sample exhibited drop of the flow rates between the first and second infiltration run and a gradual recovery of flow rates and water contents during the third run. This supports the assumption that air that was trapped in the flow pathways when water infiltrated in wet soil was dissolved in degassed water during the third run. The TDR probes show the dynamics of the quasi-saturated water content changes.

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