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Determination of the pore size distribution and hydraulic properties from Nuclear Magnetic Resonance relaxometry

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Known pore size distributions can be directly linked to the water retention characteristic which is essential for the prognosis of water and solute movement through the material. In our study, we evaluated the feasibility to use Nuclear Magnetic Resonance (NMR) relaxometry measurements for the characterization of pore size distribution in four porous samples with different texture and composition. Therefore, NMR T2 and T1 relaxation measurements at 6.47 MHz were carried out for three model samples (medium sand; fine sand; and a homogenous sand / kaolin clay mixture) and a natural soil. To quantify the goodness of the approach, the NMR measurements were compared in terms of cumulated pore size distribution functions and mean pore diameter with the two classical techniques based on water retention and mercury porosimetry measurements. The results showed that T1 and T2 derived mean pore size diameters are in good agreement with each other but deviate from retention curve derived ones. This is especially the case for well sorted sands with n values > 2.7. For finer materials differences are less pronounced. A short study was performed to evaluate the influence of the variations observed in the pore diameter distributions on the hydraulic properties of the samples: θS, α, and n. In conclusion, NMR T1 and T2 relaxation measurements can be used to estimate pore size distribution, mean pore diameter, as well as the retention function and corresponding hydraulic properties.