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Rheological investigations in soil mechanics – a link to swelling and shrinkage processes

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The functionality and application of a rotational parallel-plate-rheometer as well as recent results will be presented with scope on micromechanics and structural stability (= stiffness) on the particle-particle-scale.

Rheology is generally dealing with flow behaviour of solid and liquid substances. On a micro scale, the three-phases-system soil exhibits a certain microstructural stability, which can be detected by a rotational rheometer under oscillatory conditions. For this purpose, amplitude sweep tests are conducted on (un)disturbed soil samples, which are rich in organic matter (e.g. due to manuring) and/or in clay. Soil characteristics i.e. texture, clay mineralogy, water content, SOM, and other physicochemical parameters have an influence on this microstructural stability. Hence, achieved data include significant indicators as a yield stress or – under oscillatory conditions – a deformation limit that divide elastic from viscose compounds. A detailed interpretation of micromechanical behaviour can be achieved by using additional parameters: G' (storage modulus), G" (loss modulus), LVE range (= linear viscoelastic range), loss factor tan δ, and plotted curve characteristics.

Due to comparative investigations soil (de)stabilizing factors are pointed out; a decrease in stiffness of each substrate is recorded and supported by rheological data, which not only allow conclusions about microstructural stability, but are also linked to shear behaviour and other soil(micro)mechanical processes as swelling and shrinkage.