Relative humidity as a new parameter in rheological testing

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In addition to temperature and pressure the water content of a sample as well as the relative humidity of the ambient air are important parameter influencing the rheological behavior of many complex fluids such as for example gels, biomaterials, polymeric systems, food products, and adhesives.

A combination of a modified convection oven and an external humidity generator enables to work under defined relative humidity (RH) and temperature (T) in the ranges of RH = 5 to 95% and T = 5 to 120°C. Traditional convection ovens are mainly equipped with electrical heaters. For lower temperatures a cold gas (e.g. LN2) is brought into the chamber and the oven heats against the cold gas. In the new humidity system the convection oven is based on Peltier elements allowing to set temperatures below ambient without the need of a cold gas as input to the oven chamber. In order to control the relative humidity a humidity sensor is located in the oven and the external humidity generator provides the needed moisture of the gas flowing into the chamber. The humidity sensor and the humidity generator are fully integrated into the operating software for the rheometer, allowing the programing of combinations of T and RH including ramps in RH at constant T or ramps in T at constant RH, respectively. Various standard geometries like parallel-plate, cone-and-plate, solid bar for torsional DMTA, extensional tools for DMTA and steady extensional rheological testing, a ball on three plate geometry for tribological investigations, as well as a newly designed modified ring geometry. The later consists of two broken rings in which the sample is placed on some small portions of the ring and has the advantage of a large surface to volume ratio, enabling a fast penetration of moisture into the sample. Applications examples in the different geometries show the importance of the relative humidity on the rheological behavior of many complex fluids.