

RELATIVE HUMIDITY AS A NEW PARAMETER IN RHEOLOGICAL TESTING

Jörg Läuger, Anton Paar Germany
joerg.laeuger@anton-paar.com
Gunther Arnold, Anton Paar Germany

Key Words: Relative humidity, Moisture content, Gelling, Curing reaction

Besides 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.

The aim of this contribution is to introduce a newly designed environmental control chamber for the use with a rotational rheometer.

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 programming 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 extensional DMTA and steady extensional rheological testing, a ball on three plate geometry for tribological investigations, as well as a newly designed modified ring geometry can be used in the humidity system. The later consists of two hollow cylinders, which build a ring geometry. Because the upper cylinder has three rectangular notches only the sample below these notches is used to characterize the sample properties. Hence the characterized sample has a large surface to volume ratio, enabling a fast and homogeneous diffusion of moisture in the sample.

Applications examples in the different geometries are presented and show the importance of the relative humidity on a broad variety of samples. The new humidity system allows an easy control of the relative humidity and makes this parameter readily available in advanced rheological testing.