Revealing more Insight into Foam Generation by Using an Advanced Test Container

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- **Temperature controlled test container**
- **Production near test conditions**
- **Reproducible test results**
- **Measurement of temperature critical PU-, PIR- and phenolic foams**

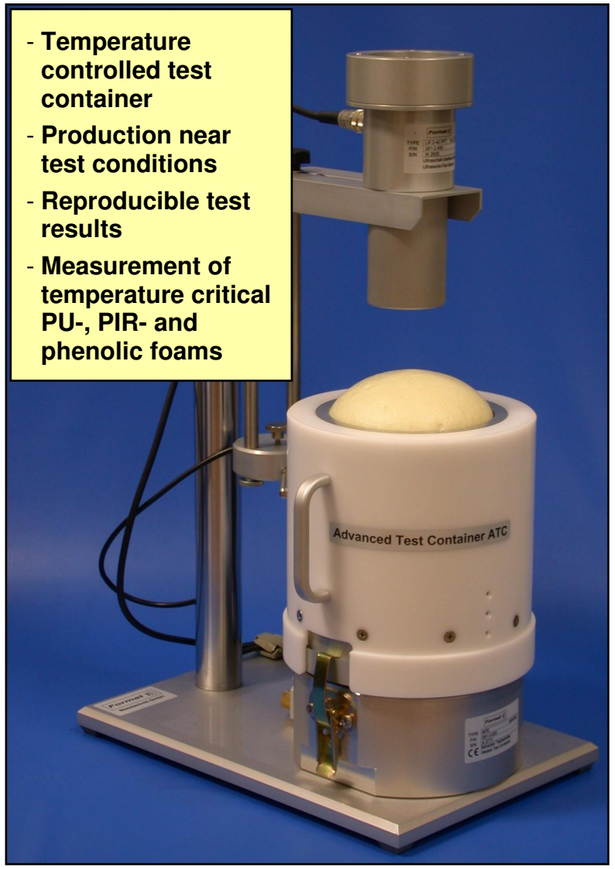

Fig. 1: The new temperature controlled Advanced Test Container ATC is part of the Foam Qualification System FOAMAT, for measuring rise height, rise pressure, curing and core temperature of rigid and flexible foams.

Disposable cups and cardboard cylinders are commonly used to measure the physical generation parameters of reactive foam formulations under laboratory test conditions. These are typically non-temperature controlled test containers. In real production, however, molds and other surfaces are precisely thermostated. Temperature is one of the main characteristics for constant product quality. When working with undefined test container temperatures there is less correlation between laboratory tests and the actual production situation. For example, PIR and phenolic foams can only cure at elevated temperatures, they will remain sticky and show voids if not allowed to do so.

To overcome this problem, Format Messtechnik GmbH has introduced the Advanced Test Container ATC. The ATC is temperature controlled and comprises both an integrated Foam Pressure Measurement unit (FPM) and a Curing Monitor Device (CMD) for measuring the dielectric polarization (curing). For manually measuring the core temperature, three fixed thermocouple ports are available. The ATC is also reusable so no consumables like cups or cardboard cylinders are needed. Additionally, the inner volume of the ATC is conically shaped, with the lower diameter on top for precise pressure measurements.

For engineering purposes, several flexible and rigid foam formulations have been tested with the ATC at different temperature settings. Due to consistent temperatures, the measurement results are much more reproducible than those measured in disposable, non-thermostated test containers. The decrease of the dielectric polarization reveals the curing process. As expected, curing goes faster at higher temperatures and more foam volume is generated. The pressure curves of rigid foam also show a more sophisticated behavior. At an intermediate temperature of 50°C, the maximum pressure peak is lowest when compared to the other test temperatures. Upon test completion, the upper part of the test container is removed from the lower part. The conical inner surface of the ATC is coated with a silicon release agent so the specimen can be easily removed from the container with a push to the bottom. For safety and thermal insulation reasons, the upper part of the ATC is covered with a plastic cylinder. The heating of the ATC is provided by a thermostated water loop. Due to the high heating capacity of the water loop, the ATC remains at a steady temperature during the exothermal foaming process; just like a production mold.

In combination with the established Foam Qualification System FOAMAT, the ATC is a versatile accessory for measuring foam parameters of all types of formulations under selectable temperature conditions. The pressure and the dielectric polarization data provide valuable information about how additives influence the gelling and curing of foams. By providing consistent, elevated temperatures, the ATC has opened a new dimension in testing PU, PIR and phenolic foam formulations.

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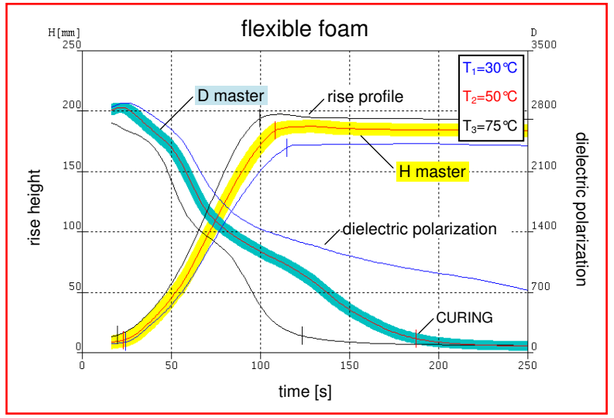

Fig. 2: Rise profile and dielectric polarization of a flexible foam formulation, measured at three different ATC temperatures. The master curves can be adapted to acceptable QC margins.

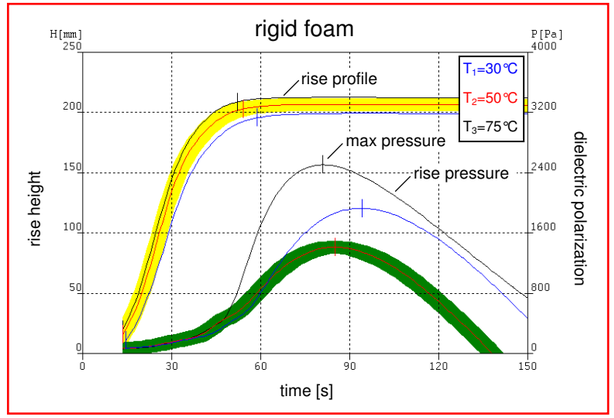

Fig. 3: Rise profile and rise pressure of a rigid foam formulation, measured at three different ATC temperatures. The maximum pressure peak is lowest at a temperature of 50°C.

Fig. 5: Cross sections of three samples of a flexible foam formulation and three samples of a rigid foam formulation, measured at different ATC temperatures.

Fig. 4: The Advanced Test Container ATC is temperature controlled and comprises an upper and a lower part, which can be separated easily for recovering the foam sample after a test.