Format
Messtechnik GmbH

Production Near Testing of Foam Generation Parameters

ERLAND E. HOFMANN
Format Messtechnik GmbH
D-76187 Karlsruhe
Germany

FRANK BERTUZZI
Eurotech Distributors Inc.
Northfield, Ohio 44067
USA

Laboratory tests of low density foam formulations are usually made in wide rectangular molds or buckets into which the mixed components are poured in. In production control of big foam parts, e.g. automotive seats or instrument panels, shots from high pressure mixing heads are injected directly into the test mold. Unfortunately conventional test containers have high heat losses and provide rise profile measurements only. Temperature critical formulations like PIR and phenolic foams cannot be tested in those setups. To overcome this, *Format* Messtechnik GmbH has introduced the **A**dvanced **T**est **C**ontainer ATC XL with an extra large test volume of approx. 10 liters (fig. 1).

Based upon the standard ATC, which has a volume of approx. 2.5 liters (fig. 4), the ATC XL is equipped with two separate closed loop controlled heaters: One for the pressure plate at the bottom and one for the conical side walls (fig. 5). The top is open enabling free rise of the foam and height measurement by an ultrasonic distance sensor. In order to get more insight into the foaming process the ATC XL has a built in **F**oam **P**ressure **M**easurement (FPM) sensor and a **C**uring **M**onitor **D**evice (CMD). The latter measuring the dielectric polarization during the transition from the liquid to the solid phase. Additionally the foam core temperature can be detected by a thermocouple being inserted through the ATC XL wall into the hot spot of the reaction zone. All data is logged by the controller unit of the proven Foam Qualification System FOAMAT® and is evaluated by the software FOAM. Due to the rotational symmetry of the ATC XL the viscosity of the rising foam can be calculated by using simple physical models. Measurement results of rigid and flexible foam samples are shown in fig. 2 and fig. 3. Due to the higher test volume and the consistent temperatures, the measurement results of low density foam formulations are much more reproducible than those measured in non-heated test containers. The repeatability of measurements with a rigid foam formulation is shown in fig. 2.

Upon test completion, the three spring locks of the ATC XL are released. Then the upper part can be separated from the bottom part. As the inner surface of the ATC XL is coated with a release agent, the foam sample can easily be removed from the upper part. A release mechanism is also available. In combination with the established FOAMAT® system, the ATC XL enables the measurement of full shots from high pressure mixing heads as they are used in the production of molded foam parts. Featuring consistent elevated temperatures and a big test volume, the ATC XL opens a new dimension in QC testing and the development of low density temperature sensitive foam formulations.

patent pending

Fig. 1: The new Advanced Test Container ATC XL is placed on the stand of the Foam Qualification System FOAMAT®. Rate of rise, rise pressure, dielectric polarization and core temperature are measured simultaneously in the temperature controlled ATC XL.

www.format-messtechnik.com

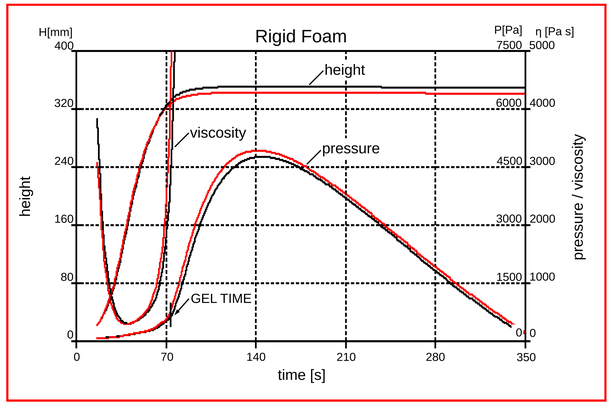

Fig. 2: The graph shows two repeated measurements of a rigid polyurethane (PU) formulation with overlaid rise height, pressure, and viscosity curves. The gel time is determined from the pressure data. The viscosity data is calculated using Hagen-Poisseuille's viscosity equation.

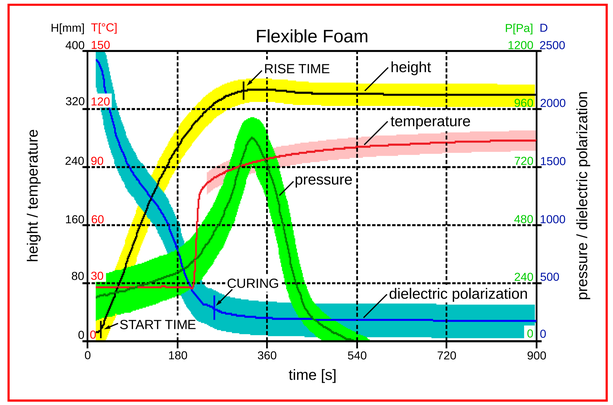

Fig. 3: Rise profile, temperature, rise pressure and dielectric polarization of a flexible polyurethane (PU) foam. The start time and rise time are evaluated from the rise height data. The curing time is determined from the dielectric polarization data. The colored areas are master curves for QC purpose.

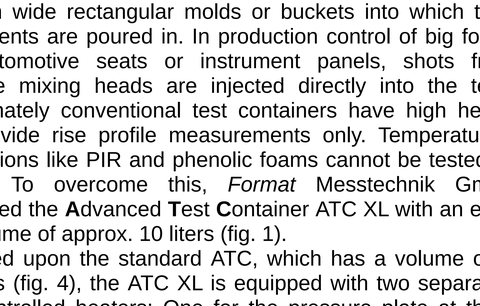

Fig. 5: Cross section of the ATC XL. A CMD sensor is integrated into the temperature controlled pressure plate.

- **Testing of big foam shots in production**
- **Reproducible measurements of low density foams**
- **Perfect curing of temperature critical foams (PIR, phenolic)**

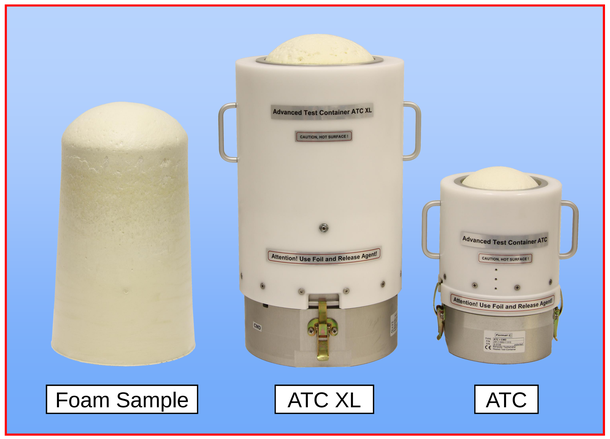

Fig. 4: The Advanced Test Container ATC XL has four times the test volume of the standard ATC. They both comprise an upper and a lower part, which are clamped by spring locks. The foam sample can easily be recovered through the bottom opening. An additional release mechanism is available.