Expansion Measurement of One Component Foam

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The main expansion reaction of One Component Foams (OCF) is based on the water isocyanate reaction. In typical application of OCF, e.g. back foaming and fixation, the water is extracted from the moisture of the ambient air. This is a long term process lasting for hours or even days. In laboratory test cycles the foaming process needs to be speeded up by adding a significant amount of water directly into the OCF froth. This is usually done by water films sprayed between each layer of OCF froth extruded from aerosol cans. Alternatively two parallel vertical walls at a low distance are impregnated with water and the OCF froth is filled in layers to a certain height. Due to different amounts of water between the foam layers and an undefined amount of froth being injected, the surface of the foam is very uneven. Therefore the rise measurement depends on the measurement position over the uneven surface. Beyond that a crust may form on the surface of the foam. This can be destroyed later by high pressure within the foam bulk resulting in foam geysers spoiling the rise measurement.

Based on this, Format Messtechnik GmbH has introduced the new **O**ne **C**omponent **F**oam **M**easurement device **OCFM** (fig. 1) for measuring the rise profile, the rise pressure and the reaction temperature of OCF. The **OCFM** comprises a narrow cylindrical expansion container made of cardboard and a special holder for aligning the cylinder under an ultrasonic distance sensor. The test volume of the expansion container is confined by the walls of the narrow cardboard cylinder, the circular pressure plate of the Foam Pressure Measurement device FPM 50 at the bottom and a movable plug on top of the foam. In order to avoid contamination of the pressure plate, it is protected by a thin PE foil (cling film). During the foam expansion the movable plug is lifted towards the ultrasonic distance sensor giving precise rise readings. The cylinder holder contains a photo switch detecting the cardboard cylinder in its final measurement position. The reaction temperature of the foam is measured with a thin glass fiber insulated thermocouple having a low heat capacity. A cross section of the **OCFM** is shown in figure 4.

When using the **OCFM**, the cardboard walls are impregnated with a defined amount of water thus giving reproducible measurements independent of the ambient air humidity. The moistened cardboard cylinder is placed over the **P**erfect **P**reparation **A**id (**PPA**) and the movable plug is put into the cylinder at a pre-aligned vertical position. A defined mass of OCF froth is injected into the cylinder, the quantity being checked with a balance. After turning the cylinder upside down, it is placed onto the FPM 50 and is fixed with a clamp ring. The FPM 50 / cardboard cylinder unit is aligned then with the cylinder holder of the **OCFM**, initiating data acquisition via the photo switch. During the foam rise the thermocouple is inserted through the cylinder wall into the foam.

Measurement results of the **OCFM** are shown in figure 2. Different rise reactions due to different water contents in the cardboard cylinders can be seen in figure 3. The foam sample can easily be lifted from the FPM 50 by just loosening the clamp ring and pulling off the cardboard cylinder containing the foam sample and the plug. The sample is available for further physical investigation (fig. 5). The new measurement technology of the **OCFM** can be used in R&D and quality control applications.

patent pending

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Fig. 1: The **O**ne **C**omponent **F**oam **M**easurement device **OCFM** has a special holder for aligning the FPM 50 and the cardboard cylinder under the ultrasonic sensor. The PPA enables defined dosing of OCF into the cardboard cylinder. The meteorological data is recorded by the GFTB 200 on top.

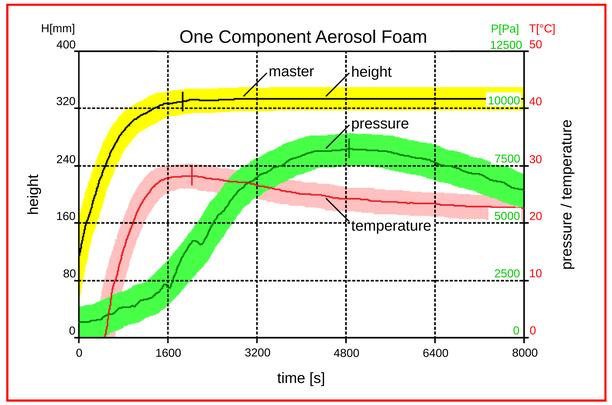

Fig. 2: Rise height (H), rise pressure (P), and reaction temperature (T) are simultaneously recorded by the software FOAM. The curves show the reaction of a **O**ne **C**omponent **F**oam (OCF) measured with the **OCFM**. The colored areas are master curves which can be used in quality control.

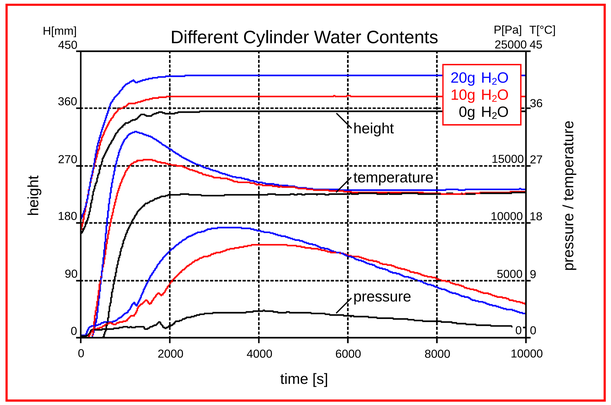

Fig. 3: Graphical overlay of three **OCFM** measurements made with the same formulation. The cardboard cylinders were impregnated with different quantities of water. Higher water contents cause higher rise height as well as higher reaction temperature and significant rise pressure.

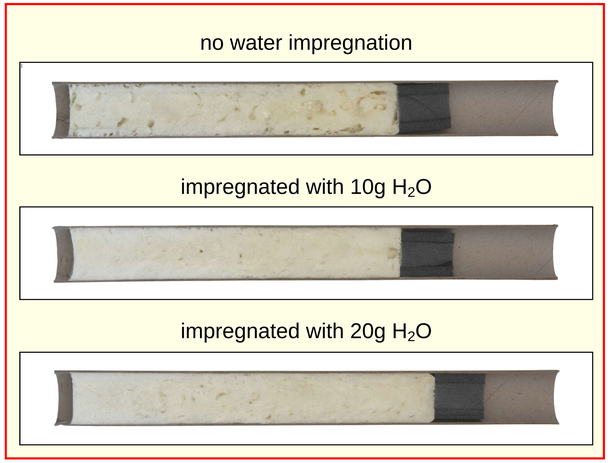

Fig. 5: Cross section of three OCF samples measured with different water contents in the cardboard cylinder.

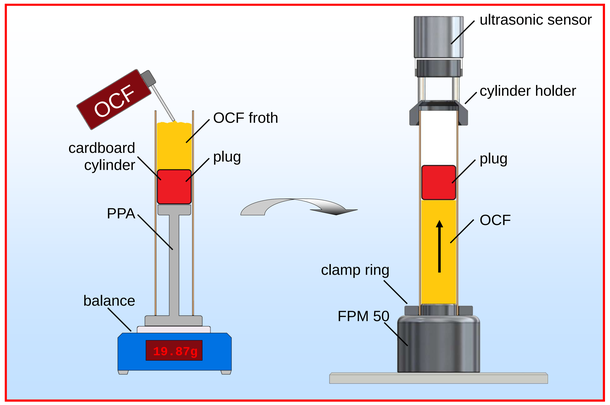

Fig. 4: The OCF froth is filled into the narrow cardboard cylinder which is placed on a balance. The level of froth is determined by the position of the plug in the PPA. The cylinder is turned upside down and clamped onto the FPM 50. The plug follows the foam expansion towards the ultrasonic sensor.