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Measurement of Physical Parameters in the Production of Slabstock Foams

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ABSTRACT

Laboratory devices for measuring foam parameters of small samples have reached a high standard in recent years. They are capable of measuring rise height, start time, rise time, reaction temperature and they determine gel time from the rise pressure data. The latest improvement is recording the dielectric polarization and plotting the curing behavior [1]. The main agenda of these measurements is to test the reaction of chemical formulations under laboratory conditions, however there has been very little information available on how the same chemistry would react with production quantities typically used in a full size slabstock production line.

Introducing the new stand alone probe SubFoam Puck*, Format Messtechnik GmbH, Karlsruhe created a new approach for testing foam in cooperation with Elastogran GmbH, Lemförde, Germany. The SubFoam Puck (fig. 1) is a ruggedized battery powered device that can be placed on the bottom of a mold or on the conveyor of a slabstock machine. Its upper surface is completely covered with a dielectric polarization sensor of the CMD type [2] that can measure the gel point and the curing behavior of the foam. The SubFoam Puck is also equipped with two temperature sensors; one on the surface and one rod shaped pointing vertically into the foam core. All data is transferred wireless to a PC and displayed on-line in a graph.

Measurements have been made at Elastogran in a $2m^3$ test mold using a HR TDI slabstock formulation based on Lupranol® 2095 and Lupranol® 4800 in combination with Lupranat® TDI 80. The foam rise profile is being measured by the ultrasonic device SONIC JOKER, while simultaneously measuring the dielectric polarization and the core temperature. The time dependant data is displayed in figure 2. Another test was made in a slabstock production line, where the SubFoam Puck transmitted data through a foam bulk of more than 30m length without any failure (fig. 3).
The software SUBFOAM, which is specially designed for this application, performs the user communication and the data handling. It has an export function generating a file format that can be read by the software FOAM of the Foam Qualification System FOMAT. Physical parameters obtained by the SubFoam Puck can be superimposed on laboratory data for small foam samples.
The SubFoam technique opens a wide field of new investigations into slabstock foams as well as in molded foams and even CASE formulations.

*Patent pending

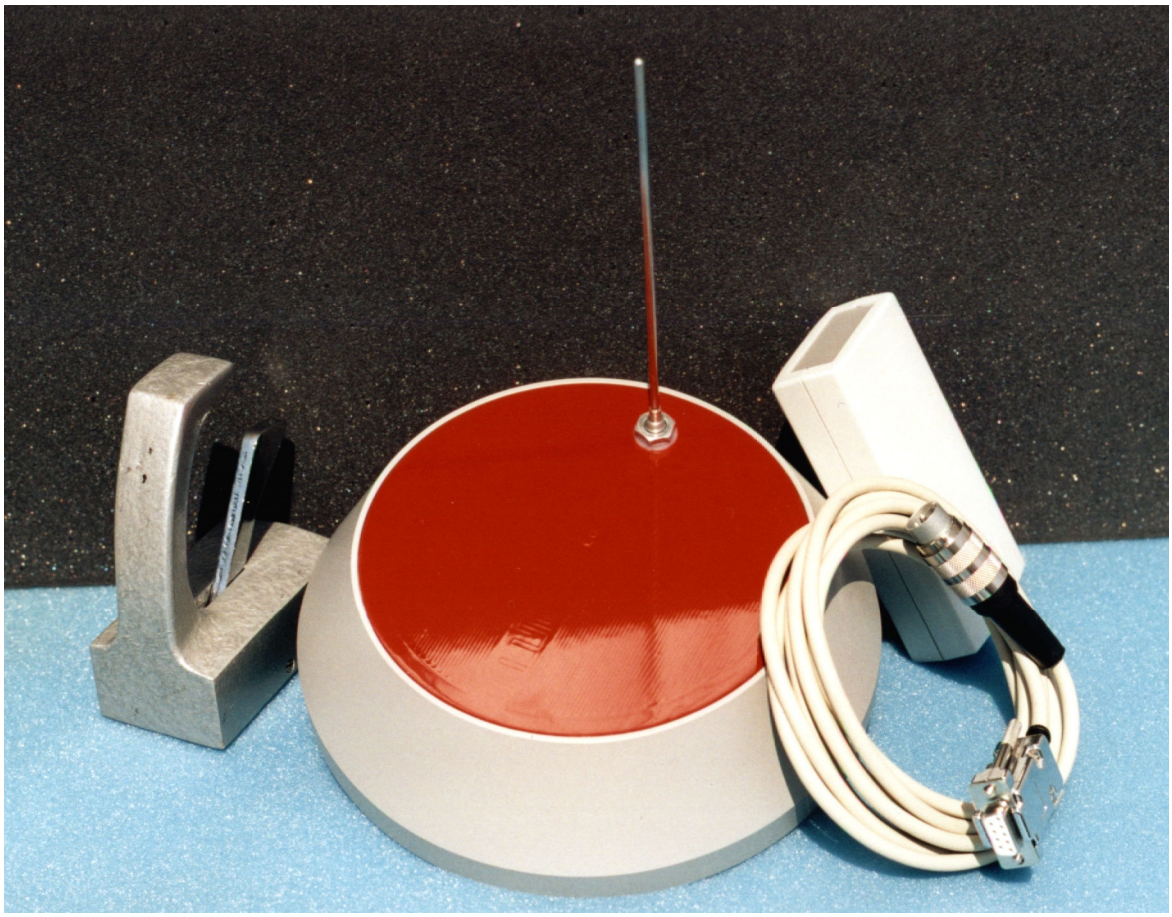


Figure 1. *The SubFoam Puck probe is equipped with a CMD-Sensor (red) and a sheathed thermo-couple. The switch magnet (left) aids the recovery of the stand-alone device. Communication is performed via the wireless serial interface communication line (right).*

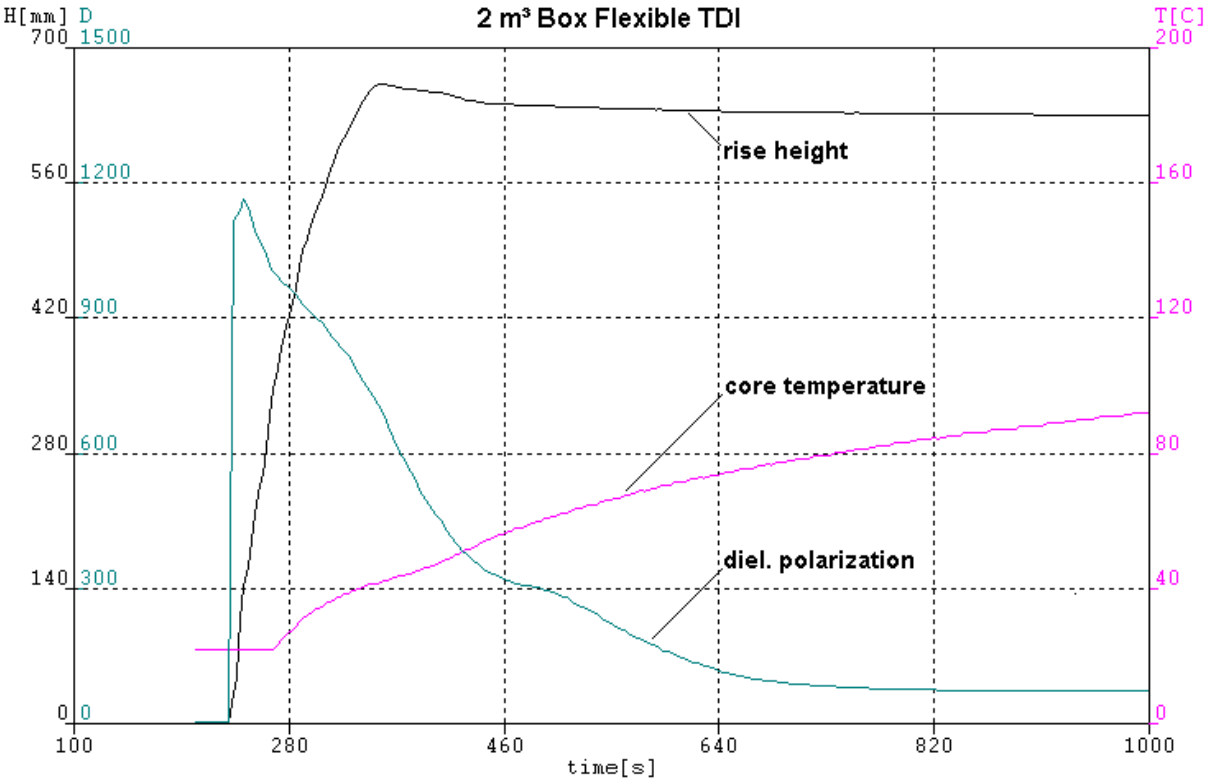


Figure 2. *The dielectric polarization and the core temperature are measured with the CMD-sensor and the thermocouple of the SubFoam Puck. The rise height curve is recorded by the ultrasonic device SONIC JOKER. The formulation bases on Lupranol 2095® and Lupranol® 4800 in combination with Lupranat® TDI 80*

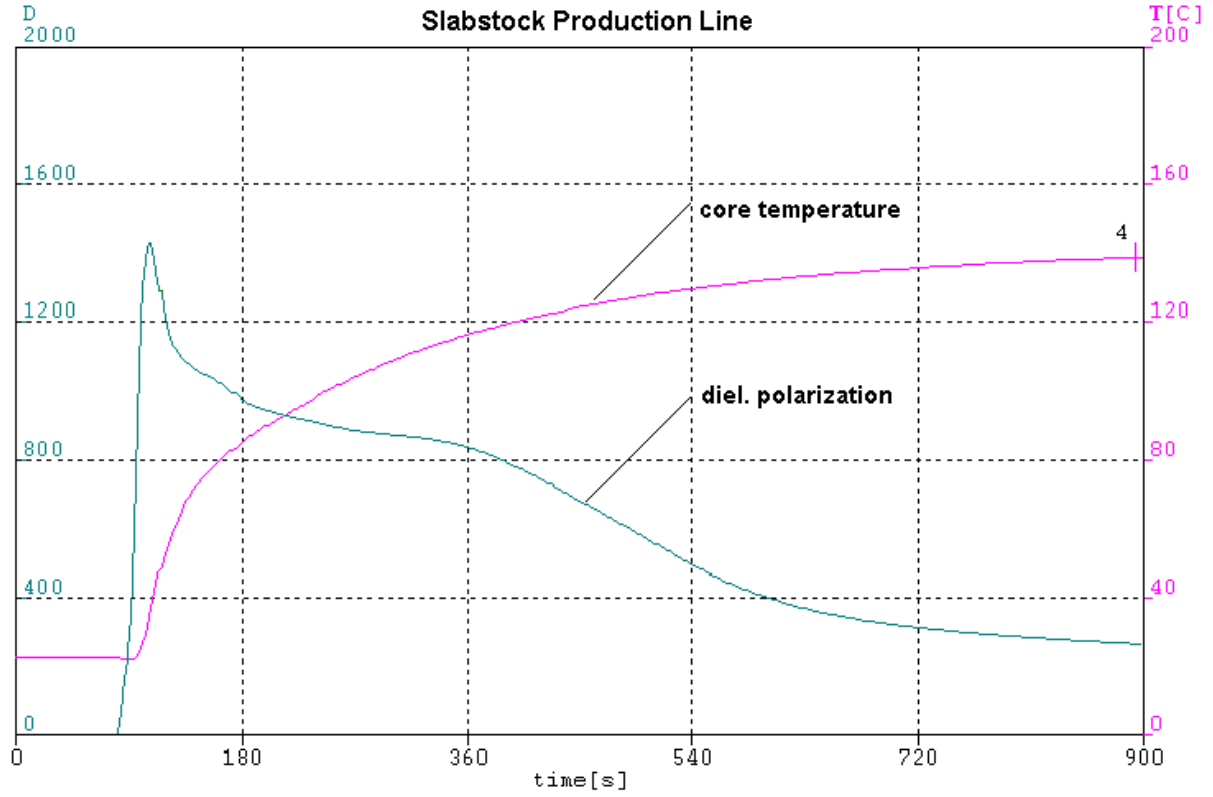


Figure 3. *Dielectric polarization and core temperature curve of a slabstock foam measured with SubFoam Puck in a production line of Otto Bock.*

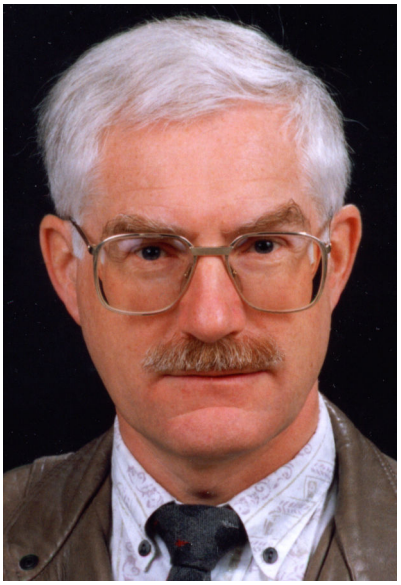
REFERENCES

1. B. Hofmann, J. Muetzelfeldt, “Qualification of Polyurethane Foams”, plast europe , 4/2001, translated from Kunststoffe 91 (2001) 4, pp. 50-53.
2. Bernd H.W. Hofmann, D. Jeffrey Gross, “Dielectric Polarization Measurement with CMD Provides New Insight into the Foaming Process”, conference proceedings, Polyurethanes EXPO 2001, Columbus, Ohio, pp. 589-591.

NOTES

BIOGRAPHIES

Bernd H. W. Hofmann



Dr. Hofmann received his Ph. D. in solid state physics from the Technical University of Karlsruhe, Germany, in 1976. He has worked in the field of conventional and nuclear physical engineering at the Karlsruhe Research Center, for ABB Reaktor and other companies. Dr. Hofmann is director of Format Messtechnik GmbH since 1994.