

Measurement of the reaction profile and the Pot Life of PU-CASE materials

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ABSTRACT

Standard laboratory methods for testing the reaction profile of CASE material are mainly concerned with the measurement of mechanical and thermal parameters. The viscosity of the reacting liquid is measured by using rotational or vibrational viscometers. The disadvantage of these devices is that the rotational or vibrational parts influence the setting of the material. They are also difficult to recover after a test. Additionally viscometers cannot be applied to very fast curing systems due to their handling delay.

Format Messtechnik GmbH, Karlsruhe, Germany has developed a new technique for measuring the reaction profile and the pot life of CASE materials: The Pot Life and Curing Monitor device * SubCASE[®] (fig. 1) provides both: Simple handling and reliable measurement data. The mechanical design of SubCASE combines a dielectric polarization sensor with two temperature transducers. The dielectric polarization is the key parameter that provides insight into the electro-chemical process during the transition from the liquid mixture of polyoles, additives and isocyanat to finished CASE material with the desired properties. The test container is made of a replaceable cardboard cylinder and a dielectric polarization sensor consisting of comb shaped electrodes forming a plane capacitor. It is mounted onto the base plate of the SubCASE device and it is covered with a cling film thus avoiding any direct contact with the reactive mixture. Polarization data is obtained from the very beginning of the chemical reaction until the end of the curing process. A temperature probe is positioned in the center of the dielectric polarization sensor measuring the reaction temperature at the bottom of the CASE sample. The core temperature is measured with an additional thermocouple (TC), which is positioned within the test sample. For process near testing and for best repeatability, the base plate can be heated up to any process relevant temperatures.

Measurements using SubCASE have been made with polyurethane cast skin formulations. Fig. 2 shows the test results of two formulations with a different amount of catalyst. The black curves show the result of a test, which was carried out with a standard formulation. The red curves show the reaction profile of a sample with 200% excess of catalyst. The dielectric polarization vs. time curves show a faster curing of the material. The temperature vs. time curves describe the exothermal reaction. The pot life and the curing are determined by the user-friendly software SUBCASE using polarization and temperature criteria. The creation of master curves (fig. 3) for QC is supported by the software. The new measurement technology gives a detailed insight into the reaction profile of Coatings, Adhesives, Sealants and Elastomers and is easy to use in QC testing.



Figure 1. Test device* SubCASE for measuring the pot life and the curing of Coatings, Adhesives, Sealants and Elastomers (CASE).

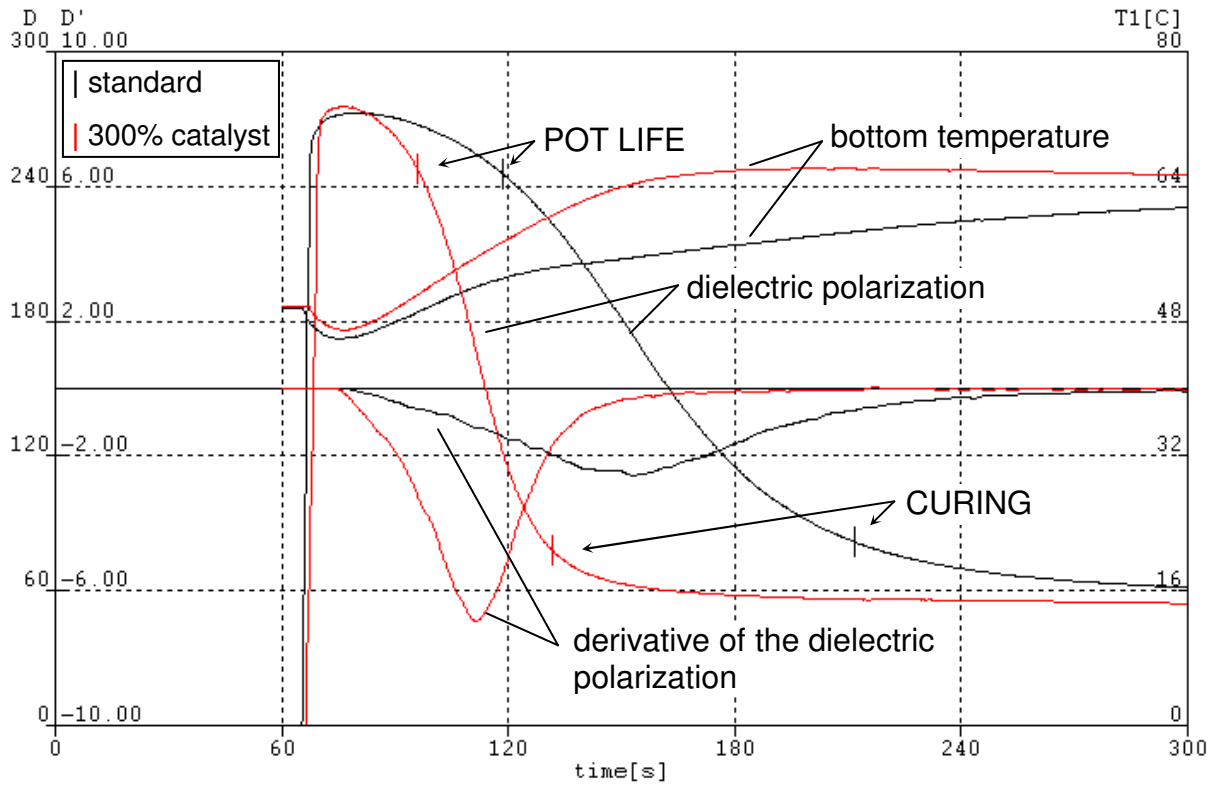


Figure 2. Graphical display of the dielectric polarization D , the derivative of the dielectric polarization D' and the bottom temperature $T1$ for two polyurethane cast skin formulations with different amount of catalyst.

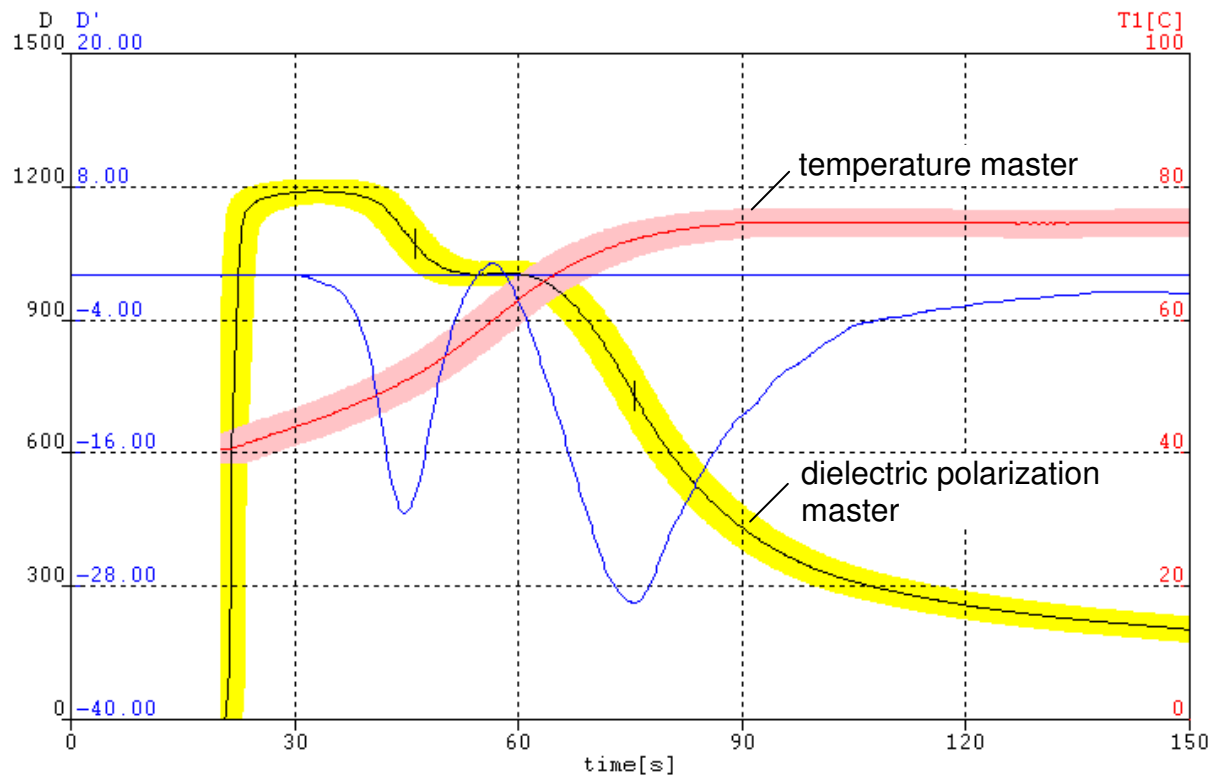


Figure 3. Graphical display of a dielectric polarization master and a temperature master generated by the software SUBCASE. The curves were obtained with a casting compound.

NOTES

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*Patent pending

BIOGRAPHY



Erland Hofmann

Dipl.-Ing. Erland Hofmann graduated in systems engineering at the technical university of Karlsruhe, Germany. Since 1998 he has been employed with Format Messtechnik GmbH in the field of development and application engineering. Today he is manager for new technologies in polyurethane testing.