

GELNORM® - DE



GELNORM® - DE is a novel measuring instrument for establishing the curing reaction of two-component reaction resin systems (thermoset resins). The new instrument is based on the determination of a function of electrical conductivity as well as the capacitance of a resin sample. This electrical function enables to trace the curing process over the whole regime of the chemical reaction.

Fig. 11 shows that the electric function as determined with GELNORM - DE is inversely proportional to the viscosity of a polymer sample. Hence, the instrument provides new possibilities to investigate the curing reaction of reaction resins such as:

- Epoxy resin
- Silicone rubbers
- Polyurethane resins
- Polysulphide rubbers
- Polyester resins

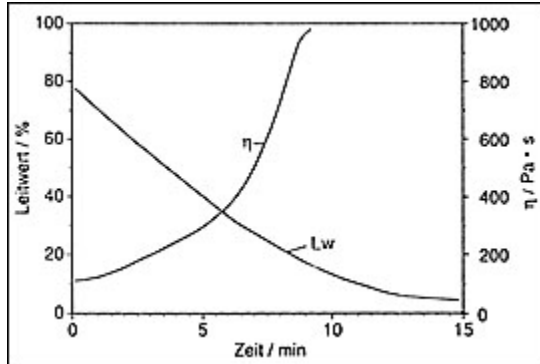
The electrical measuring technique offers numerous advantages compared to the various mechanical methods. In contrast to the conventional rheological approach (based e.g. on rotation- or shear viscosimeters), the polymer sample is in no way and at no time subject to any kind of mechanical forces. Thus, any kind of mechanical distortion of the polymer structure during the curing can be excluded.

The special design of the sensors (absolutely flat and thin, 17 x 55 x 0.04 mm) enables measurements to be made at almost any place. For example, it is possible to measure the hardening sequence of thin layers, large volumes of resin and also directly in a prepreg laminate. Experiments with GELNORM - DE can generally be made under standard conditions both at room temperature and also at elevated temperatures up to 200°C.

The instrument is very sensitive and the results show a high level of reproducibility. It offers reliability in operation and is easy to use and maintain. Hence, GELNORM - DE is not only suitable for research and development, but also in many areas of quality control.

Tests can be plotted simultaneously by either a line recorder or a X-Y-plotter. All results remain stored and can be replotted until the next experiment is started. Using a special program, the data can be transmitted to a computer for further data analysis, using MS-Excel.

Five different limiting values for the conductivity function can be preselected and thus individual processing times can be determined simply and without plotting the whole curing experiment.



DESCRIPTION OF INSTRUMENT

GELNORM - DE (Ref. 160.01) consists of a control unit which is based on a process controlled measuring system and a specially designed sensor DE. By means of this sensor, an electrical conductivity function (with also a capacitive contribution) of the resin can be determined. As discussed above, the conductivity measurement correlates with the viscosity of the resin mixture.

A liquid crystal display is used to display all functions and parameters. All selections and inputs can be made by a menu-driven program.

THERMOSTATIC CONTROL

A prerequisite for a high reproducibility of the experiments with GELNORM - DE is an optimum thermostatic control of the sample. The measurements can either be carried out at room temperature or using the Electric Heating Block DE (Ref. 160.60) designed for GELNORM - DE to provide the desired thermostatic control for temperatures up to 200°C. The temperature is regulated with the Control Unit TC-2 (Ref. 70.01).

MEASURING PROCEDURE

1. PREPARATION OF THE SPECIMEN MIXTURE

Weigh 100 g of reaction resin (deviation of 1 % permitted according to DIN 16 945) in a beaker.

Weigh hardener and accelerator according to instructions, accurate to 0,01 g. After thorough mixing (approx. 1 minute) the specimen mixture can be applied to the sensor, or the sensor can be dipped into the mixture.

2. MEASURING PROCEDURE

Before starting the measurement, the duration, desired limiting values and plotter settings (simultaneous/off) are to be selected. Having finished the sample mixture, the start button is pressed and the measurement starts.

3. EVALUATION OF THE DATA:

All data are stored and can be plotted simultaneously or later. When reaching the selected limiting values, the plotter marks the point in question and the desired signal is switched on (optically or acoustically). The data remain stored until a new measurement is started. Using a zoom-function, the curing-function can be enlarged, if necessary, and plotted with optimized resolution.

TECHNICAL DATA

Temperature range	From room temperature up to 200°C (heating block DE)
Operating voltage	220 V / 50 Hz oder 110 V / 60 Hz, $\pm 10 \%$
Plotter connection	RS-232, 9600 Baud D-Sub Stecker
Plot Data Format	HPGL
Measuring-Sensor	Special GIA Sensor Ref. 160.25 short (L = 55mm) Ref. 160.30 long (L = 330mm)
Measuring principle	Process controlled measurement signal
Program memory	Eprom
Data summary	Battery-RAM
Time/Date	Actual time module