ONset NETZSCH

CUSTOMER MAGAZINE

Edition 27 | December 2023

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Editorial

Dear Reader:

The world finds itself in a state of ongoing change, and geopolitical conditions affect our day-to-day lives in many ways.

With this in mind, it is our pleasure to introduce our newest innovations – tools to help you rise to these challenges. Our thermal analysis instruments enable you to better understand your materials and thus to incorporate more sustainability and higher quality into the design of your products – an accomplishment of which we are quite proud.

To begin, we present our new DSC 300 *Caliris*® instrument series – one of the most comprehensive and reliable DSC families for materials characterization on the market.

With our new protected heat flow apparatus, the TCT 716 *Lambda*, we are now able to close the gap between a conventional HFM and an LFA through larger samples with thermal conductivity of up to 0.03 ($m^2 \cdot K$)/W. Find out more about this starting on page 8.

In rheology, too, we are serving up something novel: The newly developed *FreeFlow* dies for our Rosand high-pressure capillary rheometers deliver more precise values for extensional viscosity than ever before.

In the *CUSTOMERS FOR CUSTOMERS* column, Dr. Andreas Cziegler from the Austrian Foundry Institute (Österreichisches Gießerei-Institut) in Leoben, Austria, offers thought-provoking insight into the use of our LFA 427 toward greater sustainability in the creation of construction materials.

Last but not least, I would like to present NETZSCH 360° – a brand-new interactive 3D viewing function of our analytical instruments. You can use it to position them – to scale – into your lab. Flip to page 17 to see how this works with our existing portfolio of almost 30 products.

I hope to have piqued your interest and now wish you an enjoyable read of our **on**set 27.

Ingo-Ludwig Hammer
Managing Director and CFO

Three Is Just Right! The DSC 300 *Caliris*® Family Is Now Complete

Dr. Gabriele Kaiser, Division Managament for Life Sciences

Fig. 1. The DSC 300 *Caliris*® Family

Following the DSC 300 *Caliris*® *Supreme* and the DSC 300 *Caliris*® *Select*, the third device in this series, the DSC 300 *Caliris*® *Classic*, was recently introduced. Read on to find out what these instruments have in common, what the differences are between them, and what makes the DSC 300 *Caliris*® *Classic* so unique in its class.

The Right Device for Every Laboratory

Every laboratory and every application has special requirements to which the respective measuring devices must be tailored. The DSC 300 *Caliris*® family by NETZSCH is so versatile and adaptable that it can be integrated into almost any laboratory environment. The user can choose between the extremely flexible DSC 300 *Caliris*® *Supreme* with interchangeable modules (= furnace sensor units); the DSC 300 *Caliris*® *Select*, with a predefined module that can be replaced with a module of the same type; and the new DSC 300 *Caliris*® *Classic*, which is characterized by its small footprint and very high user friendliness.

All three versions share a distinctive instrument design which focuses on the essentials. The heart of the front panel is the touch display (optional for the DSC 300 *Caliris*® *Classic*), by means of which measurements can be started and stopped, and measurement progress can be monitored. The illuminated, color status display also provides information from a distance about the current status of the device – "measurement is running", "measurement is finished", "device waiting for input", etc. The respective measurement and evaluation software, *Proteus*®, offers everything you would expect from state-of-the-art software – and even more, such as automatic evaluation possibilities or *Proteus*® *Search Engine*, which can be used to filter and find data and measurement results in no time.

Which DSC 300 *Caliris*® Suits Your Requirements Best?

Thanks to its proverbial flexibility, the DSC 300 *Caliris*® *Supreme* is suited for sophisticated research tasks in industry and academia. Along with the variety of accessories, the available modules (S = Standard, P = Polymer, H = High Performance), which can be changed out by the user within a short time, are particularly noteworthy in this context. This allows the instrument's configuration to be adapted quickly and easily to changing conditions.

The DSC 300 *Caliris*® *Select* is the right device for research & development or contract laboratories looking for high sample throughput with almost unlimited application possibilities. The automatic sample changer with up to 192 positions handles measurements precisely and reliably overnight or over the weekend. *Proteus*® automatically evaluates the measured data and automatically stores the results and/or analysis states in the locations you specify.

The DSC 300 *Caliris*® *Classic*, on the other hand, is ideal for routine tasks in quality assurance and for teaching. The robust instrument requires only a small amount of space and guides users safely through the definition of a measurement with the intuitive *SmartMode* user interface. Once the measurement is finished, software

The DSC 300 *Caliris®* Family

functions like *AutoEvaluation* and/or *Identify* can take over the evaluation of measured curves and the comparison with reference data, if so commanded.

In an industrial environment, it is important to organize data such that it is traceable and available for reports or further analysis. With LabV®, NETZSCH has a partner with a cloud solution that bundles all test data from all instruments used in one place and makes it available to you for further activities. All instruments of the DSC 300 *Caliris®* series are LabV®-primed, i.e., already prepared for data exchange with LabV®.

DSC 300 *Caliris® Classic*: Small, But Powerful

With just under 42 cm, the DSC 300 *Caliris® Classic* is only around ¾ the width of its sisters (DSC 300 *Caliris® Select* and *Supreme*). It is, however, a powerful dynamic differential scanning calorimeter that covers a wide range of applications – from food, pharmaceuticals, cosmetics and polymers to inorganic materials.

Particular attention was given to designing the software for simple and intuitive operation. This means that the same method can be used again and again for frequently recurring measurements. A method includes the measurement conditions such as temperature program, gas flows, and calibration curves used, but it is also possible to integrate whether and in what form the data should be evaluated and exported as data and/or results. Figure 2 shows an example of the corresponding method window in

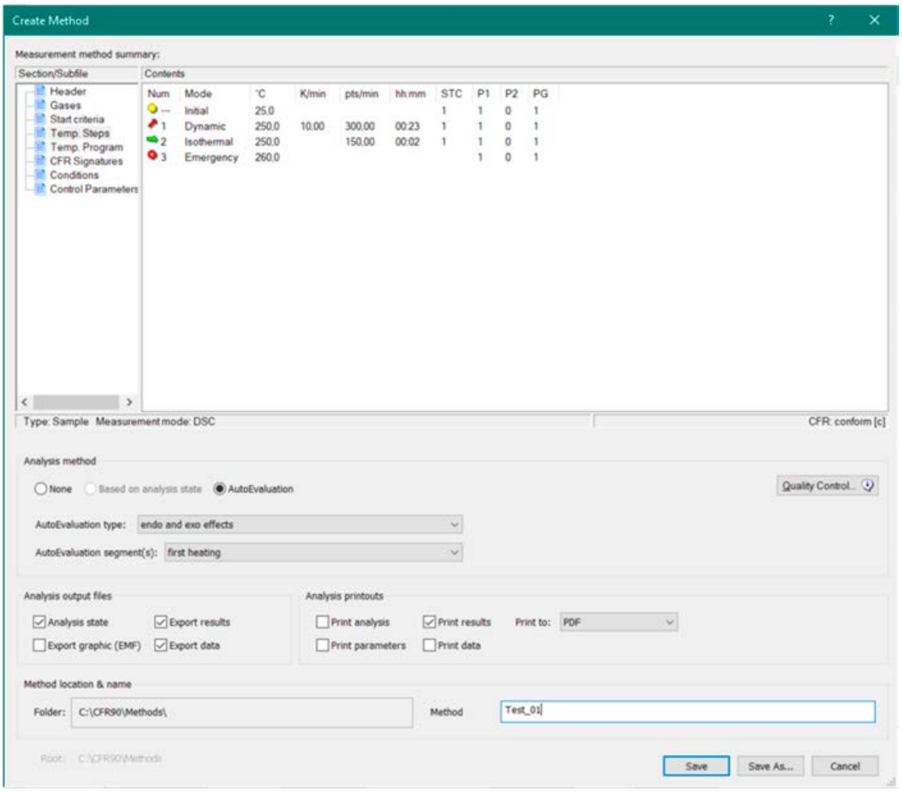

Fig. 2. Example of a method window (German, English, French, Russian*, Chinese* and Japanese* can be selectetd as user lagnuages)

*requires the corresponding language package or operating system language

the software. The measurement conditions can be retrieved in the upper part (a temperature program can be seen that includes heating to 250°C with a subsequent short isothermal phase of 2 minutes), while the analysis method and the form of output can be selected in the lower part. In this example, these are *AutoEvaluation* as the analysis method and <Analysis state>, <Export results>, <Export data> and <Print results to PDF> as the analysis results or printout.

AutoEvaluation is capable of finding and evaluating effects in curves independently (exothermal and endothermal effects in Figure 2). It is recommended to select this function if you would like to get a second opinion on the evaluation.

Alternatively, <Based on analysis state> is available. This provides the option of integrating an evaluation macro created on a sample curve with corresponding quality criteria (= tolerance limits under <Quality Control>). For curves that are evaluated this way, the system always outputs directly whether the results are within or outside the defined tolerances.

The DSC 300 *Caliris*® Family

However, users retain full control over the data and there is always the option of only obtaining the pure measured data (without evaluation) by means of <None>.

In the method shown in Figure 2, an analysis state will be generated at the end of the measurement and the data and results will be automatically exported (the results in both csv and PDF format, for example).

Even Beyond 500°C

With a maximum temperature of 600°C (regardless of the cooling option used), the DSC 300 *Caliris*® *Classic* can also be employed for the investigation of certain types of glass. Borosilicate glasses (or so-called type 1 glasses) feature high chemical (hydrolytic) resistance and are often used as primary packaging for pharmaceuticals, e.g., in the form of vials, syringes or ampoules for injection solutions.

Figure 3 shows a measurement on a borosilicate glass sample, where the determined glass transition temperature is evaluated in two ways: once as a mean value (referred to as Mid) and once as T_f according to the Richardson method [1], which is also mentioned as an equal area method in some standards, e.g., in ISO 11357-2.

Conclusion

With the DSC 300 *Caliris*® family, you are always making the right choice. The DSC 300 *Caliris*® *Classic* impresses with its small footpring and clever software solutions.

Literature

[1] Richardson M.J., Comprehensive polymer science: The synthesis, characterization, reactions & applications of polymers. Polymer characterization. Pergamon Press, NY, vol. 1, chapter 36, Thermal Analysis, 1989, pp. 867 - 901

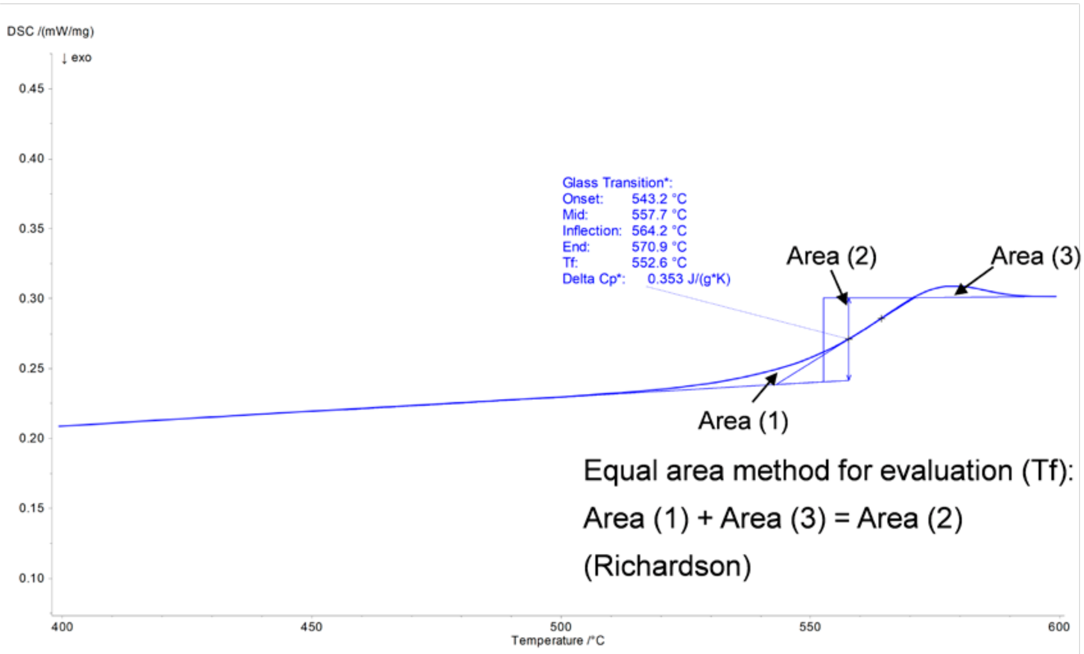

Fig. 3. Glass transition of a borosilicate glass with relaxation; sample mass: 41.92 mg, heating rate: 10 K/min, *Concavus*® crucibles.

New Management Team in the Analyzing & Testing Business Unit

Ingo-Ludwig Hammer, CFO (left) and Dr. Jürgen Blumm, CEO (right).

The shareholders of the NETZSCH Group and the management of NETZSCH Holding have transferred the position of CEO (Chief Executive Officer) of the Analyzing & Testing Business Unit to Dr. Jürgen Blumm. At the same time, he remains Managing Director of NETZSCH-Gerätebau GmbH (NGB).

Dr. Blumm will be supported in the management of NGB by Ingo-Ludwig Hammer, a long-term member of the management board who will also retain his position as CFO (Chief Financial Officer) of the Analyzing & Testing Business Unit. They took on their new positions on July 1, 2023.

After his studies of physics in Würzburg, Dr. Jürgen Blumm started his career at NETZSCH-Gerätebau in 1995 as an applications scientist in the applications laboratory, and took on its management in 2001. In this function, he supported sales worldwide, particularly in Asia, as an applications expert in the field of thermo-physical properties. Along with this, he drove forward "commercial contract testing" as a service.

In 2008, he joined the company's management team. Since then, he has been responsible for sales, service, marketing, and applications. He has distinguished himself through the successful development of international sales, including our subsidiary in Japan, as well as through the integration of several acquisitions.

Ingo-Ludwig Hammer, an experienced financial expert, took on the regional controlling of NETZSCH-Gerätebau GmbH in February 2002. For more than 20 years, he has been responsible for the financial sector of the Business Unit. Since 2020, he has been managing director of NETZSCH TAURUS Instruments GmbH in Weimar.

"We are looking forward to this new challenge and deeply value the shareholders' trust in us. We have a lot of plans and want to continue to grow profitably as we drive our international business. Our dedicated employees are a high priority for us. In the long term, we want to create attractive jobs here in Selb and all over the world, and to become not only the technology leader that we already are, but also a world market leader," states Dr. Jürgen Blumm.

Focus on Thermal Resistance – The New TCT 716 *Lambda* with Two Independent Test Stacks

Dr. Elisabeth Kapsch, Head of Applications & Services

Fig. 1. The TCT 716 *Lambda* Guarded Heat Flow Meter

Thermal Conductivity and Resistance

Thermal conductivity can be defined as how easily a material can transmit heat in the presence of an applied temperature gradient. It is used to characterize the thermal transfer behavior of a material at various temperatures. It is an important parameter because it is often used to describe whether a material is an insulator or a conductor. In the case of an insulator, the term thermal resistance is often used to describe how a material resists the flow of heat.

Thermal resistance is a key factor in the development and improvement of thermal management systems intended to prevent overheating and boost energy effectiveness. R-value (thermal insulance factor, unit [($m^2 \cdot K$)/W]) is a measure of the thermal resistance. The higher the R-value, the greater the insulating effectiveness. The R-value for any given insulation depends on its type, its thickness, and its density.

Thermal resistance is important in many areas. For example, thermal resistance is a critical part of a 3D printer's design because it affects melting and cooling of the print material. With proper thermal management and an understanding of thermal resistance, printing can be improved and errors can be avoided.

Thermal resistance is also important in the laser cutting process because it affects a material's ability to withstand high temperatures. Materials with low thermal resistance require slow cutting to avoid material damage, while materials with high thermal resistance can be cut at higher speeds with little distortion or melting.

Also in plastic injection molding, thermal resistance affects the functionality and quality of the finished product. Plastic parts with unfavorable thermal properties can warp, crack or lose their shape during the molding process, resulting in defective products. It is important to choose a plastic with the right thermal resistance to ensure consistent quality and production efficiency.

Precise Determination of the Thermal Resistance and Thermal Conductivity

The new TCT 716 *Lambda* guarded heat flow meter (Figure 1) offers the ability to analyze samples with optimal dimensions: smaller than conventional HFM and larger than LFA samples. This makes it possible to perform tests on homogeneous and inhomogeneous materials with thermal conductivity values ranging from low to medium (Figure 2).

In this instrument, the accuracy of the measurements is greatly enhanced with a temperature-controlled guard that minimizes lateral heat losses from the stacks into the surrounding environment. This is particularly helpful at non-ambient testing temperatures where heat losses would otherwise yield erroneously lower measured thermal resistance values.

The system offers precise temperature control with a resolution of 0.1°C. It is equipped with multiple high-resolution resistance temperature detectors (RTDs) to accurately measure the thermal gradient across the stack and sample thickness.

TCT 716 *Lambda*

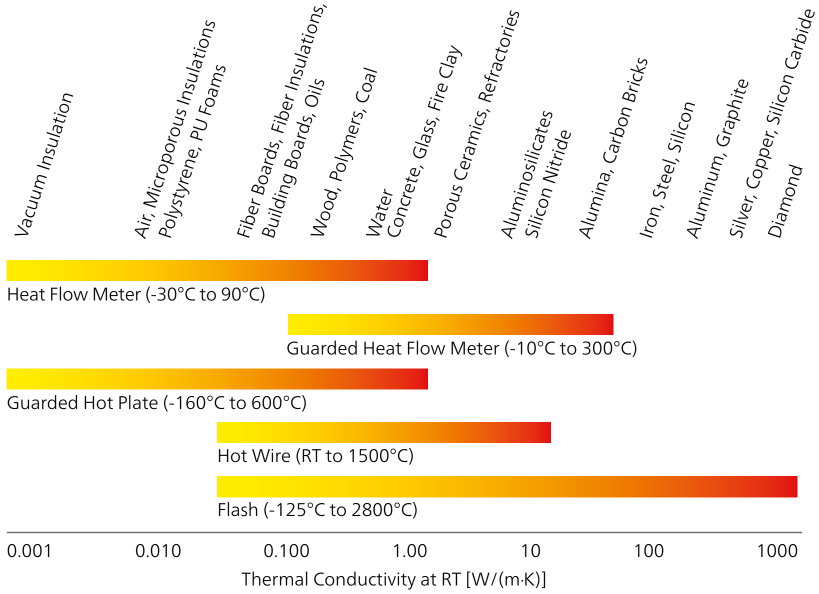

Fig. 2. Various methods covering a wide thermal conductivity range

Measurement Method

The specimen(s) are placed between two heated plates controlled at different temperatures. Resistance thermometers (RTDs) are mounted just below the plate surfaces for measurement of the temperature drop across the sample. To measure the heat flow through the sample, similar sensors are embedded in the upper and lower stacks. These signals are collected for calculation of the thermal conductivity once steady state is reached. When the software indicates equilibrium, the measurement is performed.

Unique Design – Two Test Stacks

The TCT 716 *Lambda* features a unique design with a left and right test stack, allowing tests to be carried out on a single specimen or simultaneously on two specimens (Figure 3). Clamping force and specimen thickness are independent for each stack. Both modules can operate over the entire temperature range from -10°C to 300°C. Not only does this arrangement increase the throughput of samples, but it also allows more data to be collected in a shorter period of time.

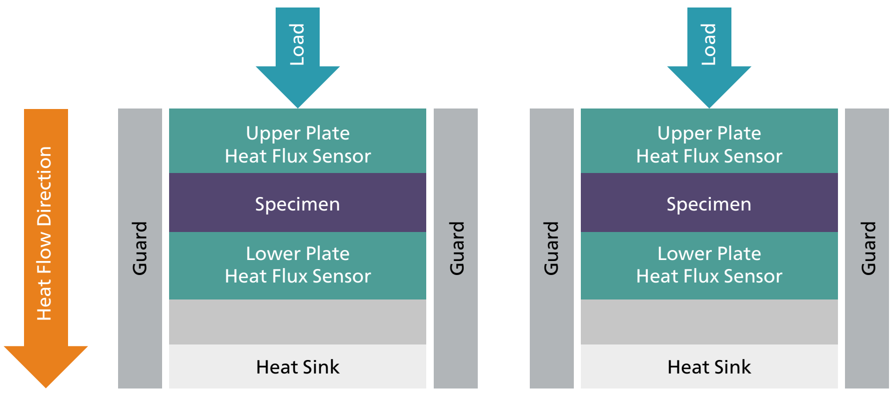

Fig. 3. Schematic diagram of the TCT 716 *Lambda*

TCT 716 *Lambda*

CO_2 Cooling

There is no longer any need for an expensive chiller unit to be installed. Unlike other GHFMs, this design allows for CO_2 cooling. This cooling method also allows for optimal temperature control. In addition, forced cooling of the instrument is possible.

Specimens and Measurement Range

Measurements are possible on round solid specimens in the low- and medium-conductive range between 0.1 and approx. 45 W/(m·K) (or within the thermal resistance range of 0.001 to 0.03 (m²·K)/W) such as polymers (filled and unfilled) and low-conductive ceramics and metals including porous specimens. The instrument simplifies sample preparation by eliminating the need to embed temperature sensors in the sample. A thermal interface paste is used to improve the thermal contact with the instrument plates.

The thermal contact between the instrument plates and the specimen is maintained reproducibly by the instrument's automatic load control.

Why Choose the TCT 716 *Lambda*

The TCT 716 *Lambda* provides a reliable and precise, non-destructive method for measuring the thermal conductivity and thermal resistance of a wide variety of solids, thus contributing to materials science research and product development. The system measures with high accuracy, achieving results well within the uncertainties of the reference specimen (Figure 4). Sample dimensions are 50.8 mm in diameter and up to 31.8-mm thick; this is larger than those used in LFA measurements, making the TCT 716 *Lambda* particularly advantageous for inhomogeneous samples. Calibration, temperature steps and pressure are fully automated by the software. In addition, only minimal training is required before the instrument can be used to its full potential.

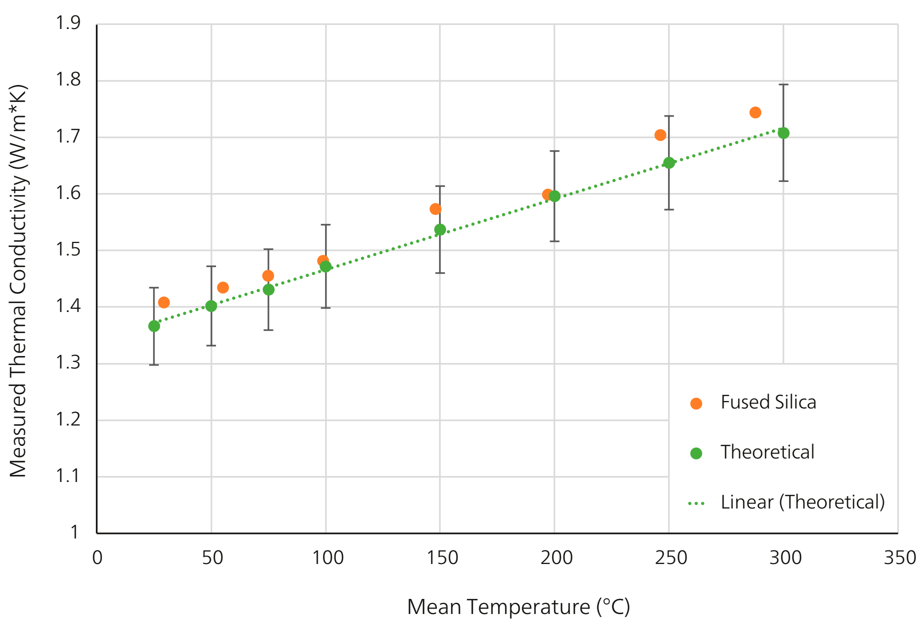

Fig. 4. Thermal conductivity of fused silica; error bars are ±5%; sample thickness 12.7 mm

Let It Flow – The New *FreeFlow* Dies for Exact Extensional Viscosity Values

Claire Strasser, Applications Laboratory, and Dr. Levente Szántó, Research & Development

How can one prevent problems during the blow-molding, extrusion or injection molding of polymers and get a quality-conform final product? For the most part, the answer lies in a good understanding of a material's rheological behavior under processing conditions (e.g., temperature, pressure and shear rate).

This is where the Rosand high-pressure capillary rheometer comes into play. This device is capable of mimicking processing conditions in order to determine the deformation and flow behavior of the sample during manufacturing.

Which Processing Issues Are We Talking About?

- Defects in the final product: These are associated with flow instabilities occurring during processing of the molten polymer [1]. These flow instabilities can be recognized in measurements performed with the Rosand high-pressure capillary rheometer. Adapting the formulation or die design, or working at a more adequate shear rate, will prevent them.
- Changes in volume/shape after extrusion (die swell): These can be investigated by measuring the diameter of the extrudate after exit from the die (laser die swell measurement).
- Wall-slip: This may happen for highly filled materials and polymers. Sometimes it is an unwanted phenomenon because it affects the orientation/stretching of the polymer chains, i.e., it results in less oriented or stretched polymer chains. However, it can be beneficial in postponing the appearance of surface defects in the final product (e.g., sharkskin) to higher shear rates. The occurrence of wall-slip can be analyzed with the Rosand high-pressure capillary rheometer, performing measurements with dies having the same length-to-diameter ratio (L/D) but different die diameter (Mooney correction).

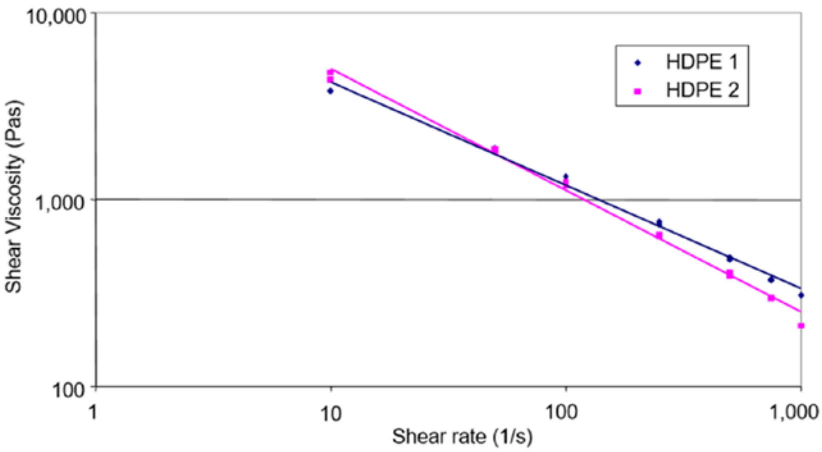

Fig. 1. Shear viscosity curve for two different HDPE materials

Thus, the Rosand high-pressure capillary rheometer not only enables identification of the processing-related problems in production, but also allows for a shorter development time, less waste and higher efficiency.

How Does the Rosand Work?

During a high-pressure capillary rheometer measurement, a piston moves downward at a constant speed and pushes a material through a die with known diameter and length (if it is a circular one) or known height, width and length (if the die is rectangular). The pressure is measured. Shear rate and shear stress are derived from the piston speed and pressure, respectively. These two values are used for calculation of the shear viscosity.

Shear and Extensional Viscosity in One Single Measurement

Viscoelastic materials deform not only under shear, but also under strain. In such a case, we no longer speak of shear viscosity, but of extensional viscosity. This is particularly important for processes involving elongation of the material structure, such as film blow-molding, filament stretching, gel-spinning, etc.

Figure 1 depicts the shear viscosity curves for two different batches of HDPE. They are almost identical and don't explain the sudden difference observed in product quality.

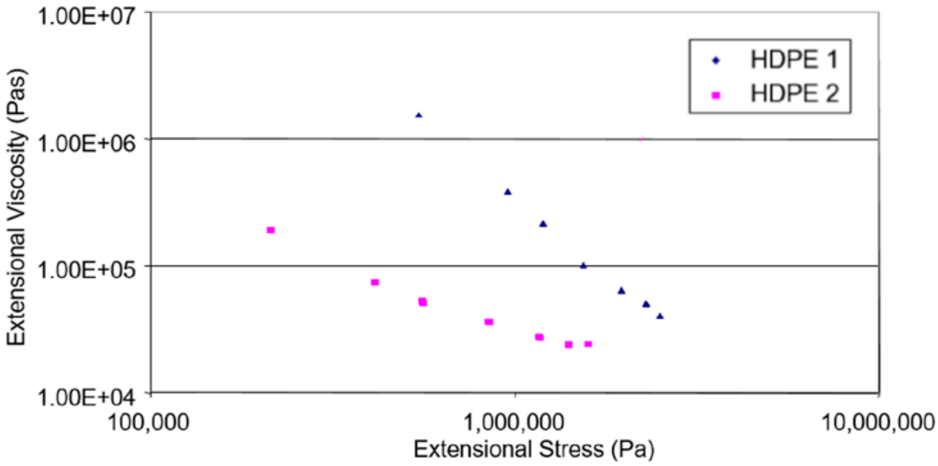

Fig. 2. Extensional viscosity of the HDPE materials

However, the two materials differ greatly in their extensional viscosity (see Figure 2). This is associated with the difference in the polydispersity index (measure of the molecular mass distribution of a polymer; 8.1 for HDPE 1 vs. 16 for HDPE 2). Actually, the extensional viscosity is highly sensitive to the molecular architecture and molecular weight distribution.

The Rosand high-pressure capillary rheometer allows for determination of the shear and extensional viscosity within one measurement. To do so, it uses a zero-length die simultaneous to the standard long die. The inlet pressure drop measured in the zero-length die is used to calculate the extensional viscosity according to the following equation (Cogswell method):

Extensional viscosity: $$\eta_e = \frac{9}{32}\,\frac{(n+1)^2}{\eta}\,\frac{P_0^2}{\dot{\gamma}^2} \quad (1)$$

η_e: Extensional viscosity [Pa.s]
P_0: Entrance pressure drop in the zero-length die [Pa]
$\dot{\gamma}$: Shear rate [s^{-1}]
η: Shear viscosity [Pa·s]
n: Power-law index

According to (1), the entrance pressure drop, P_0, enters into the calculation with a power of 2, so it is obvious that an increased entrance pressure drop will lead to a widely overestimated extensional viscosity. Unfortunately, such scenarios can easily occur as soon as the sample sticks to the die.

No Sticking for Exact Extensional Viscosity Results: The *FreeFlow* Die

To overcome this problem, NETZSCH offers the novel *FreeFlow* dies. Thanks to its new design, it entirely eliminates wall sticking, thus allowing for an exact measurement of the entrance pressure drop (Figure 3).

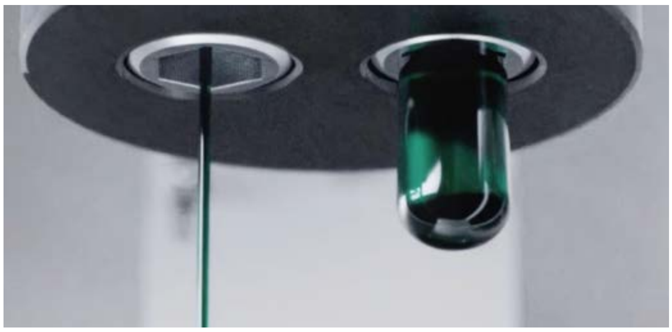

Fig. 3. Left: The design of the *FreeFlow* die prevents any sticking. Right: Same sample measured with the standard die.

The New *FreeFlow* Dies

Figure 4 displays the uniaxial extensional viscosity measured on the same sample with the standard orifice die and with the new *FreeFlow* die. Sticking on the standard zero-length die leads to overestimated entrance pressure drop values and thus to overestimated uniaxial extensional viscosity. Furthermore, due to the accumulated materials in the downstream region, the pressure may highly oscillate. Hence, the extensional viscosity oscillates, and no strain hardening can be observed (red curve). Yet this phenomenon is present and is detected by measurements with the *FreeFlow* die (blue curve): The extensional viscosity increases by approx. 60% between 8 s^{-1} and 100 s^{-1}.

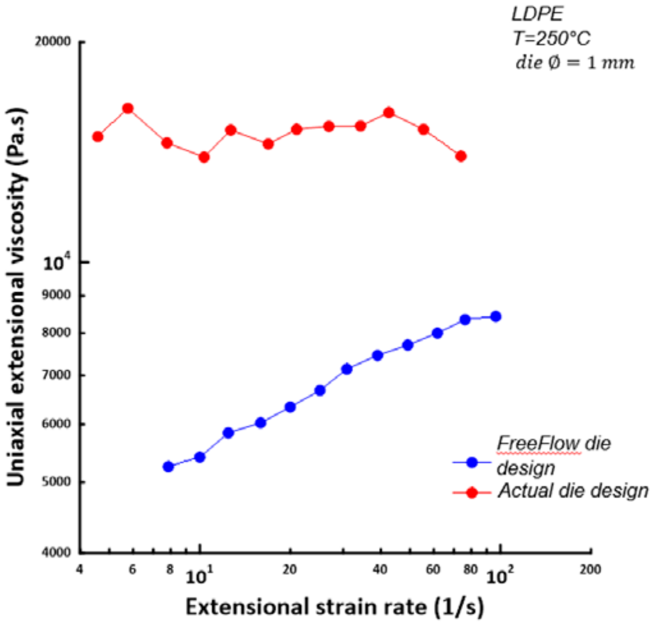

Fig. 4. Uniaxial extensional viscosity measured on LDPE with the standard orifice die (red curve) and the new *FreeFlow* die (blue curve).

Some processes don't involve a circular-shaped die, but a rectangular one, for example, for the production of polymer films by cast film extrusion. In this case, determination of the planar extensional viscosity is of interest, for instance to detect the issues of neck-in that may appear during processing. For such investigations, rectangular orifice and long *FreeFlow* dies are also available. This allows for easy determination of the planar extensional viscosity (Figure 5).

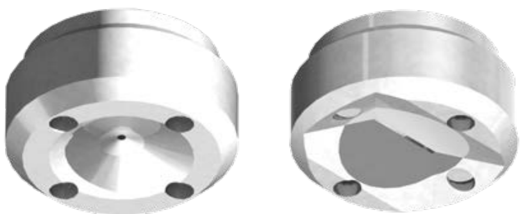

Fig. 5. Circular (left) and rectangular (right) *FreeFlow* orifice dies for easy determination of the uniaxial and planar extensional viscosity, respectively.

Literature

[1] Extrusion Defects and Flow Instabilities of Molten Polymers, B. Vergnes, International Polymer Processing, Volume 30 Issue 1

Thermophysics for Sustainable Building Projects –

The NETZSCH LFA in Use at the Österreichische Gießerei-Institut

Dr. Andreas Cziegler, Research Assistant in the Physical Laboratory and Simulation Group at ÖGI

Österreichisches Gießerei-Institut (ÖGI)

The Österreichische Gießerei-Institut (ÖGI, Austrian Foundry Institute) is the joint research institute of the Austrian foundry industry with about 40 employees. It handles issues in the foundry industry and operates its own test foundry, where application-oriented research is carried out in the respective casting processes and casting of alloys. Furthermore, the ÖGI is also one of the leading testing laboratories in Austria.

As a non-university research institute, ÖGI is accredited as a testing laboratory for 26 test methods by Accreditation Austria in the operational areas of chemical laboratory, mechanical laboratory, physical laboratory and metallography. The testing laboratory complies with the requirements of EN ISO/IEC 17025:2017.

In the thermophysical laboratory, material parameters such as thermal conductivity, thermal expansion, and heat capacity are determined from very low to very high temperatures. The data are of great importance for any material development, but also serve as input parameters for numerical simulations. The range of materials in the thermophysical laboratory is not, however, limited to metallic alloys, which are primarily characterized in the solid state but also in the liquid state. It also includes sand-based molding materials used in the foundry industry, building materials such as gypsum and various woods or wood-based materials, glass varieties and ceramic materials.

Wood-Based Materials for Sustainable Building Projects

Wood as a building material has experienced a strong upswing in recent years. Its share in future building projects continues to rise due to the positive properties of wood in terms of reducing CO_2 emissions, low energy consumption during production and also its thermal insulation properties. In this context, wood-based materials are being employed not only in single-family houses, but also increasingly in multi-story buildings or in high-rise construction projects. This allows for sustainable redensification in urban areas

The NETZSCH LFA at ÖGI

However, the increased use of wood-based materials also places higher fire-protection requirements on wood as a material. The fire resistance of wood constructions must be proven, and to date, this has been done by means of time-consuming and cost-intensive fire tests. Therefore, there is a high interest in the application of numerical simulations. As input data for the calculations, thermophysical data for the wooden materials in different states are again required: for moist wood, dry wood, and pyrolyzed material up to the high-temperature range of 900°C. These data are collected at ÖGI with the analysis instruments by NETZSCH-Gerätebau GmbH; the LFA 427 (Figure 1) is used for this, among others.

Fig.1. The NETZSCH LFA 427 at ÖGI

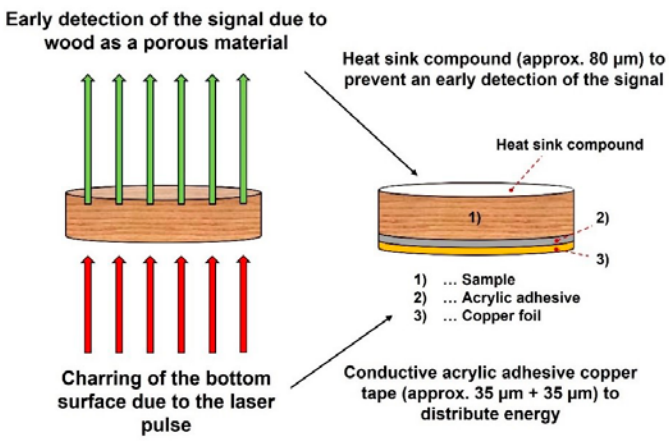

Fig. 2. Challenge in the characterization of wooden-based materials by means of LFA (schematic) and problem solving by a coating system

A particular challenge in the characterization of wooden-based materials up to the high-temperature range of several hundred degrees is presented, on the one hand, by the porous character of wood and, on the other, by the decomposition of the material under the influence of high heat exposure, as is the case with laser shots in the LFA. For the measurement of wood up to the thermal stability limit (start of pyrolytic decomposition), the samples prepared must be suitably coated. To this end, an adhesive copper foil (approx. 35 µm copper foil + 35 µm acrylate adhesive) on the underside of the sample has proven to be a suitable coating. Due to the porous character of wood, the samples must also be coated on the upper side in order to prevent detection of the temperature rise on the upper side of the sample from the pore space. For this purpose, the samples were coated with a thin layer of thermal paste (approx. 80 µm) (schematic in Figure 2). However, the coating affects calculation of the wood's thermal diffusivity due to the increase in thickness of the entire sample as well as the various materials. To estimate the influence of the coating, reference measurements were carried out with materials of similar thermal conductivity; these can be measured both with and without coating.

Figure 3 shows the measured thermal diffusivity of black Bakelite®. Related to the measured thickness of the sample, the coating leads to a lower thermal diffusivity (red curve in Figure 3) than for the uncoated sample (dark blue curve) due to the increase in rise time.

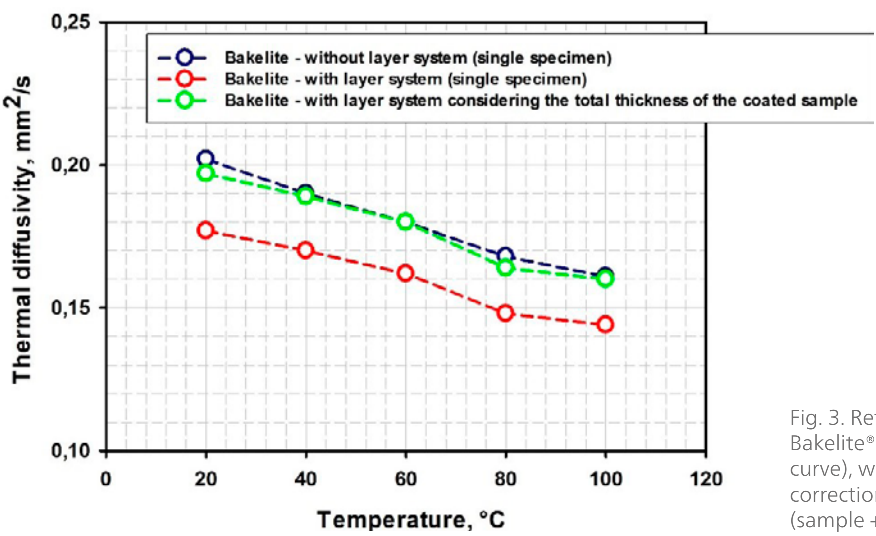

Fig. 3. Reference masurement of black Bakelite® without coating (dark blue curve), with coating (red curve) and correction of the entire sample's thickness (sample + coating, green curve).

CUSTOMERS FOR CUSTOMERS

By correction of the sample's entire thickness, the actual thermal diffusivity of the material can be approximated and the slight deviation can be considered as another term in measurement uncertainty. The thickness correction can be performed directly with the function integrated in the NETZSCH *Proteus*® LFA software in this case.

Measurement of the thermal diffusivity of pyrolyzed materials does not require a coating. Due to the porous character of wood or wood charcoal, however, the laser pulse is no longer fully absorbed at the surface. In order to take the absorption of the laser pulse in the pore structure into consideration, the penetration model of the NETZSCH *Proteus*® LFA software is used in the case of pyrolyzed samples. Figure 4 depicts the measuring signal (blue) over time for a charcoal sample and fitting using the penetration model (red).

Summary

By characterizing different wood-based materials at ÖGI using analytical instruments by NETZSCH, thus creating input data for numerical simulations, a contribution can be made to increasing the proportion of wood-based materials in urban construction and thus to reducing CO_2 emissions over the long term.

The Author

Dr. Andreas Cziegler completed his studies and doctorate in metallurgy at the Montan University of Leoben. His professional career includes positions as university assistant and project staff member at the Department of Foundry Science at the Montan University of Leoben.

Since 2020, he has been working as a scientific research associate in the Physical Laboratory and Simulation group at the Austrian Foundry Institute (ÖGI). Dr. Cziegler also holds an additional degree in patent law and certifications in SixSigma and CAD construction.

He has published several scientific articles, appearing in the journals "Metallurgical and Materials Transactions B" and "International Journal of Cast Metals Research", among others.

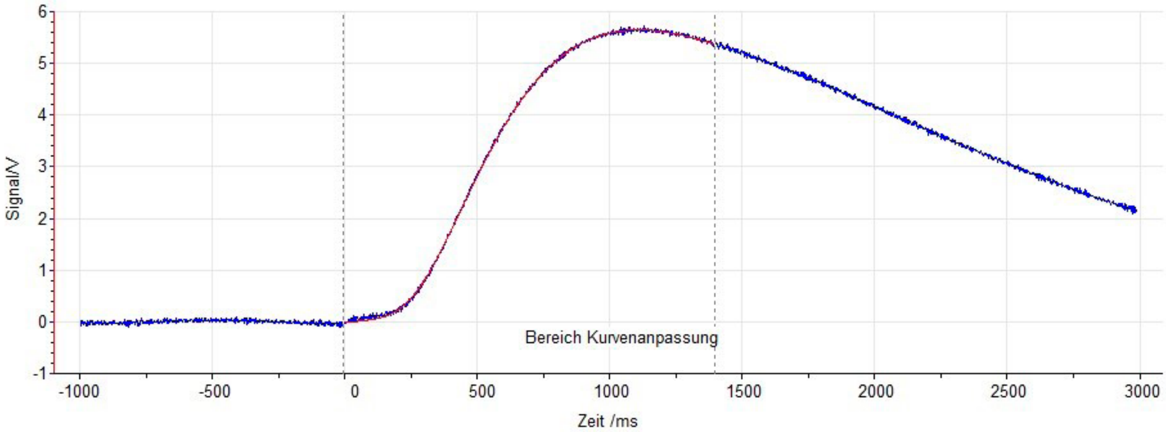

Fig. 4. Signal path and curve fitting for a charcoal sample

NETZSCH 360°: Discover Our Analytical Instruments in Interactive 3D View

Aileen Sammler, Content Marketing & Social Media Manager

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The New DMA *Eplexor*® Family

Dr. Wiebold Wurpts, Product Line Management for DMA, TMA and DIL

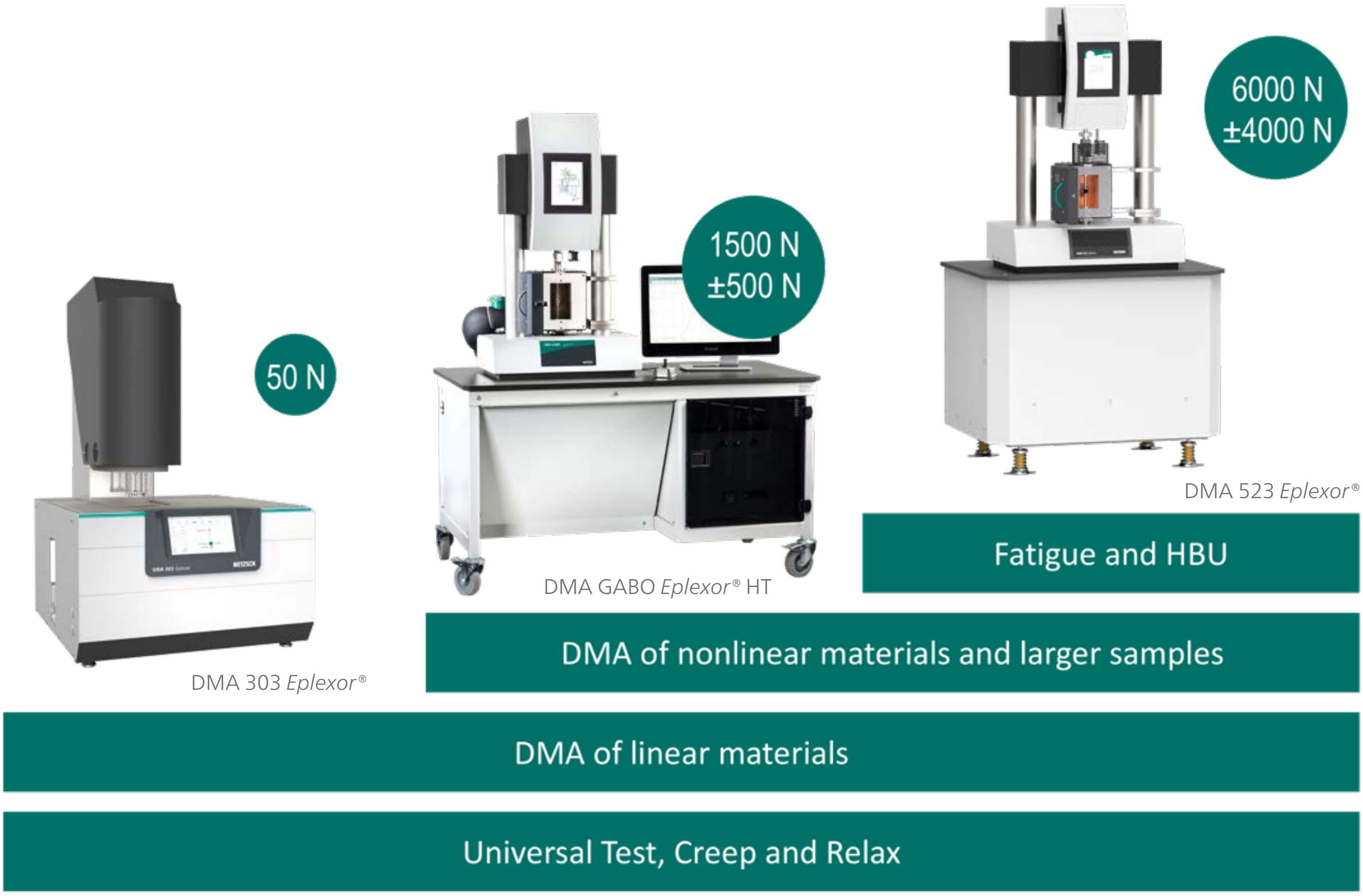

Fig. 1. The Family of DMA *Eplexor*® instruments

Introduction

Two new instruments for dynamic-mechanical analysis were recently introduced: The DMA 303 *Eplexor*® as a desktop instrument for forces up to 50 N; and the DMA 523 *Eplexor*® for dynamic forces up to 4000 N. Along with the instrument for dynamic forces up to 500 N, a variety of mechanical material properties can thus be investigated (see Figure 1).

Table. 1. Technical specifications for the *Eplexor*® instruments

	Static Force	**Dynamic Force**	**Temperature Range**	**Instrument Type**
DMA 303 *Eplexor*®	50 N*	± 50 N*	-170 to 800°C	Desktop
DMA GABO *Eplexor*®	1500 N	up to ± 500 N	-160 to 500°C	Tabletop
DMA GABO *Eplexor*® HT	1500 N	up to ± 500 N	RT to 1500°C	Tabletop
DMA 523 *Eplexor*®	6000 N	up to ± 4000 N	-160 to 500°C	Stand-alone

*For the DMA 303 *Eplexor*®, the sum of the static and dynamic force amounts to a maximum of 50 N

DMA *Eplexor*® Family

All of the *Eplexors*® (technical specifications in Table 1) feature a static and a dynamic drive. Thus, tensile tests or creep experiments can be carried out on any of the devices – on the DMA 303 *Eplexor*® for thin strip specimens, and for considerably larger specimens, on the instruments for higher forces.

DMA 303 *Eplexor*®

The focus of the compact desktop DMA 303 *Eplexor*® is entirely on the characterization of viscoelastic materials. For optimal temperature distribution, the sample is uniformly tempered from all sides. With the available 50 N, all specimens can be measured in bending and many can also be measured in tension. The instrument is the first choice when it comes to reliably determining all glass transitions with the temperature-dependent elastic modulus, or to determining the linear visco-elastic material behavior.

For many materials, the stiffness is dependent on the strain amplitude – in this case, larger forces and amplitudes are required. For example, filled elastomers exhibit completely different behavior at high amplitudes than at low amplitudes. The DMA GABO *Eplexor*® also allows for many possibilities for such non-linear materials which can be investigated according to their later application. Whether in tension or bending – no problem!

For all *Eplexor*s® with a force of more than 50 N, it is possible to change out the force sensor depending on the measurement task. Thus, tests with static forces of up 1500 N can be initially carried out with one device and after a quick modification, thin fibers can be measured for which a highly sensitive DMA is indispensable.

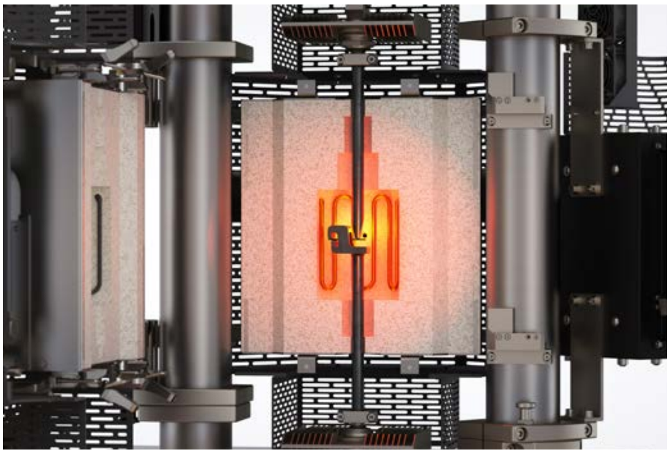

Fig. 2. High-temperature furnace of the DMA GABO *Eplexor*® HT

With the DMA 303 *Eplexor*®, transitions on metals or glasses can be investigated up to 800°C. In addition, the DMA GABO *Eplexor*® can be equipped with a high-temperature chamber (Figure 2) in order to gather information on the mechanical behavior at even the highest of temperatures of up to 1500°C.

DMA 523 *Eplexor*®

Finally, with a static force of 6000 N and a dynamic force of up to ±4000 N, the DMA 523 *Eplexor*® also allows for failure analysis of materials. The instrument can, for example, also be employed as a tensile testing machine to determine the yield strength of polymers and then, in a dynamic fatigue experiment with the same device, to take the materials to their load limit. In the case of elastomers in particular, self-heating and failure under very high dynamic loads are often investigated in a heat build-up test.

And that closes the loop: While mechanical properties are dependent on temperature, self-heating can be investigated in the higher force range due to the mechanical load. After a quick modification of the force sensor, this device is then also again available for highly sensitive applications.

Summary

With the DMA *Eplexors*®, mechanical thermal material properties can be analyzed and described across their entire range. The right instrument is available for every application!

NETZSCH

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Imprint

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