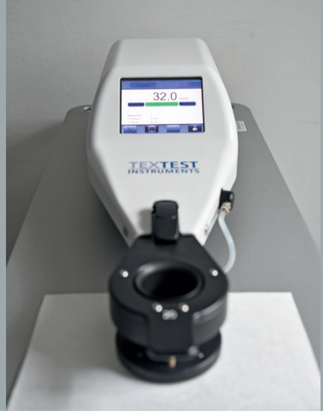

OUR COMPETENCES AND SERVICES

Fraunhofer ITWM

FRAUNHOFER INSTITUTE FOR INDUSTRIAL MATHEMATICS ITWM

STRUCTURAL AND FLUID-MECHANICAL CHARACTERIZATION OF MATERIALS

Technical Equipment

Dynamic mechanical thermal analysis (DMTA)

- EPLEXOR 500N (Netzsch Gabo Instruments GmbH)
- Compression, tension, 3-point-bending, immersion
- Various measurement modes to determine dynamic and static mechanical properties (moduli and damping)
  - Arbitrary stress and strain controlled load cycles
  - Frequency and temperature sweeps
  - Relaxation and creep measurements
  - Control of air humidity
- Determination of mastercurves
- Maximum static load: ±1500 N
- Maximum dynamic load: ±500 N
- Maximum dynamic strain: ±4 mm
- Frequency range: 0.01 Hz – 100 Hz
- Temperature range: -150 °C – 500 °C

Air permeability measurement

- TEXTEST FX 3300 LABAIR IV
- Measurement area: 20 cm^2
- Pressure range: 20 Pa – 2500 Pa
- Sequence mode: Measurement of air permeability for a given set of differential pressure values
- Determination of specific acoustic impedance

- Characterization of materials in terms of
  - grammage, thickness
  - structural mechanics: tensile, compression and bending tests incl. dependence of mechanical properties on the temperature
  - flow resistivity and acoustic impendance
- Material characterization, parameter identification, modeling and simulation from a single source

Contact

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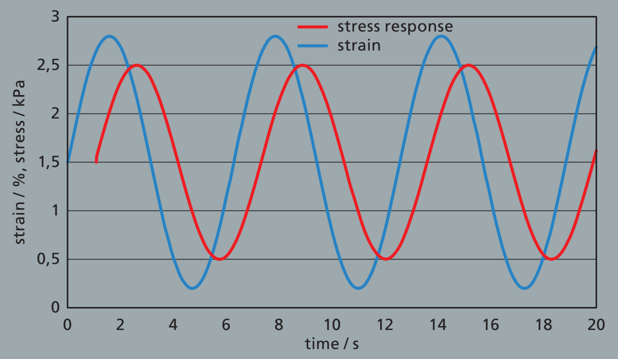

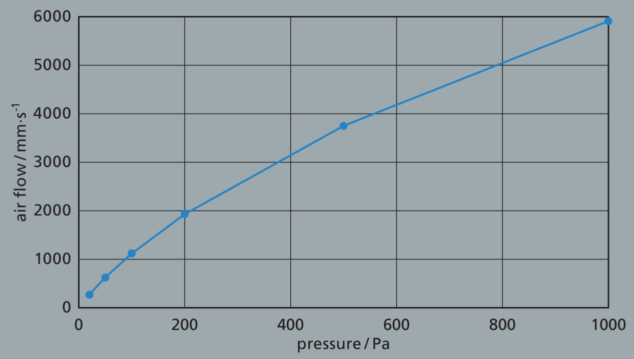

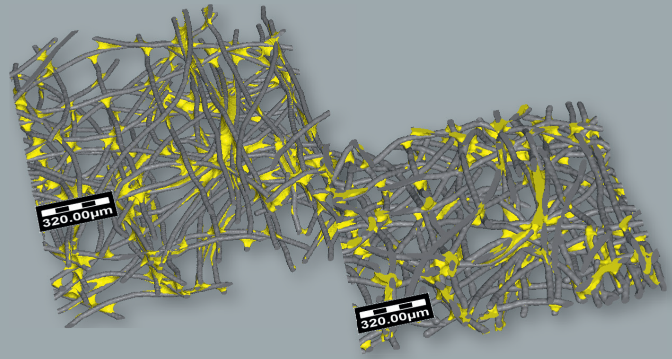

Dynamic Mechanical Thermal Analysis (DMTA)

DMT-Analysis is based on the controlled application of a displacement or a force to a sample at a specific fixed or oscillatory rate. During the application of a force, the corresponding displacement is measured (or vice versa), such that the mechanical strains and stresses are determined. Examining a material sample with such a cyclic experiment for different frequencies, amplitudes and temperatures mechanically characterizes its visco-elasto-plastic behavior.

The following loading scenarios can be performed

- Quasi-static loading and unloading with load increase for the determination of static and plastic material behavior
- Oscillatory and relaxation measurement of viscoelastic properties
- Temperature sweeps for determination of temperature dependent material behavior and master curves

The availability of different load cells (25 N, 150 N and 2500 N) allows the mechanical characterization of very soft materials, e.g. nonwovens, up to very hard materials, e.g. reinforced plastics.

Air permeability measurements

Our lab has a TEXTEST FX 3300 LABAIR IV for the accurate measurement of the air permeability of a wide range of technical textiles such as

- nonwovens (e.g. filter media, hygiene products),
- woven fabrics (e.g. meshes, webs),
- knitted fabrics (e.g. spacers).

In addition to standard procedures quantifying the air permeability for a single value of differential pressure (e.g. ISO 9237), it is also possible to detect and quantify nonlinear relations between differential pressure and flow rate (e.g. as in Darcy-Forchheimer law).

If the acoustic properties of a material are of interest (e.g. in the case of absorbers), the measurements can also provide the specific acoustic impedance.

By combining air permeability measurements with the DMTA device, effects such as the influence of (permanent) compressions of nonwovens on their flow resistivity can be studied.

Project examples

- Study of the relationship between mechanical properties of composites and their components (e.g. fiber volume fraction and fiber orientation)
- Determination of master curves for e.g. thermoplasts and rubber-like materials in terms of temperature frequency sweeps
- Measurements of nonwoven thickness
- Characterization of the tensile strength of nonwovens in machine direction (MD) and cross direction (CD) depending on ambient temperature
- Permeability of filter media depending on media compression
- Measurement of the air permeability/acoustic impedance of sound absorbers
- Creation of digital material twins for real world materials in terms of fluid and structural mechanics for
  - different length scales (microscopic to macroscopic)
  - several simulation techniques and tools