Sample conditioning and aging examination

- Sample conditioning by climate controlled storage
- Simulated weathering
- Thermal aging under air or nitrogen atmosphere
- Electrical and electro-mechanical load
- Failure analysis and non-destructive testing
- Service life time prediction

In addition to identification of suitable methods for your specific problem, we also develop testing methods and support you with the analysis and interpretation of measurement data.

Fraunhofer LBF's plastics research division, which evolved out of the German Plastics Institute [Deutsches Kunststoff-Institut DKI], supports its customers along the entire added value chain. We specialize in the management of complete development processes and advise our customers at all stages of development. As an identified skills center for questions regarding additivation, formulation and hybrids, we offer extensive expertise in analyzing and characterizing plastics and the changes in their properties during processing and in use, and also in developing methods for time-resolved processes.
CHARACTERIZATION OF ELASTOMERS AND THERMOSETS

PHYSICAL AND CHEMICAL CHARACTERIZATION
The thermo-physical properties of elastomers and thermosets depend on their molecular structure, superstructure and molecular motions. There is an especially strong dependency of the properties on the degree of crosslinking. The crosslinks can be of chemical or of physical nature. Additionally, elastomers and thermosets often contain fillers to improve their physical properties and the aging behavior. The operation temperature of elastomers is usually above the glass transition temperature, thus the polymer chains and filler particles are mobile. In contrast, the operation temperature of thermosets is usually below the glass transition temperature, where the material is in non-equilibrium. Phenomenon such as a not complete curing, post curing and the related shrinking can be observed. Moreover, physical aging processes and chemical reactions lead to further material changes.

Cured systems such as elastomers and thermosets are insoluble. Therefore, solid-state analytical techniques are required to get information about the chemical composition. The complexity of all these phenomena requires a comprehensive characterization. This is essential to interpret aging, failure analysis and to support product development and material selection.

OUR THEMATIC AREAS
Characterization of polymer materials regarding
- Structure and degree of cross-linking (Low-field NMR, swelling)
- Basic components (resin and hardener) (Pyrolysis-GC/MS)
- Type of additives and fillers employed
- Mechanical properties: tension tests, stepwise tension tests, Young’s and shear modulus
- Electrical and dielectric properties, breakdown voltage, CTI
- Thermal properties
- Master curves

Monitoring of curing / postcuring behavior
- Conversion with calorimetry and NIR spectroscopy
- Mechanical properties with DMA and ultrasonics, including Poisson’s ratio
- Dielectric permittivity, conductivity, relaxation times
- Shrinkage
- Compression set

Monitoring of aging
- Compression set at discrete times of aging
- Stress relaxation and creep
- Cyclic fatigue
- Changes in additive content during aging
- Identification of degradation products

Material data and models for simulation
- Material and kinetic models for curing
- Simulation of inhibition layer
- Thermo-physical properties and transport properties
- Parameter determination