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Analytik Service Obernburg GmbH

...And What's about The Strength at –80 °C?

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The problem:

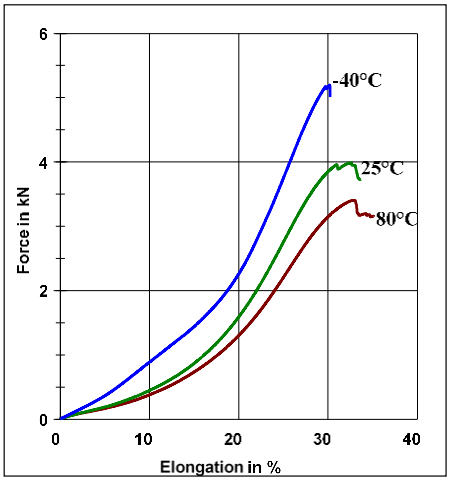
For polymeric materials, mechanical properties like the elastic modulus, the fracture strength, or the elongation at fracture are strongly temperature-dependent. Nevertheless, the corresponding material data are often known for room temperature only, but not at low or elevated temperature to be found for instance in automotive use of such materials.

The solution:

The Analytik Service Obernburg GmbH is able to measure mechanical parameters of polymeric materials within a very wide temperature range. For that, a tempering chamber is used which can be cooled (liquid nitrogen) to a temperature of down to –80 °C. On the other hand, the chamber is heatable by means of a circulating air heating system up to a temperature of 200 °C. The tempering chamber is part of a universal tensile testing machine (maximum tensile force 10 kN) being equipped with special clamps. This system thus allows very different mechanical analyses like tensile, pressure or bending tests, all in dependence on the temperature.

Example 1: man-made fiber fabric

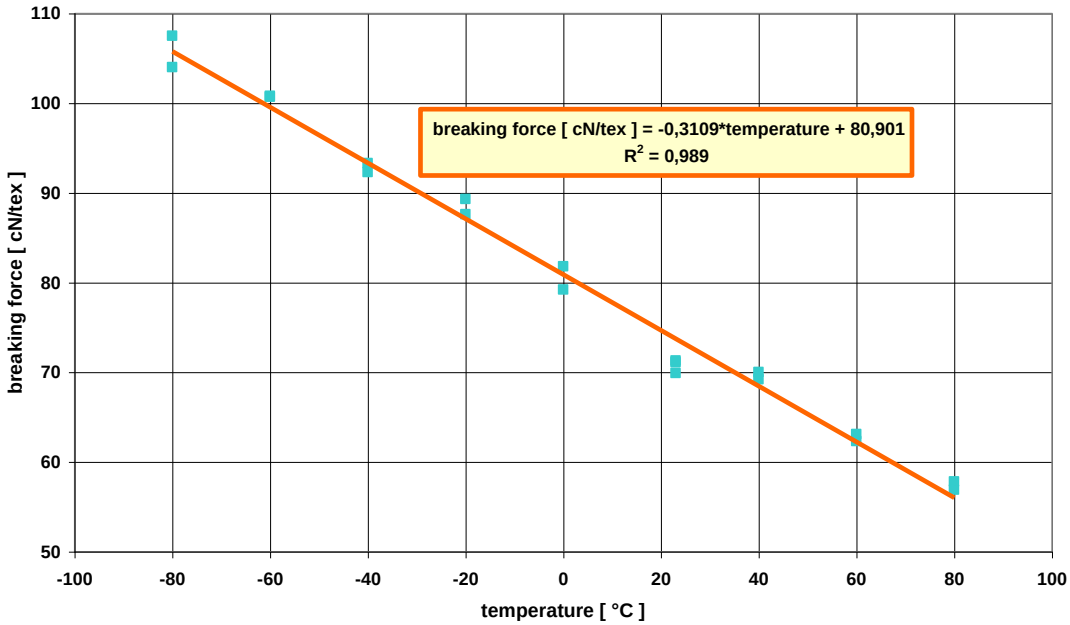
The adjacent figure shows the tensile behavior of a man-made fiber fabric at three different measurement temperatures. The fracture strength is highest at – 40 °C (blue curve). As expected, it clearly decreases at higher temperatures (green and red curve). At the same time, the elongation at fracture increases with temperature and reaches its maximum at 80 °C.



For technical application of fabrics, such effects need certainly to be taken into account.

Example 2: man-made fiber yarn

The titer-related maximum force has been measured on a man-made fiber yarn within a temperature range between –80 °C and +80 °C. The results are shown in the figure below together with a regression analysis (red line).



One sees a linear decrease of the maximum force by about 50%. Such a strong temperature dependence cannot be neglected for the later textile design and application.

The advantages:

If a fabric or, more generally, a plastic is used under very different temperatures, the temperature dependence of the mechanical properties cannot be neglected. Such effects must be considered in the design (construction and material). Tests under different temperatures provide measurement data tailored to your product.

Interested?
The microscopy group of the Analytik Service Obernburg is ready to answer your questions.

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