Determination of the mechanical properties at elevated temperature for a PP homopolymer applying tensile tests and DMA measurements

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The thermoforming process can be split into the following steps: heating of the semi-finished product (film or plate), prestretching, forming, cooling and demoulding. The plate is heated up to a temperature, where the material is in the rubber elastic state. Thus the determination of temperature dependent mechanical properties is essential for the choice of the *forming window* in the thermoforming process[1].

In this work the mechanical properties of a polypropylene homopolymer[2] were investigated by two methods. Stress-strain-curves were recorded for temperatures ranging from room temperature to a temperature near the melting point (160 °C) by a hot tensile test[3]. The curves were evaluated and characterised by the tensile moduli and tensile strengths. The material was also tested by dynamic mechanical analysis (DMA)[4,5] in the three-point bending mode at 1 Hz. The sample temperature was raised from -50 °C to 160 °C. The absolute value of the measured dynamic flexural modulus was set in relation to the static tensile modulus (fig. 1) and the tensile strength.

The values of these moduli showed a nearly linear correlation at all temperatures except 160 °C. So DMA measurements could be a quite time saving and powerful tool for mechanical material characterisation because it also allows the analysis the visco-elastic properties by analysis of the relaxation spectrum.

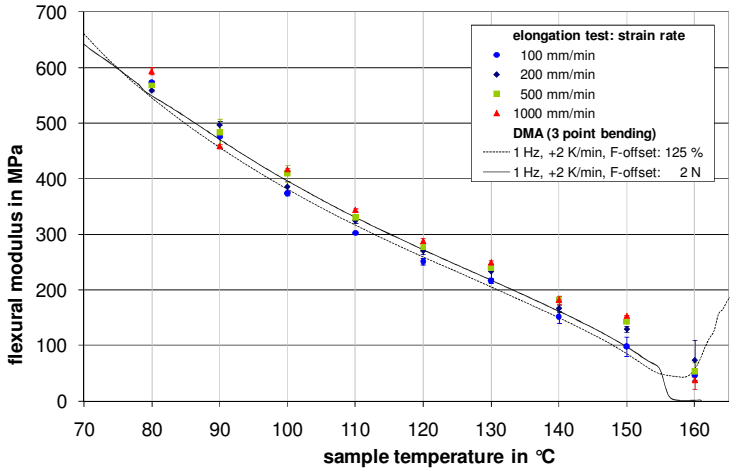

Figure 1: Comparison of the tensile moduli at elevated temperature with the flexural moduli got from DMA-measurements dependent on temperature at a frequency of 1 Hz.

References
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