Influence of water absorption on the mechanical properties of Polyamide 6 and Polyamide 4-6

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Introduction

Nylon is a generic name for a family of long-chain polyamide engineering thermoplastics. The nylon family members have recurring amide groups \([-\text{CO–NH–}\] as an integral part of the main polymer chain and are named by the number of carbon atoms in the monomers. Because of the formation of hydrogen bonds between chains in nylon crystals, nyons generally have higher melting points than many other semi-crystalline polymers, high affinity for water, and their physical and mechanical properties are often significantly affected by the absorption of moisture.

Materials and conditioning

The equilibrium water absorption depends on the relative humidity (RH) of the surroundings and on the temperature (Fig. 1).

The absorbed water in polyamides gives rise to the presence of a lower endothermic peak at around 100 °C on DSC curves (Fig. 2). Difference in the size and area of water endothermic peaks are observed in dependence on water content.

Results

The existence of two distinct yield points in semi-crystalline polymer is attributed to the deformation of the amorphous phase for the first yield point and the deformation of the crystalline phase for the second yield point. At higher moisture level the double yielding disappears displaying only a very broad yield, similar to rubber-like deformation (Fig. 3).

Conclusions

- PA 4-6 has higher water absorption than PA 6.
- Water absorbed by polyamides acts as plasticizer and causes a drastic softening and decreasing the yield stress.