MAXIMUM SERVICE TEMPERATURE OF THERMOPLASTICS

Steinwall PLASTIC INJECTION MOLDING

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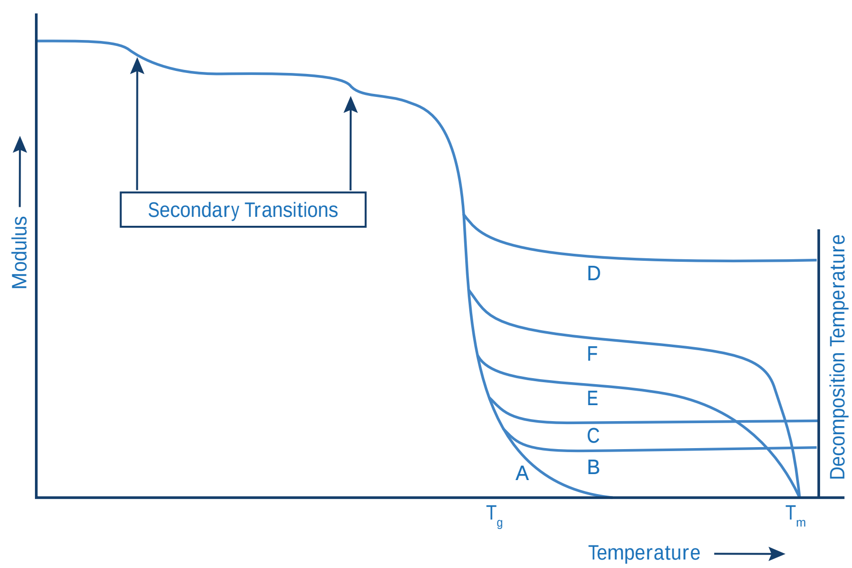
TECHNICAL ARTICLES | PROPERTIES OF PLASTICS

When designing a plastic molded part, the design engineer has a need to understand the highest sustainable temperature the material can withstand. Typical data sheets publish Vicat softening point and heat deflection temperature (HDT). Yet, how does one interpret these values to a given application? Additionally, what other factors contribute to a polymers thermal stability?

Maximum service temperature of polymers depends, primarily, on these factors:

- Amorphous or Crystalline polymer structure
- Polymer chain interactions
- Additives in the polymers; e.g. glass, talc, other fillers
- Applied loading in the application

Letís begin by looking at a generic graph depicting the dependence of the modulus of a polymer versus temperature.[1]



Schematic illustration of dependence of the modulus of a polymer on a variety of factors.

A is an amorphous polymer of moderate molecular weight whereas B is of such a high molecular weight that entanglement inhibit flow. Similar effects are shown in C and D, where the polymer is respectively lightly and highly cross linked. In E and F the polymer is capable of crystallization, F being more highly crystalline than E.

Modulus retention is a key indicator of how a plastic will survive at a specific temperature. Additives and fillers that increase the modulus of a polymer will therefore improve the heat stability of the polymer.

Due to the relationship of stress and strain; applied load will determine how successful a designed part will survive in a high temperature application. As the applied load and temperature increases, the probability of a plastic part failure also increases. This is due to the plasticís modulus decreasing as the temperature increases.

In a future article, we will discuss the standard tests for temperature stability and how they relate to end use survival of the plastic part.

[1] Brydson, Ja, Plastics Materials, Butterworths, 1989.

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