ZOTEFOAMS

Technical Information Sheet TIS29

MECHANICAL PROPERTIES AT LOW TEMPERATURES

The ability of a foam to perform at reduced temperatures is application dependent.

If used at reduced temperatures, three main impacts on the material should be considered:

1. Temporary dimension changes can occur due to thermal expansion of the polymer and the gas in its cells. At reduced temperatures, this will be seen as a shrinkage.
2. Mechanical properties will change with temperature. Changes to mechanical properties can be both a gradual and a step change (a transition temperature).

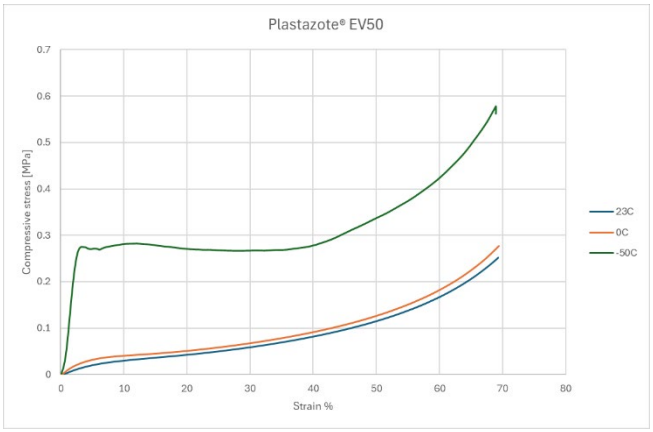
This document focuses on the mechanical property changes that can occur when foams are used at low temperatures.

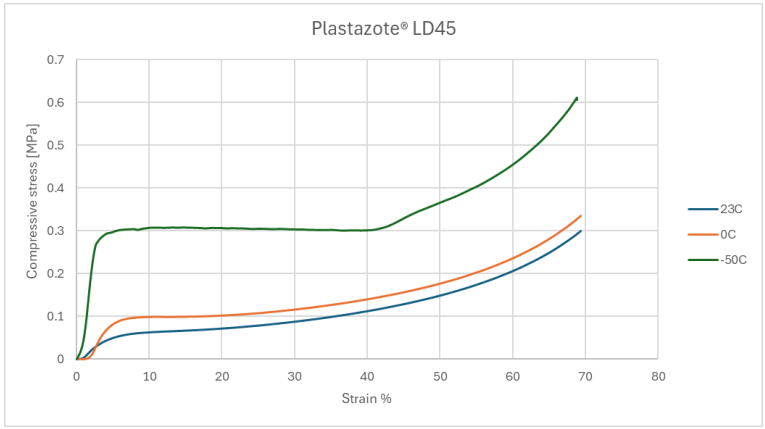
IMPACT OF POLYMER TYPE

The stiffness (modulus) of polymer foams will decrease as the temperature is increased:

Material family	**Relative change in stiffness with reduced temperature**
Plastazote® LD	Medium
Plastazote HD	Very Low
Plastazote EV	High
ZOTEK® F	Medium
ZOTEK F HT	Low
ZOTEK T	Low

For soft foams that are used in cushioning, rebound or impact protection applications, the stiffening of these materials when used at sub-zero temperatures can be particularly noticeable. Selecting a polymer where changes to the stiffness at decreased temperatures are kept to a minimum will be critical if low temperatures are expected during use. For example, ZOTEK T materials are preferable over Plastazote EV or LD materials for winter sporting applications where low temperatures are expected. The graphs on the following page show the typical compression performance of products from each of these three ranges at -50, 0 and 23°C:





For guidance on how mechanical properties will change over a wide temperature range, we can look at the response of different foams to dynamic mechanical analysis – a technique where a temperature and frequency properties of polymer materials can be studied.

The graphs on the following page show the expected change in stiffness of Zotefoams materials typically used in Aviation and Sports and Leisure markets. The percentage change in stiffness is driven by polymer type and will be similar for foams of different density made from the same polymer. For information about materials not shown below, please contact our Technical Support team for more information.

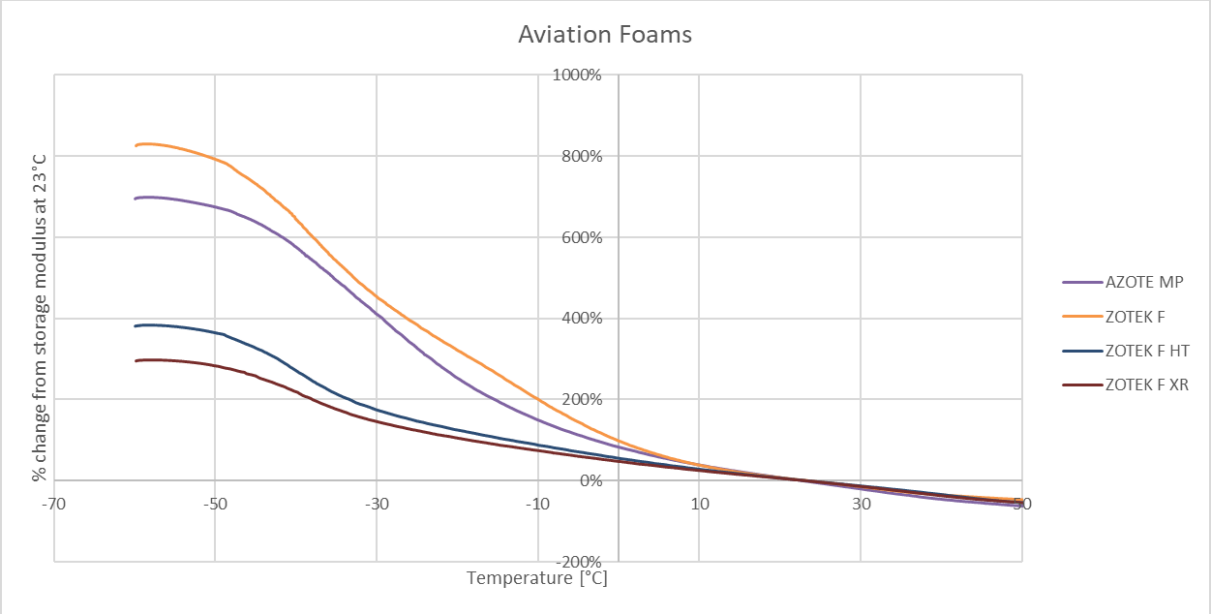


Figure 1: Percentage change in modulus with temperature compared to modulus measured at 23°C for foam materials typically used in aviation. Measured using 5 mm single cantilever bending clamps at a frequency of 1 Hz.

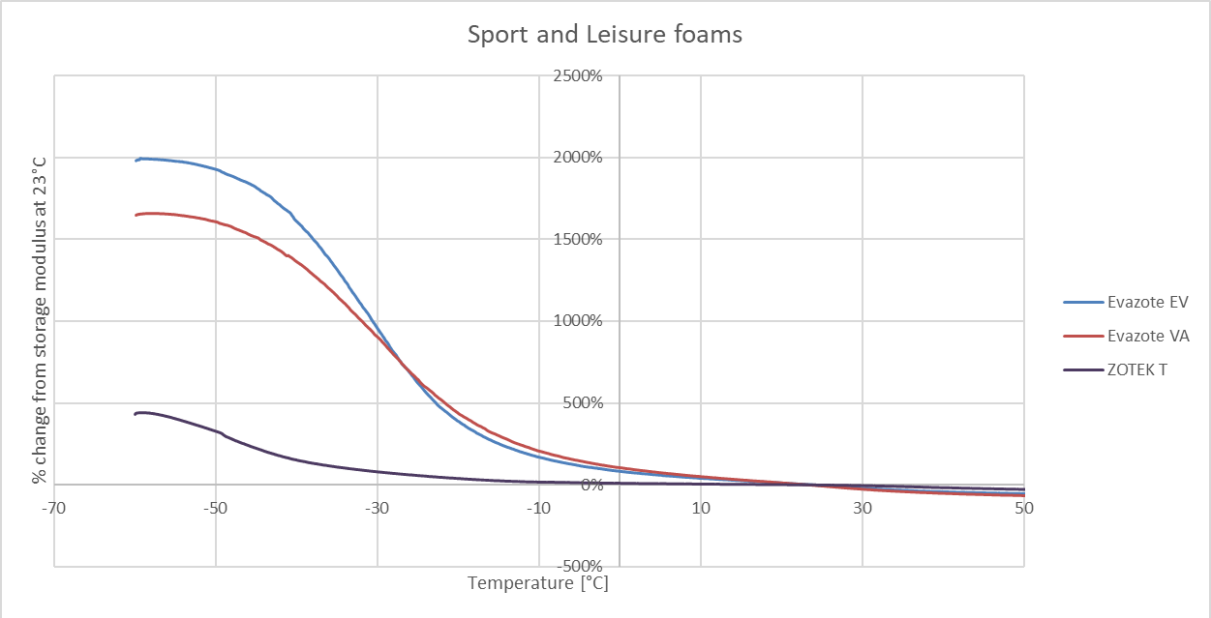


Figure 2: Percentage change in modulus with temperature compared to modulus measured at 23°C for foam materials typically used in sports and leisure. Measured using 5 mm single cantilever bending clamps at a frequency of 1 Hz.

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