ZOTEK® N

HIGH PERFORMANCE POLYAMIDE FOAMS

High Temperature Performance ZOTEK® N B50

ZOTEK N is the brand name for a range of foams based on cross-linked polyamide (nylon). They have a closed cell structure, have excellent thermal and chemical resistance and can be thermoformed into simple and complex parts.

This document explains the long term high temperature performance of ZOTEK N B50, a foam based on polyamide-6 with nominal density 50 kg/m^3.

HIGH TEMPERATURE PERFORMANCE OVERVIEW

The ability of a foam to perform at high temperatures is very application dependent. Factors such as the exposure time and whether the foam is under a load are very important.

The mechanical properties change with temperature, polymers tend to soften with increasing temperature. This can be both a gradual and step change (a transition temperature).

All polymers will chemically degrade. The amount of degradation for a polymer is dependent on the temperature and environment to which it is exposed, and the length of time in those conditions. One effect of this is a reduction in strength.

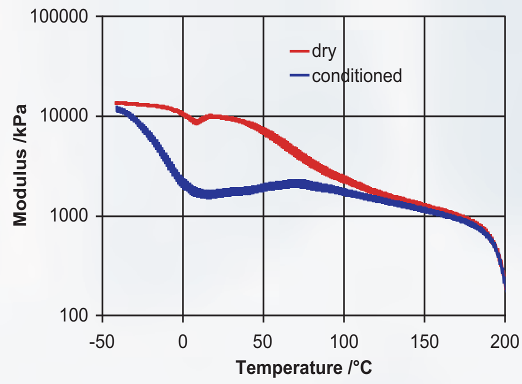
Uniquely for foams, when exposed to high temperature for long periods, then cooled to ambient, they will shrink. This diffusion of gas from the cells is not just dependent on the time and temperature, but also on thickness of the part and whether the foam is under any other load.

The following information was generated to give an indication of these effects on ZOTEK N B50.

MECHANICAL STIFFNESS

The stiffness (modulus) of polymer foams reduces as the temperature increases.

The following graph shows how the modulus of N B50 foam changes with temperature.



The modulus of N B50 polyamide foam is affected by moisture. When dry, the modulus gradually reduces with increasing temperature until the onset of melting at 180°C when the loss is severe.

When ***conditioned*** (equilibrium moisture content when stored at 23°C and 50% relative humidity) N B50 foam is much softer in the temperature range -40 to +100°C with a relatively constant modulus over the temperature range 0 to 180°C.

The mechanical damping of N B50 changes with temperature. A measure of mechanical damping is the loss tangent or tan δ and is shown in the following graph. The peaks in the tan δ seen at certain temperatures correspond to transitions occurring in the polymer.

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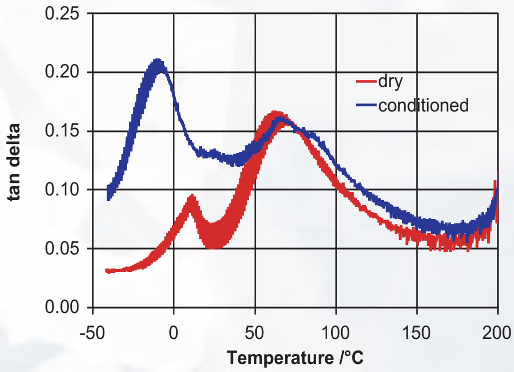
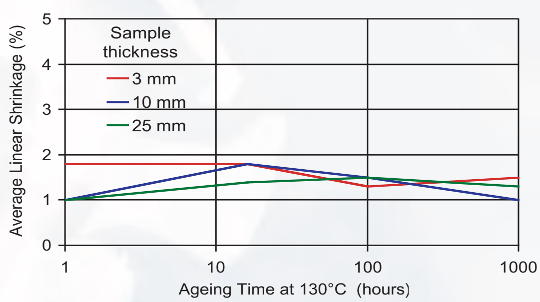
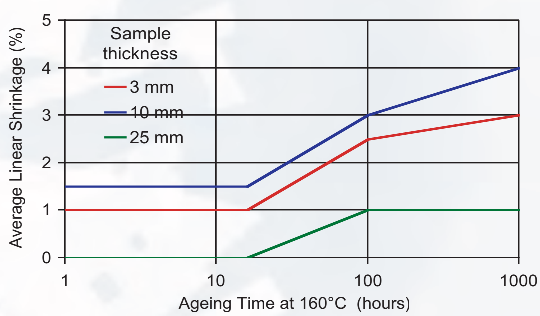


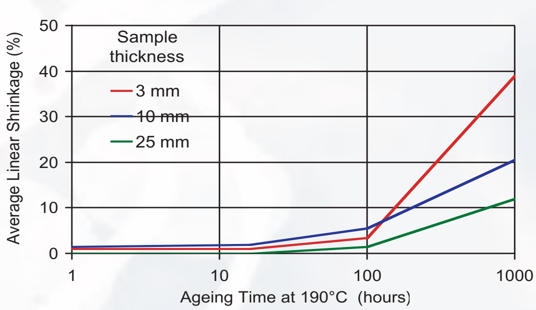
There is a significant increase in damping centred around 60°C. For conditioned foam, there is also significant damping centred around -10°C.

DIMENSIONAL STABILITY

The following graphs show the linear shrinkage over time for N B50 foam at three different temperatures and for three typical application thicknesses.





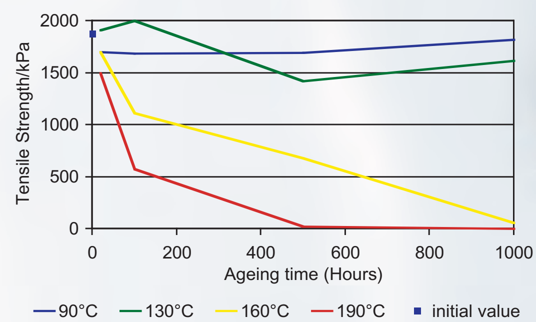


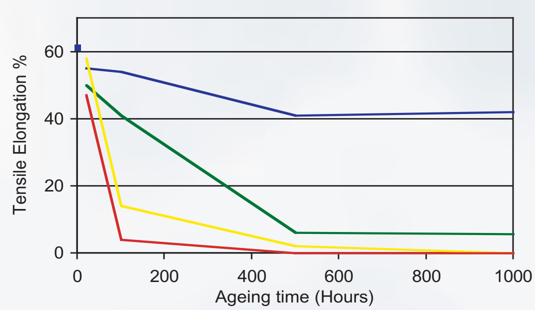
Shrinkage is negligible for long term use at 130°C and small at 160°C. At 190°C shrinkage becomes significant when exposed for long periods of time, but remains within acceptable levels (<5%) for short term exposure.

CHEMICAL DEGRADATION

The rate of polymer degradation increases with increasing temperature, particularly in aggressive environments such as air.

Degradation can lead to loss of strength and embrittlement. The following graphs show the change in ***tensile strength*** and ***elongation to break*** for N B50 after being aged in air for different times and temperatures. Note that the initial values differ from those in the data sheet as all testing was conducted on dry material.





N B50 becomes more brittle when heat aged. This is marginal over a long period of time at 90°C but becomes pronounced at temperatures above this. There is little effect on the strength of N B50 after long term ageing up to 130°C. Loss of strength becomes significant after longer periods at 160°C and above. Moisture will be dynamically absorbed which will improve the ductility of the foam.

For additional current information on ZOTEK® N foams please visit www.nylonfoam.com

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