

Stress crack test - Makrolon[®] moldings

- Polycarbonate (PC)
- Stress cracking
- Tensile creep test
- DIN EN ISO 22088-2

Introduction

Inherent stresses develop in thermoplastic moldings as a result of the molding process and subsequent cooling. Plastics that undergo pronounced relaxation eliminate these inherent stresses again in the course of time without any essential change in their external shape.

Plastics that only undergo limited relaxation are less able to eliminate these stresses. The amorphous plastics (e.g. Makrolon[®]) belong to this category on account of their low tendency to creep under load. The internal stresses are largely retained inside these plastics and are then superimposed on the external service stresses.

Both compressive and tensile stresses can result as a function of the molded part geometry and the application in question. If an excessive level of tensile stress prevails, this can lead to local deformation zones in the surface and the areas close to the surface and hence to weak points (micro-cracks, crazes).

In order to produce parts that offer a high value in use, it is in the manufacturer's interest to avoid weak points of this type, i.e. to master the stresses prevailing inside the part.

It is possible to use test fluids for a rapid estimate of frozen-in stresses in Makrolon[®] moldings.

After the molding has been immersed in the fluid, visible cracks form at points at which specific stress values have been exceeded.

The test fluids have different "reaction thresholds" when it comes to their effect on the molding being tested, i.e. they trigger cracks when a defined tensile stress is attained or exceeded.

Method

The molding is fully immersed in the test medium at 23 ± 2 °C. After a defined exposure time, the part is removed and examined with the naked eye to determine the presence and extent of any cracks that may have developed. If the test reveals excessive internal stresses through the development of cracks, this points to a poor shape, a poor mold design or a processing error.

The selection of a test medium is a function of the application in question and the level of security required for this.

A molded part in Makrolon[®] ought to pass the test with the test fluid n-propanol even if no mechanical loading is to be expected when it is in service.

If the part is subject to mechanical stressing (e.g. assembled with other parts), the test should be conducted with a test fluid of a mixture of ethyl acetate and n-propanol; 1:2 or, in the case of bigger external loads or for critical cases, with a mixture of ethyl acetate and n-propanol, 1:1 or even with propylene carbonate.

Propylene carbonate forms a film of fluid over the surface of the molded parts. It does not evaporate and, with longer immersion times, in particular, makes it more difficult to recognize cracks that have developed. The immersion time in propylene carbonate should therefore not exceed 1 min. Longer exposure times reduce the reaction thresholds - in other words, stress cracks form at even lower tensile stress values.

Due to toxicological and ecological reasons the use of mixtures of ethyl acetate and n-propanol is recommended.

If so desired, the test fluid can also be replaced by toluene und n-propanol respectively ethyl

acetate/ methanol. By altering the mix ratio arbitrary reaction threshold can be achieved.

Test medium	Volume ratio	Exposure time (min)	Reaction threshold (MPa)
n-propanol	-	15	> 15
Ethyl acetate and methanol	1:3	15	> 15
Ethyl acetate and n-propanol	1:20	15	> 13
Ethyl acetate and n-propanol	1:10	15	> 11
Ethyl acetate and n-propanol	1:5	15	> 10
Toluene and n-propanol (TnP)	1:10	15	> 9
Ethyl acetate and n-propanol	1:3	15	> 7
Ethyl acetate and methanol	1:2.5	15	> 7
Ethyl acetate and n-propanol	1:2	15	> 6
Toluene and n-propanol (TnP)	1:3	15	> 4
Ethyl acetate and n-propanol	1:1	15	> 4
Propylene carbonate	-	1	> 2

If the level of internal stresses in the production of injection moldings in non-reinforced Makrolon[®] is to be optimized by suitably adjusting the processing parameters on the injection molding machine in order to avoid crack formation, care must be taken to ensure that the stress crack test is only conducted after the part has been stored for at least one hour after production. With low wall thicknesses of < 1 mm it is possible for no crack development to occur in spite of a considerable level of stress. Sometimes it is difficult to recognize stress cracks on colored plastics. It is therefore recommended that such parts be sampled and tested in a transparent material.

If the test fluid is stored for a lengthy period of time, its composition can change through evaporation, thus producing different test results. For this reason, the mixture should be poured back into a sealable supply bottle immediately after use. The mixture should be replaced if necessary. Parts that have undergone testing should be disposed of.

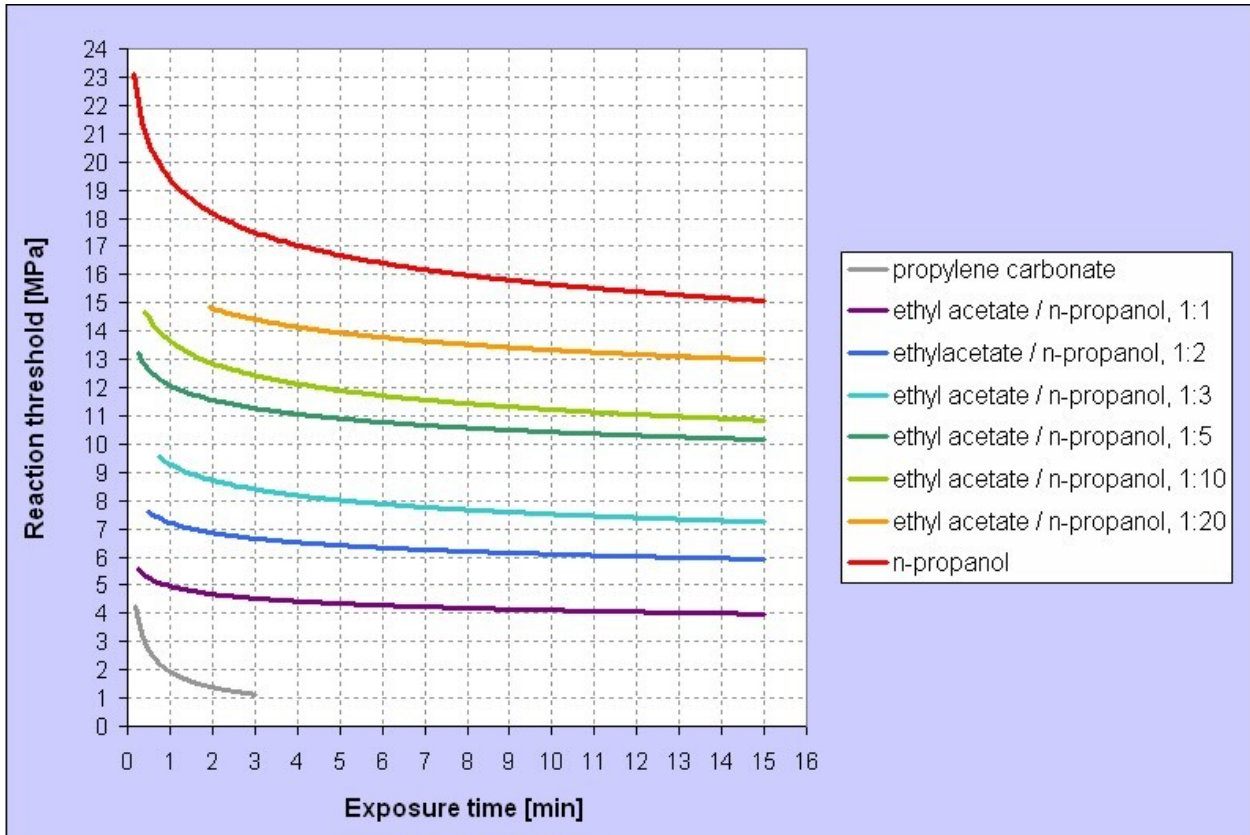
Safety Notice

When handling the recommended adhesives and solvents, it is essential for the advice contained in the Safety Data Sheets for these products to be observed.

The Safety Data Sheets can be obtained from the individual suppliers.

Further up-to-date information on individual solvents is available on the Internet in the GESTIS database on substances at www.hvbg.de/d/bia/gestis/stoffdb/index.html.

Stress crack test under load to DIN EN ISO 22088-2. Tensile creep method on medium viscosity Makrolon®



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Unless specified to the contrary, the values given have been established on standardized test specimens at room temperature. The figures should be regarded as guide values only and not as binding minimum values. Please note that, under certain conditions, the properties can be affected to a considerable extent by the design of the mold/die, the processing conditions and coloring.

Under the recommended processing conditions small quantities of decomposition product may be given off during processing. To preclude any risk to the health and well-being of the machine operatives, tolerance limits for the work environment must be ensured by the provision of efficient exhaust ventilation and fresh air at the workplace in accordance with the Safety Data Sheet. In order to prevent the partial decomposition of the polymer and the generation of volatile decomposition products, the prescribed processing temperatures should not be substantially exceeded.

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