Ultradur® HR

PBT for hot-damp environments

Ultradur® in the web: www.ultradur.de

BASF

We create chemistry

Ultradur® HR

Long life under demanding conditions

The main feature of the Ultradur® product range with the suffix HR (= hydrolysis resistant) is the extremely high resistance of the PBT polymer (PBT = polybutylene terephthalate) to damage due to water at elevated temperatures. Contact with water in polyesters, even in the form of atmospheric humidity, leads to hydrolytic cleavage of the polymer chains and thus to a weakening of the material, particularly at elevated temperatures. Ultradur® HR is based on standard PBT, but incorporates highly effective additives which greatly retard the hydrolytic degradation and can therefore considerably extend the life of a part (Fig. 1).

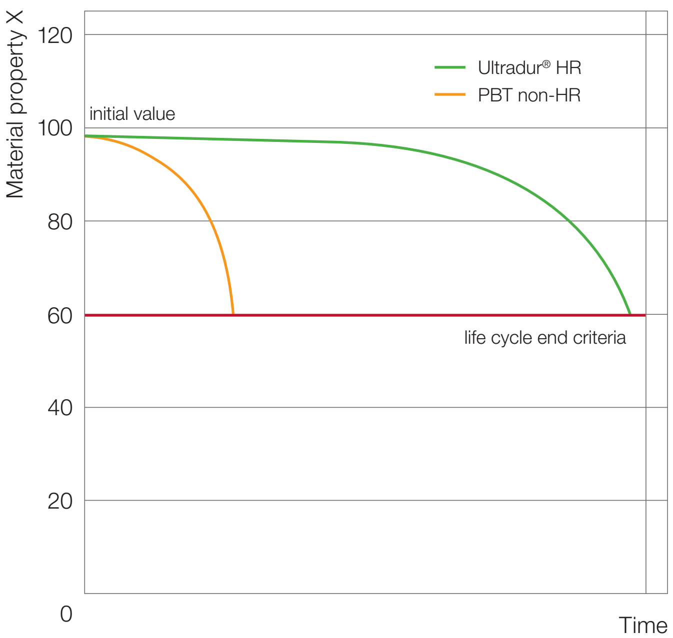

Fig. 1: Ultradur® HR keeps its material properties much longer than a PBT that is not HR-modified. The life of a part can be extended considerably with Ultradur® HR.

Higher demands for plastics applications

For critical applications such as those in automotive electronics, long life and reliability are basic requirements. It is often possible that the average operating temperature in modern electronic components increases, e.g. due to compacting. It is also possible that the components are used where they are exposed to the waste heat from the drive system to a considerable extent. Naturally, the plastic parts should be functional in all climate zones on earth, even in damp hot conditions. If spray water and road salt play a role, this can also increase the demands on the plastic. Therefore, the level and duration of the stress are key factors as to whether or not an application is feasible using a PBT without improved hydrolysis resistance. Today, the specifications for a number of plastic applications in the automotive sector include tests at elevated temperatures and humidity or tests on changing climatic conditions. These tests can only be passed by HR-modified PBT grades.

Ultradur® HR

Product portfolio

BASF offers a range of HR-modified Ultradur® grades which are notable not only for their high hydrolysis resistance, but also for their advantages in processing.

The portfolio shows the following Ultradur® grades with 15 % glass-fiber reinforcement (G3) or 30 % glass-fiber reinforcement (G6):

- Ultradur® B4330 G3 HR uncolored
- Ultradur® B4330 G3 HR black 15045 (laser markable)
- Ultradur® B4330 G3 HR High Speed black 15045 (easy flowing, laser markable)
- Ultradur® B4330 G6 HR uncolored
- Ultradur® B4330 G6 HR black 15045 (laser markable)
- Ultradur® B4330 G6 HR High Speed black 15045 (high flowability, laser markable)
- Ultradur® B4300 G6 HR uncolored
- Ultradur® B4300 G6 HR LT black 15092 (laser transparent)
- Ultradur® B4300 G6 HR black 15116
- Ultradur® B4331 G6 HR uncolored
- Ultradur® B4331 G6 HR black 15045 (laser markable)

Ultradur® HR products have a much higher hydrolysis resistance than comparable products without HR finish. However, within the Ultradur® HR portfolio there are differences regarding the resistance of individual grades. Please contact your sales representative, if you have specific questions. We are happy to advise you.

Typical applications for Ultradur® HR can be found in automotive electronics, e.g.:

- housings and covers of control equipment
- sensors
- plug-in connectors

Ultradur® HR combines hydrolysis resistance with stable processing

Important material properties such as strength, elasticity and impact strength are affected, if PBT is hydrolytically damaged. Figure 2 shows, in the example of tensile strength, how HR modification of Ultradur® HR grades has a positive effect on the continuous use. Apart from a slight effect on conditioning at the beginning of storage, the tensile strength remains virtually constant up to the end of the aging test. The reference material without HR modification, however, is clearly damaged and weakened after a third of the time.

Hydrolytic damage then takes place in the component at high temperatures – and hence with massive acceleration – because the component is unable to rid itself quickly enough of the moisture it earlier stored. In the highest test class (Class 5), the peak temperature amounts to 175 °C. Only PBT materials with excellent stabilization such as Ultradur® B4330 G3 HR make it to the end of the test (40 cycles) without their properties suffering significantly. Less well-stabilized products show perceptible damage, products with no stabilization even long before the end of the test (Fig. 3).

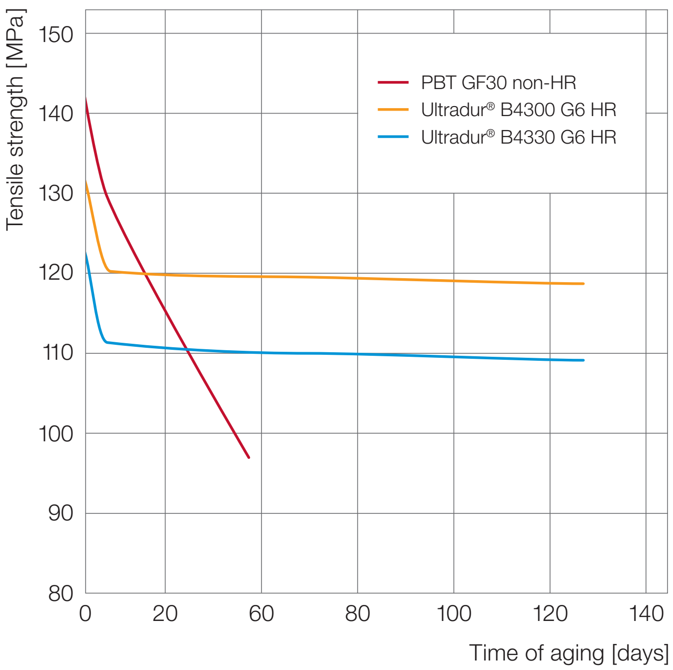

Fig. 2: Material strength in comparison to aging time in hot-damp climatic conditions (aging at 85 °C and 85 % rel. humidity).

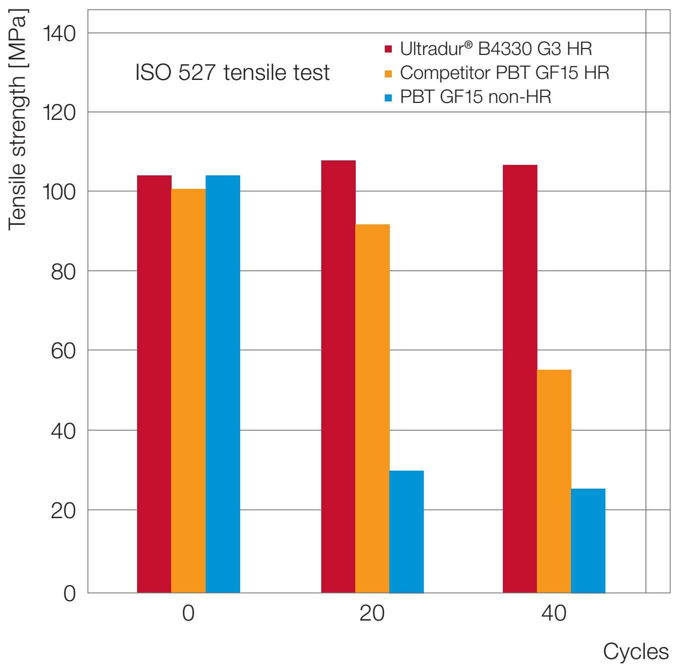

Fig. 3: Change in tensile strength in the test acc. to USCAR2 Class 5 (peak temperature 175 °C). The underlying climate profile must be run 40 times.

Even more rapid damage to PBT may occur under the USCAR2 test conditions, especially in the higher classes 3 to 5. In these tests, the components are exposed to a succession of moisture and heat, in a cycle which is repeated 40 times. In the moisture phase, the component is conditioned and largely saturated with water. The following hot, dry phase simulates the rapid heating of a thoroughly moistened component.

Additives that can be used to improve the hydrolysis resistance are normally also rheologically effective; to be more specific, they tend to increase the melt viscosity. At normal processing temperatures, this effect is greater as the residence time increases. Unattractive speckled surfaces on the parts (known as marble effect) are fairly harmless consequences of this. In extreme cases, for example, hot runners can be blocked which inevitably leads to production interruption and costly cleaning of molds and injection molding machines.

Ultradur® HR products possess a good melt viscosity. Especially worth mentioning is Ultradur® B4331 G6 HR which shows no increase in melt viscosity even at long residence times and high temperatures – ideal conditions for stable and problem-free processing (Fig. 4).

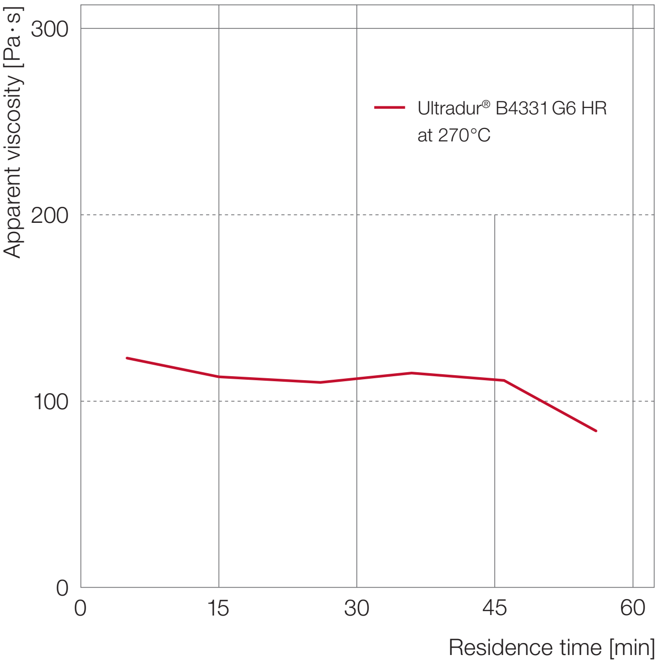

Fig. 4: Effect of residence time on the melt viscosity: Ultradur® HR keeps its flow properties and processability even with long residence times.

Chiefly at risk are plastic parts that are in direct contact with metal. In the laboratory, stress due to a stress crack-initiating medium is simulated by clamping test bars to a bending jig and coating them with caustic soda solution. Bars that do not have improved alkali resistance completely break under these conditions even after a very short time. Since stress cracks can occur independently of hydrolytic damage, bars made of HR-modified PBT can also fail in the caustic test. Decisive for the highest possible alkali resistance are additional features such as those in Ultradur® B4330 G6 HR, for example (Fig. 5).

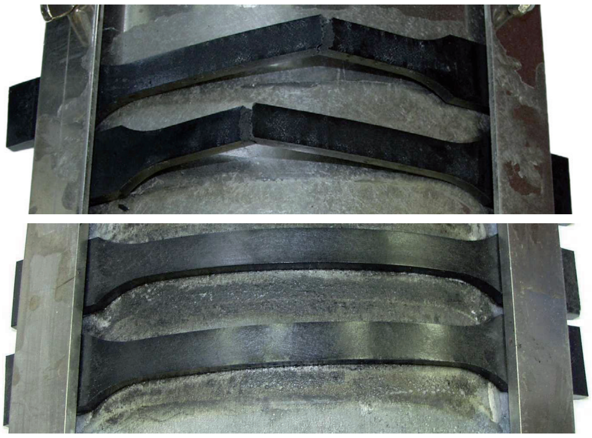

Fig. 5: PBT GF30 test bars on a bending jig after wetting with caustic soda solution. The material without improved stress crack resistance breaks quickly (top); Ultradur® B4330 G6 HR proves resistant for a considerably longer time (bottom).

Ultradur® HR is resistant to stress cracks and alkaline media

In addition to excellent hydrolysis resistance, different Ultradur® grades like B4330 G6 HR and B4331 G6 HR have a much higher resistance to alkaline media that cause stress cracks. Damage due to stress cracks propagates along the emerging microcracks. This also very rapidly leads to a macroscopic fracture. Unlike purely hydrolytic aging which normally occurs in the entire part, the material changes due to stress cracks primarily appear locally, restricted to the surfaces of the cracks. In fact, a small quantity of a crack-initiating medium can then lead to a (local) failure of the part. A critical alkaline environment can form in metal corrosion processes, for example.

Experience shows that materials that pass the caustic test in the laboratory with good results also perform considerably better in actual applications. So they improve the desired reliability of the part under critical environmental conditions.

Selected Product Literature for Ultradur®:

- Ultradur® – Product Brochure
- Ultradur® – Product Range
- Ultramid®, Ultradur® and Ultraform® – Resistance to Chemicals
- Engineering Plastics for the E&E Industry – Standards and Ratings
- Engineering Plastics for the E&E Industry – Products, Applications, Typical Values
- Engineering Plastics and Polyurethanes for Automotive Electrics – Products, Applications, Typical Values
- Ultradur® HR – PBT for hot-damp environments
- Ultradur® LUX – PBT for Laser Welding
- Laser Welding of Engineering Plastics – Technical Information

Note

The data contained in this publication are based on our current knowledge and experience. In view of the many factors that may affect processing and application of our product, these data do not relieve processors from carrying out own investigations and tests; neither do these data imply any guarantee of certain properties, nor the suitability of the product for a specific purpose. Any descriptions, drawings, photographs, data, proportions, weights etc. given herein may change without prior information and do not constitute the agreed contractual quality of the product. It is the responsibility of the recipient of our products to ensure that any proprietary rights and existing laws and legislation are observed. (September 2017)

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www.plasticsportal.eu (Europe)

Additional information on specific products:
www.plasticsportal.eu/name of product
e. g. www.plasticsportal.eu/ultradur

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