The melamine resin foam has already successfully passed various low-temperature tests. Now its thermal endurance behaviour has also been determined according to EN ISO 2578

Standardised Test Values for High-tech Applications

Melamine Resin Foam. The outstanding property of versatile melamine resin foam that sets it off from other polymer foams is its wide temperature range. As a result, the material can be used in many applications in construction or transportation. Now, this is to be proven with reliable data based on international standards.

PE103904

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The melamine resin foam Basotect from BASF AG, Ludwigshafen/Germany, is a relatively young material compared to polyurethane and polystyrene foams, and has a remarkable range of properties: It is flame resistant, halogen-free, high-temperature resistant, low-temperature elastic, extremely lightweight, sound absorbent, thermally insulating for high and low temperatures, liquid absorbent, solvent resistant and can be thermoformed. These features have opened up numerous established and potential applications for Basotect on land and water and in the air.

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A Versatile Applications Profile

Melamine resin foam has been used for many years in building construction to protect persons or products against noise, heat and cold. Decorative absorption elements can perceptibly and measurably improve room acoustics (Fig. 1). This high-performance foam can also meet the growing demands in transportation. The material has very good sound absorption in the medium and high frequency ranges. Its absorption behaviour at low frequencies can be improved by impregnation and/or acoustic facings in the form of nonwovens, fabrics and sheets.

Moreover, the low weight of the material permits large energy savings in transportation applications (Fig. 2.), but also in shipping to foam fabricators and their customers worldwide. In aircraft engineering, the ecological and economic benefits are considerable. The foam thus makes an important contribution to conserving resources.

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Determining Standard Data

For many thermoplastic foams, the literature gives temperature application limits that are not based on standardised, checkable time/temperature test criteria.

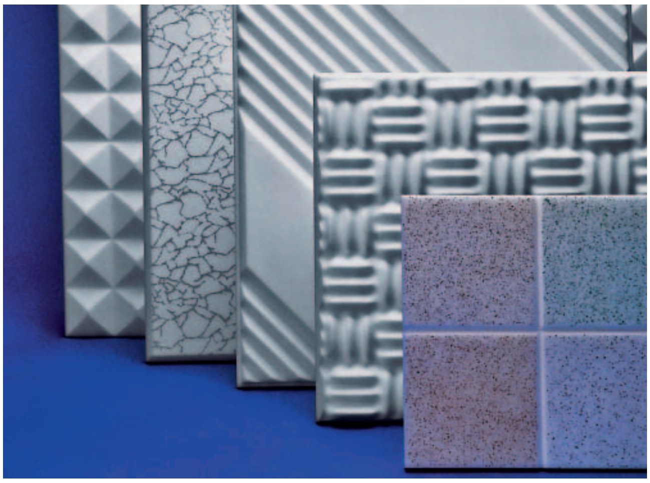

Fig. 1. Slabs of melamine resin foam with different surface structures for acoustic room insulation

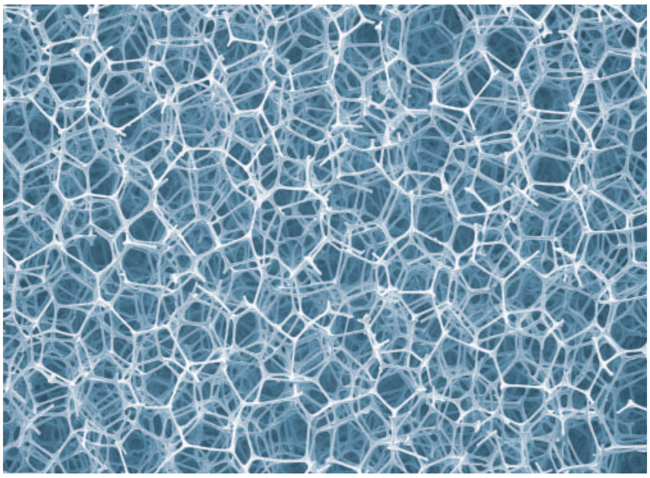

Fig. 2. Micrograph: Basotect has a delicate, open-celled structure comprising fine interconnections

The limit values given are often not testable and seem to be too high. The international standard EN ISO 2578 specifies the principles and procedures for evaluating the thermal endurance properties of plastics exposed to elevated temperature for long periods The term "thermal endurance properties" in this case applies to tests made in air without external stresses.

Definitions

Temperature Index TI:
that temperature in °C, taken from the temperature/time curve, which is associated with a particular experiment time (usually 20,000 h).

Thermal Endurance Diagram (Arrhenius Diagram):
plot of the logarithm of the failure time in a heat-ageing test against the reciprocal of the absolute test temperature.

Limit Value:
that percentage of the initial value of a tested property, at which, when it is reached, the ageing test ends (a change of 50 % is often set as the limit value).

Failure Time of the Test Specimen:
the time in h, at a given heat-ageing temperature, which leads to failure in a failure test or leads to the limit value of a particular property being reached.

To be able to offer its customers verifiable data on the thermal endurance properties of Basotect, BASF AG determined the temperature index of its foam according to EN ISO 2578. This information is important, for example, for users from the automotive or solar technology industry.

Specifying the Test Methods

According to EN ISO 2578, the heat ageing of plastics is based solely on the change in certain properties resulting from a period of exposure to elevated temperature. These properties are always measured after cooling to room temperature. The standard is based on the assumption that there is a linear relationship between the logarithm of the exposure time until a property change and the reciprocal of the associated temperature (Arrhenius relation).

This requires determining the changes of properties at three different temperatures. The mechanical and acoustic properties of the material investigated here are particularly relevant for high-temperature applications in transportation.

As mechanical property, the compression load deflection was chosen according to ISO 3386-2, since it is a conventional parameter for characterising foams and gives an indication of the ageing state of the material. The characteristic for compression load deflection was the compressive stress in the fourth load cycle at 40 % compression. Its change after heat ageing was determined at 23 °C and 50 % relative humidity as a function of the exposure time.

Since the chemical composition of Basotect means that rapid ageing is not to be expected at temperatures below 200 °C, the tests were carried out at exposure temperatures of 220, 250 and 280 °C. For compression load deflection testing, test specimens with sizes 100 mm × 100 mm × 50 mm were used. It was sufficient to carry out 14 test series at each temperature to record the time variation of the compression load deflection. Since five test specimens are regarded as suitable for non-destructive testing, 210 tests were necessary to determine the limit value at a particular temperature.

Time [h]	Temperature index TI [°C]
5,000	about 200
20,000	about 180

Table 1. Temperature indices for Basotect G melamine resin foam as a function of the heat endurance time

The limit value is the change of compression load deflection to 50 % of the initial value (Fig. 3) at a particular exposure temperature. The time within which this limit value is reached is defined as the "failure time."

Temperature Index: The failure times are presented as a function of the reciprocal absolute heat exposure temperature in the thermal endurance diagram (Fig. 4). The point of intersection of the first-order regression lines with the specified time limit results in the desired temperature index. As Table 1 shows, the temperature index is around 200 °C at the time limit of 5,000 h and around 180 °C at 20,000 h.

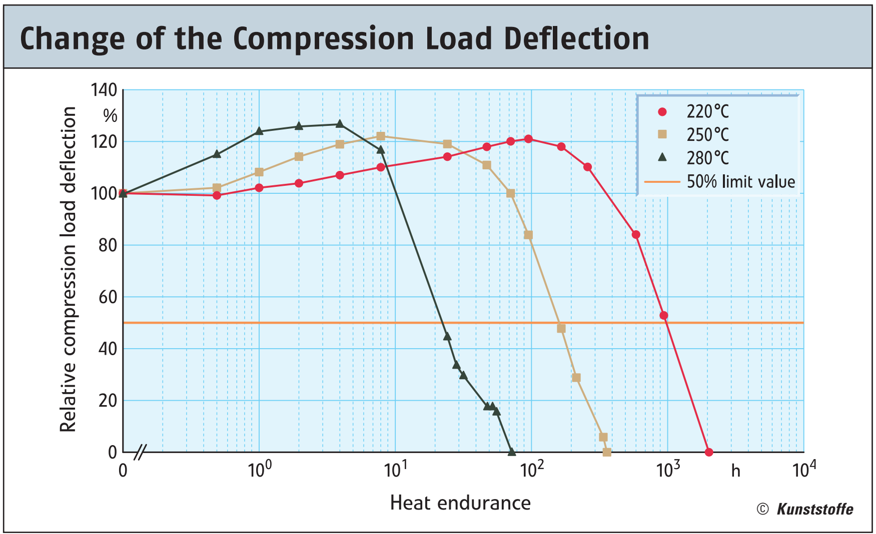

Fig. 3. Determination of the failure time of Basotect G melamine resin foam: Time at which 50 % of the initial compression load deflection is reached at a particular temperature (acc. to IEC 60216-1)

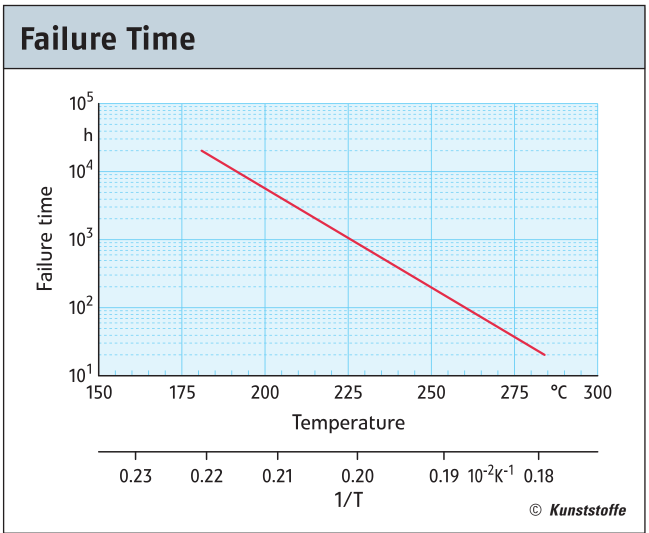

Fig. 4. Thermal endurance diagram of the melamine resin foam Basotect G: Logarithm of the failure time as a function of the reciprocal heat exposure temperature for determining the temperature index (acc. to IEC 60216-1)

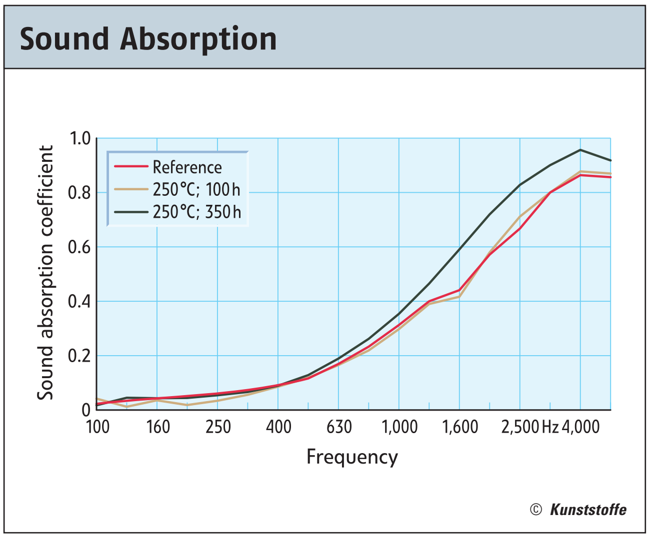

Fig. 5. Sound absorption coefficient of the melamine resin foam Basotect G acc. to ISO 10534 (impedance tube) before and after heat ageing

Sound Absorption Coefficient: The sound absorption coefficient of the samples after heat exposure was also determined on the basis of ISO 10534, in comparison to untreated reference samples after conditioning under standard climatic conditions. The test samples for these tests had diameters of 100 and 30 mm, and a thickness of 20 mm.

Fig. 5 compares the sound absorption coefficient of aged samples of Basotect with that of an untreated reference sample. The sound absorption coefficient has not changed after 100 h heat exposure at 250 °C. After 350 h, it has even improved as a result of the increase in flow resistance.

Summary

The notable property of the versatile Basotect foam, compared to other polymer foams, is the wide temperature range in which the material can be used for many applications.

With a temperature index TI (5,000 h) of 200 °C determined according to the standard, it has good performance at high temperatures and is a frontrunner among commercially available organic materials. Together with its low density and the high thermal insulation, it is good for use in transportation.

For other endurance applications at high temperatures, such as insulation materials in solar technology, a temperature index of 180 °C was determined as the chosen failure criterion according to EN ISO 2578 (Title photo). Here, too, good thermal insulation is important besides long-term thermal stability. With flat solar collectors, in particular, the absorber absorbs almost the entire spectral range of light after it has passed through the glass plate. To prevent the released heat from going to waste, the flat collectors must be heat insulated. In this advanced, and therefore growing, application field, the low thermal conductivity of the foam of less than 0.035 W/(m·K) is important, as well as the fact that the material is also available in large slab formats and can be easily cut to shape with the knife. ■

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