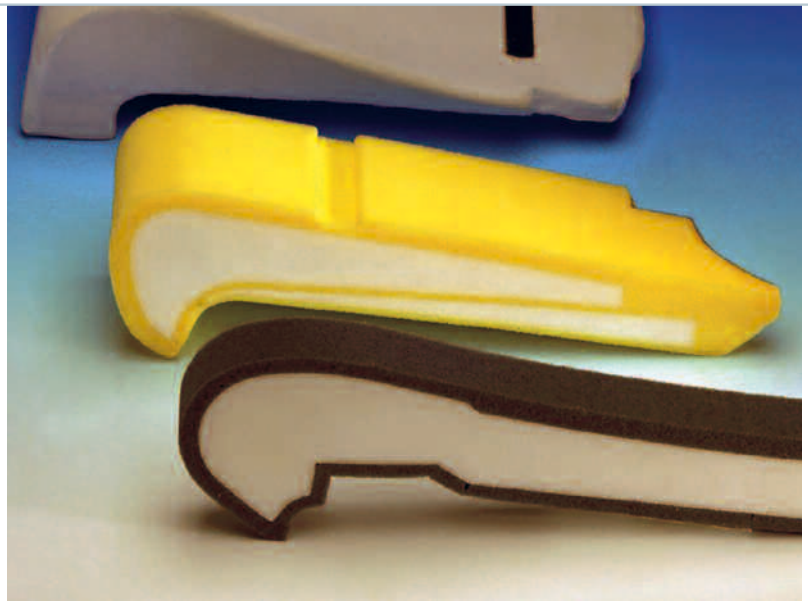
Melamine Resin Foam. A special melamine resin foam is continually finding new uses. With applications ranging from cleaning sponges to seat cushions and acoustic insulation components, this material has by no means exhausted its innovative potential.



Aircraft seats made from PUR foams with a melamine resin foam core save weight in aircraft construction

Lightweight, Versatile All-rounder

HORST BAUMGARTL

Melamine resin foams are a relatively young material class in comparison with polyurethane and polystyrene foams but offer an exceptional property profile. They are flame-retardant, halogen-free, heat-resistant, low-temperature-elastic and extremely lightweight, as well as sound-absorbing and thermally insulating. In addition, they are liquid-absorbing, solvent-resistant and – when specially modified – thermoformable. These properties have given rise to many applications, some now well established and some at the cutting edge of development.

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Melamine resins, which have been produced on a commercial scale since 1938, are cured by acid catalysis. Because of the high functionality of the melamine resin molecules, the curing process results in the formation of a closely meshed, highly crosslinked molecular structure, which is responsible for making pure melamine resins very brittle and prone to cracking.

Melamine resin foams produced in early trials showed equally brittle-hard characteristics and so could not compete with polyurethane flexible foams. It was therefore a real pioneering scientific and technical achievement when BASF AG, Ludwigshafen/Germany, succeeded for the first time in producing elastic melamine resin foams (MF foams) from brittle melamine resins without the addition of plasticisers.

Continuous production of MF foams also poses a technical challenge. Elastic melamine resin foams have so far been produced exclusively by BASF, because the company leads the way in this know-how. The foams are supplied to innovation-oriented foam converters in slabstock form under the trade name Basotect.

Conversion of the slabstock into finished parts can be carried out on machines designed, e. g. for polyurethane flexible foams. Melamine resin foam can be easily and accurately shaped by knife/wire cutting, sawing or milling. With these methods, it is possible to produce accurately dimensioned and shaped parts ready for installation, such as acoustic sheets, strand or tubular profiles.

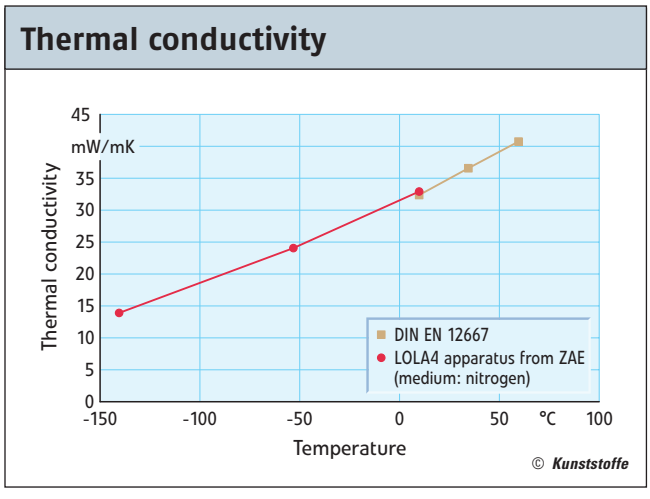

Fig. 1. Influence of temperature on the thermal conductivity of melamine resin foam

Resistant to Chemical Media and Flame-retardant

The closely meshed, crosslinked molecular structure of melamine resin explains the high solvent resistance of melamine resin foams. Fuels, oils, fats and alcohols cannot dissolve or swell MF foams. Their alkali resistance is also good. Only with strong acids is caution needed. These

agents split the melamine resin and dissolve the foam.

Because of the resistance of the melamine resin foam to organic solvents, virtually all adhesives can be used to bond Basotect parts. However, if the good flame-retardant properties of the foam are to be retained in the bonded component, non-flammable adhesives must be used.

The high long-term heat resistance of melamine resin foam as compared with PUR flexible foams can also be attributed to the closely meshed, crosslinked molecular structure.

The high nitrogen content of the resin imparts extremely good flame-retardant properties to the foam without the addition of flame retardants. Basotect does not melt or drip in contact with flame. The foam simply chars with slight development of white smoke and does not smoulder on removal of the flame. Basotect is therefore particularly suitable for applications with high flame retardancy requirements. In flammability tests according to national and international standards, Basotect achieved the highest classification that can be achieved by organic substances. The favourable behaviour of the material is also evident in the component tests and realistic model fire tests.

Lightweight with Excellent Sound Absorption

Because of its very low density of only 9 kg/m³, melamine resin foam – along with the far more expensive polyimide foams – is one of the lightest materials on the global market. This makes Basotect an ideal material for weight- and material-saving solutions. Because of its open-cell structure, the foam can also absorb very large quantities of liquid. For example, 1 m³ Basotect corresponds to around 9 kg foam and can store up to 990 l liquid. Alternatively, Basotect can be post-impregnated with silicone or fluorocarbon resin emulsions to make it both water- and oil-resistant. Fig. 1 shows the influence of temperature on the thermal conductivity of the foam in comparison with low-density polystyrene foams. The good thermal conductivity of Basotect, bearing in mind its low apparent density, is attributable to the extremely fine structure of the cell framework.

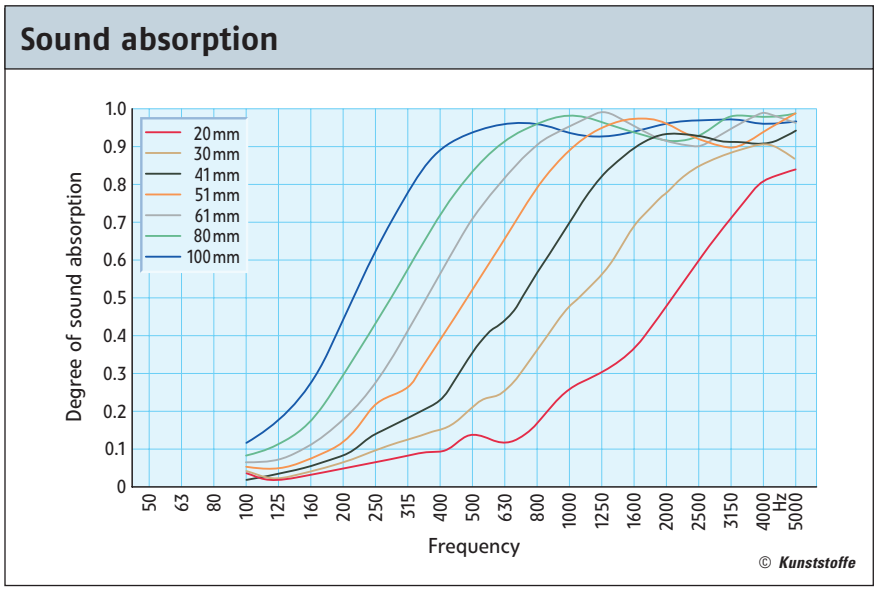

Fig. 2. Degree of sound absorption as a function of frequency and foam thickness

As a result of their open-cell structure, melamine resin foams are excellent sound absorbers for optimising room acoustics in buildings. The degree of sound absorption depends on the thickness of the foam layer, its flow resistance and the sound wave frequency. Fig. 2 shows sound absorption as a function of wave frequency and foam thickness. Low-frequency sound waves can only be absorbed with thick foam layers. Low-frequency sound absorption can also be improved by providing a hollow cavity behind the foam sheets. Acoustic testing rooms are often completely lined with thick Basotect sheets to prevent any sound reflection from the walls and ceilings.

In the mid- to high-frequency range, excellent room sound absorption can be achieved, even with thin, flat foam layers. As a result of their sound-absorbing properties, ceiling and wall elements made from melamine resin foam reduce echo caused by multiple reflection from hard reverberant surfaces. This leads to considerably better speech intelligibility in assembly rooms or offices and provides pleasant acoustics for recording and playing pieces of music in recording studios or concert halls. Noise peaks in factories, children's nurseries and sports halls can be effectively absorbed with acoustic baffles made from Basotect freely suspended from the ceiling (Fig. 3).

In automotive engineering, the aim is to achieve an overall vehicle design with harmonious acoustics. Engine and drive train noise should only be faintly audible to passengers. For applications such as this, Basotect scores highly not only be-

Fig. 3. Noise peaks can be effectively absorbed with freely suspended acoustic baffles made from melamine resin foam

Fig. 4. Nonwoven-laminated melamine resin foam ensures the required acoustic insulation in the engine compartment (manufacturer: Carcoustics)

cause of its sound-deadening properties but also in terms of its excellent thermal endurance of over 200 °C. Nonwoven-laminated Basotect components in the engine compartment, above the exhaust system and transmission tunnel, ensure the required acoustic comfort in vehicles (Fig. 4). The sound emission from stationary machines can also be reduced by lining with Basotect.

From Aircraft Seating to Cleaning Sponge

In aircraft construction, Basotect contributes to weight-saving through its low density and so helps cut fuel consumption. Among the most recent new developments are aircraft seats made from PU-MF foam hybrids with a melamine resin foam core. As a result of the fuel saving, investment in this seating is recouped within a few months (Title picture). Thanks to its flame retardancy, Basotect also meets the high fire resistance requirements specified for aircraft cabin fittings and furniture.

On account of its excellent heat resistance and low thermal conductivity, Basotect is also suitable in the form of prefabricated half pipes for thermal insulation of hot steam lines and tanks.

A completely new application has been opened up for Basotect as a cleaning sponge. The slightly moistened foam can remove stubborn dirt effortlessly, without cleaning agents, and restore the original surface gloss. The high hardness and mild abrasiveness of melamine resin are responsible for this cleaning potential. In addition, the readily deformable cell divisions can penetrate into the unevennesses in the workpiece surface and so ensure deep-pore cleaning (Fig. 5).

Fig. 5. Because of its high hardness and slight abrasiveness, melamine resin foam is also suitable for use as a cleaning sponge

Future Development

The future development of melamine resin foam will keep pace with market requirements. For example, BASF recently launched a thermoformable variant under the trade name Basotect TG. This product has made it possible for the first time to produce components from Basotect without prior impregnation of the blanks with thermoreactive crosslinking agents. The good thermoreactivity of the new foam allows manufacture of three-dimensionally shaped acoustic components by hot pressing foam blanks together with textile nonwovens in a single-stage operation. The omission of the impregnation step brings time and cost savings. This also improves the competitiveness of acoustic system solutions based on Basotect.

Basotect UL, an extremely lightweight foam, is also a recent product innovation. With a density of only 6 kg/m^3, Basotect UL is one of the lightest commercially available foams. This advantage together with its flame-retardant properties make Basotect UL a highly suitable material for many different acoustic and thermal insulation applications in aerospace engineering. ■

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