Fraunhofer ICT

High-performance foams

Structural foams – temperature-resistant foams – particle foams and extrusion foams

Common thermoplastic foams made of polystyrene or polyolefins are primarily used in the automotive, packaging and construction sectors, due to their light weight, high energy absorption capacity and outstanding insulation properties.

However, in some industrial applications the requirement profile extends beyond the performance range of standard materials. Thermoplastic foams, for example, are already used as the core material in the rotor blades of wind turbines.

In the future, thermoplastic foams could also be applied in temperature-critical areas, such as sound insulation close to the engine in the automotive sector, or for insulating air-conditioning pipes subject to high thermal loads. Both the temperature resistance and the mechanical properties of thermoplastic foams play an important role in opening up new fields of application.

The research focus of Fraunhofer ICT is the development of high-performance foams made from new material systems, in the particle foam and extrusion foam process. New materials, such as engineering polymers, often cannot be processed using conventional process control, which is why the new and further development of processing methods and plant technology in particular plays a decisive role.

High-temperature foams

Common thermoplastic foams do not have a very high temperature resistance. Expanded polystyrene (EPS) can withstand temperatures of 70 to 85 °C in the long term, and temperature peaks of 100 °C for short periods. For expanded polypropylene (EPP), the temperature resistance is between 100 and 110 °C. Foams that are resistant to higher temperatures, such as PET foam, offer the possibility of using composite materials consisting of new material combinations. Thanks to the thermally modified properties of the polymer foams, high-temperature foams can also be processed, for example, in pressing processes for sandwich production, which require high temperature and pressure resistance.

Above: KraussMaffei Berstorff Schaumtandex ZE30/KE60

Left: Extruded PET foam with and without intrinsic reinforcement

The advantages of high-temperature foams include:

- Heat resistance
- Higher short-term load capacity
- Better mechanical properties at higher temperatures
- Possibility of use in new process technologies

Structural foams

Besides being used as a sandwich core material, structural foams also offer the possibility of use in areas where high compressive strength, high energy absorption and flexural strength are required along with a low specific density. The mechanical properties of foams are adjusted at Fraunhofer ICT through the use and modification of engineering polymers and additives as well as through targeted process and parameter optimization. This allows characteristic values to be optimized and tailored to specific applications.

The resulting advantages include:

- Modifiable mechanical properties
  - Compressive strength
  - Flexural strength
- Increased continuous load capacity
- Very good specific property profiles

Possible applications for high-performance foams:

- Lightweight construction
- Air conditioning
- Automotive sector
- Aviation
- Protective equipment

Production of high-performance foams

At Fraunhofer ICT, various processes are used to develop and produce high-performance foams. A wide variety of different dosing equipment is available to incorporate polymers and additives with a high melting point. Comprehensive know-how and equipment is available for the production of foamed semi-finished products and components, in both the particle foam and in the extrusion foaming process.

In the particle foam process, an extrusion line provided by the company Leistritz with a subsequent underwater pelletizing unit (Gala) is used to produce foamed particles and also compact, gas-loaded granules. Furthermore, various autoclaves are available for the development of particle foams. For the further processing of these particles into a foamed product, prefoamers and steam chest molding lines (made by Erlenbach GmbH) are available at Fraunhofer ICT on a laboratory and industrial scale, along with a radio-frequency-based molding machine (made by the company Kurtz).

Semi-finished products such as foam sheets or foils can also be produced continuously in the pilot plant, in an extrusion foam process using the Krauss Maffei-Berstorff Schaumtandex ZE 30/KE 60 laboratory line.

Service portfolio

- Material and formulation development for the production of tailored foams
- Optimization of technical property profiles
- Process optimization for the production of high-performance foams
- Characterization of matrix materials and foams
- Particle and extrusion foams
- Tailored solutions

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