

Sustainable lightweight solutions

Production and processing of thermoplastic sandwich composites

Motivation and goal setting

Sandwich composites are characterized by good flexural properties and low weight. This is achieved by combining stiff face sheets (mostly consisting of fiber-reinforced plastics) with lightweight, compression- and shear-resistant core materials (Figs. 1 and 2). The gluing of the individual components is still one of the most common methods for sandwich production. However, if these components are based on the same thermoplastic matrix, fusion bonding processes can be applied. This approach not only offers advantages in terms of recyclability and sustainability, but also enables further lightweight construction potential to be exploited through thermoforming and functionalization in injection molding.

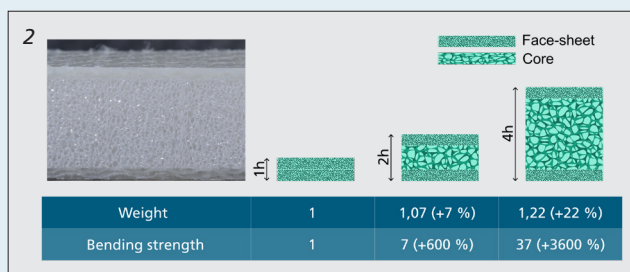
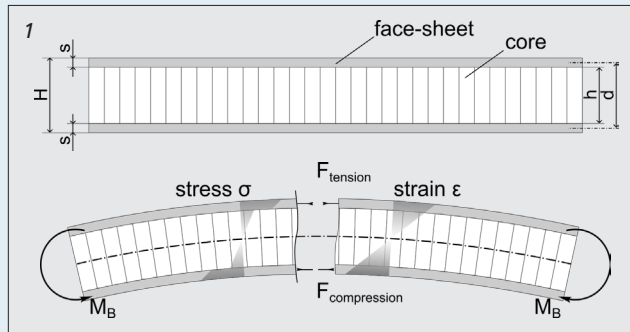
Materials and process

The fusion bonding of the face sheets and core to form the sandwich composite requires at least one of the components to be molten for a short time in the interface. The intimate

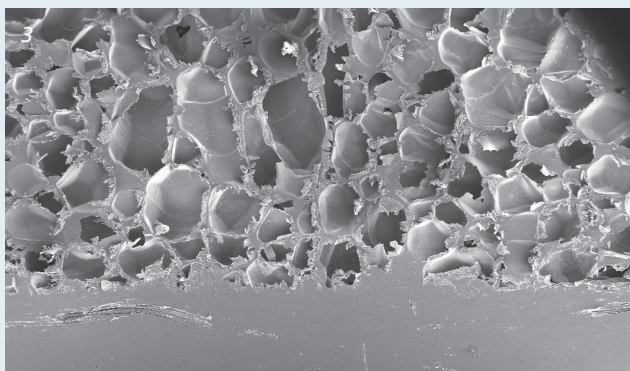
contact that results forms the basis of a strong attachment. Depending on the material combination, the molten material can be either the matrix of the top layer or the foam core itself. If the same base polymer is selected for both the top layer and the foam core, a cohesive bond can be achieved. The main objective during process control is to prevent the collapse of the foam core. To achieve this, heating times should be kept to a minimum, which also leads to short cycle times for production.

Fraunhofer ICT is conducting research into combining a wide variety of materials for the core and surface layers. In addition to carbon and glass-fiber-reinforced cover layers, the focus is on self-reinforced organic sheets, in which the fibers and matrix are based on the same polymer. Here, maximum lightweight potential can be achieved using a single material. These mono-material sandwich structures offer significant advantages for recyclable and sustainable products. With regard to the core materials, Fraunhofer ICT draws on in-house expertise in extrusion and particle foaming to achieve an optimal property profile for sandwich applications.

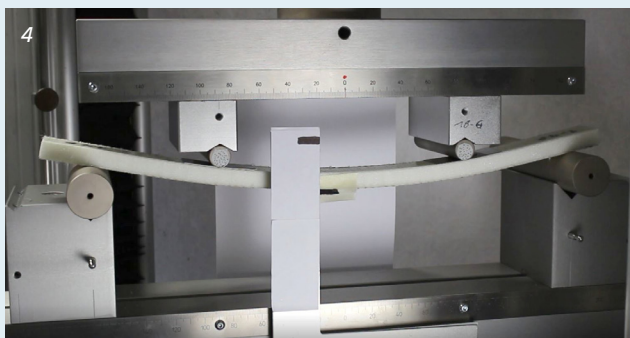
Principle of sandwich construction



Optical and mechanical examination



SEM image of a sandwich composite



4-point bend test

Forming and functionalization

The thermoplastic structure of the sandwich composites allows an additional, downstream molding process. This opens up further lightweight design potential through geometric stiffening or the integration of functions. Compact areas, and areas with a constant cross-section, can be achieved in this way. In the same process step, injection-molded components with additional functions can be integrated by back-injection molding.

Advantages and applications

Whether in electromobility or in construction, thermoplastic sandwich structures offer potential for a wide range of applications thanks to their property profile (light, stiff, high energy absorption as well as thermal insulation).

Our service offer

With our know-how in the field of sandwich composites, we offer our customers the following expertise:

- Benchmark testing
- Feasibility studies
- Process development
- Consultancy services concerning process and component design
- Characterization of the individual components and the composite (Figs. 3 and 4)
- Workshops

Cover photo: Selection of thermoplastic sandwich materials

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