"Nylon Composite Sheets" – an Innovation in Hybrid Technology

Low weight and high strength

The automotive industry is making increasing use of hybrid technology (also known as plastic/metal composite technology) for the volume production of highly integrated structural parts that can withstand high stresses while still being light in weight. The front ends of a large number of different cars, for example, are made of a combination of sheet steel and Durethan® BKV 30, a glass fiber reinforced polyamide 6 from LANXESS. Car roof frames are similarly produced in polyamide using this technique.

In a bid to extend the application and performance potential of hybrid technology still further, LANXESS is also working on replacing sheet steel and aluminum by full plastic composite sheets (Figure 1). These sheets consist of special fabrics embedded in a thermoplastic matrix with defined orientations. The fabrics are made of glass, Kevlar or carbon fibers. Polyamide is a suitable thermoplastic matrix, one of its advantages being that it displays good adhesion to the fibers.

In this development work, LANXESS is cooperating with Bond-Laminates GmbH, which has its head office in Brilon/Germany and is one of the leading manufacturers of these thermoplastic fibers (TEPEX®). The result is hybrid parts which are made completely of plastic. They are lighter than their counterparts in sheet metal and offer a higher surface stiffness and considerably higher strengths.

Potential applications are to be found not only in "classical" hybrid parts but also, and above all, in parts that are required to have a high surface stiffness – such as spare wheel recesses, bulkheads to the engine compartment and vehicle floor components.

It is also possible to integrate add-on parts, such as reinforcements, fixing points, guides and clips, by molding them onto the part.

Figure 1 Composite sheets with a test beam

Corrosion protection, which represents an additional cost factor in the case of sheet metal, can be dispensed with.

Many different potential applications exist for composite sheets outside the automotive industry too. These include protective helmets for sports, and brake levers for bikes.

All-plastic hybrid parts can be produced by a combination of thermoforming and injection molding. The composite sheet is first heated and thermoformed. Following this, the resultant semi-finished product is heated to just below the melting point of the plastic matrix and placed in an injection mold, where it is encapsulated in plastic. Thermoplastic ribs and reinforcement are provided at selected points. Since the composite sheet has been pre-heated, it adheres well to the thermoplastic over the entire area of contact, matching the efficiency of an adhesive bond or a weld.

Compared with classical hybrid technology (form-fit connection), this new technique results in a material-bonded connection between the two components, due to the melting of the surface during encapsulation. This significantly increases the mechanical characteristic values of the part as a whole. The thermoforming mold for composite sheets requires considerably less investment than the tooling for metals. This makes it economically worthwhile to produce hybrid components with composite sheets for small to medium production runs, in particular.

A hybrid part is regarded as a single-product solution if polyamide is used for both the injection molding material and the thermoplastic matrix in the composite sheet. This also constitutes an advantage in terms of recycling.

In a bid to further increase the cost efficiency of this new composite technology, development work is focusing inter alia on moving the thermoforming of the composite sheets into the injection mold (see Figure 2). The composite sheets would then not need to be heated and thermoformed separately prior to encapsulation by injection molding.

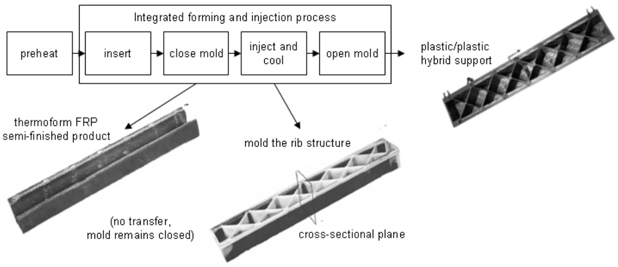

Figure 2 Production of a test beam

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