**Functionalized Fiber Reinforced Thermoplastic Composite Materials**

**Versatile Lightweight Design requires Mass Scale Production**

There is an increasing interest in using lightweight design across many branches by using endless fiber reinforced thermoplastic composite materials. Unidirectional tapes, film stacks or prepreg laminates in combination with flexible process technologies like injection molding offer short cycle times and allow mass scale production of high performance parts. For this purpose it is often necessary to optimize weight and costs by using new material combinations with improved properties.

**High Performance Endless Fiber Reinforced Parts**

Neue Materialien Fürth exhibits many years of experience in processing endless fiber reinforced sheets into three-dimensional parts for structural applications in mass scale production without rework. Thus, technologies like Inmould-Forming, FIT-Hybrid or Twin-O-Sheet have been developed in cooperation with research and industrial partners to evaluate possibilities and restrictions for full automatic manufacturing techniques.

**New Production Technology for Functionalized Laminates**

To find new composite combinations the well-established quasi-continuous compression process has been extended by implementing a direct melt impregnation to save material and energy costs. Therefore the engineers at NMF developed a new production technology to handle all kinds of thermoplastic polymers out of granules. The result: flexibility and efficiency in a universal and unique process technique. A special designed plasticizing unit is able to feed a hotrunner mould and extract a liquid balanced film in front of the hot press. To obtain functionalized laminates it is furthermore possible to run combinations with different film stacks, prepreg layers or other materials like metals or honeycomb sandwich cores. An inline roller mill enables calibration, decoration and functionalization steps directly after manufacturing and is independent from the impregnation and consolidation process. Finally the system offers high potential towards future material modifications and visionary applications.

![Schematic description of the continuous compression machine concept at NMF lab.](image)

![Picture of the modified pilot plant at Neue Materialien Fürth for mass scale production of functionalized laminates.](image)
Free Material Choice

Composites combine different types of materials to improve the properties of the compound by using synergy effects. Hence, the two components have to focus different goals: the fiber increases mechanical performance of the system while the matrix protects the fibers, guides the forces and finally shapes the composite. At last the application defines the overall requirements of the laminate and thereby the necessary bounds of its individual constituents. This relation deviates a flexible manufacturing with all kinds of components and modifications. Fabrics and textiles are selected taking the mechanical loads into account. NMF handles the whole spectrum of reinforcements whatever fiber type, fabric, size or finish. Special constructions and natural fibers are growing segments and can be manufactured, too. Even the thermoplastic matrix is having high potential for adapting certain properties. Modification of processing behavior like the viscosity, extension of functionality like flame protection, optical treatments as well as coloring or simply the reduction of shrinkage are just some of the variations this new development deals with day by day.

Evaluation over the whole Process Chain

Regardless of conventional film stacking and prepreg lamination or modern processing via direct melt impregnation, we help to evaluate your application idea with our technology knowhow over the whole process and material chain. Besides manufacturing we are able to analyze, characterize and optimize materials, parameters and properties under economical and physical aspects. Mechanical, rheological or thermal testing of new grades with unknown characteristics are essential knowledge and technical basis for product developments with improved properties.

General Advantages

- Free choice of thermoplastic matrix (amorphous and semi-crystalline polymers, filled and modified materials)
- Process evaluation of new material combination and layups (flexible parameter and material changes while evaluation)
- Economic heat transfer and less friction by direct plasticizing
- Energy savings by reducing the process chain
- Calibration, decoration and functionalization by inline roller mill independent of impregnation and consolidation
- technical data of equipment:
  - product width: 350-655 mm
  - product thickness: 0,15-9 mm
  - mould area: 660 x 1000 mm
  - mould pressure: 5-25 bar
  - temperature range: 40-420 °C

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