Fraunhofer
IMWS

FRAUNHOFER INSTITUTE FOR MICROSTRUCTURE OF MATERIALS AND SYSTEMS IMWS

1

2

1 *Cellulose regenerated fibers (CRF)*
2 *BioUD laminate of cellulose regenerated fibers and PLA-PP matrix with different fiber orientations*

BIO-BASED UD LAMINATES FOR LIGHTWEIGHT STRUCTURES

Fraunhofer Institute for Microstructure of Materials and Systems IMWS
Walter-Hülse-Straße 1
06120 Halle (Saale)/Germany

Pilot Plant Center for Polymer Synthesis and Processing (PAZ)
DOW Value Park A70
06258 Schkopau

Contact

Ivonne Jahn
Telephone +49 345 5589-474
ivonne.jahn@imws.fraunhofer.de

www.imws.fraunhofer.de

Motivation

Natural-fiber-reinforced plastics (NFRP) have been in use in industry and technology for decades already and are processed primarily using compression molding, impact extrusion, or injection molding of NFRP components. In the automotive industry, one of the largest industrial processors of natural fiber reinforced plastics, natural fibers are used above all in non-load-bearing components, such as paneling, instrument panels, and underbody protection. The use of natural fibers offers advantages above all in regard to component weight, an even CO2 balance, and acoustic characteristics. Furthermore, a newer role in the automotive industry is played by biosynthetics based on sustainable raw materials (PLA, bio-PE, etc.), which can be used above all to lower the proportion of oil-based material components. However, they are being used so far in only a few components with little relevance to weight, which have to withstand or transfer only slight loads.

Approach and goal

Currently, Fraunhofer IMWS is joining industrial partners to develop a bio-based, continuous-filament-reinforced, unidirectional laminate (UD laminate; Figure 2) for load-bearing lightweight structures and high-load components in the automotive area. At the same time, advances in established thermoplastic injection molding processes will begin making it possible to produce parts using time-efficient and cost-effective mass production techniques.

Bio-based starting materials

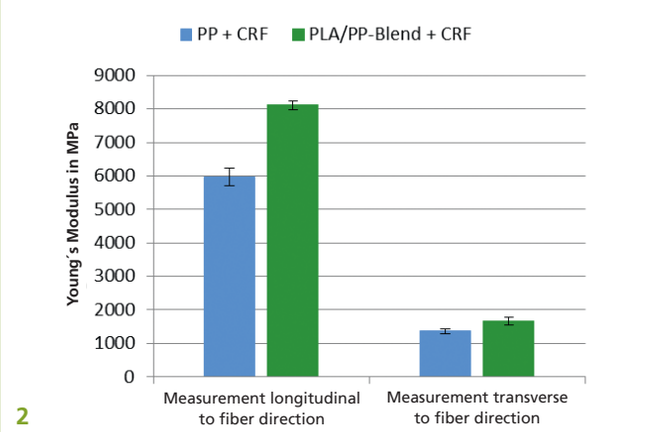
As a sustainable, high-performance material basis for composite materials with unidirectionally aligned fibers, a technically processed natural fiber, cellulose regenerated fiber (CRF), is used, which is integrated in a polymer blend of polylactic acid (PLA). Furthermore, modifiers for PLA/PP blends are developed and analysed to determine their mode of action, depending on the reactivity of PLA and the resulting blend morphology.
This is followed by studies of fiber matrix adhesion and its optimization, in order to determine the mechanical characteristic values of the PLA/PP blend and the fiber composite materials (Figure 2).

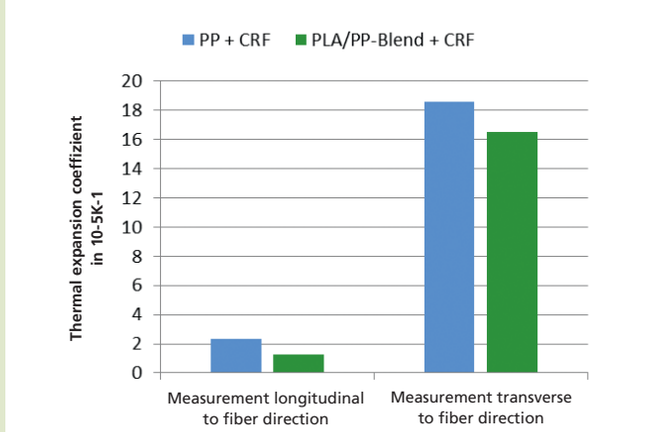
Process

In the first step, the fibers are run through a spreading unit to place them on a film of the developed PLA/PP blend in such a way that they can run into the double belt press as a homogeneous bed of fibers. The polymer film is melted, and the fiber bed is consolidated with the blend to form a unidirectional tape. Then, in accordance with the layer structure and the geometry, the tapes produced are consolidated in a double belt press using material-specific temperature and pressure distribution to form biolaminates with the proper load characteristics.
Post-processing of the bio-based semifinished materials is done in manufacturing and finishing processes.

Summary

The first test results already show the potential of the bio-synthetics based on sustainable raw materials and of the cellulose-regenerated-fiber-reinforced composite materials produced from them. The provision of such materials in industrial quality and the development of an integrative semi-finished material production and component manufacturing process suitable for mass production creates the basic material and technological prerequisites needed for establishment of specific, locally-reinforced, load-bearing injection molded components in the automotive area.





2

1 *Unidirectional, bio-based laminates*

2 *Mechanical and thermal characteristic values of unidirectionally reinforced composite materials*