Project »Espresso«

Tape materials made from rCF for sustainable sports applications based on aligned wet-laid nonwovens

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From Carbon Fiber Waste to High-Performance Tapes

The aim of the research project Espresso is to develop and process highly aligned thermoplastic tapes made from recycled carbon fibers (rCF) and tape scraps into so-called 2nd-life structural components.

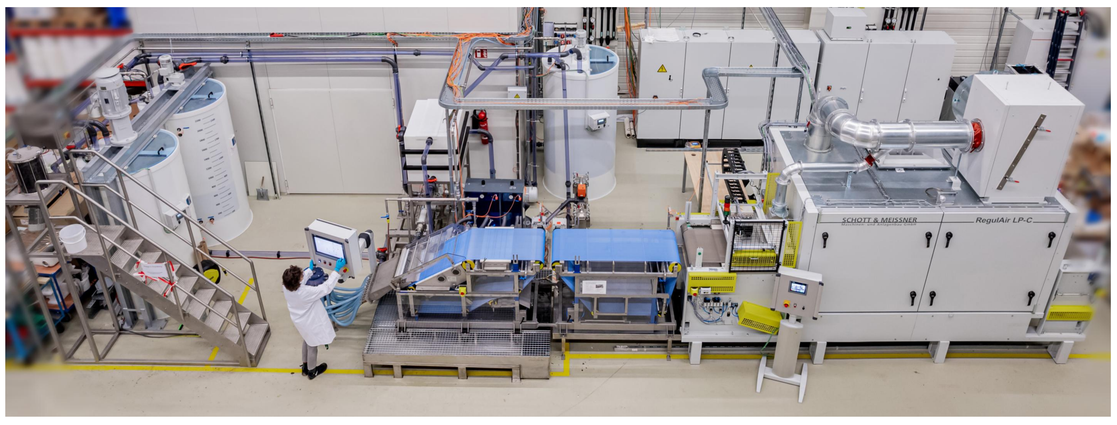






Material and Process Development

The Fraunhofer IGCV manufactures aligned semi-finished rCF products (so called SLICE nonwovens) based on the wet-laid technology. This unique process was invented by Fraunhofer IGCV. Currently, fibers with a length of 6 mm serve as the basis. The use of rCF significantly improves the material's carbon footprint, reducing emissions to less than a quarter of the original value. The nonwovens are then processed into consolidated thermoplastic rTapes by the partner companies thermoPre and held.



Used machinery from IGCV to produce aligned SLICE wet-laid nonwovens © A3-Strohmayr

In two parallel process routes, the use of aligned rTapes for thermoplastic hollow profiles and flat thermoset components is demonstrated. One selected demonstrator is a bicycle handlebar assembly, which is designed and manufactured using herone technology in collaboration with Focus. The resulting tape scraps are collected, processed, and reintegrated into the production process. As a second use case, the aligned wet-laid nonwovens are used in a snowboard and skis by silbaerg to enhance performance and sustainability in winter sports equipment. This means that not only the fibers but also their mechanical properties can be reused for new components.

Current Results

➢ Aligned nonwovens:

- The SLICE technology has since been further developed to optimize both homogeneity and fiber orientation. Currently, MD:CD ratios of > 2.5:1 are achieved based on eddy current measurement.
- The technology's current throughput is approximately 6.6 kg/h.

➢ rTapes:

- Currently, up to 100 running meters of fully consolidated rTape (with a thickness of approximately 160 µm) based on PA6 and LM-PAEK has been produced using a double-belt press.
- Both film and powder impregnation methods were investigated. In addition, direct impregnation is being further developed for an even more efficient tape production. The 600 mm wide tapes were then processed using a conventional slitting machine into widths of 1/8“, 1/4“, and 1.5".

➢ Composite properties:

- Initial test results based on composite panels show clear orientation of the developed material, with an MD:CD ratio of just under 6:1.
- Composite properties in fiber direction reach a tensile strength of 562 MPa and a tensile modulus of 48 GPa (at 35% fiber volume content with a PA6 matrix). The flexural properties show a strength of 600 MPa stiffness of 43 GPa. Due to the improved orientation in a new stage of nonwoven development, fiber volume variants of up to 45 % could also been demonstrated.

➢ Demonstrators:

- Several preforms have been braided from rTapes and ultimately shaped into bicycle handlebars. Currently, the demo part is a blend of vCF and rCF, and the goal is to steadily increase the proportion of rCF.
- Furthermore, SLICE nonwovens have already been integrated into snowboards and skis via hand-layup, and the first field tests on the slopes have already taken place.



rTapes, braided preforms and first moulded tubes made within the project © Philipp Huber

Project framework

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Funded project partners:

- herone
- thermoPre ENGINEERING
- held Technologie

Associated partners:

- Focus Bikes
- Rein4ced
- silbaerg

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