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Project title:	HyPer-Organo - Development of an ultra-thin high-performance organic sheet for series components
Partner:	SKL Schwergewebe Konfektion Lichtenstein GmbH, Oberlungwitz
Duration:	12/2018 - 11/2020
Funding Agency:	Central Innovation Programme for SMEs (ZIM)

Deficit

Thermoplastic fibre-reinforced plastics (T-FRP) have a high application potential due to their advantageous processability in hot forming processes, the associated short cycle times and the combinability with other materials. For the production of T-FRP components pre-impregnated textile semi-finished products (organic sheets) are currently predominantly used. During the production of components, these organic sheets are hot pressed into the component shape. The pressing process enables very short cycle times (< 3 min). Despite this advantage, series production of T-FRP components is currently hardly in use. The reason for this lies in the high prices for organic sheets, which result from unproductive manufacturing processes or high waste rates due to defective reinforcement fabrics.

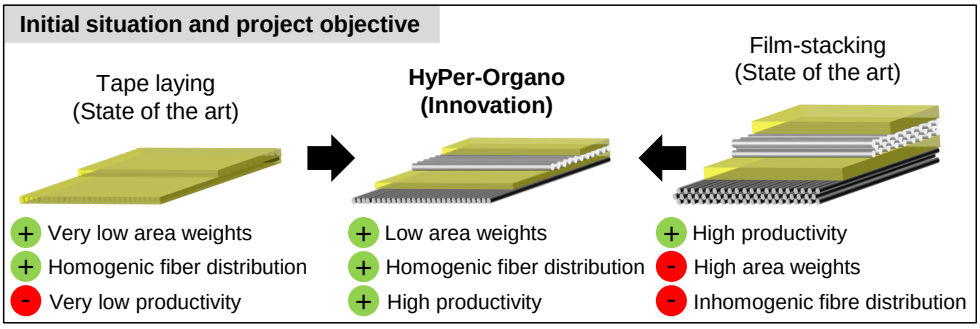
One approach to increase productivity is the production of organic sheets based on hybrid non-crimp fabrics. When processing glass fibres, however, the fabric process is currently restricted with regard to the minimum area weights that can be produced (min. 200 g/m²). This presents a major disadvantage, since the layer area weight has a significant influence on the mechanical properties of the component. Tensile strength, compressive strength, flexural strength and durability generally increase significantly with decreasing area weight. Single-layer area weights of 100-150 g/m² are therefore required for the production of high-performance components.

Objective

The objective of the project is the development of a high-performance organic sheet (HyPer-Organo) based on hybrid non-crimp fabrics with very low layer area weights. The fiber layers are characterized by a very homogenic fiber distribution. This enables very short pressing times during further processing or component manufacture. In addition, an increase in mechanical properties is aimed at through higher fiber volume contents and an improved fiber-matrix interfacial bond. The new process also offers very high flexibility due to the possibility of producing tailor-made fabric layers.

Approach

On the basis of the conventional non-crimp fabric process, a new fiber placement system is being developed for the production of the high-performance organic sheet. This deposition system consists of an online spreading device for producing very thin fiber layers and a novel device for fixing these layers. The combination of these modules enables the production of glass fiber fabrics with single-layer basis weights of 100-150 g/m² while simultaneously ensuring a homogeneous fiber distribution.



Results

Using the new fibre deposition system with online spreading device, it was possible to produce multiaxial fabrics with individual layer weights of approx. 178 g/m² using glass fibre rovings with 600 tex. From the investigations of the resulting material properties, however, it is clear that despite the reduction of the individual layer surface weights, the properties of the organic sheets are to be classified as significantly below the properties of commercially available products. This is probably due to the fibre damage caused by the spreading process. Furthermore, the process speeds typical for multiaxial lay-up technology could not be achieved with the use of fibre spreading. In this respect, further investigations and research work will be necessary in the future. Within the framework of the project, however, the process for the production of unspread glass fibre rovings could be improved to such an extent that competitive material properties can be achieved using rovings with higher titer. This leads to significantly reduced material costs. The production costs of organic sheets made from this material could therefore be significantly reduced and were approx. 35 % below the target price aimed for in the project.

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