

Projekt title: Tape2Demand - Customized carbon fiber binder tapes for out-of-autoclave RTM and infusion processes (20147N)

Duration: 11/2018 – 10/2020

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Mission statement:

Thin-ply reinforcements ($< 100 \text{ g/m}^2$) represent the next step in the development of fiber-reinforced plastics (FRP). The very thin individual layers used here lead to significant improvements in the mechanical properties of the composite. However, the advantages of the technology are currently only being exploited to a limited extent due to a lack of process and material knowledge. Although German companies have machine technology for processing prepreg tapes, there is still no application-specific design of dry, inherently stable tapes for out-of-autoclave (OOA) RTM and infusion processes.

Project Aim:

The aim of the project is to enable companies to manufacture and use carbon fiber-reinforced plastics (CFRP) with very low individual layer thicknesses, so-called thin-ply composites, in Out-of-autoclave processes. Compared to prepreg products, time-consuming and cost-intensive autoclave consolidation is not necessary.

Approach:

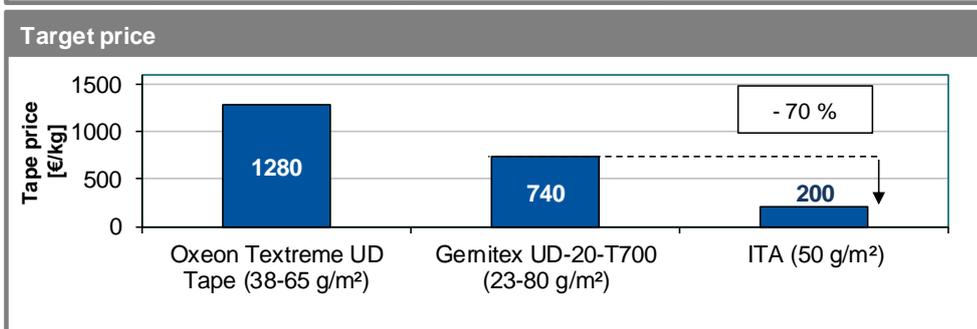
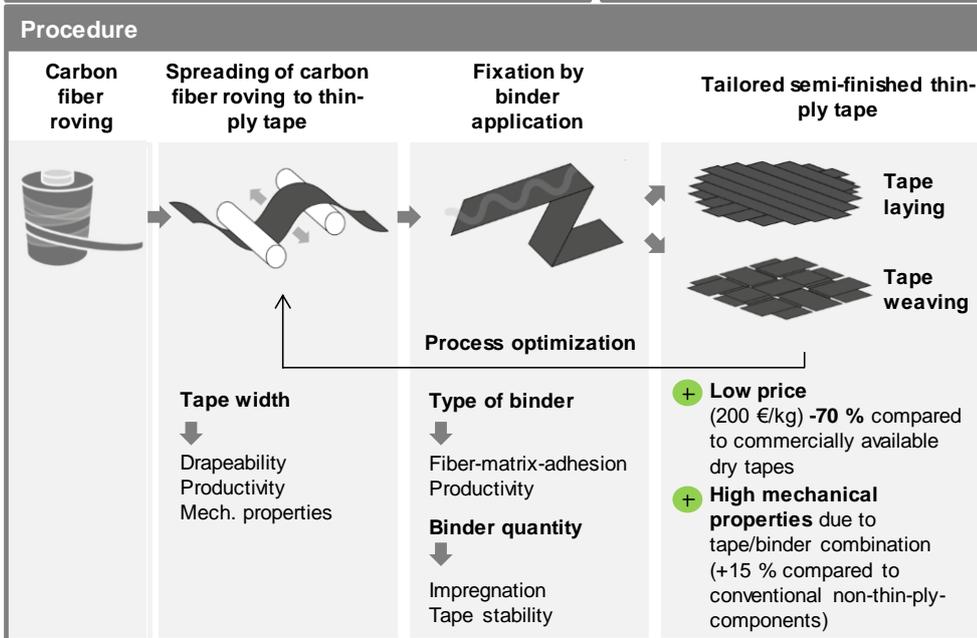
Es werden systematische Untersuchungen zum Vorfixieren trockener Thin-Ply-Tapes ($> 50 \text{ g/m}^2$) mittels Binderauftrag durchgeführt. Durch den Binder werden diese stabilisiert, um in anschließenden Tapeweb- oder Tapelegeprozessen verarbeitet werden zu können. Es werden dabei der Einfluss verschiedener Parameter der Binderfixierung (z. B. Bindersystem, Bindermaterial und Bindermenge) auf die Verarbeitungseigenschaften sowie die mechanischen Eigenschaften im Verbund untersucht. Basierend auf Versuchsergebnissen wird ein Auslegungstool erstellt, das Anwender entlang der Prozesskette zur Verwendung von Thin-Ply-Tapes befähigt, ohne auf kostenintensive Autoklavprozesse angewiesen zu sein.

Results and benefit:

The influence of material properties of thin-ply products on the composite properties has so far only been adequately researched for the areal weight. In this project, the relationships between fiber areal weight, binder application type, binder material and binder quantity on the mechanical composite properties (tensile strength/stiffness, compressive strength, interlaminar shear strength and residual compressive strength after impact loading) were investigated for the first time. Due to the large number of mechanical tests carried out, an in-depth material characterization was achieved. In addition, a comprehensive database was created. In addition to the experimental tests, economic aspects of tape production and further processing were considered and potentials for cost reduction identified.

Since thin-ply composites exhibit significantly improved mechanical properties compared to conventional semi-finished products, the same component properties can be achieved with less material usage. Compared to conventional reinforcement products, an average material saving of approx. 20 % can be expected. At an average carbon fiber (CF) price of €30/kg and a current CF demand of 5,800 t p.a. in Germany, carbon fibers worth approx. €34.8 million can be saved annually. By lowering the market entry barriers for thin-ply composites, an increase in sales can also be expected among German SMEs that manufacture the necessary equipment for tape production, tape laying and equipment for RTM and VARI processes. The calculated sales of these SMEs in Germany are €185 million. Assuming a 5% increase in sales, this corresponds to around €9.3 million.

Deficit	Aim
<ul style="list-style-type: none"> ⊖ High process and investment costs due to required autoclaves for prepeg tapes ⊖ High cost of available dry tapes ⊖ Few options of dry tapes, limited to few compatible matrix systems 	<ul style="list-style-type: none"> + Tailored thin-ply semi-finished product + Consolidation in cost-effective out-of-autoclave processes



Acknowledgement

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