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Tailored fibre placement on rCF-nonwovens

Abstract

Within the project "Tailored fibre placement (TFP) on recycled carbon fibres (rCF) -nonwovens ", funded by the "Sächsische Aufbaubank – SAB", the Leibniz-Institut für Polymerforschung Dresden e.V. – IPF and Sächsisches Textilforschungsinstitut e.V. – STFI investigate the applicability of rCF-nonwovens for the TFP-Process. Therefore (mainly primary) Carbonrovings are embroidered onto rCF-nonwovens to produce net-shaped and load bearing preforms. This enables on one hand load adapted fibre orientations and on the other hand recyclable designs and a resources saving production.

Fig. 1: TFP- process at IPF

Aim of the Project

The project considers two different approaches

a **Classic CFRP production with thermoset resins**

- By using thermoset impregnation technologies
- 100% rCF-nonwoven as embroidery fabric
- Purity of variety simplifies the recycling (rCF-nonwoven combined with C-rovings)
- Main challenge of this approach: sufficient strength of the nonwoven to be embroidered

b **Hybrid nonwoven (rCF-TP-nonwoven) including thermoplastic matrix component**

- Thermoplastic fibres of the nonwoven serve as matrix material
- Embroidery thread – developed at IPF – as part of the matrix to facilitate the impregnation of the C-roving
- Challenges:
  - appropriate amount of thermoplastic fibres to impregnate the entire composite including the embroidered roving
  - preventing ripple and floating of the roving during the impregnation process (caused by the melting of the yarn)

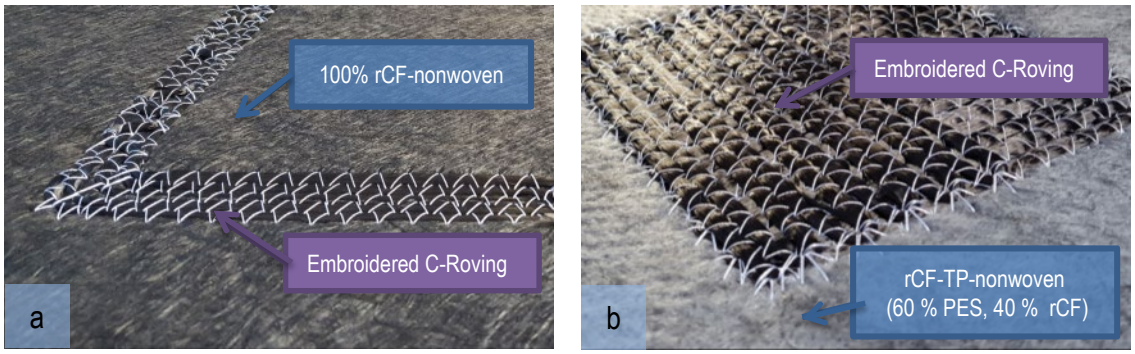

Fig. 2 : Two different research approaches (a) with thermoset matrix (b) with thermoplastic matrix

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Experimental & results

a **Development of 100% rCF-nonwovens (STFI)**

- Variation of different webforming technologies: airlay or carding process combined with needle-punching
- A variety of nonwovens with different area weights (investigation of the bottom line of area weight: 50 – 100 gsm)

Embroidering on 100% rCF-nonwovens (IPF)

- Developing an embroidery pattern with a variety of stitch densities and lengths
- Photographical comparison between theoretical and real roving deposition
- Embroidering of multilayer roving-geometries by using the "lightweight stool-geometry"
- Embroidering of the "secondary roving" (developed at STFI) was investigated

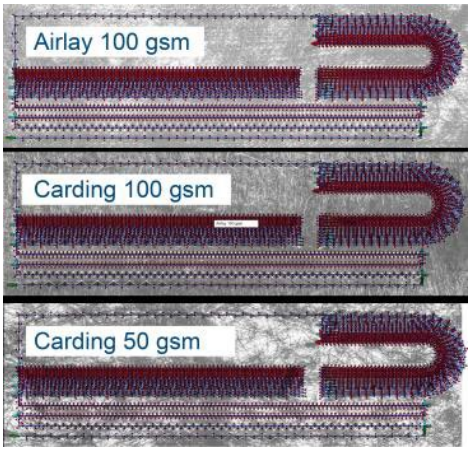

Fig. 3: Photographical comparison of different embroidery pattern

Fig. 4: Lightweight stool on 100 % rCF-nonwoven

b **Develeopment of rCF-TP-nonwovens (STFI)**

- Variation of different webforming technologies: airlay or carding process combined with needle-punching, considering an homogenous mixing of the pyrolysed rCF and thermoplastic fibres
- Determination of an appropriate fibre ratio from thermoplastic fibres and rCF to impregnate the entire composite

Embroidering on rCF-TP-nonwovens (IPF)

- Developing of a suitable embroidery thread at IPF (adapted on the thermoplastic fibre component of the hybrid nonwoven)
- Production of different embroidery patterns to consolidate them at STFI

Outlook

- Further development of the analyzing method for the comparison of the theoretical and real roving deposition
- Investigation of the consolidation of embroidery patterns based on hybrid nonwovens
  (Special focus on the floating of the roving caused by the disappearance of the embroidery threads)

Diese Maßnahme wird mitfinanziert durch Steuermittel auf Grundlage des von den Abgeordneten des Sächsischen Landtags beschlossenen Haushaltes.

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