Development of an innovative preforming process

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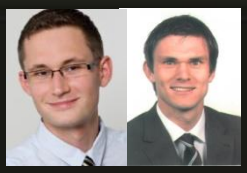

Introduction

In order to establish CFRP in high-volume automotive applications, there is a need to reduce current cost levels.
One setting lever to reduce costs is the improvement of manufacturing processes.
Hence a new cost-efficient preforming process based on dry fiber placement (DFP- figure 1) is being developed which delivers dry fiber structures for the production of CFRP parts in a subsequent high-pressure resin transfer molding (RTM) process.

There are two possible use cases for DFP:
1. Production of preform completely out of DFP.
2. Reinforcement of textile preforms out of Non Crimp Fabrics (NCF) with DFP.

One major challenge is the injection of the DFP preforms as the preforms are very dense and fiber show wash out at high resin pressures.
Therefore the research aims to create a fundamental understanding of the filling behavior of the DFP-preforms in the RTM process.

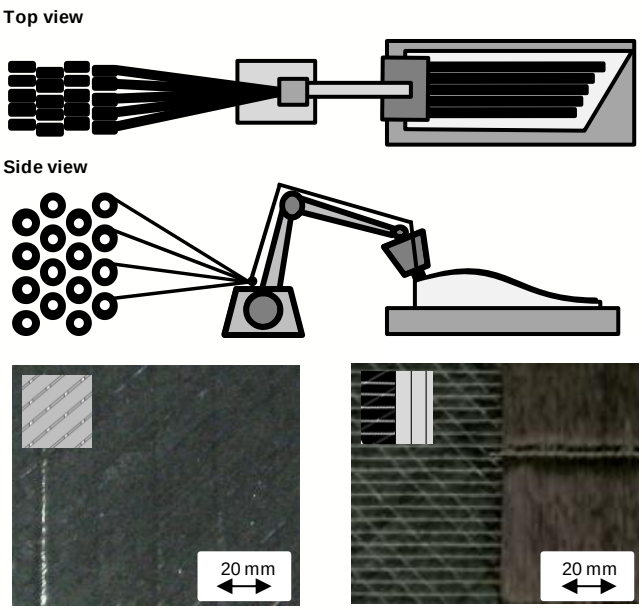

Figure 1: *Direct fiber placement and use cases*

Objectives

1. Understand and improve the filling of preforms completely out of DFP.
2. Understand and improve the filling of textile preforms which are reinforced with DFP.
3. Derive the most suitable use case out of a technological point of view.

Methodology

In order to improve the filling behaviour, channels can be integrated into the layup strategy or the DFP structure can be stitched locally.
A three step approach in order to investigate the effect of gaps and stitching on filling behaviour is proposed. This methodology is shown in figure 2.

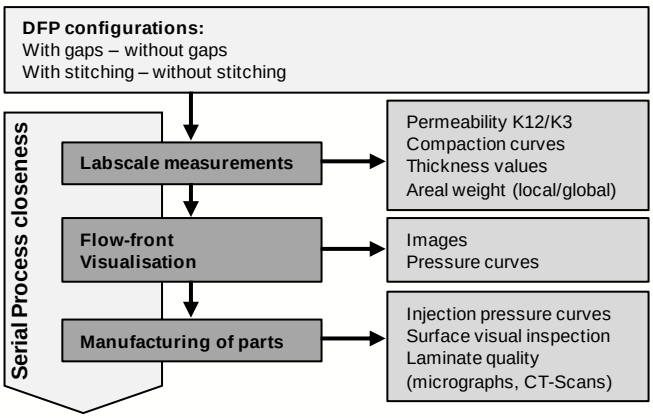

Figure 2: *Methodology and evaluation parameters*

Results

The permeability results show a relatively low K12- and K3-permeability for the baseline configuration, as compared to textiles such as NCFs or wovens. The preforms made with DFP are denser, and more easily compacted to higher fiber volume fractions (FVF). Preliminary permeability results show that gaps which are inserted change especially K3-permeability significantly. First flow-front visualisation results show that the stitching influences the local filling in thickness direction and in plane on top and bottom layer.

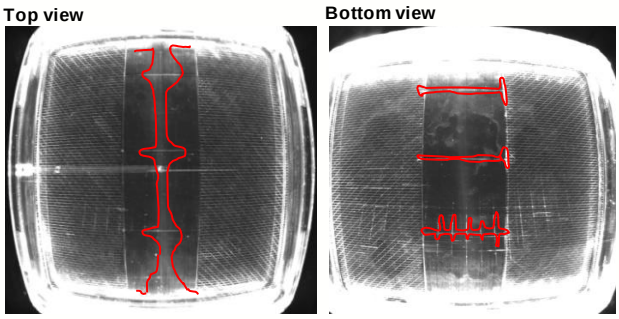

Figure 3: *Influence of stitching in flow-front visualisation of a local reinforced textile (left: top view, right: bottom view)*

Further Research

One of the major influence parameters on filling the binder activation of DFP structures has to be investigated in further studies. Furthermore the influence of the gaps on micro-filling has to be evaluated.