INFLUENCE OF LASER CUTTING ON HANDLING, DRAPE AND INFUSION CHARACTERISTICS OF PREFORMS

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Summary: Mass production of CFRP parts has lately become reality in the automotive industry, and 5-digit production volumes are feasible in state-of-the-art production technology. However, further automation and a reduction in production steps are needed to be able to compete with other lightweight solutions. Today, higher-volume production processes for CFRP consist of a number of steps, typically including a preform manufacture, followed by a trimming operation on the preform, infusion of the matrix, and a final trimming operation performed on the cured laminate. Due to its precise and force-free method of operation, a near net-shape trimming of preforms can be realized by laser cutting. Thus, a later cost and time intensive trimming operation on the cured laminate could possibly be avoided.

In this paper, the influence of the laser cutting process and its key parameters on the handling, drape and infusion characteristics is discussed. Depending on the process parameters, the fibres of single layers are attaching to each other, but no inter-layer connections have been identified. This may be favourable for the following handling steps. It can be shown that on the one hand, laser processing of preforms can be realized at high process speeds of up to 1 m/s, while on the other hand the process is getting less efficient with increasing velocity. Furthermore, by increasing the process speed, fibre attachment is decreasing and the carbon fibres are thrown up by the forces of the vaporisation, resulting in an inhomogeneous cutting edge.

A simplified drape test has been performed, measuring the forces needed to push a stamp into a circular laser cut specimen. It was observed that the connection between the fibres does only affect the forces to a minimal extent and no significant influence of the cutting parameters on the drape characteristics has been found. Laser cut specimen have then been infused in vacuum infusion process as well as in resin transfer moulding with no observable limitation. The process had been transferred from cutting of simple 2D specimens to 3D-preforms used in the manufacture of a door for a mobile home. In conclusion, laser cutting of uncured fibres has been found an alternative to conventional cutting methods, allowing for high process speeds, maximum flexibility and an easier handling of the cut material, while still fulfilling drape and infusion requirements.