INFLUENCE OF VOIDS ON COMPOSITE LAMINATES WITH VARYING STACKING SEQUENCE

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ABSTRACT

During manufacturing of composites structures the formation of voids cannot be avoided. The void content can be reduced by carefully chosen process parameters such as autoclave pressure and temperature but at the price of higher costs. In general voids have a significant influence on mechanical properties of composite laminates.

In this work, the relationship between porosity and compressive properties for CFRP composites with varying stacking sequences i.e. unidirectional, quasi-isotropic and orthotropic laminates were investigated. All laminates were cured with different autoclave pressure levels to achieve various void contents. Using this method allows formation of voids without chemical influence on matrix and fibres in contrast to the application of blowing agents. The pores preferentially developed in the matrix layers and did not significantly effect the fibre orientation. With increasing void content pores also occur between fibres and affect the fibre misalignment in a high manner and leading to lower compressive strength and modulus.

The inspection of composite laminates comprised the investigation of void formation, its size (length, height and width) and distribution. Therefore common destructive and non-destructive inspection methods such as ultrasonic techniques, radiography, microscopy and thermography were used. A combination of these techniques allows a deduction of the void volume content.

The influence of the voids on the mechanical properties and failure of the laminates was investigated and correlated with the void content. Further analysis revealed the interdependence between mechanical properties, failure and stacking sequence. It was examined whether deductions from one stacking sequence to another can be done without further influences or if the stacking sequence yields a further influence parameter in porous laminates. It is concluded that the overall compression strength of the laminate is dominated by the porosities in the 0° layers.