

Micromechanical analysis of porosities in fiber reinforced plastics: experimental-analytical correlations

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Abstract

In this contribution, the microstructure of composite laminates with respect to porosities is investigated. Pore sizes, shapes, orientations and the statistical distributions of these quantities have been extracted from micro-computed tomography scans of several laminate specimens under laboratory conditions. These experimental data have been collected by using special micrographics software. The modeling of several relevant pore geometries and the subsequent analysis highlight the influence of such microdefects on the mechanical response of fiber reinforced materials, especially in terms of the effective stiffness properties. Furthermore, the computations allow for an estimation of the statistical scatter of these effective properties on a microscale level. It was found that, depending on the pore size, shape and orientation, the impact of such microdefects concerning the effective elastic properties can be significant and as such also affects the macroscopic behavior of composite laminates. Several closed-form analysis methods are available by which results for the effective properties by the generated experimental data can be determined. One of these methods is the analysis approach according to Mori and Tanaka which will also be used in this paper. Therein, a single homogenization step is performed in which the fibers, the matrix and the pores are smeared and the effective material properties of an anisotropic material are determined.

Topics: Micromechanics, Defects

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