

VOID CONTENT MEASUREMENTS IN THERMOPLASTIC COMPOSITE MATERIALS THROUGH IMAGE ANALYSIS FROM OPTICAL MICROGRAPHS

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The interest of measurement of internal porosity in composite materials lies in particular in the possibility of relating void content with macro and micro-structural properties of the material and with manufacturing quality.

A number of methods for void content measurement in composite materials are available. These include e.g., ultrasonic scanning, nuclear magnetic resonance Imaging (NMRI) and acid digestion techniques.

In this paper, a technique based on image analysis from optical micrographs is presented. Possibilities and limits of this technique are discussed, and experimental results are shown focusing in particular on the measurement of internal void content in ®Twintex, a commingled E-glass/polypropylene composite. The materials observed were manufactured either by vacuum moulding or by compression moulding technique. The voids obtained with microscopy observations were classified, due to their size and orientation, as co-planar and bundle cracks, interfibre cracks and matrix pores.

In practice, optical microscopy of specimens was able to detect void contents of less than 1% using a statistical point-counting technique. Computerised analysis of the micrographs was also possible, based on the grey scale difference existing between voids and the rest of the composite image (matrix, reinforcement). The quality of the results obtained depends on image filtering and on appropriate image thresholding. The practical difficulties of achieving this are also discussed.

Error analysis, carried out on the images taken from specimens with different levels of void content, ranging from 0.6 to 15 %. This analysis enabled to calculate the number of images necessary to obtain a given accuracy of the void content measurement for every level of porosity in the samples.