Voids in Composites and Effects

Voids are critical imperfections in fiber reinforced composite materials. They mainly arise from the entrapment of air or the presence of volatiles during the curing[1]. The presence of voids can severely affect the mechanical performance and lifespan of the composites[2]. Voids can act as a crack nucleation site as well as allow moisture to penetrate the composite and contribute to anisotropy of the composite[1]. Regardless of resin type, fiber type and fiber surface treatment, the inter-laminar shear strength of composite material decreases by about 7% for each 1% of voids, up to a total void content of about 4% [1]. For a loaded carbon fiber laminate composite, a 1%-3% increase in void content can reduce the mechanical properties of the composite by up to 20%[3].

Current Common Manufacturing Methods

The development of the appropriate "cure cycle" to give a fully cured and void-free laminate is a vital but often difficult part of composites processing. A few composite production methods have been developed and are commonly used by different manufactures, such as Wet Lay-up, Filament Winding, Resin Transfer Molding, etc. Some of them can achieve high fiber volume of thick laminates with low void content; however it is a challenge to produce void-free composite products[4].

Akiet Unique Technology to Produce Void-Free Tubulars

Akiet has developed the centrifugal casting processing technology to a new level where it can achieve void-free laminates. A new breed of composite centrifuge is developed to achieve very high G-force levels. New resin formulations are developed to match the processing in a high speed centrifuge. The production cycle parameters are optimized to produce the highest possible quality of void-free laminate. The pipe samples were examined with three different methods (microscopy and acoustic) and zero voids were observed. Figure 1 shows the microscopy image of the cross-section of a pipe sample.

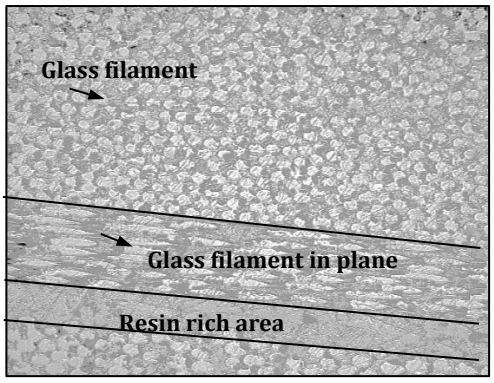

Figure 1. A microscopy image of the cross-section of the Akiet HSCT (0° - 45°) with the glass filament average diameter of 10 -16 µm.

Reference List

[1] Hull, D., & Clyne, T. (1996). Fiber Architecture - Voids. In An introduction to composite materials (2nd ed., pp. 55-56). Cambridge: Cambridge University Press.

[2] ASTM D2734-09, Standard Test Methods for Void Content of Reinforced Plastics, ASTM International, West Conshohocken, PA, 2009, www.astm.org

[3] Boey, F.Y.C. Lye, S.W. (1992). Void reduction in autoclave processing of thermoset composites: Part 1: High pressure effects on void reduction

[4] Guide to composites, Gurit, www.gurit.com

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