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Effect Of Processing Force On Architecture And Impact Strength Of Glass Fiber Reinforced Epoxy Composites

A. Nazrin, S. Mridha and Mohamad A. Rahman

Department of Manufacturing and Materials Engineering
International Islamic University Malaysia,
Jalan Gombak, 53100 Kuala Lumpur, Malaysia
Tel: 603-20564475 Fax: 603-20564853
Email: naz411975@yahoo.com

ABSTRACT

Fiber reinforced epoxy composite samples of different volume fractions of woven and chopped glass fibers were fabricated using hand lay up process. To obtain higher fiber volume fraction, a greater force was needed to consolidate the chopped fiber composite than for the woven fiber one. The woven fiber architecture suffered high amount of distortion in the fiber filament and nested with lesser matrix impregnation at higher applied force. The applied pressure has no significant effect on chopped fiber orientation. Voids, pores and matrix are low in specimen processed at higher force for both woven and chopped fiber composites. The impact testing for fracturing the sample was conducted at 30°C. The normalized energy absorption of fracturing the composites samples was found to be higher for the woven fiber composites compared to those of the chopped ones. This lesser energy absorption with chopped fiber composite is thought to be related to shorter fiber length in the chopped fiber composite which caused a lesser resistance to pull out compared to the continuous fiber in the woven fiber composite.

1. INTRODUCTION

The consolidation of fiber composites is achieved through a combination of compaction, matrix impregnation and curing which appears to vary the architecture of fiber composite. The dependency of composite properties are related to the yarn geometry and fiber orientation which have important microstructural features; the properties of the fiber composite changes as the microstructural feature changes. This expression portrays the intrinsic features of the fibers, such as their diameter and length, as well as the volume fraction of fibers and their alignment and packing arrangement.

Previous study by Saunders et al. [1] found that the compression speed within the range of 0.05 - 1 mm/min shows the elastic behavior of plain weave fiber with non matrix impregnation. They also observed with the increased of compression, the fiber volume fraction increases. Under the micro structural study, fiber yarns are deformed at an increased applied force thus decreasing the composite material thickness. Simacek et al.[2] reported that the compression analysis of plain woven fabric has a maximum value of 58 fiber vol%. The warp and weft of the yarn's geometric parameters was found to decrease from 0.6 to 0.56 mm and from 0.68 to 0.44 mm respectively. Bannister et al. [3] found at higher compaction applied forces during composite fabrication, matrix squeezes out resulting higher fiber volume fraction. They also found that the tendency of higher fiber crimping and nesting at this force rather than the low ones. Fu et al. [4] found that the notched Charpy impact energy of composite increases with increase of glass fiber volume fraction and it decreases with carbon fiber with polypropylene impregnated. They also found that the sample processing condition and the fiber length characteristic to be an important criteria to influence the amount of energy absorbed. Since microstructural features have an effect on fiber distribution, it is therefore important to develop quantitative links between microstructure and impact strength of composites. Infact no work is reported in literature regarding the explicit of topography changes for the woven and chopped fiber composites on application of force.