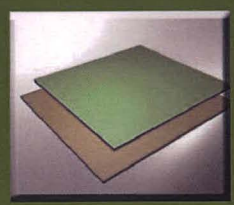
ADVANCES IN COMPOSITE MATERIALS



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Chapter 023

Impact Behaviour of Carbon/ Epoxy Composites in Moisture and Temperature environments

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Keywords: Impact energy, carbon fiber, epoxy, composites, moisture absorption, fiber delamination.

Abstract: Charpy impact tests were conducted on woven roving carbon/ epoxy composite specimens containing fiber volume fractions of 0.47, 0.56 and 0.66. Hand lay-up method was used in fabricating the composite specimens of 55 mm x 10mm x 10 mm in dimensions. The effects of fiber volume fraction and temperature on impact strength have been investigated at temperatures between - 60°C to 60°C in an interval of 10°C. Moisture absorption by carbon fiber and its effect on impact energy absorption were also studied. The impact energy was found to increase slowly with increasing the test temperature from -60°C to 0°C while it increased significantly when tested above 0°C; the impact energy absorption was highest at 60°C. Specimens with increasing fiber volume fractions gave lesser impact strengths and the specimen containing carbon fiber volume fraction of 0.47 produced the highest impact strength of about 270 kJm^{-2} at 60 ^{0}C. The moisture absorption was found to increase in specimens containing higher fiber volume fractions. The increase in moisture absorption in specimens slightly reduced the impact energy.

Introduction

Composite materials have a wide range of applications in aerospace, automotive, construction, medical equipment, sports equipment, underwater, marine structures and transportation because of their high stiffness and strength with respect to weight. In addition, composite materials have high resistance to corrosion and abrasion, superior impact and fatigue strength. They have high thermal resistivity. Carbon fibers occupy a premier position among the high performance fibers for composites and they combine high stiffness and strength with high temperature performance, especially in inert environments, and also offer relatively inexpensive routes, in comparison with other high temperature fibers, for large scale production.

Impact strength is very important for dynamic application of any material. Extensive research has been done on improving the fracture toughness on a brittle matrix composite using ductile fibers [1]. Arnold et al. [2] showed that there existed a linear relationship between damage and horizontal impact angle through the inclined impact test of chopped fiber reinforced composite materials. Broutman and Yeung [3] investigated the effect of fiber orientation angle on the impact properties of off-axis composites on E-glass-epoxy laminates. Also they varied the interface conditions by changing the surface treatment of the glass fabric. Polyester and epoxy resins were used as the matrix material. The apparent shear