Abstract

Fibers are the principal load carrying component of a composite. The characteristics of the fiber greatly influence the properties of the composite. Since most of the high performance fibers are transversely isotropic, five mechanical constants are to be determined in order to characterize the fiber. There are several techniques available to determine these constants. In this work, simple experimental techniques were adopted to characterize the fiber. These experiments were conducted on single filaments. Carbon fiber, a transversely isotropic fiber and glass fiber, which are isotropic in nature, were used to illustrate these experimental techniques. The experimental procedures to determine two mechanical properties, namely axial modulus and longitudinal shear modulus, and two damage properties, namely tensile strength and compressive strength have been explained in detail in this work.

The axial modulus and ultimate tensile strength of the fibers were determined through a tensile test conducted on single fibers, as per ASTM D3379-75. A simple torsional pendulum setup was designed and the time period of the torsional oscillation was obtained to determine the torsional rigidity of the fiber. The shear modulus of the fiber was calculated from its torsional rigidity. Tensile recoil technique was adapted to determine the compressive strength of the carbon fiber. Several fibers were tested at different stress levels and the data obtained regarding the failure of the fiber due to initiation of recoil compressive stress was used to determine the strength in compression. The recoil test data was evaluated using several approaches, both statistical and probabilistic. Weibull and Logistic models were used to evaluate the compressive strength distribution obtained from the recoil test.

Keywords: **experimental characterization, single fiber test, carbon fiber, glass fiber, torsion pendulum, recoil test, weibull model.**