High Strain Rate Testing of Fiber-Reinforced Composites

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Abstract

With the increasing use of high performance composite materials in many applications, accurate constitutive material models are required to predict the high strain rate response of composite structures. The accuracy of these models is highly dependent on the quality of the experimental data used to validate them. The split Hopkinson tension bar is considered the most suitable experimental technique to study the high strain rate tensile behavior of composite materials. However, many challenges are associated with the high strain rate tensile testing of brittle composite materials, particularly the design of sample geometry and the optimization of the measurement techniques for accurate force and low deformation measurement.

The aim of this work is to address these challenges when studying the high strain rate behavior of glass and basalt epoxy composites using the split Hopkinson tension bar. Several dog-bone sample geometries were assessed in terms of the establishment of the quasi-static stress equilibrium and the development of a homogeneous strain distribution across the gauge section, with the aid of FE models. Additionally, special semiconductor strain gauges were used on the bars to achieve a high force signal to noise ratio. Finally, the use of high speed digital image correlation technique to accurately measure the full strain fields locally in the gauge section of the sample was also discussed.

Keywords

Basalt composites; Glass composites; High strain rates; Split Hopkinson bar; Digital Image Correlation

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