Impact properties of injection molded glass fiber/polyamide-6 composites: effect of testing parameters

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Abstract
Reported data on impact properties show that wide discrepancies exist, although the same grade of materials was being used. In this article, we report some testing condition-property relationships of injection molded glass-fiber/polyamide-6 composites. It was found that an increase in specimen size/geometry leads to an increase in fracture energy and peak load; however, critical strain energy release rate and critical stress intensity factor decrease. Increase in impactor velocity, fracture energy, and peak load are all in mixed mode (increase and decrease). Similar to inconsistency obtained in fracture energy, critical strain energy release rate is also in mixed mode. However, critical stress intensity factor is marginally increased. Increases in impactor load weight and fracture energy at all notch to depth ratios are sensibly increased; however, critical strain energy release rate is marginally decreased at lower Vf and sensibly increased at higher fiber loading. With an increase in impactor load weight, changes in peak load are also in mixed mode, whereas critical stress intensity factor is marginally decreased.

Keywords
glass fiber composites, injection molding, falling weight impact, impact behavior, testing variables

Introduction
Recently, there has been a tremendous upsurge of interest in the fracture behavior and impact strength of polymer composites. One reason for this is the increasing usage of polymer composites in structural engineering applications due to its advantages such as high value of specific modulus and specific strength, improved fatigue properties, and low manufacturing costs. In such applications, it is essential to have a complete understanding of the composites’ mechanical properties.

Charpy impact testing is a cheap yet reliable method to study the fracture behavior and impact strength of materials. It is commonly required for construction codes, especially for fracture-critical structures such as bridges and pressure vessels. However, the method is highly sensitive to changes in test parameters such as specimen geometry, shape of the impactor tup, energy supplied, etc. Over the years, scientists have found that factors such as sample dimension and geometry of the notch, anvil, and striker have a great influence on the results obtained from the tests. Without uniformity of test results, the impact tests are almost meaningless as comparisons cannot be made. Therefore, it is vital to study the factors affecting the impact results scatter in order to have a better understanding of the test methods applied.

Impact properties are amongst the most important material behavior that needs to be known before deciding on an application for a specific purpose. Good impact properties are indeed important for products which during their service life are susceptible to failure due to high speed loading, such as bumpers for cars. A number of standards are available for impact tests. However, most reports on impact properties do not provide the details on how specimens were prepared, test fixture, and method of data analysis which lead...