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Editorial corner – a personal view

Can the standard impact tests become a true materials evaluation tool?

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Impact resistance constitutes one of the most popular quality control tools for polymeric materials and plastic finished parts. There are a number of standard impact test methods devoted to evaluate the impact response of polymeric materials (e.g., tensile-impact, Charpy and Izod tests, falling weight, Gardner, etc.). Nevertheless, to the questions: which test to use? how the different toughness measurements are related between each other? straightforward answers cannot be given. The shortcomings of standardized impact tests were recognized long ago: these tests are unable to generate an ‘actual material property’.

Fracture mechanics experts often criticize standard impact tests because of uncertainties about gauge length, complex three-dimensional stress states, their dependence on sample thickness, and the relationship of these factors to real situations. Indeed, to understand the true meaning of impact strength one must draw on fracture mechanics concepts. Modern instrumented devices can provide curves of high-speed stress/strain data which permit in principle the application of fracture mechanics. Even so, this approach seems to be unappealing to plastic industrialists who continue to prefer traditional impact tests. On the other hand, fracture mechanics does not take into account crack initiation in locations into the body where there are no initial sharp cracks, that is, it can't be used when the location of the failure initiation spot is not known a priori.

Nowadays, computer methods based on Finite Element Analysis (FEA) are widely used in the academia and industry for calculating forces, deformations, stresses and strains. They make possible to explore the influence of different materials and component geometries on the forces and deformations experienced in the impact event. In addition, physically based constitutive theories accounting for nonlinear and rate-dependent properties of polymers – viscoelastic and viscoplastic deformation characteristics – allow modeling the behavior of materials properly. As a consequence deeper information than that given by standard impact tests may be provided.

Future investigations should take the step forward to a full interpretation of the impact tests. Special efforts should be devoted towards understanding the existing relationship among different impact tests. This inquiry still remains as an open question which concerns polymer industry. The key lies in focusing to find the governing three-dimensional invariant-based failure criteria under impact situations. Once this goal has been achieved standard impact tests will become a true materials evaluation tool.

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