Characterization of tensile fracture of isotactic polypropylene solids.

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In this work, statistical analysis is applied to characterize the nature of tensile fracture data scatter for isotactic polypropylene (iPP) materials showing a high ductility and extensionability. All data collected from more than 100 tensile tests. In these tests, double-edged notched specimens were used to estimate the intrinsic fracture point under uniaxial tension. The fracture data of break points where the time to break, the ultimate stress, and the tensile toughness determined from the area under the stress-strain curve from the origin to the break point were obtained from each tensile condition over one hundred tensile tests. It was found that all the probability distribution curves of the fracture time, the ultimate stress and the tensile toughness approximately follow Gaussian statistics. As increasing the elongation speed, the fracture time tend to be shorter and the mean ultimate strength tend to be higher, whereas the toughness values is independent of the elongation speed. Consequently, we found a stochastic (namely Kolmogorov type) equation for fracture time of polypropylene to predict of mean and deviation of distribution of fracture time.

In addition, the use of double-edged notched specimens give a simple constitutive relation where the stress was proportional to the elongation time in the strain-hardening region beyond yielding. Consequently, we can apply a static Kalman filter system to the present fracture data to determine a conditional probability density function. Also, this application made it possible to predict the mean and deviation of tensile strength of iPP under any tensile condition.