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PROCEEDINGS

A New Analytical Method for Strength Prediction of Injection Molded Fiber Reinforced Thermoplastics Based on Progressive Delamination Failure Principle

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ABSTRACT

Accurate prediction for the tensile properties (tensile modulus and strength) of injection molded fiber-reinforced thermoplastics (IMFT) plays an important role in the design of structures made with such composites. Based on the Laminate analogy approach (LAA), a unified distribution function (UDF) of tensile properties is derived by introducing the assumption that the fiber length distribution (FLD) and fiber orientation distribution (FOD) are independent of each other. The UDF of tensile properties is simplified by introducing the modified monotonic functions of fiber length and orientation factors (λL and λO). Compared with the tensile modulus and strength distributions calculated by the simplified unified distribution, the bimodal Weibull distribution (BWD) fits well ($R2 > 0.97$), and the average tensile modulus and strength values obtained from the BWD are also very close to the theoretical values determined from the classic analytical formulae, particularly in the tensile modulus ($RD < 2\%$). Based on the BWD of tensile properties, the tensile strength of IMFT is predicted effectively by introducing the most common iso-stress and iso-strain progressive failure assumptions. The comparison results show that the predicted value of iso-strain load is more than 25% higher than that of iso-stress load, and the predicted value of the iso-stress load (RE= -14.0%) is closer to the experimental value of PBT-SGF30 whereas the simplified prediction of the iso-strain load (RE= -9.6%) is more similar to the experimental value of PA6-SGF35.

KEYWORDS

Tensile property; progressive damage failure; bimodal weibull distribution; injection molded composites; LAA

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