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Fiber Length and Orientation in Long Carbon Fiber Thermoplastic Composites

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ABSTRACT

Carbon fiber composites have become popular in aerospace applications because of their lightweight yet strong material properties. The injection molding process can be used to produce discontinuous fiber composites using less time and resources than traditional methods, thereby broadening carbon fiber composites' applications in different industries. Utilization of longer fibers offers more load carrying capability and superior strength properties for injected molded composites [1]. Since the fiber length and the orientation distribution in Long Fiber Thermoplastics (LFTs) directly affects LFT composites' material properties [2], there is a need to study the microstructure of LFTs and characterize fiber length and orientation distributions. Therefore, this work aims to experimentally measure fiber length and orientation in pre-manufactured carbon fiber LFT composites in order to validate computer simulations of the injection molding process, and to therefore better predict mechanical properties. Fiber orientation distribution was measured by the optimization of several grinding and polishing steps followed by microscopic imaging of a sample's cross-section. On the other hand, fiber length distribution was measured through the development of epoxy burn-off, down-selection, and fiber separation procedures, followed by microscopic imaging and manual fiber length measurements. By specifically optimizing these procedures for the analysis of carbon fiber LFTs, a detailed method has been developed to analyze the fiber length and orientation distributions and quantify any bias in the characterization techniques. Using the methods developed in this work, computer simulations can be validated and microstructure properties can be analyzed, allowing for better material strength predictions and industry implementation of LFTs.

KEYWORDS

Carbon Fiber, Long Fiber Thermoplastics, Fiber Length, Fiber Orientation, Injection Molding

REFERENCES

[1] Jay H. Phelps. *Processing-microstructure models for short-and long-fiber thermoplastic composites*. PhD thesis, University of Illinois at Urbana-Champaign, 2009.

[2] J. Denault, T. Vu-Khanh, and B. Foster. Tensile properties of injection molded long fiber thermoplastic composites. *Polymer Composites, Wiley Online Library,* 1989*, 10*, 313-321