CHARACTERIZATION OF MILLED CARBON FIBER ADDED RANDOM DISCONTINUOUS LONG FIBER COMPOSITES

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ABSTRACT

The effect of milled carbon fiber reinforcement on mechanical strength of random discontinuous long fiber (DLF) composites is studied. In order to determine the effect of milled fiber weight content on mechanical performance, milled fiber added carbon fiber reinforced polyetherimide (CF/PEI) DLF composite plaques with 0 wt%, 2 wt%, and 4 wt% of milled fiber loadings were molded, using compression molding process, and their in-plane and out-of-plane (through-thickness) properties, such as tensile, compressive, in-plane shear, and interlaminar tensile strengths are investigated. Post-mortem inspection on failed specimens is performed using optical microscopy and scanning electron microscopy (SEM) to characterize failure modes and fracture morphology, respectively. Finite element analysis (FEA) models to predict interlaminar tensile strength are also generated and compared with empirical strength data to observe a correlation between the model simulation and the experimental data.

1. INTRODUCTION

Random discontinuous long fiber (DLF) composites have been widely used in industry on account of their inexpensive processing methods, rapid production rates [1], and their capability to produce complex shape or geometry parts [2]. The main drawback of DLF composites, however, is their low mechanical properties in comparison to unidirectional continuous fiber composites [3], due to their short fiber reinforcement and random orientation. Strength reduction of DLF composites was predicted by Halpin and Kardos [4] and validated by many researchers. Thus, the DLF composites are very commonly used in automotive and appliance applications, but have not been considered as suitable material for aerospace structural applications.

Currently, the aerospace industry is facing a technical challenge to reduce production time and cost of composite parts, without undermining the performance benefit of composite materials. Consequently, numerous efforts have been made to develop a cost-effective composite manufacturing process, such as non-autoclave cure processes, automated processes, and resin infusion processes. If traditionally cost effective production of DLF composites can only show improved mechanical performance, DLF composites will be of great asset to aerospace application and significant interest in the aerospace industry. Efforts to improve the performance of short fiber reinforced composites have previously been conducted by studying the effect of fiber length, fiber diameter, compatibilizer, etc [5-7]. Unfortunately, these studies reveal pivotal flaws in mechanical properties, their consistency, and processing for DLF composites. For