LONG FIBER THERMOPLASTIC COMPOSITES FROM RECYCLED CARBON FIBER

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ABSTRACT

We are demonstrating that recycled carbon fiber (RCF) can be a viable raw material for making long fiber thermoplastic (LFT) compounds using two thermoplastic polymers: PA-66 and PPS. The RCF fibers are drawn from a variety of sources including dry fiber edge trimmings, thermoset prepreg scrap, and end-of-life epoxy-matrix parts. The recycled fibers compounded and molded well in all the resin compositions - whether AS4 or IM7 in as-received, pyrolyzed, or regrind conditions. The mechanical properties achieved with recycled fibers were similar to those achieved with commercial LFT material. We also made parts from scrap PPS-CF prepreg that was ground and blended with additional PPS. The results for these samples were among the best results we achieved. We have shown that LFT made from recycled carbon fiber can provide carbon fiber composite molders and users with a high-value-added alternative to landfilling their in-process and end-of-life scrap.

1. INTRODUCTION

1.1 Overview of Long Fiber Thermoplastic Composites

Thermoplastic composites are the work-horses of the composites industry in North America, due mostly to the low cost associated with the raw materials needed (typically fiberglass-reinforced polypropylene and nylon) and the fast cycle times required for part manufacturing (typically 1-5 minutes).[1,2,3,4,5] Thermoplastic composites help industry respond to calls for reducing the weight of parts and increasing their performance.

Long fiber thermoplastic (LFT) compounds contain reinforcement fiber lengths of >10 mm. This is in contrast with traditional glass- or carbon-reinforced thermoplastic injection molding compounds that contain milled or short (0.1 to 6 mm) fibers. The longer reinforcement, provides a significant increase in mechanical properties over injection molding compounds.

As fiber length increases elastic modulus, tensile strength, and impact resistance approach values for continuous fiber composites, Figure 1.[6] The main advantage of LFTs is that, unlike continuous fiber reinforced composites, they can be processed using traditional plastics molding processes such as compression molding, which provides a great deal of flexibility in part design and geometry. Therefore, parts can be manufactured at medium volume rates (10,000 to 100,000 parts per year) with excellent consistency and repeatability. Furthermore, the use of a