Long Fiber Reinforced Thermoplastics with Pushtrusion™

Stephen T. Bowen
PlastiComp LLC

Introduction

Long Fiber Reinforced Thermoplastic (LFRT) materials offer superior impact strength and stiffness compared to traditional short fiber reinforced materials. For several decades, these specialized compounds have grown in volume and diversity. Initially introduced as LFT (Long Fiber Thermoplastic) pellets, the compounds have evolved into D-LFT (Direct Long Fiber Thermoplastics) variants and expanded their process capability to include injection, compression, and transfer molding.

The D-LFT molding process has several very unique attributes. One attribute that is particularly unique is the ability to control the fiber length of the chopped reinforcing fiber roving. Initial objectives were to simulate the performance of LFT pellets with this D-LFT process. The general goal of most molders was the cost reduction derived from investment in D-LFT process equipment that allowed them to mold with purchasing pre-compounded LFT pellets. Although our process capability permitted cutting fibers longer than the typical 12 mm fibers in LFT pellets, the injection molding process typically reduced the fiber length in molded parts to 3-5mm. With the capability to provided longer reinforcing fibers into the molded part, PlastiComp decided to look at part forming processes beyond injection molding that could preserve the longer fiber length attained with our D-LFT process technology.

It All Depends on EVERYTHING

It is well known that reinforcing thermoplastics with long reinforcing fibers is quite complex due to the many controllable variables within the parameters of formulation, process conditions, part design, mold geometry, fibers type, etc. etc. Filament wet-out and fiber orientation/distribution are critical and controllable factors when making excellent LFRT parts.

To make parts consistently reproducible, most process systems “attrite” the glass fiber to shorter than desirable lengths to attain adequate filament wet-out and elimination of fiber bundles. Thus LFRT compounds do not usually result in parts with fiber lengths greater than 5mm. With the capability to deliver compounds with very long reinforcing fiber length (greater than 12mm) in the molded part, we had to look at molding processes other than traditional injection molding.

Compression and Transfer Molding with D-LFT

D-LFT processing has grown most rapidly with compression molding. Compounds are prepared on compounding extruders and transferred directly to the molding machines. Twin-screw compounding extruders adequately inject continuous roving, or pre-chopped roving – and produce compounds with adequate fiber wet-out and filament distribution. The fiber length distribution in such systems is a normal distribution with a typical median fiber length not exceeding 4mm. If pre-chopped fibers are used, then the difficulty to feed them into the extruder and then distribute them into the compound as discrete reinforcing filaments results in similar fiber lengths, at best. With capability to put fibers of up to 50mm into a molded part, PlastiComp evaluated Pushtrusion for compression molding.

Learning from Experience

Project developments that are currently in progress will be presented at the conference.

PlastiComp has developed D-LFT technology to deliver very long fibers in the molding compound and to maintain these very long reinforcing fibers in the molded parts. This D-LFT technology is analogous to GMT, as D-LFT inject molding is to LFT pellet injection molding. This process can also be used for profile extrusions, as the D-LFT process is extrusion melt based and therefore continuous.

About the Author

Stephen T. Bowen is President & CEO of PlastiComp LLC. He was President and CEO of the Ticona Celstran business from 1984-1999. He completed undergraduate studies at University of Pennsylvania and holds an MBA at Vanderbilt University.