THE DISRUPTIVE NATURE OF PUSHTRUSION™ DIRECT IN-LINE (D-LFT) COMPOUNDING TECHNOLOGY

Eric Wollan
PlastiComp, LLC

ABSTRACT

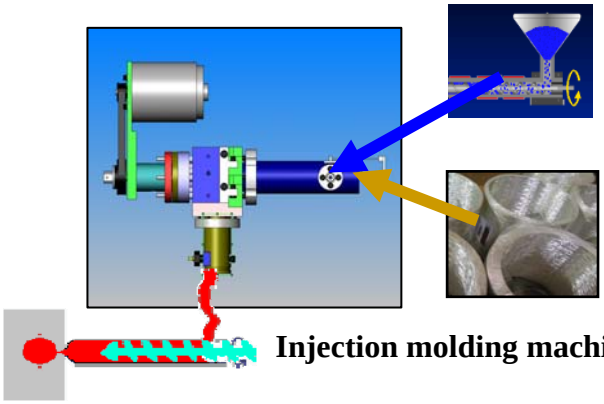
PlastiComp's Direct In-Line (D-LFT) compounding process provides processors of fiber-reinforced thermoplastics a simple and affordable alternative to pre-compounded pellets, while yielding equivalent or slightly higher mechanical properties.

Its clever and uncomplicated design allows PlastiComp's D-LFT unit to be easily mounted on top of an injection-molding machine of various size to compound both long and short fiber reinforced thermoplastics. The simplicity of the system allows converters the opportunity to compound fiber-reinforced thermoplastics themselves and capture a greater portion of the value chain. The flexibility of the technology does not favor a particular thermoplastic or formulation and therefore may be tailored to solve a particular opportunity using commercially available raw materials.

DIRECT IN-LINE COMPOUNDING

In PlastiComp's D-LFT process (Figure 1), thermoplastic resin pellets are fed into the hopper of the polymer injection unit. The injector unit is a typical injection barrel, capable of melting resin and homogeneously mixing and introducing the melt into the process at high rates and pressures. Continuous glass fibers are pulled from the supply creel and into the process die by the high-pressure flow of molten resin. The viscous entrainment die is designed to meter glass fiber and molten resin, keeping the glass fiber percentage within close tolerances. The glass fiber strand and molten resin mixture is pushed from the viscous entrainment die at several hundred feet per minute. This process starts and stops instantaneously, as dictated by the material in-feed requirements of the injection press barrel.

An in-line chopper cuts the glass fiber imbedded in the molten thermoplastic resin as it exits the viscous entrainment die. The chopper's cutting chamber is heated to maintain the cut mixture in the molten state. This mixture is directed through a transition tube positioned directly above the injection press screw. Glass fiber chop lengths of ¼ inch through several inches are possible.



(Fig. 1)

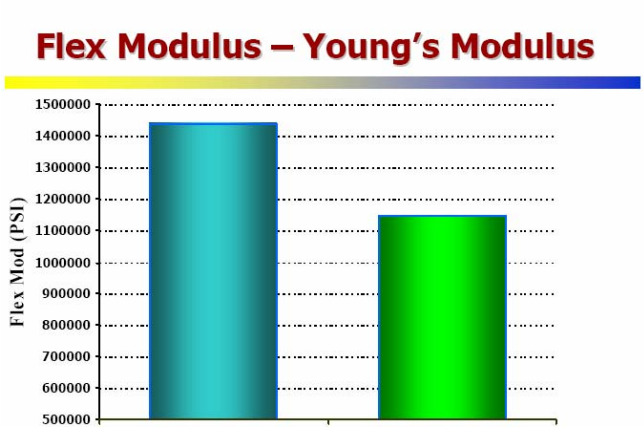
PlastiComp's D-LFT process is capable of controlling glass fiber percentages within a narrow range. A total variation of less than ±2% by weight is typical.

The significant advantage of the PlastiComp D-LFT process over other D-LFT technologies is the ability to control fiber length. The patented chopper design allows fibers to be chopped to a specified length. The other D-LFT technologies on the market today use twin screws to chop the fiber,

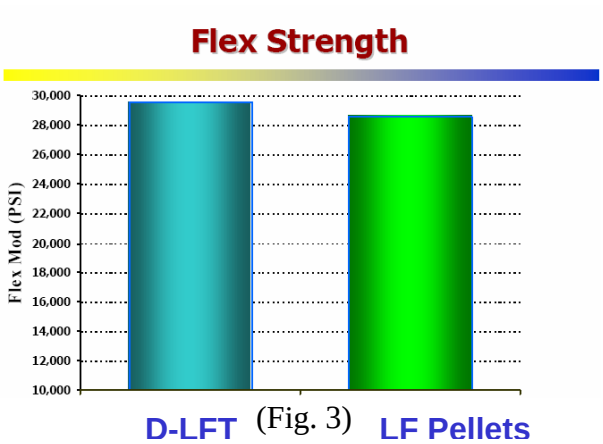
which leaves the fiber length up to a random distribution.

PROPERTY COMPARISON (PELLETS VS. D-LFT)

To compare properties between pellets and PlastiComp's D-LFT technology a comparison of mechanical properties was performed using a formulation of 40% long glass filled polypropylene pellets with 1.04% of a proprietary coupling agent. Figures 2 through 5 compare the data that was generated from pellets and D-LFT. The test bars were molded using the same mold, same injection machine, same formulation, and same initial fiber length (12mm).



(Fig. 2)



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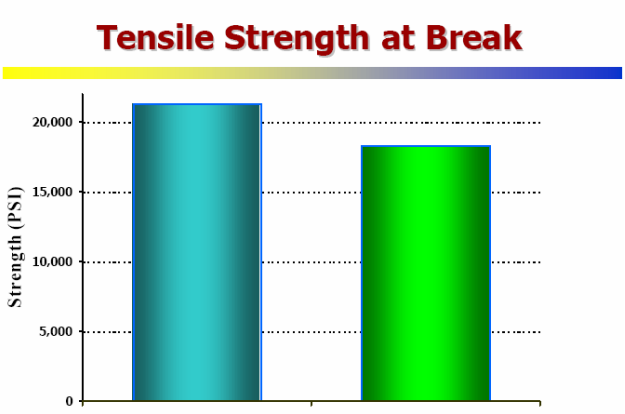
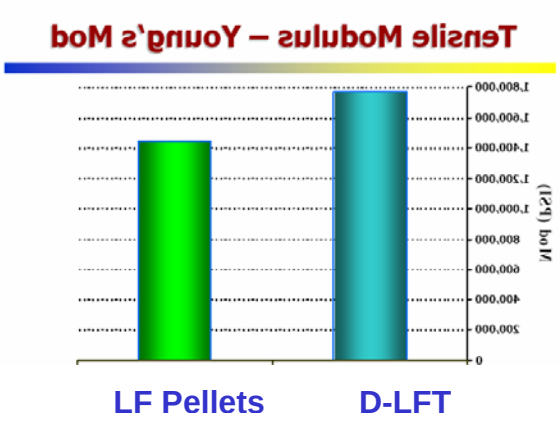


(Fig. 4)



(Fig. 5)

The data suggests that the D-LFT compounds yielded higher properties. It is important to understand the possible reasons for this when the compounds and processing conditions were identical. The D-LFT compound has only one heat history, compared to two with LFT Pellets. The D-LFT compounds are never cooled and are introduced to the injection screw in an already molten state. No compression is needed to melt the material in D-LFT processing. This results in less fiber breakage than what is seen with solid pellets.

Pellets are typically chopped at a length no longer than 12mm. This is to prevent bridging problems in the hopper of an injection machine. PlastiComp's D-LFT system delivers the chopped compound to the injection machine in a molten state right to the injection screw, so the fiber length

could be up to 2 inches long and not cause any feeding issues. This becomes much more critical when molding larger parts on higher tonnage injection presses. Fiber length retention will be much greater on larger machines that have larger screw flights and larger mold gating. The result will be an even greater property increase over LFT pellets.

THE COST ADVANTAGE

In order to stay competitive in today's global market, cost reduction is key. Raw materials are typically the largest cost component of plastic part manufacturing. This is where D-LFT has a large advantage over LFT pellets. A material processor can typically save up to 30% in raw material costs when using D-LFT technology instead of LFT pellets. The savings can be even greater when employing this technology with higher cost materials such as Nylon and TPU.

Where PlastiComp's D-LFT separates itself from other D-LFT technologies is with it's size (It's compact construction allows for the unit to be mounted on top of an existing injection machine, minimizing the need for additional floor space) and it's price. PlastiComp's D-LFT system can also be by-passed or removed when not in use so that a molder can process pre-compounded pellets if necessary. This increased flexibility reduces the risk of having an underutilized, dedicated asset on the production floor.

The PlastiComp D-LFT unit can be retrofitted to an existing injection machine, or an entirely new system can be purchased. With the large material costs savings that these systems return, the ROI on this equipment is quite rapid. Figures 6 and 7 show several different payback scenarios based on a retrofit unit or a complete D-LFT unit.

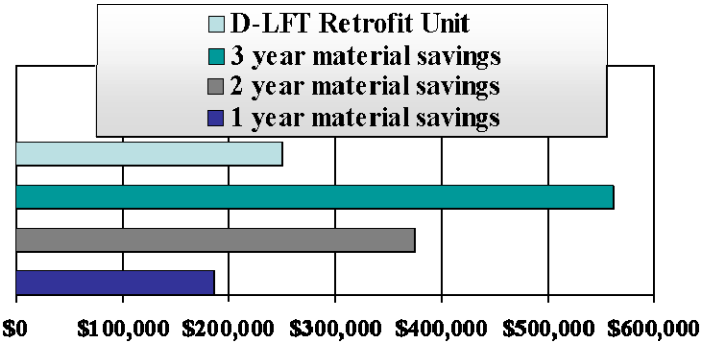


Fig. 6. Assume 5lb part or less at $2.50/lb cost of LFT PA6 material. The EAV in this example is 250K lbs and a $1.75 raw material cost with D-LFT. This results in a ROI of approximately 1.5 yrs.

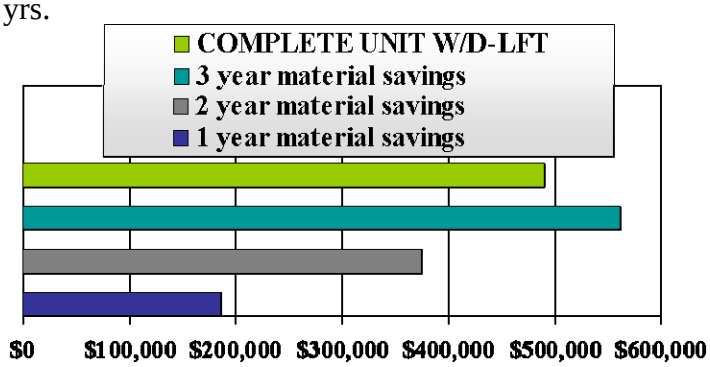


Fig .7. Assume 3 lb part or less at $2.50/lb cost of LFT PA6 material. EAV of 250K lbs. $1.75/lb raw material cost with D-LFT. This results in a ROI of approximately 2.75 yrs.

At first glance, it would appear that the retrofit option is the best Return-On-Investment. It is important to understand that under the complete unit scenario, the PlastiComp D-LFT unit is paying back the entire injection machine and compounding unit. Both units can still be used as traditional molding machines when desired, which makes both cost scenarios very conservative.

Many of the competitive D-LFT technologies on the market are three to four times the cost of the PlastiComp D-LFT system. In order to get a suitable ROI on a competitive unit, the molder must have a very large volume OEM that they are

molding for. This limits the amount of users of D-LFT technology in the marketplace. These units are only capable of D-LFT processing, thus increasing the risk if an account is lost. The PlastiComp D-LFT system reduces the expense and risk to the molder, by offering a lower cost, flexible alternative.

CONCLUSION

PlastiComp's D-LFT technology has the opportunity to disrupt the compounding industry by offering an affordable alternative to current D-LFT suppliers. The ability to be able to remove or bypass the D-LFT unit and use the injection machine to mold pellets greatly reduces the risk to the molder. The cost savings that are passed on to the molder through raw materials can be greater than 30% of LFT pellet prices. PlastiComp's D-LFT technology is able to supply formulations that yield mechanical properties equal to or greater than those of LFT pellets.