

# COMPOUNDING WITH "PUSHTRUSION" TECHNOLOGY

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## Abstract

"Pushtrusion"<sup>TM</sup> is a new technology that combines continuous fiber reinforcement with molten polymer, creating fiber reinforced compounds during the molding process. The continuous reinforcing fibers are cut to specified lengths to create short fiber compounds, long fiber compounds, or even continuous fiber reinforced materials. The "Pushtrusion" technology can be used with many part forming processes, including injection molding, compression molding, extrusion, and filament winding. "Pushtrusion" is a patented process, developed by Woodshed Technologies, Inc. The process is licensed to end-users. Equipment is manufactured to use existing molding machines (retro-fit), or for new molding machines with pushtrusion technology integrated by licensed OEM machine manufacturers.

## Introduction

Cost reduction is a dominant industry "driver" or requirement. Since raw material cost is typically the largest cost component of plastic part manufacturing, reduction of material cost can be the most effective cost reduction activity for a plastic part producer. Direct compounding (in-line compounding) is an action that creates the plastic compound during the molding process. This is a fundamental industry change that eliminates the compounder step in the traditional market value chain. Direct compounding has already been established as a successful technique for compression molding, especially for large volume, large size parts. For injection molding, direct compounding has not yet been well established as a successful technology. Alternative in-line compounding processes are expensive, complex, and require substantial floor space. Pushtrusion is a simple process requiring little additional floor space, low maintenance, and it can be added to existing molding equipment. Pushtrusion technology provides a unique route to market for injection molders to incorporate cost reduction into their business strategy.

## Direct Compounding for Injection Molding

In the Pushtrusion process, 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, homogeneously mixing and injecting 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 400 - 600 feet per minute. This "Pushtrusion" 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 and this cut mixture is directed through a nozzle positioned directly above the injection press screw. Glass fiber cut lengths of 1/4 inch through several inches are possible. The "Pushtrusion Process" is capable of controlling glass fiber percentages within a narrow range. A total variation of less than 1% by weight is typical.

A single input signal from the injection press is required for the Pushtrusion system to operate. When the injection press screw is turning, the Pushtrusion system is delivering molten material. The Pushtrusion system stops delivering material when the injection press screw stops turning.

Four significant process advantages occur when chopped glass fiber and molten resin are fed into the injection press barrel.

- Advantage #1: Conventional pultruded pellets in lengths of 1 inch or longer are difficult to feed. The mixture from the pushtrusion process is pliable, allowing very long fiber lengths to be processed without experiencing feeding problems. Cut lengths of several inches would be possible if the injection press were large enough to handle

them.

- Advantage #2: The resin has already been melted allowing for gentle mixing and maximizing retained fiber length of any given chop length.
- Advantage #3: The screw & barrel wear associated with melting resin and glass fiber pellets is eliminated.
- Advantage #4: The resin has undergone a single melt history minimizing degradation and improving physical properties.

The Pushtrusion system is compact in comparison with other in-line compounding systems. The fiber/resin mixing die has no moving parts and, therefore, functions on the basis of viscous entrainment. The integral, variable speed cutter is a unique and patented hot strand cutter. The process speed through the entrainment die is typically in excess of 500 feet per minute. Mechanical systems have been developed with either hydraulic or electric drives.

## Pellets or Direct In-Line Compounding

The industry debate over which technique - precompounded pellets or in-line compounding - is misguided, as both have merit and utility. The customer will usually select the route that best fits his business strategy. The option to go either in-line or precompounded, simply adds to the options for business success in a highly competitive industry environment.

Another side of this debate is the issue of formulation competency. Can molders formulate? They can, and several already do. A new option is now available is to use the "Pushtrusion" in-line compounding process with formulation technology provided by PlastiComp and partners of PlastiComp with expertise in both fiber and polymer technologies.

## Conclusion

"Pushtrusion" is a unique process that provides value to customers by reducing molded part cost. Retrofit to existing molding equipment, or purchased integral with new molding machines. The "Pushtrusion" process offers simple and practical solutions for today's competitive market environment.

## References

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Key Words:

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Previously (1984 - 1999), he was President and CEO of Celstran, the long fiber compounds subsidiary of Ticona.