

New Technologies

Long Fiber Reinforced Thermoplastics are a recent development in newer technologies where PP or thermoplastic material is directly compounded with long glass fibers (rovings) and then molded in one operation. Long Fiber Thermo-plastic technologies are the buzz of the auto industry in Europe and the US and are one of the most important trends in the plastics industry today.

Glass fibers of ½" (12 mm) up to 2" (50 mm) length give much higher stiffness, strength and toughness than the 1/8" (3 mm) fibers that have been used for reinforcement for decades.

Long Fiber Reinforced Thermoplastics (LFT) have excellent mechanical properties and stiffness-to-weight ratio which is of great interest to the automotive industry. These in-line compounding processes for long fiber material offer users more flexibility, as they are able to both compound and process such

materials in accordance with their own formulation and also use ready made compounds.

For this process gravimetric feeders are used to feed the main polymer as well as the additives. Short term accuracy is one of the key elements because of the very short residence time in the twin screw compounder. The process requires a 5-8% 2Sigma deviation at a sample time of 5-10 sec. at a feed rate of 1.5 kg (3.3 lbs) of irregular additive pellets.

Processes

There are currently three technologies of interest in the current market. These are E-LFT, D-LFT and S-LFT.

E-LFT is the in-line compounding and direct extrusion of long fiber reinforced thermoplastics as profiles or sheets, while D-LFT is the in-line compounding and direct compression molding of long fiber reinforced thermoplastics. S-LFT is the inline compounding

and direct injection of long fiber reinforced thermoplastics.

All three processes use continuous gravimetric feeders to feed accurately into the continuously operating extruder. Long fiber thermoplastics technology uses special screw configurations for both, single and twin screw extruders.

Ingredients

The base polymer is generally fed with a single screw or vibratory loss-in-weight feeder. The integrated vacuum receiver is responsible for the steady refill of the LWF.

One to three additives such as colors, stabilizers, etc. in powder or pellet form are added via smaller loss-in-weight feeders (single or twin screwfeeders, vibratory feeders or Bulk Solids Pump feeders).

Edge trimmings and other recycled materials are shredded and fed back into the process at a

predetermined ratio using vibratory loss-in-weight feeders.

Fiberglass

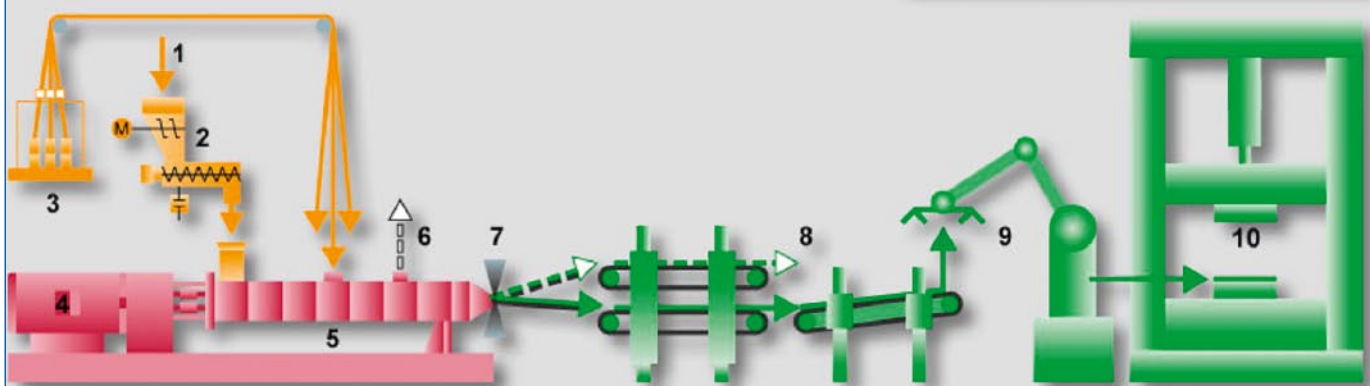
The glass fiber filaments are pulled into the extruder from continuous glass rovings on bobbins by the rotation of the screw shaft.

The throughput of the fiber is volumetric and quite steady. Each fiber stand is monitored by an infrared sensor. The gravimetric throughput of the fiberglass can also be checked by mounting the bobbins on scales and measuring the weight loss over time.

End Products

Most LFT end products are produced for the automobile industry. These molded parts include body panels, sound shields, front-end assemblies, structural body parts, truck panels and housings as well as doors, tailgates and fender sections. Development is also strong in other areas of application in the electrical and building industries.

Long Fiber Reinforced Plastics D-LFT: Coperion Werner & Pfleiderer System



- | | | | | |
|----------------------|---------------------|-----------------------------|-------------------|----------|
| 1 Polymer pellets | 3 Glass rovings | 5 Twin-screw compounder ZSK | 7 Cutting unit | 9 Robot |
| 2 Gravimetric feeder | 4 Motor and gearbox | 6 Devolatilizing | 8 Separating unit | 10 Press |



Photo of Coperton Werner & Pfeiderer D-LFT System with K-Tron Modular Loss-in-Weight Feeders

Feeder Selection Chart: provides a quick reference for initial feeder selection

Feeder Type		Granulate free flowing	Pellets free flowing	Powder free flowing	Powder poorflowing	Fibers free flowing	Fibers poorflowing	Low feed rates	High feed rates	Key Advantage
Single screw	Vol	++	++	++	-	0	-	+	+	Cost
Single screw	Grav	++	++	++	-	0	-	+	+	Cost
Twin screw	Vol	0	0	++	++	0	0	++	0	Cost, flexibility
Twin screw	Grav	0	0	++	++	0	0	++	0	Flexibility
Vibratory tray	Grav	+	+	0 Abrasive materials	-	++	0	0	+	Cost & gentle handling
Weigh belt	Grav	+	+	0	0*	+*	+*	-	+	Continuous Meas. & Headroom
Smart Flow Meter	Grav	+	++	++ Dust free materials	-	-	-	+	++	Price/feedrate ratio
Bulk Solids Pump	Vol	++	++	++	-	0	-	++	++	Cost, short term performance
Bulk Solids Pump	Grav	++	++	++	-	0	-	++	++	Cost, short term performance

++ well-suited + suited 0 partially suited - not suited * with prefeeder

Material Handling Know-How

With the diversity of the organic and inorganic components used in LFT processing, there is no single solution for reliable handling of these potentially difficult materials.

Pre-purchase testing helps determine the optimal combination of bin design, agitation and other flow aid strategies for the specific material in use. K-Tron's fully-equipped testing facilities are available to evaluate your materials and determine the optimal combination of equipment components to assure the highest level of accuracy and reliability.

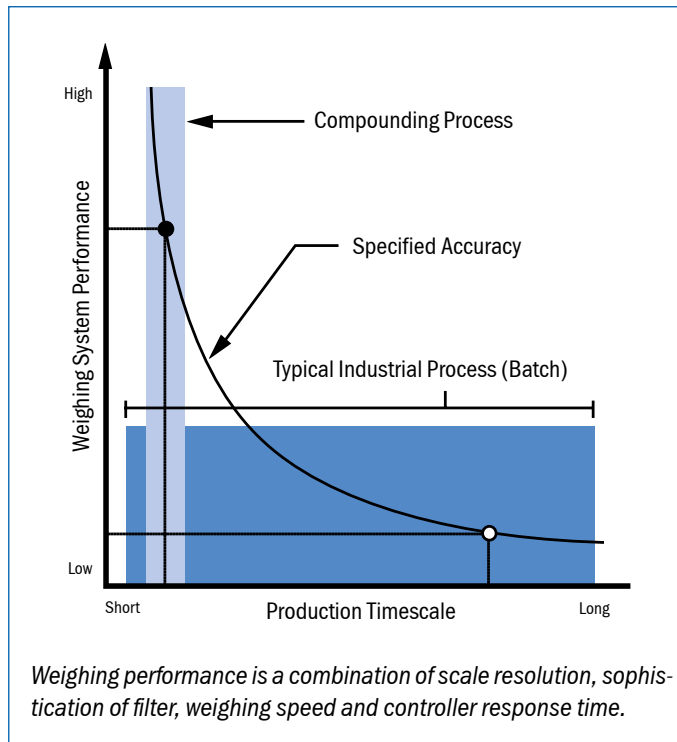
Feeder design and agitation solutions are also key to handling difficult bulk materials. K-Tron offers over 30 years of experience in material handling technology.

Feeding Systems in LFT-Compounding

Key to a feeder's ability to attain high accuracy over short intervals is the resolution of its weighing device and response of its process controller. As the illustration at right shows, lengthy performance timescales permit a given blending accuracy to be attained with a low performance weighing system.

However, to achieve the same accuracy in the short interval characteristic of continuous mixing operations, a much higher weighing performance is required.

The new generation of digital process weighing (such as K-Tron's Smart Force Transducer II & III) addresses these concerns, representing an important advancement in feeder performance.



Now fully integrated into K-Tron's complete line of gravimetric feeding, batching and metering equipment, the technology sets new standards in process feeding by delivering faster, higher resolution weighing with integrated digital filtering capabilities, especially beneficial in hostile plant environments, low rate feeding, and applications requiring high accuracy over very short intervals.

Bulk Solids Pump Feeders

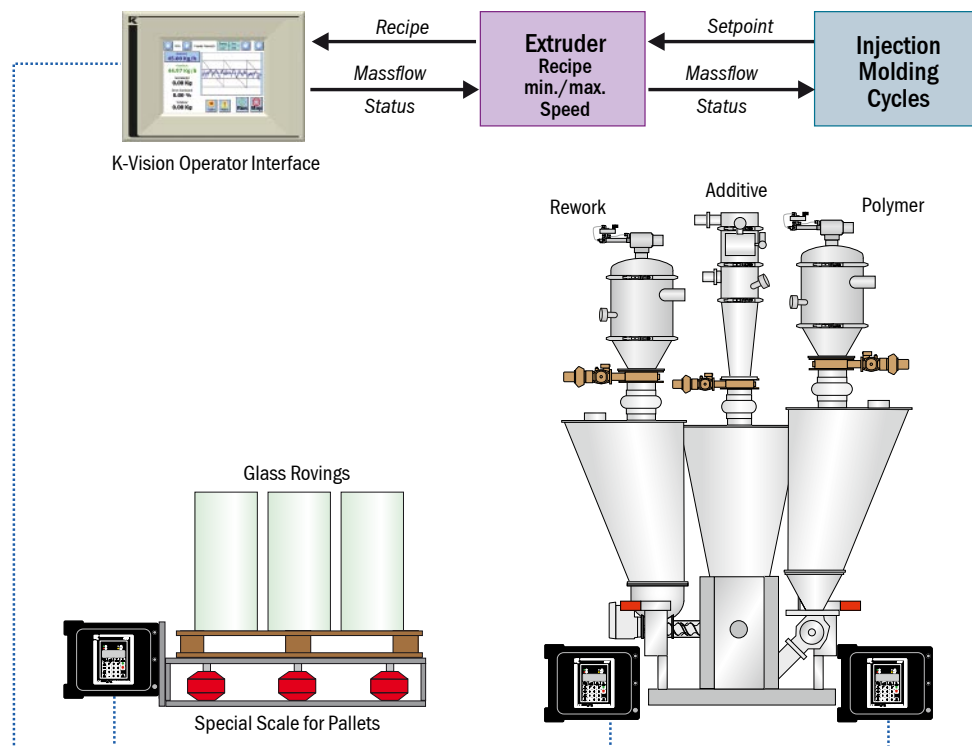
The new K-Tron Bulk Solids Pump (BSP) feeders have been specifically designed and engineered to provide gentle, precise feeding of free-flowing pellets, granules, flakes, powders and friable products.

Instead of the usual screws/ augers, belts or vibratory trays to convey the material, BSP feeders utilize positive displacement action to feed free flowing materials with astounding accuracy, offering uniform discharge, consistent volume and gentle handling.

The BSP feeders have vertical rotating discs that create a product lock-up zone, conveying the material smoothly from storage hopper to discharge outlet, achieving true linear mass flow.

Four BSP models are available for feed rates from as low as 2 dm³/hr to as high as 9000 dm³/hr (0.07 to 318 ft³/hr) in either volumetric or gravimetric configurations.

Typical Feeding System for D-LFT



- (1) The extruder speed determines the rate at which glass is pulled into the extruder.
- (2) The fiberglass massflow is reported back to the control system.
- (3) The control system then determines the setpoints of the polymer and additives based on the mass-flow of the fiberglass.



BSP-135

Smart Feeding Solutions



For Main Ingredients

K-Tron loss-in-weight feeders offer the perfect solution to precise feed rate control of a wide range of components in plastic composites.

Features include stable, all-digital SFT weighing technology with 1:1,000,000 resolution, large hemispherical feed bowls, extensive agitation options and a variety of models including single and twin screw feeders, vibratory feeder and Bulk Solids Pump™ feeders.



For Resins, Regrind and Additives

K-Tron's K4G SmartFlow™ Feeding System is designed for on-line blending of up to six components at low to medium rates. Able to accommodate various K-Tron feeders for combining pelletized, granular, and powdered or flaked materials which are blended simultaneously on the extruder.

K-Tron's K4G systems are available in 1-, 4-, and 6-ingredient stands, specially designed to be mounted directly on the extruder in a highly compact configuration. To facilitate cleaning or material changeover, each K4G feeder easily swings out providing full, unobstructed access.



For Powders, Flakes, and Non-Free Flowing Materials

K-Tron's standard and Compact Line single and twin screw and vibratory loss-in-weight feeders gravimetrically control the flow of even the most challenging bulk solid materials at rates as low as 100 g/hr.

High resolution SmartForce Transducer digital weighing technology combined with the industry's most advanced loss-in-weight control enables the highest possible accuracy even in the most difficult process environments.

K-Tron's standard loss-in-weight feeders (top left) feature stable 3-point weighing. Smaller Compact Line loss-in-weight feeders (above) employ precision platform-based weighing.



SmartConnex Smart Control Environment

SmartConnex is K-Tron's Smart Control Environment which reflects the latest thinking in process plant control and communications technology.

- One software package supports all types of applications, batch and continuous, simplifying programming
- Choose a K-Tron operator interface or direct connection between PLC/host computer and KCM feeder control module
- Reduce or eliminate feeder control panel expense
- Reduce cable purchases; feeders are networked with serial communication
- High speed field bus reduces wiring and checkout time; 90% less cable and conduit to install
- Simple connection to factory network and support for common protocols lower integration cost
- Integrated vacuum loader control

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