Case history

Vibratory tray feeder consistently feeds success

An inline compounder installs a vibratory tray feeder to successfully feed long-fiber fiberglass into an extrusion process with increased accuracy and consistency.

The difficulty with feeding long-fiber fiberglass is that it has a very high aspect ratio," says Charles Weber, president of Composite Products Inc. (CPI), Winona, Minn. "It's like trying to feed a bunch of toothpicks into a machine at an even feedrate. Our fiberglass is comprised of relatively stiff bundles ranging from ½ to 1 inch long that clog and bridge and aren't conducive to being processed in typical material handling systems. We needed to find a way to accurately and consistently feed the fiberglass without breakage and constant downtime."

CPI is a direct inline compounder that produces finished molded composites made from long-fiber fiberglass-reinforced thermoplastics. The company fabricates finished structural parts, such as running boards for vehicles, as well as covered parts. Twelve years ago, the company invented the proprietary extruding process it currently uses for integrating the long-fiber fiberglass into plastic. However, the material handling processes they used to feed the fiberglass were cumbersome, didn't achieve minimum feeding standards, and required constant maintenance. The company needed to find a better way to feed the fiberglass without extensive maintenance and downtime while increasing feedrate consistency and product quality.

Feeding problems decrease fiberglass processing efficiency

To produce the long-fiber thermoplastics, one of the process steps is to feed the fiberglass into an extruder. In the past, the fiberglass material was manually fed from a hopper in a long, continuous strand to a cutting machine. The cutter chopped the fiberglass to a discrete length above the extruder's feed throat. The material then gravity-discharged through the feed throat directly into the extruder.

The resonant-frequency feeding system incorporates a hopper with a bottom agitator, a vibratory feed tray, a loss-in-weight weighing system, and controls.

The company experienced several problems with this method, including excessive maintenance and wear problems that created downtime. "The consistency of fiberglass being fed into the extruder varied based on how well the cutter was functioning," says Weber. "As soon as we started producing at relatively high throughput rates, it began to be a maintenance issue where we were running so much through the cutter that the blades kept wearing out." When the cutter needed maintenance or repair, the entire production process had to be shut down, creating massive amounts of downtime and decreasing efficiency.

After a few years of using the cutting method, the company made a significant change. Instead of chopping the fiberglass in-house, it began ordering the discretely chopped fiberglass from glass manufacturers. The material was precut according to the company's specs, increasing quality and consistency.

Around the same time, the company replaced the cutting machine with a pinwheel feeder. The pinwheel feeder was essentially a gravimetric feeder that metered the discretely chopped fiberglass into the extruder's feed throat via rollers with pins on them. After using the feeder only a short time, the company realized that the pinwheel feeder wasn't the solution to its feedrate problem. In fact, the company experienced many of the same issues with the pinwheel feeder that it had experienced with the chopper. Says Weber, "The pinwheel feeder had a mechanical pin that, as the rollers turned, held back and dispensed the material. The pin geometry was critical – if any inconsistent material came through, it easily plugged and clogged the feeder." Since the pinwheel feeder was time-consuming to clean out, the company had to shut down production while performing maintenance and repairs.

Company hunts for new feeding method

In 1998, the company scheduled a new line installation for its licensed extrusion process at a customer's facility. This seemed like the perfect

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The tray feeder uses the supplier's patented vibration technology to provide a specified feedrate without breaking down or degrading the fiberglass.

time to search for an alternative feeding method for the long-fiber fiberglass. The company wanted to find a method that wasn't maintenance-intensive and that would be more flexible and accurate than the previous two approaches it had tried.

Around that time, Weber attended a Midwest trade show. One of the suppliers exhibiting there was Arbo Engineering Inc., Toronto, a manufacturer of custom-designed volumetric and gravimetric feeders, including vibratory, single- and twin-screw, and weighbelt models. Weber visited Arbo's booth and watched Shlomo Gicza, Arbo Engineering president, demonstrate one of the company's feeders. After the demonstration, Weber and Gicza discussed CPI's feeding problems and possible solutions that the supplier might have.

After the trade show, the company sent fiberglass samples to Arbo's Toronto facility for testing. "Fiberglass by nature is an extremely nasty material," says Marin Pop, sales manager at Arbo. "Most plastic compounders use very short fiberglass, up to 6 millimeters (¼ inch) in length, which is standard. However, CPI uses fiberglass with about ½-inch-long fibers."

The supplier tested and retested the material, and designed and built several prototypes. After several attempts, the supplier produced a feeder that fed the material with consistent efficiency and accuracy. The company installed the custom-designed feeder in early 2000.

Vibratory tray feeder answers company's plea

The model KDA-DV/100RU closed-loop, resonant-frequency, vibratory tray feeder is the first feeder of its kind on the market. The feeding system includes a hopper with a bottom agitator, a feed tray, a loss-in-weight weighing system, and controls. The feeder feeds 200 to 1,000 lb/h of fiberglass with ±2 percent accuracy.

The feeding system is mounted on a static frame with three load cells and is suspended from a mezzanine located above the extruder. This allows operators complete and unencumbered access to all of the feeder's components for easy maintenance and repairs. It also provides a center of gravity well below the fulcrum, which means the feeder won't tip over like it would if it were on a platform.

To feed the material into an extruder, the fiberglass is first discharged from a hopper to the feeder, which is attached to the extruder's feed throat. The 3.5-cubic-foot hopper holds a maximum capacity of about 90 pounds of material. "In a traditional feeder, the hopper typically cones down like a funnel," says Weber. "However, because of the nature of the long fibers, you can't funnel this material because it will eventually just plug the hopper's opening." Instead, the hopper has an agitator mounted to its flat bottom and two baffles on the hopper's sides that facilitate material flow. The agitator has a vertical axis and the agitator's paddles spin in a horizontal plane. The agitator rotates very slowly and gently pushes the material into a large tube opening located above the vibratory feeder tray. It doesn't impart any downward force while breaking up bridges and stopping them from forming.

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The material falls down the tube and onto the 9-inch-wide, 24-inch-long, horizontally mounted feed tray. The tray has 2-inch-tall sidewalls and is constructed of stainless steel with an advanced coating to make it work for

The 9-inch-wide, 24-inch-long feed tray has an advanced coating that helps it efficiently handle the fiberglass.

the fiberglass. The corrosion- and wear-resistant coating, Plasmadize, was developed by General Magnaplate Corp., Linden, N.J., a manufacturer of synergistic and high-tech surface enhancements for metals and other substrates. Plasmadize bonds a ceramic material to stainless steel, thereby increasing the tray's friction and giving the tray the "bite" to move the fiberglass.

The tray feeder uses the supplier's patented vibration technology, a variable-amplitude functioning mode that can be set to increase or decrease the vibrations to provide the specified feedrate. The vibrations' amplitude is longitudinal and moves the material forward. The faster the tray vibrates, the faster the feedrate. The tray's vibration operates at the natural (or *resonant*) frequency of the tray and its material, creating a parallel, even material discharge from the tray to the extruder's feed throat. The feeder has two control loops — one calculates the resonant frequency and the other varies the amplitude of the vibration to match the feedrate set point.

"The standard feeder type used for this kind of application is typically a screw conveyor," says Weber. "But if you put fiberglass in a screw conveyor, it will maul the fiberglass, breaking the fibers and plugging the conveyor. That's what makes this new feeder ideal for our application – it feeds with a much better accuracy than screw and other feeder types, but it doesn't break down or degrade the fiberglass material."

The vibratory tray feeder has no moving parts, bearings, or brushes that can wear or need replacement, it doesn't require mechanical adjustments, and no lubrication is necessary. In addition, the resonant-frequency method allows the company to achieve very accurate feedrates.

New tray feeder chases problems away

Since installing the feeder, the company has experienced many benefits and is extremely happy with the new feeding system. Says Weber, "We've seen an increase in production capacity because we don't have the maintenance issues that shut down the line in the past, and because the feedrate is more accurate and consistent, our product quality has increased. Also, we're no longer spending money on replacement parts, so our maintenance costs have decreased."

In the 5 years since CPI installed its first feeder from the supplier, the supplier has come out with several generations of the feeder, each with improvements. CPI currently has nine of the resonant-frequency tray feeders in its facility for handling fiberglass as well as other materials, and it incorporates these feeders when it supplies its licensed extrusion process to customers. **PBE**

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