PT PTonline.com

Plastics Technology®

MAY 2020 № 5 VOL 66

Paired Processes

Injection & Blow Molding Integrated at Sussex IM

A property of Gardner Business Media


"I love these cutters."
4,320,217,895
and they just keep cutting...
"Four billion-plus cuts each in the last five years and nothing needed but routine maintenance, no downtime, no significant parts costs. We work with many vendors, but choose the one that best suits our needs. With cutters, the best for the job is Novatec, hands down."
>> John Werner, Project Engineer, Teel Plastics, Inc.
Novatec Cutters
>> Outperform
>> Outlast
>> Out cut
Call Novatec today for best-in-class cut accuracy, repeatability, uptime, and five-year warranty.
5 YEAR warranty
LOWEST TOTAL COST OF OWNERSHIP
Downstream > Drying > Conveying > Blending
NOVATEC™
www.novatec.com
800-237-8379 | sales@novatec.com
© Copyright 2020 Novatec, Inc.

CONTENTS

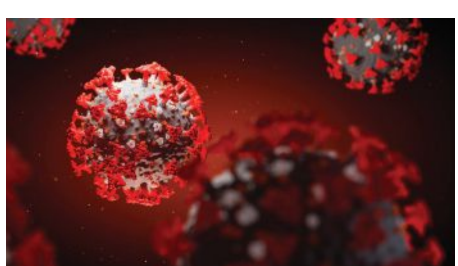
VOLUME 66 • NUMBER 5

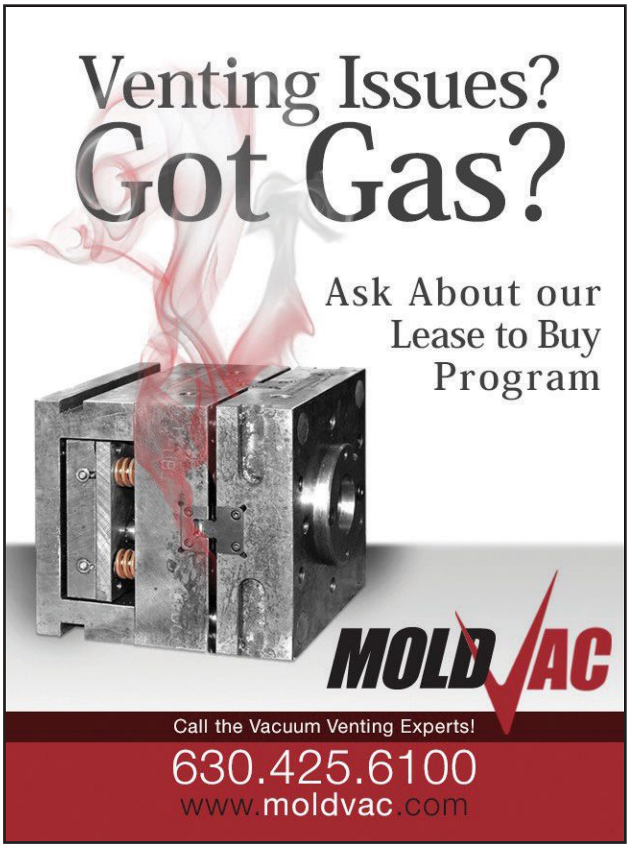
Plastics Technology

PT Web Exclusives — **There's more on the web at *PTonline.com***

BLOG: Processors Respond to Coronavirus Crisis

Check out our coverage on how processors of all kinds geared up to help the nation respond to the COVID-19 pandemic.
ptonline.com/blog





Plastics Technology

ptonline.com @plastechmag

PUBLISHER	Ryan Delahanty rdelahanty@ptonline.com
ASSOCIATE PUBLISHER/ EDITORIAL DIRECTOR	Jim Callari jcallari@ptonline.com
EXECUTIVE EDITOR	Matthew Naitove mnaitove@ptonline.com
SENIOR EDITORS	Lilli Manolis Sherman lsherman@ptonline.com
	Tony Deligio tdeligio@ptonline.com
	Heather Caliendo hcaliendo@ptonline.com
ADVERTISING SALES	Lou Guarracino loug@ptonline.com
	Jackie Dalzell jdalzell@ptonline.com
	Dale Jackman djackman@gardnerweb.com
	Michael Schwartz mschwartz@gardnerweb.com
ART DIRECTOR	Sheri Kuchta Briggs sbriggs@gardnerweb.com
MARKETING MANAGER	Chris Saulnier csaulnier@gardnerweb.com
AD PRODUCTION MANAGER	Becky Taggert btaggert@gardnerweb.com

Subscription Inquiries: For questions or issues related to your subscription, please call 513-527-8800 or email subscribe@ptonline.com.

PLASTICS TECHNOLOGY IS A PROPERTY OF

GARDNER Business Media, Inc.

6915 Valley Avenue
Cincinnati OH 45244-3029
Phone 513-527-8800
Fax 513-527-8801
gardnerweb.com

Chairman	Richard G. Kline
President	Richard G. Kline, Jr
Chief Marketing Officer	Melissa Kline Skavlem
Chief Data Officer	Steve Kline, Jr.
Chief Financial Officer	Ernest Brubaker
Chief Technology Officer	Phil Louis
Director of Custom Content	Tom Beard
Advertising and Production Director	Bill Caldwell
Director of Content and Web	Kate Hand
Director of Events	Allison Miller
Director of Strategic Engagement	Dave Necessary
Marketing and Creative Director	Jeff Norgord
Director of Market Research	Jan Schafer
Audience Development Manager	Julie Ball

GARDNER BUSINESS MEDIA ALSO PUBLISHES

Plastics Technology Handbook
Plastics Technology Mexico
Modern Machine Shop
Additive Manufacturing
CompositesWorld
Production Machining
NPE Official Show Directory
Moldmaking Technology
IMTS Directory
Products Finishing
Products Finishing Mexico
Automotive Design & Production


Canon
CANON VIRGINIA, INC.
Precision engineering.
Powered by partnership.
When it comes to mold making, plastics and advanced manufacturing, meeting precise standards is only the start of what we offer clients. See how our problem-solving acumen and comprehensive partnerships can help you rise above challenges at cvi.canon.com/mfg.

American Manufacturing Steps Up to the Coronavirus Challenge

Plastics processors are among the manufacturers that stepped up big-time in the face of the global COVID-19 pandemic. I'm proud to turn over this space this month to Rick Kline Jr., president of our parent company, Gardner Business Media, whose comments below (edited) appeared originally on March 31 in an Op-Ed piece published by the *Wall Street Journal*.

Jim Callari
Editorial Director

As a media provider to the manufacturing industry, my company has borne witness to the front lines of American manufacturing for more than 90 years, where the stories of sacrifice, ingenuity and common purpose are as countless as they are awe inspiring. As I write this, manufacturers of all sizes across the country are coming together to produce complex medical devices such as ventilators and N95 masks, finding creative and efficient ways to manufacture all the components that go into COVID-19 testing kits and countless other products needed in the fight against this new and invisible enemy.

The most amazing thing (and frankly, it's not at all surprising for those of us who know the people that own, manage and work in these businesses) is that our government did not need to direct this undertaking. The women and men who constitute America's manufacturing might are doers. And they are getting it done.

Rick Kline Jr., president of Gardner Business Media, parent company of *Plastics Technology* and eight other magazines devoted to discrete-parts manufacturing.

Ford and 3M, for example, have been working together since 1925, when masking tape was invented. Now they've taken that collaboration to a whole new level as Ford manufacturing engineers are on the factory floor of 3M facilities, helping increase the production of things like ventilators and N95 masks. What's more, they are partnering on the reengineering of a pure-air respirator so that Ford can use components from its parts bin—like the fan to cool the seat in an F-150—to quickly scale production of these life-saving devices.

3D printer maker Stratasys has committed its own 3D printers and organized the efforts of its customers providing time on their 3D printers toward a shared effort to produce face shields needed by healthcare workers at a rate of thousands per week, and HP's 3D R&D centers are collaborating with partners around the world in a coordinated effort to increase production. Initial applications being validated and finalized for industrial production include face masks, face shields, mask adjusters, nasal swabs, hands-free door openers and respirator parts.

We should deploy our capabilities closer to the markets being served. Think of it as 'Farm to Table Manufacturing.'

General Motors voluntarily entered into a partnership with Washington-based Ventec Life Systems aimed at making GM manufacturing resources available to help Ventec rapidly scale up ventilator production. GM's commitment was motivated by compassion and concern for the urgent medical need, no doubt, but also driven by the company's simple recognition that its fortunes and future success rely on the continued health of the people of the country it calls home.

Longer term, we must have better control of our supply chains, not because we want to be isolationist, but because the whole world is a better, safer place if we deploy our capabilities closer to the markets being served. Think of it as "Farm to Table Manufacturing."

Despite rumors to the contrary, America is a juggernaut of manufacturing. We are a nation of problem solvers and inventors. And, while we are overcoming today's crises, we are standing at the precipice of a Renaissance of American Manufacturing.

FOLLOW US
@plastechmag
@jimcallari

Plastics Industry Enlists to Fight Coronavirus

What are injection molders, blow molders, thermoformers, and extrusion houses—not to mention equipment and materials suppliers and trainers and consultants—doing to help combat the COVID-19 pandemic? Go to ***ptonline.com/COVID-19*** and you'll find dozens of stories on related topics by *Plastics Technology* editors—and by our sister publications at Gardner Business Media. You'll find stories on how processors of all stripes have turned on a dime to convert some portion of their capacity to production of desperately needed personal protective gear, such as face masks and face shields. (Photo: face shield made by Tessy Plastics.) Equipment suppliers are using machines in their development labs to make essentials like bottles for hand sanitizer. Some material suppliers have shifted to making hand sanitizer, while others have donated materials for making protective equipment.

You'll find stories of innovation, such as the company addressing the mountains of medical waste resulting from the crisis by developing the first compostable N95 face mask from PLA biopolymer. Others are applying 3D printing to create "instant" factories for making such supplies. And companies are applying technology to overcome travel restrictions and the need for "social distancing." Examples are the use of web-enabled remote technical service to avoid the need for in-person visits, and interactive training webinars in place of classroom sessions.

Keep checking this site: New stories are being added to the collection daily to help you keep up with the latest developments in this fast-evolving crisis.

Is Coronavirus Financial Aid Available to Your Business?

With trillions of dollars voted by Congress to help businesses and individuals cope with the economic damage of the COVID-19 pandemic, you want to be aware of any provisions that can assist *your* business and employees in coping with unprecedented circumstances. Here are two sources of comprehensive information:

- One source is the business consulting firm Plante Moran, known for its plastics industry benchmarking studies. Its website (***plantemoran.com***) offers free access to a "COVID-19 Resource Center" that includes the following: "Comparison of COVID-19 employer tax incentives," "COVID-19 crisis: Response management guide," "CARES Act resource Center." "COVID-19 resource center for manufacturers," "COVID-19: State and local tax updates," and "Leadership during COVID-19: Seven steps to restore control."
- Another information source is the Plastics Industry Association (PLASTICS), whose "COVID-19 Resources" pages are available to members and nonmembers (***plasticsindustry.org***). These resources include numerous links to state and federal agencies and documents, including pages on Federal Government Financial Responses, State Resources, and Government Resources. There's also guidance on "How to Help" by providing medical supplies or equipment to combat the pandemic.

Paulson Offers Virtual ProMolder Seminars

In a bid to "continue minimizing disruption in learning for our customers," Paulson Training Programs is transitioning its in-person Paulson Plastics Academy seminars to a virtual, live-streaming format using Zoom video conferencing. Paulson also announced that it will incorporate its web-based injection molding machine simulator—SimTech—into each of the live-streaming ProMolder classes. The company said, "You'll gain the fundamentals and advanced strategies to become a skilled plastics processor from the safety of your particular environment, and still feel connected."

This move applies to these upcoming events:

- ProMolder 1, April 20-23, 2020
- ProMolder 2, May 4-8, 2020
- ProMolder 1, May 18-21, 2020

Paulson noted that participants will need only a computer with internet access to participate. Students without a built-in or external camera on their computer can still call into the seminar with their phone and use their computer to share the instructor's screen.

Hahn Group Acquires Cobot & AGV Specialist

Hahn Group in Germany has acquired Dahl Automation, a German integrator for robots and cobots from brands like Universal Robots and Kuka, as well as suppliers of AMRs (Autonomous Mobile Robots) and AGVs (Automated Guided Vehicles) like MiR, Nipper and Robotize. Dahl has 30 employees with experience in designing automation systems utilizing cobots, grippers, image-processing systems, etc.

Hahn Group includes GeKu, Invotec, REI Automation, Rethink Robotics, Waldorf Technik and WEMO. In the U.S., the company is represented by Hahn Plastics Automation Inc.

Sencorp Modifies Thermoforming Machines to Produce Face Masks

Sencorp Thermoforming has modified its thermoforming machines to make desperately needed N95 face masks for medical professionals combating the coronavirus pandemic. Said Brian Golden, Secorp v.p., “We received a call from a large manufacturer of face masks to see if we could respond quickly to the unprecedented global demand. We converted two 2500-style machines typically used for consumer products in the plastics industry to run the material used in production of the N95 masks. With necessary modifications, two machines were prepped for shipment in less than a week. Each machine is capable of producing about 3 million masks per week.”

Sencorp’s president and CEO Brian Urban also credited the company’s skilled workforce for their dedication during this national emergency. “Despite concern for themselves and their families, our dedicated employees are working in staggered shifts to meet this unprecedented demand. Unlike others, we are self-sufficient, manufacturing parts in-house so we can quickly respond in urgent situations like this.”

(For reports on Orbis of Mill Valley, Calif., thermoforming novel washable face masks from coextruded LDPE/PVDF sheet; and on Prent Corp., Janesville, Wis., thermoforming PETG face shields, visit ***ptonline.com/COVID-19***.)

Eastman Produces Chemically Recycled Acetate Flake for Eyewear Makers

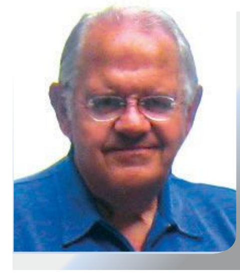
Eastman will provide its Acetate Renew, a cellulose diacetate composed of 60% biobased and 40% recycled content, to Mazzucchelli 1849 of Italy, said to be the world leader in manufacturing and distribution of acetate sheet for premium eyewear.

Made with Eastman’s carbon-renewal chemical recycling technology, Acetate Renew reportedly offers virgin-material performance while incorporating significant amounts of certified recycled content from eyewear production scrap. Mazzucchelli is providing acetate scrap to Eastman for use in carbon renewal. Eastman will soon begin collecting and recycling scrap from eyewear manufacturers for conversion into new material. Mazzucchelli expects to have sheet made from Eastman’s Acetate Renew commercially available before the end of June.

Carbon-renewal technology is a chemical recycling process combining mixed waste plastics with heat, pressure and steam to generate “syngas” hydrocarbons for use as building blocks to produce a variety of products containing high levels of recycled content without compromising quality.

Auxiliary Equipment Vet Chuck Thiele Starts On-Line Consulting Venture

Vactec LLC of Kalamazoo, Mich., has established a new on-line consulting service that offers processors a thorough on-line analysis and improvement recommendations for storage, conveying, central-drying and blending systems. Vactec On-Line has been developed for processors who are looking for solutions when access to production areas may be limited due to ongoing concerns over the coronavirus pandemic.



Vactec president and industry veteran Chuck Thiele had planned to introduce the service last month at *Plastics Technology*’s Molding 2020 Conference. That conference has been rescheduled to October 13-15 in Rosemont, Ill.

“Today’s travel and plant visitation situation seems to make online consulting even more viable. Normally we would just get on a plane or drive to our clients, but with COVID-19, it’s not that easy, for us or our customers,” Thiele says. “Now, with the evaluation process and checklists we have developed, we can troubleshoot and assist our customers quickly and efficiently, without the time and expense of on-site consulting.”

Some of the problems that Thiele says Vactec On-Line addresses include:

- Plugged conveying lines;
- Poor material flow/bridging;
- Vacuum-relief problems;
- Extending or expanding an existing system;
- Abrasion;
- Angel hair;
- Material selection and “spaghetti bowls”;
- System design;
- Tracing and validation;
- Component functionality.

Thiele, who began his plastics conveying and drying career in the 1960s, has been consulting since retiring as president of Motan in 1999. Since then, he has worked as a product and system design consultant for several leading system suppliers, and a problem-solving and facilities design consultant for numerous injection molding and extrusion processors.

Thiele says Vactec has created this venture not to sell equipment or systems, but to use his 50+ years of experience to provide solutions that reduce manpower, material and maintenance costs while improving operations and efficiency.
vactecusa.com • 269-599-3975

Medical Tubing: No Tradeoff of Speed for Quality with New Downstream Package

New technology from Novatec packages next-generation multi-pass tank, novel gauging technique, and enhanced coilers to boost rates to 1000 ft/min or more without tube-quality issues.

By Jim Callari
Editorial Director

Novatec has developed a new downstream extrusion package that will reportedly allow processors of tight-tolerance medical tubing to run at least twice as fast as the current 500 ft/min standard. While some processors already have lines running faster than the standard rate, they typically have struggled with tube shrinkage while being stymied by limitations from coiling equipment.

The Baltimore-based machine builder has addressed these issues with a three-pronged approach that includes new cooling technology, a novel ultrasonic-gauge-positioning technique, and a partnership with a builder of state-of-the-art coilers. The first solution is Novatec's new 24-ft-long combination vacuum "multi-pass" tank, within which the tube makes five passes. This tank has four wheels in it, each of which is directly driven by a servomotor and inline planetary gear reducer. The tank is also equipped with three totally independent temperature zones. According to Bob Bessemer, Novatec's v.p. of extrusion technology, these features allow tube temperature to be profiled to optimize heat transfer for given materials, while allowing each pass to be adjusted independently so that the tube can "relax."

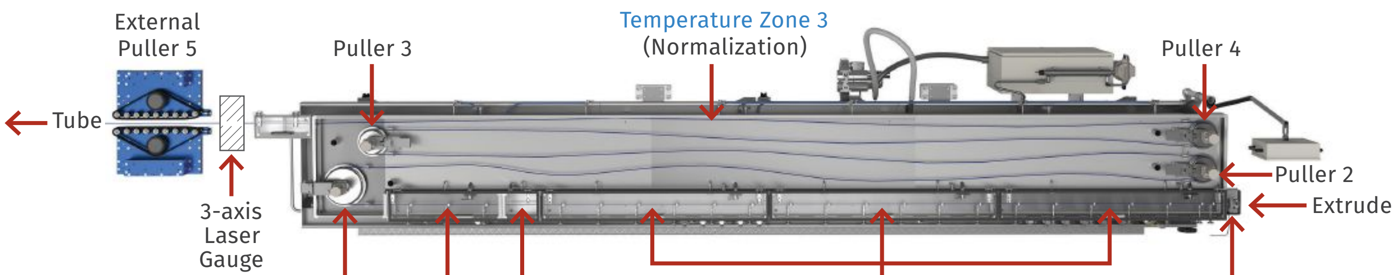
New 24-ft-long, multi-pass tank from Novatec promises big speed improvements for processors of medical tubing at a time when demand for all kinds of medical products figures to be high.

Secondly, Bessemer is equipping this tank with a novel ultrasonic-gauging technique Novatec introduced in January, using sensors furnished by Zumbach Electronics. And finally, the package includes next-generation coiler technology supplied by ReelPower International. As a package, this new downstream system will reportedly allow processors to run high-precision tubing at 1000 ft/min at a time when medical products figure to be high in demand.

HOW THE TANK & ULTRASONICS WORK

In Novatec's new tank, the first wheel acts as the primary puller, responsible for sizing the tube. This makes it the only pass in which the tube is under tension, allowing control of the tooling drawdown ratio. Says Bessemer, "Especially for high-speed extrusion, you want to minimize the drawdown ratio, which also will improve burst strength. Remember, if the tube is reheated (annealed) at typically half the melt temperature, it will start to expand to a size similar to when it exited the die. This can occur when the tube being coiled was not fully cooled in-process. If not fully cooled, heat will transfer from inside to outside the tube wall while being coiled, and the subsequent layers of tubing, as well as the collapsible coiling head or spool inside diameter, will not allow the heat to dissipate fully."

In this new tank, the temperature of the first 18-ft zone (zone one/pass one; open to atmosphere or vacuum) would typically be set at 58-65 F for flexible PVC, followed by a 3-ft dry chamber (zone two/pass one), which would temporarily slow down the heat-transfer process. This is followed by a 100-ft-long open zone (zone three/passes two to five), where temperatures would be set at a range of 75-95 F. As Bessemer explains, each servo-driven wheel after the primary wheel would be a "follower," with the ratio slowed down until the tube floats to the surface. "It is not uncommon to have as much as a 30-50 ft/min difference from the primary driven wheel to the final puller speed, which further demonstrates how much tension the tube is under while in process," he notes.



Overhead view of tank shows the path tubing takes inside. Note that all four wheels are driven and that the temperature is each zone can be controlled.

In a typical medical-tubing line, the ultrasonic wall-thickness measurement and control system is mounted in the first chamber of either an open water tank or vacuum tank. But Bessemer opts instead to move the ultrasonic system closer to the entrance of the tank (see April Close-Up). "This was done for several reasons, most importantly due to a more consistent material temperature, which has led to more precise wall readings," he explains.

"But we also saw that by moving the ultrasonics, the unit can serve as a processing aid—the display of the actual wall can help processors center the die in real time for concentricity. Even the slight twisting of the tube by the time it reaches the ultrasonic gauge can be programed to show the tube as it exits the die to aid in this visual tool. The laser gauge is then mounted between the end of the tank and the puller. The use of at least a three-axis laser gauge has been well accepted over the last 10-15 years, due to its proven ability to display an improved ovality reading compared with a single- or dual-axis unit."

Placing the ultrasonic gauge closer to the tank entrance means measurements are first made while the tube is still hot. This so-called "hot-control" technique makes the ultrasonic unit the "control point," which Bessemer says dramatically reduces control-loop distance and allows wall-thickness adjustments to be executed faster. "With 'cold' control, the laser gauge is the control point, as this is the final tube measurement of the outside diameter. The distance from this laser gauge to the 'hot' face of the die influences the time it takes for the controller to change either the internal air unit, vacuum level, or puller speed to adjust the dimensions of the tube. For instance, if the distance on a high-speed flexible PVC line from the hot die to the puller is 50 ft, then the control loop is 10-15 times that, or 500-750 ft. This means that small-diameter or wall-thickness variations will not be corrected within this distance."

For high-speed extrusion, you want to minimize the drawdown ratio, which also will improve burst strength.

The ultrasonic units have been enhanced to measure both the wall thickness and the outside "hot" diameter, as the distance can now be measured from the individual transducer face to the outside of the tube. Bessemer explains, "Mounting the ultrasonic transducer holder the traditional way—18 to 20 in. inside the cooling or vacuum tank—gives you a control distance of approximately 24 in. Software then compares the "hot" diameter to the laser gauge "cold" diameter reading; the result is then used as a dynamic offset for control. That control distance of 24 in. translates into a control loop of 10-15 times that, so you now end up with a control loop of 20-30 ft." Bessemer points out that a lot of off-spec tubing can be produced that way.

Now, though, Novatec has designed a patent-pending transducer holder that will mount on the entrance of the water or vacuum tank. That puts the transducers within 2-3 in. of the die face to reduce the control point to 20-30 in., which Bessemer believes will improve tube OD tolerances and precision. The transducer holder is a miniature vacuum chamber with water-level control, which can mount on either a cooling tank or vacuum tank with the use of a short "pre-skinner" chamber to allow an open-to-atmosphere chamber between the transducer holder and the actual vacuum tank.

"What makes this possible are the new levels of precision that closed-loop vacuum systems can attain," says Bessemer. "With highly stable vacuum, the tube can enter a fixed orifice at the entrance to the transducer holder without guide rollers, since the tube is supported by the die itself. This is similar to using low vacuum levels to control water drool at the entrance to extrusion

Stock machines
in the US

Our stock machines, located here in the US, will make your production life easier. The wide selection of all-electric and hydraulic machines available can be used for any application – high volume and precise production delivered in the shortest possible time.

Visit our website or contact ENGEL for more information about our stock products.

On your floor in 2 weeks
We guarantee the delivery of our stock machines from York, PA or Corona, CA to your US location within 2 weeks after receipt of a purchase order.

Get the best at a package price
Three of our most successful injection molding machine models that fit every application, loaded with many options.

Flexibility for your production
It is now possible to add many machine options, change the injection unit, or include a robot to build your unique production cell within just a few weeks.

Start producing efficiently
You get a free day of on-site startup and training to help your operators get to know the ENGEL CC300 machine controller and all that it can do to make production easy.

www.engelglobal.com/injectionmolding/us

tanks. The tube will actually appear to enter a wall of water, which will also aid in concentricity since the tube will be cooled consistently all around its diameter."

Downstream system for high-speed tubing from Novatec will be furnished with high-capacity coiling/winding equipment from Reel Power.

TEN YEARS THE STANDARD

Over the last 10 years, vacuum multi-pass tanks have become the standard for processing high-speed medical tubing. The lengths of these tanks were designed specifically to work with extruders sized 1.5, 2.5, 3.5, and 4 in. These units could be used with either the "free" extrusion process with internal air, or with vacuum for the non-contact sizing process. At the end of the first pass, a 12-18 in., servo-driven wheel serves as the primary puller (capstan), machined to within 0.001 in. This offers improved precision, specifically with wall-thickness control, over the more typical belt puller, says Bessemer. The multi-pass design offers processors dramatic space savings as well as improved tubing tolerances.

The first driven wheel minimizes what is known as "the rubber-band effect," especially when processing lower-durometer materials. "The 'rubber-band effect' is a phenomenon in which the tube outside diameter can be seen to drift up and down as the tube stretches and relaxes over the distance between the puller and hot die," explains Bessemer. "The longer this distance, the worse the situation, especially when the puller is being used to control the tube size."

In original multi-pass designs, the external puller could be made to follow the primary servo-driven wheel so that some shrink-back could occur within the process by inputting a slightly slower speed. Bessemer elaborates, "But because the two- to five-pass wheels were not driven, the tube was still at considerable tension, which did not let it fully normalize within the process. This was seen whether cutting or coiling inline; the tube still shrank substantially after cutting or on the coil. With cutting you could actually see the tube shrinking as it was going down the conveyor; and with coiling, the bottom wraps were often unusable due to shrinkage compression and thus flattening."

Novatec has designed a patent-pending transducer holder that will mount on the entrance of the water or vacuum tank.

Bessemer adds, "While the tanks typically had potentially two temperature zones, most processors ran at one temperature, typically 58-65 F. Several processors found that if the second zone (open zone; pass 2-3 or 2-5) was set at an elevated temperature (75-95 F) the shrinkage was minimized as the tube was stress-relieved or normalized. However, this was not typical and/or understood, even today."

The belt or wheel pullers used in high-speed tubing extrusion have always been considered the heart of the line, as they are responsible for precisely pulling the tube from the hot die and through the cooling medium. Novatec's new high-speed belt puller offers improvements that include precision flat belts, linear slide bearings, and servo booms to further enhance speed and precision while offering automatic belt-gap adjustment, which can follow the tube diameter.

"For high-speed applications, the upper and lower belts or wheels should be independently driven with servomotors and precision inline planetary reducers to offer precision while eliminating high-wear belts, sheaves, and tensioners," says Bessemer. "Flat belts are far superior for high-speed applications, as the core belt is thinner and thus more flexible and less prone to heating issues and thus outer-layer delamination. With proper crowning of the end rollers and use of supportive guide rollers, these belts are easily capable of speeds in excess of 1000 ft/min."

Bessemer says, "Novatec also offers high-speed, dual-drive servo pinch rolls, which many medical tube processors prefer over belts when using free internal-air tube processing. Pinch rolls typically provide a slight compression on a tube, which minimizes air-pressure fluctuations and thus OD size variations during cutting or coiling."

For repeatability and precision, Bessemer maintains that servo booms should be standard, as the gap between the belts or wheels should be a validation point, specific to tube diameter and material. "A hand wheel used by the operator is just not precise or repeatable enough to offer a consistent gap in relation to the actual tube OD," he states. With Novatec's patent-pending servo-boom system, the gap can be automatically adjusted to follow the gauge in *real time*, with an offset distance programmed to precisely time the movement of the belt or wheel gap in relation to the actual tubing diameter. This ensures proper compression of the tube while maintaining consistent slippage between the belt and the tube to limit distortion, according to Bessemer.

REELING IT IN

Farther downstream, Novatec is working with ReelPower, Oklahoma City, to supply the latest-generation of auto-cut-

transfer coil winders, which now feature enhancements in auto taping, strapping, stretch-film wrapping, auto loading and unloading to further enhance high-speed tube processing. "These high-speed coil winders get a follower signal from the last puller in the line and use a noncontact ultrasonic or high-speed camera system to slightly trim (typically 10%) to allow a relaxation loop prior to the tubing being wound up on the coil," Bessemer explains. "This loop is critical to allow the cut-and-transfer process and should not allow the tube to hit the floor during the cycle. Through software, the internal diameter of the coil, width of the coil, and diameter of the tube are entered into the program, which automatically trims the head speed as the circumference of the coil grows with each additional wrap."

Adds Joe Henry, ReelPower COO, "Even the lay-on arm, which is used to guide the tube onto the coil, is totally controlled to precisely guide the tube at minimal tension. This lay-on arm can be servo-motor-controlled so that the angle remains consistent and the motion of cut-and-transfer is repeatable, which can further minimize tension and improve consistency."

Novatec's new high-speed belt puller offers improvements that include precision flat belts, linear slide bearings, and servo booms to further enhance speed and precision while offering automatic belt-gap adjustment.

Bessemer notes that many processors are moving to larger-diameter coils to reduce the 4-5 min it generally takes operators to unload finished coils. But because the larger-diameter coils are heavier, operators typically need lift carts to assist them in coil removal and transport. The alternative is to limit the line speed to allow operators to keep up, which defeats the purpose of running faster, as Bessemer and Henry point out.

But newer technology allows the coil or spool to be automatically ejected and loaded without operator intervention, according to Henry. Moreover, the coil can be wrapped or banded automatically. In the future, instead of two spindles, which require 180° rotation for cut-and-transfer; four, six, or even eight spindles could be used to allow smaller coil diameters and/or additional inline operations, such as taping, slight assembly, and even bagging, Henry adds.

IMS Company

NEW and Improved
Portable Dew Point Meter/Monitor

Item # 171760
172019 - with Current NIST Certificate

Call or visit our website TODAY!

Now with expanded dew point range

- Select and swap from five sensors ranging from -40˚ to 70˚F (-40˚ to 21˚C)
- Manufactured using NIST*-traceable equipment and calibration certificate
- In stock, pre-calibrated. Also available with current certificate
- Verify the accuracy of your material dryers built-in Dew Point Meter (if equipped)
- Monitor case is compact, lockable, self-contained and completely portable
- Adjustable alarm set point and changeable temperature display (F to C)

Call: 800.537.5375 • www.imscompany.com/PT12

70+ years Serving the Plastics Industry

Redefined with You in Mind

WHERE MOLD MANUFACTURERS WILL CONNECT

amerimold CONNECTS

JOIN US ONLINE: JUNE 9-13, 2020

A *REMOTE* EVENT EXPERIENCE

Amerimold Connects is FREE to attend

This is a remote event that brings the *amerimold* showfloor experience to your home or office. A dynamic online platform, the vendor showrooms will allow you to personally engage with this industry's domain experts and thought leaders. You can easily access the latest insights on tooling, software, processes and technologies in one place. Register today then join us online June 9-13 at *Amerimold Connects*.

Features of *Amerimold Connects* include:

- Virtual exhibitor showrooms
- Online forums moderated by industry experts
- Free educational sessions and product demos
- Interactive networking experiences
- The Top 10 Reasons To Be A MoldMaker Lives!

— More details to come

REGISTER TODAY AT AMERIMOLDEXPO.COM

PRESENTED BY:

MoldMaking Technology · PT Plastics Technology · Auto Beat · AM Additive Manufacturing · Modern Machine Shop · Gardner Business Media, Inc.

MATERIALS

PART 2 Annealing Tips for Amorphous Polymers

In amorphous polymers, annealing is performed to draw down the internal stresses to a level not achievable within the conditions of a normal molding process. But a few parameters are important to achieving the desired results.

By Mike Sepe

As we discussed briefly in Part 1 last month, amorphous polymers are susceptible to failure by environmental stress cracking (ESC). We understand this mechanism to be essentially a mechanical failure that is accelerated by the presence of a chemical that locally plasticizes the polymer in an area where a small defect has been created.

The defect can be an inclusion such as a piece of metal or carbon char or it can be a notch created by incidental damage. It may also be due to a design defect such as a sharp corner or a rapid change in the wall thickness of the part that creates a locally elevated stress level. Or it can be promoted by an elevated level of internal stress caused by molding conditions. High levels of internal stress are caused by rapid cooling of the polymer.

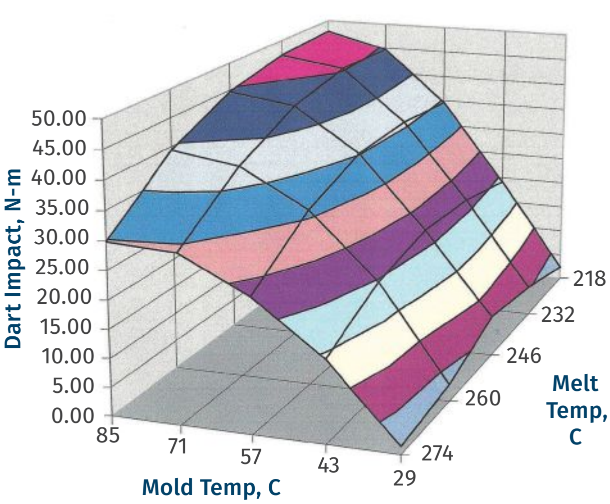
A processing strategy that involves rapid cooling can also influence short-term properties, most notably ductility. This is a concern since many amorphous polymers, such as ABS and PC, are used in large part because of their excellent toughness. Figure 1 shows the results of a study on the effects of melt and mold temperature on the impact resistance of ABS. This shows that the molded specimens exhibit very low energy-to-break when the mold temperature is set relatively low. As the mold temperature is increased, the impact resistance rises dramatically.

But even with a high mold temperature, the cooling rate of a polymer during the injection molding process is on the order of 150-300° C/min (270-540° F/min). With such a rapid change in temperature, some level of internal stress is inevitable. In situations where the application environment involves some combination of elevated temperature, extended lifetime, stresses that may exceed the proportional limit, and exposure to certain chemicals, even relatively low levels of internal stress may result in premature failure due to ESC. Failure-analysis meta studies have shown that ESC is the leading cause of field failures in plastic parts and this failure mode primarily affects amorphous polymers.

Failure-analysis meta studies have shown that ESC is the leading cause of field failures in plastic parts and this failure mode primarily affects amorphous polymers.

In amorphous polymers, annealing is performed to draw down the internal stresses to a level not achievable within the conditions of a normal molding process. There are a few parameters that are important to achieving the desired results. The first of these is the temperature of the annealing process. Typically, the recommended annealing temperature is indexed to the glass-transition temperature (T_g) of the polymer. This can be readily measured by analytical

FIG 1 Effect of Melt and Mold Temperature on the Impact Performance of ABS



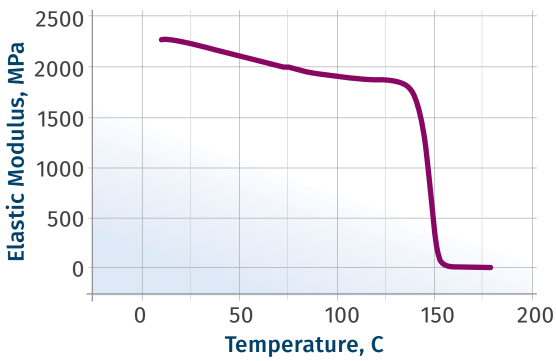
Molded specimens exhibit very low energy-to-break when the mold temperature is set relatively low. As the mold temperature is increased the impact resistance rises dramatically.

KNOW HOW MATERIALS

Learn more at PTonline.com

Get more insights on Materials from our expert author: **short.ptonline.com/materialsKH**

FIG 2 **Elastic Modulus vs. Temperature Behavior for a PC**



The glass-transition temperature occurs in the temperature region where the elastic modulus of the polymer declines rapidly over a very narrow temperature range of 140-155 C (284-311 F).

techniques such as differential scanning calorimetry (DSC) or dynamic mechanical analysis (DMA). DMA has the advantage of measuring the physical properties of the polymer, therefore it provides more information about the range of temperatures that can be used to relax the internal stresses in the part.

Figure 2 provides a plot of the elastic modulus as a function of temperature for a typical PC. The T_g occurs in the temperature region where the elastic modulus of the polymer declines rapidly over a very narrow temperature range of 140-155 C (284-311 F).

Recommendations of an appropriate annealing temperature for polycarbonate vary between 121 C (250 F) and 135 C (275 F). These temperatures are close to the T_g but remain below the onset of the rapid decline in modulus in order to prevent deformation of the parts. The objective is to use a temperature as close to this onset as possible without producing part distortion or an excessive degree of dimensional change. This will depend somewhat on part geometry and the level of support that can be provided to areas that tend to be most susceptible to distortion, such as areas around gates.

The second important parameter is the annealing time. This will depend upon the part thickness. Plastics are relatively poor conductors of heat, and the part must be allowed to come to a uniform temperature throughout. Typical recommendations are a minimum of 30 min once the parts have achieved the desired temperature, plus 5 min/mm (0.040 in.) of wall thickness. For parts with sections thicker than 6 mm (0.250 in.), the best results are obtained by doubling this time. Failure to provide sufficient time to reach and maintain a uniform temperature for an appropriate amount of time may actually produce an increase in the level of internal stress.

Perhaps the most important condition associated with annealing is the rate of temperature change, particularly the rate of change that occurs during the cooling process. Ideally, the parts should be heated from room temperature to the annealing temperature at a rate of no more than 50° C/hr (90° F/hr). But it is the cooldown portion of the annealing process that has the greatest influence on the result. Here again, specific recommendations vary.

However, a good guideline is a cooling rate no faster than 25° C/hr (45° F/hr) until the parts have reached a temperature of 60-65 C (140-149 F). Some parts may need to be cooled at a rate as slow as 5° C/hr (9° F/hr). The most common mistake that results in an unsatisfactory annealing outcome is cooling too rapidly. Often parts are removed from the oven as soon as the prescribed annealing time is completed. The parts cool rapidly from the annealing temperature to room temperature, undoing all the work that was done by the annealing process.

The ultimate test of the efficacy of an annealing process is a solvent stress-crack evaluation. For each polymer there is a chemical or a mixture of chemicals that will target a certain threshold of internal stress. Often this approach involves a mixture of two substances. One acts as the inert ingredient while the other is the active ingredient that promotes stress cracking. By changing the ratio of these two constituents in the mixture, the targeted threshold stress can be adjusted so that the stress in the part can be measured precisely.

ABS, for example, uses a mixture of an acetate such as ethyl acetate and an alcohol such as ethanol. Higher concentrations of the acetate required to induce stress cracking correlate to lower internal stresses in the part. The same approach is used in polycarbonate. However, with polycarbonate the mixture is one of n-propanol and toluene. Parts are immersed in the mixture for a prescribed amount of time, removed and rinsed, and then evaluated for cracking. The location of any observed cracking helps to identify areas of the part that are susceptible to the formation of elevated levels of stress.

A good guideline is a cooling rate no faster than 45° F/hr until the parts have reached a temperature of 140-149 F.

An alternative approach uses a single reagent and the immersion time required to produce stress cracking is related to the internal stress in the part. As an example, polycarbonate can be tested using propylene carbonate. The level of internal stress in the part is a function of the time that the part is immersed in the fluid. With either method, an effective annealing process will produce a notable reduction in the measured threshold stress.

Annealing of semi-crystalline polymers is done for a completely different reason. In our next segment we will discuss this process and the guidelines for getting most out of annealing this class of polymers. PT

ABOUT THE AUTHOR Mike Sepe is an independent, global materials and processing consultant whose company, Michael P. Sepe, LLC, is based in Sedona, Ariz. He has more than 40 years of experience in the plastics industry and assists clients with material selection, designing for manufacturability, process optimization, troubleshooting, and failure analysis. Contact: *(928) 203-0408 • mike@thematerialanalyst.com.*

INJECTION MOLDING

Follow These Tips to Sanitize Machine Controller Screens & Buttons

Keeping your workers safe from the coronavirus makes it extremely important to institute a sanitizing procedure on all touch surfaces of the controller, screen and operating panel. I did some research and here's what I found.

By John Bozzelli

We as processors tend to take the machine's controller and operating panel for granted. We like some and despise others, but rarely do we give them the attention they deserve. Daily production pressures such as process interruptions, part defects, resin issues, etc., keep you so busy that the controller screen and buttons don't really register as components that need attention. We just expect the controller to function properly and most of the time it does.

But now, with the COVID-19 pandemic, it's time to recognize the controller as another touchscreen that can have the live virus on it. This means it must be *sanitized*, not just cleaned. It needs appropriate attention, as it's a critical component of every machine. We all love to push the buttons and turn the knobs. Think about it, most controller screens are at eye level. Usually we work fairly close to the screen so we can see their inputs and process parameters or values. If anyone coughs or sneezes, tiny droplets can fly "up to about 26 ft and on average roughly 20 ft," according to the U.S. Centers for Disease Control. Essentially, that contaminates everything on the screen and control panel. Plus the viruses are hardy little buggers that can persist for hours up to a few days on some surfaces.

Its time to recognize the controller as another touchscreen that can have the live virus on it.

How often do you touch the screen and push the buttons? Can you remember the last time the screen and buttons were even *cleaned*, let alone sanitized? Now, for your own health and others, it is imperative that you take time to *sanitize* your machine screens and buttons. Maybe you thought nothing could live with all the grime and oil buildup there, but times they are a changing. We need to work at preventing the spread of the virus to ourselves and others. So, what is the best way to sanitize the controller screen?

Many shops may not clean their control panels regularly, but now is the time to develop new habits.

Stop—do *not* pick up the nearest wipe or hand sanitizer. That controller is expensive, and costs thousands of dollars to replace. So you don't want to scratch, chemically etch, smear, remove labels, fog up, or ruin the touch sensitivity of the screen. It would be nice if they were made of glass—that would make

KNOW HOW INJECTION MOLDING

Learn more at PTonline.com

Get more insights on Injection Molding from our expert authors: **short.ptonline.com/moldingKH**

things easy—but most are similar to your computer, tablet or cellphone screens. They are likely to be covered with a touch-sensitive plastic film, which may be harmed by some cleaners. The goal is to sanitize, not damage or fog up the screen. The National Institutes of Heath (NIH) states, "The virus that causes coronavirus disease 2019 (COVID-19) is stable for several hours to days in aerosols and on surfaces, according to a new study from National Institutes of Health, CDC, UCLA and Princeton University scientists in *The New England Journal of Medicine*."

So the virus can live a few hours to a few days on some of these surfaces. Hence, we now go from rarely (never) cleaning the controller screen and panel to keeping the screens and buttons free of these dirty devils. How much sanitizing can these screens take?

For your own health and others', it is imperative that you take time to sanitize your machine screens and buttons.

No easy answer to this, and you will need to monitor how your controllers are holding up to whatever procedure you implement. How often do you need to do it? My guess is a minimum of once a shift, but since there are few test kits at this time, we don't know who has the virus; so perhaps several times a shift. Frequency probably depends on how many people use the controller.

Next question: What sanitizer is best for your controllers? First step is to contact the machine manufacturer and see what it recommends. My initial queries got next-day responses, with the recommendations of soapy water and 70% isopropanol (rubbing alcohol). Both are known to kill the virus, but is there something better? An internet search turns up a list of about 300 disinfectants that kill the SARS-CoV-2 coronavirus—which is not identical to COVID-19, but hopefully this offers a clue.

This list also provides the necessary *contact time* to kill the virus. It takes 30 sec to 5 min to kill the SARS virus, depending the active ingredient(s) of the sanitizing agents. Now 30 sec is not a single swipe. For isopropanol the listed time was 5 min. For hydrogen peroxide it takes 0.5 to 2 min. For some reason soapy water is not on the list. I urge you *not* to use bleach on your controller.

There is also the choice of wearing latex or vinyl gloves, but is that practical for an entire shift? And if the bugs are there now, the gloves are then contaminated and we have the same issue with spreading the virus on anything we touch. And how well do these gloves work on touch-sensitive screens?

Suggested Sanitizer Solutions (*use at your own risk.*)

1. Solution of nine parts (90%) of either 70% isopropyl alcohol or 60% ethanol and one part (10%) hydrogen peroxide, and add two drops of Dawn dish soap per 500 ml (1 pint).
2. Solution of 3% hydrogen peroxide
3. UV light will also work and work fast, but the apparatus is expensive.

Note: I suggest adding two drops of Dawn dish soap per 500 ml (1 pint) of the above solutions to help wet the screen/panel surface, but this may slightly deplete the oleophobic coating on some touchscreens. Since this coating wears away under normal use and can be reapplied, I do add the soap.

RECOMMENDED PROCEDURE

It is best if you can power down the machine. Yes, I know this is time- consuming and problematic for barrel heats and machine restart time. But accidently changing a processing parameter or pushing the wrong button could cause significant problems if the machine is live. I don't like to admit that I have done this and had some embarrassing results. If you don't want to power down the machine, at a minimum turn off the motors/pumps so nothing can move. Safety is a first priority. Be careful not to accidently change any settings or cause a mold or injection movement out of sequence.

First, test on an inconspicuous area to make sure it does not harm the screen. Dampen (don't soak) a microfiber cloth and gently wipe the screen for at least 30 to 60 sec. Leaving a film of disinfectant/sanitizer that will stay for another minute or two will continue disinfecting. Power up when you are sure no solution is down in between the buttons, switches or electrical components. When dry, power up as usual.

Caution: 70% isopropyl alcohol is highly flammable and can easily ignite. It has a flammable range of 2.3% to 12.7% in air, Vapors may form and cause explosive mixtures. Ignition temperature is 750 F (400 C). Keep away for all heat sources, such as nozzle and barrel heaters.

Bottom line: Institute a sanitizing procedure on all touch surfaces of the controller, screen and operating panel. Use a microfiber cloth and solution that does not harm the screen.

While we are on the topic of controllers, let's hit on a major pet peeve of mine. Nearly all of us have seen a controller fried or damaged due to a power surge or outage. How many of us have surge protectors with battery backups on our computer? Perhaps most of us. Yet our molding machines cost hundreds of thousands of dollars and most do not have surge protection with a power backup so you can shut it down properly after a power outage. What's on your machine?

ABOUT THE AUTHOR: John Bozzelli is the founder of Injection Molding Solutions (Scientific Molding) in Midland, Mich., a provider of training and consulting services to injection molders, including LIMS, and other specialties. Contact *john@scientificmolding.com*; *scientificmolding.com.*

EXTRUSION

What You Should Know About Miniature Extrusion Screws

Very small screws have become more common with the growth of additive manufacturing. Designing such screws requires balancing their output requirements with their torque strength.

By Jim Frankland

To accept pellets or even ground pellets, the feed sections of very small screws need to be proportionally deeper—that is, with a greater compression ratio—to match the output of the rest of the screw. That is due to the restrictive entry dimensions into the screw and lower compaction rates resulting from far fewer particles in the screw channel. Increasing the channel depth in the feed section naturally lowers the torque capacity of the screw.

In additive manufacturing equipment, there has been a migration away from heat guns, which feed polymer filaments to supply the melted polymer, to miniature extruders. Miniature extruders increase part buildup rates or output and reduce material cost. Due to the poor heat transfer of polymers, the output of heat guns is limited, and the cost of filament is typically five times or more the cost per pound of pellets. Design of miniature or very small screws, whether used for additive manufacturing equipment or not, requires balancing their output requirements with their torque strength.

Compared with heat guns, miniature extruders increase part buildup rates or output and reduce material cost.

For additive-manufacturing extruders, this may be even more important, as many are not operated by typical extrusion processors, and cold starts are inevitable. In such applications the screw strength needs to exceed the full torque available from the drive, so that during a possible cold start, where the drive torque instantly jumps to the full drive capacity, the screw does not break.

KNOW HOW EXTRUSION

Learn more at PTonline.com

Get more insights on Extrusion from our expert authors.
short.ptonline.com/extrudeKH

There are relatively simple calculations, using well established mechanical engineering principles, to avoid screw breakage. The available torque from the drive is calculated as:

Drive torque (in.-lb) = (Horsepower × 63025) ÷ Maximum screw speed

For example, I recently worked on an extruder having a 2-hp drive motor with 1750-rpm maximum speed, coupled to a 10:1 gear reducer, resulting in a maximum screw speed of 175 rpm.

Available torque = (2.0 x 63025) ÷ (1750 ÷ 10) = 720 in.-lb of torque

Screw torque strength is calculated as: **Torque strength = $16T/(\pi d^3)$**

Torsional strength equals 16 times the available torque from the drive divided by πd^3 where (d) is the root diameter of the screw in its deepest section closest to the drive, which is the feed section. An example is a 0.625-in. diam. screw with a 0.325-in. root diameter in the feed section.

Torque strength = $(16 \times 720) \div (\pi \times (0.325)^3)$ = 106,820 psi

Torsional stress varies from zero at the center of a shaft to a maximum at its outer surface. That's why a screw-torque failure initially shows cracks initiating from the flight O.D. extending toward the center. There are different shape factors for determining the torsional strength of common shapes (squares, rounds, triangles, etc.). These have been experimentally developed, but none exist for the cross-section of a screw. As a result, the round section of the screw root is typically used, even though it represents less than the total torsional strength.

Tiny extruder screws (compared to pencil) figure to become more common as additive manufacturing expands. Shown here is a 5/8-in. diam. screw with an overall length of 16.28 in. Photo: Triex LLC-Filabot.

Tensile strength of the typical steel for extrusion screws is 4140 steel heat-treated to 32 Rc hardness, which has a tensile strength of 145,000 psi. Shear strength for steels is conservatively specified as 0.577% of tensile strength, so allowable torsional stress is 83,655 psi, although the screw flight increases the strength an indeterminate amount.

That means that the feed section for the 5/8-in. screw noted above would be stressed to essentially 128% of maximum design strength at full drive load. To obtain the desired output, the depth of the screw would then have to be decreased and the maximum screw speed increased. Alternatively, a higher-strength steel such as H-13 could be used. At a hardness of Rc 52 its tensile strength is 289,000 psi and its allowable torsional stress would be 166,753 psi, or well above the required strength. The H-13 tool steel was the solution chosen, as the polymer was a copolyester with no corrosion issues. PT

In additive manufacturing, screw strength needs to exceed full available torque.

ABOUT THE AUTHOR: Jim Frankland is a mechanical engineer who has been involved in all types of extrusion processing for more than 40 years. He is now president of Frankland Plastics Consulting, LLC. Contact *jim.frankland@comcast.net* or (724)651-9196.

TOOLING

PART 3

How to Properly Size Gates, Runners and Sprues

Get the sprue, runner and gate sizes close to ideal the first time around.

Part one of this series (in March) discussed the importance of proper gate depths and gate widths. Part two (April) discussed two different types of gates, gate land length, and gate-freeze time. This month I will discuss edge gates and runner sizes.

By Jim Fattori

EDGE GATES

Figure 1 depicts a simple edge gate. It is the most commonly used gate type—probably because it is the least expensive to machine. All that is required is an end mill to connect the cavity to the runner. This type of gate is also the easiest to measure its depth, which is critical in multi-cavity molds. However, this design has several shortcomings.

One of them is the land-length variation. The land length in Fig. 1 is 0.030 in. on the bottom of the gate and 0.042 in. on the top. This is due to the gate being machined into just the cavity side of the mold, and the runner being full round. Ideally, an equal gate depth should be cut into both the cavity and core sides, so that the material enters the cavity from the very center of the melt stream. But this is not often possible due to the part geometry in most two-plate molds. Notice how these differences in land length are only in the center of the gate. There is a considerably greater difference as you approach the outer edges—almost three times longer in this example. There is also a realistic concern that the small amount of steel between the center of the runner and the cavity, which is equal to the land length, may not be sufficient to protect the mold from damage due to high injection pressures, or in the event of flashing.

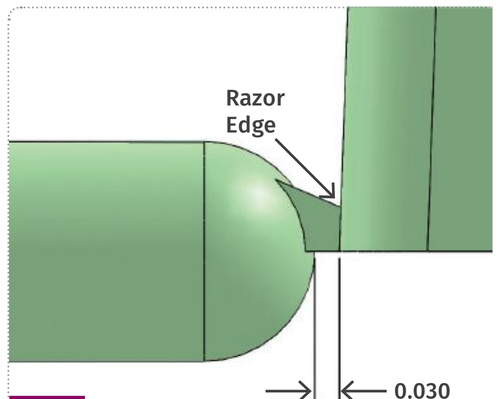


FIG 2 Razor edge on a chisel-type edge gate.

Figure 2 depicts a chisel-type edge gate, so called because it is shaped like a wood chisel. This example has a 0.030-in. land length on the bottom and zero land length on the top, where it starts to taper out to join the runner. Zero land length is both ideal and impractical. It's ideal because it provides the lowest pressure loss through the gate, and it is the easiest to trim precisely with a gate cutter or robotic nipper. It's impractical because even if the mold is made of-heat treated tool steel, the razor-sharp edge on the cavity wall will wear prematurely, especially if the material is abrasive. The steeper the angle, the faster and deeper it will wear.

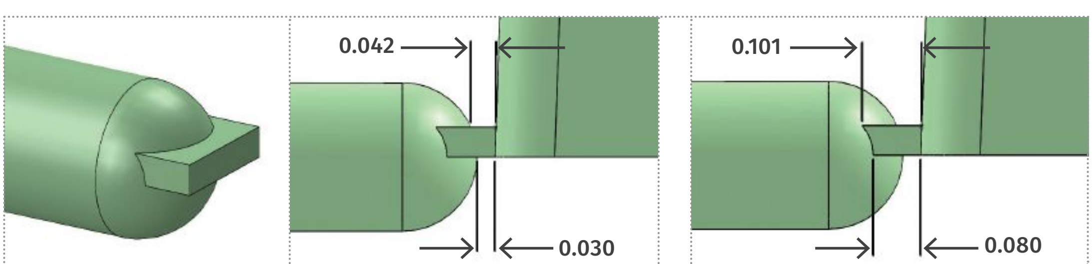


FIG 1 Land lengths of a basic edge-gate design.

Figure 3 depicts an improved tapered edge-gate design. It has the same 0.030-in. land length as the previous examples, and then tapers out in three directions. The intersection of the tapered portions and the runner have generous radii. There is also a 5° taper on the sides to facilitate release from the cavity. This design provides a sufficient amount of steel between the runner and the part. There is a uniform land length on both the top and bottom, and from the center to the outer edges. The gate depth is easy to measure. The material flow from the runner to the gate is less restric-

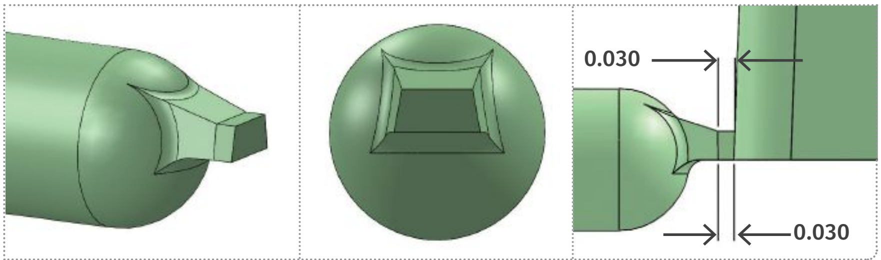


FIG 3 Improved edge-gate design.

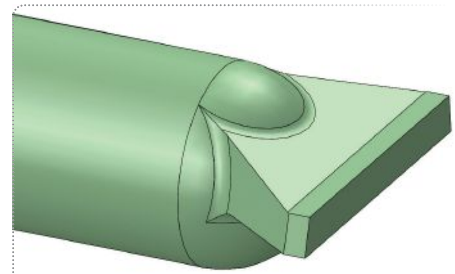


FIG 4 Improved wide edge-gate design.

tive, and there is less shear sensitivity due to the elimination of the sharp edges. This design is obviously more time-consuming to machine using an EDM electrode and then hand blending the intersections, but its benefits often outweigh the cost.

These same improved edge-gate design can be applied to a very wide gate, such as a fan gate, as shown in Fig. 4.

DETERMINING THE RUNNER SIZES

The goal of sizing a runner is similar to that of sizing a gate. You don't want the runner to be too small or too large. If it is too small it requires a lot more pressure to fill the cavities, and there is a chance it will freeze off before the part is fully packed out. Even if reground material is allowed, you still don't want the runner too be too large, because it can extend the cycle time. Determining the size of a runner, just like a gate, is a balancing act. To properly size a runner, you have to start at the gate end and work your way back toward the sprue.

Determining the size of a runner is a balancing act.

Have you ever heard the real-estate catch phrase: location, location, location? For two-plate injection molds, the runner-system catch phrase is: full round, full round, full round. While full-round, trapezoidal, parabolic and square runners have the largest ratio of cross-sectional area to peripheral, or surface length, as compared with all other runner shapes, a full-round runner provides the least amount of

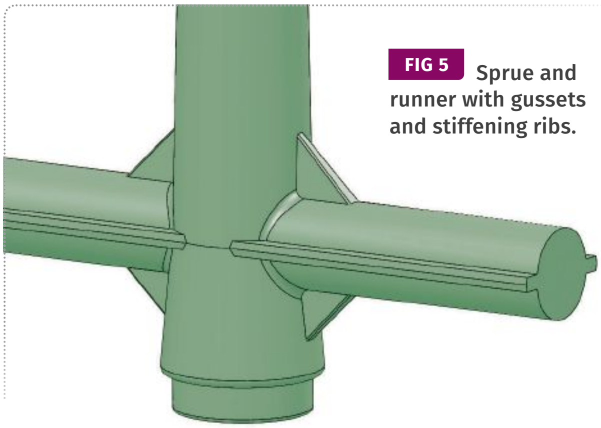


FIG 5 Sprue and runner with gussets and stiffening ribs.

shear. It solidifies quickly and more uniformly when compared with other runner shapes. And it provides the best melt conditions—especially for edge gates—because the material entering the cavity will be near the center of the melt stream.

Most of us have been taught that runner branches in a cold-runner system should vary in diameter, as opposed to having a constant or uniform diameter. The runner branch feeding the gate would be the smallest. The subsequent branches would get progressively larger, leading up to the primary runner and sprue. This varying or graduated-diameter runner requires less pressure to fill a part than a constant or uniform-diameter runner does. However, a varying-diameter runner can have a longer cycle time than a constant-diameter runner because the larger primary runner branch takes longer to cool.

If the material is fairly viscous, such as rigid PVC, a varying-diameter runner is typically the best way to go, so as not to have a significant pressure loss and elevated shear stress. But if the material has a low viscosity, such as polyethylene, and the fill pressure is not an issue but the packing pressure is, a constant-diameter runner is often the better choice, because it will set up faster. While others may disagree, my personal preference is to use a varying-diameter runner regardless of the material type. I prefer to minimize the fill pressure and shear stress as much as possible. If the large primary runner extends the cycle time, I simply add some stiffening ribs, which also act as flash traps, and some gussets connecting the primary runner to both the sprue and the cold well, as depicted in Fig. 5. This intersection, regardless of the runner type, is almost always the most massive, which takes the longest to reach its ejection temperature.

Just so we are all speaking the same language, the hierarchy of runner sizes is primary, secondary, tertiary, quaternary and quinary. These are typical in naturally balanced two-, four-, eight-, 16- and 32-cavity molds. If you have more cavities than that, the next levels are senary, septenary, octonary, nonary and denary. Note: This same terminology also applies to the flow channels in a hot-runner system.

The diameter of the runner feeding the gate is extremely critical for two reasons. First, it has a significant effect on the processing window and the part quality. Second, because the size of the other runner branches in a varying-diameter system are directly related. A good starting point is to make the last runner diameter 1.5 times the wall thickness of the part where it is gated into. This may seem like an overly simplistic rule, which it actually is, but the alternative is to perform some intricate empirical calculations, or to perform a flow analysis. For the average custom molder, the time and cost factors for either of those approaches is often not warranted or achievable.

Since rules always have exceptions, a 2004 study determined that it is often possible to use smaller runner diameters—equal to, or possibly even smaller than, the wall thickness of the part. It depends on the part's wall thickness, the type of molding material, the injection flow rate, and the resulting shear rates. If you are trying to shave seconds or minimize virgin material costs, there's certainly no harm in starting off with smaller runner diameters, since they are steel safe and can be enlarged if needed after the initial mold sampling.

Do not make the runner diameter 1.5 times that of a thicker wall section located somewhere else on the part. Packing out that section is based on the wall thickness between the gate and that section. A larger runner diameter will not help pack out that section. As most of you know, one of the golden rules in our industry is to always try to gate into the thickest section of a part. Unfortunately, the part design, the aesthetic requirements, and the gate-stress considerations often require the gate to be located in a less-than-ideal location.

TABLE 1 Last Runner Cross-Sectional Flow-Area Increase (based on fill time)

Fill Time, sec	Flow Area Increase, %
0 - 1	0
1 - 2	19
2 -3	38
3 - 4	57
4 - 5	76
5 - 6	95

TABLE 2 Runner Cross-Sectional Flow-Area Increase (based on length)

Runner Length, in.	Flow Area Increase, %
0 - 1	0
1 - 2	9
2 - 3	14
3 - 4	18
4 - 5	21
5 - 6	23
6 - 7	25
7 - 8	27
8 - 9	28
9 - 10	30

TABLE 3 Example of a Runner Calculation for PE and PVC

For PE	For PVC	Runner Sizing for Two Different Materials
0.100	0.100	Wall Thickness at the Gate, in.
0.150	0.150	Diam. = Wall Thickness x 1.5, in.
1.0	2.0	Fill Time, sec
0	19	% Increase For Fill Time (0 to 95)
4	4	Runner Length, in.
18	18	% Increase For Runner Length (0 to 30)
Low	High	Material Viscosity (Low, Medium, High)
0	20	% Increase For Material Viscosity (0 to 20)
18	57	Total Flow Area Increase, %
0.177	0.236	Adjusted Runner Diam.

Following the 1.5-times guideline, if a part has a wall thickness of 0.100 in., the last runner diameter should be approximately 0.150 in. diam. Even though today's CNC machines can cut any size desired, it is better to use a standard cutter size to reduce the machining time. Therefore, round this 0.150 in. up or down to the next standard cutter size—in increments of 1/64 in. The next step is to adjust this diameter to compensate for four variables: shot weight (parts and runner), runner branch length, material viscosity and shear sensitivity. I must point out that these adjustments usually do not need to be made if you have a very thick-walled part, with a very deep gate, and therefore, a very large runner feeding the gate. That is a unique situation where these four variables have very little effect.

Molds with large shot weights or shot volumes typically have longer fill times. During the filling phase, the exterior of the runner starts to solidify against the cold surface of the mold and the effective flow area gets smaller and smaller. The runner diameter must be adjusted accordingly. Despite my disdain for rules of thumb, the following guidelines are recommended: Increase the cross-sectional flow area of the runner—not its diameter—by 19% for each second of fill time greater than one, as shown in Table 1. If the runner diameter gets extremely large, it is an indication that a second gate and runner branch may be required. Why? As discussed last month, if you double the number of gates, the flow rate ($in.^3$/sec) and the flow speed (mph) gets cut in half. Now you can double your injection velocity, which cuts the fill time in half, and maintains the same melt viscosity entering the cavity.

The next adjustment is to factor in the runner's length. As the length of the runner branch increases, so does the material's resistance to flow. Once again, increase the cross-sectional flow area, not the diameter, by the percentages shown in Table 2.

The last runner-branch adjustment is to factor in the material's viscosity and shear sensitivity. Unless you know your way around a plot of viscosity versus shear rate, this adjustment will be based primarily on experience. Do not increase the flow area for low-viscosity materials, such as semicrystalline PE, PP or PA (nylon). For medium-viscosity amorphous materials, such as PS, ABS and SAN, add 10% to the flow area. For high-viscosity materials, such as PMMA (acrylic) and PVC, increase the flow area by 20%.

Putting this all together, a good approximation of the diameter of the runner branch feeding the gate is equal to the part's wall thickness × 1.5 + an adjustment for the fill time (0 to 95%) + an adjustment for the branch length (0 to 30%) + an adjustment for the material viscosity (0 to 20%). Table 3 shows an example of this calculation for a mold running both polyethylene and rigid PVC. In this example, they both have the same part wall thickness of 0.100 in. and the same runner length of 4 in. The only differences are the fill time and the material viscosity. As a result, the adjusted runner diameter feeding the gate would be 0.177 in. for PE, or 0.236 in. for PVC.

Once you have determined the diameter of the runner feeding the gate, calculating the sizes of the remaining runners leading up to the sprue is much simpler. Some people say that the cross-sectional flow areas of these runners should be equal to the combined flow areas of the branch runners they feed. That's another terrible rule of thumb, because it will result in excessively large runners. The correct formula for calculating the remaining runner diameters is:

$$D_{FEED} = D_{BRANCH} \times N^{1/3},$$

where D_{FEED} is the diameter of the runner feeding the branch, D_{BRANCH} is the diameter of the runner branches, and N is the number of runner branches (typically two and occasionally four for geometrically balanced runner designs.) There is no need to adjust these diameters for fill time or material viscosity. You already accounted for them when determining the runner diameter feeding the gate. However, common sense will dictate whether an adjustment should be made to account for any long runner lengths.

Let's do an example using these guidelines: Figure 6 depicts an eight-cavity mold with primary, secondary and tertiary runner branches. The material is PE, the fill time is less than 1 sec, and the wall thickness of the part at the gate is 0.100 in. The length of the tertiary runner section is 1.0 in. long. Therefore, the tertiary runner feeding the gate should have a diameter of 0.100 × 1.5 = 0.150 in. No other adjustments need to be made in this case.

Let's round this value up or down based on a standard cutter size—in this case 5/32 or 0.156 in. The diameter of the secondary

KNOW HOW TOOLING

Learn more at PTonline.com

Get more insights on tooling from our expert authors:
short.ptonline.com/toolingKH

runner would be the diameter of the tertiary runner times the number of branches to the ⅓ power (cube root). In this case it would be 0.156 × 1.26 = 0.197 in. Again, you would round this value up or down based on a standard cutter size, which is $^{13}/_{64}$ or 0.203 in. That works out to an 83% increase in flow area—not twice the flow area, as others might suggest. The primary runner should follow the same sizing formula. Therefore, it should be 0.203 × 1.26 = 0.256—rounded down to ¼ in. diam.

That works out to a 52% increase in flow area—considerably less than twice the flow area—and that makes sense. Since plastic has an extremely low coefficient of thermal conductivity, it insulates itself. The larger the runner diameter, the larger the percentage of molten material will be in the center. Therefore, the amount of pressure loss and the amount the cross-sectional flow area needs to be increased is not linear.

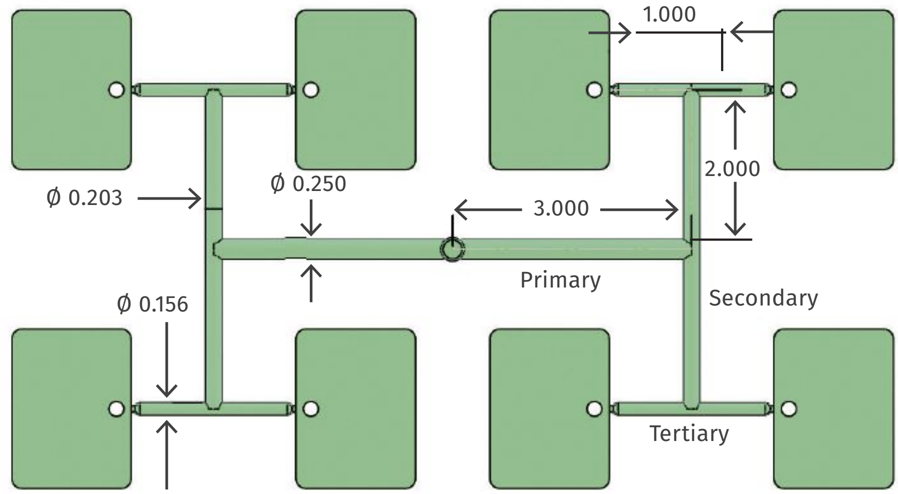


FIG 6 Examples of runner sizes.

ABOUT THE AUTHOR: Jim Fattori is a third-generation injection molder with more than 40 years of experience in engineering and project management for custom and captive molders. He is the founder of Injection Mold Consulting LLC, an international consulting company. Contact *Jim@InjectionMoldConsulting.com*; *InjectionMoldConsulting.com*.

On-Site

Sussex IM • Sussex, Wis.

By Matthew H. Naitove
Executive Editor

Sussex IM CEO Keith Everson (right) and Kyle Kopp, v.p. of manufacturing, in front of the trimming and leak-testing station of the automated injection and blow molding cell that produces sports water bottles with IML.

Injection Pairs with Blow Molding for In-Mold Assembly

At Sussex IM, compact cells of side-by-side injection and blow molding machines "assemble" reusable water bottles with insert blow molding and automated transfer, trimming and leak testing.

Sussex IM is an injection molder and contract manufacturer with broad competence in secondary operations—degating, barcoding, pad printing, digital ink transfer, in-mold labeling and decorating (IML, IMD), digital watermarking, laser etching, sonic and vibratory welding, functional testing, and even retail packaging. To make all that efficient, the company is also committed to automation. As it states on its website (*sussexim.com*), this combined focus is integral to the company's philosophy:

Four TPE soft grips are removed from the injection mold of a 120-ton press by a six-axis robot.

The robot places the TPE grips on both sides of two blow molds.

"Value-added operations are one of the criteria for distinguishing between shoot-and-ship molding—where a part is ejected from the mold and essentially goes straight into a box—and engineered molding. One of the most efficient procedures in plastics manufacturing involves integrating downstream operations to the molding cycle. While we have control of the part, through robotics and fixturing, we can effectively reorient, inspect, test, decorate, machine, assemble, and package."

Bringing an innovative technique over from Asia and adding automation in place of hand labor.

So, when Sussex needed to make a hollow-bodied object with solid attachments of a different material, it adopted blow molding as just another secondary operation to injection molding, and engineered the automation to link them together efficiently.

The concept of joining two materials in the mold—in-mold assembly—was already familiar to Sussex IM, which has experience with a wide variety of multi-shot injection molding techniques. Extrusion blow molding, however, is very different from injection molding, a likely reason why there aren't a lot of shops that do both. Fortunately, Sussex IM had a history in blow molding—and some long-time employees who remembered that experience.

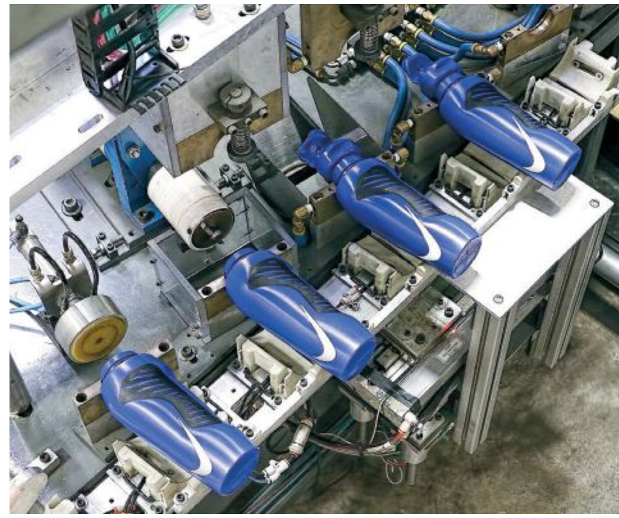
AUTOMATION & CONTROL

Sussex IM was started in 1977 as Sussex Plastics Inc. The current CEO, Keith Everson, has been with the firm almost all of that time, while Sussex grew into a $70 million operation that employs 500 people and houses 70 injection machines from 25 to 955 tons—plus two blow molders—at two facilities in Sussex, Wis., that total 210,000 ft^2. Its activities are divided almost equally among four market sectors: consumer goods (including cosmetics packaging), healthcare, agriculture, and industrial. Sussex also has a small proprietary Sussex Brands division, which makes Mr. Lid food-storage containers (***mrlid.com***).

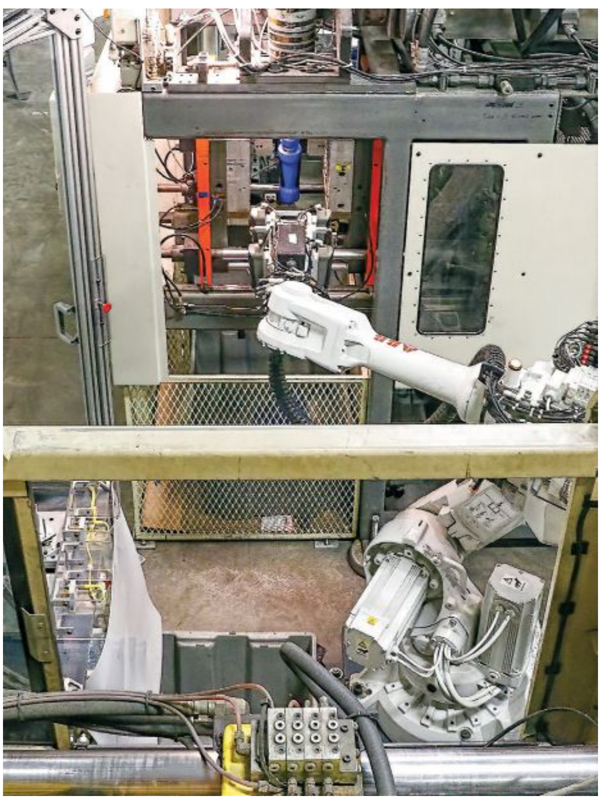
"Back in the late 1980s," recalls Everson, "we reached a fork in the road: go automated or do just manual jobs. We chose automation and to do it internally. We hired a full staff of seven automation engineers and technicians to build custom automation for specific programs. Post-mold operations are a big niche for us, so we build several million dollars worth of automation each year. If we had to buy that outside, it would cost twice as much, take twice as long, and work half as well."

Adds Kyle Kopp, v.p. of manufacturing, "In-house automation expertise gives us total control. We build systems for our people and our style of operations, so our people find it more intuitive and learn it quicker.

The same six-axis robot and EOAT that transfers the TPE grips from injection to blow molds also picks and places in-mold labels in the blow molds.



Finished bottles in trimming station.



The six-axis robot waits by the blow mold for a second robot to remove the bottles for leak testing and trimming. This view is looking over the injection press, whose tiebar is seen at bottom.

Doing automation in-house also makes it easier to optimize and fine-tune. This gives speed to market by allowing us to react faster."

Sussex IM has 100 robots and several collaborative robots (cobots), the latter used to transfer products between operations. The firm also has a 3D printer that allows it make custom plastic components for jigs, fixtures, mandrels and robot grippers, as well as prototype parts.

Kopp notes that Sussex automation engineers pride themselves on designing compact workcells that perform multiple operations within a small footprint: "By streamlining the assembly process, we can eliminate unnecessary touchpoints, minimize excess handling of WIP items, and actually yield significant energy savings. These are discrete pieces of the sustainability puzzle that may be overlooked in conventional thinking."

PAIRED PROCESSES

An example of such compact cells are the two lines making reusable water bottles ("sports bottles") in a variety of sizes and color configurations, using paired injection and blow molding machines. According to Everson, these bottles formerly were made only in Asia. The original procedure was to injection mold TPE soft grips, which were hand loaded into fixtures, from which a robot would place them in the blow mold. After molding, the bottles were trimmed and pad printed.

When Sussex IM took on this application, it had the advantage of prior experience with extrusion blow molding. "About 25 years ago, we had five machines making seasonal point-of-sale decorations—pumpkin heads, Christmas trees, candy canes," Everson notes. "Then we got out of it. Most of that business went to Asia."

When Sussex IM took up blow molding again five years ago, it decided to focus only on specialty niche applications. For the sports bottles, Sussex approached it in its accustomed fashion—with a do-it-ourselves attitude and an urge to automate.

The result was a cell in which the process starts with injection molding four TPE soft grips in a 120-ton press. A six-axis robot extracts the grips with end-of-arm tooling that also picks up two in-mold labels and places all of them in two aluminum blow molds—one grip in each mold half—in an adjoining press. ►

An operator touches the finished bottles only for a quick visual check, adding a cap and UPC label, and packing.

SPORTS BOTTLE CELL

The blow molder is not a brand-name machine but a custom system built to Sussex's unique specifications at a local machine builder with a global reputation. It has two accumulator heads—one for each cavity—and an 80-ton clamp.

After blow molding, the TPE grips are bonded to the bottle body (LDPE or PP) and in-mold decorated (eliminating the subsequent pad-print operation). A secondary robot removes the two bottles and transfers them to another station, where the bottles are automatically trimmed, leak tested and passed to a waiting conveyor system. Lastly, an operator gives a quick visual check, adds a unique multishot cap assembly, product information tag, and UPC code label, and packs the bottles for retail distribution. This is all done within the blow molding cycle.

The two sports-bottle cells currently run 24/5, but Everson sees other applications beckoning for this dual-molding approach and its nearly full-wrap IML capability. One factor is the growing popularity of refillable water bottles versus single-use PET bottles. Another is the untapped potential in products such as wipes containers and medical products (Sussex is ISO 13485 certified).

Compact, integrated cells minimize handling and save significant amounts of energy.

Other injection molders might be attracted to the idea of blowing hollow-bodied objects with grips, handles, or other attachments incorporated via an insert-molding approach. But a word of caution is in order. Notes Kopp, "There are aspects of the process that can be challenging when you combine multiple technologies. Making it all function within cycle time consistently is not easy. It's challenging, but we work very hard to eliminate variables."

CALL FOR NOMINATIONS

— HALL OF FAME AWARD
— MOST INNOVATIVE USE OF PLASTICS AWARDS

The Automotive Division of the Society of Plastics Engineers (SPE®) is announcing a "Call for Nominations" for its 50th-annual ***Automotive Innovation Awards Gala,*** the oldest and largest recognition event in the automotive and plastics industries. This year's Awards Gala will be held Wednesday, **November 19, 2020** at the Burton Manor in Livonia, Mich. Winning part nominations ***(due by September, 15, 2020)*** in 10 different categories, and the teams that developed them, will be honored with a **Most Innovative Use of Plastics** award. A **Grand Award** will be presented to the winning team from all category award winners. An application that has been in continuous use for 15 years or more, and has made a significant and lasting contribution to the application of plastics in automotive vehicles, ***(nominations due by May 31, 2020)*** will be honored with a **Hall of Fame** award.

SPONSORSHIP OPPORTUNITIES

This annual event currently draws over 800 OEM engineers, automotive and plastics industry executives, and media. A variety of sponsorship packages - including tables at the banquet, networking receptions, advertising in the program book, signage at the event and more are available. Contact Teri Chouinard of Intuit Group at **teri@intuitgroup.com**.

For more info and to submit nominations, go to: **www.speautomotive.com/innovation-awards-gala**.

- LIMITED EDITION/ SPECIALTY VEHICLES AND AFTERMARKET
- ADDITIVE MANUFACTURING
- BODY EXTERIOR
- BODY INTERIOR
- CHASSIS/HARDWARE
- ENVIRONMENTAL
- MATERIALS
- PROCESS, ASSEMBLY & ENABLING TECHNOLOGIES
- POWERTRAIN
- SAFETY
- HALL OF FAME

2019 SPONSORS

VIP RECEPTION & AFTERGLOW

Celanese
The chemistry inside innovation™

MAIN RECEPTION

sabic

WINE & FLOWERS

DUPONT

GOLD SPONSORS

Advanced Composites

American Chemistry Council Plastics Division

shape CORP

SILVER SPONSOR

PRET WELLMAN

BRONZE SPONSORS

ASCEND

BASF

GEON Performance Solutions

hp

PLASTICS INDUSTRY ASSOCIATION

ADVERTISING SPONSORS

INEOS STYROLUTION Driving Success. Together.

TOYOBO

MEDIA/ASSOCIATION SPONSORS

AUTO BEAT DAILY · AD&P · AUTOMOTIVE ENGINEERING · CPRJ · CPRJ International · CW CompositesWorld · PLASTICS ENGINEERING · Plastics Business · PLASTICS DECORATING · PLASTICS MACHINERY · PT Plastics Technology · SAE INTERNATIONAL · WARDSAUTO.COM

Is Your Feeding Technology Robust Enough?

Maybe not. But consider these factors to beef up your system to ensure reliable and even *smarter* performance.

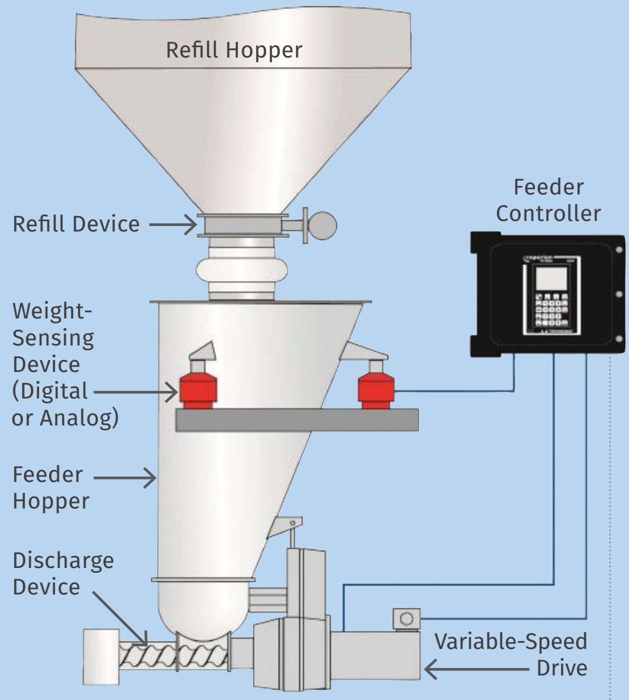


FIG 1

The LIW feeder consists of a feed hopper, refill device, discharge device with a variable-speed drive, weight-sensing device (digital or analog) and controller. A feeder operator sets the material feed rate (setpoint) by sending information to the feeder's controller.

By John Winski
Coperion K-Tron

Today's modern manufacturing processes utilize loss-in-weight (LIW) feeders as the automated dispensing technology for dry bulk solids. The most current feeding technologies have evolved in many aspects through improved control and design features with an emphasis on process robustness and intelligence. It is expected that feeder controls can easily connect to industrial networks and key process data, which has become a critical criterion in evaluating not only feeder performance but also real-time indication of the complete process.

This article will address what a processor should consider when evaluating its current feeding equipment and the feeder's ability to monitor, trend and react to process variations. The availability of this data and its management in accordance with Industry 4.0 automation can allow the user to adapt to future manufacturing requirements, which can include greater traceability, flexibility, adaptability and overall effectiveness.

The LIW feeder's ability to collect process data in real time can help you catch small process problems before they become big ones.

HOW A LOSS-IN-WEIGHT FEEDER WORKS

The LIW feeder consists of a feed hopper, refill device, discharge device with a variable-speed drive, weight-sensing device (either digital or analog), and controller (Fig. 1). A feeder operator sets the material feed rate (setpoint) by sending information to the feeder's controller.

When the feeder is in operation, the discharge device draws material from the feed hopper and meters it to the downstream process. The weight-sensing device continuously reports the material weight in the hopper (net weight) to the controller. The controller calculates an actual feed rate based on the loss in net weight, compares it to the setpoint, and increases or decreases the discharge device's drive speed to accelerate or slow the net-weight change (loss of material in the hopper) so the feed rate matches the setpoint.

To prevent feeding interruptions, the controller periodically commands the refill device to refill the feed hopper with material. During each brief refill cycle, the net-weight signal from the hopper is increasing, so it can't be used as a control signal to determine how much material is being delivered to the process. To compensate for this, the LIW feeder temporarily operates in volumetric mode during refill.

The feeder controller can be integrated into a supervisory process-control system that monitors all the feeders and other equipment in your process. The following information explains how data collected by the LIW feeder can help you detect process problems early, ensure product quality, and find setup errors before startup.

IMPROVED PRODUCTIVITY BY TRENDING FEEDER PERFORMANCE

The LIW feeder's ability to collect process data in real time can help you catch small process problems before they become big ones.

Today's advanced controllers can include communication via a wide variety of protocols, with some even including built-in Ethernet and optional WiFi modules. The capacity of newer controllers can store historical data records for an extended period of time. This data can include the feeder's feed rate, net weight, and drive-speed-to-feed-rate relationship (called the feed factor). Typical plots of such data are shown in Fig. 2 with key trended parameters as follows:

Knowing the feed factor, updated in real time during feeding, can help detect feeding problems early and prevent large feed-rate inaccuracies.

Feed Rate: The feed rate (sometimes called mass flow) is the most important data provided by your feeder controller. The feed rate's deviation from your setpoint ultimately determines whether you are producing good product or waste. Typically, the feed rate should deviate only slightly from your setpoint, as shown in Fig. 2 (top graph), and any deviations should be centered around the setpoint. A feed rate that is consistently too high or too low can indicate that the feeder controller is improperly configured, or worse, that your LIW feeder has been improperly set up for the material. Undetected and uncorrected feed-rate errors can result in consistently out-of-spec product and potential waste of valuable ingredients. This problem can be corrected by setting proper alarm limits in the feeder controller and, if possible, plotting feed-rate trends so you can detect and correct problems before they reach critical levels.

Net Weight: The net weight sensed by the feeder determines how the feeder controller must adjust the discharge device's drive speed to achieve your desired feed rate. Yet many users overlook the valuable data that can be collected by observing and plotting the feeder's net-weight trends. The center graph on Fig. 2 shows a problem detected by observing net weight during a feeding run: After about 700 sec of feeding, one refill cycle was incomplete and failed to adequately fill the hopper, most likely because of problems with the refill equipment or upstream material handling.

Although this LIW feeder continued to operate and feed normally, such an incomplete refill cycle can be a serious problem. Because the feeder is temporarily operating in volumetric mode during refill, and incomplete refill cycles require the feed hopper to be refilled more frequently, the feeder is operating for a much greater time in volumetric mode. By doing so, the feeder is not measuring actual LIW and is only reacting volumetrically. Volumetric operation delivers a certain volume of material per unit time. It does not account for any dynamic changes occurring in the feeder hopper such as variations in the material's density, formations of rat holes, or material bridges.

These dynamics often result in a much lower feed-rate accuracy. You can detect these upstream material-handling problems and prevent them from affecting product quality by using information from your LIW feeder. One way is to select a feeder controller that can prevent feed-rate inaccuracy during refills by storing information about the proper drive speed for a given net weight and setpoint. This allows the controller to take cues from past net-weight measurements and accurately control feeding during refill.

Feed Factor: The controller must estimate the relationship between your feeder's drive speed and the material feed rate for your discharge device and material. This drive-speed-to-feed-rate relationship, which is really a measure of your feeder's volumetric feeding capacity, is called the feed factor and is plotted in the bottom graph in Fig 2. Your LIW feeder's setpoint must be somewhat under the estimated maximum feed rate to ensure that the feeder can consistently achieve your setpoint. If the maximum setpoint is at or too near the upper limit of what the feeder can achieve, the feeder may not be able to reach the setpoint.

Some users think of the feed factor as a one-time measurement to ensure that the feeder they select has enough full-scale capacity. However, knowing the feed factor, updated in real time during feeding, can help detect feeding problems early and prevent large feed-rate inaccuracies. It can also help maintain the proper feed rate during refill. Since material characteristics and operating conditions can vary during a feed run, the feed factor will change ►

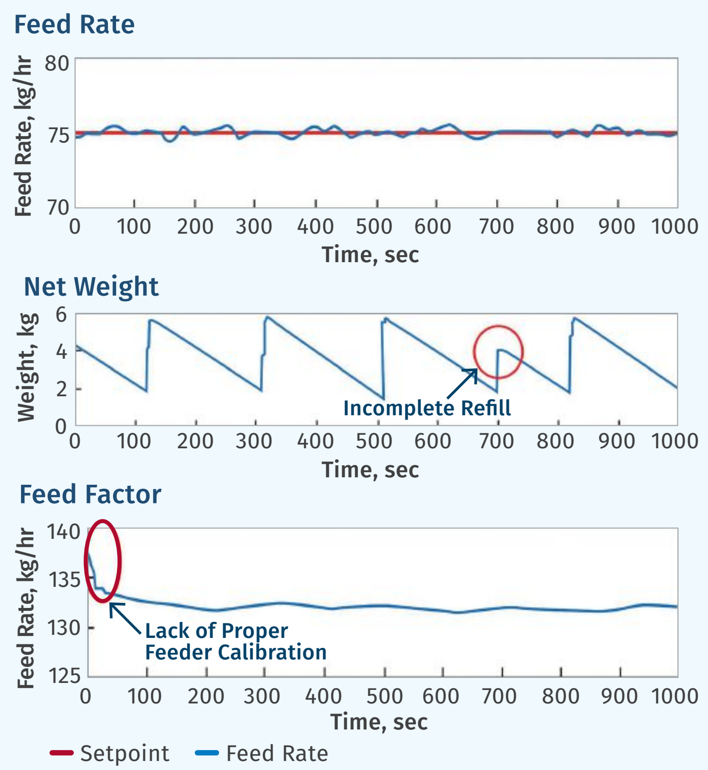


FIG 2 Data commonly collected by LIW feeder.

slightly while your feeder is running. If the trend shows large changes, however, this can indicate material density changes and other potential problems.

For instance, if the estimated maximum feed rate suddenly increases after the LIW feeder is refilled, the material density may have changed because of humidity or other contamination. If the feed factor for a LIW feeder equipped with a screw discharge device steadily decreases over time while the drive power to maintain the proper feed rate increases, the material may be building up on the screw and the feeder may be losing efficiency. This indicates that the feeder should be cleaned or receive preventive maintenance.

FIG 3

LIW feeder suspended on load cells.

IMPROVING RELIABILITY

Any LIW process controller requires accurate high-speed measurement of material weight changes in order to provide optimal feeder control and performance, especially on a second-to-second basis. The weighing system must also be able to filter out erroneous measurements due to in-plant vibrations or disturbances and be stable over changes in process material temperatures or ambient shop temperatures. To distinguish between the load to be measured and the forces induced by vibration, sophisticated digital filtering may be employed to identify and extract frequency components characteristic of in-plant vibration.

There are two types of weighing technologies typically used in LIW feeders. They are analog strain gauge and digital vibrating wire. The higher the resolution of weight measurement and the faster those weight measurements are taken, the better the information that will be provided to the control algorithm and the better any vibration-filtering algorithm will work. For example, today's load-cell (Fig. 3) and controller technologies are available with high resolution and abilities to sample the weight signal up to 50 times/sec (Fig. 4). In addition, almost all weighing systems provide temperature compensation.

LOAD-CELL RESOLUTION

When required sample durations are measured in seconds rather than minutes, the resolution of the feeder's weighing system becomes a major determinant of performance potential. For example, a typical scale with an *analog* load cell for feeding bulk solids at low mass-flow rates can have a weighing range of 32 kg and a resolution of 1:65,000. This scale can detect approximately 500-mg weight changes. Typically, weight changes per second should be approximately five times higher than the minimum resolution, which is equivalent to 2.5 g/sec (9 kg/hr).

When feeding at this rate, it takes the controller 20 sec to detect whether the setpoint is reached within a deviation of ±1%. If the mass-flow rate is below 9 kg/hr it becomes even more difficult to detect improvements of gravimetric control versus volumetric control. Therefore, any mass-flow rate below 9 kg/hr may not even see a significant improvement with gravimetric control.

Conversely, a platform scale with a *digital* load cell with a weighing range of 24 kg and a resolution of 1:4 million can actually detect 6-mg weight changes. The limit value can therefore be reduced from 9 kg/hr to approximately 108 gm/hr. Therefore, at high or low mass-flow rates, for any processor requiring the highest level of feeder performance over short time scales, weighing resolution should be a major focal point in consideration and evaluation of potential feeding technologies.

IMPROVED ROBUSTNESS

In addition to those control and load-cell options that help improve process measurement as well as process trending, there are also control options for LIW feeder technology that aid in assisting with adverse effects of external pressures as well as in utilizing vibration for assisting material flow.

In the case of external pressures, for example, a feeder's refill cycle increases air pressure in the hopper due to the sudden inflow of material. Any positive air pressure acts equally towards all sides and pushes up on ►

Weight Sensor Output

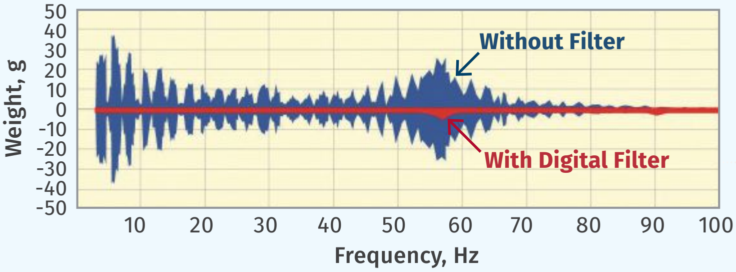


FIG 4 Today's load-cell and controller technologies are available with high resolution and abilities to sample the weight signal up to 50 times/sec.

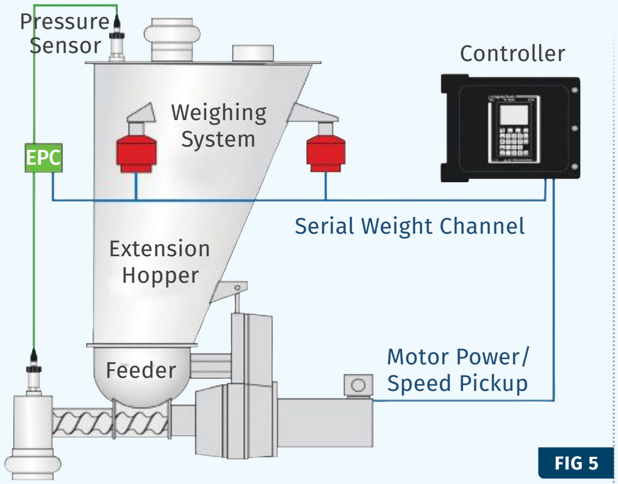


FIG 5

Function principle of the Electronic Pressure Compensation with sensors on both the hopper lid and the discharge

the hopper lid and the refill valve. Due to the inlet opening, forces acting upward on the lid are lower than those acting downward oppositely on the floor of the hopper. The higher forces acting down result in an increase in the weight signal. The LIW controller would interpret the increased weight signal to mean that mass flow is slowing and react by erroneously increasing the feeder output, creating a mass-flow error.

Hopper-pressure issues can also have other causes, such as a clogged vent filter, a dust-collection system connected to the hopper vent, or a nitrogen blanket applied to the hopper.

Conversely, a pressure fluctuation at the feeder discharge also distorts the feeder's weight signal if the outlet is sealed with a cap, or includes a clogged vent filter. Increased pressure in the discharge tube pushes upward, which also pushes up on the feeder and reduces the measured weight.

Typically, these troublesome pressure fluctuations have been compensated for by mechanical means. Alternatively, instrumentation and control algorithms can be applied to electronically monitor and compensate for this pressure influence, such as that shown in Fig. 5.

Utilizing pressure-sensor technology on both the feeder hopper and the product outlet makes possible a detailed assessment of exactly what was happening in the feeder to alter its output. By utilizing a pressure-compensation algorithm in the control system, changes in pressure can be identified and will no longer be misinterpreted as changes in bulk material weight. The data transmitted thus enables the gravimetric feeder control to regulate the mass flow correctly.

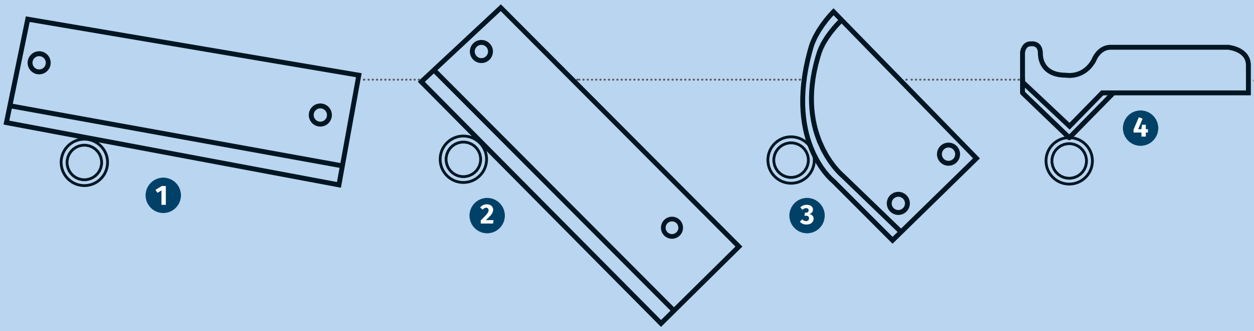
USING VIBRATION FOR POORLY FLOWING MATERIALS

In the case of LIW feeders, external vibration—including use of standard vibrators on feeder hoppers—can cause interference with the LIW signal if the control system cannot filter out this vibration. Alternatively, there are some new control technologies available that utilize vibration applied to the hopper and include an external drive tied directly into the weight-system controls (see Fig 6). This drive operates at a variable frequency and amplitude based upon the weighing and control system detecting nonuniform material flow by weight. This realtime device activates the external vibration only when there is an upset in the LIW signal, such as in the case of ratholes or material bridges. This type of "smart" vibration device is also self-tuning, with the controller adjusting the frequency and amplitude to compensate for changes in the hopper fill level or material flow, thus preventing bridges or ratholes before they can form.

Todays' advanced feeder controllers and load-cell technologies serve to improve not only feeder performance but also that of the overall process. Using these capabilities, processors can predict and prevent unplanned downtime, while also optimizing feeder effectiveness and maintenance requirements. It is important when evaluating a LIW feeder that close attention be paid to the overall connectivity, as well as reactivity of both the load cells and control systems, and any possible options for control upgrades. The investment made in a feeder that cannot only trend process parameters but also react quickly to influences of the process environment will result in a more robust feeding system. PT

FIG 6
ActiFlow bulk solid activator is mounted outside the product zone and has minimal space requirements.

ABOUT THE AUTHOR: John Winski is dir. of sales for Coperion K-Tron, Sewell, N.J., where he is responsible for sales in the Americas of feeders, pneumatic conveying and engineered systems. He has 32 years of experience at Coperion K-Tron and has held positions as a service engineer and project engineer and in regional sales management. He holds a degree in Electronics Engineering Technology from Temple University. Contact: *(856) 589-0500; jwinski@coperionktron.com; coperion.com.*



Blade shape and angle are vitally important in successful cutting. Straight blades (1) chop vertically through the entire width and depth of the tube. That's ok for softer extrusions, but can cause a lot of blade stress and wear on harder materials. Increasing blade angle (2) or adding curvature (3) creates a more gradual, slicing motion that cuts less material at once and reduces stress. Pierce blades (4) may use a variety of edges and angles to combine chopping and slicing motion.

Making the Cut: Pick the Right Cutting Technology for Pipe, Tube or Profile

Here is review of popular extrusion cutting technologies, strengths and limitations of each, and common problems and solutions.

By Ernie Preiato and Dave Czarnik
Conair

Tubing, pipe, or profiles are extruded, sized, cooled, and processed in a continuously moving process, so it's important to choose a cutting technology that keeps pace and is appropriate for the size of the product and characteristics of the materials that you're cutting. This article will discuss available cutting technologies and provide some insights on how to handle typical problems associated with each.

FOUR BASIC TYPES OF CUTTERS

Fly-Knife Cutters: Fly-knife cutters are very popular, made to cut smaller, softer tubing and profiles quickly and cleanly, using one or more blade types in a chopping or slicing motion. The simplest fly-knife cutters employ a blade mounted on a flywheel that provides cutting inertia. Fly-knife cutters are driven by a motor that transmits rotational force through planetary reducing gears. The gears increase the torque and cutting force of the blades, while also isolating and protecting the motor and motor shaft from the shock of cutting.

Single-bevel or chisel-edge blades (left) tend to concentrate the reaction force (F) of cutting on one side, so they tend to veer in the opposite direction. A better choice is double-bevel cutting blades (right), which balance cutting force on both sides and therefore tend to move straight and square through cuts.

Fly cutting blades work by "displacing" material, literally pushing all of the material to one side of the cut or the other, so no material is lost. When extrusions are small, thin-walled, or soft, a fly cutter blade may slice through in a single cut.

To hold the product and blade steady during cutting, bushings are positioned on either side of the cutting blade. The extruded tube, pipe or profile slides through the cutter bushings and the blade makes a straight cut between them. The space between the two bushings is adjusted relative to the thickness of the blade. Ideally, the spacing should allow for a very slight "drag" on the side of the blade when it cuts through the product. This "drag" fit prevents blades from flexing or curving under stress and keeps the fly cutter properly aligned, cut after cut.

Guillotine or Traveling Guillotine Cutters: Similar to their name, guillotine cutters use a vertical blade to slice or chop downward through extruded products. These cutters are often seen as fitting "in between" fly-knife cutters and traveling-saw cutters (see below), where they

Your Guide to Choosing the Right Cutter for the Job

	Typical Materials	Applications	Key Benefits	Limitations
Fly knife	Soft to medium materials (≥ Shore D 75 hardness): PP, PE, Flexible PVC	•Medical tubing •Thin-wall tubing •Flexible hose •Flexible trim and gaskets •Small rigid profiles	•Versatile •High cutting rates •Relatively inexpensive	Breakaway cuts, cracks or chips on harder materials
Saw	Hard, thick, or brittle materials and foams	Pipes or extrusions too large or wide for fly cutting	Power for large cutting jobs	Generates dust and particulates
Guillotine	Soft, sticky materials: TPEs, PE	Flexible elastomers, foams or seals, flexible gas pipe, multi-layer reinforced HDPE pipe	Handles sticky material without "gumming up"	Lacks versatility of fly-knife or saw cutters
Planetary	Rigid and semi-rigid materials	High-value, high-purity tube and pipe for automated assembly	Clean cuts with no particulate; eliminates secondary ops	•Higher cost •Lower cutting speeds mean fewer cuts/min

fill a more specialized niche: cutting very soft or sticky extrusions (e.g., thermoplastic elastomers, polyurethanes) that could "gum up" rotating fly knives or saw blades. While smaller guillotine cutters can process small-diameter products very quickly, larger-diameter products may be guillotine-cut on a moving table because cuts take longer and the extruded product is continually flowing.

Saw Cutters: Traveling-saw cutters are used on larger pipes or extrusions that are made of relatively hard, thick, or brittle materials, such as rigid PVC. Essentially, these are large circular saws adapted for cutting plastics. To ensure straight cuts of a continuously flowing extruded product, saw cutters are often mounted on traveling tables that move at the speed of the extrusion line. The extrudate is momentarily clamped to the table so that all three elements—extrusion, saw and table—move together while the cut is made. Then the table saw retracts to make a new cut. Unlike the other cutting types, which displace extruded material to either side of the cut, saw cutters remove a narrow swath of the material, creating "sawdust," which must be collected using a vacuum system.

Planetary Cutters: Planetary cutters make extremely high-quality cuts—square, distortion- and particle-free—on high-value rigid tubing products used in medical, high-purity, or automated-assembly applications. Closely resembling a plumber's pipe-cutting tool, planetary cutters hold a circular cutting wheel on the inside of a rotating ring that surrounds the pipe. The ring spins around the circumference of the tubing, pressing the cutting wheel inward so that it gradually splits the tube apart without any loss of tube material.

Like other cutters, planetary cutters are often mounted on moving tables so they can make square cuts on moving product.

COMMON CUTTING PROBLEMS & SOLUTIONS

Picking the right cutting technology for your application is step one. After that you'll likely encounter problems that require you to implement a troubleshooting strategy. Let's take a look at common issues with each of these various cutting technologies, and what you should look for to solve them.

Fly-Knife Cutting Problems

Angel hair or fines on knife surface: When cutting softer materials such as flexible PVC, fly-knife cutters tend to pull or carry out fine pieces of material as they exit the cut. To eliminate formation of these fines in "on-demand" cutting situations, the blade may be heated when it is at its home position between cuts. A heater can be added at the blade's home position, with temperature setpoints based on the material being cut.

Material buildup on knife surface: Cut quality begins with periodic sharpening and change to a new blade when needed. Blade life varies based on material hardness, presence of filler, and rate of cuts/minute.

In most situations, processors can get multiple shifts out of a sharp blade. But even with a sharp blade, any buildup of material on the sides can reduce cut quality, because that buildup tends to grab and stick to the extruded product as the cut is made. Material buildup typically occurs after a few hours of cutting softer, stickier materials.

There's no perfect solution to this problem: In some cases, it is possible to equip the cutter with a felt pad—usually wetted with alcohol—that gently wipes the cutting blade on every revolution. Another solution is to add an engineered system to spray a controlled amount of isopropyl alcohol on the blade prior to each cut. The same system can also spray nearby cutter bushings to protect against buildup and rub-off of particulates onto the finished product. Spray systems don't eliminate the need for periodic removal and thorough cleaning of particulate from blades, bushings, cutting chambers, and drip trays; but they do reduce cleaning frequency while maintaining better cut quality.

QUESTIONS ABOUT CUTTING?
Learn more at PTonline.com
Visit the Pipe/Profile/Tubing Zone.

To prevent accumulation of fines on cutting surfaces, a fly-knife cutter can be equipped with a blade-wiping assembly including an alcohol-dispensing tip and a foam wipe. For added lubrication on each cut, the reservoir below can be filled with a lubricant, typically alcohol or water-soluble silicone.

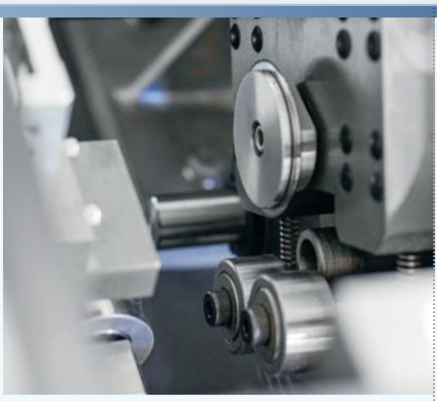
Extrudate sticks in cutter bushings: It's not uncommon for warm extrudate to bind or stick somewhat as it passes through steel cutter bushings. If extrudate binds significantly, it can affect the smooth operation of the line and cause cut consistency and quality problems. There are a few ways to address this problem:

- *Add lubricant:* Many cutters offer optional lubricant reservoirs that use pulses of compressed air to inject small amounts of lubricating fluid into diagonal, forward-facing holes located on the top of cutter bushings. Alcohol is the most common lubricant, particularly in medical applications, though water-soluble silicone may also be used.
- *Use lined cutter bushings:* Cutter bushings with inner linings or sleeves of acetal or PTFE material can ease movement of the extrudate through the bushings. Note that when such sleeves or liners are used, they must allow for clearance of ¼ in. to ½ in. at the interior ends of the bushings, so that only clean steel edges butt against the cutting blades.
- *Try air-feed bushings:* Use a controllable stream of air or lubricant that enables extrudate of a tacky material to slide easily through the cutter bushings. Use of such bushings creates a more consistent feed that allows the processor to hold much tighter length tolerances.

Material Chipping or Cracking: When fly cutting semi-rigid to rigid materials like rigid PVC or PP, you may see "breakaway" cuts—with edges that have broken, cracked, or chipped off before the cut was completed. Obviously, you'll want to address this problem very quickly, since it's going to cause reject parts or require secondary finishing operations. While there's no simple answer to this problem, a couple of approaches can be successful:

- *Reduce cutter speed:* There is a rule of thumb for cutting (especially fly cutting): For the cleanest cuts, cut softer materials at higher rpm and harder materials at lower rpm. So, if cutting semi-rigid or rigid extrusions results in chips or cracks, start by slowing down the rpm of the blade to reduce or eliminate the problem. Sometimes, especially with rigid PVC, using a slightly duller blade actually provides a better cut.

Fly-knife cutting blades come in all shapes and sizes—from small industrial razor blades to a variety of standard or custom-designed straight, curved, or scimitar blades.



Close-up of the cutting wheel of a planetary cutter, which rotates under pressure provided by twin rollers (below) around the circumference of a tube, similar to a plumber's pipe cutter. Cuts take a bit longer to make, but are so clean that secondary finishing time and expense are virtually eliminated.

- **Cut extrudate at higher temperatures:** Chipping or cracking can also be related to the temperature of the extruded product. Many processors get better results by cutting at higher temperatures so that the material is a bit softer and less likely to fracture. The optimum way to do this is to bring the extrudate out of the cooling process and into the cutter while it still retains some process heat, at a temperature of about 120-140 F. Using retained process heat is better than the alternative, reheating fully-cooled products, because process heat is more evenly distributed and costs nothing extra. But no matter how you warm the product, cutting extrudate that is warmer often enables the blade to travel cleanly through, free of cracks.

Traveling-Saw Cutting Problems

Burrs/uneven cuts: Burrs can result from a combination of factors, but often involve problems in blade selection or blade rpm. If your cutter has a variable-speed motor—something that is strongly recommended for top-quality cutting—try changing speeds first: Go faster for softer materials, and slower for semi-rigid or rigid materials. If your cutter has a fixed-speed motor, your immediate options are limited to changing blades. If these options don't get you the quality and consistency you need, the ultimate solution may be to upgrade to a planetary cutter.

Cut-length tolerances: Variability in cut lengths can be caused by a couple of subtle problems, usually associated with the traveling table. Many saws, and certainly older saws, are equipped with standard pneumatically driven traveling tables that can be tricky to adjust when a precise match with extrusion line speed is required. Fluctuations in air pressure can cause less precise operation. For these reasons, many processors are opting for servo-controlled traveling tables because they provide a much higher degree of precision and repeatability in tracking extrusion line speed. Servo-controlled tables can often eliminate the need for secondary cutting or finishing operations altogether.

Variations in square: Square cuts are key to holding length tolerances and allowing assembly of parts farther on in the manufacturing process. Aesthetics in finished assemblies are dependent on cut quality. Proper product guides and clamps are what solves these types of issues.

Planetary Cutter Problems

In general, planetary cutters are the most trouble-free type of cutter. If you can't obtain the consistent cut quality you need with a fly-knife cutter or a saw, your solution is likely to be a planetary cutter. They provide precise, clean, and particulate-free cuts and can often eliminate the need for secondary cutting or finishing operations, so they are an excellent solution for cutting extrusions that feed into automated assembly processes.

But there are some trade-offs: planetary cutters typically cost more, take longer to make cuts, and max out at lower line speeds than other cutter types. However, where cut quality is the primary concern, many processors are glad to adjust to lower line speeds in exchange for superior cut quality and virtual elimination of secondary cutting operations.

Guillotine Cutter Problems

Blade buildup and cleaning: Though the motion of a guillotine blade differs from that of a fly-knife cutting blade, the common problems are quite similar, including buildup of fines on the blade, the necessity for proper blade cleaning and lubrication, and the selection of the ideal blade for the job.

Variations in cut length and square: Like the fly-knife and traveling-saw cutters to which they are functionally related, guillotine cutters are subject to variations that affect cut lengths and the square of cuts. Generally, these are caused by inadequate or improperly adjusted product guides or clamps, or fluctuations in the movement of traveling tables.

Like many other challenges in extrusion processing, cutting-related problems may show themselves very clearly but defy initial efforts at problem solving, since multiple variables are often the cause. By breaking down the issues—first by the type of cutting technology involved, and then according to the details of the problem you're observing— you can often see the issues clearly enough to begin solving them, or to make the case for the upgrades you need to maintain top-quality cutting operations. PT

ABOUT THE AUTHORS: Ernie Preiato is v.p. extrusion for the Conair Group. Contact him at *724-584-5423*; *epreiato@conairgroup.com*. **Dave Czarnik** is R&D /lab manager at Conair's extrusion laboratory in Pinconning, Mich. Contact him at *989-460-1805*; *dczarnik@conairgroup.com*; *conairgroup.com*.

PT Keeping Up With Technology

PRODUCT FOCUS Materials

MATERIALS

Medical-Grade Compounds and Concentrates for Laser Welding

Clariant Healthcare Polymer Solutions has released a range of Mevopur medical-grade compounds and concentrates for laser welding. Clariant says laser welding offers numerous advantages in medical and diagnostic applications in terms of speed and reliability. Yet, if the combination of polymer, colorants, part design and processing techniques are not considered in the earliest stages of product development, weld consistency can suffer, risking product failure. Color choices, in particular, play a critical role in the ability of one part to transmit laser energy, and the other to absorb laser energy and melt at the bond line. Clariant experts can advise on color options in a wide range of polymers including PP, ABS, PC, and PC/ABS. In collaboration with laser equipment suppliers, the firm has developed analytical techniques to screen different solutions for the best fit for the job.

Once an optimal color has been selected, thorough and consistent distribution of pigments and additives in the plastic component becomes important. Depending on the processing equipment and flow path in the tool, a fully compounded material may perform better than a masterbatch in a particular application—thus, Clariant offers both options in its Mevopur laser-welding line.

MATERIALS

TPEs for Skin & Mouth Contact

From toothbrushes to teething rings, many manufacturers of dental and oral hygiene products are specifying materials that have been approved for food contact in order to ensure that they are non-irritating for skin and oral applications. Kraiburg TPE offers a range of suitable Thermolast K TPEs, which will be expanded this summer with new compounds offering excellent adhesion to engineering thermoplastics, particularly nylons.

In addition, the range of Thermolast K compounds with food-contact approval that show excellent peel strength and adhesion to hard thermoplastics has been expanded to

include polar plastics. New in the portfolio:

- FC/AD/PA series with reportedly outstanding tensile strength, elongation at break and wear resistance for multicomponent applications with nylons 6, 66 and 12.
- FC/AD1 series for composites with PET, PETG, PC, and ABS, as well as blends of these materials.

MATERIALS

Extremely Lightweight TPEs Without Foaming

An innovative material technology that allows the production of non-foamed TPEs with very low density has been developed by Kraiburg TPE and has resulted in commercialization of three new product lines for weight-saving components that are in increasing demand for vehicle construction and other sectors such as power tools, aviation, drones, sports, leisure and outdoor items.

While expandable materials including TPEs are often used to meet this demand, they require strict process control to achieve an even surface quality without surface waviness. Kraiburg's new TPE technology utilizes microscopic Glass Bubbles from 3M to produce TPEs with densities of 0.7 to 0.9 g/cm^3. They reportedly can be processed in standard injection molding and extrusion machinery. Very homogeneous surfaces and excellent compression-set values are claimed. Production waste can be recycled directly. Kraiburg's initial offering of what are said to be the world's first TPEs of this type comprises three series:

- Thermolast K LW/UV (lightweight + UV resistance) specifically for exterior vehicle components.
- Thermolast K LW/CS/UV (lightweight + increased compression set + UV stability) with excellent resilience and adhesion to polypropylene, making this product series particularly suitable for sealing applications.
- Thermolast K LW/PA (lightweight + adhesion to polyamides), also with UL 94-HB flammability classification, suitable for power tools.

MATERIALS

Medical PEBA and TPU Grades Resist Hydrolytic Degradation

In collaboration with a leading medical device manufacturer, Clariant Plastics & Coatings Healthcare Polymer Solutions has released new TP elastomer compounds specially formulated to resist degradation caused by exposure to high humidity and temperature. The new technology is especially crucial in resins that incorporate high loadings of radiopaque metals because these fillers are known to exacerbate the degradation effect.

Marketed under the Mevopur brand of Clariant's medical-grade materials, the new modified PEBA and TPU compounds are expected to be especially useful in applications like catheters. These materials commonly contain metallic fillers like tungsten or tungsten carbide so that doctors and technicians can see the exact position of the catheter under X-ray fluoroscopy. Such fillers can accelerate hydrolysis even with very small quantities of moisture trapped on the surface of the polymer, filler ingredients, or on the pellets of the compound, Clariant says.

MATERIALS

Colored Polysulfones for Healthcare Applications

A collaboration between Techmer PM and BASF has led to the launch of custom colors with USP Class V or VI and ISO 10993 compliance for BASF's Ultrason S, P and E (PSU, PPSU and PESU). According to BASF, these new colored grades will offer shorter development cycles, unique color options and lower scrap rates. Low-volume custom colors of Ultrason S, P and E grades are available through Techmer PM's Hifill brand; larger volumes can be obtained through BASF.

INJECTION MOLDING

Arburg Introduces Its Largest Packaging Machine Ever

Arburg reports that the hybrid Allrounder 1020 H Packaging machine, with 660-ton clamp and 40 in. between tiebars, is the largest the company has ever built that's specifically designed for packaging applications. Unveiled at K 2019, the hybrid machine, with electric clamp and hydraulic-accumulator injection, is aimed at high-cavitation molds or larger containers with volumes of up to 8 gal. A barrier screw ensures homogeneous melt preparation and a high throughput.

The new size 7000 injection unit has a shot capacity of around 4200 g (148 oz) in PS. Plastication occurs concurrently with other machine operations via a servo-electric screw drive. Hydraulic accumulators increase injection speed, with screw speed and position actively controlled throughout the cycle. Active acceleration and deceleration enable fast injection times, and injection can be started simultaneously with mold closing.

INJECTION MOLDING

Mold Mover Made More Ergonomic

German firm RUD has redesigned its Tool Mover with improved ergonomics in mind. Used for dismounting heavy tools from injection machines or dismantling machine parts weighing several tons that

previously required a crane and at least two operators, the Tool Mover simplifies these tasks, and its new lower working height means operators can work in a more natural posture. RUD is represented in the U.S. by Caldwell Inc., Rockford, Ill.

RUD's Tool Mover is available in multiple configurations, with the smallest Slim version able to handle weights of up to 22,000 lb on its 800-mm table surface. The largest model handles up to 70 tons with a 3500 × 2500 mm table (138 × 98 in). The Tool Mover can axially rotate tools and machine components safely under wireless control.

RUD says the Tool Mover can turn over objects at least twice as quickly as a crane, performing the task in less than a minute. Plugs or cooling hoses that usually have to be unplugged during component maintenance for safety reasons when using a crane can be left in place with the Tool Mover. The Tool Mover can be moved easily with a fork lift truck or pallet truck. RUD can outfit the Tool Mover with different tabletop surfaces, such as anti-slip polyurethane. Optional add-on parts include guard brackets, light curtain or protective fence to optimize safety.

EXTRUSION

Inspection System for Corrugated Pipe

The new ProfilControl7 S CorrugatedTube inline gauge from Pixargus is said to inspect the complete wavy structure of corrugated tubing. Newly developed algorithms enable inspection, reportedly for the first time, of areas previously considered undetectable—not only the peaks and valleys, but also the transition areas in between.

Eight high-performance cameras capture the surface structure of corrugated tubing from different angles. Entirely new algorithmic processes were developed to enhance the software, which is now able to detect the change from plane to wavy and vice versa by masking out specific surface structures. This makes even extremely small flaws visible. Holes, dents, blisters, nodes, scratches, fissures or poorly crimped joints reportedly are detected with 100% reliability.

AUTOMATION

Kit Turns Cobots into Autonomous Bin Pickers

Universal Robots (UR) says its brand-new ActiNav kit can turn cobots into autonomous bin pickers able to service machine-tending applications. UR notes that automated bin picking typically requires a massive amount of software integration and programming, resulting in systems that are usually only focused on the vision aspect of bin picking. If the system needs to go past picking parts to placing them—particularly if the process isn't just dropping parts into a box or tote but accurately inserting them into a fixture—hundreds of lines of additional programming can be required.

ActiNav, however, requires no vision or robotic programming expertise, but is instead based on a "teach-by-demonstration" principle using a six-step, wizard-guided setup process integrated into the UR cobot teach pendant. The ActiNav kit combines real-time autonomous motion control, collaborative robotics, vision and sensor systems. Working with UR5e and UR10e cobots, ActiNav can be integrated with a UR+ component or user-defined end effector and application-specific frame or fixture as needed. The kit includes the Autonomous Motion Module (AMM) and ActiNav URCap user interface software, along with a choice of 3D sensors.

Automating machine tending stations typically involves using trays, bowl feeders or conveyors to get the parts to the machine—a step bypassed by ActiNav. Many of these parts are already in bins, and ActiNav allows the vision-guided cobot to pick directly from even deep bins and place them in the machine, minimizing floor space and reducing the need for part-specific tooling.

ActiNav uses a structured-light scanner to take an image of the bin and generate a point cloud. The technology than applies a CAD-matching algorithm that integrates CAD models of the robot, part and end effector, creating a "clearance shape" so the arm can move in and out of the bin without colliding with anything.

The system is focused on machine tending and secondary operations like drilling, tapping, polishing, grinding, deburring and CNC machining. Typical package price is around $100,000, with ROI possible in as little as 18 months for a two-shift operation. Target parts would be "two fists" in size or smaller. For very small parts, equipment like bowl feeders would make sense; while for very large parts, with longer cycles, conveyors or trays are more applicable.

EXTRUSION

Measure Optical Distortion in Sheet in Real Time

LiteSentry LLC, Northfield, Minn., which has made Osprey distortion and flatness inspection systems for the glass industry for over 20 years, says its technology has been enhanced to meet the inspection requirements of PC and acrylic sheet. The new Osprey 9 CW provides realtime inspection and measurement of all types of optical distortion over the entire web area. By inspecting soon after extrusion but prior to cutting, processors can immediately recognize distortion issues and adapt process variables accordingly.

LiteSentry says that maintaining high-quality aesthetics and meeting architectural specifications in sheet has long been managed through manual inspection processes. As a result, sheet processors experienced inconsistent optical distortion and costly scrap when quality defects were discovered too late.

The system was developed for monitoring continuous product and works with clear and colored PC and acrylic of >15% light transmission.

MIXING

Triple-Shaft Mixer with Powder Induction Manifold

The latest 600-gal Ross VersaMix Model VM-600 is capable of high-speed subsurface powder induction with the proprietary Ross Solids/Liquid Injection Manifold (SLIM). SLIM incorporates powder or liquid phases directly into the rotor-stator mix head, causing instant wetout as it rotates at 3600 rpm. The classic dual-post, triple-shaft design has been upgraded with this feature to streamline processing of substantial powder phases.

The robust anchor agitator moves product from the high-shear rotor/stator head to a high-speed dispersing head, which deagglomerates any remaining fisheyes. Used to quickly mix large batches, the SLIM feature reportedly accelerates loading phases exponentially. This design is available from laboratory sizes to upwards of 4000 gal.

Price of PP First to Plunge; PE, PS, PVC, PET Are Next

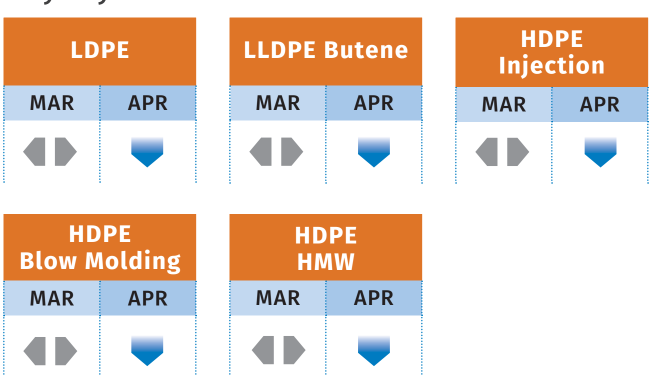
Coronavirus fallout: Slowing demand, higher resin inventories, low global material prices, plus labor and transportation challenges.

By Lilli Manolis Sherman
Senior Editor

The impact of the coronavirus pandemic looms large over the entire plastics manufacturing chain, with high resin inventories, dropping demand, and record-low global prices of materials and feedstocks. Commodity resin prices are expected to plunge at least through mid-May. Other challenges include a significant decline in "non-essential" manufacturing production and an anticipated slowdown in some "essential" product manufacturing as a result of overbuying and/or difficulty in keeping enough healthy workers in the plants.

These are the views of purchasing consultants from Resin Technology, Inc. (RTi), senior editors from *PetroChemWire* (*PCW*); and CEO Michael Greenberg of The Plastics Exchange.

Polyethylene Price Trends



PE PRICES STAY FLAT, THEN DROP

Polyethylene prices were flat in March after strong demand from consumer products resulting from the coronavirus impact. Suppliers suspended their 4¢/lb price increases for March, and buyers were expecting price concessions in April and May, according to Mike Burns, RTi's v.p. of PE markets, *PCW*'s senior editor David Barry and The Plastic Exchange's Greenberg. They expected at least some decline in April, and definitely in May.

At the end of April's first week, Greenberg reported that most spot PE prices were flat except for LLDPE film grades, which lost a penny, while injection molding grades dropped 2¢/lb on improved supplies.

Both Burns and Barry agree that the strong demand was peaking in early April, partly because consumers had overbought throughout March. Says Burns, "Manufacturers of non-essential PE products, such as sporting goods, are reportedly running their plants at only 30%. Expect suppliers to throttle back production."

Market Prices Effective Mid-April 2020

Resin Grade	¢/lb
POLYETHYLENE (railcar)	
LDPE, LINER	96-98
LLDPE BUTENE, FILM	79-81
NYMEX 'FINANCIAL' FUTURES	32
APRIL	26
HDPE, G-P INJECTION	101-103
HDPE, BLOW MOLDING	94-96
NYMEX 'FINANCIAL' FUTURES	32
APRIL	27
HDPE, HMW FILM	108-110
POLYPROPYLENE (railcar)	
G-P HOMOPOLYMER, INJECTION	53-55
NYMEX 'FINANCIAL' FUTURES	42
APRIL	38
IMPACT COPOLYMER	55-57
POLYSTYRENE (railcar)	
G-P CRYSTAL	108-110
HIPS	112-114
PVC RESIN (railcar)	
G-P HOMOPOLYMER	86-88
PIPE GRADE	85-87
PET (truckload)	
U.S. BOTTLE GRADE	45

Adds Barry, "We expect a slowdown going into May on top of the drop in demand for durable goods, due to closed plants and unemployment. If low oil prices prevail, I can see multinational PE producers shifting their production elsewhere and dropping domestic production rates to the 70-80% range." PE exports also have been challenged by a lack of shipping containers and several short-term port closures in Texas and India. Sums up Burns, "Potential demand destruction by the coronavirus will be the primary driver of PE market prices for the remainder of the second quarter. Oil price recovery will be the first indicator of improved demand."

PP PRICES DOWN

Polypropylene prices dropped 4¢/lb in March, in step with March propylene monomer contracts, though some suppliers were aiming

Polypropylene Price Trends

Homopolymer	
MAR	APR
4¢/lb	

Copolymer	
MAR	APR
4¢/lb	

to push through a 3-4¢/lb increase, separate from the change in monomer pricing. Their justification: tighter supply, according to both Scott Newell, RTi's v.p. of PP markets, and *PCW*'s Barry. On the contrary, both analysts expected further price *declines* in April of 3¢ to 6¢/lb, with this month flat to slightly down.

Barry characterized PP supply as balanced-to-snug, despite fears of weaker demand due to the spread of COVID-19. He noted that PP demand had dropped off in durables but remained strong in packaging and disposable medical supplies. Going into April, Newell noted that the industry started seeing some "cracks" in falling demand for consumer goods. He said this was indicated by sales at Walmart, Target and Dick's Sporting Goods, with replenishment of orders down 30% to 80%. As a result, "Some PP processors were shutting down for at least a couple of weeks."

Barry says some suppliers were unable to produce enough of certain grades to meet demand, while others experienced a surplus of certain grades. Meanwhile, international PP markets continued to soften in early April, with ample availability from the Mideast and Asia. Greenberg reported that spot PP demand showed a bit of improvement in the first week of April, though prices for both homopolymer and copolymer PP slid by another 2¢/lb—totaling a 6¢/lb drop in a five-week period and sending prices 2¢ lower than at the start of the year.

On the market bouncing back, Greenberg offered: "It will be some time, but with early signs of improvement out of Italy, Spain, and U.S. COVID-19 hot spots, markets appear to see some sort of light at the end of this tunnel. Until then, we expect demand to be sporadic, with processors filling just-in-time needs."

PS PRICES FLAT, THEN PLUMMET

Polystyrene prices stayed flat in March, but initial indications in April were for a fall of 7¢ to 9¢/lb, driven primarily by the $1.36/gal drop in April benzene contracts, according to *PCW*'s Barry and Robin Chesshier, RTi's v.p. of PE, PS and nylon 6 markets. In early April, spot benzene dropped to below 87¢/gal, the lowest level since 2009. By the end of April's first week, the implied styrene cost based on a 30/70 ratio of spot ethylene/benzene was at 11.9¢/lb, down 14.6¢/lb from early March.

Polystyrene Price Trends

GPPS	
MAR	APR
	7-9¢/lb

HIPS	
MAR	APR
	7-9¢/lb

Chesshier sees price concessions in both April and May. Both note that while we may not see a "renaissance" in PS demand, some communities have suspended their bans on PS foam containers. Barry reports that initial April reports indicated healthy PS demand, encouraged by lower prices. "The shift in the restaurant industry to takeout business was increasing the usage of PS foam containers; and demand was strong for disposable medical supplies such as testing kits and lab dishes."

PVC PRICES FLAT, THEN TUMBLE

PVC prices have remained flat through March, but a decrease in the range of 5¢ to 8¢/lb was expected in April and May, according to Mark Kallman, RTi's v.p. of PVC and engineering resins and *PCW* senior editor Donna Todd.

Kallman noted that the big drop in oil prices had driven the cost of ethylene and nearly all other feedstocks to record lows. Spot ethylene prices in March were under 10¢/lb at times, and late-settling February contract prices dropped another 2¢ to 24¢/lb. Much lower demand for exports resulted in a 5¢/lb price drop in export prices, a typical signal for impending lower domestic prices. Kallman says the virus outbreak resulted pullback in the construction market, though PVC demand in the food-related and medical markets was healthier. Both Kallman and Todd had heard that processors were struggling to keep their facilities staffed amid spikes in coronavirus cases. Todd says suppliers in March indicated that customers had begun canceling resin orders for April.

PVC Price Trends

Pipe	
MAR	APR
	5-8¢/lb

Gen. Purpose	
MAR	APR
	5-8¢/lb

PET PRICES FLAT, THEN PLUNGE

PET prices started April in the mid-40¢/lb range for railcars delivered to the Midwest, holding steady from late March. *PCW* senior editor Xavier Cronin ventured PET would be steady to slightly lower through the rest of April, depending on the severity of the COVID-19 outbreak and how the U.S. economy recovers from its effects. In May, Cronin predicted, we could see PET prices plunge to historic lows, in step with key feedstocks, if oil prices continue to drop.

PET Price Trends

Bottle Grade	
MAR	APR

Demand from consumer-brand companies using PET for bottles, containers and packaging has slowed due to the COVID-19 outbreak. At the same time, demand for bottled water appeared to have skyrocketed; bottle producers had received strong orders since mid-March, Cronin notes.

QUESTIONS ABOUT MATERIALS?
Learn more at PTonline.com
Visit the Materials Zone and the Materials Database.

Processing Index Adjusts to Coronavirus Disruption

COVID-19 results in changes to many Index components.

By Michael Guckes
Chief Economist/Director of Analytics

These are unsettling and somewhat confusing times in plastics processing. On the one hand, anecdotal evidence suggests processors were extraordinarily busy in March, responding at break-neck speeds to demands for medical products and packaging of all kinds spurred by COVID-19. Sources say some molders with capacity constraints even turned to their machine suppliers to run parts for them. On the other hand, all this activity was not reflected in March's Plastics Processing Business Index, which dipped to 43.5.

Several components of the Index dipped, including new orders, export orders, production and employment. Remember, though, that these readings represent the *breadth of change* occurring within the plastics processing industry and should *not* be confused with the rate of decline taking place. These low readings indicate only that a large proportion of the industry reported decreased levels of business activity.

The reading for supplier deliveries moved significantly higher. In normal times when demand for upstream goods is high, supply chains cannot keep pace with these orders. The resulting backlog of supplier orders thus lengthens their delivery times. This delay causes our surveyed firms to report slowing deliveries. It is this disruption, as opposed to strong demand for upstream products overall, that has caused supplier delivery times to lengthen and the reading to increase.

Michael Guckes is chief economist and director of analytics for Gardner Intelligence, a division of Gardner Business Media, Cincinnati. He has performed economic analysis, modeling, and forecasting work for more than 20 years among a wide range of industries. He received his BA in political science and economics from Kenyon College and his MBA from Ohio State University. Contact: *(513) 527-8800*; *mguckes@gardnerweb.com*. Learn more about the plastics processing Index at *gardnerintelligence.com*.

Gardner Business Index: Plastics Processing

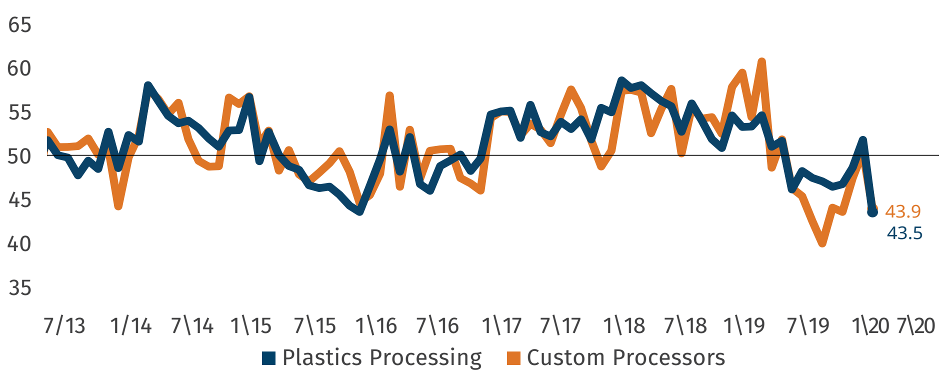


FIG 1

After a nascent recovery appeared to be at hand earlier in the year, the Plastics Processing Business Index contracted sharply as the world's economy was ordered to close in hopes of slowing the spread of COVID-19.

Plastics Processing: New Orders and Supplier Deliveries

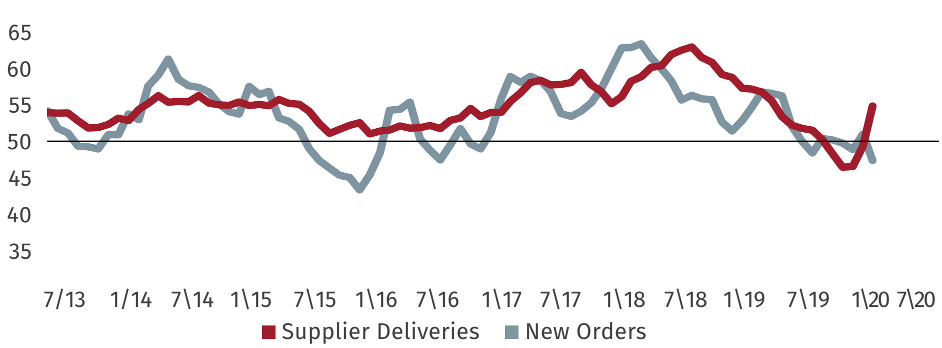


FIG 2

The reading for supplier deliveries is designed to increase when supplier deliveries slow, under the assumption that suppliers are experiencing higher backlogs and need longer to get goods to manufacturers. In the current situation, though, it is COVID-19's massive disruption to the world's supply chains that is causing those longer delivery times and the supplier delivery figure to rise.

infoNET

This is *Plastics Technology's* online listing for plastic processing equipment builders, material suppliers, auxillary manufacturers and more.

WWW.ENTEK.COM

ENTEK

ENTEK is the leading US-based supplier of twin-screw extruders, replacement wear parts and complete extrusion systems for compounders.

WWW.WITTMANN-GROUP.COM

Wittmann Battenfeld

Wittmann Battenfeld's website provides global access to the full range of Battenfeld injection molding machines, process engineering, customer service, training and turnkey solutions, in addition to automation and auxiliary equipment including Wittmann robots and automation, material conveying, drying, blending, granulating and water temperature controllers.

WWW.NOVATEC.COM

NOVATEC™ The Power of Touch

World's largest selection of dryer technologies and blenders with unmatched system design and control capabilities.
1-800-BESTDRY (1-800-237-8379)

WWW.MAGUIRE.COM

MAGUIRE® Intelligent Simplicity

Over 100 pages of easy browsing packed with useful information on Maguire Blenders, Loaders, Granulators, Feeders, and Liquid Color Pumps.

WWW.DRI-AIR.COM

DRI-AIR® Industries, Inc.

Dri-Air Industries is the leader in compressed air and desiccant drying technology. Our systems offer a full range of solutions for drying plastic resins, mixing, blending and conveying virgin, regrind and plastic colorants.

infoFILE Monthly Resource Guide

You can get copies of literature from suppliers listed on these pages by sending an e-mail to the address provided at the end of each writeup. Or, where provided, contact the company by phone or fax.

DRY-CONVEY-BLEND-EXTRUSION

Novatec is one of the largest U.S. based manufacturers of resin drying and conveying equipment for the plastics industry. Together, with Maguire Products, we offer the largest line of manufactured resin handling equipment in North America.
Product Overview: www.novatec.com/about

Baltimore, MD • sales@novatec.com

CLEAR-VU™ LOADING SYSTEM

Provides all the benefits of a central loading system with the added convenience of portability & low maintenance. Brochure & video describe this complete vacuum conveying system that will control up to eight stations. Receivers allow full view of the loading action.

Aston, PA • info@maguire.com

PROGRESS THROUGH INNOVATION

Complete overview of the company, its history and the relentless product developments that have made it the leading manufacturer for plastics processors worldwide. Its innovative products include injection molding machines, robots and automation systems, auxiliary equipment .

Torrington, CT • info@wittmann-ct.com

TWIN-SCREW EXTRUDERS

ENTEK is the leading US-based supplier of co-rotating twin-screw extruders (sizes from 27mm-133mm), replacement wear parts and turnkey manufacturing plants for plastics compounders. This brochure provides complete information on our products and services.

Lebanon, OR • TStraw@entek.com

NEW THINKING IN PNEUMATIC CONVEYING

Gentle material handling with pellcon3® applies STRANDPHASE® conveying and Pellbow® pipe bends to reduce creation of fines, and DeDuster® systems to remove remaining contaminants.
www.pelletroncorp.com

Lancaster, PA • info@pelletroncorp.com

PLASTRAC AUTO-DISC

Plastrac Inc. manufactures Disc-based Blending and Dosing equipment for all plastics processing. Auto-Disc™ features gravimetric self-calibrating Dosing units and multi-ingredient blenders. Plastrac has recently added a Powder Additive Feeder option to the Auto-Disc™ Series.

Edgemont, PA • info@plastrac.com

SPECIAL SERVICES

PACKAGE ENGINEERING

MACHINERY

PURGING COMPOUNDS

⊕ For additional product information, refer to this company's Advertising/Data Sheets in *PLASTICS TECHNOLOGY's 2020 PROCESSING HANDBOOK & BUYERS' GUIDE*

SALES OFFICES

MID-ATLANTIC/NORTHEAST
Lou Guarracino
Regional Vice President
215/327-9248
Fax: 513/527-8801
loug@ptonline.com

CENTRAL US
Dale Jackman
District Manager
630/345-3469 Fax: 513/527-8801
630/360-5306 (mobile)
djackman@gardnerweb.com

MOUNTAIN/WEST
Michael Schwartz
District Manager
818/865-8881; Fax: 513/527-8801
818/213-0278 (mobile)
mschwartz@gardnerweb.com

EASTERN GREAT LAKES, INCLUDING CANADA, AND SOUTHEAST US
Jackie Dalzell
Regional Vice President
513/338-2185; Fax: 513/527-8801
216/233-6794 (mobile)
jdalzell@gardnerweb.com

CLASSIFIED/ RECRUITMENT ADVERTISING
Chris Brock
440/639-2311
Fax: 513-527-8801
cbrock@gardnerweb.com

JAPAN
Toshiro Matsuda
Director of Overseas Operations
Plastics Age Co. Ltd.
03-256-1951

KOREA
Chang-Hwa Park
Far East Marketing Inc.
02-364-4182
Fax: 02-364-4184
femchp@unitel.co.kr

TAIWAN
May Hsiao
J&M Media Corp.
886-4-2296-5959
Fax: 886-4-2293-9730
may@jandm.com.tw
www.jandm.com.tw

CHINA
Erica Chang
Gedy Advertising
86-185-1531-1075
erica@gedyinc.com

EUROPE (except Italy/Spain/Portugal)
Edward Kania
RGH International (UK)
44-1663-750242
ekania@btopenworld.com

ITALY
Nicola Orlando
Com 3 Orlando sas
39-02-4158056
Fax: 39-02-48301981
ppoint@com3orlando.it

SPAIN/PORTUGAL
Conchi Aranguren
Neben Consulting
34-600-424223
conchi@nebenconsulting.es

INDIA
Paresh Navani
Vogel Business Media India Pvt. Ltd.
91-22-4123-4715
paresh.navani@vogel.de

Need **Custom Article Reprints** or **Back Issues**? Email *SClifton@gardnerweb.com*

PT Plastics Technology

PLASTICS TECHNOLOGY (ISSN 0032-1257) is published monthly and copyright © 2020 by Gardner Business Media Inc. 6915 Valley Ave., Cincinnati, OH 45244-3029. Telephone: (513) 527-8800. Printed in U.S.A. Periodicals postage paid at Cincinnati, OH and additional mailing offices. All rights reserved.

POSTMASTER: Send address changes to Plastics Technology Magazine, 6915 Valley Ave., Cincinnati, OH 45244-3029. If undeliverable, send Form 3579.

CANADA POST: Canada Returns to be sent to IMEX Global Solutions, P.O. Box 25542, London, ON N6C 6B2. Publications Mail Agreement #40612608.

Printed in the U.S.A.

BLACKHAWK MOLDING — SPARKS, NEV.

Single-Dose Purge Compound Yields Big Savings for Molder

Blackhawk Molding switched to premeasured packets of a new purge compound for 63% overall cost savings.

Blackhawk is a leading molder of caps and closures for dairy and water bottles.

By Lilli Manolis Sherman
Senior Editor

Blackhawk Molding was so pleased with results from using a relatively new purge compound that it adopted the product for all its injection molding machines, the bulk of which are 300-tonners.

Based in Sparks, Nev., Blackhawk is a leading molder of caps and closures, supplying the dairy and bottled water industry with HDPE or LDPE caps ranging from 33 mm to 55 mm. According to project coordinator Jason Ferguson, Blackhawk needs to perform frequent color changes, so purging and cleaning screws in its presses is critical to quality control.

First shift foreman/supervisor Monica Perez dropping a QuickShots 3-oz packet into the barrel of an injection machine to clean the screw.

Ferguson recalls that Bruce Lundstrom, Blackhawk's plant manager, asked to sample QuickShots single-dose purge compounds from iD Additives, which were launched commercially in 2017. "Initially, the potential of improved ease of handling for our operators was primarily what we anticipated. It didn't take long to see the benefits of using this product. It helped make color changes much easier and dramatically reduced our downtime when cleaning the screws. We loved the results, so we went ahead with a large order."

The significant savings realized at Blackhawk include a 50% to 60% reduction in scrap, a 55% reduction in downtime, and a total of 63% cost savings. Ferguson confirms that the proprietary, FDA-compliant chemical purging compound is now being used on all of its molding machines and molds.

Previously, for shutdowns and cleaning the screws, Blackhawk used a combination of a liquid chemical purge, which required premixing with virgin material, and a mechanical purge from two different suppliers. "We reduced the cleanup time from 2½ hr to 40-45 min. We were not expecting to see the cost savings achieved, either."

"While I think the MP is more powerful, the QuickShots HD purging action is sufficient for us."

The company is using the original QuickShots liquid-in-pouch for color changes. More recently, for monthly preventive maintenance, Blackhawk has evaluated both iD Additives' MP (mechanical purge) compound and QuickShots HD (heavy-duty) with glass prills mixed in for extra cleaning strength. "While I think the MP is more powerful, the QuickShots HD purging action is sufficient for our needs," Ferguson states. He calls himself a "huge fan" of iD Additives customer service in terms of the time spent assisting the company in optimizing the use of its purge compounds.

QuickShots are single-dose purge compounds that come in individual packets, which allow operators to purge their machinery by simply dropping the packets into the feedthroat/hopper of their machine. They work with all resin types on all plastics-processing machinery, including injection molding, extrusion and blow molding. Typical dosage is 1 oz per inch of screw diameter, so a 6-in. diam. screw would require two 3-oz QuickShots packets.

HONEYCOMB DESICCANT ROTOR DRYERS

FEATURING THE LATEST HONEYCOMB MATRIX DESICCANT ROTOR TECHNOLOGY

PPE DRYERS BRING YOU CURRENT STATE-OF-THE-ART DRYING TECHNOLOGY

ONE FLORIDA CUSTOMER'S COMMENT:

"THE BEST DRYER I HAVE EVER USED!"

Delivers Constant - 40° Dew Point Air with up to 25% Energy Savings!

Touchscreen Microprocessor Control Display

Model **FX-050230**
45-65 lbs/hr **$5,650.00**

MAX-Dry® Standard Features:

- Easy to use, touchscreen microprocessor control displays set point temp, process temp, regen temp, dew point and more.
- Process Heater included.
- Digital Dewpoint Display for accurate drying performance.
- Return Air water cooling coil included.
- Delivers constant -40°F dewpoint air.
- Save up to 25% on energy costs.
- 7-Day Timer for increased control.
- Rotation Alarm.
- Process Temperature Alarms.
- Circuit Breakers eliminate the need for fuses.
- Two hoses with clamps required:
  1 Silicone (for higher temp supply air) and
  1 Neoprene (for lower temp return air).
- Remote Thermocouple Ports.
- Maximum drying efficiency at minimal operating cost.
- Easy access panels for maintenance - no tools required.
- Durable powder coat finished cabinet.
- No dust or desiccant beads to change.
- Full One-Year Warranty on dryer.
- Five-Year Warranty on desiccant rotor wheel.

***MAX-Dry®* World Class Resin Drying Solution.**

7 MODELS IN STOCK
SIZED FROM 45 TO 530 LBS/HR

With *MAX-Dry®* you will get:

- Delivers precise and consistent, **- 40° Dew Point Air** and process temperatures.
- The latest desiccant honeycomb matrix drying technology.
- Seven standard sizes from 45 - 530 lbs/hr.
- Easy-to-use operation and maintenance.
- Higher performance in a smaller machine footprint.
- Lower operation costs.
- Easier maintenance.
- Instructions included.
- A machine built to last.
- Delivery: From Stock.

Our unique honeycomb matrix wheel has a series of channels or air passages that form our matrix. These passages are coated with molecular sieve and silica gel that are permanently bonded to ceramic fibers inside the rotor thru special chemical crystallization.

TO ORDER CALL TOLL FREE 800-362-0706
CALL 1 NUMBER FOR 3 LOCATIONS.

PLASTIC PROCESS EQUIPMENT, INC. www.ppe.com • sales@ppe.com

PPE WEST 6385 Montessouri Street, Las Vegas, Nevada 89113
702-433-6385 • 800-258-8877 • Fax: 702-433-6388

PPE SOUTH 11218 Challenger Avenue, Odessa, Florida 33556
727-834-8888 • 800-282-6783 • Fax: 727-834-8873

PPE 8303 CORPORATE PARK DRIVE, MACEDONIA (Cleveland), OHIO 44056, U.S.A.
216-367-7000 • Toll Free: 800-321-0562 • Fax: 216-367-7022 • Order Fax: 800-223-8305

Toll Free: USA, Canada & Mexico
800-362-0706