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24 Cobot Helps Molder  
Keep Pace

62 Purging Done Right

66 Solve Extrusion Woes Before  
Production is Impacted



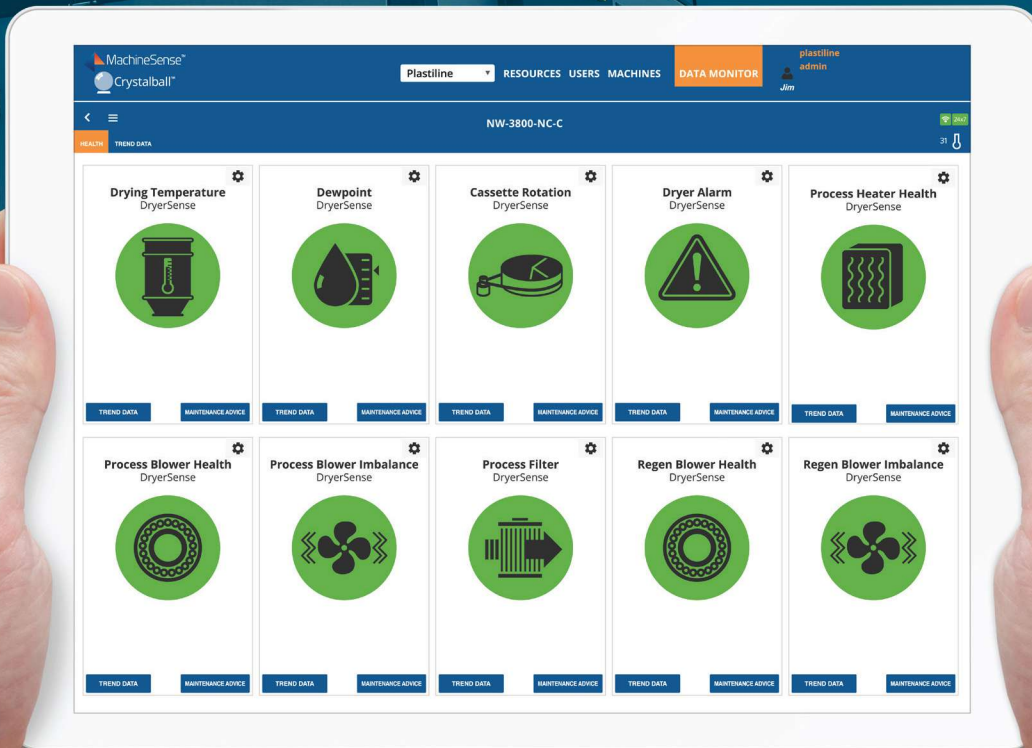
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**On-Site  
'Engage, Innovate, Evolve' —  
Future-Oriented Culture at Octex Group**

Using science, technology, and talent to give high-tech customers unprecedented speed to market.

*By Matt Naitove  
Executive Editor*

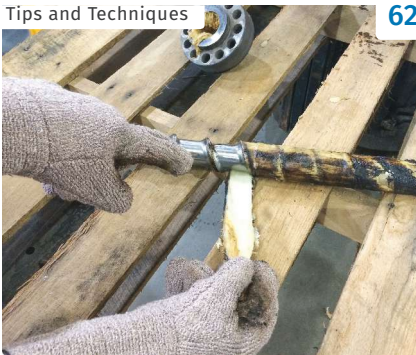
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**Follow These Tips to Power Up Your Purging Process**

A properly executed purging process can save processors thousands a year in lost production while helping them increase output and avoid scrap. Here's how to optimize your results.

*By Jarred Packard, Sun Plastech Inc.*



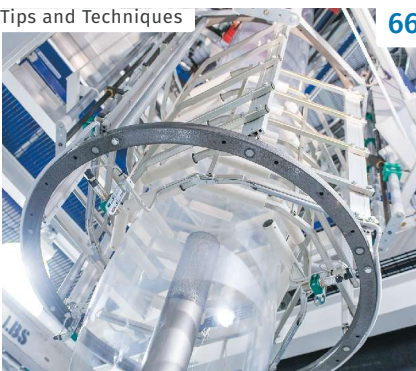
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**What is Your Extruder Trying to Tell You?**

Being in tune with your film extrusion equipment will allow you to identify issues before they start impacting production.

*By Wes Hobson and Mike Rutkowske,  
The Dow Chemical Co.*



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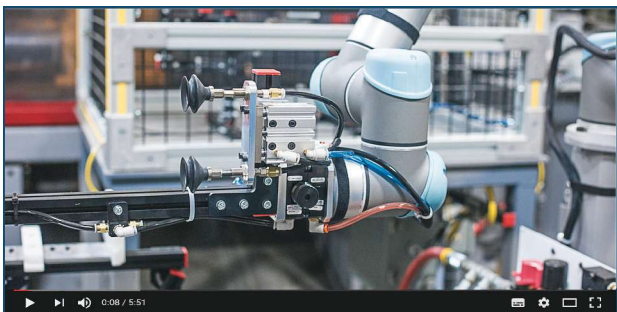
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### ▶ Cobot in Action

Wisconsin Plastics Inc. (WPI) targeted one of its most complex assembly jobs for the addition of a collaborative robot (cobot). Read about how the system boosted efficiency while freeing workers for more value-added tasks on p. 24 and watch the automation in action online.

[short.ptonline.com/WPI](http://short.ptonline.com/WPI)

### BLOG: Cracking the Code on Industry 4.0

This May, the plastics processing world will shift its focus to Orlando and NPE 2018, where all along the aisles of the massive event, attendees can be sure to see and hear all about Industry 4.0. Executive Editor Matt Naitove offers a preview of next-generation plastics processing with an automation slant. [short.ptonline.com/decode4.0](http://short.ptonline.com/decode4.0)



### BLOG: Cramming With UMass Lowell

It was finals week when *Plastics Technology* caught up with Robert Malloy, now a professor emeritus at UMass Lowell's Plastics Engineering program. The former department head's time on campus at one of the nation's preeminent plastics programs goes back to the 1970s as a student. He offered his views on where plastics education and workforce development have been and where they're headed.

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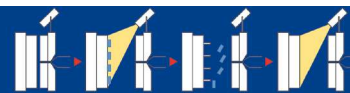
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**Jim Callari**  
Editorial Director

It's not too early to start planning for NPE2018: The Plastics Show, May 7-11 at the Orange County Convention Center in Orlando, Fla. And the Plastics Industry Association (PLASTICS) can help you start the planning process now. Just go to apps on your smart device, search for NPE2018,

and download the show's official app. It'll help you navigate around the Convention Center; get up-to-the-minute details on all

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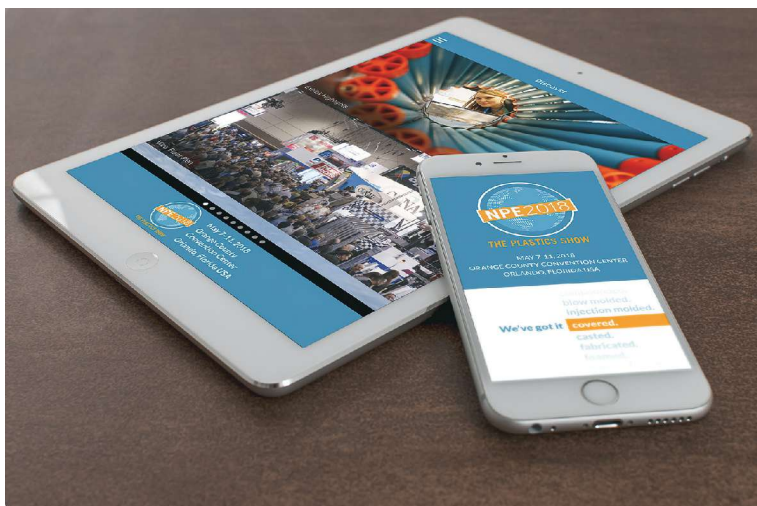
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I've downloaded the app myself and found it useful. I think you will too. [PT](#)

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*James P. Callari*



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## Chinaplas Tries Out New Shanghai Digs in April

Chinaplas, which rotates annually between Shanghai and Guangzhou, is moving to the massive new National Exhibition and Convention Center (NECC) in Hongqiao, Shanghai, this April 24-27, having outgrown its previous location, according to show organizer, Adsale Exhibition Services. The show had been staged at the Shanghai New International Expo Center (SNIEC) in Pudong, some 22 miles due west of the NECC. The new venue, which is the largest single-block building and exhibition complex in the world, will provide 30% more exhibition space than the previous Shanghai site.

The NECC, which has 15.8 million ft<sup>2</sup> of constructed space, opened its doors in 2015 and has been in full operation since 2016. It has more than 4.3 million ft<sup>2</sup> of indoor space, including 16 exhibition halls that cover 107,000 to 310,000 ft<sup>2</sup> apiece. In 2016, when Chinaplas was last in Shanghai at the SNIEC, the show had a record 3323 exhibitors covering more than 2.58 million ft<sup>2</sup> of space. Despite increasing the space for Chinaplas 2018 to 3.66 million ft<sup>2</sup> (which would cover 800 basketball courts), space demand has once again outstripped supply, according to Adsale.

The NECC is just under one mile from the Hongqiao Transportation Hub, which is connected with Hongqiao Airport and Hongqiao Railway Station via the city's primary east/west subway line, the Metro Line 2.

## R&D Effort to Boost Efficiency in Thermoformed Packaging

German firms Kiefel GmbH and Wattron GmbH have joined forces on a long-term R&D project aimed at increasing quality and efficiency in thermoforming, especially for thin-gauge packaging. Kiefel (U.S. office in Portsmouth, N.H.; [kiefel.com](http://kiefel.com)) furnishes thermoforming machines for packaging, medical, and other markets. It also owns toolmakers SWA in the Czech Republic, Bosch Sprang in The Netherlands, and Mold & Matic Solutions in Austria.

The key to this R&D effort is ceramic heating technology developed by Wattron. Called cera2heat, the technology relies on square heating elements smaller than a penny that can be individually controlled and regulated to specific temperatures. This allows targeted, uneven heating of the film, enabling it to be optimally adapted to the desired shape to create more uniform wall thicknesses. This enables the processor to use much thinner films, significantly reducing energy consumption.

Wattron ([wattron.de](http://wattron.de)) is a new spinoff of the Institute of Natural Materials Technology of the Technical University of Dresden and the Fraunhofer Institute for Process Engineering and Packaging Dresden.

## Maag Buys Ettlinger

Switzerland-based Maag (U.S. office in Charlotte, N.C.) has purchased Ettlinger Kunststoffmaschinen GmbH of Germany (U.S. office in Tyrone, Ga.). The move expands Maag's position in melt-filtration products, particularly for recycling. The two companies will continue to operate under their existing brand names.

Ettlinger produces melt filters for extrusion and injection machines (pictured). It also builds high-tonnage, large-shot injection machines for pallets, pipe fittings, and manhole covers (see Starting Up, Sept. '16 and Oct. '16). Maag officials believe there is a potential to grow Ettlinger's injection molding machinery business under new ownership.

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## Evonik to Expand PMMA Compounding in U.S.

Evonik, Parsippany, N.J., is beginning construction of an additional line for compounding its Acrylite PMMA in Osceola, Ark., with a scheduled startup in the first quarter of 2019. The expansion will nearly double the production capacity of its methacrylates business line for specialty molding compounds.



According to Jack Chenault, head of the Americas region for the Performance Materials Segment, the expansion is in direct response to increasing demand for Acrylite in the U.S. and growing Mexican and South American markets, especially for construction, lighting, and automotive applications.

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## Plastics Hall of Fame To Induct 10 New Members

The Plastics Academy will induct 10 new members into the Plastics Hall of Fame at its awards gala at NPE2018 in Orlando, Fla. The event is scheduled for the evening of May 6 at the Linda W. Chapin Theatre at the Orange County Convention Center. The Plastics Hall of Fame, Class of 2018, is as follows:

**Robert Ackley** was instrumental in leading Davis-Standard, LLC to become the leading extrusion machinery manufacturer in North America. He has also served the industry's leading associations in senior management roles, including as chairman of PLASTICS (formerly known as SPI) in 2000-2001, and as a board member of the National Plastics Center and Museum.



Bob Ackley

**Ira Boots** founded and grew what is now Berry Global, Inc. into one of the world's largest plastics packaging companies. Today, he is the chairman of Milacron, a leading producer of plastics processing machinery.

**Karlheinz Bourdon** worked in senior management positions for Ferromatik Milacron and currently is senior v.p. of integration for KraussMaffei Corp.

**David Cornell**, a pioneer in PET bottle commercialization at Eastman Chemical Co., went on to become a champion of plastics recycling as the technical director of the Association of Plastic Recyclers (APR).

**Donna Davis** has worked for ExxonMobil Chemical in process design and the development of polyolefin products, from early gas-phase technology through metallocene-catalyzed polymers.

**Donald Graham** founded Graham Engineering Corp., a world leader in the manufacture and sale of high-speed plastics processing machinery. He invented the rotary wheel line for extrusion blow molding of plastic containers.



Donald Graham

**Max McDaniel**, a senior fellow scientist for Chevron Phillips, has been responsible for significant advances in polymer chemistry, particularly in polymer and catalyst technologies for polyethylene. He has received numerous awards and recognition worldwide and is the author of over 370 technical patents and hundreds of peer-reviewed papers.

**Steve Maguire**, a prolific inventor and founder of Maguire Products Inc., Maguire has transformed plastics material-handling technology, as well as how processors control the preparation and consumption of plastic materials. With over 41 patents, his products are visible in most processing plants today.



Steve Maguire

**Martin Stark**, chairman of Bekum America Corp., has continuously strived to promote excellence, providing innovation in process, customer experience, and quality. His lifetime devotion to education has resulted in the establishment and support of many quality programs, from apprenticeships through graduate education in plastics.

**Hideo Tanaka** helped lift Toshiba Machine Co. to its pre-eminent position in the plastics machinery industry. His engineering designs spanned a wide range of processes from nylon inflation blown film through all-electric injection molding machines.

### Planetary Mixer Testing at No Charge

Charles Ross & Son Co. has added an advanced planetary mixer at its Ross Test & Development Center in Hauppauge, N.Y., and is making the unit available for testing at no cost. The new 4-gal Planetary Dual Disperser (Model PDDM-4) has two high-viscosity blades and two high-speed dispersers. All four agitators rotate on their own axes while orbiting the vessel, ensuring rapid powder wetout and deagglomeration. The jacketed mix vessel can operate under vacuum and reportedly delivers excellent dispersion and uniformity over a wide viscosity range up to around 2 million cp.

The PDDM-4 is one of more than 40 mixers and blenders showcased at the Ross T&D Center. A typical mixing test utilizes the end user's actual raw materials and process conditions as close as possible to actual production. Proof-of-concept demonstrations such as high-shear emulsification, particle-size reduction, dryblending, vacuum drying, high-viscosity mixing, and three-roll milling are performed routinely.

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## '4D Printing' Academic Project in Collaboration with Stratasys

A new process, known as 4D Printing, is being developed via a research collaboration between the Education and R&D departments of Stratasys, Eden Prairie, Minn., and the Self-Assembly Lab of the Massachusetts Institute of Technology (MIT), Cambridge, Mass. Led by Skylar Tibbits, Self-Assembly Lab director and trained architect, computer scientist, and artist, the focus of this research focuses on developing self-assembly technologies for large-scale structures.

Tibbits' 4D printing project is enabled by Stratasys' Objet Connex multi-material 3D-printing technology, with the added capability of embedded transformation from one shape to another, directly off the 3D printer. The Connex technology works as follows: A single print, with multi-material features, can produce a 1D strand that transforms into a 3D shape, a 2D surface into a 3D shape, or morph one 3D shape into another.

The Connex multi-material technology allows the researchers to program different material properties into each of the various particles of the part geometry and harnesses the different water-absorbing properties of the materials to activate the self-assembly transformation process. With water as its activator, this technique promises new possibilities for embedding programmability and simple decision making into non-electronic materials. Imagine, for example, robotic-like behavior without the reliance on complex electromechanical devices.

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## Solvay to Start PEKK Production in U.S.

Polyetherketoneketone (PEKK) resin production from Solvay (U.S. office in Alpharetta, Ga.) will soon be underway at the company's Augusta, Ga., site. The new U.S. capacity will address fast-growing demand for thermoplastic composites and 3D-printing materials for aerospace and other markets. To be sold under the trade name NovaSpire, this high-performance PEKK is used in thermoplastic composites reinforced with carbon fibers and in additive manufacturing in a range of industrial applications.  
800-621-4557 • [solvay.com](http://solvay.com)

## Husky Will Get a New Owner

Platinum Equity announced last month that it has signed a definitive agreement to acquire Husky Injection Molding Systems International Ltd., Bolton, Ont., from Boston-based Berkshire Partners LLC and OMERS Private Equity Inc., the private-equity arm of the pension plan for Ontario's municipal employees. Berkshire and OMERS acquired Husky in June 2011. Platinum Equity is a NYC-based global investment firm. The Husky transaction is expected to close in the second quarter.

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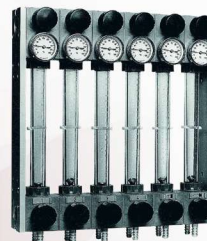
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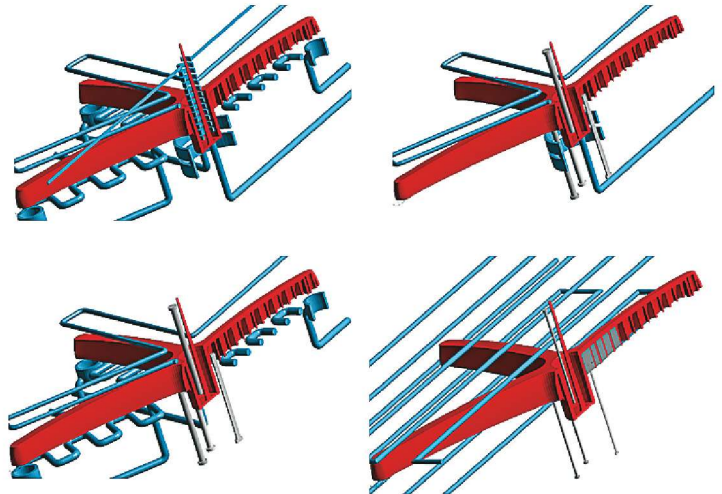
## Mold Simulation Now Optimizes Processing

Simulation software provider Sigma Engineering (U.S. office in Schaumburg, Ill.) introduced at last fall's Fakuma show in Germany a new tool said to "find out the optimum design and production conditions even before the mold is built." New Sigmasoft Autonomous Optimization "finds automatically the best process setup to meet a specific demand," according

to the company. Part of new Sigmasoft release v5.2, Autonomous Optimization works with a new "virtual DOE (design of experiments) functionality. The molder can ask for a particular result and the software will automatically find the best production setup to meet this demand. For example, if a new job demands tight dimensional tolerances, it is possible to ask the software to minimize part deformation, and the virtual machine "will set up itself." This eliminates the urgent pressure to identify the processing window for a new mold after it is built and delivered, without taking time to optimize factors such as energy consumption or cycle time.

In the case of one early adopter of Autonomous Optimization, a thick-walled base for a rolling office chair had to be produced in a cycle time below 60 sec. The mold-maker identified the parameters he could vary in the mold to achieve the requested cycle time—mold material, layout and diameter of cooling channels, a conformal cooling concept, and high-conductivity pins. All the possible combinations of these variables gave a total of 40,000 different mold configurations. (Alternative cooling layouts evaluated by the software are

pictured here.) The Autonomous Optimization simulation tool evaluated these possible scenarios to find the ones that produced a cycle time under 60 sec. Among those possible design combinations, it was then possible to filter the ones with lower cost. That



eliminated conformal cooling in this case, while high-conductivity pins and water channels of a specified diameter were found to meet the objectives.

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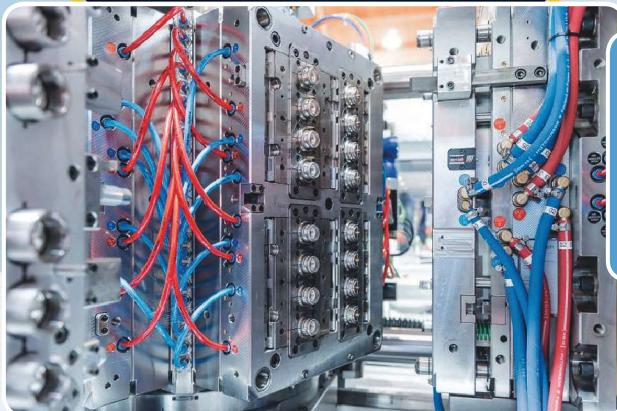


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# Technology Takes Aim At Drying Specialized Resins

Novatec develops new at-the-press drying solutions for molders tackling highly tailored nylons and other specialty materials.

By Jim Callari  
Editorial Director

An increase among molders in running highly tailored nylons—some for the first time—has encouraged one machine builder to develop features aimed at ensuring these materials are dried properly. Novatec Inc., Baltimore ([novatec.com](http://novatec.com)), will debut these technologies May 7-11 in Orlando, Fla. at NPE 2018.

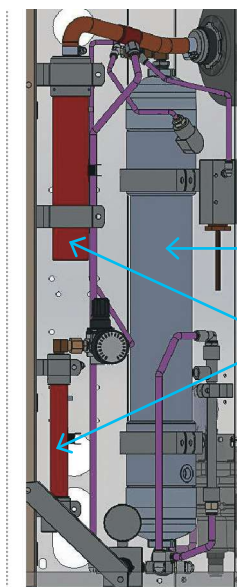
“Over the past few years, we’ve seen hundreds of specialty nylons developed for a range of markets that include automotive—where lightweighting is the driver—medical, packaging and more,” remarks Mark Haynie, Novatec’s dryer product manager. “And as the business of molding commodity resins has continued to move offshore, we’ve

seen quite a few molders taking on projects running nylons and other thermally or visually sensitive resins like PBT, PETG, and others for the first time.” What’s more, adds Haynie, these molders are typically using press-side dryers—more typically

associated with drying commodity materials—to dry these materials.

Drying nylon can be tricky business, Haynie points out.

Most engineering resins require drying to 100 ppm. Nylon drying specifications, on the other hand, are roughly 500-800 ppm. Molders not accustomed to these parameters tend to overdry the material, which invariably will make the part brittle and fail. “In some cases, nylon straight out of the gaylord does not have to be dried at all,” states Haynie. “But still, if the molder’s procedures say the material must be dried, that’s what they will do.”

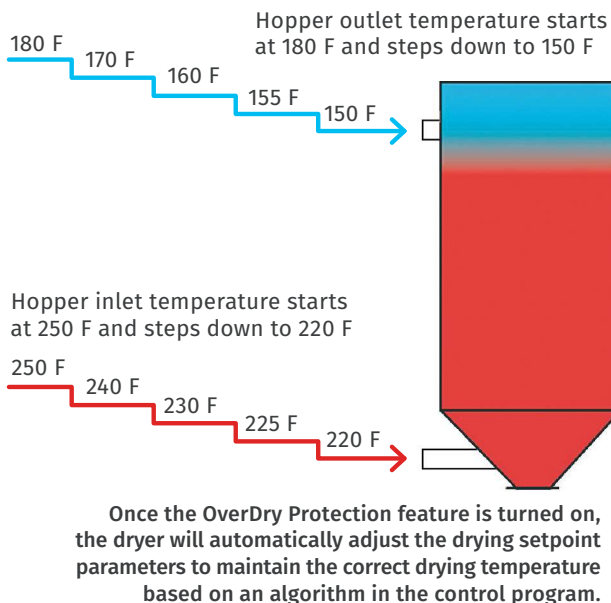


Side view of Nitrogen NovaDrier shows the air-drying membrane replaced with a membrane that both dries the air and separates nitrogen from compressed air.

Nitrogen membrane

Upper- and lower-loop heaters

As a result, Novatec has taken two technologies established in central drying and adapted them to its line of NovaWheel portable dryers: Moisture Manager and OverDry Protection. Says Haynie,



“These methods are much more effective and advanced than common features like dewpoint control and temperature setback. Moisture Manager and OverDry Protection are both designed to ensure that the dryer automatically responds to changes in resin moisture and ambient conditions that can lead to improperly dried resins. They have features that eliminate the possibility of overdrying nylons and other sensitive engineered resins. Plus, the technology controls the drying temperature to limit or eliminate the possibility of discoloration or polymer breakdown in thermally or visually sensitive resins like PC, PET, ABS, and other translucent and colored resins.”

Novatec’s Moisture Manager uses valves in the dryer and a dewpoint measurement out of the drying hopper to determine if moisture is being pulled from the resin, or if the resin is already dried to the appropriate moisture level. If the resin is already dry, the blower loop will exclude the desiccant and recirculate and heat without using dry air at -40 F/C dewpoint. If, however, the moisture monitor in the hopper outlet senses that the resin requires ▶

## QUESTIONS ABOUT DRYING?

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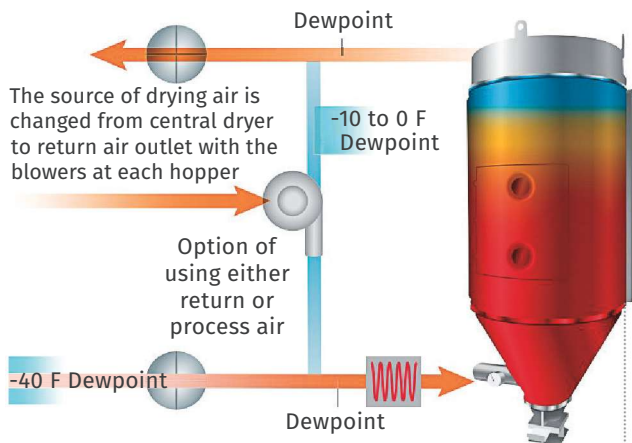


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Moisture Manager uses valves in the dryer and a dewpoint measurement out of the drying hopper to determine if moisture is being pulled from the resin or if the material is already dried to the appropriate moisture level. If the resin is already dry, the blower loop will exclude the desiccant and recirculate and heat without using -40 F/C dewpoint air.

additional drying at any point, dry air is introduced into the loop automatically, and then bypassed again automatically when the desired dryness is achieved. Each resin can have a recipe that ensures proper resin moisture always.

This is significantly different from running the dryer at a fixed dewpoint other than -40 F/C, where operators must first determine that they need to start the dewpoint change and then figure out—mostly through trial and error—what change is required. In doing this manually, operators will wind up making many bad parts first and then experiment on what they need to do to correct the issue. Moisture Manager does this automatically.

As for OverDry Protection, once this feature is turned on, the dryer will automatically adjust the drying setpoint parameters to maintain the correct drying temperature based on an algorithm in the control program. Once the operator inputs the desired drying temperature, the dryer control takes it from there, determining the appropriate hopper exit temperature at which the drying temperature should be reduced, and find automatically the temperature that gives the proper temperature profile in the hopper. No further intervention is necessary, and the dryer will automatically adjust and maintain the temperatures to have a consistent drying-temperature profile. ▶

**OverDry Protection is an automated control process that takes the guesswork and human intervention out of the process.**

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In cases where operators change a gaylord or resin source—and the resin temperature or moisture is different from the previous lot—the dryer control automatically adjusts to maintain the temperature profile. Competing temperature-setback features require operators to determine the temperature at which the drying temperature should be lowered and to what temperature it should be reduced. OverDry Protection, on the other hand, is an automated control process that takes the guesswork and human intervention out of the process.

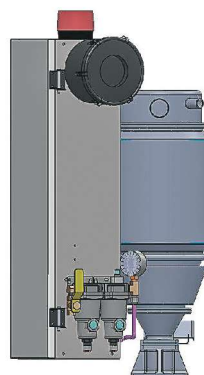
OverDry Protection will be standard on Novatec's NovaWheel portable dryers; Moisture Manager will be available as an option.

## NITROGEN DRYING

At NPE 2018, Novatec will also take the wraps off a new Nitrogen NovaDrier. As with the Moisture Manager and OverDry Protection system, this technology was also developed in response to increased use of polymers with unique properties that can be diminished if not handled properly during the drying process.

The dryer introduces an inert gas or nitrogen to inhibit the oxidative degradation of polymers. Resins that tend to degrade with prolonged exposure to heat in the presence of oxygen include nylons, PBT, PLA, and TPUs.

A loss in properties due to oxidation occurs more readily in the presence of the heat used in drying.



Novatec's nitrogen drying system here is equipped with an integral hopper.

Each polymer has different limits on temperature and the amount of degradation that occurs with exposure to heat and oxygen during drying. Typically, the drying temperature can be 10-50°

F higher with a nitrogen source in lieu of air, allowing for shorter drying times. These shortened exposures lead to better polymer performance in terms of strength, ductility, color/clarity, viscosity, chemical resistance, stiffness, and stability.

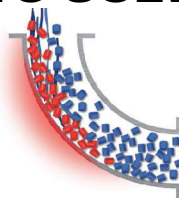
Using nitrogen in dryers is not altogether new. This dryer is unique, however, in that it requires no handling of cryogenic nitrogen or bottles. There isn't any need to have both the handling and risk of using bottled nitrogen. This dryer uses standard plant compressed air as the feedstock, from which it extracts the nitrogen for drying, so only air is released from the dryer unit (in two streams, one oxygen-rich, and one nitrogen-rich). This approach eliminates the hazards involved with venting of nitrogen into a closed area. It can be used anywhere without special procedures or handling, Novatec says. PT

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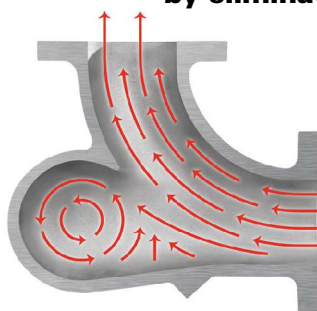
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# Cobot Helps Molder Keep Pace

Collaborative robot boosts process efficiency by 25%, while unburdening workers from the shop floor's more tedious tasks.

By **Tony Deligio**  
Senior Editor

When the employees at Wisconsin Plastics Inc. (WPI), first met their new coworker, a UR5 collaborative robot, or cobot, from Universal Robots, Ann Arbor, Mich. ([universal-robots.com](http://universal-robots.com)), they saw a threat to their jobs. Today, they see an opportunity to work more efficiently.

"Initially everyone was concerned about the robots replacing them," explains Carl Bartle, plant manager. "Once they realized the robot was there to help their own efficiency, there was a lot of excitement."

Based in Green Bay, WPI ([wisconsinplastics.com](http://wisconsinplastics.com)) is a contract manufacturer with an emphasis on injection molding and assembly, including its own line of paper-towel dispensers. Game to see how a collaborative robot might fit into its business, the company targeted an existing product—one of its most complicated, in fact—as a test case for integration of a cobot.

maintained a steady, repeatable rate of production. The towel-dispenser line, where the cobot was to be tested, formerly saw parts injection molded in one building, packaged, and moved across the street to the assembly facility. Bartle admitted this was inefficient on various levels, but also noted that it was less complicated than trying to put a large assembly line adjacent to a molding machine. Notably, it protected against an inherent risk with that kind of inline assembly scenario: "If you run short on assembly people one day, you might not be able to run the entire line," Bartle says. "Whereas, if I have the injection molding machine separate, I can at least run the

***'The robot didn't speed anything up; it just works consistently at the same pace. There are fewer distractions for the robot.'***

parts. I'm not shutting things down because I'm a person short on assembly."

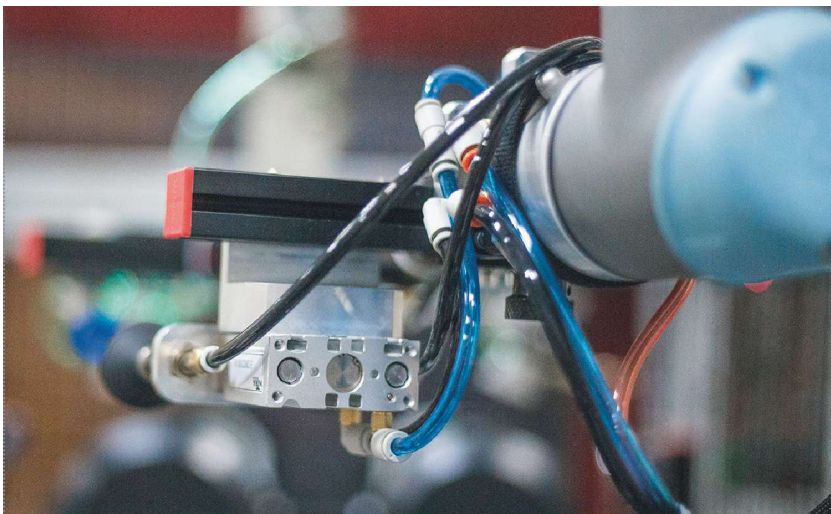
One of the advantages claimed for cobots is that they don't need "hard" guarding to protect human workers in the vicinity. However, in this case, the cobot is largely isolated from likely human interaction.

In the cobot-centered setup, WPI integrated the two injection machines that make the body and the cover of the dispenser. Situated next to each other, they mold parts that are conveyed to a central assembly station. The UR5 cobot removes parts from the machine and places them on a pad-printing fixture, where a customer logo is added. The robot then switches the housings to a second pad-print fixture, where a second customer logo is imprinted.

The cobot then pivots and sets the parts on a conveyor for final assembly (see a video of the cell in action at [short.ptonline.com/WPI](http://short.ptonline.com/WPI)).

"By having the robot in between, it allowed us to really reduce the size of the assembly line," Bartle says, "because the cobot can do multiple tasks in less space than would be required with a human assembly line."

WPI brought in a new pad printer for the cell and had some special integration fixtures built to help the robot. The machines are running



Custom fixtures allow the cobot to take on different tasks.

"We picked one of our more complicated assembly lines for the cobot," Bartle says, "one that actually had the most intense human interaction and the most variable rate to it. We figured that if we could do that, we could do anything, so we went all out on the first one."

## KEEPING PACE

A key concept for WPI throughout the process was pace. Not necessarily getting employers to work faster, but creating a process that

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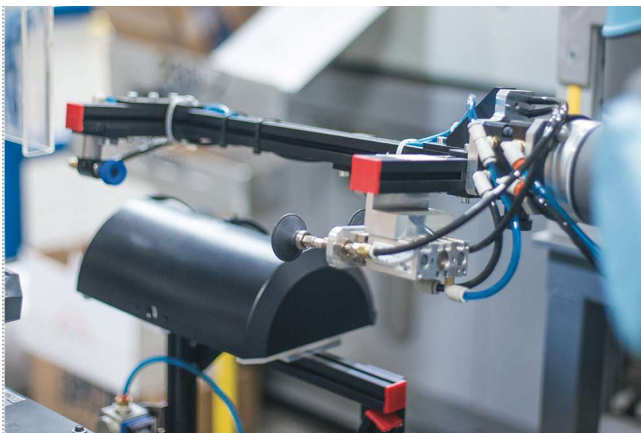
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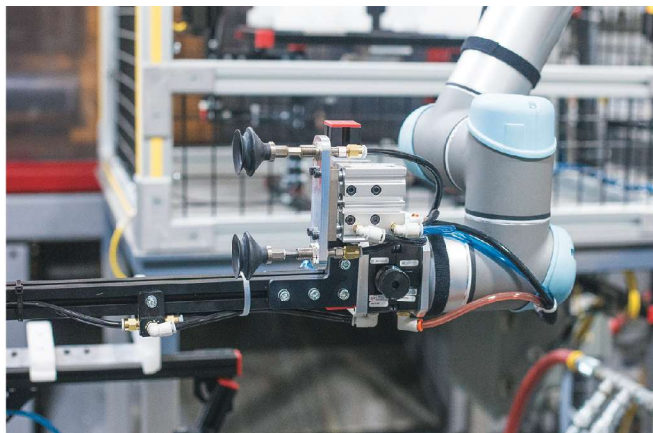
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WPI uses the UR5 robot to cycle parts through various printing steps before assembly.



Universal Robots' UR5 model boasts 11-lb payload capacity, a reach of 33.5 in., and six rotating joints.

two-cavity molds, so when parts are removed, they're placed on a fixture that rotates so that the robot can grab from a single orientation instead of multiple orientations. After it places the first part on the fixture, the robot swings back and grabs the second part.

The human footprint in the cell is now significantly smaller, Bartle notes, because assembly tables are no longer needed, since workers combine components directly off a conveyor. "The pad printing and the cobot—that integration all happens in a very small space—and then the cobot hands off to the assembly line," Bartle explains. "So I don't really have a square-footage reduction, but you go from an extremely linear line down to a very small, short line that doesn't extend out much past the footprint of the machine itself."

WPI has seen an increase in throughput because, as Bartle explains, "When you have the robot driving the cadence, people can maintain that pace more consistently." Machines know only one speed, or at least they can be set to run at a specific, consistent speed. "Human pace goes up and down throughout the day," Bartle says. "What this does is allow us to work at the pace of the machine, constantly. The cobot can maintain that pace, and then the humans will naturally maintain that pace too. The cobot didn't speed anything up, it just works consistently at the same pace. There are fewer distractions for the robot."

### MORE COBOTS COMING

After overcoming initial anxiety about the cobot, WPI's workers more than embraced the technology, seeking added work for it, not less. "The team we put together to test this out was really active in trying to figure out ways to utilize the robot even more than we originally planned," Bartle says. "It was the assemblers on the line who were coming up with ideas: 'What if we position the robot in

this direction and have it grab from here?' And, 'What if it sets it on the conveyor here vs. there?' They were really interactive in the process, and they're really proud of what they're a part of."

The integration has been successful enough that WPI is now planning to bring in four more UR cobots over the next few years, according to Bartle. Despite the overall success, he does see one aspect of cobot integration that WPI would change next time around: "I would definitely get the manufacturing team, the assembly crew, the shift supervisor, and our shop technicians involved sooner in the setup because a lot of their ideas were what really took it to the next level."

Going forward, WPI is considering using cobots to move parts from one location to another, as well as in packaging finished assemblies. "Maybe we can streamline one of those jobs

that tend to be a low-skill boring job where folks are easily distracted," Bartle says, "so I can take my skilled-labor set and apply them to more challenging jobs."

Increasingly, that's how WPI sees the role of automation going forward—getting more out of the people they have vs. getting to fewer people. "This is an opportunity for us to change how we're using our workforce," Bartle says, "because it can take the boring and tedious tasks away from assemblers and give them more challenging tasks, and at the same time open up some opportunities for robot programmers. The cobot freed up individuals to put them on other lines, which helps us grow, because in this day and age it seems like we tend to be short on employees rather than over." PT

*The robot can do multiple tasks in less space than would be required with a human assembly line.*

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# New Engineering Materials for Challenging Automotive Applications

## Nylons, PPA, and PPS for high heat and chemical resistance and/or high strength with light weight.

By **Matt Naitove**  
Executive Editor

Two units of Solvay (U.S. office in Alpharetta, Ga.) have introduced several new engineering materials for demanding automotive applications requiring high heat resistance, chemical resistance, and superior strength with light weight.

### NYLONS FOR THERMAL MANAGEMENT

Solvay Performance Polyamides ([technyl.com](http://technyl.com)) introduced two new Technyl nylon products for automotive thermal management. One is Technyl Blue D 218CR V33, a nylon 66/610 copolymer that features very high hydrolysis resistance plus high resistance to road salts. Main immediate applications are radiator end tanks, oil-filter housings, and exhaust-gas recirculation (EGR) heat exchangers.

This product has been grouped together with two existing series of Technyl nylon 66 products in the Technyl Blue family with three levels of performance. The new grade has “very high hydrolysis resistance”; below it are the Technyl Blue G2 grades (“high hydrolysis resistance”) and Technyl Blue 34NG grades (“hydrolysis resistant”) in a range of glass contents.

All three reportedly offer thermal-aging resistance in presence of aggressive coolants (hot water/glycol mix). Technyl Blue 34NG reportedly shows 15% higher tensile-strength retention than standard nylon 66 after 1000 hr at 130 C/266 F. Technyl Blue G2 raises that to 30% greater strength retention; and the new D 218CR V33 grades provide 60% greater tensile-strength retention than standard nylon 66. All three are said to offer high flow and excellent surface quality, relative to competing specialty polymers.

The second new product from Solvay Performance Products is Technyl Red S, a nylon 666 that is highly heat stabilized for continuous use at 200 C/392 F. It is aimed at turbo engine air ducts and charge-air coolers (pictured on p. 30), as well as cylinder-head covers. It is said to be an advance over the established Technyl HP grade. Technyl Red S has been tested at 200 C for 2000 hr and at 210 C/410 F for 1000 hr. It also boasts high resistance to impact and to acid condensates, as well as high flow, superior surface quality, and excellent weldability.

**New nylons fight off attack from road salt and glycol coolants.**

### MORE SPECIALTY ENGINEERING GRADES

Meanwhile, Solvay Specialty Polymers ([solvaspecialtypolymers.com](http://solvaspecialtypolymers.com)) also has fielded several new materials for specialized applications. Solvay added more automotive thermal-management materials

with new Ryton R-4-300 PPS with 30% glass and Amodel A-89XX series of polyphthalamide (PPA) resins with 30-50% glass. The new Ryton grade is a linear PPS with improved tensile strength and elongation, as well as “best-in-class” weld-line strength. The new PPAs are for underhood components such as thermostat housings, multi-coolant valves, and water inlets/outlets and crossovers. ▶



A new grade of Ixef semi-aromatic nylon is colored “signal orange” for use in electric-vehicle rechargers. Despite 50% glass content, it reportedly offers high flow in thin sections and a glossy, resin-rich surface.

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New Technyl Red S is a 666 nylon highly heat stabilized for parts such as charge-air coolers.

Also new is orange-colored Ixef 1524 polyarylamide (PARA, also known as MXD6 nylon), a halogen-free flame-retardant grade with 50% glass fiber for electric-vehicle recharge connectors. It is color matched to "signal orange" for this application (photo, p. 28).

Despite high glass content, it reportedly shows high flow for walls as thin as 0.5 mm, supporting high injection speeds and short cycles. It offers a balance of high stiffness and toughness, as well as a glossy, resin-rich surface. It also meets UL 94V-0 at 0.4 mm.

Another new Ixef PARA grade is black Ixef 3012, containing 55% carbon and glass fibers. It was developed to offer extremely high strength and stiffness at low weight, along with "exceptional" surface finish. Its high flow allows molding long, thin parts that need no painting for automotive, aerospace, and consumer applications. Additional properties include electrical conductivity and high creep resistance. Applications could include auto air-vent lamellas and throttle-body levers, drone components, and action-camera fixation parts and cantilever snaps. [PT](#)



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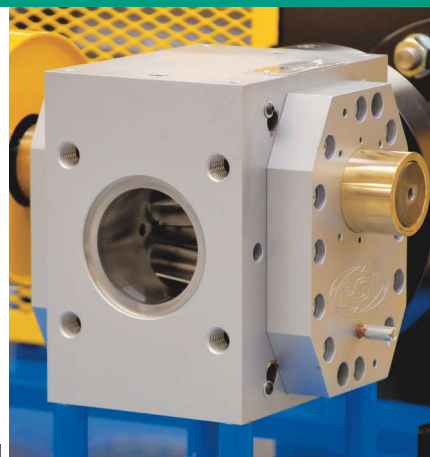
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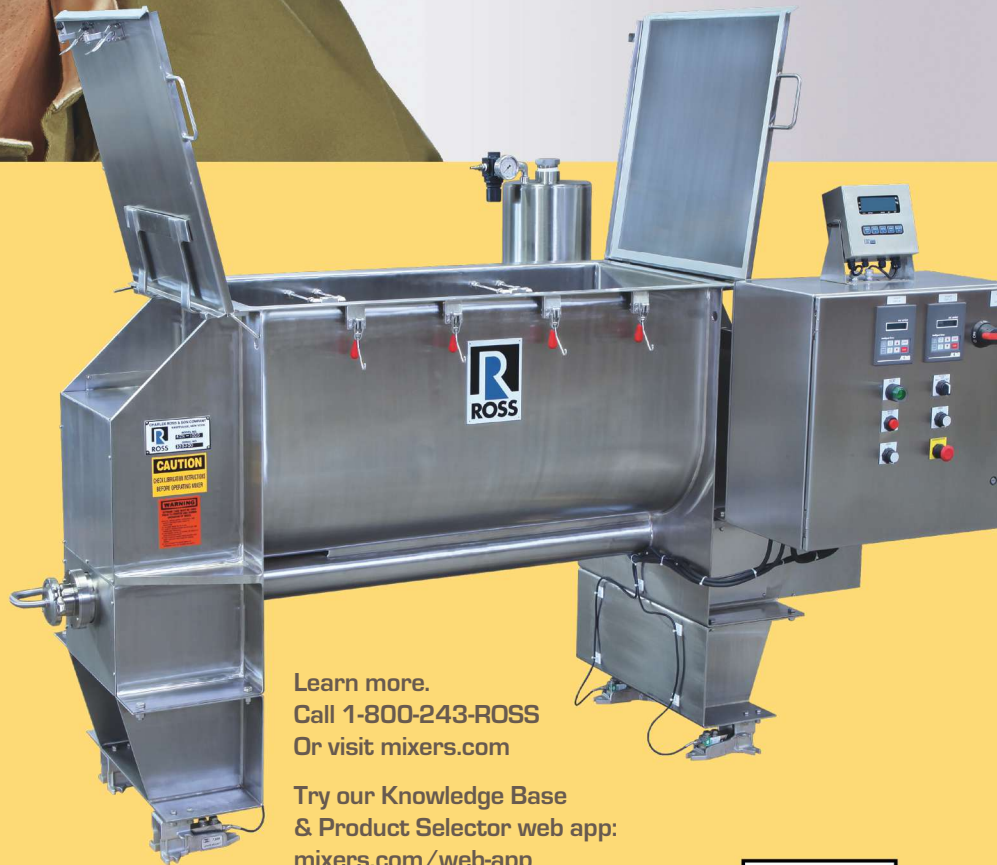
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## Engineering Resins Maker Focuses on 3D Printing Materials

SABIC develops arsenal of specialty products based on its engineering resins for a new range of processes.

By **Lilli Manolis Sherman**  
Senior Editor

In the last three years, SABIC (U.S. office in Houston) has significantly stepped up its efforts to enable use of additive-manufacturing processes for mass production. The focus has been on development of materials that are optimized for use in additive processes (aka 3D printing) and that meet the end-use performance requirements of highly regulated industries such as aerospace and healthcare.

SABIC has been working to develop materials for such additive processes as fused deposition modeling (FDM) and fused filament fabrication (FFF); selective laser sintering (SLS); and large-format additive manufacturing (LFAM).

### NEW FILAMENTS AND POWDERS

SABIC (*sabic.com*) has been active for more than a decade as a supplier of engineering resins to customers who produce filaments for FDM-type processes. The company was best known as the supplier



Two new Thermocomp AM compounds were used for a concept boat hull from Livrea Yacht—a carbon-fiber reinforced PEI for the inner lattice support structure.

of Ultem PEI resin used by Stratasys, Eden Prairie, Minn. (*stratasys.com*) in its Fortus series of industrial FDM printers.



This 3D-printed concept drone is based on Lexan EXL PC/siloxane copolymer filament, which boasts has up to four times the impact performance of standard PC.

In 2014, SABIC began to expand its footprint when it became involved in the emerging technology of LFAM. For example, the company was a sponsor of a collaborative effort with Local Motors, Oak Ridge National Laboratory, and Cincinnati, Inc. that resulted in printing the Strati electric vehicle live at the 2014 IMTS show in Chicago.

In May 2017, SABIC launched its initial portfolio of Thermocomp AM compounds for LFAM (see Jan. '18 Keeping Up report). Print parameters and mechanical properties for these materials were developed using test specimens printed on the company's big-area additive manufacturing (BAAM) machine. Reinforced with carbon or glass fibers, the new compounds can be used for applications in tooling, aerospace, automotive, and defense industries. The first eight Thermocomp AM compounds are based on four of the company's amorphous resins: ABS, PPE alloy, PC, and PEI, which exhibit good creep behavior. Compared with semi-crystalline resins, lower shrinkage during cooling and less thermal expansion during end use also mean these amorphous materials demonstrate greater dimensional stability.

Expect 2018 to be a very active year in terms of the variety of products planned for commercial launch, say SABIC sources. For LFAM, there may be an expansion of the Thermocomp AM portfolio. SABIC is currently evaluating new compounds based on semi-crystalline resins such as PBT, nylon, PPS, and PEEK to address the industry's needs for LFAM materials with improved chemical resistance and stiffness.

SABIC is also aiming to grow its involvement in SLS with new custom-made powder forms of engineering resins. Company sources note that semi-crystalline materials have been used nearly exclusively for SLS processes. However, expect to see the launch of a unique PC powder that will allow fully amorphous parts to be produced. The company plans to expand this unique material and process technology to other amorphous resins. ▶

*Developing amorphous and semicrystalline compounds, filaments, and powders for a wide variety of additive processes.*



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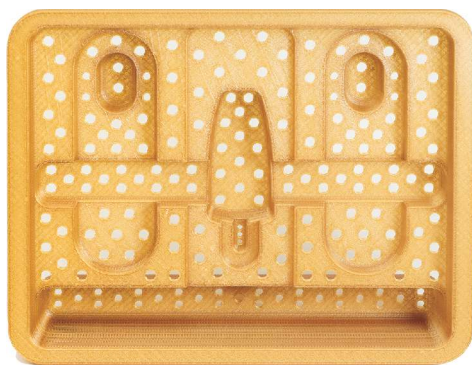
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For FDM/FFF, SABIC expects to launch Lexan PC and Ultem PEI healthcare-compliant filaments that meet ISO-10993 biocompatibility standards, as well as a series of support materials for each of its build materials. Just last year, the company introduced the first of a new portfolio of filaments based on Ultem PEI, Cycolac ABS, and Lexan PC resins, which reportedly offer the same composition as the company's injection molding grades. The nominal diameter of all SABIC filaments is 1.79 mm  $\pm$ 0.05 mm, and they are available in a 1510-cc spool size. Here's how the new filaments are characterized:



For FDM/FFF, expect to see healthcare-compliant filaments that meet ISO-10993 biocompatibility standards, such as a new Ultem PEI filament used for this sterilization tray.

- Ultem AM9085F filament is a high-performance PEI manufactured from Ultem 9085 resin. It is said to provide high-heat resistance and mechanical strength, is UL 94V-0 compliant at 1.5 and 3.0 mm thicknesses, and meets FAR 25.853 and OSU 65/65 requirements with low FST (flame, smoke, and toxicity) evolution. It is available in black and natural colors.
- Cycolac AMMG94F filament is a general-purpose ABS made from Cycolac MG94 resin. It reportedly provides a balance of properties suitable for a wide variety of applications, and is UL 94HB compliant at 3.0 mm. It is available in black, white, and natural colors.
- Lexan AM1110F is a general-purpose PC filament produced from Lexan HF1110 resin. It boasts higher heat resistance than general-purpose ABS filaments, is UL 94V-2 compliant at 3.0 mm, and is available in white.

#### 'DIFFERENTIATED MATERIALS' AND MORE

Last year, SABIC unveiled Lexan EXL AMHI240F filament, based on SABIC's Lexan EXL PC/siloxane copolymer and aimed for use in Stratasys' Fortus FDM printers, as well as other printers with sufficient temperature capability and an open-format architecture. Compared with standard PC, this material delivers up to four times better notched Izod impact at room temperature and up to three times better at -30 C, depending on print orientation.

Lexan EXL filament also sports a heat-deflection temperature of 140 C, higher than that of general-purpose ABS filaments. It

is initially offered in black, though white and other colors are in development. It meets UL 94V-0 at 3.0 mm in both flat (XY) and on-edge (XZ) orientations.

Company sources confirm that this is the first of a planned series of "differentiated materials," noting that they aim to apply similar approaches to impact modification of other polymer systems to help expand the target application space for additive manufacturing.

While SABIC will continue to be a supplier of resins to the additive manufacturing industry, it is also moving along the value chain to supply materials in printable form (filaments, powders) to help accelerate the adoption of additive manufacturing for end-use production.

Having made significant investments in state-of-the-art equipment in its additive manufacturing Centers of Excellence in the U.S., The Netherlands, and Saudi Arabia, the company has internal process capability for FDM/FFF, SLS, and LFAM as well as a variety of other specialized printer technologies. It can convert raw materials into printable filament and powder forms, develop optimized print parameter sets, and conduct extensive performance testing on printed parts.

For example, in the case of LFAM, SABIC can formulate unique compounds, evaluate their processing performance on its BAAM printer, and test printed part performance—all within a matter of days. In this way, SABIC offers customers materials that have been fully characterized as candidates for specific printing processes.

Looking ahead to the next three to five years, SABIC officials expect to see a continued focus on the industrialization of additive manufacturing. This will require introduction of a wide variety of new materials. They also expect to see the continued evolution of design software and process capabilities to enable repeatable production capabilities. It is also likely that new additive manufacturing processes will continue to be introduced, which offer improved part performance and reduced production costs.

The "additive manufacturing ecosystem" will also remain highly collaborative as alliances are built across the value chain to bring new products to the market as efficiently as possible and build sufficient production capacity to support the growing demand for production parts. They also see the intersection of additive manufacturing and composites as an area that will receive increased focus in the near future. PT

#### QUESTIONS ABOUT ADDITIVE MANUFACTURING?

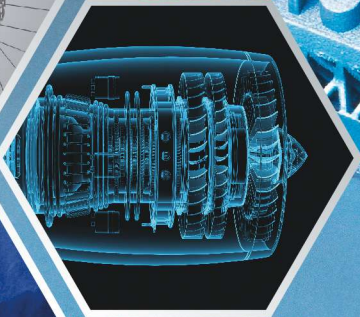
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# MATERIALS

PART 2

## A Processor's Most Important Job

Process conditions help determine the difference between the maximum degree of crystallinity that can be achieved in a polymer and the degree that is present in a molded part.



By Mike Sepe

Thermoplastics are divided into two general classes: amorphous and semi-crystalline. The term semi-crystalline is used because in a commercial setting there is no such thing as a polymer that has achieved 100% crystallinity. That may occur in low-molecular-weight systems, but in polymers, the length of the chains and the myriad ways in which they can be arranged prevent such a complete level of crystallization from occurring. Of the commonly used commercial polymers, high-density polyethylene (HDPE) achieves the highest degree of crystallinity; and even in this instance, the level rarely exceeds 85%, even for the highest density grades. For many semi-crystalline polymers, the typical degree of crystallinity is less than 50%.

For all grades of materials capable of crystallizing, there is a maximum degree of crystallinity that can be attained. The shape and size of the crystals will depend upon several factors

**Crystallization is a process that depends upon time and temperature.**

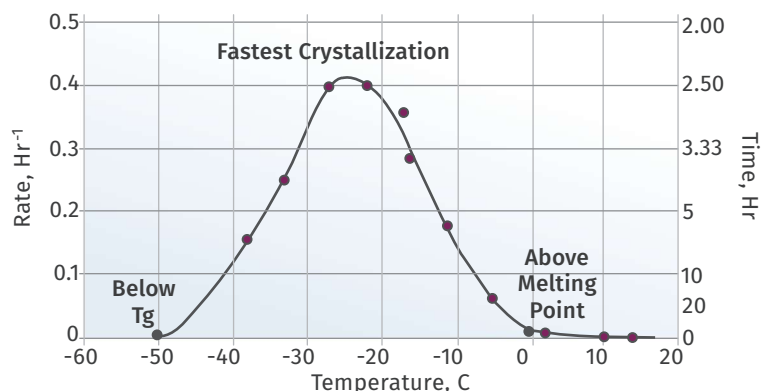
that are far beyond the scope of these articles, and a review of the scientific literature on the process of crystallization is very interesting but very complex. The focus of

this discussion is the role that process conditions have on the difference between the maximum degree of crystallinity that can be achieved in a polymer and the degree that is present in a molded part. This difference plays a very important role in determining performance characteristics.

Crystallization is a process that depends upon time and temperature. While other factors come into play and will be discussed later, their effect on the final structure of the part is relatively small compared with the effects of time and temperature. For crystallization to occur, the temperature of the polymer must be below its melting point. The lower temperature reduces the mobility of the individual chains and allows the process of crystallization to begin. This process will continue until the temperature of the material drops below the glass-transition temperature ( $T_g$ ). The  $T_g$  is the point at which the non-crystallized material, known as the amorphous glass, reaches a level of greatly reduced mobility. While the polymer is above its  $T_g$ , the mobility in the amorphous regions allows polymer chains to be added to the growing crystals. Therefore, the window of opportunity for forming crystals is below the melting point and above the  $T_g$  of the polymer.

Within that temperature region, the rate of crystal formation and crystal growth will vary. Often people will quote general rules of thumb, such as, "Crystals grow at their fastest rate halfway between the melting point and the glass transition temperature." If only it were that simple. But it is true that for every polymer there is a definable relationship between the temperature of the polymer and the rate at which crystals form. ▶

### Generalized Relationship Between Temperature and Rate of Crystallization



Crystallization generally occurs slowly at temperatures just below the melting point. The rate will accelerate as the temperature declines, reaching a maximum crystal growth rate. Beyond this point, the rate of crystallization will slow; and once the temperature declines below the  $T_g$  the process will stop. This graph applies to natural rubber, but the overall pattern that it displays is common to all polymers. Source: *Crystallization of Polymers, Vol. 2: Kinetics and Mechanisms*, by Leo Mandelkern. Published by Cambridge University Press.

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Generally, crystallization will occur at a relatively slow rate at temperatures just below the melting point. The rate will accelerate as the temperature declines, reaching a maximum crystal growth rate at some point. Beyond this point the rate of crystallization will slow, and once the temperature declines below the  $T_g$  the process will stop altogether. A generalized pattern for this behavior is shown in the accompanying graph. This graph applies to natural rubber and is therefore not that useful for plastic injection molding. But the overall pattern that it displays is common to all polymers.

There are a couple of very important points contained within this graph. First, in a semi-crystalline polymer, cycle time is governed to a significant extent by the rate at which the material achieves a certain modulus. This modulus, in turn, is related to the number and size of the crystals that form. The faster the crystals form, the faster the part can be demolded. The graph shows that at some point, reducing the temperature of the mold, probably the most common tactic that processors use to reduce cycle time, can be counterproductive. Even more important, reducing the mold temperature will reduce the degree of crystallinity that is achieved within the molded part. This is where the performance element of the discussion comes in.

We choose semi-crystalline polymers over amorphous polymers for a variety of reasons. Among these are improved chemical resistance, environmental stress crack resistance, and fatigue resistance. In addition, a higher degree of crystallinity is associated with higher strength and stiffness. If the polymer is not given the opportunity to crystallize, these properties will be compromised. There are other benefits of increased crystallinity. One of these is the degree of modulus retention above the glass transition. One of the key benefits of semi-crystalline polymers is that they possess useful solid-state properties above their  $T_g$ . While amorphous polymers essentially soften and become useless as load-bearing materials above their  $T_g$ , semi-crystalline materials, even when unfilled, will retain 10-30% of their modulus. For example, an unfilled PBT polyester, with a room-temperature modulus of 340,000 psi (2340 MPa), will still have a modulus of 48,000 psi (330 MPa) at 100 C (212 F).

This retention can be improved by incorporating fillers such as glass fibers into the material. But if the material fails to achieve its intended degree of crystallinity, the expected modulus retention at elevated temperatures will be reduced. This can have implica-

tions for creep resistance, as we will show in a later article.

Another benefit of higher crystallinity that is often overlooked pertains to the way that nylons interact with moisture. As nylon parts absorb moisture they lose strength and modulus. They also exhibit changes in dimensions. As nylon parts take up moisture they swell. But the moisture is only absorbed by the amorphous regions of the part. Therefore, the more crystalline the material in the part, the smaller the effect of the absorbed moisture will be on critical dimensions.

Since cooling rate is a critical factor in determining the degree of crystallinity in a semi-crystalline polymer, the mold temperature selected by the processor will be important to part performance. Part geometry will, of course, be an important aspect of this picture. The wall thickness of the part is a significant element in determining cooling time, and it will always be the case that material that is in direct contact with the mold wall will cool more rapidly than material in the center of the wall. This means that the degree of crystallinity in any molded part will vary with location. But part geometry is a constant. Mold temperature is a variable that is set at the discretion of the processor. Often, the

selection of a mold temperature is made without any awareness of its importance to the performance of the part.

Higher mold temperatures will typically promote a higher degree of crystallinity if the mold temperature is somewhere on the left side of the curve in the graph on p. 36. But raising the mold temperature is usually considered to bring

with it an automatic penalty in cycle time. For some materials this may be true. Polyethylene has a  $T_g$  well below room temperature. Studies show that the peak crystallization rate for polyethylene is also below room temperature. For materials like this, colder is better and there is likely no downside to part performance. But with higher performance engineering polymers, where the  $T_g$  is well above room temperature, lower mold temperatures can introduce a wide range of problems that may not be apparent until the part is in use.

In our next article we will look at some examples of the unintended consequences of attempting to improve productivity by reducing mold temperature. [PT](#)

*For every polymer there is a definable relationship between the temperature of the polymer and the rate at which crystals form.*

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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](mailto:mike@thematerialanalyst.com).



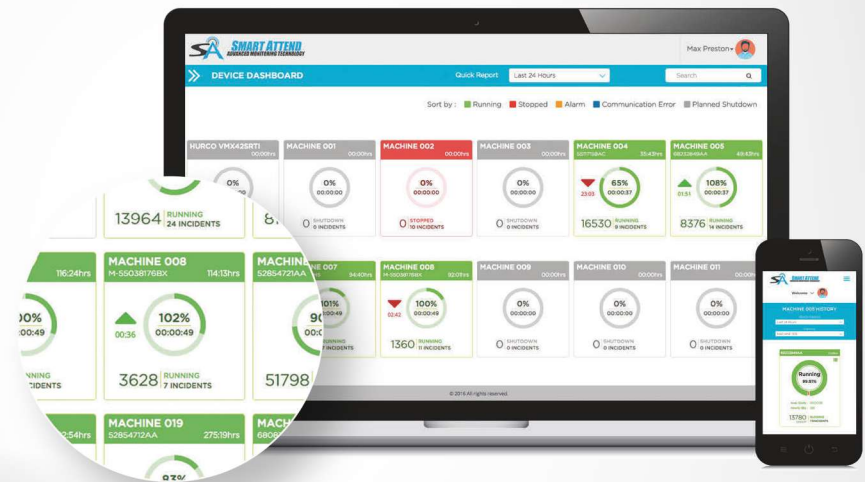


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# INJECTION MOLDING

## Melting Amorphous vs. Semi-Crystalline Plastics

Understanding the differences in how each melts is crucial to obtaining melt uniformity.

There are hundreds of variables to contend with in developing a 24/7 injection molding process, and it can be difficult to decide on



By John Bozzelli

which to focus. Some are more important than others, but no matter where you rank a given variable, the fact is the process will not run unless each is controlled to whatever the resin and part need.

My pick this month is melt uniformity, and it should be in your top 10 list of variables. By uniformity I mean not just melt temperature, but melt consistency, meaning no swirls, streaks, or partially unmelted pellets. If you want consistent

dimensions and performance 24/7, you must have melt uniformity.

Our focus here is on the difficulty in achieving melt uniformity between amorphous and semi-crystalline resins. These resins melt differently, and a processor needs to understand how each of these polymers melts to obtain melt uniformity.

**If you want consistent dimensions and performance 24/7, you must have melt uniformity.**

Normally, the differences relate to the different arrangement of the polymer chains in a part. With amorphous polymers, the chains are random—meaning they have no specific order or alignment, something like tangled pieces of string. Semi-crystalline polymers have a structure or ordered pattern of chain alignment.

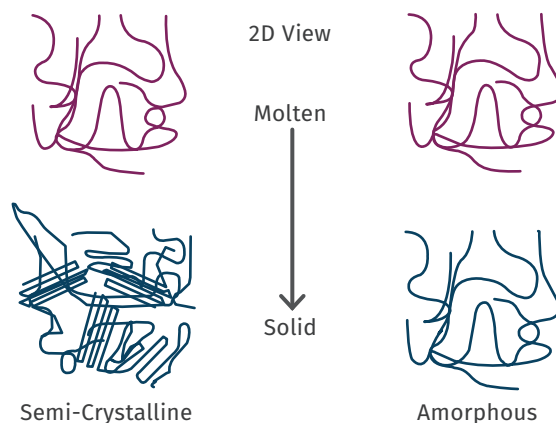
The prefix “semi” is used to note that not *all* the polymer chains in a semi-crystalline part are crystallized. There are areas of crystallinity and areas of random (amorphous) chain orientation within a given part. Colors, additives, and cooling rate influence the degree of crystallinity, which changes part size and properties.

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### Structure Difference Between Semi-Crystalline and Amorphous Polymer Chains



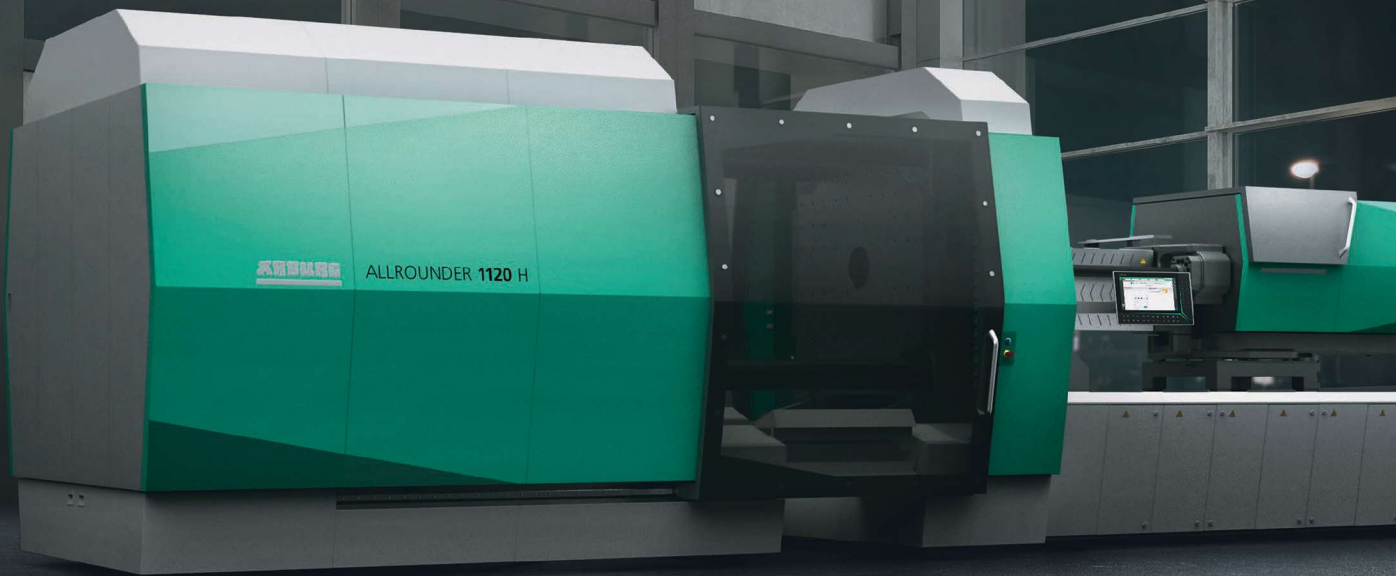
Semi-crystalline polymers have a structure or ordered pattern of chain alignment. With amorphous polymers, chains are random—meaning they have no specific order or alignment, something like tangled pieces of string.

Regardless of whether the polymer you are processing is semi-crystalline or amorphous, melt uniformity is required to obtain consistent part dimensions and performance. Understanding how each melts allows the processor better control in processing.

Whether semi-crystalline or amorphous, each relies on the same sources of energy for melting: the barrel, screw, and heater bands. Most of the energy, about 80%, comes from friction of the pellets against the barrel wall and compression in the transition zone of the screw. The remainder comes from the heater bands around the barrel. The energy-transfer mechanism is the same for both amorphous and semi-crystalline resins. However, this is where the similarity in melting these plastics ends.

An important factor that differentiates them is the amount of energy required to melt each. A kilogram of a semi-crystalline resin, such as nylon 6, requires significantly more energy than 1 kg of an amorphous resin such as ABS. In fact, nylon takes ▶

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about twice as much energy to melt as an ABS (about 716 BTU/kg vs. 342), yet their processing temperatures are similar. Twice the energy requirement for the nylon means your processing ducks had better be in a row.

So now we know what we must do to melt nylon vs. ABS from an energy standpoint. But there is another issue to make your processing life harder. Semi-crystalline resins stay hard until they reach their melting temperature. It's like melting ice. Ice does not change in hardness significantly as it warms up from -10 C (14 F) to -0.5 C (31 F). Fall on ice at either temperature and I doubt you will feel any difference in hardness. Like ice, semi-crystalline resins do not soften until they reach their melting temperature. They stay hard until they meet two criteria: First, you put in enough energy to bring them to their melting point; and second, you have to put in another dose of energy to overcome the heat of fusion (melting)—that is, break up their ordered chain pattern. It is like an energy barrier to melting.

How does the screw and barrel handle this difficult situation? The semi-crystalline pellets flow from the hopper into the feed throat and fall between the deep flights of the feed section of the screw. The feed section augers the pellets forward and compacts them, forcing air and some volatiles out the

hopper (it is a vent). The feed section may warm the pellets, but it does not and should not do any melting.

The material then reaches the transition or melting zone, where the root diameter of the screw tapers thicker to provide compression of the pellets against the barrel wall. This compression, along with friction of the pellet against the barrel wall,

drives energy into the pellets to raise their temperature. The problem is that not all granules get to the barrel-wall/flight interface—some get the energy needed to melt and some do not. Solid-bed breakup occurs, which leads to some partially unmelted pellets getting through the transition and metering zones. These partially unmelted pellets can wind up in the part and wear the screw.

For the sake of discussion, let's say you are also running liquid color and using a general-purpose screw design. Liquid color often uses an oil carrier, which lowers the friction of the pellet against the barrel, which in turn reduces the energy transfer for melting. Is this really something you want to happen? Turn off the liquid color; does the screw rotation time decrease? A general-

purpose screw with a 20: 1 L/D ratio has only five flights in the transition zone. This is a significant problem with shot sizes larger than about 40% of the shot capacity. It's often recommended that barrier screws be used instead, but they often cause degradation, producing excessive black specks. You're better off with a screw designed to provide melt uniformity.

Amorphous resins melt differently. They require substantially less energy and are easier to melt. They melt like frozen butter.



The solid break-up that can occur when processing semi-crystalline materials leads to some partially unmelted pellets getting through the transition and metering zones of the screw. These partially unmelted pellets can wind up in the part (left) and wear the screw (above), even this one running only PE.

An amorphous pellet at room temperature is hard, but as it warms up it begins to soften. With more energy, amorphous materials continue to soften until they are suitable for molding. They do not stay hard until they reach the melting point, and they do not have to overcome the heat of fusion. A partially unmelted pellet may be like taffy or a marshmallow. If it gets wedged between a screw flight and the barrel wall, it will squash without severe damage or wear to the screw or barrel. Amorphous resins thus are more forgiving during the melting process. A general-purpose screw *may* provide acceptable processing, but again, that's not my recommendation.

In a nutshell, semi-crystalline pellets are more difficult to melt uniformly than amorphous pellets. A general-purpose screw might process amorphous pellets, but with shot sizes at the small end (below 20% of barrel capacity), and at the high end (above 40%), most molders will have problems with semi-crystalline pellets. I don't recommend barrier designs. Instead, specify a screw design that provides melt uniformity with a minimum L/D ratio of 20:1, though 24:1 is preferred. PT

**Like ice, semi-crystalline resins do not soften until they reach their melting temperature.**

**Amorphous resins melt like frozen butter.**

**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](mailto:john@scientificmolding.com); [scientificmolding.com](http://scientificmolding.com).

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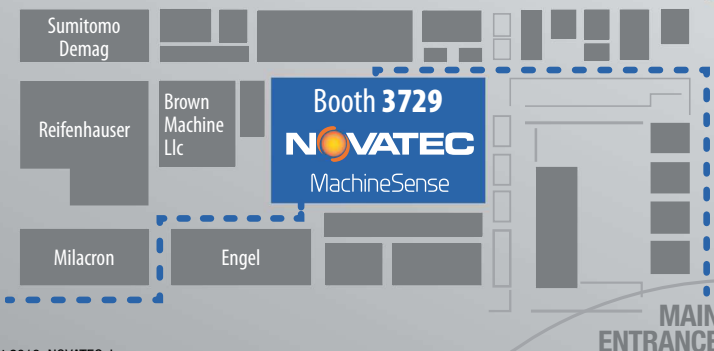


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# EXTRUSION

## How Much L/D Do You Really Need?

Just like selecting the extruder size and drive combination, the L/D should be carefully evaluated.

In the early 1960s, extruders typically had a length/diameter ratio of 20:1, and a machine with a 24:1 L/D was considered long. Since then, extruders have gotten longer, with 30:1 to 36:1 L/D becoming the industry “standard.” Some extruders even exceed 40:1 L/D for special purposes like double venting, compounding, or high-speed processing.



By Jim Frankland

What benefits does the additional length provide? Mostly increased output and improved homogenization.

Since the feed section stays approximately the same length, regardless of the L/D, the rest of the screw is devoted to melting and pumping. The deeper the screw channels, or the higher the specific output (lb/rpm), the more length you need to complete

melting and develop the pressure necessary to push the polymer out the die. As designers reached these limits, extruders were built longer to handle the economic requirements to pump out more and better product.

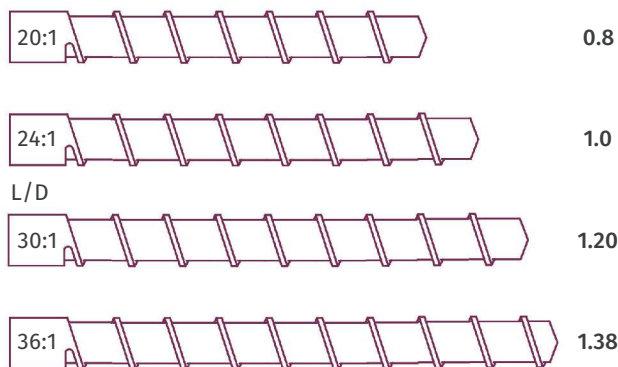
**A screw that is too long for the overall processing situation can actually limit output.**

However, there are actual limits on increasing output as L/D is increased. Usually these limits are due to the inability

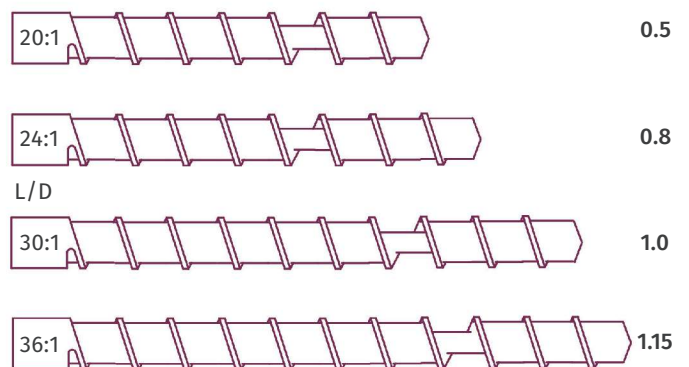
of the feed section to deliver more polymer. On smaller-diameter screws, that limit often is determined by screw strength. On small screws you can only go so deep in screw channels before the screw is overtorqued and fails. On larger extruders, the efficiency of feeding decreases as the channels get deeper until there is no further increase in output.

### Relative Output Levels

#### Single-Stage Screws



#### Two-Stage Screws



For most applications, you'll need a longer two-stage screw to match the output of a single-stage screw.

Two-stage screws benefit more with increasing L/D because about 4-6 D is consumed in the vent area, which contributes very little to melting or pressurization. For most applications, you'll need a 30:1 two-stage screw to match the output of a 24:1 single-stage screw (see illustrations above). ▶

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Are there any disadvantages associated with longer extruders? Some polymers melt much easier and faster than others. Also, some processes typically have low head pressures, while others have much higher discharge pressures. Inherent viscosity differs a lot between polymers, and some shear-thin significantly while others do not (i.e., are more “Newtonian”). As a result, screw performance is optimized at a variety of L/Ds rather than at any one standard L/D.

A screw that is too long for the overall processing situation can actually limit output. The limitation generally shows up as excessively high melt temperature that can cause

polymer breakdown, color shift, loss of additive effectiveness, and plate-out, to name a few issues. For a polymer that melts easily, the melting length should ideally be shorter, as excessively long transitions can actually reduce melting rate. The same is true of pressure development, as widely used melt pumps greatly reduce the need for long metering sections to handle the discharge pressure.

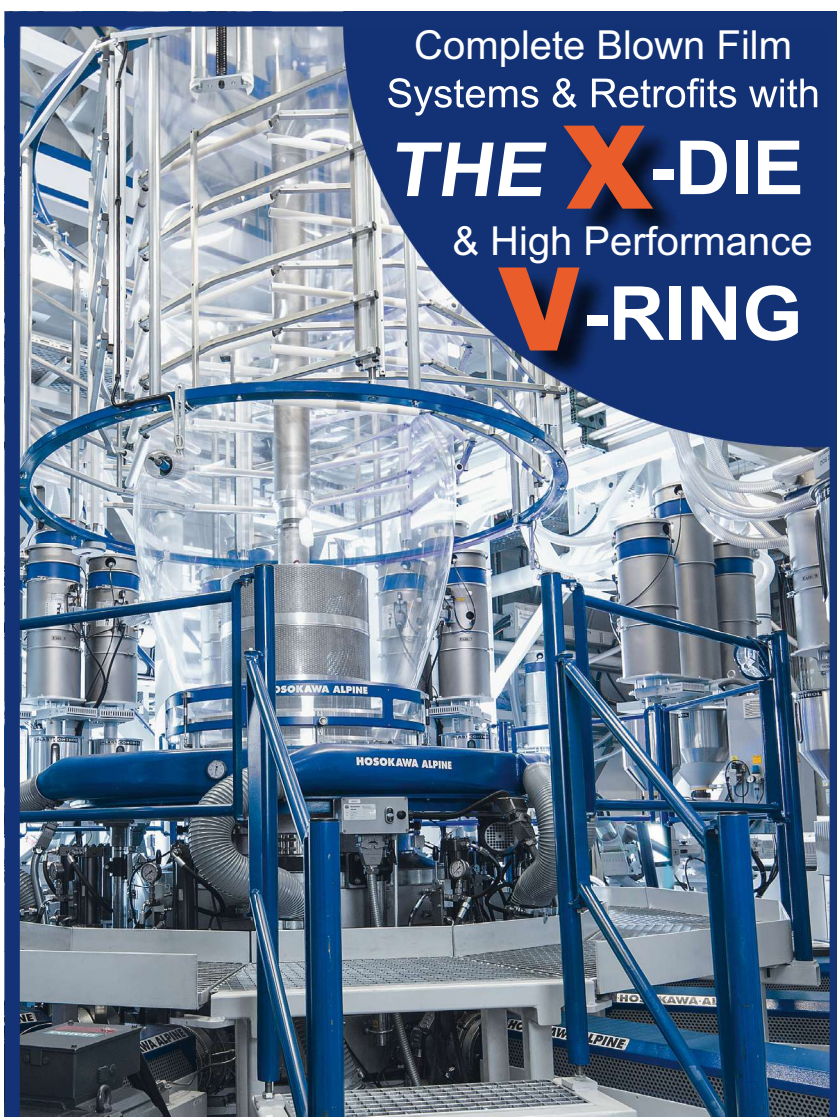
As a result, the tendency to buy longer and longer L/D extruders can actually penalize overall performance. Custom extrusion houses may simply have to live with this reality because they never know what they

*The tendency to buy longer and longer L/D extruders can actually penalize overall perfor-*

will be running next year, and a longer extruder has more inherent flexibility than a shorter one. But if you have a dedicated process, there can be self-imposed limits with an extruder that is too long.

Just like selecting the extruder size and drive combination, the L/D should be carefully evaluated. Everyone wants the most usable output from their extruder, but if the material comes out too hot or too degraded then the singular focus on rate is actually reducing the extruder’s capability. Data such as diffusivity, power-law coefficients, melting points, head pressure, viscosity, and crystallinity should be part of the evaluation process. **PT**

**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](mailto:jim.frankland@comcast.net) or (724)651-9196.



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# TOOLING

## PART 2

# Tunnel Gates for Processors

What you need to know to overcome problems out on the production floor.



By Jim Fattori

Tunnel gates can be temperamental. Sometimes they work flawlessly. Other times they're a real challenge. In the last column, I addressed issues from the point of view of the mold designer. Here, I'll cover the more common problems with tunnel gates from the processing perspective, and offer some proven solutions to those problems.

Four very common problems associated with tunnel gates that you may run into are:

- They don't want to come out of their bore;
- They break off;
- They shoot across the mold upon ejection;
- One gate comes out, but another stays put.

If the tunnel gate is machined into the stationary side of the mold and it doesn't want to come out, open the mold about  $\frac{1}{4}$  in. and check to see if the runner is being pulled out of the moving side of the mold. If so, you need to retain the runner better.

Increasing the length of the boss near the tunnel gate, or increasing the amount of undercut formed on that boss, will usually solve the problem. But don't rule out a worn gate or an unpolished bore as contributing factors.

The more common scenario of why a gate doesn't want to come out is because it broke off where the gate meets the runner, or where the runner meets a boss formed by a shortened ejector pin. This is very common with rigid and filled materials. The culprit is almost always a sharp inside edge at their intersections. The solution is to radius the heck out of these areas. It may not look pretty, but it works. In addition to reducing the notch sensitivity in these locations, you'll also increase the mass

***If you have a problem with jetting, it's probably because the material isn't hitting an obstruction or impinging on some type of molding feature right away.***



***If an ejector pin is too close to a tunnel gate, increasing the length of the boss and increasing the mass of plastic at the parting line often fixes the problem.***

of plastic. This extra mass stays hotter longer, and allows the material to be more ductile. If there is room available, you can also increase the included angle of the tunnel gate to further increase the mass of plastic at the parting line.

Increasing the mold temperature on the side of the mold that the tunnel gate is machined into often works, but at the expense of having to extend the cycle time. Some people increase the size of the runner in and around the gate location to increase its flexibility. I don't recommend doing that on multi-cavity molds because it can

affect the cavity balance. Before you try any of these suggestions, make several shots at a faster cycle time. The faster the cycle, the hotter the mold, and the hotter and more flexible the gate and runner become. If you're still making good parts at a faster cycle and the gate sticking and breaking issues went away—you're a hero.

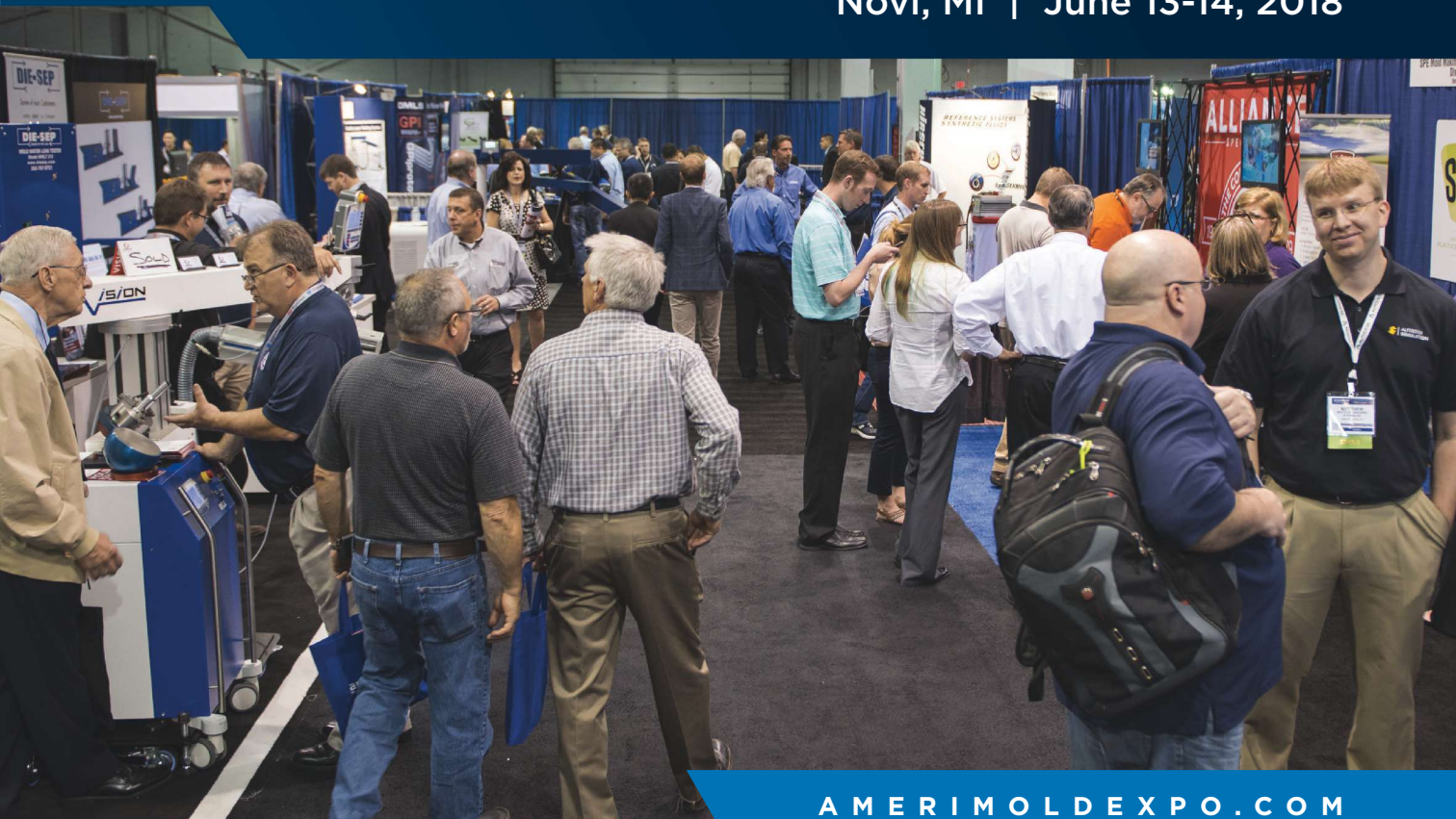
Have you ever gotten grease on your parts because the runner bounces off the leader pins or tiebars before it goes down the ►

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If an ejector pin is too far away from a tunnel gate, adding stiffening ribs to the runner will reduce its flexibility.



Determining the location of the ejector pin that forms a boss for a tunnel-gated mold that will run multiple materials is especially challenging.



Converting elliptical gates to chisel gates often solves a flaking problem.

chute? That often happens when the tunnel gate is machined in the moving side of the mold and the boss next to the gate is too short. The tunnel gate is basically a pre-loaded spring up until the point where it clears its bore. If the boss disengages from the mold before the tunnel gate disengages, the runner becomes a projectile. Extending the length of the boss formed by the ejector pin will usually solve the problem.

For multi-cavity molds, or parts with multiple tunnel gates, it's not uncommon for one gate to come out, while another gate stays put. Usually this happens because one of the ejector pins slides past the runner during the ejection stroke. Again, extending the length of the bosses formed by the ejector pins will usually solve the problem.

For tunnel gates machined into the moving side of the mold, the length of the boss formed by a shortened ejector pin should always be greater than the length of the tunnel gate—not its depth, but its hypotenuse. If you don't have the bearing surface in the mold to shorten the ejector pin by the required amount, or if there isn't enough ejector stroke available (either from the mold or the machine), try putting a point on the tip of the ejector pins. Some people call this a "centering cone." The goal is to keep the boss engaged with the pin, even when the pin is beyond the parting line of the mold.

***If you are fighting a flaking issue, one of the best solutions is to convert the elliptical gate to a chisel gate.***

When a tunnel gate is machined into the stationary side of the mold, the initial mold opening speed can influence the ability to remove the tunnel gate from its bore, and it can affect the condition of the vestige on the part. Conversely, when the tunnel gate is machined into the moving side of the mold, the initial ejection speed can influence the ability to remove the tunnel gate from its bore, and it can affect the condition of the vestige on the part. Since varying these speeds can give you different results, even if you don't see a problem, it's good practice to find out which works better—fast or slow. Then adjust your setpoints accordingly to help widen your processing window.

If you have a problem with jetting, it's probably because the material isn't hitting an obstruction or impinging on some type of molding feature right away. If the material is shooting into a large void, jetting can be difficult to overcome. And if the gate is undersized, that makes the matter even worse. Increasing the gate size is the first thing you might try, because it is usually the least expensive option. Raising the temperature of the core might help, because sometimes the melt bounces off a cold core and squirrels its way farther down the cavity. ▶

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You can also profile your injection velocity—going very slowly from right before the gate until it makes a small molten puddle just beyond the gate. The puddle acts as an obstruction to the material behind it. Once the puddle is formed, you should be able to go back to the desired injection velocity. The downside to this “solution” is that you are now processing around a tooling problem. If you want to fix the root cause, ask if a small core pin directly opposite a gate can be added, specifically to create an obstruction to stop the jetting. The core pin does not need to extend all the way to the cavity, which would form a through hole. It can be left short—with a height approximately equal to the depth of the gate.

The mold designer will select the type of tunnel gate, where to put it, what size it should be, and what method to use to remove it. This is all derived from what he has been taught and learned over the years. But no two molds are alike. What worked 100 times before may not work the 101<sup>st</sup> time. When something goes wrong, the designer and the tool shop would benefit from your input on how to resolve the problem. But first, you must define or describe the problem to them. Nothing does that better than a video taken with your cell phone, played back in slow motion.

**No two molds are alike. What worked 100 times before may not work the 101<sup>st</sup> time.**

The photo at right shows an ugly gate scar from an elliptical tunnel gate machined into the stationary side of a two-plate mold. Notice how the gate scar is rough and somewhat indented. There are also some drag marks on the side of the part below the gate. One of the obvious reasons this happened is because the cutting

edge of the gate is worn. A second, not-so-obvious reason is that the tunnel-gate bore is rough or pitted. A third, not-so-obvious reason is because the gate is rather large, and the runner may be flexing during mold opening.

Large gates have a significant amount of holding force on a part. It's often enough force to pull a flexible runner out of the moving side of the mold during the mold-opening

stroke. Once the holding force of the bent runner overcomes the holding force of the gate, it pulls or rips the gate off the part. Since the inner wall thickness of the part is usually warmer than the frozen gate, it breaks off at the warmer or weaker portion—leaving an indentation in the part. The solution to this combination of problems is to sharpen the gate, draw polish the bore, and increase the rigidity or holding force of the runner.

The most common cause of a runner being too flexible is because the shortened ejector pin that forms the boss is too far

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An ugly tunnel-gate scar is often caused by more than just one problem.

away from the gate. If the pin cannot be relocated closer to the gate, due to a water line or some other obstruction, ribs can be added to stiffen the runner and reduce the flexing. Stiffening ribs can be added to either side of the parting line, or in severe cases, both sides.

Deciding where to locate the shortened ejector pin so that the runner isn't too stiff or too flexible is no easy task. And if the mold has to run more than one type of material, it makes the decision that much harder. One option is to add a second—interchangeable—shortened ejector pin, closer to or farther away from the gate than the existing pin. This gives you the ability to use one pin for one material, and a second pin for a second material.

Got flakes? Last month I touched on how flakes are formed at the tip of any type of tunnel gate, with elliptical tunnel gates being the worst offender. If you are

fighting a flaking issue, one of the best solutions is to convert the elliptical gate to a chisel gate. The tunnel gate pictured on p. 52 is one I modified for a part made of 45% glass-filled nylon 66. You can still see where the elliptical gate used to be. The flaking stopped immediately, and the processing window widened. [PT](#)

**ABOUT THE AUTHOR:** Jim Fattori is a third-generation injection molder with more than 40 years of molding experience. He is the founder of Injection Mold Consulting LLC, and is also a project engineer for a large, multi-plant molder in New Jersey. Contact [jim@injectionmoldconsulting.com](mailto:jim@injectionmoldconsulting.com); [injectionmoldconsulting.com](http://injectionmoldconsulting.com).

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By Matthew H. Naitove  
Executive Editor



# 'Engage, Innovate, Evolve' Future-Oriented Culture At Octex Group

Using science, technology, and talent to give high-tech customers unprecedented speed to market.

How a commodity custom injection molder of cups, lids, and handles remade itself into a proponent of super-precise tooling, cutting-edge metrology, and paradigm-busting validation procedures for the most demanding customers in medical, aerospace, defense, and automotive industries is a story about big ideas and the passion to put them into practice. Ideas about what constitutes a company culture, what a custom molder's business is really about, and what can make plastics manufacturing into a "noble" calling.

Something of what makes Octex different from the norm is evident in talking with Brett Wigton, 32 years old, with two masters degrees in synthetic biology and computer science. His title is chief scientist: "I'm responsible for applied sciences, research, IT, and developmental technology throughout all Octex operating companies." He also leads the company's Office of Scientific Innovation, the advanced development arm and specialized research service for the group. "I conduct professional studies in material science, biological engineering, and mechanical engineering, and use science and technology in parallel to solve complex challenges for the medical, aerospace, and defense industries." How many custom molders have such a job title or job description?

Culture starts at the top. John W. Hoskins, president (right), with Brett Wigton, chief scientist.

And how many molders have such an attitude toward what they do? Listen to John W. Hoskins, Octex president: “Quality is foundational; it’s who you are. We get hundreds of millions of chances every year to affect someone’s life through the parts and tools we make. We play a noble role—helping save someone’s life when they’re sick or undergoing heart surgery, for example. Because we did what we’re supposed to do. We strive to keep that feeling every day—it’s the key to our brand.”

### REMODELING A MOLDING COMPANY

Octex Group in Sarasota, Fla., started out as an injection molder in 1990, but today it is about a lot more than molding. It consists of three businesses with total revenues under \$50 million: the Octex molding business (*octex360.com*), moldmaker Choice Tool & Mold (*choicetool.com*), and metrology services provider Omnia Scientific (*omniascientific.com*).

The transformation started four or five years ago, in a series of conversations between Octex CEO Jim Westman, who bought the molding company in 2009, and Hoskins, who had 30 years’ experience in plastics injection molding, extrusion, and thermoforming. He “grew up in plastics,” in a family business that started in 1918 to make buggy awnings and got into plastics in the 1950s. He sold that business in 2000 and went on to senior positions in consulting and managing other molding, moldmaking, and plastics materials companies.

Hoskins joined Octex in 2014 as executive v.p. and became president last June. He and Westman began to implement the plans they had discussed on how to change the company, which served mostly consumer and industrial customers, to one



Octex has spent at least \$2 million on upgraded facilities, including this expanded main clean room, 6000 ft<sup>2</sup>, Class 8, containing five presses (including two of KraussMaffei’s new CX series), with room for two more.

**“We don’t ‘think outside the box’—there is no box.”**

focused on medical, aerospace, and defense industries. But they had even bigger ambitions, as Hoskins puts it, “to push the edges of technology, move the market forward, do what others can’t do or won’t do.”

Just four years later, Octex Group’s business is about 75% medical/pharmaceutical devices and disposables, 1-2% aerospace/defense, and 23% consumer/industrial. This business transformation resulted from a thorough overhaul of the firm’s physical plant and equipment, and injection of a whole new culture.

Over the last five years, Octex invested more than \$10 million in numerous upgrades and additions. It acquired a 20-year-old moldmaker, Choice Tool & Mold of Largo, Fla., and relocated it to a 15,000-ft<sup>2</sup> former storage building on Octex’s 10-acre grounds in Sarasota. Octex renovated the building and upgraded the tooling operation with state-of-the-art equipment (details below).

In addition, Octex purchased a top-of-the-line CT scanner and other sophisticated metrology equipment for what became Omnia Scientific. Octex also made major investments in IT systems, ERP systems, and a central supercomputer data hub. And the last eight months have seen a total renovation of the main building (70,000 ft<sup>2</sup>) with new floors, LED lighting, and major expansion of clean-room and white-room areas. Noting the shiny new floors throughout the molding areas, Hoskins says, “The whole place looks like a big operating room.”

In fact, the whole 30,000-ft<sup>2</sup> manufacturing area in the main building has been upgraded in terms of cleanliness. The former 4000-ft<sup>2</sup> Class 8 clean room has been expanded to 5000-6000 ft<sup>2</sup> (containing five injection presses), while the rest of the building’s manufacturing area is a Class 8 white room. They have the same air quality, except that the white-room area lacks HEPA filtration and positive air pressure. But all areas are operated under the same FDA GMP standards—e.g., gowns, caps, and measuring particulate ▶



Molding areas outside the clean room are white rooms, held to the same GMP standards. White Room 1, shown here, is convertible to a clean room. It contains a Wittmann Battenfeld MicroPower 15-ton micromolder, the first step into a new business area for Octex.

counts to 5 microns. The facility has the flexibility to segregate and upgrade another 4000 ft<sup>2</sup> of white-room space to a clean room. Also, modular, temporary clean rooms can be erected around machines in the white-room area, if needed.

**“What do customers really want? To get new products to market faster.”**

Octex also upgraded its injection machinery stock, retiring some older presses used to mold cups, etc., and bringing in new machines in several phases. The current line-up includes 25-35 injection machines (the population is still in flux) of 15 to 400 tons. Six new presses arrived in the past year—two 55-ton Engel presses and four KraussMaffei models (65 to 200 tons)

of the new CX series, “with all the bells and whistles,” Hoskins says, including extra valves and switches and a gas accumulator. Octex also bought extra injection barrels in different sizes for the Engel and KM machines. “These give us added flexibility. We can swap barrels in 45 min,” Hoskins explains.

In 2015, Octex also added a Wittmann Battenfeld MicroPower 15-metric-ton, all-electric micro-molding system, one of just a handful of such machines in the world. It has shot sizes down to 0.05 g and can mold parts as small as 0.0008 g with micro and “near-nano” feature capability. It is molding PEEK parts in the 0.02 g range. The entire machine is a Class 5 & 6 clean room with integrated automation and inspection capabilities. Micro parts are a new business direction for Octex, one that Hoskins expects will grow, though it will require additional parallel investments in micro tooling capabilities.

Several more machine purchases are planned, including an Engel two-shot press, a vertical machine, and larger sizes beyond 500 tons. Four new Engel and KM presses are due for installation (and four more are planned) in Launch Center 34, a white room to be dedicated to a demonstration facility for the company’s new quick-launch program, called Launchpad (discussed below). The machine builders will use this as a demo area to show other customers their newest machines, Hoskins says.

Other upgrades coming soon include new Novatec blenders and dryers, as well as a Frigel central cooling system.

Octex is also investing in automation. While most machines already are equipped with Cartesian robots (some able to lift up to 80 lb), a new cell will have two six-axis articulated robots serving two side-by-side presses to laser mark, assemble, test, and box parts. Already in operation is a medical cell in which the end-of-arm tooling (EOAT) for the Cartesian robot cost a whopping \$100,000. It is designed to demold 32 delicate medical parts in 2.5 sec and is equipped with laser and optical sensors for good/bad part detection and for mold protection. Sophisticated controls are necessary to guide removal of groups of parts from multiple angles. The cavities are arranged in vertical rows round a convex curve, so each row is at an angle to the next.

The robot deposits the parts in a home-made device with multiple chutes to achieve cavity separation for quality control. This replaces manual sorting and saves 30 sec per cycle and the need for an operator. “That’s what Lean means to us—eliminating whole processes,” remarks Wigton.



**Extreme automation:** This robot’s end-of-arm tooling cost \$100,000 to demold 32 delicate medical parts from a curved mold face in 2.5 sec, using laser and optical sensors and sophisticated controls. Parts are deposited below in an in-house-developed cavity separation system, which eliminates the need for manual sorting.

## CULTURE IS KING

According to Wigton, all the new hardware and facilities upgrades would be useless without one additional ingredient. “Culture is the most important part of our business,” he asserts.

“Our culture comes down to three words,” Hoskins explains:

- “Engage: Always question things; be proactive—don’t wait for the customer to come to you.
- “Innovate: Take hold of new, fresh ideas; embrace nascent cutting-edge technologies.
- “Evolve: Embrace new partnerships, envision the world you want, and make it so.

“There’s a lot of misunderstanding of what culture really means. People say, ‘We have a culture of continuous improvement.’ We say that is a *byproduct* of a company’s culture, not the culture itself.”

## BIG AMBITIONS

“Our goal is to offer the ultimate in high-precision, high-cavitation tooling,” proclaims Hoskins. Choice Tool is pursuing that ambition in a renovated building with a 32-ft ceiling, new LED lighting, and an engineering area elevated above the production floor—“so

the engineers can keep an eye on things,” Hoskins notes.

The tooling operation employs 15 to 20 people, out of about 100 for the whole Octex group. Octex had a much smaller tool-making capability before integrating the Choice Tool operation.

New state-of-the-art equipment is designed to attract medical and aerospace customers. That includes what Hoskins calls “the most precise, high-speed, five-axis machining center you can buy,” a Yasda system that offers precision to a 20-millionth of an inch on all axes. That one machine alone costs over \$500,000. Plans are to add a robotic loader and a three-axis Yasda system. That will constitute the plant’s “hard-milling” section (capable of milling hardened steel). In coming years, Hoskins aims to add a duplicate of that entire cell. Meanwhile, a new wire EDM machine will arrive soon (the first of a planned three or four); and a new

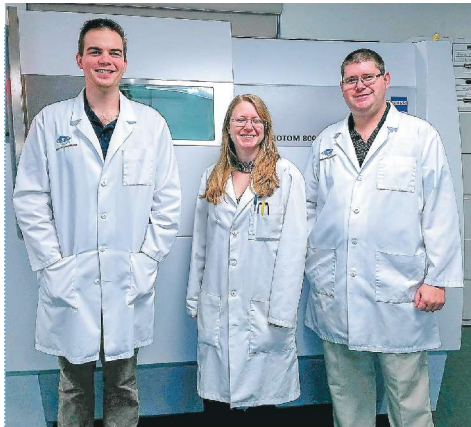
horizontal milling machine will replace several older Bridgeport machines. It will be automated so that it can be loaded up with two days’ work and run unattended. The facility also has a CNC lathe.

Choice Tool is occupied 60-70% with outside tooling business

and builds only about 30% of Octex’s molds. One thing that stands out from its competition is that Choice Tool offers a 3-million-shot warranty (as compared with the usual 1 million shots) for jobs that Octex molds in-house.

Choice Tool has experimented with 3D-printed plastic molds for prototyping. Octex has a Stratasys Objet 30 inkjet-style 3D printer, which it also uses to make robot EOAT, jigs, fixtures, and support structures. Octex is interested in using 3D printing to make plastic production parts, but this requires work on establishing parameters for certifying such parts, Wigton notes.

Choice Tool is involved in projects designed to drastically accelerate the tool development and qualification process. ▶



The heart of the Omnia Scientific metrology lab is the Zeiss Metrotom 800 CT scanner, shown here with (l. to r.) metrology engineer Michael Pare, senior metrology engineer Sarabeth Smith, and Omnia director Thomas Schuler.

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**Choice Tool & Mold's production area, seen from the engineering office. Right: Hoskins with Choice Tool's pride and joy, a five-axis hard-milling machine said to be unmatched for speed and accuracy. Future plans include a three-axis version and a robot loader, and ultimately another duplicate cell.**

One element of that effort is more than three years of ongoing R&D on a "hybrid" manufacturing process for tooling that involves both additive manufacturing—laser sintering of powdered metal—and high-speed machining to final dimensions. Some production tooling has already been built with different variants of this method.

More immediately important to shortening the timeline for tool development is Octex's implementation of world-class metrology facilities at Omnia Scientific. The heart of that operation is the CT scanner, an x-ray imaging device that "provides the most accurate resolution and is extremely fast," according to Thomas Schuler, director of Omnia. This machine costs between \$500,000 and \$750,000. Octex believes it was the first molder of its size to have such a system (see Apr. '16 Processor's Edge).

According to Schuler, it can provide 50,000 measurements in 65-85% less time than conventional CMMs. Beyond that, it can visualize internal geometry nondestructively and can reveal internal porosity, weld lines, and glass-fiber distribution and orientation. Requiring no fixturing, entire assemblies can be measured and then separated or "exploded" in animated views.

Schuler expects the CT scanner to add value to Octex's new micromolding business. That's because the machine registers 2 million voxels (3D pixels) per scan, regardless of the size of the part, which translates into much greater resolution on micro parts.

"What's unusual about Omnia," Schuler adds, "is that it's a metrology business run by plastics processors. Anyone can report measurements, but they can't tell you why the measurements are the way they are."

He cites the example of parts from a 32-cavity hot-runner system that was unbalanced. Omnia was able to measure all 32 parts and overlay each part on a CAD model to determine the variances, and then place those parts on a CAD image of the mold to help understand how the runner system needed to be balanced.

Two case histories illustrate how the CT scanner has helped Octex penetrate the medical molding business. In one case, resorbable surgical implants were cracking, and the OEM spent three years unsuccessfully trying to find the root cause. "With the CT scanner, we solved it in two weeks," Wigton says. "It was a processing issue."

In a second case, a biomedical storage medium required ability to withstand immersion in liquid nitrogen for up to 10 years while retaining a hermetic seal. The OEM could not find a way to make the product pass this test. According to Wigton, "We solved it with the help of the CT scanner, and now this is one of our biggest customers."

Omnia Scientific's staff of fewer than half a dozen has other remarkable metrology resources. Two Instant Measuring Machines from Keyence Corp. of America use optical sensing and ring illumination to measure up to 99 critical dimensions in 3 sec with accuracy of  $\pm 2 \mu$ . 3D microscopes are also used for production QC.

Omnia is looking into inspection capabilities that even go beyond that of the CT scanner. One is transmission electron microscopy, to look for porosity in micro parts. Another is XRAD, which Hoskins describes as a hybrid of CT scanning and x-ray microscopy. It has the advantage of revealing surface morphology, unlike CT scanning alone.

Fast and accurate measurements are only half the story: Omnia Scientific supports that ability with a super-fast, high-capacity IT infrastructure. This was Wigton's first project; he completely redesigned the company IT capability to acquire and store all the data from all the Octex operations and to provide data security. He installed a fiber-optic data superhighway to transfer data from all the plant's machines to a supercluster. The data are encrypted for storage on-site and backed up in the cloud to a redundant network of seven different data centers.

Wigton says his network can handle transfers of up to 250 terabytes (1 TB = 1024 GB), which he claims is equivalent to the capacity of a national cell-phone carrier. Why so much capacity? One CT scan can generate up to 10 GB of data, and one mold might require scans of up to 32 parts. To illustrate what that means, Wigton says, "To put 10 GB on a flash drive takes 10 min. To download that data to a central computer takes another 10 min. Multiply that by 32. My system can do a direct transfer in 2 min per scan, with no USB drive."

This central computer handles more than metrology data. It will be linked to the firm's IQMS production monitoring system and to process data from the injection-machine controls. "Every keystroke is monitored by the central computer," Wigton says. "And I can shut down anything in the plant from my phone in 30 sec, if necessary."

**REAL-TIME FIRST-ARTICLE INSPECTION**

World-class metrology and a high-capacity data network add up to what Hoskins considers to be his firm's key strategic advantage: "real-time first-article inspection." This requires some explanation:

A CT scan takes 1 hr for each of 32 cavities: That's 32 hr to collect the data. According to Wigton, it then usually takes weeks more to process the "point cloud" of data and resolve it into dimensional measurements. "That's weeks to obtain usable data—versus 5 minutes for us." He says there was no software available to do this, so Octex wrote its own. So "real-time" in this case means, "As fast as we can scan, we can get usable data. We can load all 32 point clouds and 10 sec later, we start getting measurements."

This is the key to competitiveness for Octex. Says Hoskins, "I can't fight somebody who has nine plants and 2000 machines. But I can do things nobody else can. Others just want the manufacturing part; they see validation as a nuisance. For us it's a core strategy."

Adds Wigton, "We have competitors in molding, in metrology, in tooling. But not all three together. That means we can do all the qualifications here, so the customer gets into production faster."

"And what do customers really want?" asks Hoskins. "To get new, innovative products to market faster than ever before."

**ACCELERATED LAUNCH PROCESS**

These synergistic capabilities—tooling, molding, and metrology—have led Octex Group to propose a new paradigm for product launches. Called Launchpad, Octex claims it can offer 40-90% reduction in tool-build time, 45-75% reduction in tool cost, and 60% reduction in time to market.

The usual process can easily take 45 weeks from the start of design validation through production tool build, tool qualification, and production process and validation development. With the new process, spearheaded by Omnia Scientific, that

process can be collapsed to 30-35 weeks.

The difference, Hoskins explains, is that the different phases of the launch process are typically handled by

different groups with different cultures—resulting in "loss of fidelity," as Hoskins puts it. "But we have all the pieces of the puzzle under our roof. So we can conduct different phases *concurrently*. Our goal is to compress the usual eight- to 12-week tool-build process into just three weeks. This is what OEMs have been begging for." Octex plans to introduce Launchpad in May at NPE2018 in Orlando, Fla. [PT](#)

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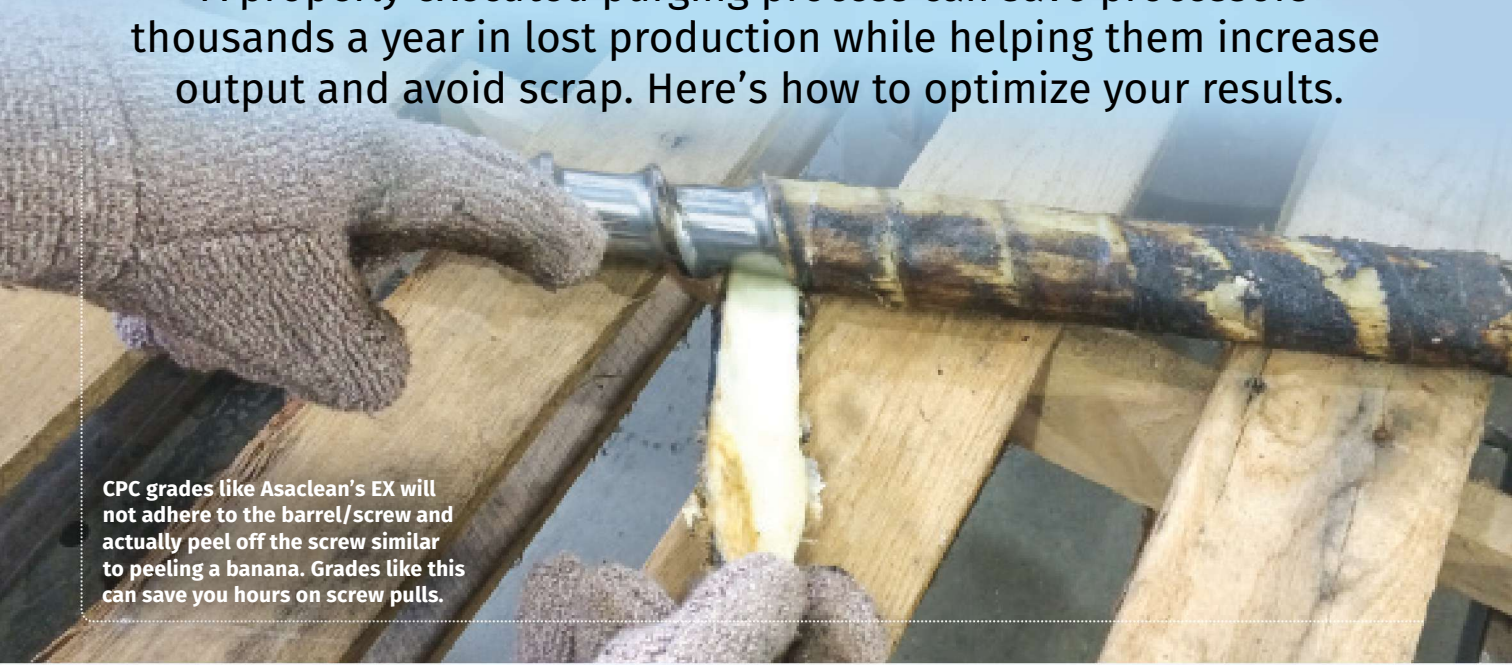
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# Follow These Tips to Power Up Your Purging Process

A properly executed purging process can save processors thousands a year in lost production while helping them increase output and avoid scrap. Here's how to optimize your results.



CPC grades like Asaclean's EX will not adhere to the barrel/screw and actually peel off the screw similar to peeling a banana. Grades like this can save you hours on screw pulls.

This article is an adaptation of a technical presentation given by Jeremy Cooley at *Plastics Technology's* Extrusion 2017

By **Jarred Packard**  
Sun Plastech Inc.

Conference, held Oct. 18-20 in Charlotte, N.C. Cooley is a technical sales representative at Asaclean-Sun Plastech Inc. and has

spent the past 15 years focusing on helping processors develop robust purging programs. These eight tips are aimed at helping processors increase output, lower production costs, reduce machine downtime, and decrease scrap rate.

## PROPER GRADE SELECTION

All purging compounds are not created equal. Some grades may work extremely well for certain applications and resins but are completely ineffective in other situations. Understand what you are working with before you put something in your machine. When selecting a commercial purging compound (CPC), a good strategy to start with is determining compatibility with the resins you are running. Before beginning, ask yourself the following questions:

- 1) What are my expectations of this CPC?
- 2) What challenges do I face?
- 3) Do I struggle with contamination (black specks, color, etc.)?

If you can set quantifiable goals, you can check the results against them at the end of the trial. Depending on the machine, the application, and the answers to the questions above, a chemical purging compound might provide a distinct advantage over a mechanical purging compound, or vice-versa. Mechanical CPCs use the machine's power to create pressure and agitation in the barrel. These types of purge rely on higher viscosity, additives, and inorganic minerals to

## WHAT YOU WILL LEARN

1. **CPCs ARE NOT ALL THE SAME.** What works in some situations may be ineffective in others. Grade selection is critical.
2. **COST SAVINGS.** Look beyond the per-pound price of CPCs to the cost savings they can offer. Analyze the cost factors.
3. **PREVENTIVE PURGES.** These might make sense to remove deposits before they have a chance to settle in.
4. **READ THE LABEL.** Follow the supplier's instructions to set up a baseline, but don't be afraid to experiment thereafter.
5. **DISCO PURGING.** This procedure creates turbulence in the machine to remove set-in layers of contaminant.



clean the barrel. Chemical CPCs are used in lower-pressure applications, such as extrusion, blow molding, etc. This type of purging compound uses an endothermic chemical reaction that expands to create the pressure and agitation necessary to clean the barrel. Depending on the grade and severity of the problem, this reaction generally requires 5 to 30 min of soak time in the barrel. If you don't make sure you're using the right grade, there's a good chance that your contamination and changeover issues won't improve.

## CHANGEOVERS

Changeovers are unavoidable for almost all processors. In cases of changing resins or colors, the previous resin/color can sometimes linger in the barrel, creating scrap. The material will travel through the barrel following the path of least resistance, which causes layers of resin to accumulate over time. Resin alone cannot remove these layers as effectively as a CPC can. Changeovers introduce a way for the layers to "shake loose" because the machine is not at steady state. Figure 1 shows how contamination and layering can occur. By not purging during the last changeover, an operator might see some of those layers come out in the next product. In other words, there's a ripple effect of not purging during every changeover.

It is critical to understand your total machine downtime cost in order to truly understand how well the purging compound is working. This requires gathering a bit of data, but it is necessary to quantify a purging trial. So rather than subjectively determining "it was OK" or "good," you can make decisions based on concrete data.

Figure 2 details a profile extruder's real-world cost-savings analysis for its changeovers. This particular processor was using virgin HDPE to purge. The changeover took it 2 hr, and it calculated that since the machine runs at \$100/hr, the downtime cost was \$200 per changeover. They used 25 lb of purge material, priced at 75¢/lb, to give a changeover material cost of \$18.75. Adding in the machine downtime cost equates to a total purge cost of \$218.75. Assuming this profile processor performs five changeovers a week for 48 weeks in a year, this computes to \$52,500 annually. If you bring additional staff onto the line to help speed up the changeover, how much more is that purge costing you in terms of labor?

## SHUTDOWN & SEALING

One of the most often overlooked functions of a CPC is to use it to shut down and seal. Unless your operation runs 24/7/365, you will have periods of extended downtime for holidays and weekends. Even if you do run 24/7/365, you'll eventually have shutdowns for preventive maintenance and repairs. In any of these circumstances, sealing the barrel with a CPC will help prevent degradation-causing oxygen from entering the barrel, thus reducing carbon from settling into the system. Another benefit to shutting down and sealing with

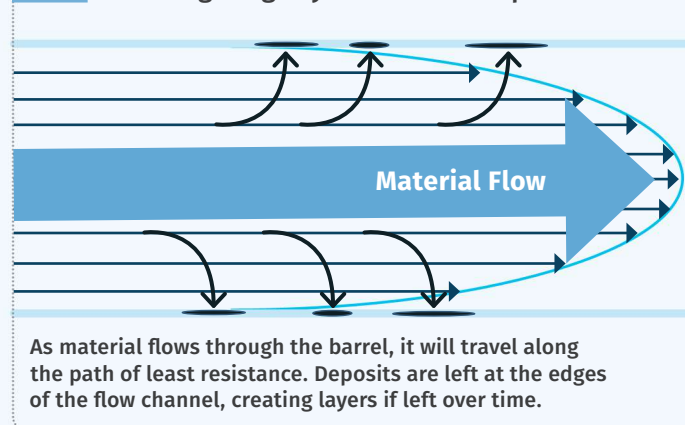
a purging compound is that starting up is much easier, because the production resin can be run directly after the purging compound is purged. The barrel will be clean and free of contaminants, so a start-up step is eliminated by using this method.

## SCREW PULLS

For difficult changeovers (black to natural or white, for example), a screw pull can be an effective option. Pulling a screw is time consuming and labor intensive, but using a CPC can significantly lighten that burden. By running the barrel full of certain CPCs, then pulling the screw, the technician could have to exert significantly less force to pull the screw and also have much less manual cleaning to do, because the purging compound does a good portion of the cleaning. This decreases the overall changeover time. There is even a grade on the market available that will not adhere to the barrel/screw and peels off the screw similar to peeling a banana (see photo at left).

*If you're worried about increasing production numbers and decreasing scrap rates, preventive purging can be a life saver.*

FIG 1 How Lingering Layers Create Scrap



## PREVENTIVE PURGING

If you're worried about increasing production numbers and decreasing scrap rates, preventative purging can be a life saver. The first step in establishing a preventive purging program is to start tracking production rates, changeover time, and even the amount of purging material used during changeovers. When production rates start to fall, it might be time for a preventive purge, even if it is not time to change over. This method effectively removes deposits in their beginning state and prevents them from settling in and becoming more difficult to remove. ▶

## QUESTIONS ABOUT PURGING?

Learn more at [PTonline.com](http://PTonline.com)

Visit the Purging Zone.

## FOLLOW DIRECTIONS

A common mistake with CPCs is not following supplier instructions. While experimentation is encouraged, it should be conducted only after establishing a baseline by following the step-by-step purging instructions. Try purging with or without the die, or purge with the screen packs in or out. Maybe consider other grades of purge compound, and increase temperatures by about 50° F where extra cleaning is necessary (like areas of heavy contamination). Optimization is always the end goal of every process, and your purging program is no exception. Consult with a purging expert before you decide to experiment on your own.

## ANALYZE COST FACTORS

Smart companies will thoroughly and continuously examine processes to evaluate where cost can be reduced. If you're not already keeping track of changeover time, scrap rate, production reject rate, and lost production due to downtime, start now; you can't know if the changes you make are working unless you know where you started. Being consistent is also critical to accurately understand whether your efficiencies are improving.

***If you're not already keeping track of changeover time, scrap rate, production reject rate, and lost production due to downtime, start now.***

One of the most common objections processors have about purging compounds is that they are priced more expensively than regrind or virgin resin. But you should also consider the costs associated above, and see that scrap rate, production reject rate, and changeover time will all increase by not using a CPC.

If you think about these costs in terms of cost per purge, rather than the cost per pound of CPC, you'll see that the purge compound will actually save you a substantial amount of time and money. Refer again to Fig. 2. In a trial using 5 lb of Asaclean's U-grade purging compound, the changeover took 20 min., reducing the machine downtime cost from \$200 to \$33 and lowering the changeover material cost from \$18.75 to \$16.70. This results in a \$49.70 total changeover cost

**FIG 2** A Profile Processor's Purge Cost (Virgin Resin vs. CPC)

	Virgin Resin	CPC
<b>Changeover Time</b>	2 Hr	0.33 Hr
<b>Machine Running Cost</b>	\$100/hr	\$100/hr
<b>Machine Downtime Cost</b>	\$200	\$33
<b>Amount of Material Used</b>	25 lb	5 lb
<b>Price of Material</b>	75 ¢/lb	\$3.34/lb
<b>Changeover Material Cost</b>	\$18.75	\$16.70
<b>Total Changeover Cost</b>	<b>\$218.75</b>	<b>\$49.70</b>

**Profile processor slashed 83% in changeover time and cut changeover cost by 77% by using CPC to purge as opposed to virgin HDPE.**

using CPC as opposed to the \$218.75. Assuming the same five changeovers a week for 48 weeks a year, this totals a cost of \$11,928 annually. The customer would save \$40,572, or 77% annual savings in changeover cost simply by using CPC instead of virgin resin.

What about home-made purges? Some think in-house purges are better because they are less expensive. However, ask yourself these questions if you are using an in-house purge: Is my in-house purge resistant to oxidation? If I shut down

and seal with my in-house purge, will I have defect-free product when I start up again? Am I positive my in-house purge is not adding another layer to the contamination? If the answer to any of these questions is no, and you are looking for a better way, maybe changing to a CPC is the way to go.

## DISCO PURGING

This tip is specific for extrusion and is even effective for twin-screw setups. As mentioned earlier, not purging during every changeover can cause long-term contamination issues.

However, using a purging compound and a technique known as a "disco purge" lets the machine do the work and remove those set-in layers.

In a disco purge, the operator runs the machine at the maximum safe speed, then stops the screw abruptly, repeating that process several times. This allows the purge material to settle into those layers when the machine is not running, but when it starts up again, it creates more turbulence and starts to remove the layers with the CPC. Repeating this process removes more and more of the layers, and eventually the remaining contamination should shake loose and come out before running the next product. PT

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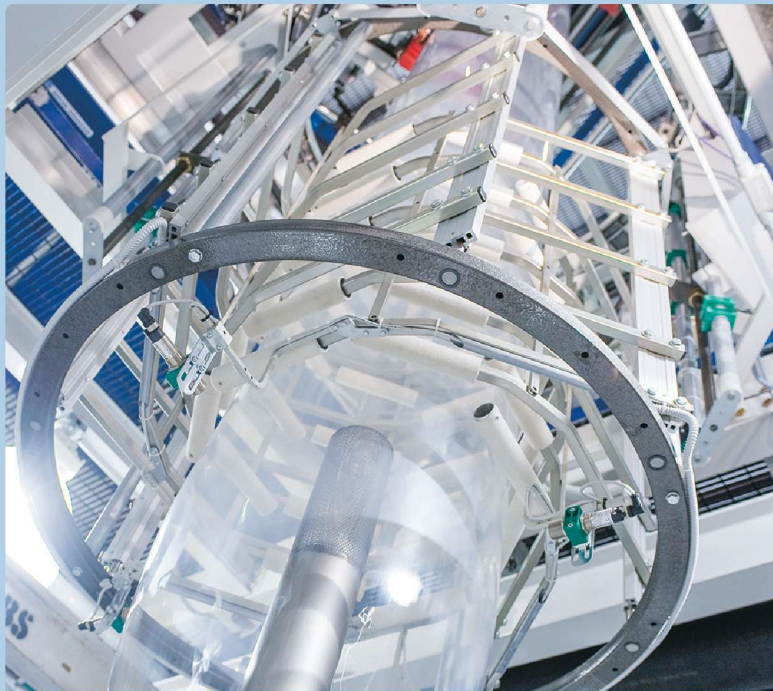
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# What is Your Extruder Trying to Tell You?

Being in tune with your film extrusion equipment will allow you to identify issues before they start impacting production.



Dow has a full-scale production seven-layer blown film line furnished by Hosokawa Alpine American at the Pack Studios facility in Freeport, Texas. The system is used for customer trials and also by Dow for process optimization and troubleshooting.

Extruder wear can cause serious issues in polyethylene film production, resulting in decreased output rates and increased costs. Some

challenges include loss of throughput, poor melt-temperature control, decreased mixing, gel generation, and increased energy usage.

Many times, the amount of wear in an extrusion system happens gradually, and often the issues can go unobserved until it is too late.

There are certain indicators that plant operations should monitor to determine the onset of extruder wear and possibly when the extruder screw should

be replaced. In this article we will take a look at key process-control points and data that could indicate a change in the process due to extruder screw wear.

## DEVELOP A STANDARD METHOD—BASELINE

One key to using your process-control system to identify possible extruder wear is to create a baseline using a standardized method and formulation. Ideally this baseline would be created when the line is new and operating at its maximum efficiency. However, a

process baseline can be created at any point in the extruder's life.

Creating a baseline of performance is a fairly simple process, and there have been many articles written about how to properly baseline your system. One point that is often overlooked when talking about how to baseline an extrusion system is the need for a standardized formulation. When baselining a system, you should try to minimize any variation when generating your data.

One way to do this is to run the same formulation each time you generate the data. The formulation should preferably be simple and not include blends, in the

spirit of reducing variation. However, if you choose to use a blend in your standardized formulation for creating your baseline data, it is important to ensure, to the best of your capability, that the blend is exactly the same each time.

***As a rule of thumb, it is considered time to replace the screw when the flight clearance increases by 4 times the original clearance.***

## QUESTIONS ABOUT EXTRUSION?

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By **Wes Hobson and Mike Rutkowske**  
The Dow Chemical Co.

Now that you have your standardized formulation identified, it is time to standardize the process. To do this you would want to find a set of conditions that best represents your desired production targets. Usually this target is based on some production value established by management. Using your standardized formulation and process conditions, now generate your baseline data. Sufficient time should be allowed for your process to reach a steady state and ensure a homogenous extrudate. Data should include head pressure, melt temperature (using a probe submerged in the center of the melt), motor load, motor rpm, specific rate (lb/[hr rpm]), frost-line height, extruder heater output, and film quality. Additionally, measuring film properties at these conditions and looking for film quality or performance fade over time is a good indication of extruder issues.

#### SIGNS OF WEAR: WHAT TO LOOK FOR

After creating a baseline of performance, it is recommended that this same data set is generated on some routine frequency. It is important to note that screw wear happens over a long period of time and the amount of wear typically is very small unless there is some catastrophic failure. Some conditions and resins or formulations can increase wear and significantly shorten screw life. Running an extruder at the upper end of the rpm range can not only damage the motor, but the amount of shear generated in the extruder can shorten screw life. Combine this with very high melt temperature, and a formulation that includes acid copolymers and/or high amounts of abrasive materials like talc or calcium carbonate can work as a perfect storm and greatly shorten screw life.

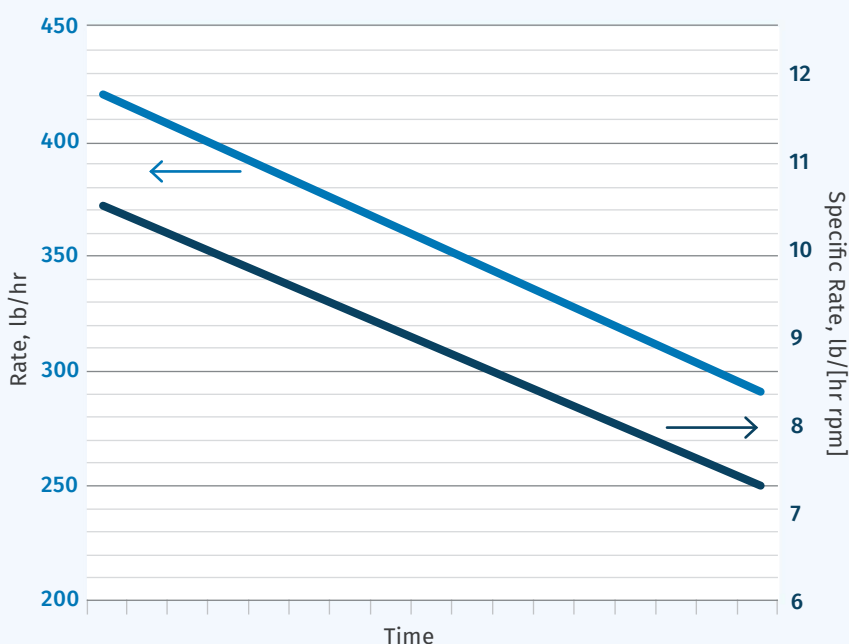
So how can we use our control system to tell us that we may be having a problem? Once we have the baseline data, the extrusion system should be spot-checked to see if there is drift from the baseline. The most common and apparent sign that something has changed in the extruder would be the need to run a different screw speed vs. baseline to achieve the specified target rate. As a screw wears, you could see a decrease or increase in specific rate, which would result in a need for higher or lower

extruder rpm to achieve the target rate. An increase in specific rate may not be a bad thing, but often as a screw wears you'll experience a loss of efficiency, which will result in a need for higher rpm at the same rate. This is especially true for blown film applications, where the discharge pressure is relatively high. Additionally, if you are experiencing a loss of efficiency in your system that results in a need for a higher screw speed, you will experience higher energy usage for that system.

Another key indicator often overlooked is the heater output. As you establish your baseline data, you should look at the heater output for each of your extruder zones and catalog this. This can typically be seen on the control panel as an output percentage or total amperage draw. As the screw wears you will lose some shear heating due to the distance

*When baselining a system, you should try to minimize any variation when generating your data.*

**FIG 1** Screw Wear Over Time



As the extruder wears, the efficiency could suffer, reducing production.

between the flight and the extruder wall increasing. As this happens, the mechanical heaters will be called on to provide more energy to each zone to maintain temperature targets for each zone. Therefore, you will see gradual increase in heater output over time, which would indicate wear. The zones most influenced by this would be the compression zone through the end of the screw, especially where a mixing element may be placed in the metering section. ▶



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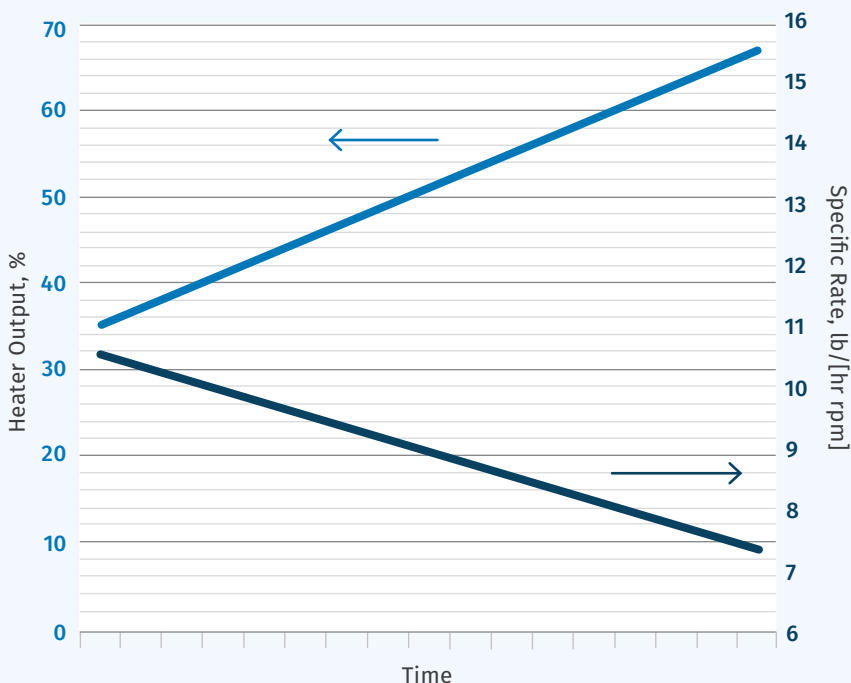
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Film quality should be monitored and cataloged as a key indicator of extrusion performance and can be used to determine extruder wear. It was mentioned earlier that an increase in specific rate may not be a bad thing. That is not always true. A problem that may appear with higher specific rate could be degradation via higher shear heating. An increase in background gels—gels that constantly appear in the

**FIG 2** Screw Wear Over Time vs. Heater Output



As the screw wears, shear is decreased, causing the heater to add more energy to maintain setpoint.

film—may result from degradation due to shear heating. An increase in unmelt gels in a system could result from a loss of efficiency in the mixing element. Another symptom of mixing issues would be high melt-temperature variation and/or mixing issues that manifest themselves as film abnormalities.

A good way to measure the melt-temperature variation would be to use a variable-depth thermocouple. With your transfer-line pipe temperature setpoint near the extrudate temperature, start with the thermocouple retracted as far out of the melt as possible. Take a reading, then insert the thermocouple into the melt one complete turn and stop. Allow the measurement to come to a steady state, then take a reading and repeat. Continue this procedure until you have reached maximum extension. Now take the data and look at the amount of temperature variation across the melt. If you see less than 10° F variation, you have good homogenization of the melt. If your data shows more than 20° F variation, you have poor melt homogenization.

**Film quality should be monitored and cataloged as a key indicator of extrusion performance and can be used to determine extruder wear.**

**WHEN IS IT TIME TO REPLACE YOUR SCREW?**

After you have established your baseline data and tracked your extruder performance over time, it is important to set a target range for optimal performance. When the system wear causes you to fall outside your optimal performance metric, it is time to consider replacing the extruder screw.

The optimal performance metric could be a balance of extruder output/ energy usage. If you can still maintain your target production rate, but because of screw wear you are operating at too high a screw speed and using more energy, you may find it valuable to replace your screw to increase your extruder efficiency. The next step

would be to pull the screw and measure the tolerances to determine the amount of wear. As a rule of thumb, it is considered time to replace the screw when the flight clearance increases by 4 times the original clearance. For example, the typical flight clearance is the diameter divided by 1000. Thus, a 6-in. screw would have a clearance of 0.006 in.

Based on the process meeting our

defined performance metric, if this screw were pulled and measured at a clearance of 0.024 in., it would be recommended to replace the screw.

Being in tune with your extrusion equipment will allow you to identify issues before they impact production. Creating a baseline set of data from a standardized formulation and standardized process conditions will be critical when trying to track extruder performance over time to identify potential issues. Aside from generating data, film-quality fade over time should be monitored, as this could also be a key indicator of something wrong in your extrusion system. Finally, establish some target metric to determine when to replace the screw, then replace it as soon as this tolerance is exceeded, to improve efficiency and reduce cost. [PT](#)

*As you establish your baseline data you should look at the heater output for each of your extruder zones and catalog this.*

**ABOUT THE AUTHORS:** **Wes Hobson** is a senior engineer in The Dow Chemical Co.'s Performance Plastics Technical Service and Development group in Freeport, Texas. He has 22 years of experience focusing on cast and blown film and sheet extrusion. Hobson is currently application development leader in Dow's Industrial and Consumer Packaging group, focusing on stretch film. He has a Master's Degree in Packaging Science from Michigan State University and is a member of ISTA and the Society of Plastics Engineers. Contact: 979-238-1610; [jhobson@dow.com](mailto:jhobson@dow.com); [dow.com](http://dow.com).

**Mike Rutkowske** is a senior technologist with The Dow Chemical Co. and has 13 years of experience in polymer research and technical development. He has spent the majority of his time operating both small and large-scale packaging equipment (blown film, twin-screw extrusion, extrusion coating, etc.). He is an author of one patent and has significant experience in optimizing fabrication processes and equipment. Rutkowske is currently in the process of completing his BS in Mechanical Engineering Technology from the University of Houston and is a member of TAPPI. Contact: [mrutkowske@dow.com](mailto:mrutkowske@dow.com).

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## PRODUCT FOCUS Materials



MATERIALS

### High-Temperature PPA For Metal Replacement

A new higher-temperature PPA has been introduced by Evonik Corp. (U.S. office in Parsippany, N.J.). New Vestamid HTplus TGP3717 also offers very good chemical resistance and dimensional stability. Due to its high crystallinity, the resin can withstand mechanical stress at up to 135 C (275 F); its glass-transition temperature is 155 C (311 F). It also retains 85% of its original modulus of elasticity at 120 C (248 F). The Vestamid HTplus line was developed specifically to substitute for metal. 973-929-8000 • [evonik.com](http://evonik.com)

### MATERIALS No-Post-Cure LSR for Baby Care, Medical, and Food Contact

New from the German parent of Wacker Chemical Corp., Adrian, Mich., is Elastosil LR 5040, a liquid silicone rubber (LSR) that reportedly shows excellent mechanical properties without post-curing. Its low volatile content complies with regulatory specs for sensitive applications in baby care, medical, and food-contact uses. In many cases, post-cure will not be needed, Wacker says.

Parts made of Elastosil LR 5040 are translucent with a delicate blue shimmer. Volatile content without post-treatment is below the required 0.5%. Tear strength without post-cure is said to be equivalent to that of a post-cured high-strength standard LSR. The line initially covers a hardness range of 30 to 70 Shore A. Without post-cure, hardness of the product reportedly deviates by no more than  $\pm 3$  durometer points.

888-922-5374 • [wacker.com](http://wacker.com)



### MATERIALS

### New 'Recyclable' Barrier Polyester for Multi-Layer PET Bottles & Films

A new barrier polyester for use with PET in bottles and films was launched in September at the Drinktec 2017 show in Munich, Germany. Verian High Barrier Polyester (HBP) was introduced jointly by the resin producer, Solvay Specialty Polymers (U.S. office in Alpharetta, Ga.; [solvay.com](http://solvay.com)) and injection machinery and tooling builder Husky Injection Molding Systems, Bolton, Ont. ([husky.co](http://husky.co)). Husky ran its HyPET HPP5 multi-layer injection molding system with the new resin, producing 17-g carbonated soft-drink preforms in a 72-cavity mold on an 8.7-sec cycle time. The three-layer system sandwiched a thin barrier layer of Verian HBP between inner and outer layers of PET.

The material is said to be in the final stages of development, with production to begin in the second half of this year. Solvay currently declines to discuss details about Verian's barrier or other properties, or its compatibility with the PET recycling stream. Solvay states only that Verian HBP is based on polyglycolide chemistry, is "recyclable," and will "enable a new generation of sustainable packaging solutions for PET bottles and films."

There is one other glycolide barrier polyester on the market—Kuredex PGA (polyglycolic acid) from Kureha America Inc., Houston ([kuredex.com](http://kuredex.com)). That premium material boasts high barrier to oxygen, carbon dioxide, moisture and flavor/aroma chemicals. It also is compostable, similar to cellulose, according to Kureha.

## MATERIALS

## Marine-Grade PC Sheets

A new family of marine-grade PC glazing sheets for flexible boat enclosures are now available from Covestro, Pittsburgh. These specially formulated Makrolon marine-grade sheets boast a glass-like, wrinkle-free appearance.



Combining long-term clarity with durability, Makrolon PC sheet provides a clear, unobstructed view in flat or curved applications. These low-distortion, high-impact products can be adhesive bonded or sewn using commercial, heavy-duty sewing machines. They are said to withstand the harshest environments, including salt and sun exposure. Makrolon Marine 5 PC sheet carries a five-year limited warranty for micro-cracks, yellowing, and breakage. It boasts low optical distortion and two-sided hard-coat protection against abrasion, UV, and chemical attack. It comes in 0.060 and 0.080 in. thicknesses. **844-646-0545 • covestro.com**

## MATERIALS

## New Nylon & PET Electrical Compounds

DowDuPont Specialty Materials, Wilmington, Del., has introduced two new electrical/electronic grades. One is Rynite FR533NH, the company's first halogen-free PET compound for IT equipment such as chargers, transformers, relays, switches, and motors in unattended household appliances. Containing 33% glass, it reportedly offers improved flow and lower density than halogenated PET compounds, which makes it a more economical solution. It also boasts "the best long-term heat-exposure performance in the market," DuPont says.

The second new product is Zytel LT70G35EF, a laser-transparent black nylon 66 with 35% glass, suitable for automotive electronics. It eliminates the need to laser weld a clear part to a black part—now both parts to be joined can be colored black, as automotive customers have wanted. Also, its electrical properties are said to be stable after exposure to 85 C and 90% RH. **800-441-0575 • plastics.dupont.com**

## MATERIALS



## 3D Printing Filaments From New Source

Standard and customized 3D printing filaments with special features and color options are available from the new 3D Printing business unit of Clariant Corp. (U.S. office in Charlotte, N.C.). The company 3D prints and tests all of its material to ensure printability and the required consistent high quality. Extensive material, application and production expertise allows the company to work closely with customers on polymer, additive, and colorant selection to address typical end-use conditions such as weathering, flame retardance, and electrical properties.

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## BLOW MOLDING

## 'Individual Mold Control' for PET Reheat Stretch-Blow Machines

Agr International, Inc., Butler, Pa., a specialist in quality-monitoring and process-control systems for PET stretch-blow molding ([agrintl.com](http://agrintl.com)), has teamed up with KHS, a major supplier of reheat stretch-blow machines (U.S. office in Waukesha, Wis.; [khs.com](http://khs.com)), to add another level of control for PET bottle making. The two firms worked to enhance Agr's Process Pilot controls with new Individual Mold Control for KHS Series IV and V machines. Monitoring the performance of individual molds through the Process Pilot system can quickly identify and correct issues at individual mold stations and

captures valuable mold performance data that can help determine the optimal time for system maintenance.

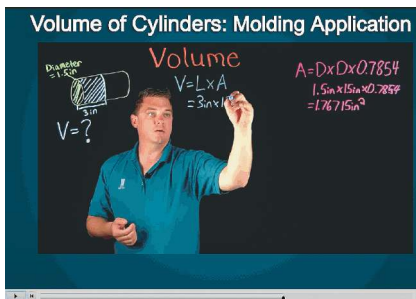
Agr's Process Pilot system works with the blow molding machine to proactively manage and maintain container material distribution at a specified thickness within around 0.01 mm. This is accomplished by continuously monitoring each bottle for material distribution, analyzing minute changes, and adjusting the machine controls accordingly. Individual Mold Control takes this to the next level by eliminating mold-to-mold variability that is common in PET bottle production.

## INJECTION MOLDING

## New eLearning Course on 'Math for Molders'

RJG Inc., Traverse City, Mich., has introduced its first eLearning course, "Math for Molders." It develops foundational math skills needed in the field and for more advanced RJG courses.

The online course allows students to complete each module at their own pace, including the option to replay sections as needed. It takes an average of 9-10 hr to complete. There are eight units in the course, each with multiple interactive modules that include videos, animations, and practice activities. Using



real scenarios, molders will be better prepared to calculate data, enabling them to match mold requirements with appropriate machines and avoid common defects while preventing machine and mold damage.

Some course highlights include calculating areas of various shapes and total projected area at the parting line; ratios used in screw design and hydraulic intensification ratios; and volumetric shot size and barrel capacity.

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## EXTRUSION

## Quick-Change Manual Screen Changer

New-generation manual screen changers from Nordson Corp. reportedly reduce by 50% the force required for switching screens on an extrusion line, making easier a task that typically tests the strength of machine operators. Like Nordson's standard manual screen changers, the new BKG NorCon EMR and XMR models provide a less expensive alternative to stationary screen-changer systems. The operator replaces a contaminated screen with a clean one by turning a handle or lever that activates an indexing system. The new EMR and XMR screen changers contain a ratchet mechanism that reduces the force required to turn the handle. This mechanism can also be retrofitted



onto corresponding standard models EM and XM, at either the customer's plant or a Nordson technical support facility. While EMR and EM units are for use with extruders sized in inches, the XMR and XM units are for metric equipment.

Available standard NorCon manual screen changers range from 10 to 65 in. for EM units and 30 to 120 mm for XM units. EMR and XMR models are available in most of these sizes. 828-326-9888 • [nordson.com](http://nordson.com)

## EXTRUSION

## High-Speed Stretch-Film Line

A new stretch-film line from Davis-Standard, Pawcatuck, Conn., is said to set a benchmark for modular efficiency for high-grade stretch-film operations. Installed in early 2017 at an undisclosed, large North American film producer, this line reportedly offers a compact layout, ease of operation and servicing, excellent profile control, consistent roll quality, and an intuitive control package to produce film at thicknesses from 7.8 to 13 microns at high speeds.

Davis-Standard's side-by-side DS S3 overlapping winder (photo) is essential to this capability. The S3 winder enables maximum slit widths for hand-wrap, machine-wrap, and jumbo rolls, supporting multiple market segments on one winder. Films discharge from the front of the line to a common side to simplify roll packing and future automation. Cores are also same-side loaded from the back to prevent disruption of packing activities. There is an auxiliary lay-on roll to eliminate top-wind waste during transfer, optimizing roll quality and eliminating outer-wrap transfer waste.



High-volume core bins minimize refilling frequency and feature simultaneous core-set discharge of multiple core lengths while also decreasing cycle time, improving slit-width flexibility, and net film utilization. Core widths can be changed on the fly to maximize uptime. There is a 30-sec cycle time regardless of the number of slit widths, which is ideal for hand-wrap products. A pull-through trim system reportedly eradicates trim jams into the granulator regardless of line speed or film thickness. Motor-driven web-support rollers with an air-venting finish improve film transport at high line speeds, providing high-quality roll formation. The air-venting idler-roll finish locks film on the rolls at low tension for excellent tracking and roll edge straightness.

In addition to system components, an over-the-line mezzanine accommodates a smaller footprint, while also enabling safe servicing of the extruders, screen changers, melt pipes, and associated control systems. With the unique "through-the-mezzanine feedblock riser," there is safe and convenient access to the selector plug for layer-sequencing changes. Selector plugs can be changed with minimal downtime, allowing product flexibility in layer-sequencing to easily accommodate production schedules. 860-599-1010 • [davis-standard.com](http://davis-standard.com)

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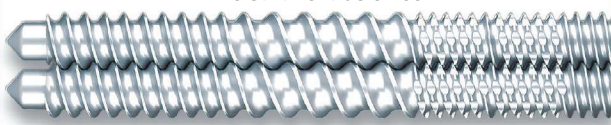
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## EXTRUSION

## Extrusion Line Control System

The new maax 400S extrusion control system from Maag (U.S. office in Charlotte, N.C.) can control up to four variable-speed drives and can be upgraded up to a maximum of 32 heating/cooling zones in the basic software configuration. The maax 400S retains the intuitive user control, screen page layout, and color concept of Maag's existing controllers. It also enables customer-specific requirements, such as page layout, additional pages, or special component control. Integrated statistical functions and process-data memory enable traceable quality management.

888-622-4872 • [maag.com](http://maag.com)

## BLOW MOLDING

## New Buffer Integrates Bottle & Cap Molding with Filling Operations

What's said to be "the world's first cross-process platform" capable of integrating bottle blow molding and cap injection molding inline with filling was shown operating at September's Drinktec 2017 beverage technology fair in Munich, Germany. SACMI of Italy (U.S. office in Des Moines, Iowa) present a system using its new CPB cap and preform buffer magazine, which reportedly permits synchronizing the two molding operations, despite their differing productivity parameters. SACMI says the CPB unit offers converters "the ability to move closer to bottlers" by using through-the-wall or in-house manufacturing solutions.

Other news from SACMI at Drinktec included HeroBlock, an all-new "quad-block" system that combines stretch-blow molding, filling, capping, and labeling in one machine. "Total elimination of conveying systems and intermediate stages" offers "unique compactness," according to SACMI.

Also new was digital label printing, a further advance on SACMI's Colora Cap digital (inkjet) cap-printing technology, which offers "agile customization"—the ability to change the print image from cap to cap. Drinktec 2017 also previewed a new digital label-printing module, integrated into the bottle labeler, which allows agile customization of preprinted labels without the difficulties that come with printing directly on the bottle. This is described as an affordable device that can be retrofitted to existing equipment and can be used with any bottle shape.

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## WELDING

## Compact Ultrasonic System Enables Secure Electronic Records Management

The latest addition to the Branson 2000Xc series of ultrasonic assembly systems from Emerson's Branson Ultrasonics Div., Danbury, Conn., is the compact Branson 2000Xc 40-kHz Micro Actuator with 800 W output. It is only 70 mm (2.76 in.) wide and 660 mm (25.98 in.) high.

The Micro Actuator can be integrated in automation systems or used as a stand-alone. Look for it at NPE2018 in May in Orlando, Fla.

The unit locks in the welding process with fully electronic welder settings, hierarchical password protection, and Ethernet connectivity access. It can store 100,000 weld histories and 1000 weld presets. The touchscreen system offers secure process controls and detailed weld data to meet the global compliance, traceability, and security needs of today's medical, automotive, and electronics markets.

The security feature helps to ensure compliance with medical manufacturing regulations, including FDA 21 CFR part11.

888-282-9353 • [emerson.com](http://emerson.com)



## PROCESS COOLING

## Variable-Speed Chillers Boast Dramatic Energy Savings

After introducing a new line of variable-speed, air-cooled chillers last July, Delta T Systems, Richfield, Wis., is coming out in May with variable-speed, water-cooled chillers of 2 to 30 tons (see May '17 Close-Up). A variable-speed compressor, together with an electronic expansion valve, a modulating control valve, and sophisticated controls are said to provide at least 30% to 50% energy-cost reductions. A 10-ton chiller operating one full shift per day reportedly could pay for itself in energy savings within three years.

Integration of variable-speed controls is proven technology but relatively new to process cooling. The number of brands offering this feature is gradually multiplying (see, for example, Keeping Up in June '17, Dec. '17, and Jan. '18).

The new water-cooled chillers are said to offer temperature control within  $\pm 0.5^\circ$  F, a stainless-steel and copper brazed-plate evaporator for reduced maintenance, nonferrous chilled-water piping, "the smallest footprint in the industry," and advanced controls that are "ready for Industry 4.0."

Learn more about these variable-speed chillers in a technical presentation at *Plastics Technology's* Molding 2018 Conference, Feb. 27-Mar. 1 in Long Beach, Calif. ([moldingconference.com](http://moldingconference.com)). The new chillers will also be on display at NPE 2018, May 7-11 in Orlando, Fla.

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At October's Fakuma show in Germany, Sesotec GmbH (U.S. office in Bartlett, Ill.) presented for the first time its Protector, Rapid Pro Sense, and GF metal separators with OPC-UA communications protocol integrated into their controls. These systems detect and separate magnetic and non-magnetic metal particles, even embedded within plastic pellets or regrind. OPC-UA (Open Platform Communications-Unified Architecture) is becoming an international standard for "smart factories," or Industry 4.0. With OPC-UA, these metal separators can communicate with central plant computers or directly with injection and blow molding machines and extruders to protect against damage and clogging of mold and die channels.

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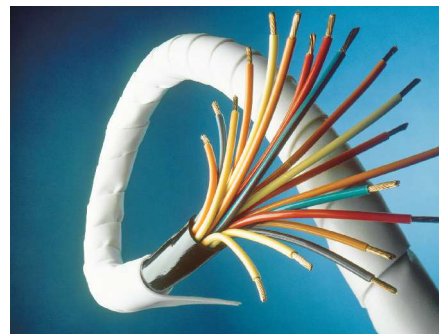
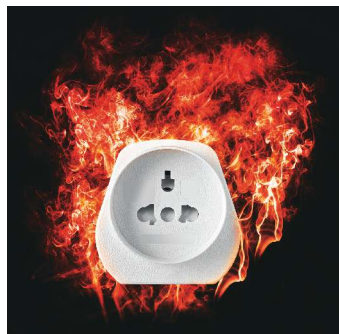
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## New Additives for BOPP, Wire/Cable, FR Nylon

At the recent Fakuma show in Germany, Dow Performance Silicones, a unit of DowDuPont Materials Sciences Div., Midland, Mich., presented three new and recently introduced silicone-based additives for quite different applications:



- **Non-migrating slip agent for BOPP film:** Dow Corning HMB-6301 Masterbatch delivers stable, long-term slip performance without migration. Filling a gap in the market, this unique additive allows BOPP and cast PP film to run about 30% faster in printing, laminating, and metalizing operations, according to the company. It also shows no migration of the slip agent—which can interfere with converting and affect the clarity of the film—after 18 months' storage. Unlike other slip additives, HMB-6301 is added only to the outer layer of BOPP film. It is stable over time and temperature, so its slip properties are permanent (e.g., 0.2-0.3 CoF in film on film at 2-5 wt. %). The free-flowing pellet product is said to comply with EU and U.S. FDA food-contact regulations.

- **FR synergist for nylon:** Introduced last spring, Dow Corning 43-821 additive is described as a novel solution to the drawbacks of using phosphorus-based additives in glass-reinforced flame-retardant nylon 6 and 66 used in electrical/

electronic applications. The phosphorus additives are nonmelting solids used at high loadings—typically 18-20%—which can degrade the compound's physical properties and flowability. Also, the phosphorus additives are acidic and can corrode connectors; and they are susceptible to accelerated aging that can cause embrittlement. New 43-821 Additive is a powder synergist for phosphorus additives (it's said to work well with Clariant's Exolit OP, for example) but it allows their loading to be reduced to 10-12%, which restores nylon's mechanical properties and processability and reduces corrosivity by cutting down the total phosphorus content. It also can reduce total cost of the compound by at least 10%. A loading of just 2% 43-821 Additive with 10% aluminum phosphinate reportedly can achieve UL 94V-0 at 1.6 mm. Raising the phosphinate content to 13% meets V-0 at 1 mm.

- **Process aid for wire & cable:** Dow Corning MB25-502 masterbatch is said to boost output by up to 25% of highly filled LDPE LLDPE, and XLPE wire and cable by decreasing extruder torque and minimizing die pressure and buildup. Introduced in early 2017, this product reportedly is more efficient than the older MB50-002 masterbatch but is still more economical than other high-performance process aids. **800-248-2481 • dowcorning.com**

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# PE, PVC Prices Down; PP, PS, PET Up

## But what's going up could go down again soon.

By **Lilli Manolis Sherman**  
Senior Editor

Once again, prices of the five high-volume commodity resins were a mixed bag going into the first month of the new year. Whereas PE and PVC prices had dropped, those of PP, PS, and PET had moved up. In both cases, feedstock costs were key drivers. But the winds of change were also blowing in different directions, potentially deflating PP and PS prices while lifting PVC prices back up.

Those are the views of purchasing consultants from Resin Technology Inc. (RTi), Fort Worth, Texas ([rtiglobal.com](http://rtiglobal.com)); Michael Greenberg, CEO of the Plastics Exchange in Chicago ([theplasticsexchange.com](http://theplasticsexchange.com)); and Houston-based PetroChemWire (PCW, [petrochemwire.com](http://petrochemwire.com)).

### PE PRICES DROP

Polyethylene prices were reported to have dropped by 3¢/lb in at least some cases in December, although suppliers announced no price reductions, according to Mike Burns, RTi's v.p. of client services for PE. He said the price move was confirmed by several RTi clients. PCW said no suppliers had indicated a market-wide PE price reduction for December.

The Plastics Exchange's Greenberg reported that after peaking in mid-September, spot PE prices have been sliding ever since. He noted that most spot PE prices were still several cents higher at year's end. PCW characterized spot PE prices as mostly flat following the year-end holidays, adding that spot availability appeared scarce, and low-end December sale prices were no longer seen on the market.

RTi's Burns, for one, ventured that further price reductions on the order of 5-7¢/lb were plausible in January and February. He noted, "If global oil prices remain up, PE suppliers will export a lot more material, which would in turn slow down domestic price reductions." He said there are industry expectations for increased first-quarter exports, due to higher cost and lower

### Polyethylene Price Trends

LDPE	
DEC	JAN
↓	↓
5¢/lb	

LLDPE Butene	
DEC	JAN
↓	↓
5¢/lb	

HDPE Injection	
DEC	JAN
↓	↓
5¢/lb	

HDPE Blow Molding	
DEC	JAN
↓	↓
5¢/lb	

HDPE HMW	
DEC	JAN
↓	↓
5¢/lb	

### Market Prices Effective Mid-January 2018

Resin Grade	¢/lb
<b>POLYETHYLENE (railcar)</b>	
LDPE, LINER . . . . .	97-99
LLDPE BUTENE, FILM . . . . .	83-85
NYMEX 'FINANCIAL' FUTURES . . . . .	48
FEBRUARY . . . . .	48
HDPE, G-P INJECTION . . . . .	99-101
HDPE, BLOW MOLDING . . . . .	89-91
NYMEX 'FINANCIAL' FUTURES . . . . .	50
FEBRUARY . . . . .	50
HDPE, HMW FILM . . . . .	106-108
<b>POLYPROPYLENE (railcar)</b>	
G-P HOMOPOLYMER, INJECTION . . . . .	79-81
NYMEX 'FINANCIAL' FUTURES . . . . .	59
FEBRUARY . . . . .	59
IMPACT COPOLYMER . . . . .	81-83
<b>POLYSTYRENE (railcar)</b>	
G-P CRYSTAL . . . . .	109-111
HIPS . . . . .	115-117
<b>PVC RESIN (railcar)</b>	
G-P HOMOPOLYMER . . . . .	80-82
PIPE GRADE . . . . .	79-81
<b>PET (truckload)</b>	
U.S. BOTTLEGRADE . . . . .	69

inventories in Southeast Asia and China. Domestic PE production is pretty strong, according to Burns, who characterized first-quarter supplier inventories as "healthy but not long."

### PP PRICES INCH UP, BUT REVERSAL LIKELY

Polypropylene prices moved up 1¢/lb in December as they had in November, in step with propylene monomer contracts. Scott Newell, RTi's v.p. of PP markets, ventured that we would possibly see a bit higher PP prices in January, but he expected a reversal in the price trend to follow.

An unplanned outage at a Dow propylene unit in December had contributed to the monomer tightness, but

### Polypropylene Price Trends

Homopolymer	
DEC	JAN
↑	↑
1¢/lb	

Copolymer	
DEC	JAN
↑	↑
1¢/lb	



Newell expected monomer prices to start dropping, as the new Enterprise Product Partners propylene production unit is due to be fully ramped up by now. Spot monomer prices had moved above the 50¢ mark by year's end.

Newell noted that fourth-quarter PP production was above average, whereas demand did not bounce back as well, and he characterized the domestic market as better balanced. He expected that suppliers have been building up inventories as there are some planned PP plant shutdowns coming in the first and second quarters. He added that a significant volume of PP imports has been seen, which could dampen demand for domestic PP if prices stay up.

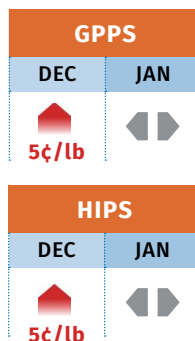
Both PCW and Greenberg characterized spot PP resin activity as limited. "Offers in general have been scarce, and the market has maintained an upward bias," said Greenberg, who anticipated continued upward pressure into the new year. PCW reported spot PP prices as flat-to-higher following the holidays, with attention focused on the sharp uptick in spot propylene monomer. Despite the severe winter weather that affected the Northeastern U.S. in the first week of January, no production issues were reported for PP units at Braskem's Markus Hook, Pa., site or that of Phillips 66 in Linden, N.J.

## PS PRICES UP

Polystyrene prices moved up 5¢/lb in December, according to PCW and Mark Kallman, RTI's v.p. of client services for engineering resins, PS, and PVC. This was driven by a 46¢/gal increase in December benzene contracts. One PS supplier was seeking an additional 2¢/lb in January; however, January benzene contracts dropped to \$3.22/gal from December's \$3.30, and spot prices last month were also dropping—an indication of improved benzene availability.

Kallman ventured that January PS prices would be flat, with the potential for a drop in prices this month, based on lower benzene prices. PCW reported that based on spot feedstock prices, the 30% ethylene/70% benzene cost formula for PS dropped back to 38.8¢/lb by the end of December, compared with 40.4¢/lb at mid-month. Kallman did add that planned styrene monomer plant shutdowns in the first quarter could hamper a PS price reduction this month.

### Polystyrene Price Trends



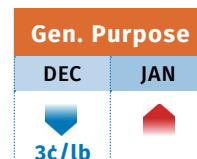
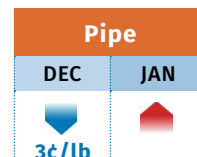
## PVC PRICES DROP

PVC prices dropped in December, essentially nixing the October 3¢/lb price hike, and another 1¢ was coming off in January, according to RTI's Kallman. On Jan. 5 PCW reported price-increase

announcements for 3¢/lb effective Feb. 1 from the four major suppliers as follows: Formosa's applies to its PVC homopolymer suspension-grade resins and compounds; Westlake's applies to all of its suspension grades only; increases by Shintech and OxyVinyls apply to all their PVC products.

PCW also reported that processors expected more increases to emerge in the next two months as suppliers aim to recoup the price declines of fourth-quarter 2017. According to Kallman, domestic demand dropped following the highs in November, driven by cold weather; but export demand from Southeast Asia was picking up once again and was expected to be stronger, particularly from India and China. He noted that it is generally expected that demand in the second quarter will be strong domestically and globally.

## PVC Price Trends

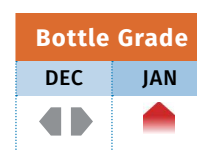


## PET PRICES UP

PCW reported that domestic bottle-grade PET resin ended 2017 at 69¢/lb for Midwest spot delivery via railcar/bulk-truck shipments—which was steady from the start of December. Spot supply remained tight, as it was understood that production from M&G Chemicals' PET plants in Apple Grove, W. Va., and Altamira, Mexico, remained at limited levels. The plants are major suppliers to U.S. customers, and both were idled in October when M&G subsidiaries filed for bankruptcy protection. The company's unfinished "Jumbo" PET plant (80% completed) in Corpus Christie remained in limbo with no resin expected from the plant until second quarter at the earliest.

PET feedstock costs were on the rise in early 2018 due to rising global crude oil and mixed xylene (MX) prices. December North American PET feedstock costs averaged 76¢/lb, up 6.38¢/lb from November. January costs were expected to be higher than December's, if crude-oil and paraxylene prices stayed at December levels or went higher. PCW also reported that domestic PET prices were expected to climb over 70¢/lb in the first quarter due to less production from M&G and a drop in imports because of pending anti-dumping duties on imports from South Korea, Brazil, Indonesia, Taiwan, and Pakistan, expected to be effective March 5. [PT](#)

## PET Price Trends



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# Processing Index Finishes 2017 Strongly

December's reading of 55.5 was second highest of 2017.

By Michael Guckes  
Chief Economist

Registering 55.5 for December, the Gardner Business Index (GBI): Plastics Processing closed 2017 at its second highest reading of the year. December's value put the Plastics Processing Index at 53.9 for all 2017, which is only slightly lower than the record figure of 54.6 set in 2014. The index is computed based on survey results from subscribers of *Plastics Technology* Magazine.

December's reading was the second highest in a calendar year that experienced volatile month-to-month fluctuations. Compared with the same month a year ago, December's index was up approximately 11.6%. Gardner Intelligence's review of the underlying data for the month indicates that new orders, production, supplier deliveries, and exports lifted the business index higher while employment and backlogs pulled the index lower. No components of the Index contracted during the month. The December data showed a significant positive change in both new orders and exports. One surprise in the monthly data was the strength of exports, which helped lift the overall Plastics Processing Index.

Among custom processors specifically, the GBI increased in December to end the year slightly above the index's calendar-year average. Compared with the broader Plastics Processing Index, custom processors reported slightly lower growth in 2017, but still had a very solid year when measured against their results of past years. ■



Michael Guckes is the chief economist for Gardner Intelligence, a division of Gardner Business Media,

Cincinnati. He has performed economic analysis, modeling, and forecasting work for nearly 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](mailto:mguckes@gardnerweb.com). Learn more about the Plastics Processing Index at [gardnerintelligence.com](http://gardnerintelligence.com).

## Gardner Business Index: Plastics Processing

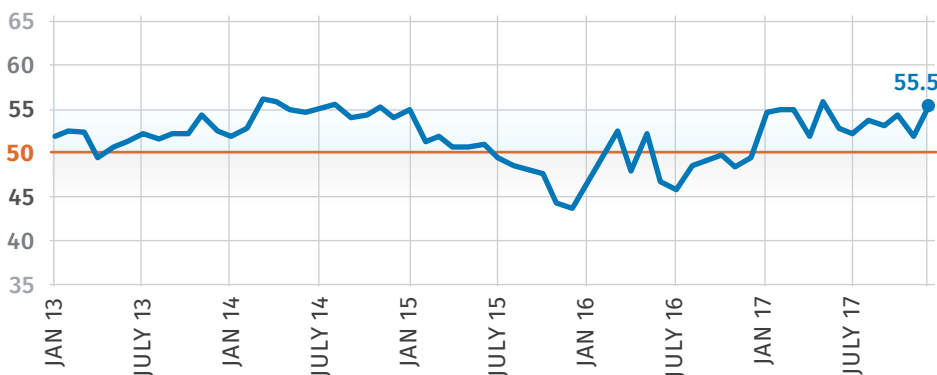


FIG 1

The Plastics Processing Index ended December and the year on a positive note. The strength of new orders suggests that the industry is likely to experience a strong start to 2018.

## Gardner Business Index: Plastics Processing—New Orders & Exports

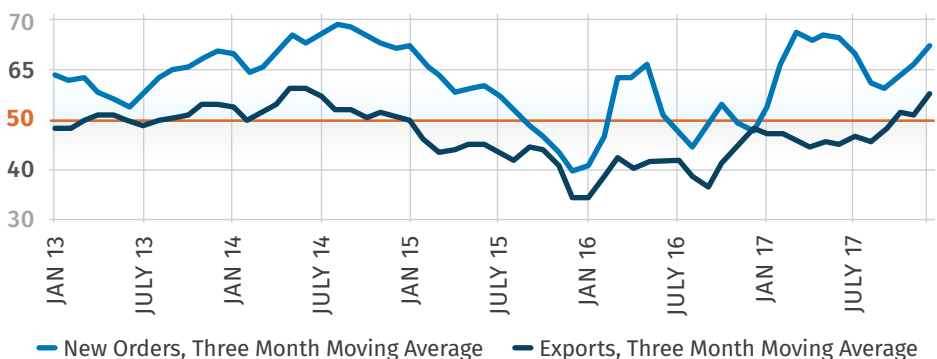


FIG 2

Exports and new orders expanded sharply in December. When new orders growth exceeds production growth, this is typically associated with short-term increases in backlogs and/or exports.

# Projections Point to Robust Growth in Packaging

Revenues for publicly traded firms in plastics packaging and containers increased by more than 7% in the third quarter of 2017 compared with a year earlier. The growth trend is up for this year and next.

Directly measuring packaging and containers is a difficult task due to the permeation of such products in everyday consumer activities,

By **Michael Guckes**  
Chief Economist

as well as along many—if not most—supply chains in many industries. For this reason, examining broad measures of the economy, such as consumer spending, industrial production, and capacity utilization, acts as a proxy for estimating the direction and rate of change in the packaging and container industry.

Annual measures of industrial production of the packaging and plastics industry—last measured for 2016—can tell you where the industry has been in the prior year, or even two. In response, Gardner Intelligence has built customized tools that collect and analyze the quarterly business results of publicly traded firms in the plastics packaging and container industries to provide those serving this industry with more up-to-date information.

Examining the financial data of U.S. publicly traded packaging and container manufacturers of plastic and rubber, revenues for the group grew 7.1% between the third quarter of 2016 and

the same period in 2017. Using the forecast projections from Wall Street brokerages for these same firms, revenues are expected to increase 2.6% and 6.1% respectively in Q3 2018 and Q3 2019 before accounting for inflation. Taking an extended look at inflation-adjusted (“real”) historical and forecasted revenues for the period 2000 to 2020, one will see that the growth rate of real revenues increased around 2012 and is projected to continue to grow at that

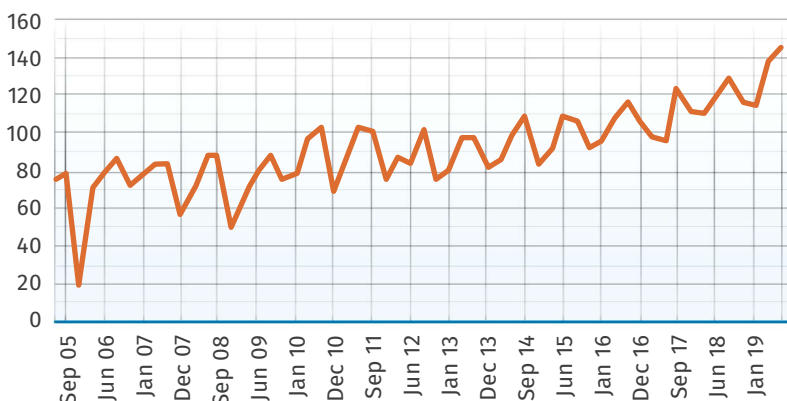
faster rate through at least early 2019.

(Projected revenues, starting in 4Q 2017, are from Wall Street estimates. All values are indexed, with “100” representing the average level of

**Publicly traded packaging firms are predicted to see EBITDA growth of 5.1% between Q3 2017 and Q4 2018 and an impressive 11.1% between Q3 2018 and Q4 2019.**

revenues in 2015 among Gardner’s list of plastics packaging and container firms for which data are available. All figures have been adjusted for inflation, with forecasted figures adjusted by a 2.5% annual expected inflation rate.)

**Revenues: Indexed Real Dollars, Weighted by Company EBITDA 2015 = 100**



Revenues for publicly traded companies in packaging and containers grew 7.1% between the third quarter of 2016 and the same reporting period in 2017. Using the forecast projections from Wall Street brokerages for these same firms, revenues are expected to increase 2.6% and 6.1% respectively in Q3 2018 and Q3 2019 before accounting for inflation.

Additionally, examining Wall Street consensus projections for Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA), we see that these same packaging firms are predicted to see EBITDA growth of 5.1% between Q3 2017 and Q4 2018 and an impressive 11.1% between Q3 2018 and Q4 2019. Gardner attributes these robust forecasts to the expected strength of the U.S. and world economy, driven by strong consumer spending and low unemployment over the forecasted period. [PT](#)

**ABOUT THE AUTHOR:** Michael Guckes is the chief economist for Gardner Business Intelligence, a division of Gardner Business Media (Cincinnati, OH US). He has performed economic analysis, modeling and forecasting work for nearly 20 years among a wide range of industries. Michael received his BA in political science and economics from Kenyon College and his MBA from The Ohio State University. [mguckes@gardnerweb.com](mailto:mguckes@gardnerweb.com)



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Many crossover situations may affect the system selection process but typically...[more\(+\)](#)

### Vacuum System Design



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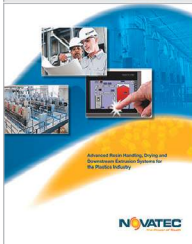
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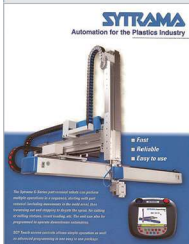
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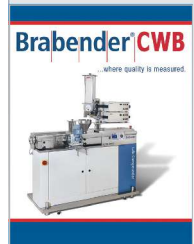
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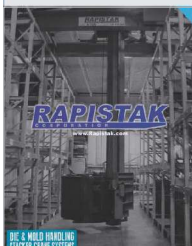
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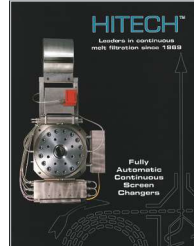
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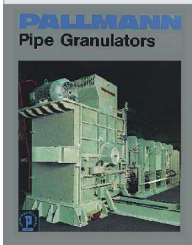
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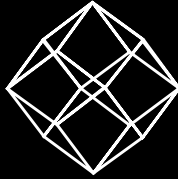


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R&amp;D PLASTICS LLC — HILLSBORO, ORE.

# Vacuum Drying Sucks Wasted Time From Process Set-Up

A switch to vacuum drying resulted in a completely revamped process for this custom molder.

By **Tony Deligio**  
Senior Editor

The contrast before and after R&D Plastics installed a vacuum-drying system alongside its largest press was stark. Instead of two desiccant units with a large footprint and multiple hours of drying time, there was one vacuum dryer covering just over 5ft<sup>2</sup> with only a 30-min wait for process-ready material. “The difference was night and day,” states Don Altorfer, maintenance manager.

“We were putting materials in to dry way ahead of time, and on bigger jobs we needed two drying systems to do that: One dryer to predry material and then, of course, a production dryer to keep it dry and running.”

R&D Plastics ([rdplast.com](http://rdplast.com)) is an ISO 9001:2008 certified custom molder based in Hillsboro, Ore. It serves markets as diverse as agriculture, medical, recreation, and defense.

**“It’s an easy system to use, and it’s so fast.”**

Supplying such disparate customers results in an eclectic mix of applications and a diverse array of materials.

R&D runs “everything from ABS to Xenoy (PC/polyester alloy)” on its largest machine, a 720-ton Toshiba, according to Altorfer. When it used desiccant drying alongside that press, workers would start drying material “at least three, four, five hours before we’re going to start that job,” Altorfer said. But with the new VBD-150 vacuum dryer from Maguire Products Inc., Aston, Pa. ([maguire.com](http://maguire.com)), the set-up team has a little more time on its hands.

“The result from buying the VBD-150, is that basically we’re going to let the material from the previous job run out,” Altorfer said. “Then the set-up can start for the new job, and the material handlers can start. The material handlers will have the new material all dried and ready to go long before the set-up is finished on a machine that size.”

By eliminating predrying, R&D was able to re-evaluate how it sets up and runs jobs. “We had a little bit of relearning to do there,” Altorfer said. “In this case, you didn’t really have to prepare anything ahead of time. So the set-up team needed to learn not to predry—it’s just something that they didn’t have to do anymore. Now they can just let the hopper run out; clean it; put the new material in to dry; and it’s going to be ready before the mold has been changed.”

Faster drying means less energy is used. In comparison with desiccant dryers, Maguire says the VBD vacuum dryer consumes 60% less energy, drying resin in one-sixth the time, which substantially reduces the material’s heat history. In the dryer, once material reaches the desired setpoint, it’s discharged from the heating hopper into the vacuum vessel. Vacuum is brought to 700 mm of mercury (mm Hg) and held to a 20-mm Hg differential for the set cycle time. Maguire says the vacuum cycle typically lasts about 15-20 min, resulting in ready-to-process material in 30-40 min.

“It’s an easy system to use,” Altorfer said, “and it’s so fast. The setup time takes longer than the drying time now.” **PT**



**Maguire’s vacuum-drying technology is said to dry faster, using less energy, in a smaller footprint.**



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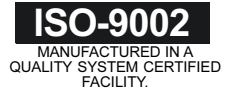
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