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JULY 2020 № 7 VOL 66

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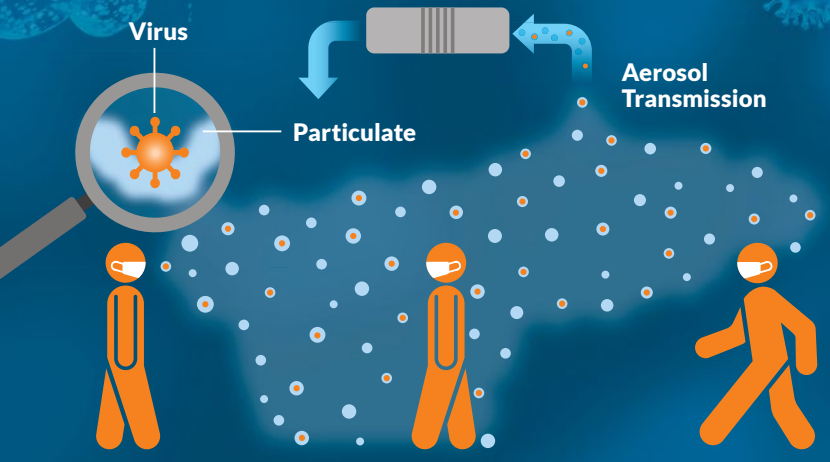

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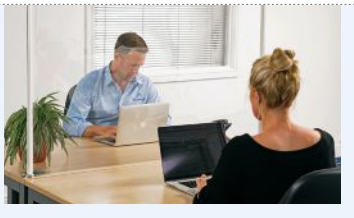
By Ronald Harris and Hari Rajaraman
Chroma Color Corp.

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

BLOG: Plastic Molds for Chocolate Molding Formed from Aluminum Tools

Micelli Mold Co., one of a handful of chocolate moldmakers globally, became one of Chinese injection molding machine maker Bole's first U.S. customers, using its presses to mold polycarbonate chocolate molds in Long Island. Senior Editor Tony Deligio reports.
short.ptonline.com/chocolate



NEWS: Machine Builders Are Responding to COVID Pandemic, Too

Maguire Products Inc., known as a leader in blending, drying, size-reduction, and other auxiliaries, has joined the fight against the coronavirus pandemic by supplying a flexible shield for safe social distancing that can be installed and uninstalled in seconds.
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BLOG: Processors Respond to Coronavirus Crisis

Check out our updated coverage on how processors of all kinds geared up to help the nation respond to the COVID-19 pandemic.
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Two for One: Molding, Extrusion Conferences Co-Located in October

Plastics Technology is bringing Molding and Extrusion Conferences to Illinois in October. Attendees for either can attend sessions in both.

Jim Callari
Editorial Director

Over the years you may have attended of one our webinars. These are hour-long presentations on a Go-to-Meeting platform.

Registration is generally free, and those who attend can interact with the presenter and ask questions. We archive these presentations on our website. If you go to ***ptonline.com***, click on the Events dropdown on the top navigation bar and select webinars, you'll see lengthy list of webinars we have coming up (feel free to register) and those that have been held over the last year (you can register for those too.)

These webinars have been very well-attended over the years. But since the coronavirus pandemic, attendance has in some cases quadrupled. Clearly, people working from home are taking the opportunity to catch up on technology and emerging trends and, well, learn.

As states begin to loosen restrictions on travel, we hope this desire to learn continues. To grow as a professional—and to help your company evolve and grow along the way—the learning must never stop. I'm a firm believer that as we emerge from the worst of the COVID-19 crisis, there will be opportunities for the entire plastics supply chain—including processors—to expand their business as new opportunities come to the fore.

Molding 2020
A Plastics Technology Event

Extrusion 2020
A Plastics Technology Event

I bring all of this up because, as I write this column in mid-June, we are still a go for the *Plastics Technology* sixth annual Extrusion Conference. And not only that: This year, Extrusion 2020 will be co-located with Molding 2020. (We had to reschedule Molding 2020 from its original March 17-20 date because of the pandemic.) Both conferences will be at the Donald J. Stephens Convention Center in Rosemont, Ill., Oct. 13-15. Both technical programs have been finalized. Turn to p. 17 of this issue for more information on Molding 2020 or point your browser to ***moldingconference.com***. Turn to p. 57 for more information on Extrusion 2020 or point your browser to ***extrusionconference.com.***

Both Extrusion 2020 and Molding 2020 are educational conferences where industry leaders discuss the latest developments in various processes, equipment, materials and management techniques, with special emphasis on adding value to your business. Both place a heavy emphasis on best practices. Both feature morning general sessions that focus on broader topics, with afternoon breakout sessions that hone in on more specific areas.

Anyone who registers for either conference will have unfettered access to both. Of course, we don't expect all that much moving about between conferences, but it's possible, for instance, that a blown film processor who registered for Extrusion 2020 might be interested in a presentation on smart manufacturing that's on the docket for Molding 2020. If that's the case, he or she can simply walk to the other side of the hall and sit in. It's also possible, of course, that a process engineer who registered for Molding 2020 may work for a company that also does some complimentary profile extrusion. In that scenario, such an attendee can check out any or all sessions in the Extrusion 2020 Pipe/Profile/Tubing track. We will have ample signage and staff at the combined event so everyone will know what is happening and when.

Importantly, we've synchronized our two programs so that all networking opportunities—breaks, lunches, receptions—occur at the same time. So as an attendee you'll be able to visit all exhibitors and rub elbows with all attendees at both events.

I recommend that you bookmark our conference websites and check there regularly for updates to the agenda, exhibitors and sponsors, registration, and hotel information.

One final note: We are carefully monitoring the five-phased reopening plan for businesses by Illinois Governor J.B. Pritzker. Our events team will continue to provide updates as we learn more regarding the state's plan for hosting conferences and trade shows this fall.

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New Global Standard Aims to Harmonize Injection Molding Machine Safety

ISO 20430 for injection molding machines will allow machine builders to have one global standard for machines, eliminating the need to create different models for different markets, while also allowing countries that had no safety standard to apply an international one, according to Dr. Harald Weber of the German Plastics and Rubber Machinery Association (VDMA). Using the existing European EN 201 standard as a basis, the new international ISO standard was created via collaboration among 40 experts across machine makers, trade associations and health and safety organizations from 13 countries.

From the U.S., Stan Glover of Zeiger Industries represented the Plastics Industry Association (PLASTICS). Also representing U.S. interests in this project were experts from Milacron and Arburg's U.S. subsidiary, among others. "The most important thing is the harmonization of the existing international standards, so that machine manufacturers do not need to build different versions of the machines," Weber told *Plastics Technology*, citing as an example the U.S. market's prior requirement for an additional mechanical restraint, known as the jam bar.

Covering 148 pages and created by the ISO/TC 270 technical committee, the document, according to ISO, "specifies the essential safety requirements for the design and construction of injection molding machines for the processing of plastics and/or rubber and provides information for their safe use." The standard applies only to injection machines with hydraulic and/or electrical drives for platen movement (not manual presses).

Weber told *Plastics Technology* that the new standard also takes into consideration technological progress by machine makers, including improvements in safety features. In particular, the group looked at newer machines' ability to perform specific machine movements, which were previously not allowed, in special control functions like maintenance or setup in a manual mode when the safety gate is open.

"With the described safety concept, these operations can be carried out safely and do not give incentives for manipulation of the safety system," Weber states. "A too-safe machine, which cannot be operated, becomes unsafe." Weber also noted that annexes within the document describe different solutions that have been completely revised, making them clearer and inclusive of additional solutions, like the use of contactless position detectors.

Milacron Announces Rental Options for New Machinery

Milacron, in conjunction with its exclusive financing partner, Equipment Finance Group (EFG), launched an equipment rental option on March 25 to give processors the ability to temporarily increase capacity for production of items to aid in the fight against COVID-19. Machinery rental is available with 12-, 18- and 24-month options. At the end of the term, the equipment can be returned with no further obligation; or bought for a predetermined price that includes credits from previous payments; or continue to be leased.

Milacron's Quick Delivery Program, which includes the Roboshot, Q-Series and MPs, allows machines to be delivered to domestic facilities in as little as five days.

Brown Machine Group Acquires aXatronics Robotic Capabilities

Thermoforming equipment manufacturer Brown Machine Group (BMG) has acquired the robotics capabilities of automation equipment supplier aXatronics of Loveland, Ohio. The aXatronics staff is joining BMG's Nalle Automation Systems (NAS) department and will manufacture and support aXatronics equipment at the NAS facility in Knoxville, Tenn. Dave Whelan, formerly aXatronics' president, is now NAS' director of robotics.

A certified Motoman Robotics Strategic Partner, aXatronics offers such products as stackers, loaders, product handlers, case packers and robotic end-of-arm tools. Says BMG CEO Greg Wolf, "This addition to BMG fills a much-needed void to expand our automation capabilities."

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Thermally Conductive PC Used for Auto LED Fog-Lamp Housing

Covestro reports what is believed to be the first application of a thermally conductive polycarbonate to injection mold an automotive LED fog-lamp housing. The company's TC8030 PC is used on a light truck by a major OEM. The application was named a Materials Category finalist in the 2019 annual SPE Automotive Innovation Awards Competition.

The plastic lamp housing provides more than 40% weight savings vs. the previous die-cast aluminum version, as well as over 10% reduction in component count resulting from design integration, 20% cost reduction for the full lamp assembly, and a 30-lumen increase from improved LED heat management.

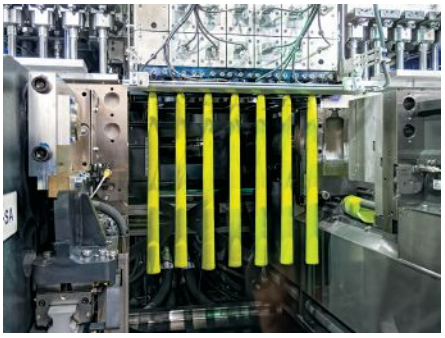
Mytex Polymers Plans Expansion

Engineered polyolefins custom compounder Mytex Polymers, owned by Mitsubishi Chemical Corp., plans to expand capacity at its Covington, Ga., facility to meet demand for long-glass polypropylene (LGF-PP) compounds. The $7 million investment will entail a new production line at the company's 140,000-ft^2 facility and will create 15 new jobs.

Mytex compounds high-performance polyolefin materials for automotive parts (exterior and interior), household appliances, recreational vehicles, industrial equipment and specialty packaging. The company is best known for its Funcster pultruded LGF-PP for injection molding in structural applications.

Coronavirus Doubles Demand for Used Blow Molding Machines

"The used machinery market since February is experiencing huge demand and supply swings that are affecting used machine prices," says Gema Álvarez, marketing and public relations director of MachinePoint, a global dealer in used plastics machinery, based in Spain with offices in the U.S., Mexico and 10 other countries (***machinepoint.com***). Attributing this instability to the coronavirus pandemic, she adds, "Blow molding machines of all kinds (stretch, injection-stretch or extrusion) have doubled in demand and halved in supply" in response to soaring demand for hand sanitizers, alcohol, glycerin, bleach, cleaning products, and beverages like water, juices and beer. "The bottle and bottling industry is producing at 100% above their regular capacity, running up to five shifts in some cases," says Álvarez.

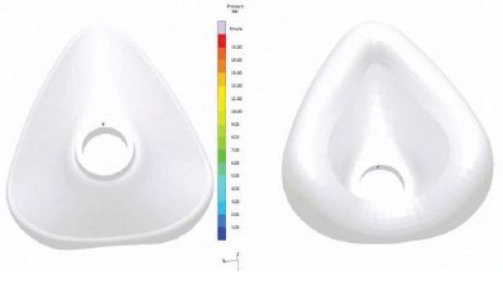


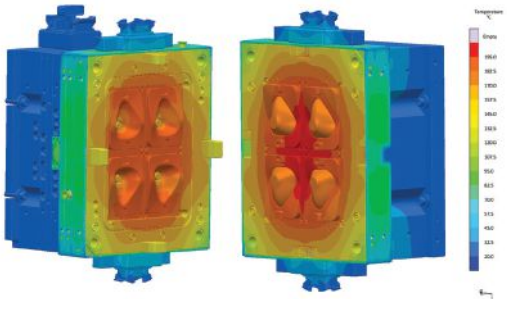
Injection molding machinery for crates is also in higher demand, she notes, as consumers stock up their home inventories. "While a large part of the economy stands still, the flexible packaging industry is at full capacity, running 30% above normal levels." MachinePoint also handles film extrusion equipment.

An additional factor, Álvarez notes, is governments closing borders and disrupting trade. "We have many machines waiting to be picked up due to trade barriers at origin, destination or transit countries." Making things worse, "Cargo air fare is at 300% of the prices before COVID-19. We are having to accept these prices to ship molds, hot runners, or die heads that are urgently needed in Germany, Italy, Spain, Mexico or the United States."

Simulation Software Speeds LSR Mask Development

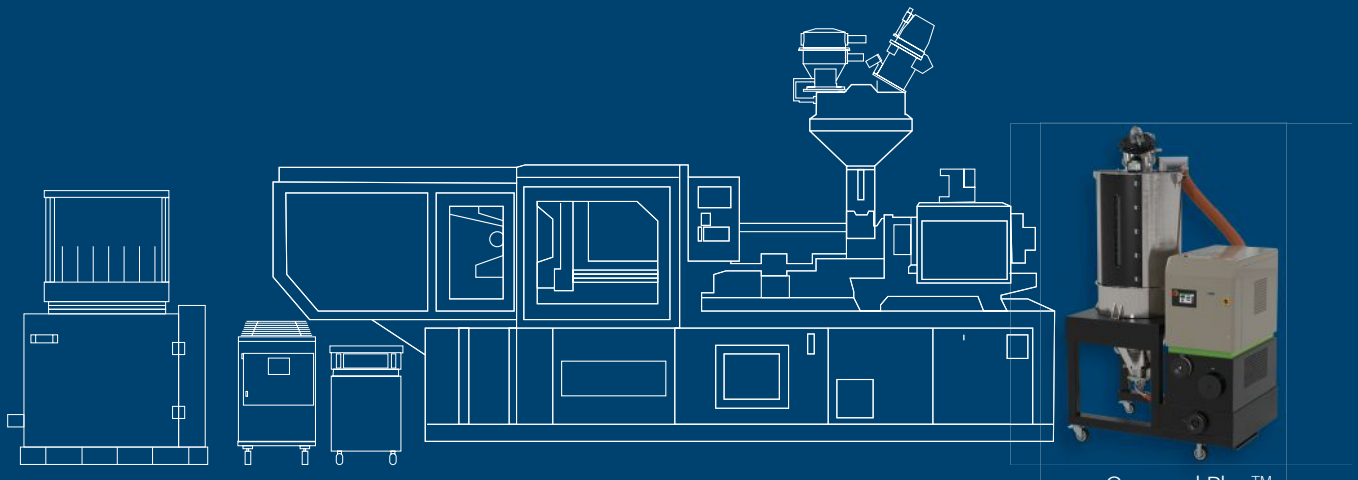
Arburg and moldmaker Polar-Form Werkzeugbau of Germany worked with CAE software provider Sigmasoft to simulate the layout of a complete LSR mold for protective face masks and optimize the mold design for process efficiency and robustness, according to Sigma's Thomas Klein. In particular, Sigmasoft virtual molding software was used to evaluate gate location, venting, and cooling channels for a four-cavity LSR tool. The program was able to predict the process parameters for the mask, including required cure time. This ensured a tool that would not trap air and lead to defects.





For precise control of the mold's temperature profile, the simulation determined that the number of temperature sensors in the mold should be increased to six, and it optimized their best location within the tool. Sigma noted that this helped profile the heating cartridges and determined optimal insulation of the mold to be as energy efficient as possible.

"The partners were under enormous pressure because everything had to run smoothly right away," says Klein. The simulation work was completed within 24 hr. The mold runs Wacker's nonpostcure Elastosil LR 5040 at 180 C.



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Turnkey Molding Cell for COVID-19 Test Swabs

Engel has partnered with moldmaker Hack Formenbau of Germany to deliver ready-to-run production cells for COVID-19 test swabs. The two-component test swabs feature an elastomeric tip for specimen collection overmolded onto a rigid stick produced from a 32-cavity mold with a cycle time of 6 to 8 sec.

The cell is based on a tiebarless, hydraulic, two-component Engel victory injection machine with an integrated Engel viper linear robot, which automates removal and depositing of the swabs. The machine is equipped with Engel's iQ weight control for high process and part consistency.

An Engel spokesperson told *Plastics Technology* that the production cell is sold "off-the-shelf" but can be customized according to individual requirements. Hack developed the two-component design, initially with three different head design proposals, building on its experience with tooling for small bristles. At K 2016, Hack and Engel partnered on a cell to mold interdental brushes. Engel says the mold and cell can be adapted in the future for other projects, such as test swabs for influenza or other medical examinations.

Stork Names Distributor for the Americas

Stork Plastics Machinery BV of The Netherlands has signed an agreement with Chudleigh Sutch of the U.K. to distribute Stork injection machines in North and South America. Established in 1978, Chudleigh Sutch provides global service and sales in Europe, Asia Pacific, and Oceana for turnkey injection molding systems. The company represents Brink Group and Frigel, along with Stork. Per the agreement, Chudleigh Sutch will develop a local service and sales network throughout North and South America.

Ben Sutch told *Plastics Technology* that "Stork has been a long time player in the U.S. market and works with many prominent well-known converters." Stork machines range in clamp force from 200 to 2000 tons and focus on high-speed packaging applications. The company has dedicated lines for specific applications, including the Potline for flower pots, Crateline for logistics packaging, Foodline for food packaging, Pail-Line for buckets, and the Plus-line for high-speed and thin-wall applications.

Polymax TPE Boosts Capacity of Medical Grade TPEs to Combat COVID-19

Custom compounder Polymax TPE, Waukegan, Ill., has expanded capacity for its P-Series and A-Series medical-grade TPEs used in products to help meet the increased demand caused by COVID-19. The company has been increasing production of medical-grade TPE's since February, starting with the P-Series product line. One grade, P3838, is molded into a diaphragm serving as a critical component for a sputum aspirator. With rapidly spiking demand for medical-grade TPE's, the company has increased its focus on producing TPE's suitable for face-mask applications and other personal protection equipment (PPE).

TPEs are possible substitutes for traditional materials used to make face masks, such as silicone and latex. Polymax has shifted focus to helping provide solutions to meet the growing demand for reshoring of PPE products to North American production. Says Polymax TPE's v.p. of sales Tom Castile, "The COVID-19 crisis has quickly created an urgency to source TPE products domestically."

Polymax has expanded production of its A-Series medical-grade TPE that adheres to engineering thermoplastics and features the widest hardness range of its kind in the industry. Some specialty production will be moved from the firm's Chinese plant to Waukegan.

Injection Molding: RJG Adds Virtual Training, Consultation

Injection molding training and technology supplier RJG Inc. has developed virtual training and consulting services to continue serving clients from afar during the coronavirus outbreak. RJG transitioned several of its training courses to an online setting, offering live interactive sessions as well as self-guided labs. These courses are led by RJG's experts, and most take place over several days for a few hours a day.

The online courses include:

- Fundamentals of Systematic Injection Molding
- eDART Training in Spanish
- Fundamentals of Machine Performance
- Injection Molding Essentials (English, Spanish)
- Math for Molders
- Part Design (coming soon)
- Mold Design (coming soon)
- Systematic Molding for Liquid Silicone Rubber (coming soon)

In addition, RJG has launched several free online webinars to support injection molding education, including molding tips and discussions of the latest innovations. Finally, the company has also introduced virtual consultation services to provide one-on-one guidance to molders. RJG said its online consulting services can support companies dealing with unique processing issues, launching a new tool, or getting started in injection molding. RJG develops custom consultation plans for each client.

Virtual consultation services include curve interpretation, where RJG helps clients determine what their process-monitoring data is telling them so they can make adjustments and improve efficiency; sensor placement strategy, where RJG assists clients in choosing the correct sensor type and placement; and process optimization, where RJG helps clients optimize their injection molding processes, whether they are using RJG equipment or not.

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BOPE Takes Aim at BOPP & BOPET Films

Nova's new biaxially oriented HDPE is an easily recyclable monomaterial contender with multilayer BOPP or monolayer BOPET films.

HD-BOPE has potential for becoming an industry standard for recyclable films.

By Lilli Manolis Sherman
Senior Editor

Within the last couple of years, biaxially oriented polyethylene (BOPE) has emerged as a major potential contender in packaging designed for recyclability. As is the case with the longer-running trend of all-PE blown-film packaging (e.g., standup pouches), the drivers for this monomaterial option are sustainability and the circular economy. Nova Chemicals is among the companies leading in development of BOPE.

At the 2019 K show in Düsseldorf, SABIC launched a new LLDPE for BOPE films. The company showed examples of BOPE standup pouches suitable for confectionary and snacks; frozen, fresh and dried fruit and vegetables; and packaging for personal-care products. BOPE boasts good printability, high mechanical properties and toughness, as well as very high seal integrity. SABIC's new material also enables BOPE film to provide controlled, linear tear direction, thus making the package easy to open.

HD-BOPE offers a monomaterial alternative to multilayer BOPP or monolayer BOPET

More recently, Nova has collaborated with several organizations across the supply chain to develop monomaterial BOPE packaging, focusing on a particularly pressing market need for bi-oriented HDPE (HD-BOPE) for the tenter-frame process to replace multimaterial packaging based on bi-oriented polypropylene (BOPP) or monolayer PET (BOPET).

Nova says HD-BOPE packaging is more easily recyclable and can enable higher recycling rates for flexible packaging and help brand owners achieve their circular-economy commitments. While BOPP has a decades-long head start in bi-oriented films, HD-BOPE has potential to become an industry standard for recyclable packaging over the next several years, says Owen Lightbody, team lead for technical service in performance films.

OPTIMIZED HDPE

The tenter-frame process used to bi-orient films is very demanding, and most of the equipment in place today has been designed around PP, PET and nylon, Nova experts explain. While LLDPE can easily be stretched, films made with it lack the stiffness and heat resistance required for most high-performance applications, which can be achieved with HDPE. As such, Nova views HDPE as the more desirable material for BOPE film, though conventional HDPE also presents a major challenge—a lack of elasticity to be stretched to any great extent.

Now, Nova Chemicals has developed HDPE grades specifically for the biaxially oriented film process, improving the production of HD-BOPE films, which the company believes will enable game-changing opportunities to create monomaterial packaging suited to a circular economy.

Two film designs are already receiving considerable market interest. The first is a 100% HDPE print web, and the second is a sealant film. The sealant film provides low seal-initiation temperatures on a packaging line without sticking to any rollers on the tenter-frame line.

"We're seeing a high level of interest and activity in HD-BOPE across multiple global regions, and we anticipate a rapid expansion of these films in many packaging segments. We also expect oriented LLDPE films to grow in the next few years due to performance advantages over conventional blown and cast films. As the

flexible packaging industry pursues monomaterial packaging solutions, LLD-BOPE is well positioned to replace cast PP, BOPET and BOPA (bi-oriented nylon) in many applications," says Lightbody.

PROCESSING CHALLENGES

While the profile of BOPE has been elevated by the combination of sustainability commitments made by brand owners and the attractiveness of monomaterial packaging for enhanced recyclability, the reality is that the supply chain is mainly equipped with legacy tenter-frame lines designed around PP. The primary challenge is developing HDPE technology that has a suitable orientation window to be processed on these existing tenter frames.

Another potential application for HD-BOPE.

Nova collaborated with leading tenter-frame machine builder Brueckner Group to optimize HDPE resin technologies for BOPE and accelerate the commercialization of HD-BOPE films. Areas of focus were extrusion output and achieving reliable production with no film breaks. Continued improvement in output rates will be achieved through a combination of novel PE resin architecture and equipment optimization such as Brueckner's novel BOPP/BOPE hybrid tenter-frame design.

Highly specialized resins that offer a tailored viscosity profile for the tenter-frame process, extremely low gels, and lot-to-lot consistency are required for processing defect-free films, according to Lightbody.

ADVANTAGES OVER BOPET, BOPP

The number and complexities of the different applications using BOPP, BOPET and/or BOPA (biaxially oriented nylon) are sizable and completely replacing them with BOPE would be unrealistic. Nonetheless, there are many packaging segments where a BOPE option is advantageous from a performance and/or circular-economy perspective. The most significant benefit of BOPE over alternative materials is easier recyclability.

Polypropylene is typically more difficult to recycle due to lack of recycling streams in some world regions, including much of North America, and many BOPP-containing structures and applications are multimaterial. HD-BOPE could thus be an important innovation for the widespread adoption of monomaterial recyclable packaging.

More broadly, many traditional flexible packages are composed of mixed-material laminates such as PET/PE to deliver the required performance such as stiffness, heat resistance and seal performance. Due to the wide range of PE product densities, PE can meet a wide range of performance requirements. Lower-density materials such as LLDPE exhibit outstanding seal properties, while higher-density PE materials provide stiffness and heat resistance. HD-BOPE results in stiffer films that enable downgauging, as well as low tear properties to create easy-open packaging, and a dramatic enhancement of optical properties, which improve the package's shelf appeal compared with standard HDPE. Nova also has several LLD-BOPE grades and can work with processors to design HD-BOPE/LLD-BOPE monomaterial laminate films. PT

Nova Collaborates With Processors, Machine Builders

Recognizing the need for HD-BOPE in the marketplace, Nova Chemicals sought out industry leaders and partners, including:

- **Toray Plastics America Inc.,** Providence, R.I., whose film manufacturing expertise and knowledge of oriented films in packaging applications was very valuable in developing HD-BOPE technology, according to Lightbody. Toray Plastics has been a leading manufacturer of PET, PP, bio-based and metalized films for flexible and rigid packaging, lidding, and graphic, industrial, optical, and electronic applications. Nova and Toray jointly conducted pilot-line trials, which provided instant feedback on processing and orientability of various HDPE resin candidates, and evaluated the resulting film performance. This collaborative approach helped Nova Chemicals to optimize its resins for HD-BOPE.

- **Brueckner,** a leading tenter-frame OEM, and Portugal's major film manufacturer Polivouga. Together they have evaluated a number of HDPE resins for biaxial stretching on pilot lines at Brueckner's facility and on a commercial line in Portugal. Both Nova and Brueckner view BOPE as a promising circular-economy building block, providing another solution for the industry to reach the target of 100% recyclable packaging.

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Fast, Simple, Low-Cost Method Unveils 'True' Melt Temperature

Long a mystery to injection molders, actual temperature of melt entering the mold is said to be revealed by an easy procedure that is repeatable and takes less than a minute.

By Matthew Naitove
Executive Editor

There is general agreement among processing specialists that melt-temperature control remains one of the "last frontiers" of injection molding process control. "You can't control what you can't measure" is a fundamental axiom, and the real problem here is the lack of an accurate, repeatable, practical, and generally accepted method of measuring the melt temperature inside the barrel or nozzle of an injection machine.

Methods tried in the past include inserting a sensor through the wall of the nozzle. Experts say the sensor reading with this method is overwhelmingly influenced by the steel temperature of the nozzle rather than the melt. Even if the tip of the sensor is exposed directly to the melt, it will measure only the cooler, slower-moving melt closest to the nozzle wall, due to the laminar-flow behavior of plastics. And it has proven impractical to insert the sensor near to the center of the flowing stream, owing to the dynamic forces on the fragile sensor.

The other main approach has been to purge some melt and stick a probe manually into the blob of purge—which has been proven by long experience to give highly variable results that are sensitive to operator technique. A variation on this method using an infrared scanner reportedly also requires careful technique and measures only the surface of the purged material.

A few companies are addressing this problem with new technologies that are not yet widely adopted. (We have reported on such technologies from Md Plastics and Futaba Corp.) Just released onto the market this spring is an approach developed and patented by a retired tooling and molding specialist that is said to overcome the limitations of historic methods.

New Melt Temperature Measurement System (MTMS) comes as a kit with metal "purge puck" and retainer ring, 50 plastic insulator cups for one-time use each, two thermocouples, and peak-hold pyrometer.

DISPELLING THE MYSTERY

Rich Bleck spent 38 years in plastics as a mold technician, tooling buyer and supervisor, program manager, molding process engineer and R&D engineer at global medical injection molder Phillips Plastics (now Phillips Medisize, part of Molex), and worked closely with RJG Inc. and John Bozzelli of Injection Molding Solutions/Scientific Molding. Since retiring in 2010, he has operated Procon Training & Consulting in Phillips, Wis.

Bleck's career afforded him ample experience with the vagaries of melt-temperature sensing. "I spent thirty or forty thousand dollars buying different infrared and conventional pyrometers, probes and preheaters for Phillips to try to solve this problem," he says. "Melt temperature has always been a mystery, as it is difficult to measure accurately. Few processors have the time, knowledge or equipment to get a handle on it. When they have a processing problem, one of the first things a service technician asks is, 'What's your melt temperature?' The molder answers, 'My barrel is set at such-and-such. Beyond that, I don't know.'

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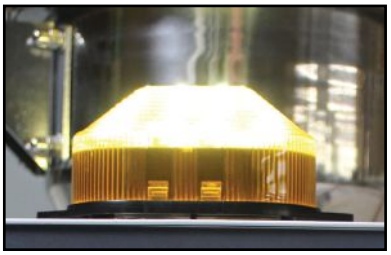

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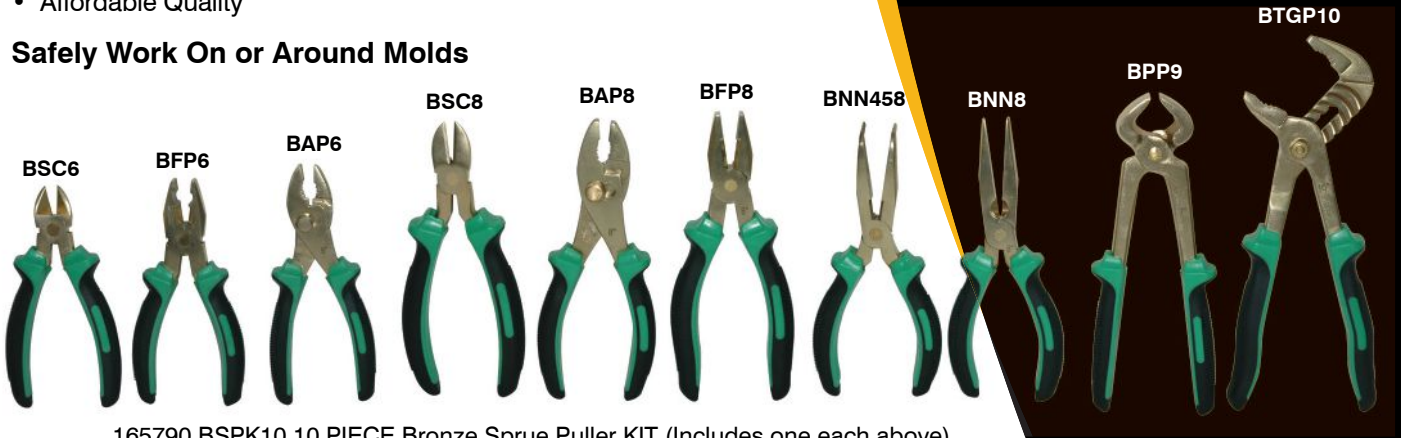

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"Please do not make the mistake of thinking the temperatures shown on the controller screens are actual melt temperatures. Those thermocouples are reading steel temperatures along the barrel, *not* melt temperatures."

And why is melt temperature so important? Answers Bleck, "Melt temperature influences the plastic's viscosity or resistance to flow, which is critical in obtaining optimal part dimensional control. Consistent viscosity allows for repeatable filling of the mold with consistent cavity pressure."

That is what led Bleck in 2015 to start developing his patented Melt Temperature Measurement System (MTMS). It involves an adaptation of the purge measurement concept, but with an important difference. The shot is purged into an insulated cup fitted with a thermocouple. Bleck notes that such an approach has been tried in the past, but says it is very difficult to use with small shots, because it requires multiple shots to fill the cup. This not only takes additional time, but ignores the effects of screw rpm, backpressure and residence time on the melt temperature.

Bleck's MTMS avoids such limitations by purging into and *through* an insulated cup, which has a large exit channel on the side. This can measure temperature of almost any size shot, from 0.5 oz to 10 lb, Bleck says. It works as follows:

You can't control what you can't measure.

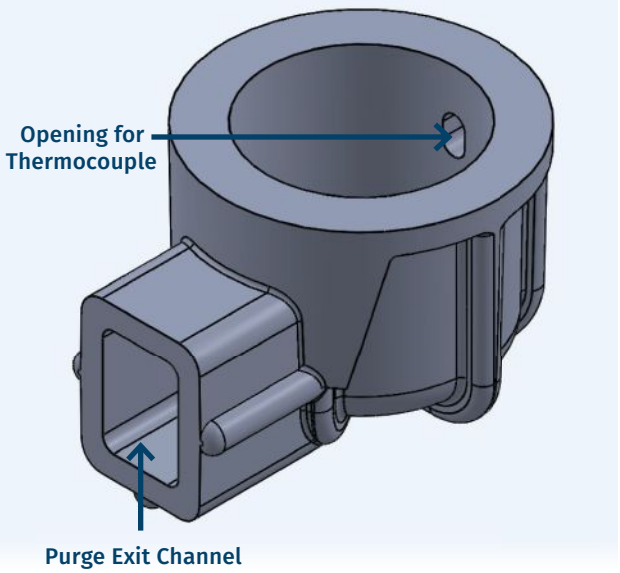
1. Establish a stable process—run for at least 10 min or around 20 shots.
2. Switch the machine to manual control.
3. Retract the barrel.
4. Set a machined metal "purge puck" into the locating ring on the platen, where it is held in place by magnets.
5. Before placement in the locating ring, the purge puck has a small plastic "insulator cup" pressed into place, and a thermocouple probe inserted through the side of the purge puck and through the insulator cup. The probe is connected to a simple handheld pyrometer readout device.
6. Bring barrel forward and purge a full shot through the insulator cup. Read melt temperature on the pyrometer. (Watch this in action at ***short.ptonline.com/MTMS2***.)

Bleck says the procedure involves less than a minute of total cycle interruption—as little as 35 sec. It's also advantageous in terms of operator safety, as personnel are protected by the closed purge guard during the measurement.

The insulator cup is injection molded of PP, but it reportedly can be used for almost any material at a temperature up to 650 F, because the heat exposure is brief and "We generate no pressure in the cup," Bleck notes. He concedes that the cup is not suitable for use with highly filled materials. The cup itself is "smaller than thimble size" with a volume of only 0.8 oz. It is used only once.

The thermocouple probe is deployed in a manner so that melt flows first over and surrounds the body of the probe before it flows past the sensing tip. This prevents the body of the probe from being a heat sink that distorts the temperature measurement. What's more, Bleck points out that the probe can be removed cleanly from the cup and purge puck, because at the end of the test, material in the center of the purge is still molten. "When you do a conventional purge measurement, you'll typically find a 'skin' of plastic solidified around the sensing probe. Not with this system."

Insulator Cup for MTMS



PP "insulator cup" is smaller than a thimble. During a purge shot, melt passes continuously over a thermocouple (inserted through a hole in the side) and out the side exit. The cup is used only once and costs as little as 50¢. Since no pressure is generated, it reportedly can withstand melt temperatures up to 650 F.

Bleck notes that this method requires minimal training—"So anyone on the floor can use it"—and has excellent repeatability (±1% or typically ±4-5° F) between operators.

The MTMS is manufactured and marketed for Procon by Schmit Prototypes, a rapid-prototyping service in Menomonie, Wis. (***schmitprototypes.com***). It is supplied as a kit ($899) in a carrying case containing the purge puck, a pack of 50 insulator cups, a metal ring that holds the cup in place, two thermocouple probes, and a pyrometer, which measures three times a second and displays the peak temperature measured during the purge shot. Additional cups are available for as little as 50¢ apiece.

Commercially available since mid-April, 15 kits were shipped in the first two weeks, including one to Austria; and there have been inquiries from as far away as Singapore. "The biggest response was from medical molders," says Bleck.

Andy Gruber, a process engineer at Phillips Medisize in Phillips, Wis., worked with Bleck when he was on staff there and since last November has helped with prototyping the MTMS. He describes the new system as "ground breaking" and "a huge advance" because it's

"repeatable from user to user," requires less downtime, is safer than typical purge measurements, and "gives more true temperature numbers than I've ever seen."

Gruber sees more accurate temperature measurement as the key to more consistent part dimensions and overcoming warpage, flash and short shots. "If we can repeat our process, we can make the same part from run to run, lot to lot, and week to week." His plan is to eventually purchase a handful of MTMS kits for the two plants at that location. "I have one for troubleshooting, and I want the pre-production guys to have them. I'd like to have enough kits to use them on every startup, every restart, and every shutdown."

WHY IT MATTERS

"There are five variables that affect melt temperature," says Bleck. "They are external heater bands, screw rpm, backpressure, screw design, and residence time. But 80% of the influence comes from screw rpm and backpressure." With MTMS, he says, molders can do a DOE material characterization study to determine which input has the greatest effect on temperature of a particular material. "For example, what happens to melt temperature and cavity pressure when you turn up the rpm? What happens to gate blush, orange peel, degradation and outgassing?"

We need a better understanding of melt temperature to reduce part-to-part variation.

His main overall point: "We need a better understanding of melt temperature to reduce part-to-part variation and narrow that Bell curve—especially when moving a mold to a different press. How can we commit to continuous improvement if we can't measure what we are doing inside the machine?"

John Bozzelli, a well-known injection molding trainer and consultant (and a columnist for this magazine), confirms Bleck's message: "Temperatures on the machine's controller screen can be way off—50° to 100° F—due to a host of reasons, from the type of thermocouple used to its placement in the barrel hole, etc. Different machines may be set at the same temperature, but they rarely achieve the same actual result. This changes the process and the parts. Most processors run the resin in the upper end of its temperature range, often causing degradation without knowing it."

His opinion of the MTMS: "My preference is to have a method to provide melt temperature as you are making parts, every shot. That is what I have been working on. No luck yet. But Rich's system is the best I have tested or seen in the industry to date for purge methods. It will give you good results and you will get repeatability from different people with a minor amount of training. It also does not interrupt the process for very long." PT

New Mold Grease Smooths Operations for Troublesome Tool

Switching to a new synthetic grease helped an injection molder keep a difficult die running, eliminating unplanned downtime and cutting scrap.

By Tony Deligio
Senior Editor

Ask tooling managers to identify their "problem child" tools, and they can quickly rattle off a list of their shop's difficult molds and each one's particular issues. William Duffield, toolroom supervisor at Erwin Quarder Inc., Grand Rapids, Mich., is no different. After coming to the custom molder at the end of 2017, he sought out the company's most headache-inducing molds as he worked to augment the company's preventive-maintenance program.

Erwin Quarder is a full-service injection molder with 32 presses from 50 to 500 tons and just under 100 employees. A primary line of business is overmolding electronic leads for the automotive sector, and most parts are fit-in-the-palm-of-your-hand small. The Michigan plant is a wholly owned subsidiary of Erwin Quarder Systemtechnik GmbH in Germany, which also has facilities in Mexico and Asia.

This mold component has approximately 20,000 cycles on it, with the grease still intact and lubricating as designed.

The same component after cleaning. Erwin Quarder is studying to see how long it can run this tool under continuous operations.

The first troublesome tool targeted by Duffield was a two-cavity mold he described as a basic open/shut design with two sets of slides. Grease was used to keep the slides moving, but over time, the processing temperature of 350 F liquefied the grease, forcing the shop personnel to apply more. Eventually building up and caking on, the grease led to myriad molding issues, including poor shutoff and resulting flash; clogged vents and burns; and excessive buildup, leading to broken mold components. All these in turn caused excessive unscheduled downtime.

"We would have to clean the tool, pulling it out and doing a full preventive maintenance on it," Duffield says. "Obviously, if the tool's not making parts, we're not making money. The tool was actually having trouble opening back up because of the lack of grease. The old grease would wear right out, and then you were steel on steel with no lubrication." Duffield says the weekly shutdowns took up to 4 hr as the toolroom was forced to clean out the mold and re-grease.

At his previous job, Duffield had become a user of products from Nanoplas Inc., including its Syn-Lube synthetic, food-grade grease, which boasts high-temperature and water resistance, as well as pressure protection. Duffield requested some Nanoplas product samples and undertook a two-week study with the difficult die.

Nanoplas products have extended scheduled preventive maintenance, helping tools at Erwin Quarder run more cleanly and smoothly.

Starting with a "fresh, clean tool," the tool room applied Syn-Lube and saw an immediate impact, according to Duffield. "We regained that 4 hr of production time throughout the week," Duffield says, "and our parts looked better because the Syn-Lube is not caking up and getting on the parts and causing shutoff issues." In addition, Duffield says the plant is using less grease overall, cutting back on the amount initially applied and not having to re-apply more mid-run.

Erwin Quarder was so pleased with the Syn-Lube grease, it incorporated other Nanoplas products into its preventive-maintenance program, including Zap-Ox stain remover, Power Clean degreaser, and Defender rust preventative. "We actually use Nanoplas products on every tool in the building," Duffield says. That's true for tools in production, maintenance and storage, where it gets more benefit from using less of the Defender rust preventative on molds placed back on the rack.

> ***"By using less rust preventative, we're not having the sticky residue on the mold after it sits for a period of time."***

"By using less rust preventative, we're not having the sticky residue on the mold after it sits for a period of time," Duffield says. "The result is fewer clogged vents and less residue on the first shot." PT

QUESTIONS ABOUT MOLD MAINTENANCE?

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Captive Molder Spiffs Up, Seeks Bigger Footprint in Custom Business

Pittsfield Plastics Engineering has spruced up its facility and added new technology as it seeks to expand its business beyond its proprietary line of reels and spools.

"Man cannot live on reels alone." Those words, spoken by Thomas Walker, president of Pittsfield Plastics Engineering, LLC (PPE), explain the captive spool and reel molder's many initiatives over the last few years to bolster the custom side of its business. The most recent of these efforts includes the addition of a 1204-ton injection machine with a shot capacity of 155.6 oz from Absolute Haitian. (see Processor's Edge, March 2020). But over the last five years, PPE has made a run of enhancements, both cosmetic and technical, to its plant in Pittsfield, Mass., to better position itself as a high-end custom molder.

By Jim Callari
Editorial Director

The company started in 1968 as a moldmaker but in short order branched out into injection molded spools and reels. Its founder, David Chiorgno, sold the business in 1997 to Walker and Tom Holmes, chairman and financial advisor. A large percentage of its business is still proprietary spools and reels, says CEO/CFO Bruce Dixon. These come in a wide array of styles and sizes that are sold to the wire, tape, cable, solder, textile, and other industries.

Back in 2009, PPE forayed into the extrusion business, initially seeing it as a way to round out its spool business. It started by making the barrels and film cores for all its reels and spools, then got into the custom profile business for applications that included packaging, wire, tape, film, industrial, home construction, recreation, and avian protection.

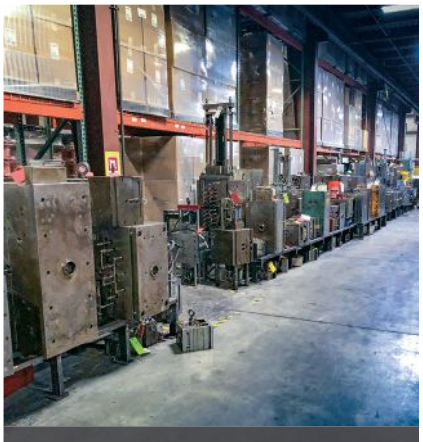
But once PPE realized the move to extrusion did not generate the expected results, the firm took steps to modernize its facility, enhance its toolroom, and invest more in quality and R&D by setting up a new Technology Center. PPE upgraded its offices, built a conference room, and added a diamond-polish finish to the floors. "We didn't want our facility to look like a typical factory," recalls Walker. "We wanted a clean environment, a professional look. There was one instance where we had a potential customer come in to evaluate our operation from top to bottom, and we didn't get the order. Then, we spruced up our offices, modernized our toolroom, added new molding machines, and started up our Technology Center. Once we were done, we invited that customer back in. That was back in 2014. They are still a major account of ours today."

> ***"We didn't want our facility to look like a typical factory. We wanted a clean environment, a professional look."***

PPE's CEO Bruce Dixon (right) and Tom Walker, president and co-owner, with small and large electrical enclosures used in commercial real-estate development.

In the toolroom, PPE has recently added a new EDM machine, as well as lathes and milling machines. With its roots in moldmaking, PPE sought to give itself better tools with which to work. Tooling engineers work with clients from the design phase, defining all critical aspects such as mechanical action, ejection, manifold design, and runner system. Then they work with the customers to develop a specification sheet, which is used as a basis to compare sources. PPE can build molds in-house or source tools from other parts of the world.

Nick Roth, PPE regional sales manager, in the Technology Center with line of outdoor telephone enclosure boxes used in offshore drilling sites and in baseball bullpens.



PPE has capacity to store and maintain customer molds.

After the mold vendor is selected in collaboration with their customer, PPE awards the purchase order and begins the process of monitoring the progress of the mold. It will then review and finalize tool acceptance at the mold vendor's shop. Once accepted, the new mold is crated and shipped to PPE's production facility. PPE maintains all tools for its customers, ensuring that they are always production-ready and secure.

The new 1204-ton Haitian press brings the number of injection machines in PPE's 64,000 ft² plant to 26. Other recent additions include five all-electric Sumitomo Demag presses and three large hybrid presses from Milacron. To help facilitate the recent energy-efficient machine purchases, PPE has received significant rebates from its electric utility company.

PPE's Technology Center provides the company with precision measurement capabilities, using a recently acquired Hexagon CMM with direct computer-control (DCC) capability and a Vertex Micro Vu optical inspection device. PPE also conducts material testing with moisture analyzers, melt indexers, PPE's own design of impact-testing equipment, and a Sintech tensile tester that can reach 20,000 lb. Also among the company's tool set are laboratory-grade freezers and ovens, utilized in conditioning safety products for testing product performance against the worst environmental conditions they may be exposed to.

Two years ago, PPE added an ERP system from IQMS. On the production floor, each press is now equipped with notepads, so operators may monitor material consumption and scrap rates for every run. Dixon says the software has streamlined PPE's operations by linking sales, order processing, finance, human resources, operations planning, production scheduling, inventory status, material procurement, and more. Adds Walker, "It's brought us a new level of detail that's helped everyone who works here."

All this spiffing up has resulted in the company obtaining new business. Those opportunities include making seats, oars and foot pedals for a kayak manufacturer; electrical enclosures used in commercial real-estate development; and industrial safety helmets in multiple styles and colors. PT

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MATERIALS

PART 4

Annealing Tips for Semi-Crystalline Polymers

You *can* forgo the elevated mold temperatures normally recommended for high-performance semi-crystalline materials. But it's risky and likely to yield parts that under-perform expectations, assuming that they emerge from the annealing process looking anything like the drawing.

By Mike Sepe

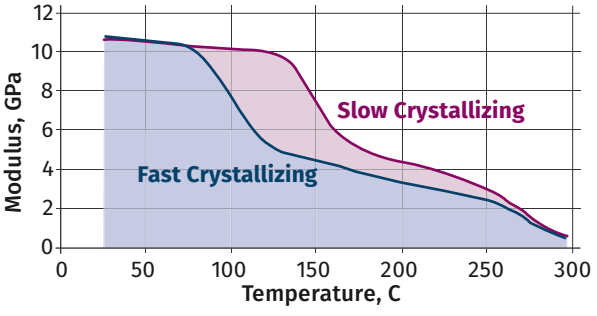
High-performance semi-crystalline polymers typically have high glass-transition temperatures. This results in the need for high mold temperatures to ensure that an appropriate level of crystallinity is established in the part. Polymers such as PPS, PEEK, PPA, SPS, and even some PET polyesters fall into this high-performance class where mold temperatures of at least 120 C (248 F) and as high as 200 C (392 F) are needed in order to achieve the desired structure. Some PET suppliers have developed nucleating technologies that allow for development of an appropriate level of crystallinity while still using mold temperatures that can be achieved with traditional water heating.

In the case of PPA, almost all suppliers of this class of materials have developed fast-crystallizing grades as an alternative to the original materials that required the more demanding mold temperatures. However, this improvement was achieved by manipulating the chemistry of the polymer so that the glass-transition temperature (T_g) is reduced. This is something that material suppliers neglect to mention, and while the molder may be very pleased to be able to produce parts without resorting to extreme mold temperatures, the end user may not be so enthusiastic.

The accompanying graph shows a plot of modulus as a function of temperature for a high-performance PPA and a fast-crystallizing grade. The fast-crystallizing grade sacrifices over 50° C (90° F) of performance. This is an excellent illustration of the continual tradeoff between processability and performance that we see in the world of plastics. If a change is made to a material that makes life easier for the processor, it almost certainly involves a reduction in field performance.

The converse is also true, and with most high-performance semi-crystalline materials, achieving the optimal structure requires the use of mold temperatures that cannot be achieved with traditional water heaters. Instead, pressurized water, oil, or heater cartridges are required. This can be a significant barrier to entry for some processors. Consequently, some processors attempt to anneal into the parts most of the crystallinity that is required.

Comparative Properties of Slow- and Fast-Crystallizing PPA



As shown here, the fast-crystallizing grade sacrifices over 50° C of performance, illustrating the continual trade-off between processability and performance that we see in the world of plastics.

Instead of using the annealing process to produce the last 10% of the achievable crystallinity, they run the material at a low mold temperature that essentially results in an amorphous structure and then they "bake in" the crystal structure after the parts are molded.

While this may work in some cases, it is an approach fraught with downsides. These can be appreciated by illustrating what occurs structurally when a material that "wants" to be semi-crystalline is molded in an amorphous state and is then crystallized later. PEEK is a good example of a material that can be fabricated into an amorphous or a semi-crystalline structure, depending upon the rate at which the material is cooled. In fact, some data sheets for unfilled PEEK give a density for both the amorphous and the semi-crystalline form of the material. As a semi-crystalline material, the density is given as 1.30 g/cm^3. In amorphous form it is 1.26 g/cm^3.

Most of us know that semi-crystalline polymers shrink more out of the mold than amorphous materials. A typical mold shrinkage value for an unfilled amorphous polymer is 0.005 mm/mm or about 0.5%. Unfilled PEEK in semi-crystalline form shrinks approximately 1.5%. This may lead a processor seeking to "anneal in" the crystal structure of PEEK to calculate that the molded part dimensions will be reduced by approximately 1% during the annealing process. However, the difference in density between the amorphous and the semi-crystalline form suggests a volume change of over 3%. Why the discrepancy?

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What many of us forget is that mold-shrinkage values are calculated from the way that parts shrink after they have been formed under significant pressure. As a material cools in a mold, we continue to apply pressure to compensate for the relatively large change in volume that would occur if the part were to cool in an unrestrained state. Amorphous polymers typically exhibit mold shrinkage values of approximately 0.5%, but we know that the melt density of an amorphous polymer is approximately 10% lower than that of the solid material. Without the constraints of the mold and the ability to apply pressure while the material is cooling, our experience of the way materials shrink would be very different.

The dimensional changes that the part will exhibit during annealing will be much greater than expected from our experience as processors.

Annealing takes place in an unrestrained environment. Therefore, the dimensional changes the part will exhibit during annealing will be much greater than expected from our experience as processors. In addition, a part molded at a relatively low mold temperature will contain a much higher degree of retained orientation in its structure. The material that forms the surface will have a substantially different structure than the material in the core, and during the annealing process the molded-in stress will tend to relax. This frequently results in warpage.

I once worked with a processor who had corrected a warpage problem in a long connector of a semi-crystalline material by reducing the mold temperature from 120 C (248 F) to 35 C (95 F). When the customer received the parts, it promptly placed them in an oven at 120 C and the parts warped to an even greater degree than they had coming out of the hot mold. The processor claimed that the customer was "cheating." I explained to them that the customer was merely determining what would happen to the parts when they reached their operating temperature in the field and that the crystallinity that they had suppressed to correct the warpage problem would occur anyway once the part reached the operating temperature of the device.

The final problem with "annealing in" most or all of the crystalline structure goes back to something we mentioned in our last article: Crystals formed in the solid state through annealing are not as large or as perfect as crystals formed from the melt. It is known that crystals that are "annealed in" will melt at a temperature slightly higher than the temperature at which they were created. Consider PEEK again. A common annealing routine for PEEK is a 2-hr exposure to 200 C (392 F). This temperature is well above the T_g of the polymer and will effectively provide that last little bit of crystallinity that we could not obtain from the molding process.

But consider a part that has been molded in an essentially amorphous state. When annealed at 200 C, assuming the part is still in a form that is recognizable, it will consist of crystals that melt at approximately 220 C (428 F). This is a long way from the typical melting point of 343 C (649 F) we expect from the polymer. It is also below even the quoted continuous-use temperature for the material, which on the UL yellow card can be as high as 260 C (500 F).

Therefore, while it is technically possible to forgo the elevated mold temperatures normally associated with best practices for processing high-performance semi-crystalline materials, it is very risky and likely to yield parts that dramatically under-perform expectations—assuming that they emerge from the annealing process looking anything like the drawing. In our next column we will extend the annealing discussion to its application in crosslinked materials.

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*.

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INJECTION MOLDING

Use This Check List to Get Your Machine Properly Installed

Whether you bought a new machine or one that's been refurbished, you need to prepare for installation so that it can be executed as seamlessly as feasible. Here's some advice.

By John Bozzelli

Buying a new or used injection molding machine is always an experience. Often there is a time crunch to get it ordered and delivered. A non-repairable breakdown, unexpected new business, a new rush job for your best client, and other circumstances can make for near panic to get a new or used machine installed and running as soon as possible.

Finding time to make a complete list of the machine specifications needed, canvasing the suppliers for what is available by your target date, and negotiating price can make almost anybody frantic. Once the order is placed, the panic subsides a bit and, unfortunately, many molders do not start planning right then for the installation. All they can think about is the price and worry about paying it off. Do not miss the opportunity to plan and prepare for the installation, as this is a significant time- and money-saving opportunity.

Installation is no simple task and there are a multitude of details. What are they and how do you get a handle on them before the machine arrives?

Consider raising the machine a few extra inches off the floor to permit cleaning beneath it. Make it easy to clean and it might get done.

The list below is long and likely is missing a few items. One aspect not covered in the list but highly recommended is that you should set this machine up to handle as many different molds as possible. Why? Many new, "sure-bet" projects die before or shortly after startup. You do not want your floor space taken up by expensive equipment you cannot use. Custom or captive molder, you must build in adaptability.

Start by getting as many of the details you can. Don't wait until the machine is scheduled for delivery. In fact, check regularly on the machine-build status, as new questions are likely to arise. Many machines sit idle because some small detail was overlooked or changed. Machine downtime is expensive. While no one can predict every machine installation requirement, here is a checklist to get you started:

- Obtain the machine's specification sheet, which will have all of the dimensions and weight of a "standard" machine. Will your machine have anything different?

- Make sure you have enough room for:
  - The molding machine;
  - Box/bags/line feeder for material, resin and color;
  - Auxiliary equipment:
    - Mold temperature controllers;
    - Granulator;
    - Hot-runner controller—and make sure each mold has a diagram of the drops and wiring;
    - Anything else you want to add.
  - Auxiliary equipment for the operator, degating, sonic welder, etc.
  - An operator or two for assembly or perhaps something else;
  - Easy access to the mold for both operator and process technician—i.e., platform or step or perhaps something else;
  - A work table;
  - Scrap bins;
  - A ladder to access the hopper loader;
  - Fork-lift truck;
  - Automation equipment, robot, assembly.

- Do not use floorspace near an area of the machine that will see routine maintenance or troubleshooting. If you must put something near the control cabinet, make sure everything has quick disconnects and is on wheels for easy access.

- Check the floor's weight rating. ►

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• Check ceiling area for obstructions to the robot and crane for mold installation/removal.

• For hydraulic and hybrid machines, check type and quantity of oil required.

• For servo-hydraulic machines, order at least two extra filters, as the one filter will often plug in a day or two.

• Check power requirements for motor and heater bands. Is a step-down transformer required? Do you need a new electrical panel? Discuss with electrician before arrival.

Put together an action plan to make sure your machine installation is a seamless as possible. (Photo: Garner Industries)

• Check power requirements and outlets for temperature controllers, hot-runner controller, robot, oil heater, material dryer, material loader, color feeder, conveyor, lighting, as well as extra 110V outlets on both the operator and non-operator side for various manufacturing, repair or inspection equipment.

• Check routes and connections for power, water, chiller lines and drains. Order appropriate fittings, tubing, clamps etc. Include water filters with inlet and outlet pressure gauges. Pressure differential will tell when filter clogs. This is critical to keep feed throat, mold, and other cooling channels clean and effective. It's rarely done, but inexpensive (less than $200).

• Is an adapter plate required to connect a sprue picker or robot to the fixed platen?

• Is an adapter plate needed for a hopper magnet or color feeder/blender?

• Ensure proper venting around nozzle-tip area for purging resins that give off noxious fumes, such as PVC or acetal.

• Ensure space and power requirements for things like boxes, box labels, part labels, tape dispenser, poly bags, bag sealers, weigh scales, inspection lights, and paperwork (work orders, quality-control documents, etc.).

• Order and set up mold-temperature controllers with gpm (lpm) flow monitoring and pressure sensing on inlet and outlet. Order and install appropriate cooling for machine, mold and auxiliaries. Remember all lines to the mold must carry the same temperature and volume of water for every run. That is, each machine must have a mechanism (usually a mold-temperature controller with flow meters and pressure gauges to push the same volume and temperature of cooling/heating agent every time the mold is in the press.

• Obtain necessary quality-control equipment.

• Ensure there is a mechanism to call for help.

• Review space and power requirements for boxes, box labels, part labels, tape dispenser, poly bags, bag sealers, weigh scales, inspection lights, and paperwork such as work orders, quality-control documents, etc.

• Consider where to locate and mount processor supplies, such as mold preservative, ejector-pin lubricant, brass tools, purge bucket, ejector-knockout bars, propane torch, nozzle, and sprue-bushing radius gauges, etc. Location of each should be labeled so anyone can easily see what is missing. Yes, these tend disappear, but how much time and money is lost and tool damage done because the processor uses a drywall screw instead of brass for digging out a stuck sprue or section of a part. How much does it cost to repair the mold?

• Obtain proper number and size of mold clamps, bolts and spacers.

• Arrange for proper venting for noxious fumes from resin like PVC, acetal, fluoropolymers, etc.

• Consider raising the machine a few extra inches off the floor so folks can get a mop, vacuum, or broom under it for cleaning purposes. Make it easy to clean and it might get done.

• Will the operators need any special equipment to inspect, assemble, label, trim, box or other function?

• Have I missed anything you think is important?

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

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EXTRUSION

‘Melt-Blown’ Fiber: What You Need to Know to Enter the Face Mask Market

Coronavirus pandemic has made extrusion processors curious about entering the face-mask market. But melt-blown fiber is very different from most other extrusion processes and requires specialized equipment.

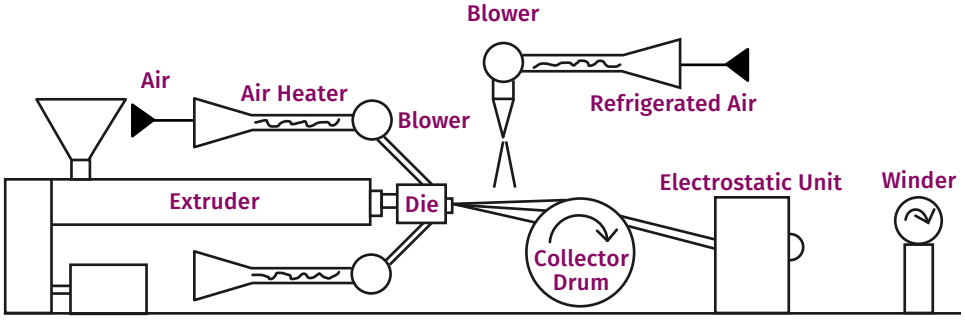
By Jim Frankland

The COVID-19 pandemic has resulted in a demand for billions and billions of face masks, and one of the best filtering materials for such masks is a labyrinth of tiny fibers made by the “melt-blown” process. The face-mask market is wide open right now, but extrusion processors must evaluate all of the unique aspects of polymer melting and pressurization baked into this process before jumping in. And because of the distinctive nature of the melt-blown process, they’ll most likely need to buy new machinery, as most existing extrusion equipment is unsuited for processing such low-viscosity polymers.

The microfiber made from the melt-blown process is sandwiched between two layers of more conventional waterproof fabric to make the masks. Although PP is now the most commonly used polymer for such fibers, other high-flow polymers can also be used, depending on filtering requirements. Up to now, most melt-blown fiber manufacturing has been used to make industrial filters, particularly for the oil and chemical industries. The polymers deployed have to provide high melt flow so they can be easily stretched to make the tiny fibers; melt indexes vary from 300 to 1500 g/10 min, somewhat like hot syrup.

Melt-blown fiber manufacturing requires high extruder discharge pressure to force the polymer through the tiny holes in the die tooling. The dies are similar to a sheet die, except that instead of a slit, the face has thousands of tiny holes spaced 0.010 to 0.015 in. apart. There can be as many as 1000 holes per foot of die width. The holes can be as small as 0.003 in. diam. with long L/Ds to provide stability. Even with the extremely low viscosity of the polymers used, the pressure drop through such tiny holes with long L/Ds can be several thousand psi.

Once the polymer fibers leave the tiny die holes, they enter a supersonic hot-air stream that stretches the fibers and randomizes them before depositing them on a vacuum collector drum (see illustration). The hot-air stream can approach 1000 ft/sec, or greater than 680 miles/hr. The air is at or above the melt temperature, so it does not cool the melt during stretching. The stretching phase of the process occurs very quickly over a short distance, and the fibers end up being drawn down to a final thickness of 0.00001 to 0.000015 in. diam.



Typical layout of a melt-blown extrusion line. This version assumes use of a grooved-feed extruder; otherwise, a melt pump would be added.

The stretched fibers are then cooled by refrigerated air, matted on the vacuum collector drum, and wound into rolls. The fibers at this point look a lot like cotton candy. Different thicknesses, orientations, and densities can be obtained by varying a host of process condi-

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tions. Many lines also give the fibers an electrostatic charge to improve their ability to retain trapped particles during use.

What's the best kind of extruder for this type of process? Because the processor requires use of extremely high-flow, low-viscosity polymers, smooth-bore extruders will have difficulty developing the necessary discharge pressures at reasonable output rates. There are two ways to improve that performance. European extruder manufacturers have used grooved barrels to develop high head pressures, while U.S. builders have tended toward longer L/Ds and, more recently, to adding melt pumps. There are advantages and disadvantages to each approach, which I covered in a column that appeared in the March 2015 issue.

Smooth-bore extruders have difficulty developing the necessary discharge pressures at reasonable output rates.

I recently consulted for a company that was trying to expand rapidly into the manufacture of masks using melt-blown fiber technology. They were surprised at how little of their existing extrusion equipment could be used without significant modification. So, to reduce the cost of the lines and speed up the availability of equipment, this processor decided to start with some grooved-barrel extruders with special screws suitable for the high-flow polymers.

Special screw designs will be needed regardless of whether a processor uses a grooved-barrel extruder or a smooth-bore extruder with a melt pump to develop the necessary die pressure. Polymers with low melt viscosities still melt at the same temperatures and require the same amount of power to melt as materials extrusion processors are more accustomed to running. Extruder screws introduce most of their energy into the polymer to melt it through viscous dissipation or the shearing action of the rotating screw on the polymer. The amount of power introduced is proportional to the polymer viscosity and consistency for a given screw design.

In other words, to get sufficient output and shear to process low-viscosity polymers, extruder screws need very shallow channels and high rpm, a combination that is very atypical of most equipment in operation today. 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* or *(724)651-9196*.

TOOLING

PART 5 OF 5

How to Properly Size Gates, Runners and Sprues

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

By Jim Fattori

This month I sifted through four decades of Post-It notes, hand sketches and photographs to uncover a number of worthwhile tips and tricks related to this five-part series on gates, runners and sprues. Therefore, this month's conclusion to the series will simply be a bullet-point list of helpful information.

RUNNERS

• Full-round, parabolic and trapezoidal are the only three types of runners to be used in an injection mold—in that order.

• Always use geometrically (or "naturally") balanced multi-cavity runner layouts. Multi-cavity molds inherently have balancing issues. Don't compound the problem with fishbone, ladder, or other types of unbalanced runner designs.

• Some runner layouts can have a heavy mass at branch intersections. These can often be cored out without affecting the material flow or pressure, as shown in Fig. 1.

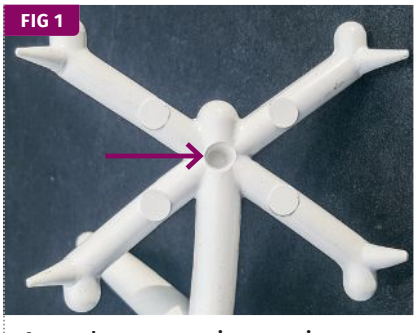
• Never machine a runner on a split line of two or more mold inserts. The injection pressure will try to push the components apart, resulting in "down-flash" that could cause the runner to stick.

• Designing the mold with a separate runner bar or runner block will cost a little more but has multiple benefits—especially for long running molds.

1. Any runner size adjustments are faster and easier to machine.
2. It can be easier to put a cooling channel in the insert on a separate circuit, which can help reduce the cycle time.
3. In the event of parting-line flash, the runner inserts can be skim ground and shimmed up. This eliminates the need to make any other height adjustments to the cavities, interlocks, cams or shutoffs.
4. The inserts can affordably be made of a different material, such as a high-hardness tool steel for abrasive materials, or thermally conductive materials for faster cycles.

• Flash traps are beneficial in any cold-runner system, whether it's a two-plate, three-plate, or stripper-plate mold.

FIG 1



A cored-out runner intersection.

FIG 2

An engraved runner

FIG 3

Proof that overflows work

• One clever engineer engraved text on a family-mold runner to help the operators identify similar-looking parts for sorting and assembly, as shown in Fig. 2. Engraving the cavity number on the runner is also helpful when the parts are very small or the aesthetic requirements do not allow a cavity number on the part.

• Add a runner overflow at each runner intersection. This is particularly important for stripper-plate molds when there is no cold well opposite the sprue. The length of the overflow should be 1.0 to 1.5 times the runner diameter or width. Overflows work very well, as shown in Fig. 3.

• Figure 4 shows two different runner designs. Both runners have sub-gates machined into the injection half of a two-cavity mold. The runner on the left is far superior to the one on the right because: ►

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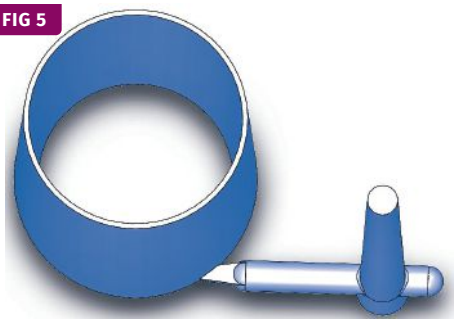
FIG 4

A really good, and a not-so-good runner design.

FIG 5



A tangentially gated part.

1. The cold well is large enough to catch and retain any cold slugs from the machine nozzle tip.
2. The gussets help pull the sprue out of the bushing without detaching from the runner. Otherwise, the cycle time is increased until the thick intersection is sufficiently solidified.
3. There are no pullers directly under the sub-gates, which would prevent them from flexing when the mold opens. If the sub-gate didn't flex, it could break off or produce flakes.
4. The sub-gates feed off the side of the runner, allowing for a small overflow and a good location to add a runner vent.
5. The sub-gates are chisel-shaped. They allow adjustments to the width and the depth, like an edge gate does—independently controlling either the flow speed or the gate-freeze time.

• For shear-sensitive or glass-filled materials, radiused runner turns are preferred over 90° bends.

• "Breaking" or blending the sharp edges of the runner system will help reduce stress on the material and help prevent the runner from cracking upon ejection. Sharp edges are typically located where the sprue meets the runner, where the cold well meets the runner, where the gate meets the runner, and at every runner intersection.

GATES

• It is best to edge gate parts from a full-round runner.

• Sub-gates can be fed from a full-round, parabolic or trapezoidal runner.

• For high-volume molds (about 500,000 cycles or more), consider incorporating replaceable gate inserts, especially for abrasive materials.

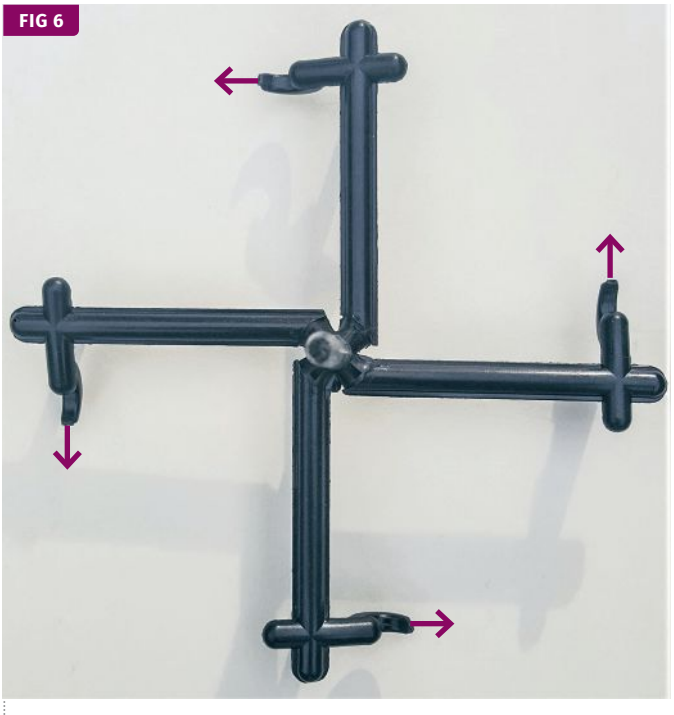
• Avoid using sub-gates if the molding material is abrasive, or if the cavity is made of a soft metal, such as aluminum or copper. They will wear out quickly.

• Sub-gates do not necessarily have to be machined parallel or perpendicular to the runner. They can be machined on almost any angle. This is helpful when gating into a part with a radius or a steep angle, or when you want to shift a weld-line location.

• An edge gate or sub-gate that intentionally feeds a part on an angle is referred to as tangential gate, as shown in Fig. 5. It is often used to prevent core shifting, relocate a weld line, or improve weld strength. However, it can cause jetting inside the cavity.

• Keep in mind what effect the gate location and runner pattern will have on the mold. The gate and runner in Fig. 6 may be a balanced design, but it caused the cavity and core halves of the mold to rotate in opposite directions, resulting in parts that had a core-shift problem.

FIG 6



A bad gate location design.

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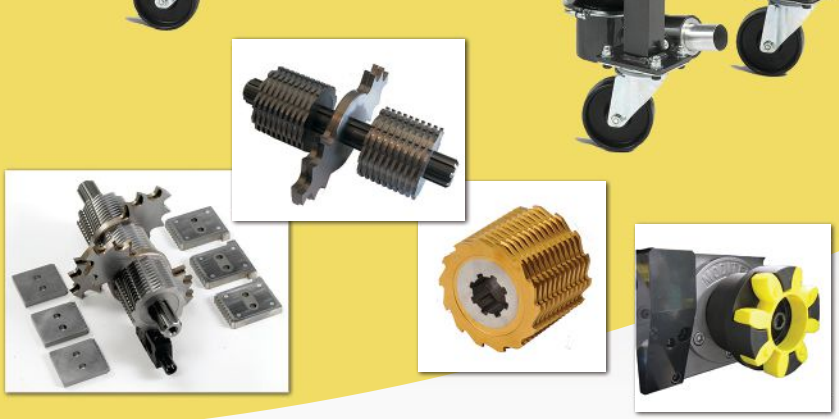

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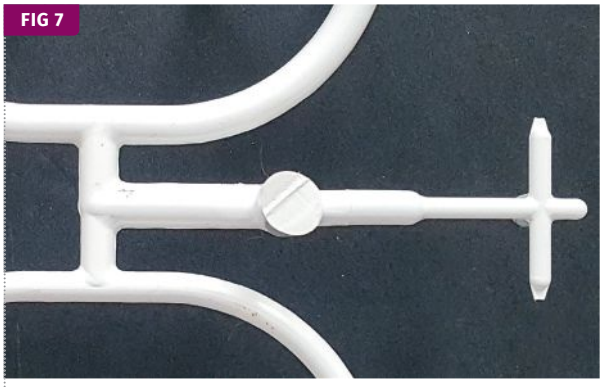
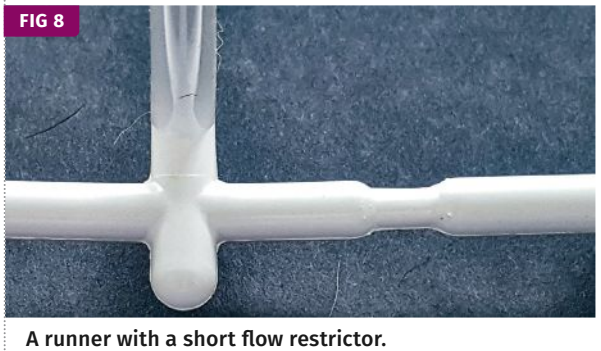
FIG 7



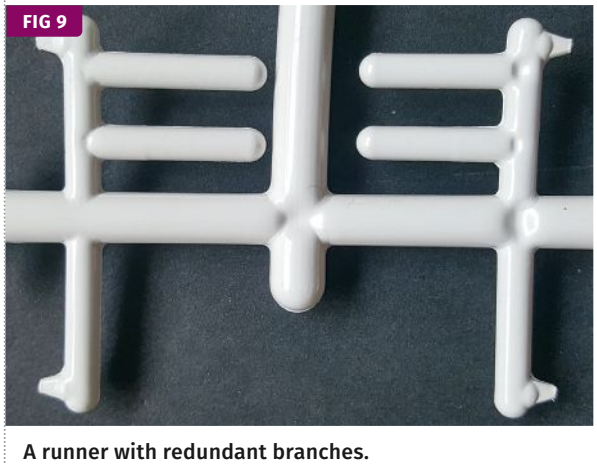
A runner with varying diameters.

FIG 8



A runner with a short flow restrictor.

FIG 9



A runner with redundant branches.

BALANCING FAMILY MOLDS

• The goal in balancing a family mold is to have all of the parts finish filling at the same time—not *start* to fill at the same time. Keep that in mind when you are making progressive short shots.

• One reason you want all of the parts in a family mold to finish filling at the same time is so they all receive the same amount of packing pressure. If they don't, you waste material by overpacking some cavities, which makes them heavier. Another reason is that cavities that are underpacked or overpacked will have dimensional issues because they will have a different shrinkage rate than what was used to machine the mold.

• The trick to adjusting a family mold is to adjust the flow rate of the material in the runners feeding each cavity. Changing the gate depth or width only changes the fill speed (mph). It does not change the flow rate (in.³/sec). Changing the gate depth will also create different gate-seal times, which leads to parts having different packing pressures. Therefore, to correctly balance family molds, change the runner diameters to each cavity, as shown in Fig. 7.

• If you want to increase the size of the gates, runner or sprue by some percentage, you need to run the numbers. For example, if you feel a 0.050-in. gate should be about 20% larger, don't multiply the gate size by 1.2 and get 0.060 in. That's not 20% larger. In terms of flow area, that's 44% larger. An easy and correct way to determine the new gate is size is to use the following formula: $D_{NEW} = D_{EXISTING} \times \sqrt{(1 + \text{percentage increase})}$. In this case, it would be $0.050 \times \sqrt{1.2} = 0.055$.

• Adding a short flow restrictor, as shown in Fig. 8, is not as effective as reducing the diameter of the entire runner branch.

• Adding redundant runner sections, as shown in Fig. 9, has only a minor effect on cavity balance. They will also narrow the processing window and increase the amount of runner scrap or regrind.

EJECTION

• Ejector pins should be flush with the bottom of the runner. They should never enter into the flow channel.

• A shortened ejector pin is required for ejecting a runner puller near a sub-gate machined into the cavity side. A good puller design is shown in Fig. 10. Note how the ejector pin has a smaller diameter than the puller and how the puller has a radius and small pad on the bottom. This design will minimize the risk of getting flakes or shavings on the parting line.

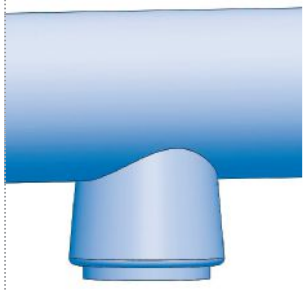
• Shortened ejector pins with a conical tip are used to stabilize a runner from shifting or rolling over during ejection, as shown in Fig. 11.

• Ideally, an ejector pin should be located at each runner intersection, because as the massive runner shrinks, it will try to stick on the inside corners.

• If a full-round runner sticks on the cavity side of the mold, instead of using pullers, you can add undercuts on the ejection side. A teardrop-shaped undercut is best for preventing flakes or shavings, as shown in Fig. 12.

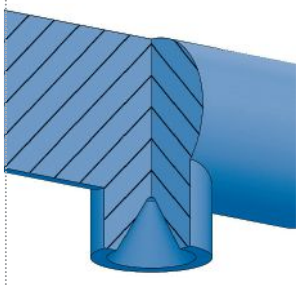
• Consider the location of any runner undercuts. They should be at or near an ejector pin to prevent the runner from bending or cracking during ejection.

FIG 10



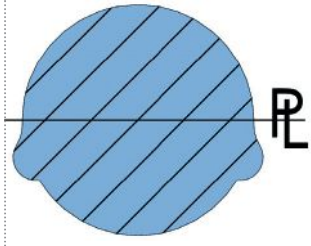
A well designed runner puller.

FIG 11



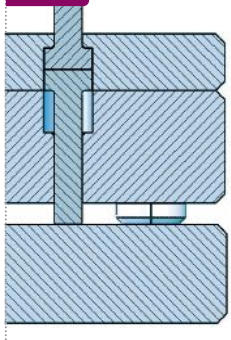
A cross-section of a runner stabilzer.

FIG 12



A teardrop-shaped runner undercut.

FIG 13



A delayed ejector design.

• An inexpensive way to delay the ejection of a runner (or a part), without having to incorporate a two-stage ejection system is shown in Fig. 13. The pins are well supported and have positive return. This design can help reduce flaking from sub-gated parts.

VENTING

• Specify the vent locations, depths and widths on the mold drawing. Do not leave venting up to the toolmaker's discretion.

• Some moldmakers and molders do not like to add vents until after the first sampling. This can lead to an erroneous fill pattern. At the very least, add vents at the last place to fill.

• Try to add a runner vent as close to the gate as possible.

Note: Special thanks to Roy Glenn, a retired moldmaker and mold designer, for his valued input on this month's column. PT

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

By Tony Deligio
Senior Editor

Coronavirus Test Kits Test MGS' Manufacturing Mettle

MGS Manufacturing is marshalling its injection molding, moldmaking and automation skills in a tightly compressed timeline to outfit the equivalent of a full-scale injection molding plant for COVID-19 test kits.

MGS employs approximately 300 at its Germantown headquarters, with plans to add 40 more staff in 2020.

The coronavirus pandemic has exerted an unprecedented stress test on nearly every aspect of the U.S. economy, including plastics manufacturing. In the earliest days, machines idled from normal business paused by the outbreak were rapidly repurposed for making whatever products could help right now, whether it was personal protective equipment (PPE) for frontline medical personnel or valves for much-needed hospital ventilators.

By the start of April, the immense scale of the challenge facing the country, and what plastics manufacturing's role would be in rising to that task, began to come into focus. "Everyone knew that in order to have containment and not keep the country shut down—to have a more strategic approach to the outbreak—we needed information; we needed data; and we needed much, much more testing," says Paul Manley, president of MGS Manufacturing, Germantown, Wis.

At that time, as the coronavirus pandemic pushed towards an initial apex in cases and deaths, MGS Manufacturing shifted from supplying tooling to a competitor for a new rapid molecular-level test kit for COVID-19 to taking a sizable portion of the mold-making and injection molding for the project in-house. Founded in 1982 as Moldmakers Inc., the Wisconsin-based company that is now global with operations in Europe and Mexico has expanded into injection molding and custom automation, with a specialization in two-shot molds and molding and medical manufacturing. That amalgam of abilities put MGS in a special position help ramp up production of urgently needed test kits.

"Our customer, who was familiar with MGS and our unique capabilities, saw us as a perfect partner to help scale these components," Manley explains. "I say 'unique capabilities' because there are a lot of really good toolmakers in the United States and a lot of really good injection molding companies. There are also a lot of companies that build automation, but at MGS, our integrated solution, our unique value proposition, is that we do all three."

> ***"Several of the parts are multishot components, adding another layer of complexity. I wouldn't classify any of the parts as simple open-and-close molds."***

TESTING TIMES

Since the outbreak took hold in the U.S., coronavirus testing has ramped up continuously, but the gap between where things stand and where they need to be, according to public health experts, remains wide. In April, when MGS first became involved, a daily average of just over 173,000 tests were being performed in the U.S. according to ►

MGS Manufacturing's Healthcare Center of Excellence, including its ISO Class 8 cleanroom, is well suited to tackle molding components for COVID-19 test kits.

MGS Manufacturing's automation capabilities, paired with its injection molding and moldmaking capacity, came into play for taking on the COVID-19 test-kit job.

the COVID-19 tracking project. In May, that figure doubled to more than 343,000 tests/day—rising to 391,173 average daily tests over the last two weeks of the month. Given the size of the U.S. population—328 million people—and the extent of the outbreak here, Harvard's Global Health Institute said the U.S. should be doing more than 900,000 tests per day.

If the country ever gets to that figure—theoretically completing 27.9 million tests a month—it will be by virtue of the efforts of manufacturers like MGS and the suppliers that support them.

As of June 1, 17.6 million tests had been completed in the U.S.—a staggering figure when considering the sheer volume of molded components required. The total number of individual tests created and completed in just a few months were equivalent to light-vehicle sales in the country for an entire year. Additionally, this output was for a wholly new line of products requiring new tooling and validation, with a ramp-up of just weeks rather than months.

"These are complex plastic parts," Manley says. "We all understand the urgency of getting these to market, and in a suite of tools where lead times would typically be 18 to 20 weeks, we're building them in six to eight weeks." Manley says this testing kit, for which MGS cannot reveal the OEM, was on the market, but it needed to be scaled up "exponentially."

"The ability to take something designed for half a million or a million tests per month and scale it to 5 to 10 million tests per month—in a very compressed time frame—is a challenge," Manley says, with considerable understatement.

18 NEW MOLDS & MILLIONS OF PARTS

MGS is limited in the specific information it can share about the individual elements of the project, but generally speaking, the job involves a number of components molded by MGS in tooling it is building. These components are then sent to the customer for assembly into a single-use consumable, including the reagent. After introduction of the patient's sample, the consumable is ►

To complete the 18 new molds required for the COVID-19 test kits, MGS's toolroom saw employees working 60- to 70-hour weeks with split shifts instituted to maximize equipment usage.

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inserted into the testing instrument. "Several of the parts are multishot components, adding another layer of complexity," Manley says. "I wouldn't classify any of the parts as simple open-and-close molds."

Ultimately, MGS signed on to build 18 injection molds, eight of those being multicomponent tools, by mid-July, giving the company approximately 10 weeks from project launch to sample parts from new molds with a streamlined validation process. The monumental moldmaking task was made possible by employees working 60- to 70-hr weeks and instituting split shifts in the toolroom to maximize equipment usage.

PLASTICS MANUFACTURING PRIDE

The breakneck pace of the project, paired with the underlying challenge of running a complex manufacturing operation in the midst of a pandemic, could prompt many responses, but there has been one overriding sentiment for Manley.

"I've been a part of MGS for 24 years now," Manley says, "and truly, I've never been more proud to be a part of the organization than in the last couple of months, seeing how so many people have responded so admirably."

That pride extends to the broader U.S. manufacturing base, which leapt into action to address the outbreak from the very beginning. "Whether it be transport tubes and caps for sample collection for testing or these rapid test kits," Manley says, "all of it has been a testament—and I'm sure this is what many companies are seeing—a testament to the great work that U.S. manufacturers do here."

MGS' capabilities include creating customized automation cells to support its own and outside manufacturing.

As the molds are being completed, MGS is staging 18 injection molding machines in its ISO Class 8 cleanroom into a sort of "super cell" to allow coordinated molding of the components. The plan is to be in mass production by mid-September. When that time comes, Manley anticipates the monthly volume of individual parts for this project to be in the range of 12-15 million.

MGS' ability to take on a project of this scale is a direct result of recent investments. In June 2019, the company announced an injection of $20 million into its Germantown headquarters, expanding its cleanroom molding with a new 13,000-ft² Class 8 space that is the heart of its new Healthcare Center of Excellence. That new cleanroom houses 20 injection machines, ranging in clamp force from 160 to 650 tons, and it joins existing cleanrooms in Germantown that covered 15,000 ft² and 6500 ft², respectively. MGS has more than 100 molding machines and 300 employees in Germantown, and despite broader market difficulties, it anticipates hiring 40 new employees in 2020.

> ***"If we can share best practices, if we can learn from what they've done, or they can learn from what we've done and get to market faster—great, let's do that."***

That work, in many ways, is just getting started. The continued need for personal protective equipment, testing, and components related to vaccine development and manufacturing, mean plastics' role in responding to this crisis is just getting started.

"We certainly have a common enemy here," Manley says. "This isn't about the competitive nature of tooling organizations or plastics companies; we do have a greater good to serve here. There's a cadence of meetings where all partners are on the phone and are sharing all information in order to make sure another partner doesn't have to go through the same hurdles we have. If we can share best practices, if we can learn from what they've done, or they can learn from what we've done and get to market faster—great, let's do that." PT

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Highly-loaded color concentrates have been proving their mettle in terms of cost-performance in rigid packaging and building products.

New to Using Color Concentrates? Follow These Tips to Improve Results

With a focus on highly loaded color concentrates, here is a guide for processors of rigid packaging and building products on how to specify the appropriate colorant for these applications.

By Ronald Harris and Hari Rajaraman
Chroma Color Corp.

As younger engineers and buyers enter the plastics industry, there is a need to provide the next generation with the right fundamental knowledge and awareness to produce high-quality colored plastic parts. Designers and brand owners understand the importance of choosing the right color to ensure their products stand out from the competition. Yet they often may not have enough fundamental knowledge and awareness to produce quality colored plastic parts, and so turn to their processing partners for help. With a focus on highly loaded pellet concentrates, here is a guide for processors of rigid packaging and building products on how to specify the colorant, along with examples of how processors in these markets are using new color technologies to give their products a boost. Most of the principles discussed here generally apply to other end-use markets as well.

PROCESSING BASICS & TECHNOLOGY OPTIONS

Choosing colors for your products is a critical part of the development cycle. Designers and processors looking for ideas or trends can use sources such as Color Marketing Group, Pantone, paint companies, magazines, and social media.

Once you get some general ideas, the most effective way to complete this part of the process is to work directly with a color concentrate supply partner. They can mold color chips, bottles, or other sample parts in your resin that capture your vision of the end product.

One of the most important factors to keep in mind when designing a plastic product is that both the resin and color concentrate must be suitable for the intended process, such as injection, blow, compression molding or extrusion. This is because resins, pigments, dyes, and additives must be able to withstand extreme heat exposure during the molding process, including shear heat generated when a material flows into a mold. If the material on its own is not sufficiently durable for its end-use environment, it will likely need additives that screen out UV rays, antioxidants, or other stabilizers to protect against polymer degradation that can lead both to discoloration and product failure.

The next decision is to choose your colorant technology. The two most widely available choices are precolor and masterbatches in either liquid or pellet form. Both liquid and standard pellet options have their benefits and challenges. It is best to investigate both in depth to determine what would work best for your operations. Ideally, a winning program requires a colorant format that provides maximal benefit with minimal challenges.

Precolor is easier to use since the color is already fully incorporated into the resin process. However, precolor costs more to produce and often requires keeping considerable inventory on hand, as compounders generally have minimum order requirements. Even with good forecasting, there is always a threat that the product might reach the end of its sales cycle before your precolor supply is depleted.

Masterbatches minimize your color inventory. Even so, there are choices to be be made. For example, conventional pelletized color masterbatches are typically more costly than liquid colorants due to the latter's high letdown ratios.

Today, with recent advances in dosing equipment and availability of new technology for highly loaded pellet concentrates, processors can reduce cost and production challenges. The latest pellet feeding systems can dose highly loaded pellets at levels down to 1.0% and below.

Color-concentrate pellets can be strand cut (cylindrical) or underwater cut (round). In general, the pellets are smaller than those of the customer's resin. For special needs, concentrates can be provided as mini-pellets.

For the most part, highly loaded color concentrates use carrier technology similar to that of conventional color concentrates. Typically, the carrier resin is generically the same as the customer's resin—e.g., a PE carrier is used for coloring a PE part. However, the concentrate pellets commonly have a higher melt flow than the customer's base resin to ensure the color is readily distributed throughout the part during processing.

Both liquid and standard pellet options have their benefits and challenges.

COLORING POLYOLEFIN AND PET PACKAGING

In the packaging world, there is no one-size-fits-all solution for a particular type of container. It all depends on the intended contents and use. Both HDPE and PP have proven to be good options for a variety of rigid packaging applications.

HDPE is one of the most common resins for rigid packaging because it is very durable. It also maintains its stiff shape during filling and is resistant to abrasion and punctures. Yet, compared with clear PS, PET, and PVC, HDPE can look a little gray on the shelf next to clear containers. This is why most HDPE packages are colored.

Moreover, colored HDPE packaging generally has better stress-crack and chemical resistance, which is especially important for applications such as household cleaners and detergents that require more durability and a longer shelf life. HDPE is also resistant to warpage, distortion and UV light.

Polypropylene is also used in a variety of packaging applications because it is tough and heat resistant up to 180 F. One of the popular uses for PP is living hinges on bottles for ketchup, sour cream, and water.

Many PP living-hinge applications require nucleating agents such as silica, talc and organic salts to accelerate the crystallization rate to help reduce injection molding cycle times, thus lowering production costs. A reputable color pellet concentrate supplier will know the right choice of pigment and nucleating agents to capture production efficiencies without compromising living-hinge performance.

Highly Loaded Concentrates Give Building, Packaging Processors the Edge

Processors in the building/construction and packaging markets have gained an edge from switching to highly loaded pellet concentrates such as Chroma Color's G2 and G3 products. Here are some specifics:

- **Radiant Pipe**: G2 provided one processor a cost-effective solution for a high-temperature coextruded pipe used in radiant heating. A vibrant color was used for the ultra-thin outer skin layer of PE-RT (raised temperature) HDPE and a standard solid color for the PE-RT HDPE inner layer against the copper pipe core, thereby reducing the overall colorant cost.

  The G2 concentrate was used here at 0.75%. Despite being used at a lower level than for conventional concentrates, the highly loaded G2 pellets delivered a sufficiently high concentration of UV stabilizers and absorbers used to prevent fading and polymer degradation. The pipe is now available in red, blue and white.

G2 provided a cost-effective solution for a pipe used in radiant heating with only the ultra-thin outer layer—coextruded PCR-HDPE—colored in a vibrant red.

- **TPO Roof Membrane:** Chroma formulated a G2 product package that offered UV and antioxidant stabilization at *half* the usage rate of the existing product in the market for a

Roofing membrane required highly loaded concentrate with UV and antioxidant stabilization.

Highly Loaded Concentrates Give Building, Packaging Processors the Edge

processor extruding lightweight TPO roof membranes. Typical concentrates in this market are used at 12-15%, whereas the G2 concentrate is used at 6%. The lower use level ended up substantially slashing overall price per pound, and also resulted in reduced inventory requirements to free up floor space and cash.

On the packaging side, developing products to meet customers' demands can be challenging as the major brands have exacting color requirements. Restrictive cost pressures compound the difficulty of consistently meeting brand retail shelf expectations.

- **Teal (Turquoise) HDPE Lids:** The particular teal color-space is critical to this brand's identification in a cosmetics product line. Yet, it faced multiple color-related concerns, such as part-to-part inconsistency, which forced the processor to consume the existing colorant at substantially higher use rates to achieve visual color uniformity. These higher use rates forced production inefficiencies, significantly higher than desired colorant inventories, and elevated levels of finished component inventory to ensure required lead times were maintained.

Consequently, the brand's packaging team and processor jointly began searching for an alternative colorant to resolve the multiple challenges of color stability, processing difficulties, excessive use rates, and overall package cost. During their investigations, we introduced the patented G-series colorant technologies. The G-series technology includes both G2 and G3 formulations. Molding trials were conducted with both technologies to identify the most appropriate and beneficial package.

Chroma's G3 highly loaded concentrate provided superior dispersion, eliminating color variations in the sensitive teal color space for a cosmetics line.

The solution proved to be the G3 system, which provided superior color

Both virgin and recycled PET are used heavily for a variety of packaging beverages, food, and consumer products. Color concentrates for these resins have been around for years. Until recently, conventional pellet concentrate based on a PET carrier had not been cost-effective for coloring PET because pigment loadings were low compared with liquid color, and the concentrated had to be dried. Recently a new polymeric carrier technology was introduced (Chroma's UltraPET). This carrier not only has excellent compatibility with PET polymers used in packaging but also offers these benefits:

- Mini beads provide more pellets per gram with a larger surface area to improve color distribution—a feature especially useful for tint colors.

dispersion, eliminating color variation. It also reduced the use rate from 4% to 1.5% letdown, lowering the overall coloring cost. Moreover, it provided faster cycle times, more cost-effective color changeovers with less purging, and reduced downtime.

The lower use rates along with the processing benefits of the G-series, allowed the molder to meet the required production demands. Further, the lower color requirements, coupled with the improved production efficiencies, provided desperately needed warehouse storage space. The numerous benefits brought to the program by this technology eventually led to a complete switch on all colorants for this brand's needs.

- **HDPE Blow Molded Bottle:** Chroma participated in a trial with one very large blow molder in the packaging industry. The company had been impressed with their current suppliers' letdown ratio; however, after talking with Chroma, it agreed to test out the new G3 product line.

The previous supplier's color concentrate had a recommended letdown of 2.5%. Chroma submitted two samples of G3 concentrates at 1.5%, and 1.7% letdowns. During the blow molding trial, the 1.5% sample achieved the color specification at a 1.14% average usage. In comparison, the competitive concentrate's average usage rate was 5.96%, as determined by post-trial thermogravimetric analysis (TGA) testing. The TGA testing also confirmed that G3 concentrate contained 65% pigment versus 26% in the incumbent's conventional concentrate—2.5 times more pigment per pellet.

Equally important, no changes to the blow molder's processing parameters were required to run the Chroma concentrate, eliminating any additional challenges for the manufacturing team.

G3 concentrate contained 2.5% more pigment than the incumbent colorant.

- They process at a much lower temperature than conventional PET concentrates, reducing the heat stress on the pigments and dyes.

- They offer exceptionally high loading of both pigments and dyes, and consequently, economical letdown ratios. In most cases, the extremely low use rate eliminates the need for drying and recrystallization, unlike conventional PET pellet concentrates.

Targeted applications for this new PET product line include cosmetic packaging, vitamin bottles, nutraceuticals, sample liquor bottles, spice jars, and thermoformed sheets.

COLORING RECYCLED MATERIALS

There is much talk and growing action among consumer brands regarding use of more recycled materials in their packaging. Many brand owners are focusing on meeting goals for packaging made with post-consumer recycled (PCR) content, particularly PET and polyolefins, by 2025 or a little later.

If you are serious about making the switch to recycled resins, select a color company with success in providing color and additive concentrates that include processing aids, impact modifiers and UV and other stabilizers, because additives besides color may be required to bring PCR up to spec. Today, some suppliers even offer 100% PCR-based color and additive concentrates that allow brand owners to claim that the product is 100% PCR.

As the demand for coloring recycled PE and PP packaging continues to grow, you are going to need a colorant supplier you can count on for the right colorant package, as lots of the recycling stream is colored yellow or gray, and the only way to produce a package with great color using rPET is with highly loaded color concentrates.

COLORING BUILDING & CONSTRUCTION PRODUCTS

Every year there is an increase in the diversity and number of plastic products used in the building and construction industry. The broad range of plastic building products in this market includes cables, conduit, pipe, cladding, windows, doors, protective and decorative shutters, architectural roof tiles, decking, siding and flooring. Although these products perform well, adding color delivers the aesthetics desired by the brand or consumer, identifies them for specific usage (color-coding), and in many cases, defines the application. You may be familiar with the fact that plastic pipe and conduit are color-coded by their end-use application, such as:

- Blue = potable water
- White = irrigation and water
- Green = sewer
- Purple (lavender) = reclaimed water
- Gray = electrical conduit
- Orange = telecommunication conduit
- Yellow = natural gas (methane or propane), oil
- Red = electric power lines, lighting cable

Once again, the biggest challenge related to coloring plastic building products is accurately matching the desired color in the specific product resin. Typical plastic resin types used in construction include PE, PP, TPO, PVC, PC, ASA, ABS, acetal (POM), nylon, acrylic, and a variety of thermoplastic composites.

It is critical to establish a partnership with your color and additives supplier early in the development process to achieve specific color and performance attributes. After determining the correct resin, your conversation may move to color selection. Typically, your supplier will have color sample chips or Pantone color charts to pinpoint the desired color for each plastic product or part.

During this selection process, colors may look different depending on gloss, grain, filler, resin type, light sources, and other factors. For example, in high UV light environments, colors such as red, orange, and yellow typically fade faster than darker colors such as blue or green.

ABOUT THE AUTHORS: Dr. Ron Harris has been a technology development consultant to Chroma Color Corp. and its legacy company Carolina Color for 14 years. For the past 39 years he has been involved in several aspects of coloring plastics, from making pigments and polymeric materials to formulating custom colors. He holds 16 patents in the fields of plastics materials, laser marking, and plastics coloration and decoration. Contact: *704-637-7000; rharris@chromacolors.com; chromacolors.com*.

Hari Rajaraman has over 33 years of industrial experience with polymers. He has been a consultant for the past 21 years in the areas of color concentrates, polymer additives, plastics processing and landscape coatings. Hari's full time work experience includes six years with a leading manufacturer of nylon resins and fibers in India and six years with M.A. Hanna in the U.S. He has been granted six U.S. patents and has three patent applications pending. Contact: *hrajaraman@chromacolors.com*.

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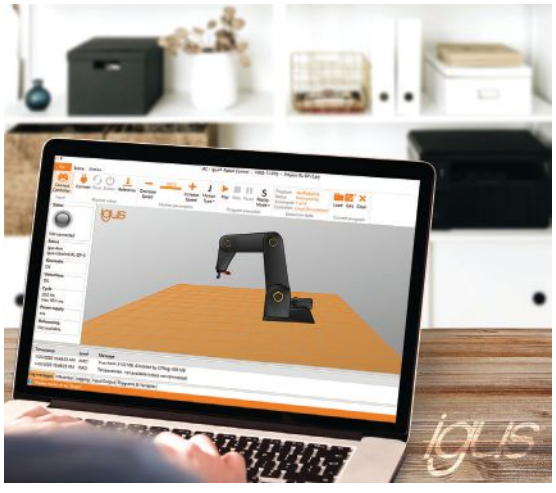
AUTOMATION

New Hardware & Software for Low-Cost Robots

A new linear seventh axis, free downloadable control software, and a new range of modular components are available for the Low-Cost Automation platform from igus (see February Close-Up on robots at K 2019). The company's four- and five-axis robolink DP articulated-arm robots already have a sixth rotational axis available. Now, igus has added another modular option, a linear seventh axis (horizontal or vertical), which can expand the robot's working volume fourfold. What's more, the new linear axis—which makes use of igus's drylin linear guides—is also available for other robot brands, such as Universal Robots.



Second, igus introduced new easy-to-use programming software for its entire line of robots—articulated-arm, delta, and linear types. The software is downloadable for free. It allows for simple "lead-through teach" programming of a "digital twin" or simulated robot on-screen (photo). The user manually moves the robot through the desired positions, using a mouse or a finger on a touchscreen. Virtual safety boxes can be specified to prevent the robot from colliding with other equipment. The program can then be applied to an actual robot. It also can connect to a higher level control system via interface communication, with digital I/O or Ethernet protocol using an IP address. igus calls this offering "try before you buy" because you can try out the simulated control before buying actual hardware.

Speaking of hardware, igus has launched the RBTX online platform (***rbtx.com***) with a catalog of compatible modular components for robots from a range of suppliers. Such components currently include grippers/end effectors, vision systems, pneumatics, control hardware and software, and auxiliaries. These products currently come from igus and five other partners; 10 more are due to come on board this year with 70 to 80 new products.

EXTRUSION

On-Line Sensor Brings Clarity to Transparent Films

Haze is a critical quality parameter for film, sheet, and other transparent materials. NDC's new HazePro gauge reportedly solves this problem by measuring the haze from narrow to wide films online with high accuracy and reliability. With HazePro, processors can immediately see the impact of process changes on haze and learn how to maintain haze quality. Process adjustments can be automated for real-time control of haze.

HazePro is reportedly immune to ambient changes as well as process variations, such as web flutter. NDC's haze measurement complies with ASTM standard D1003 for transparent materials.

AUTOMATION

New Dust- & Waterproof Cobot for Sanitary Applications

Yaskawa Motoman has introduced the model HC20XP collaborative robot with 20-kg (44-lb) payload capacity and 1700-mm horizontal and vertical reach. It's said to be well suited to working safely with, or in close proximity to, humans without protective guarding (depending on a risk assessment).

It is described as "the industry's first IP67-rated collaborative robot," a rating for dustproof and waterproof construction. Made of cast aluminum, with an "easy-to-clean" surface, the new model can be used in sanitary environments where wipe- or washdown is required, according to the company. HSF H1 food-grade grease is standard.

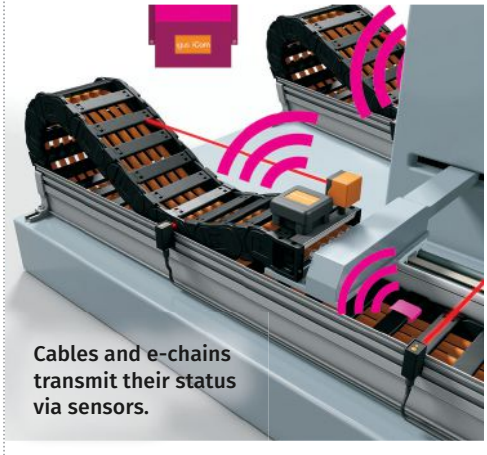
The HC20XP offers four modes of collaborative operation, including Power and Force Limiting (PFL), where dual-channel torque sensors in all joints constantly monitor force to quickly and safely react to contact. It has a "pinch-less" design with through-arm utilities to hide cabling and reduce risks of snagging or interference with other equipment. The cobot can easily shift between collaborative speed in PFL mode to full speed in industrial mode in order to optimize cycle times based on risk assessment and process requirements.

AUTOMATION

Predictive Maintenance, Cleanroom Versions & Recycling of Energy Chains

In a recent review of new developments in its flexible plastic energy chains, or "e-chain" cable carriers, used in robotics and other automation components, igus highlighted the following:

- The company is now taking back used e-chains for recycling—regardless of the manufacturer. It has collected one to two tons of cables since December.
- For clean rooms, igus launched its first "clean cable system" that can be opened and closed. This e-skin flat, modular, flexible sleeve snaps open and closed, allowing for quick and easy expansion or replacement of the cables in an e-chain. A new e-chain support for this system allows for longer travel than before. In addition, igus has commissioned a new cleanroom lab, certified to ISO Class 1, at its German headquarters.



Cables and e-chains transmit their status via sensors.

- igus has several new products aimed at remote maintenance monitoring (condition monitoring) of energy chains. A new small electronic box connects to all sensors on the e-chain and to a junction box for communication with the customer's or igus's servers. An info dashboard presents the maintenance status to the user.

Also new is the ecw wear-detection sensor for e-chains. It's attached to the e-chain and connects directly to the igus cloud. Cost is around $500. Igus also supplies a new eci wear sensor for "smart bearings." Non-lubricated bearings with integral wear sensors are now available in five types.

The company's ecp push-pull force-detection sensor, which previously functioned for chain movements up to 120 meters, is available in a new ecpr version that can travel up to 1000 m or more.

A new ecpp position sensor is being used by one overhead crane supplier to monitor crane position. This new device reportedly saves four to six days in crane installation time.

Also new is software for use with the cfd cable condition-monitoring sensor to predict the cable's lifetime, using artificial intelligence (AI) and machine learning. One customer is using this system to help achieve 50 million cycles for bread-packaging machinery that operates at 120 pieces/min.

INJECTION MOLDING

Mold Dehumidifier Adds Germ- and Virus-Free Version

Austria's Blue Air Systems, represented in the U.S. by Comet Plastic Equipment, has introduced a new germ- and virus-free version of its DMS (Dry Mold System) mold dehumidifier. Sterilizing the production area is a common practice among food and pharmaceutical manufacturers, and plastics processors producing packaging for the same manufacturers face the additional demand for sterile and low-particle goods production.

To support these manufacturers, Blue Air Systems has introduced DMSterile to generate a germ- and virus-free atmosphere during mold dehumidification. Molded products such as pharmaceutical containers, PET preforms or sealing caps come in contact only with sterile air during production within the partitioning.

Blue Air Systems notes that microorganisms thrive in environments where moisture and heat are present—conditions often found in molding plants. Here, old or irregularly maintained filters in air conditioners, ventilation systems and even production machines can facilitate the generation of germs and viruses. Blue Air Systems notes that using DMS dehumidification can also reduce energy usage with savings of up to 80%, while also boosting quality and output.

EXTRUSION

Start Your Extruder Drive With No Technician or Manual

Integrated Control Technologies (ICT) is offering a product enhancement for its ACPAK AC drive package that allows extrusion companies to start it up without needing technicians or operation manuals. And the product gives ICT remote access to help verify the settings if necessary.

The Smart-Up Assistant takes users step by step through the start up of the ACPAK while permitting ICT to connect to the drive and verify the settings. The Smart-Up Assistant includes:

- Ewon for remote startup and troubleshooting support.
- Software with step-by-step instructions and photos.
- Yaskawa Bluetooth operator interface option.
- 7-in. color touchscreen.
- Speed and load monitoring; fault log; trending; and drive-health monitor.

The Smart-Up Assistant can be mounted in a separate enclosure or on the door of ICT's ACPAK with ARC Flash Plus. It is compatible with the Yaskawa A1000 and GA800 drives and the entire design not only guides the customer throughout the startup, it checks their work while teaching best practices.

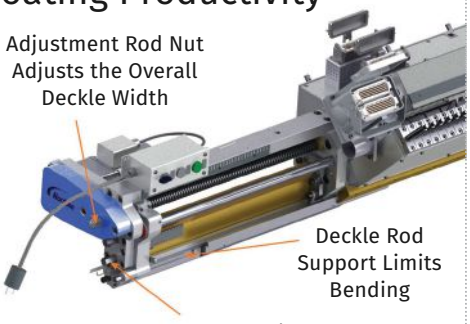
EXTRUSION

Enhanced Deckle Boosts Coating Productivity

Nordson has streamlined the design of the EPC deckle system for EDI extrusion coating/laminating dies to make it easier to control edge bead and reduce downtime for width changes and cleaning. The widely used EPC die includes an internal deckle system that reduces resin cost and trim waste by controlling edge-bead formation, plus an external deckle for convenient width adjustment. The new enhanced design provides these improvements:

• *Easier control of edge bead*: For independent adjustment of the internal deckle components, Nordson has replaced a rack-and-pinion gear with a threaded stud that makes it easier to fine-tune the edge bead, reducing the amount of trim required and increasing material savings.

• *Easier manual adjustment of deckle width*: Nordson has replaced a gearbox used for adjusting overall deckle width with a nut on the adjustment rod, reducing the width and weight of the deckle system and increasing access for operators.



• *More robust and user-friendly construction:* A durable new deckle-rod support guide makes deckle adjustment easier.

• *Easier access for cleaning and maintenance:* A low-profile external deckle can be removed as a single unit, or it can slide out for installation of a lip scraper without removal of the entire deckle assembly. Similarly, internal deckle components can be taken out by removing six bolts from the end of the deckle system without disengaging the entire unit.

MIXING

High-Shear Mixer

The patented MegaShear from Ross is an ultra high-shear rotor/stator suited to high-throughput emulsification, dispersion and homogenization.

The 11,300 ft/min tip speed and proprietary geometry of the MegaShear mixing head generate a level of shear typically unseen among rotor/stator mixers and usually reserved for high-pressure homogenizers. The Ross MegaShear Model HSM-706M-50 in the photo features a 50-hp motor and is mounted on a movable pallet. A MegaShear mixer reportedly costs considerably less than a comparably sized high-pressure homogenizer, while being much less sensitive to clogging and changes in viscosity.

AUXILIARY EQUIPMENT

Sanitizing System Stops Particulate & Dust from Spreading Coronavirus

Novatec has introduced the patent-pending ScrubX Sanitizing System to remove and sanitize dust and plastic particulate that may have been exposed to harmful airborne pathogens. Individual units provide 200 cfm of airflow and can provide dust/particulate control for up to 3000 ft² of interior space.

The machine was invented to help remove the novel coronavirus from factory air by removing dust and particulates from work areas, along with any pathogens that might be present. "Viruses can easily attach to dust and particulate, which provides a media for the airborne pathogens to stay suspended and to circulate in factory air longer than typical aerosol transmission," notes Mark Haynie, Novatec's dryer product manager. "While most airborne viruses can circulate for up to 5 hr, with dust and particulate hanging in the air, the virus could stay present for 48 hr or more."

Novatec's ScrubX features a multi-stage air circulator, scrubber, and sanitizer that traps airborne particulates and then kills any viral matter automatically with a multi-stage ultraviolet system. Airflow is moved and directed by a regenerative blower to enter through an intake that can be oriented to provide maximum circulation.

The air enters a cyclone designed to remove most of the dust and then directs it to a collection container that has ultraviolet C (UVC) germicidal lamps with 2-4 mJ/cm² intensity. Any dust that is too fine to be removed by the cyclone enters a second-stage filter, which has more UVC lamps and includes a 0.1-micron ultra-HEPA filter that removes dust and small pathogens, including coronavirus.

A built-in control designed by sister company MachineSense LLC automatically measures air-quality index, filter status and particulate levels for complete remote monitoring. The control system receives feedback from particulate-monitoring sensors in dust-prone areas.

Both mobile and stationary units are available. Mobile units can be moved throughout the factory; stationary units can be installed in a fixed location indoors or outdoors.

"Novatec is hoping our technology will get more people back to work safer and faster than thought possible," states Novatec's CEO and managing partner, Conrad Bessemer. Bessemer also cofounded MachineSense, which has introduced FeverWarn, a low-cost infrared temperature-scanning system that can be used to help detect and screen for COVID-19.

CLEANING/SANITIZING

Products to Help Keep Workers Safe from COVID-19

Manufacturers of all kinds are grappling with procedures for keeping their plants clean and safe from coronavirus contamination. New Pig, a supplier of industrial housekeeping aids, offers a range of products suited to the current health crisis. Here are three examples:

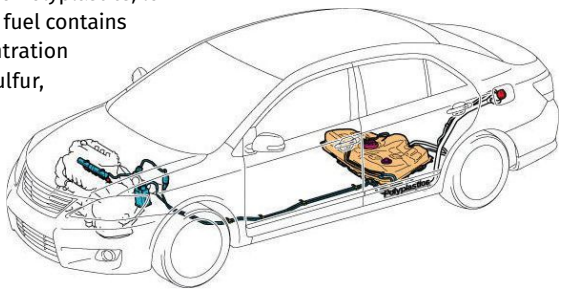
- *All-purpose, disinfectant-compatible, disposable dry wipes.* Both medium-duty and heavy-duty versions are available for use with spray bottles of all sorts of sanitizers or disinfectants to wipe down surfaces in work areas, offices, etc.
- *Medical-supply storage cart.* Originally developed for hospitals, this plastic, two-wheeled cart comes in two sizes with adjustable shelves. It makes supplies accessible where they are needed and is lockable when not in use.
- *Social distancing floor markers.* A variety of peel-and-stick markers to indicate social distancing standing positions and traffic directions, remind personnel to wash hands, etc. These anti-slip markers reportedly withstand heavy foot traffic, have absorbent surfaces, and can be removed easily without damaging floors or leaving a residue.

MATERIALS

Acetal for Automotive Fuel Systems

A new acetal (POM) grade from Japan's Polyplastics Group (U.S. office in Farmington Hills, Mich.) reportedly delivers improved diesel fuel resistance for injection molded automotive fuel-system components. Duracon H140DR is said to offer superior performance over competitive materials and is targeted for global markets. It has a higher MFR than standard grade M90-44 and is also denser, with smaller crystal size, providing a higher degree of crystallinity.

According to Polyplastics, low-quality diesel fuel contains a high concentration of acid and sulfur, which have a negative effect on acetal. H140DR has been shown to have better resistance than a competing diesel-resistant acetal.



The new grade boasts the same level of creep-fracture properties as competitive materials and appears to have sufficient long-term mechanical properties as well. Environmental stress-fracture testing reveals that DH140DR has high resistance to acid rain and various acidic solvents used in cars.

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Image above (screws) courtesy of Davis-Standard

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PROCESS COOLING

Chiller Line Adds Remote Viewing & Control

Delta T Systems says a new VNC client connection capability can keep production managers and personnel remotely connected with plant cooling systems, a situation more likely during the COVID-19 pandemic. The company says the VNC remote access and control capability make it possible for personnel to fully interact with every interface display element and control parameter in its variable-speed chiller product line, from anywhere, anytime.

All Delta T chillers feature a touchscreen with an RJ45 port that connects via cable or a wireless access point to the VNC software client. For remote workers located outside of the facility's LAN (Local Area Network), a VPN can be used to access chiller displays

DRYING

Cost-Effective, Flexible Multi-Hopper System

Simple enough for basic applications or upgradable to a fully featured drying solution, Conair's Multi-Hopper Cart (MHC) is said to deliver value, portability, flexibility and productivity.

The MHC features up to four Conair CH Series mass-flow hoppers mounted on a lightweight, yet durable, caster-mounted push cart. Even with the largest hoppers mounted, the cart is only 35-in. deep, saving valuable floor space and making it easy to maneuver down narrow aisles and through doorways. Material can be dried offline and then wheeled where it is needed or stationed remotely to supply material to multiple machines at once.

Two basic configurations are available: The simplest has only hoppers with an insulated manifold system for supply and return of dehumidified air from a central dryer, which, for smaller applications, can also heat the material. For higher-throughput applications or jobs requiring higher temperatures, the cart is supported by a Conair D Series Carousel Plus dryer with the DC-C Premium control package. The cart can be wired for power and individual heaters added to each hopper. This allows many convenient features, including the ability to dry at different temperatures in each hopper, Temperature Setback to prevent over-drying, as well as Dewpoint Monitoring and Dewpoint Control. It can also be integrated into Conair's SmartServices central monitoring and control platform, providing real-time alarm displays, a key performance indicator (KPI) dashboard, machine view with real-time readouts of setpoint and actual temperatures, as well as condition indicator lights. The system can also display trend lines for key measurements in real time.

Seven different hopper sizes are available, ranging from 0.5-ft³ volume and a nominal capacity of 18 lb, to 6 ft³ and 201-lb capacity. Carts are built in two sizes: A large version can accommodate up to four hoppers (depending on hopper size); and the smaller cart can be mounted with up to three hoppers (depending on size). A slide-gate discharge port prevents material leakage but facilitates easy hopper draining.

Available in carbon or stainless steel, all hoppers are fully insulated from top to bottom in order to preserve heat and save energy. All are designed for easy cleaning with a large cleanout door (with sight glass) and a removable air-diffuser cone. The mass-flow hopper design ensures that all material is evenly exposed to dry air and heat. Funnel flow and material hangups reportedly are eliminated for superior drying. Each hopper is equipped with an isolation valve so that it can be taken off-line without disrupting operation of other drying hoppers.

AM 2020

Additive Manufacturing Conference

As the first and only event focused exclusively on additive technologies for industrial part production, the conference takes a practical, applications-based look at the machines, materials and methodologies being used to create end-use tools and components. The event is designed for owners, executives and engineers at contract manufacturers, as well as OEMs involved in durable goods manufacturing.

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TOOLING Remote Tool Validation Kit

Progressive Components can make remote validation of a new tool possible via its new Remote Validation Kit, accelerating the PPAP or IQ/OQ/PQ approval process and helping speed molds into production. The Remote Validation Kit includes a dedicated tablet mounted in a customized case, as well as a press module and gateway to connect to an on-mold CVe Monitor.

Data points and process parameters that can be captured by the kit include graphs and charts of OEE, cycle time, efficiency, and activity (mold open/close). The production-rate graph identifies tools that aren't producing as many parts as expected, while the reject Pareto graph and listing tracks historical rejects by disposition (reject vs. regrind) and type (burn, splay, short, etc.). The downtime Pareto graph and listing monitors historical downtime by type of equipment (mold, press, etc.), as well as the reason for downtime (out of material, no operator, mold cleaning, etc.). These downtime codes are customized for the user. Finally, it also tracks press connection history, with time- and date-stamped data summarizing performance of a run.

In terms of its potential impact on the PPAP or IQ/OQ/PQ approval process, Progressive components says the Remote Validation Kit reduces the need to be onsite at suppliers while providing visibility for anyone who has a role in managing the performance of a fleet of tooling assets.

"Tooling startup, changes or updates can receive approval and get into production even if the customer can't travel on-site," a spokesperson told *Plastics Technology*, adding that once a tool build is complete, the process for qualifying is sped up by giving access to real-time mold sampling. Additionally, if there are issues, value-added input can be provided during troubleshooting at startup after a mold has been shipped.

TOOLING Larger Pump/Filter System for Cleaning Internal Cooling Passages

iD Additives has expanded its Eco-Pro 360 line of rust removers. The new Eco-Pro 360 XL Cart is a larger version of the company's previously released mobile integrated pump/filter system for cleaning internal cooling passages in molds and other products. The original cart runs up to 13.5 gpm, while the XL will go up to 28 gpm. The standard cart's operating capacity ranges from 5 to 30 gal, while the XL runs from 25 to 55 gal, suiting it to larger molds and extrusion chill rolls.

The cart pushes iD Eco-Pro 360 solution through channels to provide fast, "eco-friendly" rust removal on injection molds, heat exchangers, blown-film dies, and other products. iD Additives says the new XL Cart more than doubles the output of the company's standard Eco-Pro cart, suiting it for larger molds and extrusion chill rolls. In addition, the Eco-Pro 360 XL Cart and the standard Eco-Pro 360 Cart both have added a new pressure-relief valve. iD Additives says this safety feature provides pressure relief in the case of completely blocked cooling passages.

3D PRINTING

3D Printer Allows Introduction, Orientation of Functional Fillers

Boston-based Fortify says it can run fiber-reinforced liquid SLA and DLP (Digital Light Processing) resins on its patented DCM (Digital Composite Manufacturing) platform. By reinforcing a photopolymer with ceramic microparticles, Fortify says it has been able to produce injection molds that are stronger, stiffer, and more heat and wear resistant. The company says present interest is mostly in tooling but notes that it's gaining traction in printed components.

The company is currently providing filled materials as masterbatches, and it has printed parts with up to 20% filler, such as ceramic and glass fibers and metal flakes. Fortify says the process uses high-aspect-ratio fibers that are shorter than the layer height of 50 microns. Longer fibers up to 1 mm can be used, but cannot be oriented in the Z axis.

Fortify recently introduced two additional technologies to its printing platform that make it more suited to creation of injection mold cavities. Its new CKM (Continuous Kinetic Mixing) system ensures additives stay uniformly distributed throughout the material, reducing sedimentation and aggregation. CKM is integrated into all of its machines.

In addition to CKM, Fortify's printer utilizes Fluxprint—a magnetic technology that aligns reinforcing fiber within a photopolymer resin during fabrication. To achieve this, fibers undergo a proprietary treatment to make them magnetically responsive. Magnetic fields then align fibers throughout the build to optimize strength, stiffness and other characteristics of the part. The company says users can now optimize fiber orientation based on load conditions of their parts. Fortify says degree of orientation can be highly localized, down to the 50-75 micron level.

TOOLING

Bar Lock Series of Mold Aligners Expanded

Progressive Components has expanded its Z-Series Bar Locks for alignment of large molds and multi-plate sequencing tools. Originally introduced with four bars and eight guides, the Z-Series now has eight bars and 20 guides, as well as a new metric series. The Bar Locks, which target complex molds for packaging and medical applications, are guaranteed for the life of the mold.

The company also now provides its Mold-Ready service for the product, which allows custom lengths and corner radii for when a lock pocket is not machined through the full plate width.

ADDITIVES

Liquid Colorants with New Carrier for Polyolefins & Styrenics

A line of custom liquid colorants with a unique, proprietary carrier is newly available from Britec Solutions, Tyler, Texas. The new Qd² Liquid Carrier System has been shown to provide multiple attributes in injection molding, blow molding and extrusion of polyolefins and styrenics. The Qd² carrier system was developed to provide improved particle distribution in the carrier to support higher pigment loadings and reduce use levels; deliver superior suspension to eliminate hard settling of pigments; remove processing concerns such as screw slippage; and promote cost savings.

Testing and case studies have established that when used in PP, the Qd² carrier creates nucleation, resulting in cycle-time reduction. In some cases, it has the potential to reduce or eliminate the use of a nucleating agent. Colorants with the new carrier used by a Texas molder of PP caps and closures yielded a 5% cycle-time reduction and 12% overall cost savings that resulted from a lower use level.

An Ohio injection molder of 5-gal HDPE pails and lids compared the Qd² Liquid Carrier System against their existing pellet color concentrate in blue and white. The company realized a 5-sec shorter cycle time, reduced part warpage and quicker color change with the Qd² system.

A North Carolina injection molder of PP outdoor patio furniture reported that it cut the use level from 1.65% to 0.8% and also achieved improved color dispersion and physical properties. This was achieved using an 82% TiO_2 white liquid with the Qd² carrier.

ADDITIVES

Dual-Action Additive Concentrate for PET & rPET

An additive masterbatch line is designed to provide an elegant silky surface treatment as well as recyclability to PET and rPET packaging. The new Silky Bliss collection from Ampacet Corp. is said to offer a sophisticated, contemporary delustering effect to plastic packaging without requiring mold changes. The products are also near-infrared (NIR) transparent to allow sorting with NIR for recycling. Silky Bliss features very low light reflection for better readability of packaging graphics and text and includes six shades, though it can be customized with an unlimited number of colors.

ADDITIVES

Additive & White Masterbatches for BOPE Films

Additive masterbatches developed specifically for biaxially-oriented polyethylene (BOPE) film are newly available from Ampacet Corp. The new Biax4ce line includes additive as well as white masterbatches formulated for specific BOPE film structures. The range includes antiblock, antistatic, migrating and non-migration slip and high-performance antifogs. (See this month's Close-Up article for more on BOPE film as a new contender.)

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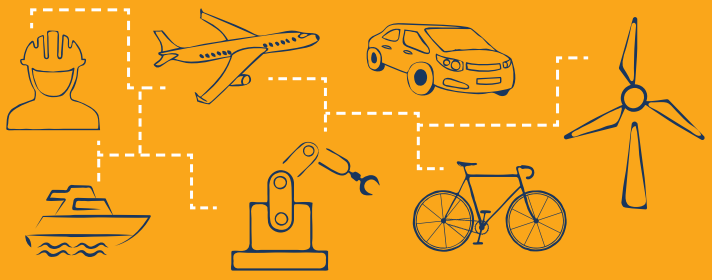

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Prices of Volume Resins Bottom Out

Increased exports, higher prices for feedstocks, and a slow ramp-up of production of industrial and durable goods are projected to stabilize resin prices and put upward pressure on PE and possibly PVC.

By Lilli Manolis Sherman
Senior Editor

Moving toward the third quarter, prices of volume commodity resins generally appeared to have bottomed out, though there was potential for some further downward movement for PS, nylon 6 and perhaps PET. In contrast, upward movement for some resins is also likely with the return of the Chinese export market, for which a significant volume of domestic supply is dedicated. For example, 40% of domestic PE production and 30% of PVC is earmarked for export to China. The combination of higher exports, increased costs of feedstocks such as ethylene, and the throttling back of resin production contribute to the potential for price increases. Additional factors are the slow ramp-up of production of industrial and durable goods that had been suppressed by coronavirus pandemic, along with potential increases in crude-oil prices, and what is expected to be an abnormally active Atlantic hurricane season.

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

Market Prices Effective Mid-June 2020

Resin Grade	¢/lb
POLYETHYLENE (railcar)	
LDPE, LINER	92-94
LLDPE BUTENE, FILM	75-77
NYMEX 'FINANCIAL' FUTURES	24
JUNE	26
HDPE, G-P INJECTION	97-99
HDPE, BLOW MOLDING	90-92
NYMEX 'FINANCIAL' FUTURES	24
JUNE	27
HDPE, HMW FILM	104-106
POLYPROPYLENE (railcar)	
G-P HOMOPOLYMER, INJECTION	52-54
NYMEX 'FINANCIAL' FUTURES	31
JUNE	32
IMPACT COPOLYMER	54-56
POLYSTYRENE (railcar)	
G-P CRYSTAL	96-98
HIPS	97-99
PVC RESIN (railcar)	
G-P HOMOPOLYMER	78-80
PIPE GRADE	77-79
PET (truckload)	
U.S. BOTTLE GRADE	40-41

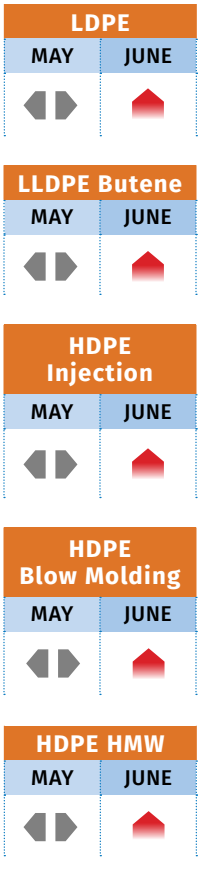
PE PRICES FLAT TO HIGHER

Polyethylene prices remained unchanged in May, following a 4¢/lb drop in April, but suppliers came out with a 4¢ increase for June. Spot-market prices moved up by mid-May due to tight availability and strong exports to China, according to Mike Burns, RTi's v.p. of PE markets, *PCW*'s senior editor David Barry, and The Plastic Exchange's Greenberg.

Both Burns and Greenberg thought the 4¢ hike had some potential to take effect in June. However, *PCW*'s Barry did not see it as a "slam dunk," noting that a partial increase—and only for some grades—was more likely, but he suspects that another increase will surface for July. He confirmed that spot prices were closing the gap with prime material—now at 6¢ to 7¢/lb vs. a more typical 8-10¢. Both Barry and Burns attribute supply tightness partly to suppliers "quietly" slowing production. Greenberg expected spot prices to move up by the second week of June, despite uncertainties in the market: "Some who sensed the upward price momentum bought extra resin, fearing that this would be their last chance at these prices, while others, still reeling from demand loss, decided to wait, not because of price, but rather uncertainty regarding future business."

Burns said domestic demand for "essential" PE products (as defined in COVID-19 terms) got even stronger in May, and "non-

Polyethylene Price Trends

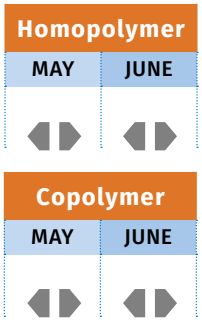


essential" products started to pick up faster than might have been expected. As examples, he noted that production at a maker of outdoor plastic furniture dropped 50% between mid-March and mid-April, then shot upward by end of May to 95% of normal. Similarly, a shrink-wrap film maker lost business from the automotive sector but was sold out for wrapping water bottles. He characterized this as "recovery demand," noting, "June will be an interesting month. It will depend on whether we see an uptick of coronavirus cases and where." Moreover, both he and *PCW*'s Barry cited NOAA's Climate Prediction Center, which expects above-normal activity for the 2020 Atlantic hurricane season, June 1 to Nov. 30.

PP PRICES FLAT

Polypropylene prices in May were flat, in step with propylene monomer contracts, and were expected to follow the monomer in June and July—flat or at most 1¢/lb up or down, according to Scott Newell, RTi's v.p. of PP markets, *PCW*'s Barry, and The Plastic Exchange's Greenberg. They cited improved availability and demand in the spot market, along with attractive pricing.

Polypropylene Price Trends



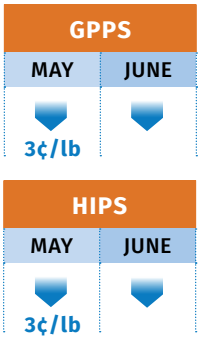
"The PP market relies on the domestic market for the vast majority of sales, quite different from PE, which exports some 40% of production. With so many domestic processing facilities temporarily shut, the PP market has struggled during the pandemic period and April sales were the lowest since February 2018," reported Greenberg.

According to these sources, suppliers had reduced production rates to 80% of capacity or lower by the start of June, though upstream inventories were still building, albeit from historic low levels. Said Barry, "I don't see production rates going back up to the previous 95% levels any time soon." Added Newell, "Processors were heavy on inventory in May, which could last them twice as long as is typical." These sources also project a gradual ramping up of production through the summer. By early June, automotive and other durable-goods manufacturing was starting to come back, but Newell noted that that PP manufacturing had dropped by 50% between mid-March and mid-April. "We're still about 30% below plan. There is a lot of uncertainty across the supply chain in the 'non-essential' products area, including staffing shifts."

POLYSTYRENE PRICES FALL

Polystyrene prices dropped 3¢/lb in May, following the 9¢/lb decrease in April, as benzene prices dropped from $1.21/gal to 95¢/gal. While *PCW*'s Barry thought prices would be flat in June and possibly July, Robin Chesshier, RTi's v.p. of PE, PS and nylon 6 markets, saw another price drop of 1¢ to 2¢/lb as likely because processors would seek further price concessions. She noted that in April to June, prices of all PS feedstocks dropped by 17¢ to 20¢/lb, while suppliers had reduced PS prices by only 12¢/lb.

Polystyrene Price Trends

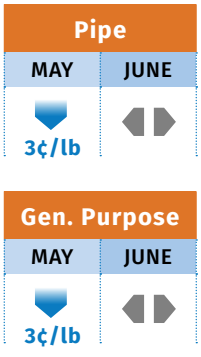


Both sources ventured that a price hike was likely to surface in July, with suppliers citing an uptick in costs of raw materials—primarily ethylene and benzene—along with some modest demand recovery. The implied styrene monomer cost based on a 30/70 ratio of spot ethylene/ benzene was at 12.8¢/lb in early June, up 1.1¢/lb over the previous four weeks.

PVC PRICES DOWN FOR NOW

PVC prices dropped 5¢/lb in April and were expected to drop another 2¢ to 3¢/lb in May, according to both Mark Kallman, RTi's v.p. of PVC and engineering resins, and *PCW* senior editor Donna Todd. Nonetheless, suppliers issued a 3¢/lb hike for June, and soon added another 3¢/lb for July. Demand in the construction sector dropped by over 30% going into June, while medical, e-commerce and retail sectors held up relatively well, according to Kallman. He predicted that suppliers would succeed in pushing through the July increase, noting that they had cut back on production while export markets had strengthened and ethylene prices were moving up.

PVC Price Trends

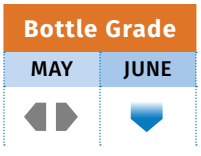


Late-settling May ethylene contract prices rose 3.5¢/lb, which represents an increase in the cost to produce PVC of about 1.68¢/lb, reported Todd. She also noted that about 30% of domestic PVC production goes to exports, whose prices have moved up substantially. Combined, those two factors could impact domestic prices. It remained to be seen whether suppliers would succeed in implementing the 6¢/lb increases already on the table.

PET PRICES FLAT TO LOWER

PET resin prices stagnated by the end of May in the low 40¢/lb range due to an oversupply of imports and robust domestic production, according to *PCW* senior editor Xavier Cronin. By the first week of June, some off-grade spot resin was selling in the high 30¢/lb range. Typically, lower-priced PET can be found on the U.S. West Coast where many imports from Asia land, Cronin noted.

PET Price Trends



Prices for domestic prime resin were expected to be steady in the low 40¢/lb range for railcars (190,000 lb) delivered Midwest and South. Said Cronin, "Traditionally, PET prices peak for the year in July during the period of heavy bottled beverage and water consumption. But with the COVID-19 situation keeping beach crowds to a minimum, demand is expected to be weak compared with July 2019." He ventured that July PET prices would be flat if not down.

ABS PRICES BOTTOM OUT

Prices of ABS between March and the end of May dropped 5¢ to 10¢/lb due to a drop in demand during the coronavirus lockdown, and to availability of well-priced imports, according to RTi's Kallman. ABS prices were likely to remain flat through June and July. Said Kallman, "The ABS market is at the bottom. When feedstock prices start moving up, we'll see an upward movement, but we're two to three months away from that." He expected a slow recovery to take place in the automotive, appliance and electronics sectors for this globally well-supplied market.

PC PRICES DROP, THEN FLATTEN OUT

Polycarbonate prices dropped by at least 5¢ to 10¢/lb through much of the second quarter. RTi's Kallman predicted that PC prices would be flat to lower in June and July. "The overall market is reaching the bottom. Feedstock prices have dropped and suppliers have reduced production output due to the slowdown in automotive and construction sectors," said Kallman. The one bright spot has been the PC sheet business, due to strong demand for clear separation barriers, face shields and other personal protective applications, though that business has not been enough to offset lower demand from the major market sectors.

NYLON PRICES SLUMP

Nylon 6 prices dropped by 5¢/lb in April, following the historic drop in benzene prices, along with lower prices of all key feedstocks. RTi's Chesshier expected May nylon prices to fall another 5¢/lb, followed by relatively flat pricing in June and July. She expected that prices are likely to stabilize late in the third quarter as automotive, carpet and textile markets start ramping up. Even if demand improves, suppliers will not be able to raise prices in this well-supplied market, Chesshier ventured.

Prices of nylon 66 dropped 5¢ to 10¢/lb through May. RTi's Kallman ventured that prices would be flat to lower in June and July. Nylon 66 suppliers have throttled back production by as much as 50% owing to the drop in demand, particularly from the automotive sector. Kallman expected a slow recovery.

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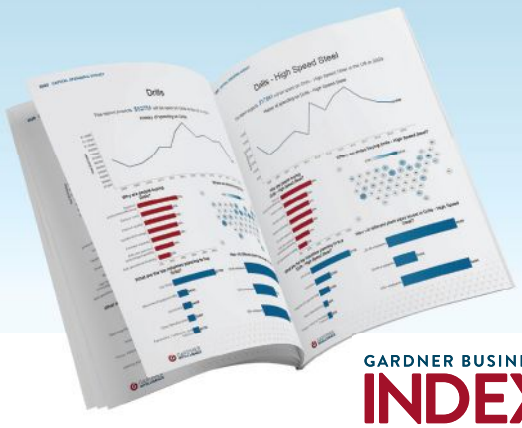

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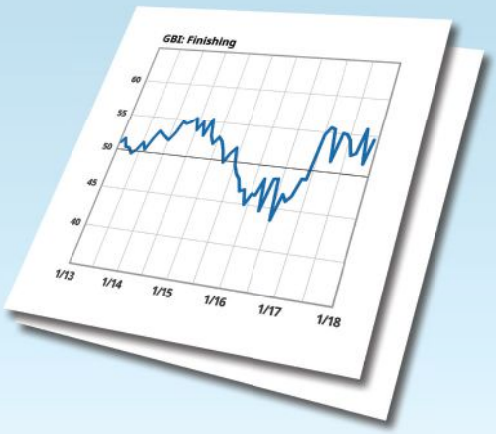

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Contraction Slows for Processors

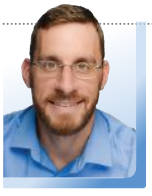
For the first time since the coronavirus pandemic, Gardner Business Index signals decelerating contraction as all components report improved readings.

By Michael Guckes
Chief Economist/Director of Analytics

The Gardner Business Index for plastics processing moved up by eight points in May, registering 41.5 after setting an all-time low in April. For the first time since the government curtailed normal business operations to prevent the spread of COVID-19, all components of the Index moved towards more "normal" levels. Excluding supplier deliveries, all components moved higher from their prior-month readings, although each remained below 50. This situation signals that the industry is experiencing a slowing contraction, meaning that while conditions deteriorated further in the latest month, they did so at a slower rate than in the prior month.

The supplier delivery reading fell slightly in May, which may indicate a turning point in the unprecedented disruption that affected upstream production and slowed deliveries earlier in the year. (Quickening supplier deliveries lower this Index component's reading.) The plastics processing market was exceptional in May in that survey participants reported both falling material prices and weaker pricing power for their own products.

Across manufacturing in general, material prices increased during May. But not for plastics processors. Even though most resin is derived from natural gas feedstock, the price of resin has historically tracked that of oil. West Texas Oil prices have plunged 50% since the beginning of 2020, which likely explains why plastics processors' materials costs have bucked this trend.



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

Gardner Business Index: Plastics Processing

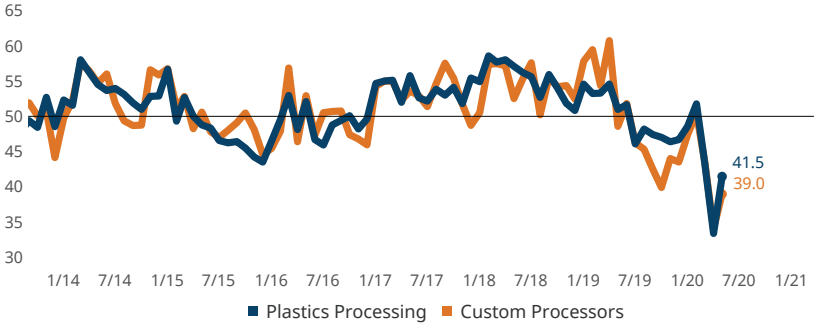


FIG 1

Both the overall plastics processing and custom processors indices moved higher in May. Higher readings for new orders, production, exports, backlogs, and exports, along with a decline in the supplier deliveries reading, were welcome news as they indicate the first signs of a turn towards more typical business conditions.

Prices Drop for Plastics Processors

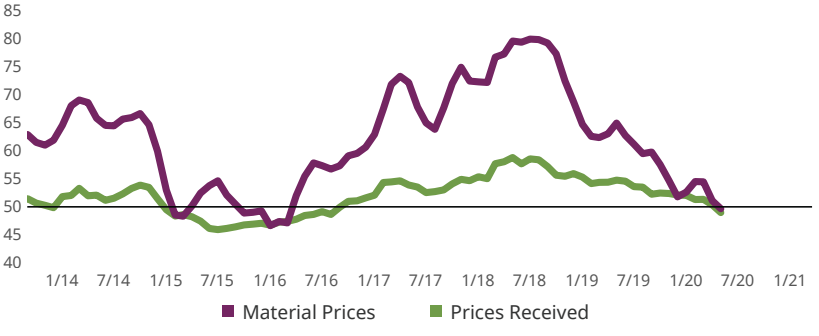


FIG 2

Most manufacturing industries saw higher prices for raw materials in May. But not for plastics processors. While most polymers are derived from natural gas, resin prices have traditionally tracked oil prices. Prices received by processors for their goods also declined.

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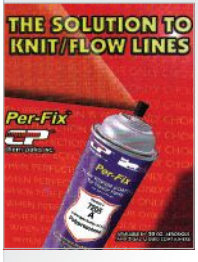

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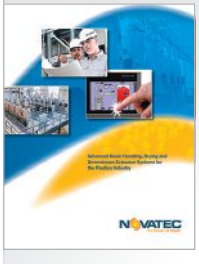

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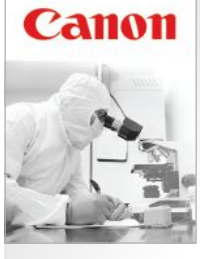

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EVCO PLASTICS — DEFOREST, WIS.

EVCO Plastics Gears Up To Mold Coronavirus Test Kits

The firm has added shifts, reassigned people and injection machines—and is buying new ones—in a crash program to mold and assemble COVID-19 test kits.

New saliva-based coronavirus test kit will be produced 24/7 in a five-machine cell with automated assembly, filling, sealing, weighing, labeling and packaging in a thermoformed tray.

By Matthew Naitove
Executive Editor

EVCO Plastics is a global custom injection molder with nine plants and 210 machines devoted to a wide range of markets. Its medical business, in particular, is humming with new projects aimed at combatting the coronavirus pandemic. The company has three plants and a Tech Center at its headquarters location in DeForest, Wis. Both people and machines were transferred from some of these to the EVCO Plastics MED (Medical and Electronic Devices) plant, which has an ISO Class 8/Class 100,000 clean room, where the bulk of these COVID-19 related projects are underway. At the end of May, EVCO had 17 machines molding COVID-19 related parts, and orders were still increasing.

EVCO's tooling group worked through a weekend to design a two-cavity injection mold for PP head bands for thermoformed face shields and got into production in eight days.

"We've been doing DNA test kits, used for criminal investigations and consumer ancestry analyses, for some time," says EVCO president Dale Evans. "So we repurposed some resources from that to COVID-19 test components."

Since March, EVCO MED has had three machines devoted to making the three main components of coronavirus nasal-swab kits. They have been running 24/7 instead of the 24/5 schedule used for previous work.

Another press has been molding parts 24/5 for a newer saliva-based test; that project migrated to commercial production last month with the startup of a five-machine cell molding and assembling five parts for the newer test kit. Those presses are running 24/7 molding parts of medical-grade, clarified PP in 16 cavities. One of those machines is a new 130-ton Engel press that was bought for this job. Initially, the cell utilizes manual assembly, but the customer designed and built custom automation to assemble the five parts, fill the assembly with test fluid, seal it, weigh it to confirm the degree of fill, then apply a barcode label, load kits into a thermoformed tray, and apply a Tyvek seal. Automation will triple output to one finished kit per second. Evans figures that cell will require 40 people (10 per shift), some of them transferred from other operations, and some of them new hires. Meanwhile, tooling is being built for another cell of five machines, some shifted from other buildings, including two presses from the Tech Center, and some new purchases.

And that's not all. EVCO has designed and molded PP head bands for thermoformed PET face shields sold by two customers. "Our tooling group worked through a weekend to design a two-cavity mold, which we got into production in eight days. Two such molds are now running."

To prepare EVCO's facilities for operations in the age of coronavirus, "We cleaned and cleaned and cleaned some more," says Evans. "We buy alcohol by the drum to formulate our own cleaning solution and disinfectant. We have hand sanitizer all over the place. Employees get their temperature scanned and wash their hands when they enter the plant. They wear masks everywhere—not just in the clean room. We employ social distancing. All this we learned first at our Chinese plant."

In addition, EVCO has adopted handheld UV lights to disinfect machine control panels. Dale uses one in his office for his computer keyboard and phone. PT

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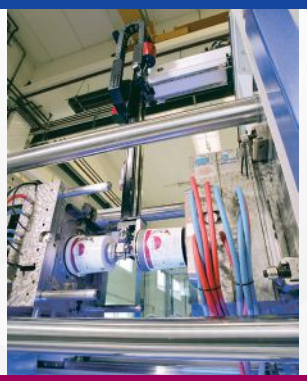


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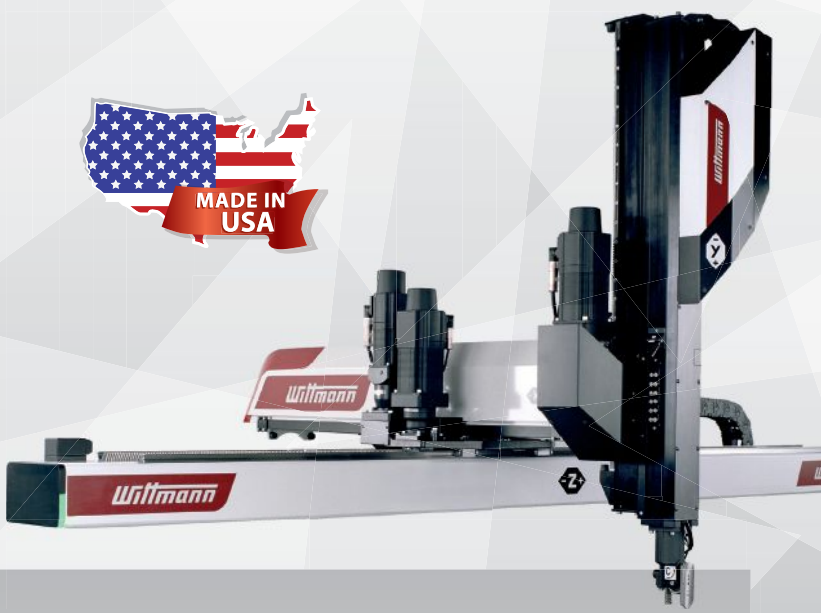

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