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

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

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GARDNER Business Media, Inc.

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

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President	Richard G. Kline, Jr
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The Molding 2020 Conference: Go and Learn

Global thought leaders on injection molding will be gathering at Molding 2020 in Lombard, Ill., on March 17-19. There's still time to get in on the action.

Jim Callari
Editorial Director

Last summer, a subscriber of this magazine received his copy in the mail in a plastic bag that also contained the registration brochure for the *Plastics Technology* Extrusion 2019 Conference, which was held in September. This reader—a manufacturing manager for a mid-size Midwestern sheet extruder—walked the brochure into the office of his new young engineer. He tossed the brochure softly to his engineer and gave him eight words of advice: "Take a look at this. Go and learn."

I know this because the young engineer did indeed attend our conference and told me the story during one of the evening networking receptions.

If you work for a company involved in injection molding, you received *this* issue in a plastic bag, and inside you would have found the registration brochure for the *Plastics Technology*'s Molding 2020 Conference. So, let me be the first to repeat the sage words above: "Take a look at this. Go and learn."

I hope this doesn't sound condescending. We work in an industry that, while mature, is still evolving. On the molding side of the business, the industry is beginning to embrace the tenets of "scientific molding," though perhaps not quickly as it should. To evolve as a person and to grow as a professional—and to help your company evolve and grow as well—the learning must never stop. In this way, conferences such as Molding 2020 are valuable not only to young engineers and operators shooting their first shots, but also to seasoned professionals who've made millions of them.

I encourage you to look through this brochure. Peruse the agenda, the individual topics, organized by veteran *Plastics Technology* editors Matt Naitove and Tony Deligio. Take out a pen. As you finish reading the title of each topic, ask yourself a question: "Is there anything I can learn from this presentation that I can bring back to my factory and improve on what we are doing there?" Even better, ask yourself this question too: "Is there anything more I can learn from the presenter if I chat him or her up after the presentation, during lunch or a break?"

Then take your pen and put a check mark next to any presentation title to which you answered "yes" to any of these questions. My hunch is you'll have a registration brochure full of check marks.

To grow as a professional, and to help your company evolve and grow as well, the learning must never stop.

Molding 2020 is an educational conference where industry leaders discuss the latest developments in various molding processes, equipment, materials and management techniques, with special emphasis on adding value to your business. It will be held March 17-19, 2020 at The Westin Chicago in Lombard, Ill.

Each day will begin with "Best Practices"—talks of practical value in defining best approaches to specifying or selecting equipment, organizing production, or addressing processing issues, as well as expert know-how on problem solving and troubleshooting. Afternoon sessions will consist of three concurrent breakout sessions focused on areas of technology such as LSR or robotics, and market areas such as medical or automotive. And throughout the event, there will be ample time to network with speakers, exhibitors, and other attendees on a peer-to-peer basis.

The early-bird registration fee will save you a couple of hundred bucks per registration. But it ends Jan. 31. Go to the conference website at ***moldingconference.com***.

Molding 2020: Take a look at this. Go and learn.

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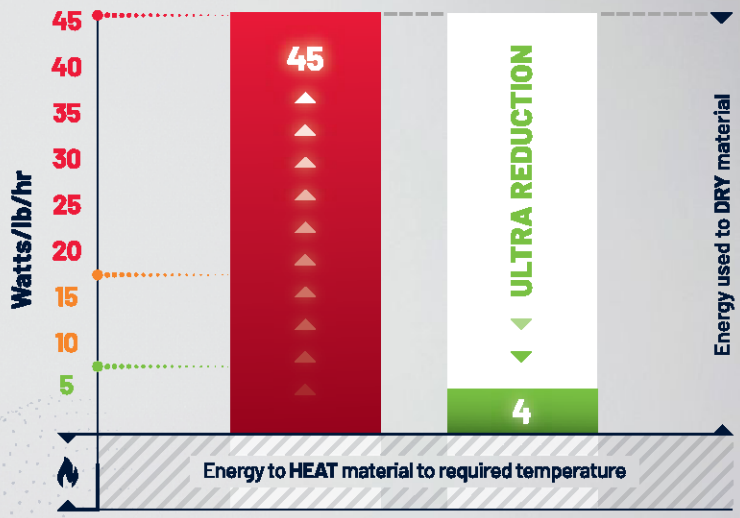

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Simulation Is Making Injection Machines Smarter

October's K 2019 show in Düsseldorf revealed progress toward realizing the long-held goal of integrating mold-filling simulation with injection molding machines (see show report in this issue). News from Engel includes a collaboration with Autodesk Moldflow to integrate simulation with injection process control. While other machine builders—like Arburg, Wittmann Battenfeld and, most recently, Sumitomo Demag (see below)—are investigating ways to use flow simulation to analyze the injection process in real time, Engel is focused on using simulation offline to optimize both the prediction of molding results and the actual machine settings for a given mold. This simlink software is now being tested with specific customers and is expected to become available globally in 2020.

Engel envisions two-way communication. On the one hand, the machine can tell Moldflow what its true processing capabilities are, so that the simulation can recommend more realistic process settings that can be achieved by this specific machine. After performing the simulation based on the constraints of the actual machine's performance capabilities, the process settings can be imported directly into Engel's CC300 machine controller. Then, after performing a real-world molding trial, the process results can be re-transmitted to Moldflow to refine the simulation based on what really occurred inside the mold. Further optimized process settings can then be uploaded again to the injection press.

This approach is based on use of Engel's econnect customer portal. The user can go online and select the machine intended for a molding job and then download from Engel the parameters for machine capabilities—speeds, pressures, acceleration ramps, and temperatures. That way, Engel says, the simulation won't recommend process values for a machine you don't have.

In addition, Sumitomo (SHI) Demag revealed at K that it is working on integrating mold-filling simulation with its injection-machine controls. Sumitomo Demag is collaborating with German software startup SHS plus GmbH to develop online simulation of plastication, filling and cooling, along with a knowledge database. Artificial intelligence (AI) will use that database to predict melt quality and temperature and use those to optimize the filling simulation.

South Korean Machine Builder Offers Novel Foam Extrusion Technology

A South Korean supplier of extrusion lines has acquired an exclusive worldwide license from Dr. Foam Canada to make and sell turnkey foam extrusion equipment for PLA, PP, and PET foam sheet for food packaging and automotive parts.

Machine builder Myung-il-Foamtec licensed the technology from Dr. Richard Eungkee Lee, president of Dr. Foam Canada, who developed extrusion foam technology to process challenging semi-crystalline polymers. Myung-il-Foamtec has been in business for 44 years, selling foam extrusion lines globally. Before founding his own company, Dr. Lee worked as an R&D project manager for Macro Engineering and Technology.

Lee describes his foaming system as a fusion of polymer chemistry and functional additives; screw design for reactive extrusion with low shear, efficient mixing and uniform cooling; and die design technology for controlling foam quality.

Nissei Acquires Controlling Interest in Negri Bossi

Rumors were flying in early October, and they were validated in late November, when Nissei Plastic Industrial Co. of Japan decided to acquire control of Negri Bossi Group in Italy. For now, Nissei plans to buy 75% of the shares of Negri Bossi and the remaining 25% in a few years. Both firms make injection molding machines, and Negri Bossi Group also includes robot maker Sytrama.

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Nissei's announcement of the move noted that Nissei will benefit from Negri Bossi's strong presence in the European market and in ultra-large injection machines not currently in Nissei's line. Future plans include sale of Nissei machines in Europe through Negri Bossi; development of future machines "based on Italian design and Japanese quality"; and shorter delivery times and price reduction by sharing supply chains. Nissei says production efficiencies can be realized by using Nissei's manufacturing facilities to produce Negri Bossi machines, since Negri Bossi is currently "highly dependent" on outsourcing. Negri Bossi's sales dropped a total of 13% from fiscal years 2016 to 2018, though net income improved 31%.

Yizumi-HPM Introduces Molding Auxiliaries

At an October open house at its technical center in Iberia, Ohio, Yizumi-HPM Corp. showed off three new series of injection machines tailored for the U.S. market (see August Keeping Up for details), along with a new line of robots and other auxiliaries that allow the company to supply complete molding cells.

As previously reported, the robots span a range from sprue pickers to three-axis Cartesian models for presses up to 4000 tons. The auxiliaries include portable chillers, mold-temperature-controllers (TCUs), dryers, and hoppers.

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Micromolder Makuta Adopts Carbon 3D Printing

Makuta, a well-known custom micro injection molder in Shelbyville, Ind., is now a Certified Production Partner of Carbon Inc., supplier of 3D printing equipment and materials using Digital Light Synthesis (see Nov. '18 Close-Up). Makuta (see Sept. '15 On-Site profile) gains from this the ability to offer high-performance plastic parts prototyping and limited production runs with Carbon technology. "We were truly excited when we saw this additive manufacturing technology in action, and are now pleased to expand our business capabilities by being able to offer this service to our customers," says Stu Kaplan, president of Makuta. (Kaplan is pictured here with a Carbon M2 printer and wearing Adidas Futurecraft 4D sneakers with midsoles printed in a Carbon urethane elastomer.)

"The addition of Carbon digital manufacturing technology enables us to offer customers fast, cost-effective prototypes and limited production runs of small and complex parts, larger than the micro-sized parts we injection mold," Kaplan adds. "Further, due to Carbon's innovative technology, these are high-performance 'working prototypes,' with quality similar to injection molded parts and superior structural integrity and surface finish when compared with conventional 3D printing."

Techmer PM & Plastix Partner on Recycling Abandoned Fishing Nets

Techmer PM has partnered with Danish recycler Plastix on turning obsolete and discarded fishing nets, trawls and ropes into new products. Each year an estimated 11 billion to 29 billion lb of plastics end up in oceans, more than 10% of which is discarded fishing gear. Most of these fishing materials are either sent to landfill, burned, or lost at sea. Plastix's process transforms post-use fishing gear into recycled HDPE or PP under the OceanIX brand.

Through the use of Techmer's proprietary Techsperse technology, Techmer is helping its customers use up to 100% recycled materials such as OceanIX while maintaining physical properties and achieving their color and appearance targets. Techmer PM's exclusive track-and-trace program will also enable brand owners to validate their packaging claims to consumers, regulatory agencies, or anyone interested in confirming their commitment to sustainability.

"We have quickly seen great interest in the modified OceanIX material and currently have several development projects pending with consumer packaged-goods companies looking to differentiate their brands," says Steve Loney, Techmer PM's director of market development.

Techmer is providing a solution to give these materials a second life, which could be bottles, caps, closures or more durable products like outdoor furniture and kayaks, using custom-tailored UV-stabilizer packages.

2019 SPE Auto Innovation Award Winners

Spanning nine categories, the winners of the 49th annual Society of Plastics Engineers Automotive Division's 2019 Blue Ribbon Automotive Innovation Awards (which Lilli Sherman, *Plastics Technology* senior editor, helped judge) exemplify broad technology transferability in the use of plastics. Again this year, thermoplastics and/or thermoplastic composites dominated, and additive manufacturing was featured for the second year in its own category as well as in the aftermarket categories. Here's a brief look at some of the nine winners, starting with the Grand Award winner—also the winner of the Body Exterior category:

BODY EXTERIOR: Composite Pickup Box (photo). The industry's first pickup box in carbon-fiber reinforced thermoplastic composite is featured in the 2020 GM's Sierra LD FST pickup.

AFTERMARKET & LIMITED EDITION/ SPECIALTY VEHICLES: Multiple Additive Manufactured Components. Additive manufacturing proved the most efficient and cost-effective method for producing 19 parts on the 2020 Jaguar Land Rover LXE SV Project 8 supercar sedan, whose total build volume will be limited to 300 cars.

BODY INTERIOR: Integrated Button Carrier Modular Strategy. To reduce overhead console complexity in the 2020 Ford Explorer/Aviator/Corsair SUVs, a new design was developed that integrated mechanical, lighting, electrical, and safety functions into a single modular button carrier injection molded by Methode Electronics from The Materials Group's MIC Opticarb PC/ABS. With all program variants, this reduced part count from 70 to 17 per vehicle and achieved $7 cost savings per vehicle and $1.42-million program savings for tooling and testing. BSR (buzz, squeak & rattle) was improved, and the headliner fits better. To date, two patents have been filed and one has been granted on this technology.

ENVIRONMENTAL: 100% PCR Carbon Canister Housing. The first 100% PCR PP carbon canister (derived from carpet backing) is featured in the 2019 Ford Mustang.

MATERIALS: Glass Wool-Reinforced Composites for Improved Scratch Resistance. To improve both long-term scratch resistance and dimensional stability in PP interior trim panels, glass wool (crushed glass and sand from reclaimed building insulation) was used to replace talc, whiskers, and fiberglass in the 2017 Hyundai Elantra sedan.

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Successful Launch for New Molding & Moldmaking Event in Mexico

Meximold, a new event targeting Mexico's burgeoning moldmaking and injection molding sector, attracted nearly 4000 attendees to the Querétaro Convention Center on Nov. 20-21 to see 135 exhibitors filling the sold-out show floor and to participate in two days of presentations at a conference, which also sold out. The event was organized by Gardner Business Media, publisher of *Plastics Technology* and *Plastics Technology Mexico*, and the Mexican Association of Manufacture of Molds and Dies (AMMMT). The second Meximold show and conference will be held at the same location on Oct. 7-8, 2020.

Ineos Styrolution & Agilyx to Build PS Chemical Recycling Plant in Illinois

Ineos Styrolution and Agilyx are planning to build a chemical-recycling facility in Channahon, Ill., capable of processing up to 200,000 lb/day of post-consumer polystyrene and converting it back into styrene monomer for manufacturing new PS resin. The facility will leverage Agilyx's proprietary chemical-recycling technology, which reportedly can recycle PS contaminated with food and other organics and convert it back into new, food-grade plastic. Agilyx recently completed a development program for Ineos Styrolution that qualified the monomer product to Ineos' specifications and identified post-consumer PS feedstock for the process. The next phase of the project will advance the engineering and design of the facility.

According to Ricardo Cuetos, v.p. of Ineos Styrolution Americas, Standard Products, "A benefit of chemical recycling is there is no degradation over multiple cycles; the polymers can continue to create new products over and over again of the same purity and performance as virgin polystyrene. This plant will dramatically increase recycling rates in the greater Chicago area, dispelling the myth that polystyrene can't be recycled."

Bekum America Is Expanding

As part of its 40th anniversary celebration in November, Bekum America broke ground on a 40% expansion of its headquarters in Williamston, Mich. The new facility will add 40,000 ft² of manufacturing space and 7400 ft² of offices to the existing 115,000 ft². Estimated completion of the project is mid-to-late 2020.

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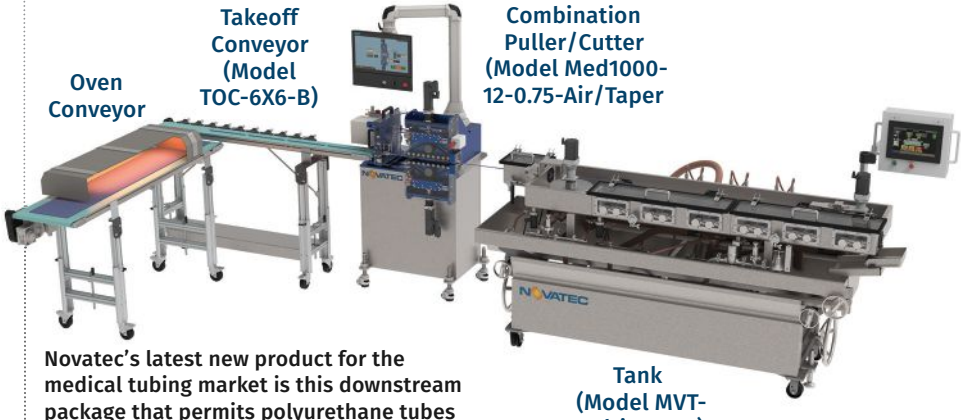
New Downstream System for Inline Cutting, Curing of TPU Tubing

Novatec will debut an altogether new approach for processing tacky, hard-to-cut thermoplastic polyurethane tubes at next month's Plastec West show.

By Jim Callari
Editorial Director

Novatec has developed a downstream package to permit low-durometer thermoplastic polyurethane medical tubing to be cut precisely and cured inline. The Baltimore-based machine builder will debut the system next month at Plastec West, Feb. 11-13 in Anaheim, Calif.

The patented-pending system was designed by Bob Bessemer, Novatec's v.p. of extrusion technology, in collaboration with a coterie of experts in TPU materials and tube-processing technology. It relies on an 8-ft-long, "three-pass" tank with three independent temperature zones, each with its own water pumps, heat exchangers, modulating valves, and heaters. Since most TPU tubing is processed on 1-in. extruders, Bessemer determined that 8 ft provided enough length. Relying on input from Tony Walder, head material scientist for TPU supplier Lubrizol, the tank features an initial 3-ft "hot zone" (open to atmosphere or under vacuum) maintained at 110-130 F, followed by a 3-ft "cold zone" at 45-55 F, and then an approximately 18-ft-long "warm zone" at 90-110 F.



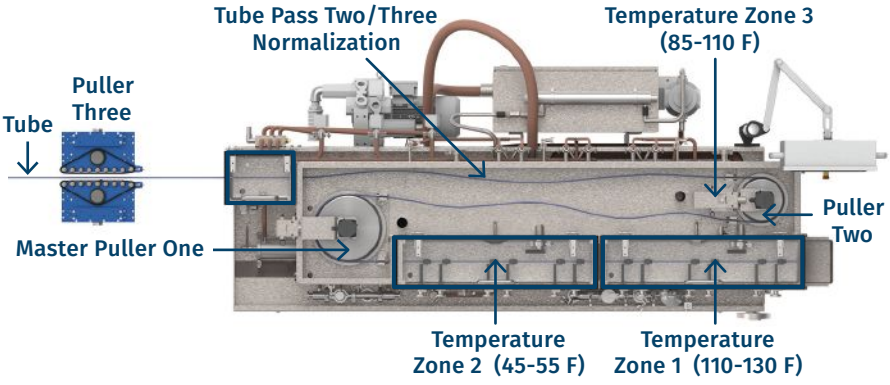
Novatec's latest new product for the medical tubing market is this downstream package that permits polyurethane tubes to be cut and cured inline.

Walder explains the science behind this setup: "Copolymers such as polyurethanes have both crystalline and amorphous characteristics. Proper extrusion melts the polyurethane's hard segment and mixes the hard and soft segments into a homogeneous melt. Upon removal of shear and cooling, the hard and soft segments begin to separate. The tack and shrinkage of polyurethanes is due to the way the macrostructure—the separation of the soft and hard segments—organizes as the polyurethane cools. Building the macrostructure of the polymer can be considered a 'curing' of the polymer. Freezing the movement of the melt will result in a lower tack by freezing the surface. Stresses will be high by freezing mixed hard and soft segments, resulting in considerably high shrinkage as the segments organize. Cooling the melt too slowly will result in low shrinkage as the polymer is allowed to organize. But then the tube will have significant tack because the lack of freezing the surface."

Walder continues, "The multi-stage water trough allows for curing the polymer melt to reduce shrinkage and minimize tack by allowing the polymer melt to properly organize with controlled cooling. The concept of controlled cooling can be used with other copolymers or semi-crystalline materials to control the crystallization/organization rates to improve the quality of the tubing."

A three-pass tank saves space vs. one long, continuous tank, says Bessemer. Moreover, with the first and second wheels being driven, as well as the external puller/cutter, the tubing could be allowed to normalize (shrink-back), greatly reducing post-extrusion shrinkage. The first wheel is the master, drawing the tube directly from the hot die and performing the sizing, along with either internal air or non-contact vacuum sizing. This first pass is the only pass during which the tubing is under tension. The second wheel would be adjusted at a percentage slower than the first until the material floats to the surface, thus allowing shrink-back inline. The external puller speed would then also be adjusted slower than the second wheel to allow further shrink-back prior to being cut to length.

"Many years ago," Bessemer recalls, "medical tubing experts such as Steven Mayol and Braulio Polanco advised me that when TPU



TPU medical tubes take three passes through Novatec's cooling tank that features three independent temperature zones. The first and second wheels are driven. Controlling those speeds, as well as that off the external puller/cutter, allows the tubing to normalize, greatly reducing post-extrusion shrinkage.

is processed in a cooling tank with two to three times the typical length, the surface tack was minimized such that you could cut to length inline and have a short window by which the tubes could contact each other without sticking together. They knew I had developed a combination vacuum multi-pass tank for high-speed tubing processing and asked if I could build one specifically for TPUs with a total length of 6-10 ft with three passes, which would give extended time in water, while also minimizing tension. At the time it did not appear that this was an industrywide processing issue, so the potential of building any volume of this product was not great, so nothing was done. They also felt the tube could be cured by having the cut tubes ejected onto a perpendicular conveyor, driven by a stepper drive, with an oven of appropriate length to allow exposure to 165-170 F for at least 1 hr."

Like the line of medical-tubing tanks Novatec introduced a year ago, this tank uses tri-clover fittings as well as rounded corners electro-polished to minimize the growth of biofilms. "Many of the same features from the Novatec micro-medical line of precision vacuum tanks have been carried through to this new multi-pass tank," says Bessemer. "For example, both the driven wheels have been mounted on pivoting brackets, which allow them to be pivoted perpendicular to allow total cleaning of the wheel and the tank surface below. Great attention has been paid to features specific to this process such as rollers and product guides to allow minimal drag while ensuring the tube stays on the wheels even when the material floats up as the tension is removed in-process."

STICKY WICKET

Low-durometer TPUs are typically very tacky and have tendency to shrink at variable rates, which makes cutting to length extremely difficult inline, says Bessemer. The tubes are so tacky that if they touch each other, they can't be separated after cutting. And, Bessemer explains, these tubes are difficult to cut to length: Since they are so flexible, the drawing of the tube from the hot die and through the cooling medium causes stretch, a variable that makes it difficult for them to be cut to a tight length tolerance demanded by medical applications.

To overcome these challenges, the tubes are typically cut longer than required and manually hung on racks for 24 hr and allowed to dry and semi-cure. They are then cut to length manually, which costs ►

time and money in labor. Says Bessemer, "This also takes up valuable real estate in a clean room. I have seen this at many medical extrusion facilities and have been asked repeatedly for help with handling and possibly packaging these tacky tubes so they don't touch each other."

One of Bessemer's collaborators, Larry Alpert, is a long-time medical tubing processor who now has his own consulting firm, Med1Extrusion LLC. Alpert says, "Trying to combat the tackiness of TPUs is part of the reason polyurethane processing is a 'black art.' In order to reduce the tacky nature of the surface, processors will often try to run these materials as cold as possible in order to change the surface morphology enough to reduce the tack. But doing this increases variability by changing the stresses of the extrusion line, which in turn will change the stress relaxation of the part and thus the dimensions. Since the dimensional shift is nonlinear on a time scale, without any form of controls in place, it turns what can be a predictable nonlinear function into unpredictable chaos. As well, this habit is not always desirable for product performance, as there are noticeable losses in physical properties such as tensile and elongation or chemical resistance.

TPU tubes are so tacky that if they touch each other, they can't be separated after cutting.

"To add to the confusion, many urethane tubes, such as PICC (peripherally inserted central catheter) lines, go through an oven cycle for annealing. The processor needs to correlate the online extrusion measurements to what the dimensions will be a day later to what the dimensions will be after the annealing cycle. As for the tacky nature itself, there have been many workarounds. I've seen parts hanging from IV dispenser racks, laid out on tables with butcher paper placed between layers, spools with PE liners between layers, blow-off conveyors onto secondary conveyors, or secondary conveyors at the end-of-the-line conveyor (for shorter parts) to add accumulation time before parts would come into contact with each other. Depending on the day and location, one could walk through some processing shops and see a kaleidoscope of tubes hanging/laying/accumulating all over the place, taking up valuable floor space and labor needed to secondary process parts—cutting/bagging/organizing."

Alpert recalls an experience in the late 1980s when he was charged with developing the initial high-pressure braided tubing (a 0.142 × 0.071 in. urethane/nylon braided tube). "The tack of the 2363-80AE Pellethane [then a Dow TPU product, acquired later by Lubrizol] was a huge problem that had to be solved for high-volume manufacturing. In order to make the tubing, a layer of polymer had to be extruded over a mandrel in lengths that were as long as possible in order to braid and then extrude a final layer over the braid while minimizing reel changes and thus scrap.

"Initially the urethane would tack together on the first extrusion, to the point where the layer paying off of the spool into the braiding process would stretch the urethane underneath it, pulling it away from the substrate beneath it beyond its deformation point. After the final extrusion process, the spools would move into the cut-off and mandrel-pull process. The layers coming off the spool would tack again, though instead of pulling and deforming the product (much thicker with braid support), they would leave visible parting lines.

"The first thing we tried was adding a second water trough to the line. The effect of this was subjectively 'better,' but still not good enough, as once the PUR exited the trough, the tack would return after a short while. That's when it was decided that we needed to increase cooling time and maximize as much as possible the crystallinity of the urethane.

"Luckily there was a two-zone water trough available. I then attempted a discrete hot-to-cold water system. The problem was 90-95% alleviated, though we still needed an ironclad solution to manage over 20 million ft of extrusion and 10 million ft of final product over the course of a year. It was decided to increase cooling time further, so I created a virtual three-zone tank by changing the flow properties of the two sections that

we had so the heated water flowed back into the adjacent section and formed a another 'virtual' section where the water temperature was reduced over a few feet from the front temperature to the back chilled section, and a spillover port was positioned at the "end" of this section. The chilled water was introduced just downstream of that.

"Based on the overall length of the trough and the line speeds, the extrudate residence time in each section was 4 to 6 sec for cross-sections ranging from 0.3 to 0.55 mm (ultimately the cooling rate to the final water temperature was approximately 8-10 sec). This combination allowed us to wind product in 20,000-ft continuous-length spools and eliminate the problem. Another benefit of this was that the mandrel removal for the final product took about 30% less force. While this solved the problem for this product line, it did not remove all the tack of the urethane. The layers still stuck, but damage no longer occurred in the downstream processing steps."

While working for a medical-tubing processor, Polanco, founder and CEO of the consulting and training firm Systematic Extrusion, designed and implemented a three-level cascading conveyor placed downstream after the cutter conveyor. "The cascading conveyor had the option to apply heat and/or ionized air to the tubes," he recalls. "With careful control of line speed, tubes would lay uniformly without touching each other to allow the tubes significant time to cure before packaging. The conveyor provided about 10-15 min for the tackiness to be reduced. Once again, the key is to provide time post-extrusion for the molecules to align."

The combination of three temperature zones and minimization of tension permits the tubing to be cut to length with consistent shrinkage.

NO MORE WORKAROUNDS

The new Novatec system is intended to make these workarounds and added steps unnessary. A patent-pending closed-loop vacuum system in the first chamber is used to maintain vacuum to two decimal points, which Bessemer says helps to size the tube while improving ovality precision. "Vacuum is so stable that no water will exit the tank as the tube enters, even with a much larger orifice than the tube OD. This is typically below 1 in. of water vacuum, such that internal air can still be used if preferred, but without unwanted water drool," he states. Controlling both the vacuum and water-pump rpm helps to minimize unwanted water turbulence, especially at low vacuum levels, adds Bessemer.

"The combination of three temperature zones and the minimization of tension permits the tube to be cut to length with consistent shrinkage," Bessemer states. "With a proper cutting bushing and blades, even larger-diameter, thin-walled urethane tubes can be cut successfully inline."

The system consists of a standard discharge conveyor to both support the cut tube and allow for controlled ejection to either a collection tray or a perpendicular conveyor. A perpendicular conveyor, with a stepper or servo drive, can be indexed a specific amount per cut tube, allowing a space between tubes. At typical speeds of 20-50 ft/min, these parts will then pass under an oven hood with a temperature of 165-170 F for approximately 1 hr, which will cure the tube in-process.

Notes Steven Mayol, senior processing engineer for Vesta Thermoplastics, Corona, Calif., a molder and extruder of thermoplastic and silicone medical components, such as catheters, "Curing the tubing inline into another conveyor with some sort of heating source on top minimizes the inspection time as it does not have to be cured in the oven nor wait 36 to 72 hr before final inspection to find out it might be out of specification. But today processors still struggle with the same issues I faced 14 years ago processing the same materials. Their solution is to rack or table lengths of product or spool them in order to cure for a few days. This new multi-stage water trough would be ideal for scenarios like this and predict your final tubing dimensions." PT

MATERIALS

PART 4 OF 5

Fundamentals of Polyethylene

How the development of new catalysts—notably metallocenes—paved the way for the development of material grades never before possible.

By Mike Sepe

In Part 1 of this series we gave a brief overview of the historical developments related to polyethylene. The most important aspects of the advances made in the synthesis of PE involved the development of new catalysts.

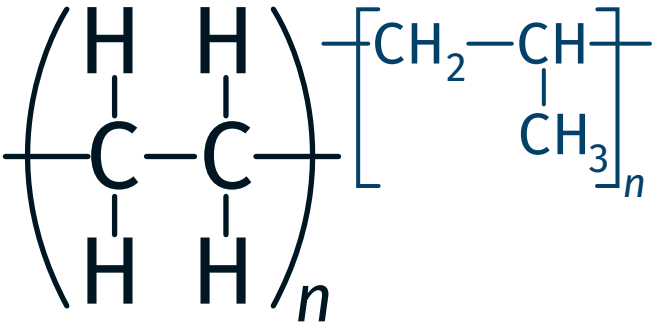
By definition, catalysts are substances that promote a chemical reaction without actually becoming part of the product. An example is the dissociation of hydrogen gas, composed of molecules of two hydrogen atoms, into monatomic hydrogen using a platinum catalyst. The platinum makes the separation of the hydrogen atoms occur much more readily, but the final hydrogen product contains no platinum. (The technical reader will recognize that while in classical chemistry it is true that the catalyst does not become part of the product, in polymerization reactions catalyst residues are often found in the final product). These substances allow the chemical reaction to run more efficiently and, in the case of polymers, to control the structure of the product in ways that were not possible with older technology.

New catalysts often bring unforeseen benefits that were not part of the initial development effort.

New catalysts often bring unforeseen benefits that were not part of the initial development effort. The same Ziegler-Natta and Phillips catalysts that made HDPE possible also ushered in the commercial era of polypropylene. Before those catalysts were developed, the researchers who first developed PE using their high-pressure process naturally sought to extend their work to other substances. Propylene gas was a natural next step. Polymerization of propylene did, in fact, occur in their high-pressure reactor.

But unlike the PE, which was a crystalline solid at room temperature, the PP was a sticky, viscous fluid. While useful as an adhesive, it could not be fabricated into the types of products that polyethylene could be molded into. Using the Ziegler-Natta catalysts, propylene was polymerized into a crystalline solid with properties that extended the capabilities available in polyethylene.

FIG 1 **Repeating Units for Polyethylene and Polypropylene**



Shown here are the chemical structure of the ethylene and propylene units that make up the polymer chains. If the chain can be made in a linear configuration, multiple chains can pack close together and produce HDPE. In PP, one of the four pendant groups is not a hydrogen atom. Instead it has been replaced by a multi-atom structure known as a methyl group.

The problem with PP can be understood by looking at the chemical structure of the ethylene and propylene units that make up the polymer chains, shown in Fig. 1. Hydrogen atoms are the smallest atoms in existence; therefore, they do not create much space between polymer chains. If the chain can be made in a linear configuration, multiple chains can pack close together and produce what we know as high-density polyethylene (HDPE). In addition, having hydrogen atoms attached to the carbon backbone throughout makes for a very symmetrical arrangement.

In polypropylene, one of the four pendant groups is not a hydrogen atom. Instead it has been replaced by a multi-atom structure known as a methyl group (-CH3). This group is bigger and bulkier than a hydrogen atom and it creates more space between the polymer chains. It turns out that the methyl groups can be arranged in three different patterns, as shown in Fig. 2. Almost all commercial polypropylenes are primarily isotactic, meaning that ►

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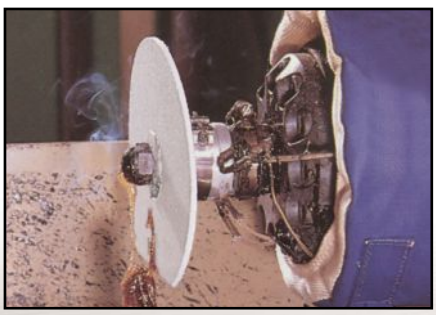

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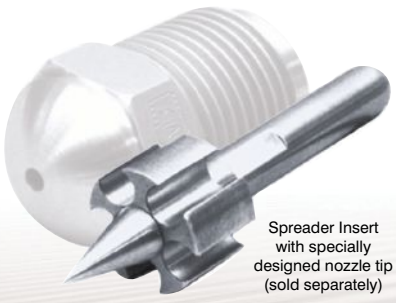

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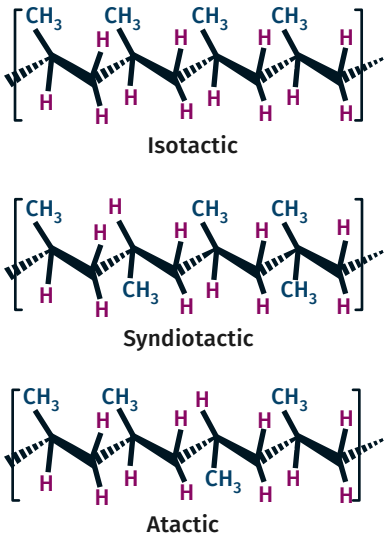
FIG 2 The Three Tacticities of Polypropylene



Methyl groups can be arranged in three different patterns. Almost all commercial PPs are primarily isotactic, meaning that the methyl group is located in the same position on each repeating unit.

the methyl group is located in the same position on each repeating unit. This allows for sufficient regularity in the structure so that crystals can form and polypropylene in this form actually has a higher melting point than HDPE and is a useful, solid material at room temperature. This is the type of polypropylene that the Ziegler-Natta and Phillips catalysts made possible.

The team that tried to use the brute force of heat and pressure in the 1930s also made PP. But without the advanced catalysts that came along in the 1950s, they could not control the placement of the methyl group. Instead, they produced atactic PP, a molecule where the placement of the methyl group varies in an unpredictable way. With this disordered arrangement, the polymer chains cannot get close enough to each other to form crystals, and the material remains amorphous.

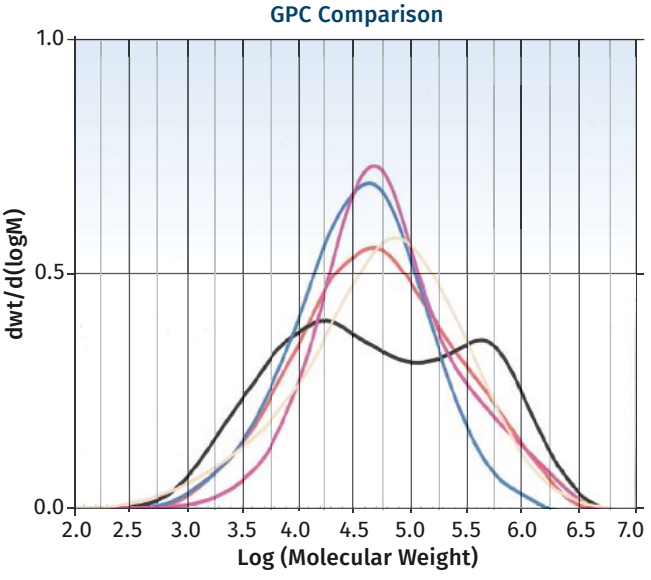
If amorphous polymers are to be useful at room temperature, they must have a glass-transition temperature (Tg) that is above room temperature. Unfortunately, the Tg of PP is approximately 0 C (32 F). So, at room temperature, in the absence of a crystalline structure, the material remains a viscous, sticky fluid. Essentially, the Ziegler-Natta and Phillips catalysts, by allowing for a rearrangement of the atoms in polypropylene, converted this glue into a useful solid material.

The metallocene catalysts have made it possible to achieve much narrower MW distributions than were previously possible.

The metallocene catalysts brought another new feature to the world of PE and PP. To fully appreciate this advancement, it is important to understand that while we sometimes talk about the molecular weight (MW) of a polymer as though it were a single value, all commercial polymers consist of chains that vary greatly in length. The molecular weight that we often talk about is really an average of all the contributions from these different chain lengths. This is similar to the situation where a quality-control person evaluates the parts in a capability study. A critical dimension on the part will have a certain average value for the entire sample population, but within that population there will be parts that are larger than the average and others that will be smaller.

Figure 3 shows a range of HDPEs of comparable average molecular weight that exhibit very different molecular-weight distributions. Generally, narrower distributions provide for improved properties. However, broad distributions are associated with easier processing. Metallocene catalysts have made it possible to achieve much narrower MW distributions than were previously possible. This has created opportunities to make products that were not possible before these catalysts were developed.

FIG 3 HDPE Materials of Similar Average Molecular Weight



Shown here is a range of HDPEs of comparable average molecular weight that exhibit very different molecular-weight distributions.

In our next and final segment of this series, we will take one last look at the subject of density and molecular weight in HDPE in an application where a change to these two properties is expected to significantly extend the life of a product.

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

Revisiting Shot Size vs. Barrel Capacity

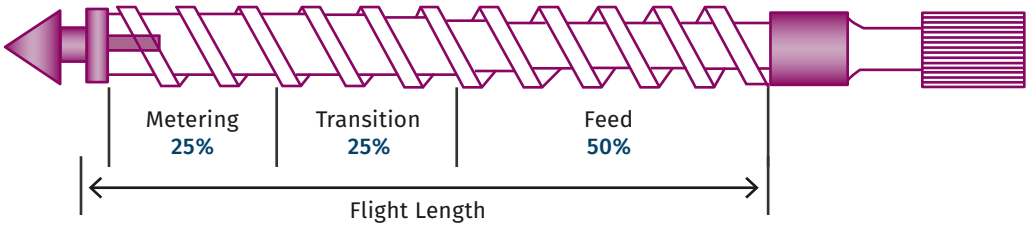
We've covered this topic before, but it's important enough to warrant another look.

By John Bozzelli

While I've written on this two on two separate occasions (see March 2017 and October 2011 Injection Molding Know-How columns), I think it's important enough to warrant yet another examination. There are hundreds of variables associated with developing an injection molding process, so it's easy to let this not-so-obvious variable fall through the cracks.

Typically you determine the shot size that can fill and pack the part(s), and work up a process from there. Suppose that everything seems OK, the process is stable, cycle is repeatable, and things look good. Parts even look good. Unfortunately, when you submit parts to quality control, some of them meet specifications and others don't, while some—not all—fail performance tests. This could be due to size, appearance or even warp issues. One possible reason for these types of issues is that you are using too small or too large a shot size.

Components of a General-Purpose Screw



With GP screws, if you run less than 25% of the barrel capacity, you'll get poor melt quality because of low rpm and a small number of screw turns needed to make the shot size. If you run greater than 65% of barrel capacity you'll get only 3.5 flights to pick up the granules, compress them and prepare them for the transition or melting zone.

One critical issue for all injection molding processes is the quality of the melted plastic. Is it uniform in temperature, viscosity, composition? Is there unmelt or partially melted granules within the part? Are there swirls or streaks of color or shade differences in some parts? These issues may be hard to measure, monitor or document, but they will ruin performance and production. If the plastic granules are not melted properly and uniformly all the above and more could be inviting "Murphy" to your production run. In terms of melt quality, all you can do is pay attention to the processing variables that influence the melting process and melt quality.

So what are those variables? My list includes:

1. Percentage of barrel capacity for the shot size.
2. Type of resin you are working with (amorphous or semi-crystalline); is there any filler, and if so what type?
3. Design of the screw—its length-to-diameter ratio or L/D; whether it is a general-purpose (GP), barrier, mixing, or other type of screw. For this article, the focus will be on the GP screw. It is the one most often used, but please note: I do *not* recommend it.
4. Shape and size of the granule or pellet.
5. Consistency of granule size.
6. Types and sizes of heater bands.

Here, I will focus on only the first two on the list. For me, it would be ideal to be able to view what actually happens as the plastic granules enter the feed zone then transfer to the transition zone and finally go through the metering zone to provide melted plastic for the shot. Unfortunately, that capability does not yet exist. But between studies and observation of processing plastics, running different screws, and most importantly pulling screws and analyzing what is happening in the feed, transition and metering zones, I can offer some guidance on what percentage of the barrel should be used.

Let's start with this question: What percentage of barrel capacity should be acceptable for proper melting? Use 25% to 65% of the barrel capacity for your shot size. Less than 25% will unlikely yield a uniform melt. Most would agree that for a shot size less than ►

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25% of the maximum barrel capacity, the concern is residence time. While that is an issue, I have also found that the melt quality is often poor. Logically you would assume the long residence time would thermally melt the granules. This assumption may be logical, but think of it from the screw's perspective.

With a GP screw (see illustration) you have three sections: feed, transition and metering. Next time you run a job that uses less than 25% of the barrel capacity, notice the low screw rpm and, more importantly, count how many revolutions it takes to make the shot size. Note that recovery time is short even with low rpm. The big culprit is that the screw does not turn many revolutions. Those few turns and short recovery times prevent the screw from doing its normal job of properly melting the granules via shear and compression.

Lower rpm and short screw-rotation times combine to provide a non-uniform melt.

Will thermal energy migrate evenly through the barrel wall to the wad of plastic in the flights? Remember ~80% of the energy to melt the plastic should come from shear, not the barrel heaters.

With shots greater than 65% of the barrel capacity, the screw does get to rotate at proper speeds, but now you have a different situation. Note what happens to the granules as they fall into the feed section of the screw. On a typical 20:1 L/D screw, there are 10 flights for feeding. At 65% of the shot size, that means 6.5 flights are "behind" the feed throat and thus empty. That means there are only 3.5 flights available to pick up the granules, compress them and prepare them for the transition or melting zone. There is a thermal aspect to melting, even if relatively small; but with a large shot size does the feed zone get enough time to provide whatever thermal effect is needed? That question requires some understanding of the resin type—is it amorphous or semi-crystalline?

You might be OK if you're running an amorphous resin, but you are inviting Murphy to your process if your material is semi-crystalline. The difference has to do with how these resin types melt:

- Amorphous resins melt like margarine or butter. As energy is applied, they soften and eventually melt. They also take less energy to melt. For example, ABS is an amorphous resin and takes ~150 BTU/lb to bring it from room temperature to a molten state.
- Semi-crystalline resins melt like ice; they stay hard until they reach their melting point. They do not soften gradually like amorphous resins. Moreover, they take twice as much energy to melt. For example, polypropylene takes 300 BTU/lb.

Therefore, if processing a semi-crystalline resin using a large shot size, you will have only two to four flights of the feed section to start the energy transfer. In addition, you will be expecting the transition zone to supply nearly all of this energy. Turns out this is wishful thinking and, unbelievably, PP or PE will literally grind metal off the flights of the screw when using large shot sizes, especially when they are greater than 65% of the barrel capacity.

In short, there are lots of variables to pay attention to when injection molding, but do not forget to check out how much of the barrel you are using to make parts. Too big or too small shot sizes relative to barrel capacity can bring on major problems. Granted this is easier said than done with the pressures of production, but do check barrel capacities when scheduling jobs. Keep Murphy at bay. PT

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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By Tony Deligio
Senior Editor

Tenere Shapes Market Niche
Where Metal and Plastics Meet

Joining metal and plastics to target some of today's most dynamic industries, contract manufacturer Tenere reinvented itself—and its customer list—in 2016.

Back in 2016, Tenere was a very different company and served a much different customer mix. At that time, the company's Colorado operations included injection molder Mountain Molding, located in Longmont and acquired in 2015; rapid prototyper Protogenic, located in Westminster and acquired in 2013; and its original Colorado purchase—Denver Tool and Die of Lakewood, which it bought in 1995.

Those companies with disparate capabilities and locations would be combined into a new 135,000-ft² facility in Westminster in 2016, the same year the company wound down business with 80 of its customers. Tenere, which was itself acquired by Massachusetts-based private-equity firm Watermill Group in 2012, is headquartered in Wisconsin, where it operates a sheet-metal fabrication business. In 2016, the company also opened a sheet-metal operation in Monterrey, Mexico. That facility has since quadrupled in size. Finally, in 2018, Tenere sold its rapid-prototyping division to Midwest Prototyping, which kept the operation in the new Westminster facility, leasing the space from Tenere.

Tenere's molding floor has 34 injection machines from 28 to 720 tons, including Toshiba, Engel, Arburg, Toyo, Roboshot and Nissei machines.

Tenere's molding floor has 34 injection molding machines, ranging in clamp force from 28 to 720 tons (three of them vertical insert molders), supplied by Toshiba, Engel, Arburg, Toyo, Milacron/Fanuc and Nissei.

After realigning its business and client list, Tenere used its metal and plastics capabilities to create enclosures, among other applications, for customers in cloud infrastructure (server racks and cabinets), network architecture (server chassis and network hardware), fiber optics (enclosures and boxes), renewable energy and autonomous transportation.

We're seeing the play between metal and plastics, which probably a lot of people don't see because usually you're either in the metals business or the plastics business.

"If you look at us versus another injection molder, we don't really go after the same customer base," explains Brian Steel, Tenere's CEO. "We're seeing the play between metal and plastics, which probably a lot of people don't see because usually you're either in the metals business or you're in the plastics business—you're not in both."

Having a foot in both worlds has been advantageous for Tenere, helping it win—and keep—business it might have missed out on otherwise. Steel recalls a customer that had been sourcing an aluminum box from Tenere for the fiber market that decided to move to a molded plastic enclosure, which Tenere still makes. "If we were just a metal fabricator, we would have lost the business," Steel says. "Even when it was a metal box, there was plastic inside it, and as a plastic box, there's still a stamped metal tray inside."

Steel estimates that about 40% of what the company molds in Westminster is tied to an integrated plastic and metal product, while fully 30% of its molded output actually ships to one of Tenere's other facilities to get built into something else. So far, the recalibration of its operations and strategies to target such products has proven successful. "As we went into that intentional shedding of markets we didn't want to play in, for the most part, we held our own," Steel says, noting that plastics revenue held steady. In 2019, plastics was its fastest growing segment, rising by about 20%.

Tenere has embraced automation as a means to boost productivity, pairing a traditional three-axis Yushin robot with a UR cobot in this cell.

DYNAMIC MARKETS, INNOVATIVE CUSTOMERS

Intentionally targeting markets like autonomous vehicles, renewable energy and information technology opens up Tenere to sizable opportunity and risk. "Because we play in very dynamic markets with innovative customers," Steel says, "the good news is they're growing markets. They're fast, and if we're responsive, we're going to capture market share—we're going to grow. The bad news is a project can go from prototype to production in about 60 to 120 days. Depending on the program, it can ramp up to very high volumes, and it can turn off just as fast as it started."

Steel offered a specific example of a project that started with a volume of 1500 parts per week before going completely silent for six months. The customer then came back and asked for production of 4000 a week. Tenere acquiesced, and the customer proceeded to ask for output increases to 7200 and then 10,000 parts per week over the next two months. "We said, 'Yes,' and 'How long is it going to run?'" Steel explains. "We can't get there without automation; we can't get there without upping cavitation."

EMBRACING AUTOMATION

Automation has become a big part of initial discussions with customers. Steel notes that three years ago, Tenere had robots on eight or nine of its 34 presses, and only three were being used. Today the company has 11 Yushin robots, as well as a collaborative robot (cobot) from Universal Robots, and it has hired three automation engineers (two in Wisconsin and one in Colorado) to design and implement automation cells, with plans to hire or develop internally automation technicians for support.

On the shop floor, there's currently a cell consisting of four molding machines that are all connected via conveyors. The cell features the UR cobot as well as four Yushin three-axis robots.

An automated paint booth supports Tenere's enclosure business, including painted bezels.

Tenere's Westminster, Colo., operation has 125 employees and runs three shifts five days a week, with an additional three shifts over the weekend.

Tooling was switched from one to two cavities, and output for the overmolded trays was boosted from 60,000 to 110,000 per week, while required staff was reallocated from 12 to just three or one operator per shift. Return on investment came in just three months.

Flexible automation is key for Tenere as it purchases new technologies for new cells. "Whatever we invest in, we have to be able to use it for something else if that project goes away," Steel says. "We're not going to invest in any technologies that we can't repurpose quickly."

Tenere has a complete tool room in support of its roughly 500 active molds.

PUTTING DATA TO WORK

Just as an improvement in automation utilization prompted the hiring of a new person for a new role, Tenere's vision of how it will gather, analyze and utilize data has led to the addition of a new person in another new role: data analyst. Steel says the company, which utilizes IQMS software, sees this as a logical progression of what most of the industry is already doing. "The base is taking operational performance data to make yourself better, whether it's quality, safety or productivity," Steel explains. "I think all of us in the industry have been there for a while to varying degrees. The next level is how do we use those data analytics to make smart decisions on what we invest in and when we invest in it, and then measure the outcomes."

With the dynamic nature of our customers' programs, we are never going to build 1000 widgets an hour of the same product for the next 20 years.

The ultimate goal is what Steel calls predictive analytics on demand. "We're in a dynamic market serving innovative customers, working to help them improve their forecasting and planning process," Steel says. "With the dynamic nature of our customers' programs, we are never going to build 1000 widgets an hour of the same product for the next 20 years." Eventually, Tenere hopes to use analytics to interpret customer demand signals. "That's the holy grail we're working towards," Steel says. "Start with the base—how do we get better on the floor. Move to how do we use it to make better decisions internally and end with how do we add value to our customers."

Ultimately, the value-add will be in Tenere better understanding its customers and its customers better understanding their own needs. "We're really trying to use the analytics on customer demand signals," Steel says. "How we're responding to those internally and what we're doing to drive supply-chain and material flow, labor, and machine utilization—then what were the actual results of that demand signal." PT

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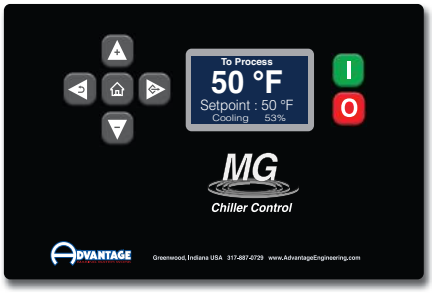

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2019 INJECTION MOLDING

Faster, Smarter, More Efficient Machines Tackle Sustainable Molding at K 2019

Blazing speed plus shrinking energy consumption supported the "green" theme at the big show. Smarter controls and growing connectivity were another key focus.

"Green" was the theme of K 2019, and Wittmann Battenfeld showed an all-electric machine specially modified to process the new Zeroplast 100% biobased, *non-plastic* material that is biodegradable/ compostable and potentially recyclable.

Matthew Naitove
Executive Editor

A profusion of new and upgraded injection machinery at K highlighted twin themes of Circular Economy and Smart Manufacturing. While presses keep getting faster, they also grow ever more energy efficient in kWh/lb of plastic processed. The vast majority of injection machines at the show were all-electric, hybrid, and/or servohydraulic. This year's exhibits featured machines equipped to process large amounts of post-consumer recycle (PCR) or biobased materials.

Reducing waste and downtime also contributes to more efficient and therefore more sustainable manufacturing. In that vein, K 2019 saw a continued push toward greater self-regulation in processing, greater connectivity between machines, and improved communication between humans and machines as milestones along the road to Smart Factories and Industry 4.0.

The following report presents news not already covered in our September show preview and elsewhere. An expanded version of this article with added detail is available at ***ptonline.com***. And a report on robots will come next month.

GOING FOR THE 'GREEN'

Our September show preview highlighted several exhibits of machines from Arburg, Engel, KraussMaffei and Wilmington Machinery tailored to handle large amounts of regrind or PCR, in some cases through foaming and/or sandwich molding. Other examples at the show included Boy Machines

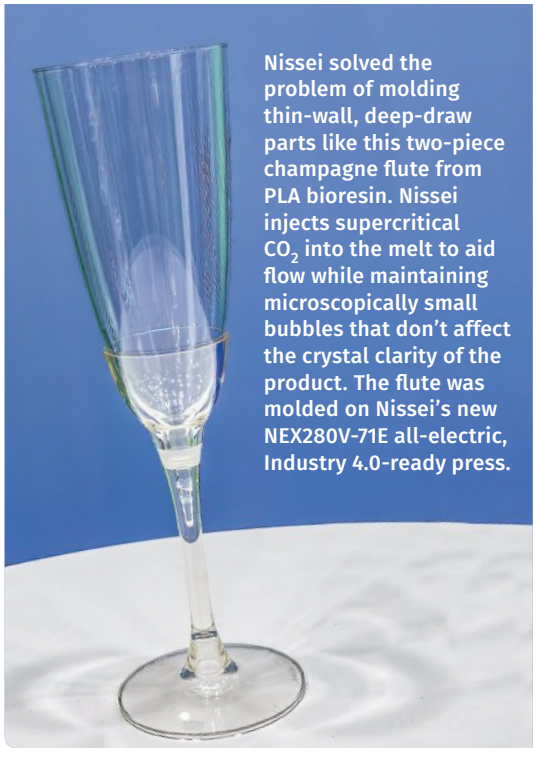
processing wood-plastic compound on a Boy 125 E. Husky highlighted the ability of its newest HyPET HPP5e system to mold PET bottle preforms from 100% PCR with no sacrifice of cycle time or product quality (e.g., color). What's more, the Husky machine can take molten PET reclaim directly via melt pipe from Erema, NGR, or other recycling systems, thereby eliminating pelletizing, crystallizing and drying steps and saving large amounts of energy. Husky says customers prefer this approach to feeding reground flake. This "RMTP" capability is expected to be commercial mid-to-late this year.

Machine capabilities to process large amounts of recycle or bioplastics supported the "green" theme of K 2019.

Chen Hsong demonstrated three-layer sandwich molding with recycle in the core. And Milacron showcased its M-Powered integration of iMFLUX low-pressure molding technology, which is said to adjust automatically for large variations in melt viscosity, a potential risk in processing PCR. Milacron's multi-nozzle low-pressure injection molding (LPIM) technology for structural-foam and structural-web molding already handles up to 100% regrind, and testing is underway with iMFLUX.

Another "green" thrust in molding exhibits involved processing biobased materials. One impressive demonstration in this vein was Nissei's production of champagne flutes from PLA bioresin. Nissei says PLA has poor flow characteristics but was able to mold this deep-draw drinkware with what it claims is the thinnest wall ever molded in PLA—as thin as 0.65 mm over a flow length of 125 mm. To accomplish this, Nissei came up with a new way to inject supercritical CO_2 into the melt to improve the fluidity of the material. Remarkably, the glassware is crystal clear, owing to the use of only 0.5% CO_2 and the microscopic size of the gas bubbles. The glasses were molded on Nissei's brand-new, all-electric NEX 280V-71E (details in Keeping Up section). Nissei will speak about this application in the Green Molding session at the Molding 2020 Conference, March 17-19 in Lombard, Ill.

A new option on J-ADS all-electric machines from JSW is said to be advantageous for molding *thick-wall* parts from PLA and other resins. The optional JS servo drive is said to enable extended hold times together with fast injection and high responsiveness.



Nissei solved the problem of molding thin-wall, deep-draw parts like this two-piece champagne flute from PLA bioresin. Nissei injects supercritical CO_2 into the melt to aid flow while maintaining microscopically small bubbles that don't affect the crystal clarity of the product. The flute was molded on Nissei's new NEX280V-71E all-electric, Industry 4.0-ready press.

Another unusual demonstration at K was the debut of a machine and material for molding a new kind of eco-friendly products. Zeroplast is a patented material from a Polish company of the same name (***zeroplast.com***) that is composed entirely of mineral and nonfood plant-derived waxes, fibers and fillers (including rice hulls and calcium carbonate). This "plastic-free" material is compostable and biodegradable in natural environments. It is also recyclable without any loss of properties, the company says. The material is said to be heat stable to greater than 200 C (392 F) in processing and to 70-75 C (158-167 F) in end-use.

Zeroplast worked with Wittmann Battenfeld on an exclusive basis to develop a molding process for this material. The result is a specially modified, all-electric EcoPower 240 press (240 metric tons) with a special injection unit, heating system, and processing software. According to Wittmann sources, this system was adapted to the Zeroplast material's sharp transition from solid to liquid and the resulting narrow process window.

At the show, Wittmann molded a thick-walled cosmetic jar and cap with the heavy feel of glass, molded in two colors in 4 + 4 cavities, with a paper in-mold label (uncoated for biodegradability) and automatic assembly of jar and lid in a screwing station outside the press. Wittmann Battenfeld will present this innovation in the Green Molding session at the Molding 2020 Conference.

DEVELOPMENTS IN LSR MOLDING EQUIPMENT

Apart from news reported in our September K preview, Fanuc of Japan (represented here by Milacron) has developed new standard software for LSR processing on Roboshot all-electric machines of 50 to 100 tons, as well as its own screw and barrel design for this process.

Sumitomo (SHI) Demag also introduced a turnkey LSR package for its IntElect series with a special screw, nonreturn valve, vacuum system and other LSR-specific options. For the pumping/metering system, the company has partnered with Nexus Elastomer Systems of Austria.

Elmet has shrunk its TOP 5000 P pumping system with 15% smaller footprint and 10% reduced height. Also, Elmet is developing an alternative to this pneumatically driven piston-pump system: the TOP 5000 E with servoelectric screw pump. Elmet says servo drive is more expensive and will offer the same precision as the existing version, but it is being offered to meet market interest. ►

Zeiger Industries' latest LSR conversion packaging includes quick-disconnect water jackets and a pump connection without threads that can lock up if exposed to resin leaks.

Elmet showed its new servo-driven TOP5000E LSR dosing system with web connectivity and remote monitoring/control via mobile devices.

Meanwhile, Elmet introduced a web-enabled Premium Connectivity Package with email functionality and remote support for the whole TOP 5000 series. All TOP 5000 dosing systems already have a VNC and OPC-UA interface for data exchange with the molding machine. The new remote-access interface allows users to change settings and monitor system status via the new Elmet Connect online portal and an app.

Zeiger Industries has enhanced its LSR conversion kits with new quick-disconnect water-cooling jackets for the barrel to facilitate maintenance. These also come in a toolless version. Also new is a connection to allow easier uncoupling of the pump assembly from the barrel. This version eliminates threads, reducing the risk of damage to the barrel in case of LSR leakage into the coupling, which can lock the threads.

Advanced controls and extended processing range are coming to low-pressure structural-foam machines.

MORE NEW MACHINES & UPGRADES

Arburg introduced its first machine that can be configured with an app. The Allrounder 270 S compact (hydraulic, 35 m.t.), as the name suggests, has a space-saving design with reduced width and the control cabinet integrated into the machine base. It can be configured and ordered online with an app on Arburg's customer portal in a few simple steps. The customer benefits from faster delivery and prices about 25% lower than standard hydraulic machines, Arburg says.

Arburg also is extending features launched with the new hybrid Allrounder "H" series to other Allrounder lines. At this show, the all-electric 570 A (200 m.t.) and 630 A (250 m.t.) appeared for the first time with the new "H" series clamp design, exterior styling, and Gestica controller with gesture-based commands.

Another introduction from Arburg was the vertical, hydraulic Allrounder 1600 T (200 m.t.) with a larger (1600-mm) servo-electric rotary table for automated overmolding of metal inserts.

Boy Machines introduced a couple of new features not previously reported: an electric slide table for the Boy 35 E VH with vertical clamp, and integration of a Regloplas TCU with the Procan Alpha controller on a Boy XS (10 m.t.), enabling mold temperatures to be displayed and adjusted on the press control screen.

Chen Hsong is offering several new lines of machines, not all of which were at the show. The Jetmaster MK6 line of servo-hydraulic toggle presses comes in 88 to 668 m.t. The clamp, base, and injection unit have all been redesigned and beefed up. Also redesigned is the Jetmaster Large SVP/2 series from 650 to 3000 m.t. Evolution MK6e servohydraulic toggles (90 to 650 m.t.) are a new, lower-cost version said to be suitable for 80% of the market. There's also a smaller low-cost line, the new Focus SVP/2 from 20 to 60 m.t. At the higher-performance end is the new Speed series of servohydraulic toggles (128 to 468 m.t.) with a high-response servomotor for ultra-high-speed injection. The related new Speed-Pack series (260 to 470 m.t.) has longer screws, up to 26:1 L/D. Finally, a new all-electric series is the Spark line from 100 to 230 m.t., boasting a more compact and more open design.

Fanuc has a new standard execution for medical Roboshot machines, including such features as stainless-steel construction, special screws, HEPA filter, and new "bush-less" tiebars.

JSW introduced its patented SOFIT foam injection technology. It involves injecting nitrogen gas into the barrel in a decompression zone between the melting zone and metering/compression zone. A special screw and barrel are required, but a cost-saving feature is the ability to feed nitrogen directly from a storage tank via a pressure-reducing valve, without a high-pressure metering pump.

KraussMaffei showed the new Netstal Elios 4500 (450 m.t.) high-speed, hybrid toggle press. The series was launched at NPE2018 with a 750-tonner, which is now supplemented by models of 450, 550, and

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650 m.t. Also new was a 21.5-in. multi-touch display on the KM CX 80 hydraulic machine with a PLC control based on the KM MC6.

Milacron showed its new Q-Series of servohydraulic toggle presses and hinted that an all-electric version is on the way—perhaps as soon as October's Fakuma show in Germany.

Several new features have been introduced to Milacron's LPIM line, including the Mosaic+ control, which has VNC capability to mirror control screens from third-party auxiliaries like robots and hot-runner controls. This allows monitoring and setup of auxiliaries from the injection controller. Also new for LPIM machines is a hybrid option with a Fanuc servomotor and drive for the screw, cutting energy consumption by 20-25%. Other new options are a 7-in.-diam. extruder capable of 3200 lb/hr, 4500-in.^{3} accumulator, and 10,000-psi injection-pressure capability, vs. the standard 6000 psi.

Negri Bossi showed the first model of Nova iP servohydraulic hybrid two-platen presses in a 1000-m.t. version. This is an extension of the Nova i hybrid toggle line introduced in 2018.

Negri Bossi also displayed a Cambio St servohydraulic toggle press outfitted with the new Motus control system and 21.5-in. multi-touch display. It has a finger-operated mini-joystick that can be used in setup mode to move the screw, clamp and ejector. This is the same controller used on the new Nova s servohydraulic toggle and Nova i series. Coming soon is a new injection unit for Cambio presses.

Also on display was a new Nova e 130T all-electric press converted to an injection-blow molding system by means of a mold from Molmasa of Spain. The tool has eight preform injection and eight blowing cavities. A mold plate slides up and down to move preforms to blowing cavities. It's suited for small to medium production.

Artificial intelligence (AI) is increasingly a feature of Industry 4.0 digitization of molding operations. An example is KraussMaffei's new app to provide early warning of production anomalies. KM plans to extend real-time production monitoring to non-KM equipment.

For PET preforms, SIPA of Italy introduced an enhanced version of its hybrid XForm system, dubbed Gen4 XP. It reportedly provides a new operator experience with a 21.5-in. touchscreen, swipe functions like a smartphone, and a multifunction control knob for one-handed operation. The control features automated setup routines and an in-depth part-quality troubleshooting tutorial. The servohydraulic toggle boasts a super-fast dry cycle and braking kinetic-energy recovery. Other upgrades are increased injection rate and energy efficiency. Cycle time for a 7.5 g preform is said to be 7.5 sec. Maintenance is reportedly made easier by mounting the accumulators on a pull-out rack inside the machine frame. SIPA also introduced a smaller size in the XForm range—250 m.t., suited to 96 cavities; existing models are 350 m.t. for 128 cavities and 500 m.t. for up to 180 cavities.

Sumitomo (SHI) Demag added new sizes to several machine lines. Its IntElect S high-speed, all-electric series for thin-wall and precision parts in cycles of 3 to 6 sec will gain a larger size this year—500 m.t.—complementing the new 500-m.t. IntElect model for general-purpose technical molding in cycles under 10 sec. Also, IntElect Multi two-component machines will extend their size range from 100 to 180 m.t. upward to 500 m.t.

Web connectivity and remote monitoring/control come to LSR metering/pumping systems.

Sumitomo Demag's El-Exis SP high-speed packaging hybrid series gained a new 1000-m.t. model at the upper end of its size range, aimed particularly at pail production. Accumulators provide 1000 mm/sec injection speed. At the show, it molded two 17 L PP pails (675 g each) from 50% PCR, with IML, in 12.9 sec.

Victor Taichung of Taiwan (represented here by Fortune International) brought out its third-generation all-electric series, the Va III. The first machine in the line is the biggest model, 230 tons, which was displayed at K. Starting at 50 tons, the line features an upgraded controller and linear bearings on the injection carriage.

Wittmann Battenfeld introduced a high-performance plasticating unit with modified barrier screw and improved throughput rate for molding PET blood tubes in 48 cavities on an all-electric EcoPower Xpress 160-m.t. medical machine. Also new are nonreturn valves with improved wear protection and flow engineering.

SMARTER & MORE CONNECTED MACHINES

Smart machines, smart production, and smart services—the three-part mantra of Industry 4.0 drove a lot of the news at K 2019. Arburg, for example, promoted all three as part of its "arburgX-world" (pronounced "Arburg's world") concept. Available in Germany since last March, it is now active globally in 18 languages. In future, all Allrounder macines will be equipped with Basis Connectivity, an IIOT (industrial internet of things) gateway to networking with higher-level software tools and the web portal.

Among the new apps available via the customer portal are the MachineFinder, which helps the user choose the right Allrounder machine for a job. The MachineDashboard delivers status information and key performance indicators (KPIs) for the user's machines.

VirtualControl simulates the machine controller; while SelfService provides guided error analysis and troubleshooting. And Shop allows customers to place orders 24/7 with direct access to prices, availability and order history.

New "digital assistants" include the "filling assistant" for the Gestica controller, which provides 3D graphic animation of the part's fill level in relation to the screw position; and the "plasticizing assistant," which utilizes a memory chip integrated into the barrel to record data on the working history of the screw and barrel to facilitate predictive maintenance.

Engel's latest initiatives in digitization include integrating processing and simulation (see Starting Up) and a program in horizontal networking via its participation in the German ADAMOS (Adaptive Manufacturing Open Solutions) consortium for Industry 4.0 and IOT solutions (*adamos.com*). A key product of the alliance is the ADAMOS Hub, a software solution for access to control applications of different providers. This one platform reportedly can interconnect all the machinery in a plant, permitting an integrated view of the operating status, settings, and performance parameters of all those machines. The result, says Engel, can be one dashboard for a whole plant or department, rather than many dashboards for individual equipment. The result could be OEE (Overall Equipment Efficiency) calculation across all machinery, something that has not been possible before. Another use could be monitoring energy consumption for a whole plant and individual equipment.

TEMIone is a new MES for a single injection machine, integrated into Wittmann Battenfeld's B8 controller.

KraussMaffei also launched a range of new apps for digital manufacturing. New smartAssist provides immediate remote technical service at the press of a button. New forensicExpert is a consulting service: Via the web app, KM technicians can analyze high-resolution process data for customized process optimization.

KM's new socialProduction app for machine-to-human communication provides realtime remote production monitoring for all KM injection machines—and soon for non-KM equipment. Using AI, the app provides early notice of potential upsets.

Also new is easyTrace, a central data hub for collecting production data for any age, type, and brand of machine, including auxiliaries. It translates different protocols for communication with MES and other central plant IT systems.

Milacron is enhancing its M-Powered suite of Industry 4.0 services and predictive functions through partnership with ei³, a 10-year-old firm based in New York, which specializes in remote collection and analysis of industrial machine data. Ei³ developed AI that Milacron says paves the way for new applications to support preemptive spare-parts stocking and expanded lifetime tracking for tooling and auxiliary components. Thus, M-Powered is now able to interpret the data to determine impending failures, maintenance needs, or incorrect machine settings. Any Milacron machine can be enhanced with ei³ AI capabilities in less than two weeks.

New from Nissei is N-Constellation for networking all cell components using Euromap protocols, with the new TACT5 injection-machine controller as a hub. Data collection in the cloud allows centralized management of all connected devices. Coming soon are Nissei's Support Cloud to provide visibility of the operating status of all connected machines, and Maintenance Assistance Cloud to analyze operating data and facilitate predictive maintenance. Nissei has also updated its PQ Manager with v3.16 of this quality and production-control system. It monitors and graphs process data and events, and sends email or text alerts.

And JSW has enhanced its Net 100 plantwide monitoring system with newly upgraded J-Wise remote troubleshooting capability.

Wittmann Battenfeld introduced a data reporting and analysis concept that does not require access to company IT systems or external (cloud) data storage. New TEMIone "one-machine MES" involves a server inside the machine control cabinet that is integrated with the B8 controller and Wittmann 4.0 router. This allows TEMIone to access and store production data from the press and cell peripherals to provide completed data traceability for up to five years of production. It can display customized KPIs (key process indicators) in a dashboard and an hourly OEE trend for the machine and workcell. It also merges error messages from individual devices into one list. Data can be stored externally via USB or network connection.

AI for autonomous machine learning is the goal of research involving Sumitomo (SHI) Demag and the German Institute for Plastics Processing (IKV) in Aachen. The project is aimed at automated process optimization and quality control of part weight, geometry and temperature. Trials at a molding plant are planned this year. (For more on AI injection controls, see Keeping Up section.) PT

QUESTIONS ABOUT INJECTION MOLDING AT K 2019

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2019 FILM EXTRUSION

Towers of Power & Sustainability

At K 2019, developments in blown film highlighted recyclable film structures for new applications and technology aimed at making product changes more efficient.

Hosokawa Alpine's HX Select series extruders feature a new screw and barrel design that is said to permit energy savings up to 20% along with lower melt temperatures and higher throughput. The series is available with screw diameters from 50 to and 120 mm.

By Jim Callari
Editorial Director

More than a dozen blown film lines were humming each day during October's K 2019 show in Düsseldorf, either at the show or at off-site open houses. Responding to demand from consumers and brand owners, more than half of these machine builders debuted all-polyolefin multi-layer extrusion technology to facilitate recycling. All-polyolefin coextrusions for applications such as standup pouches abounded from machine builders such as Bandera, Hosokawa Alpine, Kuhne, Macchi, Reifenhauser, and Windmoeller & Hoelscher, among others.

What follows in this article is new technology *not* previously covered in *Plastics Technology*'s September 2019 K Show Preview, as well as product launches that were featured in our Keeping Up with Technology section in the September, October, November, and December issues. Check out p. 48 of this issue for compounding news from K 2019 not reported in previous issues.

In addition to using recyclable materials in support of sustainability efforts, machine builders also debuted technology aimed at boosting efficiency of film processing. Hosokawa Alpine took the wraps off its newly developed HX Select series extruders that is said to be flexible enough to run LLDPE, mLLDPE, PCR (post-customer recycle) and bioplastics. A new screw and barrel design is said to permit energy savings up to 20% along with significantly lower melt temperatures and much higher throughput. This, in turn, results in increased bubble stability at lower cooling requirements. The series is available with screw diameters from 50 to and 120 mm.

Hosokawa Alpine also showcased a high-efficiency cooling package for blown film consisting of the Alpine CRX cooling ring for outer cooling and the Alpine HT cooling tower for inner bubble cooling. The CRX series is described as a low-counterpressure system that reportedly makes more efficient use of the available cooling capacity and increases throughputs. The base body is thermally insulated and also contributes to increased energy effi-

ciency. The high-performance cooling ring is also characterized by optimized air distribution, resulting in improved film tolerance. Since the Alpine CRX has only a single cooling-air supply line, it more user friendly for operators and maintenance personnel.

The HT cooling tower, meantime, features new nozzle geometry that reportedly reduces counter-pressure and provides high volumetric flow to provide extremely high line outputs. A patented monomer collection system prevents paraffin splashes on the film bubble, which substantially increases intervals between cooling-tower cleanings.

Enhanced cooling was among the many new developments on display at Windmoeller & Hoelscher's K 2019 exhibit, and at the company's open house in Lengerich, Germany. W&H showed a new Arctis cooling ring at the show, offering increased output and higher bubble stability. The new system includes Intensive Cooling (IC) technology W&H licensed from Addex. IC technology uses high-velocity air streams aimed alongside the bubble to create a suction force pulling outward to create new lock points that hold the bubble in place, explains Bob Cree, president of Addex and developer of the system (see June '16 Close-Up). Intensive Cooling works to both stabilize and intensely cool the bubble.

Notes Dr. Falco Paepenmueller, W&H's chief technology officer, "Intensive trials were conducted over a one-year period in the W&H technology center. The W&H team and the Addex team worked directly on a 400-mm production-quality line in Lengerich. During these trials, the technology was changed and refined to fit the W&H process. We then focused on optimizing the rest of the system as a whole: We analyzed all elements, reworked and optimized it and added some other developments. We also focused on advancing the rest of the W&H cooling system. We analyzed all elements of the cooling system and optimized it, including new development of some other components."

Adds Cree, "At the W&H open house during the K, all visitors were asked to guess at what output rate could be achieved with IC, and my guess was 2646 lb/hr. They ran 3437 lb/hr with IC on a 400-mm die. The W&H concept combines IC technology sitting at the bottom of the air ring with other things, and W&H managed to get rid of the enclosure, which greatly simplifies operation."

QUICK-CHANGE ARTIST

W&H also displayed new technology for both cast and blown film focused on expediting product changeovers. Three times throughout the day during the entire K 2019 show, W&H demonstrated its Turbostart automation system for stopping and restarting blown film lines 50% faster, safer, and easier.

At the fair, W&H showed live stopping and starting of a Varex II blown film line with Turbostart in less than 15 min, half the time generally required. Operators activate and control the process at the touch of a button on a screen of W&H's Procontrol operating panel. With conventional systems, in order to prevent quality problems caused by air inclusions, operators had to cut the bubble with a knife at the top of the haul-off, W&H explains. This costs time and is a safety hazard.

For cast film, W&H displayed the Die Control Wizard (DCW), an automation module developed for its Filmex II cast film line. W&H has been working on this technology for about three years, along with Cloeren Incorporated, which developed a new Reflex die to improve product quality and increase yields through faster, more efficient product changes. With the DCW, fully automated width and thickness changes are said to be possible in the shortest possible time. Both changeover time and scrap are reduced by up to 70%.

"Previously, dies had to be adjusted manually during production or job changes. This takes a long time until the desired film profile is achieved," says Torben Fischer, W&H's head of its cast film division. "With the full automation of the DCW, a complete width change from one production order to the next can be carried out within 20 min, which in the past meant up to 90 min of manual work."

In other extrusion news not reported previously, Hosokawa Alpine announced it is now making its own screen changers. The Alpine ASW screen changer is constructed according to the compact, hinged-plate principle. The resulting short melt lines, combined with an 800-bar maximum permissible pressure, reportedly permit extremely high output rates.

With its 1500-mm winding diameter, Alpine's new HWD winder is designed for high roll weights at web speeds of up to 984 ft/min. Through continuous use of the central drive and therefore constantly defined web tension, the unit allows consistent winding from the first foot of film.

During the K 2019 show, W&H demonstrated its Turbostart automation system on a Varex II line, stopping and restarting a blown film line 50% faster, safer, and easier.

DON'T FORGET DATA

Digitizing the extrusion process was also a big theme in blown film. W&H showed Ruby, a new IoT system for digitizing the value chain in packaging. By connecting digital data with process knowledge, W&H will offer several possibilities for data-based optimization of ►

ALPINE'S LATEST INNOVATIONS

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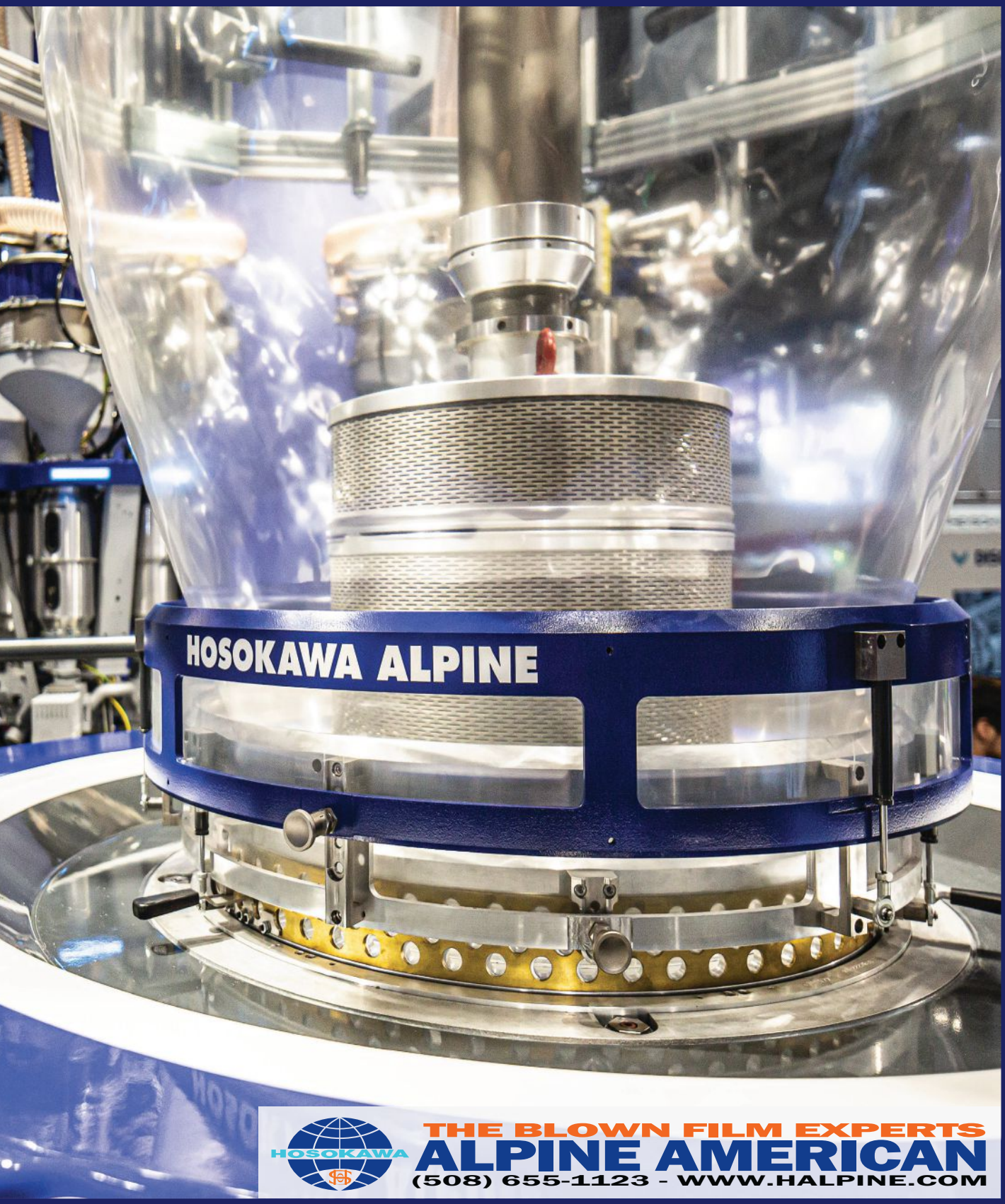


In cast film, W&H displayed the Die Control Wizard, an automation module specially developed for its Filmex II cast film line. Fully automated width and thickness changes are possible from the control panel to cut changeover time and scrap by up to 70%.

the production process, from increasing productivity to quality management. Ruby will be offered as a standard platform with tailor-made extensions for extrusion and downstream processes.

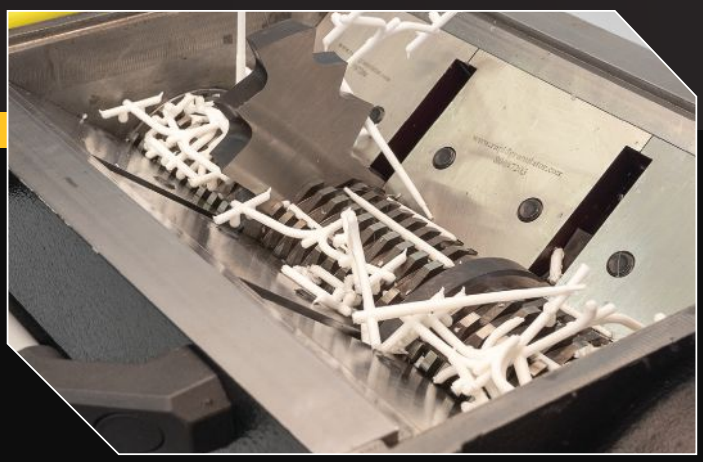
W&H has had a central, digital information system called ISP since the 1990s, which many customers have used to collect and display production and process data. "Ruby automatically evaluates this data and is the basis for additional digital services to further optimize these processes," explains Wolfgang Hoffmann, head of extrusion software services at W&H. With the extensions, W&H offers enhancements for each specific type of machine. "As an example, Ruby supports extruders using algorithms to evaluate production data, analyze trends and define thresholds for good production, which the system then monitors for adherence," explains Hoffmann. "Then Ruby can link production data with quality data from the lab and downstream processes."

Hosokawa Alpine showed two new digital tools. Isa (Intelligent Software Assistant) is a central "smart production" platform that can read out, save, display, and analyze process data from a wide range of lines. Its ExVis 5.0 system, meantime, is a fully networked system that merges and centrally manages the data of all system components. It also offers a wide range of smart options for daily work on the machine, making it possible, for example, for processors to view immediately the quantity and type of metered raw materials, as well as the consumption level within a specific period.

A wide range of analysis options is available within ExVis for assessing product quality. Immediate intervention in the production process is possible if necessary. It is also possible to store film formulations and machine settings for subsequent use. PT

Rapid OneCUT PRO

The smart way to use slow-speed granulation



Rapid has set the new standard for slow speed granulation with the OneCUT PRO and it features a wide range of new innovations and benefits.

All plastics have different properties, so why use the same speed to recycle them? With OneCut PRO, you can adjust the rotor speed at any time, so you can be sure you're using the best setting to get the optimal output, regrind quality, lowest noise level and lowest possible energy consumption through Rapid EnergySMART.

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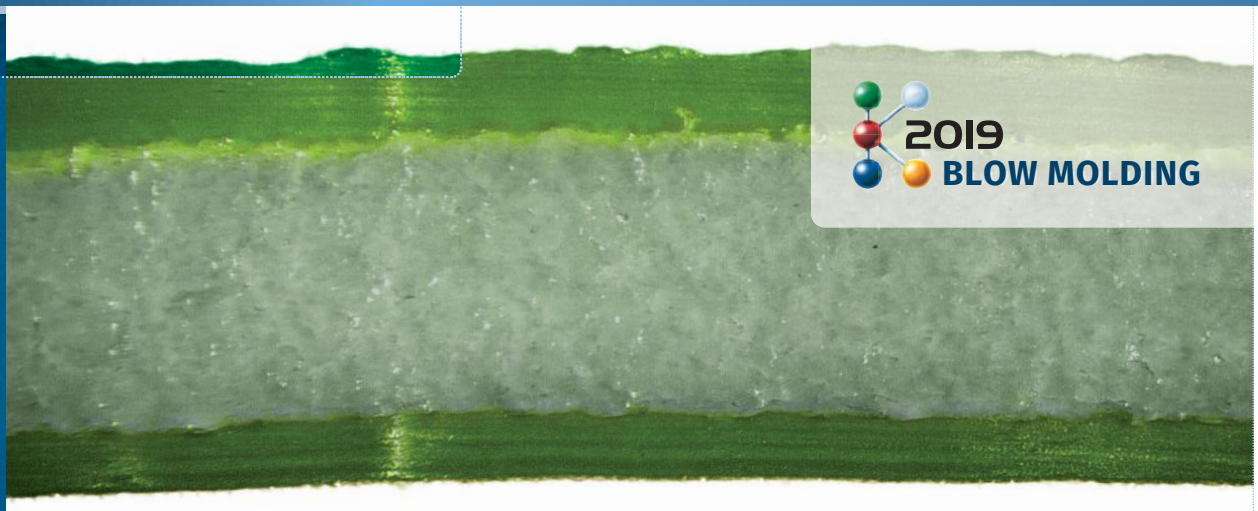

2019 BLOW MOLDING

Something for Everyone at K Show

Packaging, industrial, continuous-extrusion, accumulator-head, injection-blow, stretch-blow, EPET, foam, sandwich co-injection—the blow molding news was wide ranging at K 2019.

By Matthew Naitove
Executive Editor

Consumer packaging, beverage bottles, jerrycans, drums, automotive parts—all were in evidence among the blow molding exhibits at K 2019 in October. Special technologies on display included foams, barrier co-injection, and digital printing on blown bottles. There was also growing emphasis on remote monitoring and data acquisition from blow molding operations.

In addition to the details presented below, see our K Show preview in September and Keeping Up items in September, November, and this issue for additional news from the show. Also, an expanded version of this report, with added detail, is available at *ptonline.com*.

Bekum's new Concept 808 shuttle machine debuted with optional magnetic quick mold clamping—possibly a first in blow molding—which allows changeover of molds and blow pins in 15 min per side.

FOAM BUBBLES UP

Interest in foam extrusion blow molding continues to percolate. Kautex emphasized a three-layer "green" bottle blown from sugarcane-based HDPE from Braskem, which had a core layer of foam comprised of 70% PCR from the same biobased PE. Foaming was achieved by injecting nitrogen gas between the screw and die head. Compared with a similar monolayer solid bottle, overall weight reduction was almost 19% while maintaining the same cycle time, same overall bottle cost, and slightly improving topload strength.

Pursuing the "green" theme at K, Kautex molded containers entirely out of biobased HDPE from Braskem, including the center foam layer. Kautex's foaming technology injects nitrogen gas between the screw and die head, in this case achieving almost 19% overall weight reduction while maintaining the same cycle time and slightly improving topload strength.

Meanwhile, W. Müller, the well-known maker of extrusion heads, has been working on foam for several years and with its first customer for about a year. Cimplast S.A.C.I. in Paraguay is using Müller's foam technology in 20-liter jerrycans for pesticides made from Braskem's "green" PE. Müller's technology involves injecting nitrogen gas directly into the head.

A third advocate for foam blow molding was Trexel, which saw "a lot of activity last year" in use of its MuCell microcellular foaming technology for automotive ducts of HDPE or PP. Weight reduction is in the range of 30% to 50%. Trexel credits its new Tip Dosing Module, which allows use of existing screws and barrels.

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INJECTION-BLOW NEWS

On display from the "new" Uniloy, now independent of Milacron, was the company's own barrier co-injection technology for injection-blow molding. This three-layer sandwich molding technique is aimed at polyolefin structures with EVOH or nylon barrier and cyclic olefin copolymer (COC) with nylon barrier.

Meccanoplastica of Italy showed off its new Jet 85 machine, an 85-ton size in the three-station, all-electric Jet series.

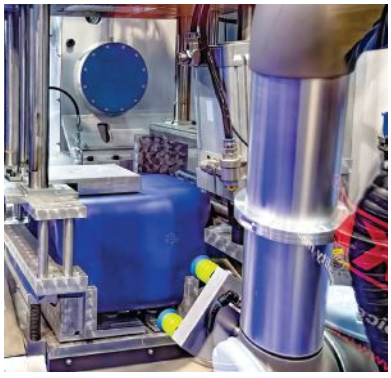
Another Italian producer, Magic MP, launched its first injection-blow machine. The all-electric ISE 150 evolved from the company's MTM 150 one-step stretch-blow machine for PET. It has two stations positioned in-line with the 7-oz injection unit. Injection clamp force is 16 tons. The machine can blow containers from 25 ml in eight cavities to 150 ml in four cavities.

Ossberger of Germany showed the newest version of its Pressblower system, a unique combination of injection and extrusion blow molding. Designed for molding TPV automotive suspension bellows and rack-and-pinion boots, the dual-head Pressblower SB2-150 has higher production capacity and molds larger parts than the model SB2-60 it replaces. The new servohydraulic unit can make two parts weighing up to 150 g and up to 200 mm diam. Ossberger is represented here by FGH Systems.

KHS introduced a PET bottle design with undercuts that take a snap-in HDPE handle.

EXTRUSION BLOW MACHINES

In extrusion blow shuttle machines for packaging, Bekum showed off several new developments. One was the prototype of a new all-electric series, called the Concept 808 (see September Keeping Up). It has a clean new look, new control system, large 24-in. touchscreen with multi-touch capability, 800-mm platens, and new energy-saving extruders. The new Control 8.0 is described as "Industry 4.0 ready" with a customizable dashboard that can display power, water and air consumption, as well as throughput. Remote maintenance is also available.



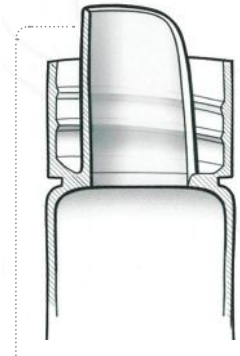
Jerrycans were a focus of machine development at K, like this all-electric FD-20E from BBM. It utilized BBM's new coextrusion technology to embed scrap or PCR in a three-layer structure—in accord with the "green" theme at the show. And the trend to automation was exemplified in the use of a Universal Robots cobot inside the machine to demold parts and re-orient them for vertical deflashing (right), said to be a neater solution than horizontal punch-out of flash.

At K, the machine was displayed with optional quick-change magnetic mold clamping—possibly a first for blow molding, Bekum says—that allows changing molds and blow pins in 15 min per clamp unit, without tools.

Bekum's new HiPEx 36D servo-electric extruders boast up to 20% energy savings, higher output than standard 24D extruders, gentler melting and better mixing—reportedly good for using reclaim.

Two other new machines from Bekum include the EBlow 807D, a larger electric machine with 55-ton clamp. The EBlow 707D is a smaller electric model (33 tons).

Kautex showed off the latest evolution of its all-electric KBB series, the KBB evo. It boasts faster movements, plus low-friction roller bearings. Improved diagnostics are said to monitor performance and reduce downtime. And all this comes at lower upfront cost for buyers.



R&D/Leverage developed a tooling concept for PET bottles with internal threads and integral drain-back pour spout.

Kautex also emphasized its new-generation die heads for consumer packaging that are said to speed resin and color changes by 75%. Other advantages are reduced center distances and higher throughputs on smaller heads, saving investment cost; fewer cleaning cycles due to a head design that reduces deposits; and convertibility from mandrel to die movement and vice versa.

Among the new digital services from Kautex are DataCap packages for central data acquisition via the OPC UA protocol.

Magic has a new jerrycan machine, model ME-T50-1000D, said to be the largest all-electric extrusion blow machine in the world. It has 55-ton clamps and 1-meter stroke. An even larger T60 size is available with 69-ton clamps and 1.6-m stroke.

BBM of Germany showed its 22-ton FD 20E all-electric, single-station machine for stackable jerrycans of 10-20 L. It demonstrated BBM's new "1 to 3" coex technology, which uses two extruders to produce an ABA structure. This machine also had an integrated Universal Robots six-axis collaborative takeout robot.

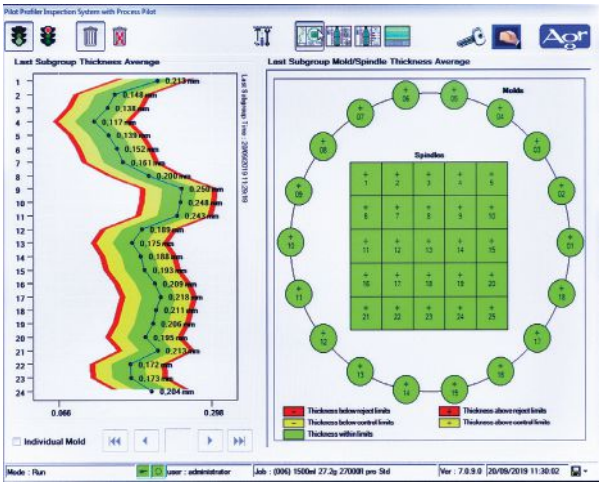
Two machines were shown by Plastiblow of Italy. The PB26ES-8 is a single-station, electric machine with 26-ton clamp. Shown for the first time on this machine was electronic weight adjustment via individual servomotor for each parison.

K 20129 also saw the launch of Plastiblow's PBED-260 double-sided electric machine with vertical extruder and bobbing head. This small, compact model with 2-ton clamp is aimed at cosmetic and pharmaceutical containers.

Techne introduced an aseptic process for its new all-electric e-line shuttles, which are single or double sided, with one to four parisons and clamps from 14 to 55 tons. The company plans to open an office in Miami, Fla., this year.

W. Müller has made its flow-channel coating that permits quick color changes available now for large heads (40-50 L) and coex heads.

Also on the large end of the scale is Rikutec of Germany, a blow molder of large industrial packaging and industrial parts, which builds (and licenses) its own accumulator-head machines. The company is developing a machine with around 60-lb head for 200 L (55-gal) chemical drums.



New from KHS is Unit Mold Control, developed with Agr International, which monitors material distribution in each cavity and automatically adjusts process settings for each individual mold station.

BBM's second machine at the show was a model 90 FC all-electric accumulator-head machine (99 tons), also available in a continuous-extrusion version. It's aimed at technical parts or drums up to 250 L. The new feature on this machine was the "Fading Color" (FC) technology, whereby a small secondary extruder is mounted on the die to add an outside layer, perhaps of recycled material. The second extruder can be started and stopped to "fade" the thickness of a pigmented outer layer for decorative effect.

One further development for industrial parts was on view at the Kautex booth. Toray Engineering Co. in Japan has developed simulation software for suction blow molding to address problems in manufacturing automotive turbo ducts and piping. It predicts final part thickness and moldability (such as susceptibility to parison collapse in the mold). So far, the software has been developed for nylon 6 and PPS.

Simulation software arrives for suction blow molding.

NEWS IN PET

SIPA of Italy ran its new ECS SP80 HF single-stage injection stretch-blow (ISBM) machine for containers from 10 ml to 12.5 L. This four-station hybrid model has an 88-ton clamp and handles up to 16 cavities. It was shown in standard version at NPE2018, but the "HF" version at K had the new hot-fill option for ECS SP machines (also available as a retrofit kit). At the show, SIPA produced 420-ml, 28-g ketchup bottles in six cavities on a 14-sec cycle (1540 bph). The bottles are said to withstand hot filling at up to 85 C (185 F).

One of several developments from KHS is wide-neck PET food containers for hot filling. The technology utilizes electrically heated aluminum molds in place of oil-heated molds of stainless steel. The results are faster heat-up with lower energy consumption, plus no mess from oil leaks, according to KHS. Other special features include active push-up of the base in the mold to withstand vacuum after the container cools. Also, the neck finish is not injection molded as usual, because such a finish provides no crystallization to withstand hot filling. Instead, KHS blow molds the neck finish with a dome above it that is cut off.

Meccanoplastica came out with the MiPET line of two-stage, all-electric, linear stretch-blow molders for one to eight cavities and bottles from 100 ml to 10 L. They have preferential heating for odd shapes.

1Blow of France is offering several new features on its uniquely compact reheat stretch-blow machine. For one thing, it is now making functional use of an unusual feature of its system—holding onto the blown bottle before releasing it onto a conveyor. One example is a new leak-testing system that employs a high-voltage generator to detect microcracks in the base of carbonated soft-drink bottles. It's a non-contact method that involves no blowing of air into the bottle.

Also new is a flow-control valve for the preblow step that allows programming a profile of up to five different airflow rates as the stretch rod descends into the preform, before high-pressure blowing air is released. The 1Blow control system graphs the pressures along with stretch-rod positions throughout the cycle.

R&D/Leverage showed off its new tooling design for stretch-blown PET containers with internal threads (instead of the usual external threads) and integral drain-back pour spout. This one-piece design eliminates post-mold assembly with a separately molded pour spout of another resin, such as PP. If used, for example, for liquid detergents, the new system could help prevent messy drips. PT

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2019 RECYCLING & SCRAP RECLAIM

Machinery Technology Advances As 'Circular Economy' Takes Hold

The circular economy and recycling were the top themes at K 2019, and machine builders responded with new systems to improve equipment performance and material quality.

By Heather Caliendo
Senior Editor

October's K 2019 show in Düsseldorf, Germany, focused heavily on the role plastics will play in the "circular economy." Recycling is a critical component of realizing real gains in sustainability. Based on the new technology showcased at the giant triennial trade show, builders of recycling machinery are ready to answer the call.

Here are some of the latest developments displayed during the weeklong trade show not previously reported (check out September's Keeping Up section for more news on recycling and scrap-reclaim equipment at K 2019 from Amut, Erema, Gamma Meccanica, Herbold, Lindner, Tomra, and Weima).

Next Generation Recycling Machines (NGR) presented its new NXT:Gran series at K 2019. The company announced that this series will replace its S:Gran series (shredder-feeder-extruder combination) for processing plastic waste. The new design is said to provide up to 40% higher throughput rate, simplified control and operation, and updated safety feaures.

At K 2019, recycling machine builders focused on higher production outputs and answering the demand for high-quality recycled materials. Photo: Messe Düsseldorf.

NGR announced that the NXT:Gran will replace its S:Gran recycling machine series.

NGR says the NXT:Gran model builds on the S:Gran's ability to repelletize internal scrap for reuse in the primary production process. Also improved is overall maintenance accessibility. NXT:Gran still features the Start-Stop function, which readies the system for operation in only a few minutes and does not require any supervision when stopping.

At the NGR booth, visitors also could scope out NGR's Liquid State Polycondensation (LSP) technology. Using a gamepad, attendees were able to take a virtual walk through NGR's PET Test Center in Austria to experience the PET recycling process.

Using a gamepad, attendees were able to take a virtual walk through NGR's PET Test Center in Austria to experience the PET recycling process.

NGR also announced that its C:Gran series—a cutter-compactor-extruder combination—has been extended to machines for outputs of 4850 lb/hr and over. The system offers inline measurement of MFI, mechanical, and optical properties (color, polymer defects)—and even can identify the polymer itself—to give recyclers the ability to determine melt quality in-process and to initiate appropriate sorting measures or additive feeds immediately.

Ettlinger, a member of the Maag Group, unveiled the ERF 1000 high-performance melt filter for high throughputs in recycling of plastics, its largest model to date. Four filter drums provide a total of 6280 cm² of filtration surface—twice as much as the previous largest size, model ERF 500—to remove foreign particles from polymer feedstock containing up to 18% contaminants. Both machines share the same small footprint. ERF filters are now available in four sizes, from the ERF 200 for throughputs up to 1763 lb/hr to the new model for up to 22,046 lb/hr.

The ERF 1000 reportedly combines high productivity with ability to meet ever stricter quality requirements. The company says it is suited to virtually any kind of material, including packaging based on LDPE, LLDPE and HDPE. The large filtration surface, along with its 60 µ (230 mesh) screen size (which is now available for all Ettlinger filter models), enables quality that "was previously out of reach," the company said.

Like all Ettlinger ERF filters, the new ERF 1000 is self-cleaning and works with a rotating, perforated drum, through which melt flows continuously from the outside to the inside. A new feature is that the ERF 1000's four filter drums can be replaced individually without disrupting production.

SORTING TECHNOLOGY ADVANCES

STF Group of Germany launched two new products, the STF self-cleaning friction cleaner and the star screen. Both can be retrofitted to existing sorting and washing lines. The new self-cleaning friction washer features a counter-rotating screen basket. Reported advantages include the self-cleaning function and reduction of fines, which reportedly provide recyclers with a better yield and less screen wear, resulting in longer screen life.

The New STF star screen deck is a modular design of seven rotary shafts per module. These modules can be combined and extended, depending on the amount of material to be treated (tons/hr). The main application of star screening is to separate bottles and already loose labels efficiently after the label scraper. An additional air-suction and air-vacuum system can be added to the deck to increase separation efficiency. The company says the new design is more maintenance friendly; the shafts can be removed with two bolts per side. ►

Ettlinger's new ERF 1000 high-performance melt filter supplies high-quality recycled material.

Tomra's Innosort Flake sensor-based solution combines color and material sorting, reliably removing PVC, metals and opaque flakes.

Tomra Sorting Recycling extended its line of high-precision flake-sorting offerings with the new Innosort Flake sensor-based system that combines color and material sorting, reliably removing PVC, metals and opaque flakes. The company touts it as an all-in-one PET sorting solution for plastic recovery facilities, which ensures constant and high-quality output as well as a high throughput.

The PET flake dual-sensor sorting solution is equipped with the unique combination of RGB cameras and ultra-high resolution NIR sensors to sort plastic particles from 2 to 12 mm by color and simultaneously by polymer types.

Innosort Flake also features Tomra's patented Flying Beam technology. High-speed, high-precision NIR sensors enable 2-mm polymer recognition, which is said to significantly reduce loss of valuable PET flake material, with final losses averaging below 2%. The sensor detects a broad range of polymers, so that contaminants such as PVC, PE, PP, nylon, and POM (acetal) are eliminated, resulting in higher-quality yields.

Sesotec GmbH showcased metal detectors from its GF, Protector and Rapid Pro Sense 6 series at K 2019. The detectors can be used in a variety of material infeed applications and ensure high availability for processing machinery and equipment by preventing unscheduled machine downtime due to metal particles, and avoiding the repair costs associated with breaks in production and potential recalls.

Hellweg's new MDSi digital Smart Control system on the MDS 150 granulator.

The Rapid Pro Sense 6 metal detector, which was unveiled at K 2019, has a newly-developed reject mechanism designed for compound manufacturers that have frequent color changes or process abrasive materials.

Low speed granulation with Rapid's "Open Hearted" design provides maintenance access in less than 30 sec.

NEW INNOVATIONS IN GRANULATORS

At K 2019, Hellweg Maschinenbau of Germany showcased its granulators with its new digital Smart Control system. This enables networked communication of the machines with upstream and downstream components, as well as with operators, in line with Industry 4.0 principles. The new system measures and stores power consumption as well as (for example) rotational speed and bearing temperatures and monitors the service life of bearings, blades, screens and the wedge-profile drive belts (V-belts). This new Smart Control system is available for all Hellweg granulators from the 150 series upwards.

The new "boost operation" option enables a short-term increase in grinding performance, in order to compensate for production-related fluctuations. In addition, speed ranges have been defined for various plastics, thanks to which, low melt-temperature granulation, for example, can be performed continuously without problems, so that water cooling is not required.

Rapid Granulator unveiled what it calls "the biggest innovation in low-speed granulation in years." The new OneCut Pro gives injection molders the flexibility to adjust the speed range when granulating at low speeds—from the standard 25 rpm to a range of 15-35 rpm.

New sensor-based system combines color and material sorting, reliably removing PVC, metals and opaque flakes.

Running the new machine at the low end of the speed range helps improve the quality of reground highly brittle materials by minimizing dust generation, Rapid says. Reducing rotation speeds from 25 rpm to 15 rpm also reduces noise levels as much as by 3-5 dBa. Meanwhile, the ability to run the machine at higher speeds allows molders to increase capacity by 30-40%. The torque level is maintained regardless of speed, states Rapid.

Additional benefits of the new machine include the operator-friendly "Open Hearted" design. The OneCut Pro also uses a new system that reportedly can cut energy usage by 80%. Operators can stop the machine when accumulating materials, rather than having it run continuously. PT

QUESTIONS ABOUT RECYCLING AT K 2019

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PT Keeping Up With Technology

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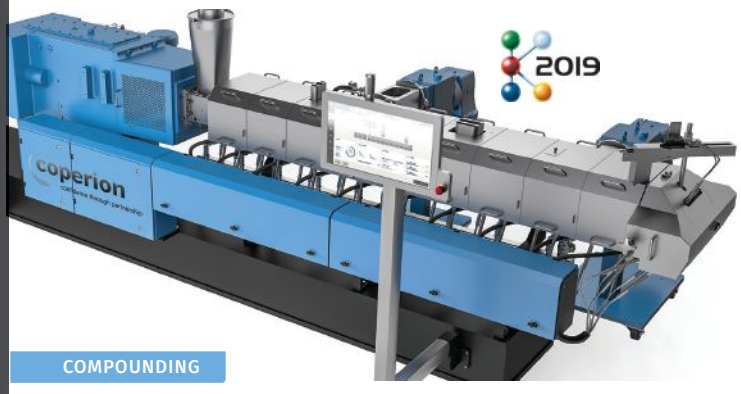


COMPOUNDING

More Digital Solutions Come to Compounding

Coperion presented digital concepts and applications for networked plastics production at K 2019. First was a uniform graphical user interface (GUI) that can display Industry 4.0 functionalities and is being gradually implemented into all Coperion extruders, compounding machines, and material-handling systems for compounding. The new GUI design creates a uniform look and feel across the various equipment families and provides an improved operator and user experience. Essential data on speed, throughput, melt temperature, head pressure, specific energy input or "next tasks" can be identified at a glance.

Second was a new intelligent support program (Smart Machine Features) that includes diagnostic and monitoring functions to increase productivity and machine availability. They were displayed at the show on iPads in an application similar to an app; in the future, they will then be integrated into the GUI. Smart Machine Features enable the integration of intelligent functions—for example, recommendations on responses to alarms.

These display the most probable causes and corresponding solution approaches for rectifying errors. Implementation of predictive maintenance based on diagnostic data will be possible with these new functions, which display maintenance intervals, such as for changing wear parts or for utilities. The required parts can then be obtained using the C-Beyond 4.0 online platform. Operation-critical maintenance is displayed as a notification as well as in the overview list in the controls. Coperion's service department can be notified of pending maintenance via a Coperion ServiceBox built into the extruders and can work with the customer to create an optimized maintenance plan.

Thirdly, Coperion showed its C-Beyond 4.0 app, which makes various applications available for customer use: an overview of the installed machine components with relevant documentation; intelligent spare-parts lists with an ordering function; and analysis of overall equipment effectiveness. With this app, Coperion puts important production data from the entire line at managers' disposal within a "cockpit."

Coperion is implementing the OPC 40084 open interface, built on OPC UA, into its machines, enabling seamless use in heterogeneous, networked production environments.

COMPOUNDING

Revamped Line of Compounding Twin Screws

During October's K 2019 show in Düsseldorf, Leistritz Extrusion showed its redesigned series of ZSE iMAXX twin-screw corotating extruders for compounding. They come in screw diameters of 18 to 60 mm. The exterior of the extruders features a continuous closed cover, including the processing unit and side feeders. This makes the machine contamination-free and easy to clean, says Leistritz. This is particularly beneficial for masterbatch production with frequent product changes.

Other highlights include integration of the temperature control unit in the machine frame. Replaceable components are positioned for optimum accessibility. The die head has only two screw connections and can be opened easily and safely in a few simple steps. Quick cleaning during color change is ensured by the removable screen and die.

For increased energy efficiency, the ZSE iMAXX extruder uses a synchronous motor and can be completely insulated to reduce heat losses.

Torque measurement is an option for 35-mm and larger models. The closed dual-circuit temperature-control system, which is installed in the base frame together with the coax valves, reportedly reduces water consumption. A resin cartridge, installed as standard, treats process water to minimize calcification and contamination.

MATERIALS

High-Temperature Nylon 66 for Blow Molded Auto Parts

Two new glass-reinforced, heat-stabilized nylon 66 grades have been introduced for blow molding hot charge-air automotive ducts by DSM Engineering Plastics. Akulon Diablo PA66 GF25 and GF20 grades are both said to maintain tensile strength in heat-aging tests exceeding 392 F/200 C for 3000 hr. High initial and retained strength reportedly allows for thinner walls, which can reduce total system mass by up to 40%

INJECTION MOLDING

New Electric Presses Are Industry 4.0-Ready

At K 2019, Nissei Plastic Industrial Co. of Japan previewed its NEX-V Series of all-electric injection machines for the global market (see show report in this issue). The model at the show was 280 metric tons, but it will be available—starting this spring—in 30 to 360 m.t.

It's said to have one of the widest platens and longest daylights in the industry while maintaining the industry's smallest footprint. The main new feature is the TACT5 controller, designed to be Industry 4.0-ready with OPC-UA communication protocol standard and Euromap 77 and 82 capabilities available, respectively, for integration with MES systems and with mold-temperature-control systems and hot runners. The controller has a 15-in. screen with top and bottom dual windows. Nissei says this is also is one of the first machines to conform to the upcoming ISO20430 Universal Injection Molding Machine Safety Standard.

INJECTION MOLDING

Artificial Intelligence Predicts Part Quality

The K 2019 show made clear that artificial intelligence (AI) is the leading edge of innovations to create smarter machines and production systems (see show report in this issue). Kistler Instrument revealed it is using AI to predict part quality based on process data. Kistler's newly commercial ComoNeo Predict software (pictured) is powered by STASA QC, developed by Steinbeis Angewandte Systemanalyse GmbH (Steinbeis Applied System Analysis) in Germany. STASA QC uses machine learning to predict quality data such as part dimensions (or strength) based on the cavity-pressure curve derived from in-mold sensors. The result is automated QC without time-consuming metrology tests.

The STASA QC software is "trained" by means of DOE configured by the software and executed automatically on an injection machine. The DOE involves five to seven repetitions of variations of three parameters—hold pressure, hold time, and temperature—in three steps each. The trial parts are measured and the data entered into STASA QC. The software then determines the influence of each parameter on part quality. (Cycle time can also be included in the optimization.) The result is a "systematic process setup" in which the user enters the upper and lower quality limits for the part, and the software determines how to optimize settings to achieve the desired quality. In production, ComoNeo Predict can be used to make accept/reject quality decisions on each cycle based on the cavity-pressure data.

At the K show, Sumitomo (SHI) Demag said it is experimenting with STASA QC, which it interfaced with its NC5 machine controls.

BLOW MOLDING

Digital Inkjet Printing onto PET Bottles

Digital inkjet printing directly onto PET bottles—in place of labels—made a vivid appearance at K 2019 in Düsseldorf in October (see show report in this issue). Krones showed printing of sophisticated graphics on PET bottles, followed by UV curing (below, left). Atmospheric plasma pretreatment prepares the bottles for printing. Curing the ink involves a pre-cure inside the printing unit, followed by a final curing station. Called DecoType Lab, this printing technology comes from Dekron GmbH, a new Krones subsidiary.

A second example at the show was 1Blow of France. Despite the unusual compactness of its two-stage (reheat) stretch-blow machine, there is room to perform inkjet printing inside the machine. An example (above, right) is a PET honey bottle shaped like a bear, with inkjet-printed eyes and nose.

Volume Resin Prices Flat or Down

Feedstock costs are lower, supply is outpacing demand, and overall global demand has slowed.

By Lilli Manolis Sherman
Senior Editor

Prices of nearly all volume resins were largely expected to bottom out by the end of 2019, and flat pricing was generally projected for the start of this new decade. Factors driving the downward trajectory included lower feedstock prices, supply outpacing demand, and an overall global demand slowdown and lower global prices.

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

Market Prices Effective Mid-December 2019

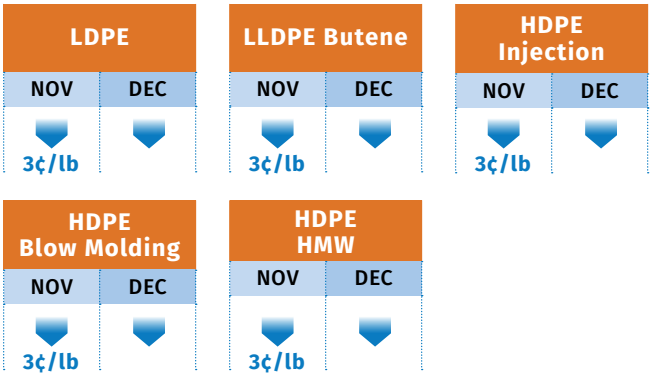
Resin Grade	¢/lb
POLYETHYLENE (railcar)	
LDPE, LINER	92-94
LLDPE BUTENE, FILM	75-77
NYMEX 'FINANCIAL' FUTURES	28
DECEMBER	28
HDPE, G-P INJECTION	97-99
HDPE, BLOW MOLDING	90-92
NYMEX 'FINANCIAL' FUTURES	29
DECEMBER	29
HDPE, HMW FILM	104-106
POLYPROPYLENE (railcar)	
G-P HOMOPOLYMER, INJECTION	63.5-65.5
NYMEX 'FINANCIAL' FUTURES	38
JUNE	38
IMPACT COPOLYMER	65.5-67.5
POLYSTYRENE (railcar)	
G-P CRYSTAL	105-107
HIPS	109-111
PVC RESIN (railcar)	
G-P HOMOPOLYMER	81-83
PIPE GRADE	80-82
PET (truckload)	
U.S. BOTTLE GRADE	45-50

PE PRICES DOWN

Polyethylene prices dropped 3¢/lb in November and there was potential for another price drop in December, according to Mike Burns, RTi's v.p. of PE markets, as well as *PCW* senior editor David Barry and The Plastic Exchange's Greenberg. These forecasts appear to brush off suppliers' announced 4¢/lb increase for December (delayed from November); meanwhile, Dow announced a new 5¢/lb hike for Jan. 1. Said Burns, "The historical first-quarter upward pricing pressure may be challenged this year due to overcapacity and lower global prices that domestic suppliers need to keep matching in order to export."

These sources saw PE prices bottoming out in December. *PCW*'s Barry noted that weather-related issues may offer suppliers a slim chance to push through some or all of their fourth-quarter 4¢ price hike. They noted that material was being offered on the spot market at significant discounts, but conceded that U.S.-Canadian PE operating rates had dropped to around 85% , which could have some effect on resin availability.

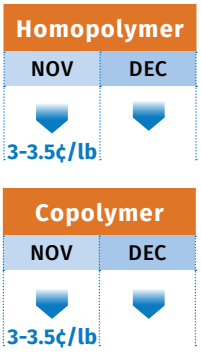
Polyethylene Price Trends



PP PRICES DROP

Polypropylene prices dropped 2.5¢/lb in November in step with propylene monomer, which dropped to 35¢/lb. However, both Scott Newell, RTi's v.p. of PP markets, and *PCW*'s Barry noted that additional price concessions on the order of 0.5-1.5¢/lb were granted that month. Another 1-2¢/lb decrease for December was projected for the monomer, potentially leading to an additional 1¢ decrease for PP. While these sources ventured that PP demand might continue to "struggle" in this first quarter, they expected prices to be flat.

Polypropylene Price Trends



The Plastic Exchange's Greenberg observed healthy spot buying activity in PP in early December, but the flow of offers diminished as spot prices slid by 3¢/lb. Meanwhile, plant production rates were cut back in the fourth quarter and production slated to come on stream from two new facilities was pushed back to sometime this quarter. Greenberg reported that propylene monomer inventories are high and supplies are likely to remain ample.

PS PRICES DROP

Polystyrene prices dropped 3¢/lb in November, in step with that month's benzene contract settlement of $2.23/gal, down from October's $2.60/gal, which had been the lowest of 2019, according to both Robin Chesshier, RTi's v.p. of PE, PS and nylon 6 markets, and *PCW*'s Barry. They anticipated the November drop and saw potential for another 2¢/lb decline in December.

Chesshier noted that December benzene contract prices looked likely to remain flat and PS suppliers would aim to hold onto their margins. Barry cited industry data through October that showed domestic demand down by over 5%.

Polystyrene Price Trends

GPPS	
NOV	DEC
↓ 3¢/lb	↓

HIPS	
NOV	DEC
↓ 3¢/lb	↓

PVC PRICES FLAT TO DOWN

PVC prices held even in October and were projected to drop 1¢/lb in November and possibly again last month, noted both Mark Kallman, RTi's v.p. of PVC and engineering resins, and *PCW* senior editor Donna Todd. Todd noted that the suppliers' October 3¢ price hike was the first time in 2019 that suppliers "failed utterly to enact a price hike."

Prices last year rose 2¢/lb in June, then dropped 1¢/lb in August, leaving suppliers with a net gain of 1¢/lb, though the projected drop in November and/or December would take pricing to flat or down for 2019. Todd reported that at least one supplier threatened to announce a "big" price increase for Jan. 1, even while a drop was being predicted for November and December. Kallman thought pricing would be at a standstill going into this year, due to potential for lower ethylene prices and new PVC capacity from Westlake Chemicals.

PVC Price Trends

Pipe	
NOV	DEC
↓ 1¢/lb	◀▶

Gen. Purpose	
NOV	DEC
↓ 1¢/lb	◀▶

PET PRICES FLAT OR SOFT

PET prices were steady at 45-50¢/lb as December rolled in and were expected to stay at that level through the holidays, with very little spot-market activity, according to *PCW* senior editor Xavier Cronin. He characterized demand as weak and supply as abundant.

Railcar business for first-quarter 2020 was booked at the low end of the December price range. Meanwhile, imported PET was down to the low 40¢/lb range for supersacks delivered to Southern California. Vietnam emerged in 2019 as the third top source of U.S. PET imports, after Mexico and Canada. Cronin ventured that PET prices this month could tumble a few cents as demand for single-use PET bottles and containers is typically weak during the cold-weather months.

PET Price Trends

Bottle Grade	
NOV	DEC
↓ 1-2¢/lb	↓

ABS PRICES FLAT

ABS prices were flat in the fourth quarter, as in most of the previous two quarters, and were expected to continue as such entering 2020, according to RTi's Kallman. He noted that pricing is already in a "good place," with fairly tepid demand and a well-supplied market, including a healthy dose of imports. One caveat noted is the potential impact on butadiene prices following the explosion of the TPC Group's plant at Port Neches, Texas, on Nov. 27. It has a significant yearly production of nearly 370 million lb/yr. Butadiene prices reportedly had already moved up 2-3¢/lb by December, though styrene monomer prices were dropping.

PC PRICES FLAT TO DOWN

Polycarbonate prices were flat to modestly lower (by less than 5¢/lb) through the fourth quarter after some erosion in the third. RTi's Kallman predicted that prices would drop going into the first quarter, as costs of key feedstocks were expected to be lower going into 2020. Meanwhile, there were ample domestic supply and well-priced imports, and lower global demand.

NYLON 6 DOWN; NYLON 66 FLAT TO LOWER

Nylon 6 prices in the fourth quarter were weaker than in the previous two quarters, with price concessions from suppliers aiming to maintain or gain market share, according to RTi's Chesshier. Automotive demand is waning due to the move toward electric or hybrid vehicles, which is making nylon 6 easy to replace with materials such as PP where heat resistance is not required. Chesshier ventured that nylon 6 prices had further potential to drop this month, noting that demand is lower across key markets, and there is new global supply of both caprolactam and nylon 6 coming on stream. Nylon 6 imports are down as domestic supplies have kept prices in check.

Nylon 66 prices were flat to modestly down (under 5¢/lb) through the fourth quarter, but RTi's Kallman foresaw a downward trajectory going into the first quarter. He said demand would be challenged going into 2020, but not as much as in 2019. The slowdown in automotive appeared to have moderated in the third quarter: U.S. car sales were down 1%, Europe down 0.7% and China down 9.4%. (That was a big improvement over the first half of 2019: U.S. down 2%, Europe down 3.1%, and China down 12.4%.) PT

Index Dips as New Orders, Production Slow

November's dip continues a three-month contraction in business activity.

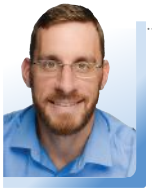
Gardner's Plastics Processing Index dipped marginally in November to 46.4 as new orders and production activity each contracted. (Index readings above 50 indicate expanding activity while values below 50 indicate contracting activity. The farther away a reading is from 50, the greater the change in activity compared with the prior month.) Supplier deliveries also contracted.

By Michael Guckes
Chief Economist/Director of Analytics

During most of the current calendar year, these components have played an important role in supporting the Plastics Index. Having lost most of that support in recent months, the Index has been trending farther below a "no-change" reading of 50, representing a decline in business activity since August.

Particularly severe contractions in backlogs and exports throughout 2019 worsened the fall Index readings relative to all other components. Similar to the overall Plastics Index, the Custom Processors Index fell as a result of both production and new orders transitioning from expansion to contraction.

The Index is based on surveys conducted each month of subscribers to *Plastics Technology* Magazine.



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

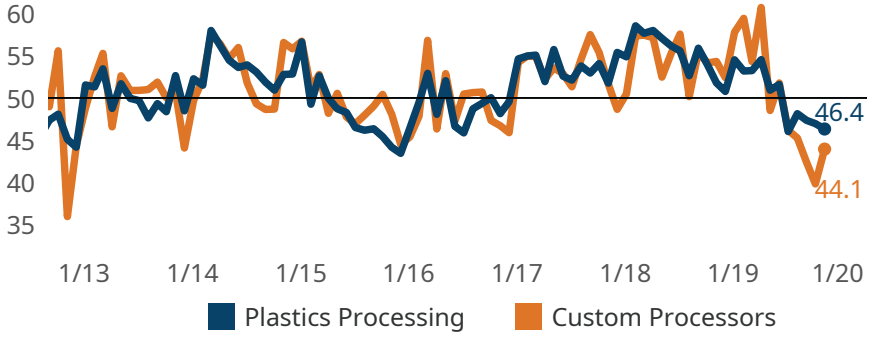


FIG 1

Plastics business activity worsened in November, with all index components reporting contracting activity for the first time since late 2011.

Plastics Processing: Production & New Orders

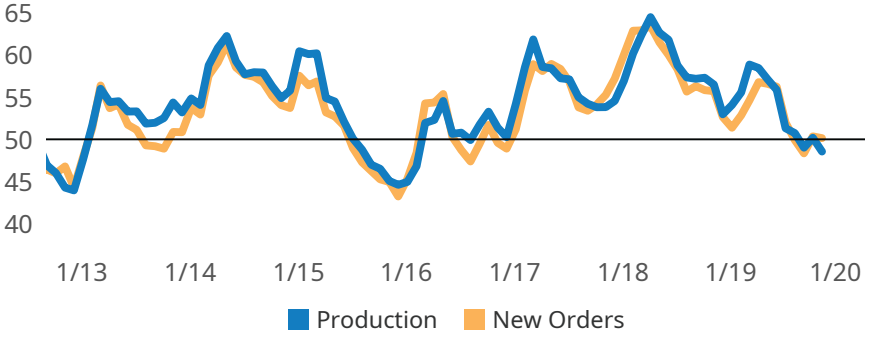


FIG 2

Erosion in production and new orders during the third quarter of 2019 has left the Plastics Index without two of its critical supports. The result has been a three-month accelerating contraction in the Plastics Index.

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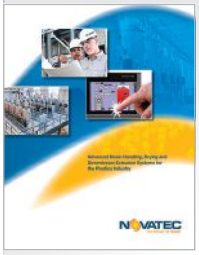

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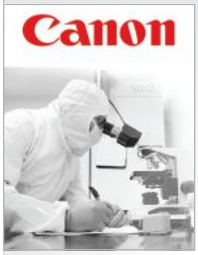

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PEAK PERFORMANCE COMPOUNDING — LEOMINSTER, MASS.

Start-Up Compounder Seeks Niche in Short Orders, Quick Turns

Peak sets its sights on high-performance industrial and medical markets.

By Jim Callari
Editorial Director

Backed with a combined 100 years of industry experience, a new compounding business has set up shop in Leominster, Mass., dubbed the "pioneer city" of the U.S. plastics industry. Peak Performance Compounding Inc., started pumping pellets in September 2019 as a service-based company undaunted by requests to run engineering resins at small volumes.

"We've been thinking about this type of business for over two-and-a-half years," says Todd Marchand, Peak president. "We feel there is a major need in the market for a customer-driven compounding business that can fill orders ranging from 50 lb to a truckload at fast turnarounds." Peak runs a wide range of materials, offering pre-colored high-quality, specialty and unique engineered products to industrial and medical markets.

The start-up compounder is owned by Marchand along with Robert Tocci Jr., Michael Carota and Jonas Angus. Tocci and Carota also own and run Aaron Industries Corp., also in Leominster.

Start-up Peak Performance Compounding operates from a plant in Leominster, focusing on running a wide range of materials for industrial and medical markets at order sizes down to 50 lb.

Aaron is more focused on the high-volume commodity-materials side of the business, while Peak's focus is on more customized runs at smaller volumes. Notes Marchand, "There is common ownership, but the businesses are run separately."

Peak currently has eight employees, operating from 10,000 ft^2 of manufacturing space and additional space for warehousing, with room for growth. It currently runs new 75- and 52-mm twin-screw corotating compounding extruders purchased from an undisclosed supplier. On order are 35- and 22-mm twins. Peak's service portfolio includes custom formulating, custom coloring, toll processing with customer-specified ingredients, and applications requiring use of radiopaque additives. Marchand says the business will serve customers nationally through direct sales and distribution agreements.

> ***"There is a major need in the market for a customer-driven compounding business that can fill orders ranging from 50 lb to a truckload at fast turnarounds."***

In addition to twin-screw compounding, Peak also offers pellet or dry powder blending, pellet pulverizing, and material testing. Peak is working towards making its production area humidity and temperature-controlled in Leominster. Peak has started the process of ISO 13485/9001:2015 certification, which is expected to be in place by the first quarter of this year. Marchand says that will enable Peak to penetrate deeper into medical compounding markets.

BEST-IN-CLASS SERVICE

Comments Marchand, "Peak believes in treating customers with integrity and best-in-class service; prioritized with reasonable lead time and uncompromised quality. Fast turnaround of samples and no minimum order size is our mantra. We view our relationship with our customers as a partnership; our partners know we care about their products and businesses as if they were our own."

By sheer coincidence, shortly before Peak opened its doors, LyondellBasell announced plans to shutter the former A. Schulman compounding plant in nearby Worcester, Mass. PT

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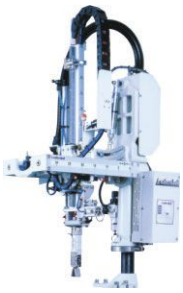

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Don't just take our word for it

Left to right: Travis Smith, Molding Process Manager ; John Avery, Senior Product & Manufacturing Engineer ; JP Magat, Product & Manufacturing Engineer

"WITTMANN 4.0 has helped to increase productivity with seamless robot and auxiliary integration all controlled through the injection molding machine control. The improved connectivity of equipment, superior human interfacing and strong data acquisition are just some of the many benefits.
Having full network capability improves data acquisition and archiving manufacturing and quality data. The web connectivity allows improved molding machine service and support via remote access. It also enables us to monitor our machines from anywhere using the WIBA app. You can even run a web cam on the machine to visually monitor unattended molding. These are just a few of the many benefits resulting from Stenner Pump Company's use of WITTMANN 4.0."

– John Avery, Senior Product & Manufacturing Engineer,
Stenner Pump Company

STENNER PUMPS

wittmann 4.0
plug & produce

Nobody can do it like we can!

- Integration is seamless - since we **manufacture all the equipment**, the challenge of combining miscellaneous and wide varying data protocols is not an issue!
- **One and Done!** Injection molding machine is the central interaction point for all connected auxiliaries
- Windows based for more **flexible integration**
- **Global exchange of information**

Call us today for your 4.0 consultation!

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WITTMANN BATTENFELD, INC.
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