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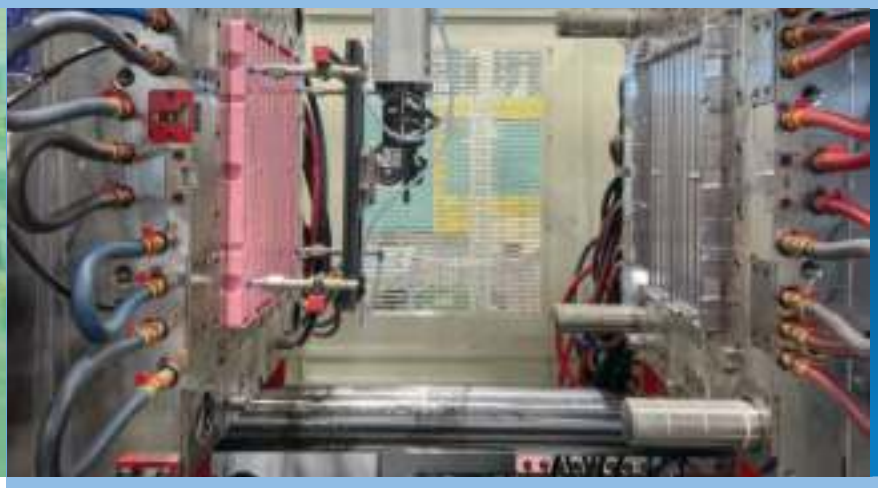

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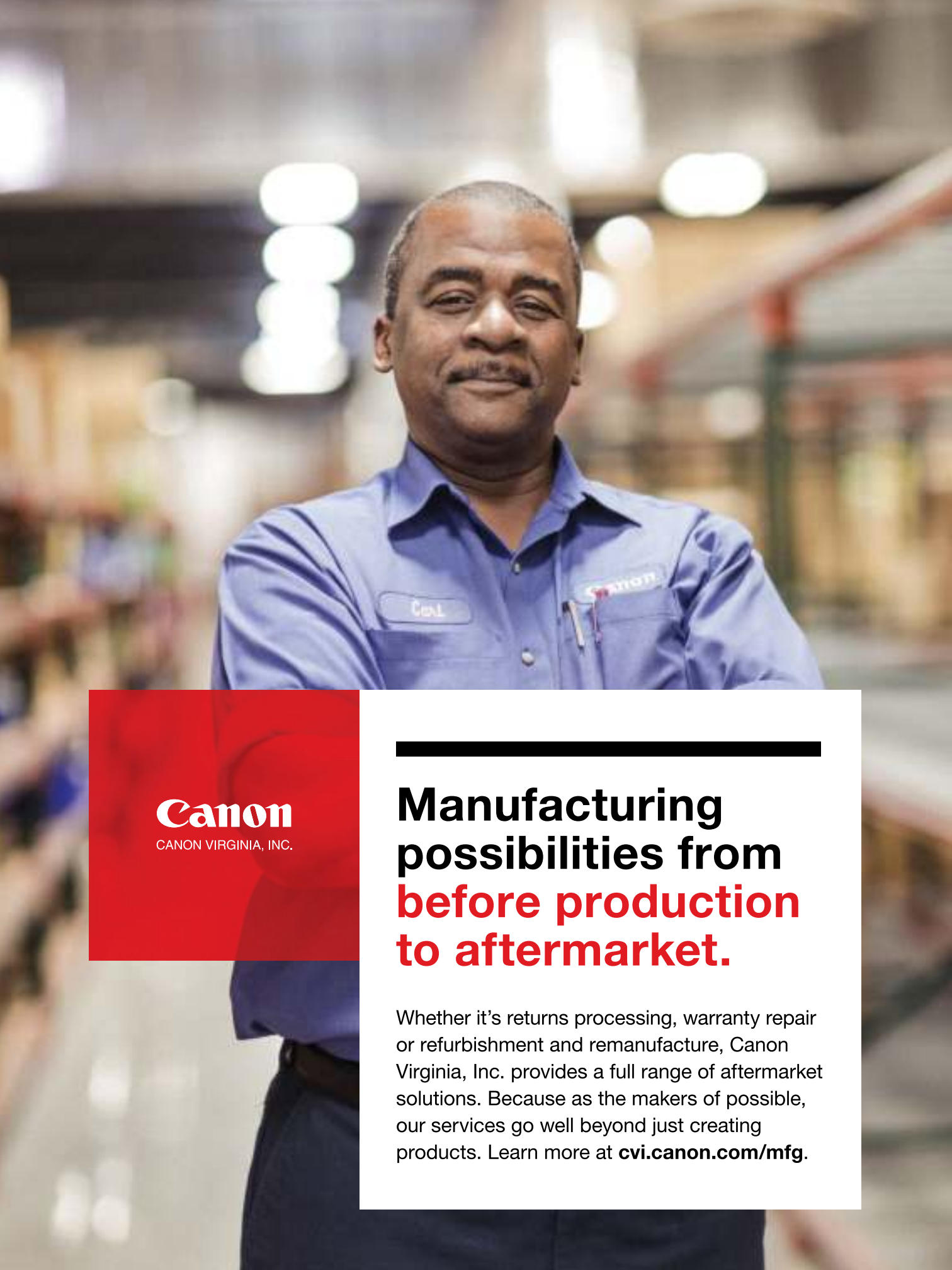

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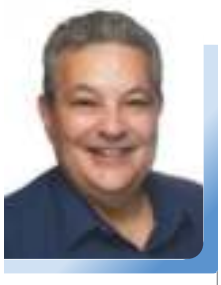
Revisited: A Processor's Checklist for When Business Is Slow

Business slowdowns may provide you with more time for introspection. If you want to take a deeper dive into your operation, here are some things to consider.



Jim Callari
Editorial Director

In this space in June, I ventured that because business had slowed, processors could use the extra time to dig deep into their operation and reevaluate what they can do to improve it. My point was that when business is running on all cylinders, many manufacturers tend to rightfully focus on getting quality product out the door to their customers on time, and push aside bigger-picture items.

So back in June, I talked about things such as reengaging with the outside world, revisiting your strategic plan, investigating new technologies, investigating training and do some housekeeping for such times. Since then, I have visited a few processing plants and talked to numerous others, and thought I'd add to that list:

Develop a Sustainability Plan: Disabuse yourself of the notion that the only processing companies that need to worry about sustainability are those that make products for the single-serve packaging market. Brand owners/OEMs and big-box retailers are looking to do business with companies across the supply chain that are

Photo Credit: Getty Images

committed to sustainability … not just through words but actions. We report on one such company in this month's Processor's Edge article on p. 48. In the months ahead, we'll continue to shine a light on companies that have put sustainability plans in action.

I for one was surprised to learn from my various contacts how many processors are still selling production scrap to recyclers rather than reutilizing it themselves. I recognize that for some applications reintroducing scrap to the process is either impractical or impermissible. But if it's neither of those, that might be a place to start a sustainability initiative.

Simplify: This piece of unsolicited advice applies primarily to flexible film and sheet producers. One thing I have noticed over the past few years — mostly from press materials I receive regularly from suppliers — is the move away from complicated, multimaterial structures that are not recycling friendly to single-material solutions, usually based on PE. Is your product overengineered for the application? Are you making it in the same way you have been for the last 20 years because, well, you're still using the same equipment you had 20 years ago? Have you looked into technologies like orientation to perhaps give you a wee bit more barrier? When was the last time you sat down with your material supplier to investigate whether you can fortify your base material with additives that can perhaps approximate the properties of your structure without adding complexity?

Think Like a Realtor: You know what that say about real estate: the three most important things about it are location, location and location. In processing, it's automate, automate, automate. Many molders have not embraced even robot technology to the extent they should have. Many are still of the mindset that they are "too small" to appreciate its value. Maybe that mindset needs to be changed. My advice is to bring in an automation specialist to your plant — either a supplier or a consultant — and have him or her evaluate what steps in your process are ripe for automation.

And this advice isn't just for molders … and "automation" isn't just about robots. In all processing, time is money, and anything that can facilitate product changeovers should be explored. You might be surprised at the payback.

Investigate Big Data: There have been a number of obstacles that have stood in the way of widespread acceptance of Industry 4.0. Network security has been one. One molder I have a tremendous amount of respect for had a more practical concern, telling me, "All this data is great, but someone needs to tell me how it's going to make me more money." I'd say start slow and see how it unfolds. PT

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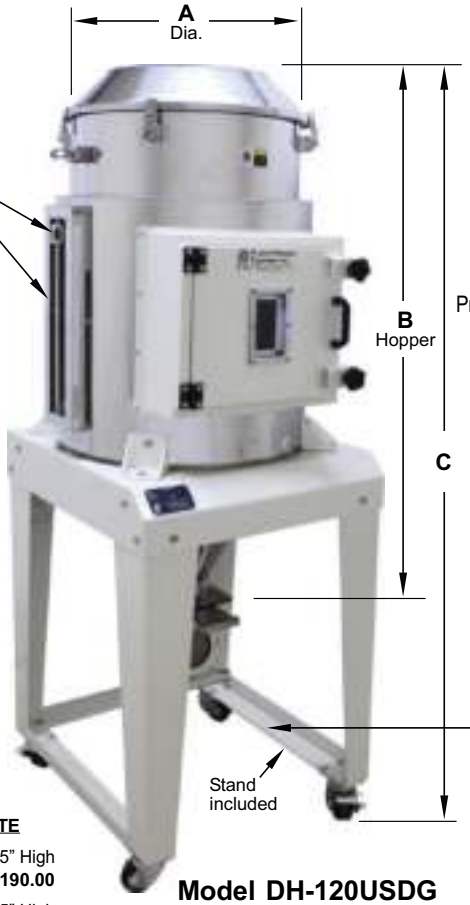

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TC Transcontinental Installs 'First Ever' BOPE Line in North America

TC Transcontinental Packaging will be installing what it says is the first-ever biaxially oriented PE (BOPE) line in North America. Scheduled to be commissioned in the spring of 2024 at the company's Spartanburg, South Carolina, plant, the new line is part of a $60-million investment that expanded the facility by 120,000 ft^2. Supplied by Brueckner, the line will enable TC Transcontinental to expand its offerings of sustainable packaging. The flexible packaging firm's vieVERTe product line, for example, includes structures that are recyclable, compostable and made from PCR content.

Rendering of BOPE line to be operational next year at TC Transcontinental. Image: Breuckner/TC Transcontinental

Says Thomas Morin, president and CEO of TC Transcontinental, "This new offering will be a game changer in TC Transcontinental's recyclability journey, demonstrating our commitment to distinguish ourselves and gain market share with innovative, sustainable solutions for our customers. Our offering aligns with our customers' desire to accelerate speed to market with recyclable products that also protect and preserve customers' content throughout the life cycle of their products in addition to creating a more circular economy for plastic."

Adds Alex Hayden, TC Transcontinental's senior vice president, R&D, Innovation, Sustainability and ESG, "Our investment in BOPE is a strategic decision that positions us to address sustainability shortcomings in existing offerings. This new equipment will advance the commercialization of recyclable film solutions to meet the challenging requirements of our different applications without sacrificing fill speed or performance."

Italian Packaging Company Will Use Recycled PET From Food Trays to Produce New Film

AMB Spa, a packaging producer based in Italy, will use PET flakes from Indorama's PET tray recycling operations in its food-grade packaging film. The partnership between AMB and Indorama is aimed at diverting 150 million lbs of post-consumer trays from landfill or incineration by the end of 2025.

Indorama produces flakes from post-consumer PET trays at its facility in Verdun, France. In 2022, the European Food Safety Authority assessed Indorama's process, based on NGR technology, and reported that the recycling process, which includes melt-state polycondensation, is able to ensure low levels of migration of potential unknown contaminants.

The panel concluded that recycled PET from the process was not a safety concern and could be used at up to 100% for the manufacture of materials for food contact.

The European Union has set a target to have all packaging recyclable by 2030, and recyclable at scale by 2035.

Neste to Develop PET Bottles Using Renewable and Recycled Material

Neste will soon be using PET bottles based on material from its own biobased feedstock as part of a collaboration between it and three other companies.

The agreement between Neste, ENEOS, Suntory and Mitsubishi works this way: ENEOS will use bio-intermediates based on Neste RE to produce bio-PX (bio-paraxylene) in Japan.

Neste's RE is made 100% from bio-based raw materials such as waste and residues — used cooking oil, for example — to replace fossil feedstock in the value chain.

This bio-PX will then be converted to PTA (purified terephthalic acid) and subsequently to PET resin, which Japanese beverage company Suntory will utilize to produce bottles beginning in 2024.

Mitsubishi will be coordinating the collaboration between the value chain partners.

"Through partnering along the value chain, Neste can contribute to reducing the polymers and chemicals industry's dependence on fossil resources as well as to manufacturing of products that have a lower carbon footprint," says Lilyana Budyanto, head of sustainable partnerships APAC at Neste Renewable Polymers and Chemicals business unit.

A mass balancing approach will be applied to allocate the bio-based materials to the PET bottles.

JV in Thailand Will Produce PE From Ethanol

Biopolymer producer Braskem and SCG Chemicals have signed a joint venture agreement to produce bio-ethylene from bio-ethanol dehydration, and to commercialize Braskem's "I'm green" bio-based PE.

The EtE evergreen technology resulted from a development and licensing partnership between Braskem and Lummus Technology. The bio-based PE "I'm green" polymer is made from ethanol from agricultural sources instead of traditional naphtha. The resulting material can be used in a variety of consumer products and is suitable for recycling as ordinary PE.

The project will be located in Map Ta Phut, Rayong, Thailand. Braskem is contributing its production technology and branding, while SCGC is providing expertise in PE grades and market reach in Southeast Asia.

Seaweed-Based Biomaterial Can Run on Existing Machines

Montachem International announced it will make a move into biomaterials by virtue of an agreement with Loliware, a California-based company that makes resins from seaweed that reportedly can be processed on existing processing machinery. The distribution agreement is expected to be finalized by the end of 2023.

Loliware's SEA Technology Resins are made completely from seaweed and other natural materials. They have reportedly been engineered to be processed on conventional injection molding, extrusion and thermoforming machines to ease the transition for processors more accustomed to running petroleum-based resins.

Victoria Piunova, chief technology officer at Loliware, says processors only need to make subtle changes — such as adjusting melt temperatures — to run the material on standard machines, though some postprocessing steps might be necessary in some applications.

Loliware's resins are already on the market in North America. Its extrusion formula is used to make drinking straws, and its injection molding formula is used to make utensils. The material is home-compostable. Testing indicates products manufactured from the resin will break down in around 51 days via aerobic degradation.

AIM Institute Adds Mold Maintenance Training Courses

The American Injection Molding (AIM) Institute — which already trains molders in materials, mold design, part design and simulation — will now offer mold maintenance education, following the acquisition of Moldtrax training courses and specialized equipment from Steve Johnson, Moldtrax owner and founder.

When Johnson decided to discontinue MoldTrax's in-person training to focus on the continued advancement of his MTWEB mold documentation/tracking software, he sought a buyer that would utilize his equipment and lesson plans to continue teaching these skills through hands-on mold maintenance training courses. This led him to AIM.

Johnson says he's watched AIM grow since its creation in 2015 and sees that evolution as creating a natural home for Moldtrax's in-person training. "It's going to be a perfect fit for the industry because (the AIM Institute) is going to be a one-stop shop. That's one of the goals I've always had since day one," Johnson says.

Beaumont Vice President Alex Beaumont told *Plastics Technology* that he also sees the addition of mold maintenance as getting AIM closer to a complete training resource for injection molding companies. "Adding mold maintenance helps complete that circle," Beaumont says. "Anything in injection molding you need education wise, there's a resource for you, whether it's a four-hour course, 10-month program up to two-year apprenticeship."

The acquired equipment includes four 3 × 12-ft steel die benches and a bridge crane for moving tools, as well as a Blue Wave Ultrasonic mold cleaner, Cold Jet dry ice blaster and an EcoPro 360 mold channel cleaning system. In addition, the course gives students hands-on access to a surface grinder, milling machine, lathe, Gesswein laser welder, and polishing and measuring equipment. Most recently, it was gifted some new molds for training purposes.

The AIM Institute said it will eventually create new courses to use with the acquired training molds that will cover a variety of maintenance topics, including mold and hot runner maintenance and repair, toolroom management, tooling components and texturing.

The AIM Institute is currently building a Mold Maintenance Center of Excellence at its facility in Erie, Pennsylvania, where the new courses will eventually be held. In the meantime, these courses will be held at the Ashland, Ohio, facility. MoldTrax will continue to operate and provide its software and support services.

Glenn Keith, formerly an instructor with Moldtrax who will move with the program to AIM, says the combination with AIM jibes with the founder's ultimate plan for the program. In that scenario, mold maintenance students would complete training to troubleshoot a problem, take corrective action with the tool and then test the mold in a machine to verify the maintenance and repairs were done correctly.

DuPont Sells Majority Share of Acetal Business to Private Equity

DuPont has reached a definitive agreement to sell an 80.1% ownership interest in its Delrin acetal homopolymer business to TJC LP (TJC) in a transaction valued at $1.8 billion.

TJC, a middle-market private equity firm, has received fully committed financing in connection with the transaction, which is expected to close around year-end 2023, subject to customary closing conditions and regulatory approval.

Early last year, Celanese Corp. signed a definitive agreement to acquire a majority of the Mobility & Materials (M&M) business of DuPont, which will be added to Celanese's Engineering Materials (EM) business.

"Today's announcement largely completes our planned exit of the former M&M segment, advancing our position as a premier multi-industrial company," says Ed Breen, DuPont executive chairman and CEO. "This transaction is structured to maximize value for our shareholders, providing significant cash proceeds at close to be deployed in line with our strategic priorities, while providing an opportunity for DuPont to participate in future upside potential upon exit of our retained equity interest in the Delrin business."

Notes Ian Arons, a TJC partner, "Delrin is widely recognized as the material of choice for safety critical and high cost-of-failure applications across diverse end markets... (providing) its customers high quality, innovative solutions."

'Contactless' Accumulator Is Gentle to Superthin PET Bottles

Suntory Japan's newest bottling facility, Shinano-no-mori Plant, is the production home for Tennensui mineral water, packaged in one of the lightest PET bottles in Japan. The bottles' thinness increases quality risks during production, such as dents caused by contact between the filled bottles or bottles falling over.

For this brand-new plant, Suntory was seeking a product-handling solution for the filled water bottles that would prevent both sorts of damage and thus maximize both quality and productivity. Suntory settled on Sidel's Gebo AQFlex compact, all-in-one conveying and accumulating system for its gentle, "100% contactless" and single-lane container handling. Although the system is not brand new (it was introduced in 2017), this is one of its most challenging applications due to the extreme thinness of the PET bottles.

The Gebo AQFlex system had already proved itself at Suntory France. The system is notable for its flexibility, suited for output from 1,000 to 100,000 bottles/hr. It operates automatically at more than 99.5% efficiency, whatever the speed, according to Sidel. The Shinano-no-mori Plant bottles Tennensui mineral water in 550-ml and 2L bottles, but the system can easily handle additional formats, Sidel says. Changeover is done automatically.

The installation started during the pandemic, limiting the ability of Gebo AQFlex experts to visit. However, they supported local Sidel technicians and Suntory teams by means of a remote factory acceptance test using augmented reality glasses, and by providing 24/7 assistance during installation and commissioning. Once able, they visited the plant to fine-tune the machines and optimize efficiency.

As sole production site for Tennensui mineral water, the plant must run 24/7 and Sidel's remote support helped ensure the production line was never stopped.

Exxon to Produce Certain HDPE Molding Grades in Texas

To help mitigate potential delivery delays caused by harsh weather, injection molding grades of HDPE for pails and crates are now available from ExxonMobil via its plant in Beaumont, Texas.

"Previously, our injection molding HDPE grades were only available from the Sarnia, Canada, facility, but this could be an issue during harsh Canadian winters," says Dr. James Stern, HDPE business development manager, North America & EMEAF. "Introducing dual sourcing from Sarnia and Beaumont helps overcome any potential logistical issues that may arise from harsh Canadian winters or tropical storms affecting the Gulf of Mexico." Grades are functionally equivalent between facilities, so they are an easy drop-in product for customers, ExxonMobil says.

MATERIALS

PART 2

What's the Allowable Moisture Content in Nylons? It Depends

Operating within guidelines from material suppliers can produce levels of polymer degradation. Get around it with better control over either the temperature of the melt or the barrel residence time.

Last month, we covered the results of a study that examined the correlation between moisture content in a nylon raw material and the outcome of changes in average molecular weight. The results show that operating within guidelines published by the material suppliers can produce levels of polymer degradation that cause product failures.

By Mike Sepe

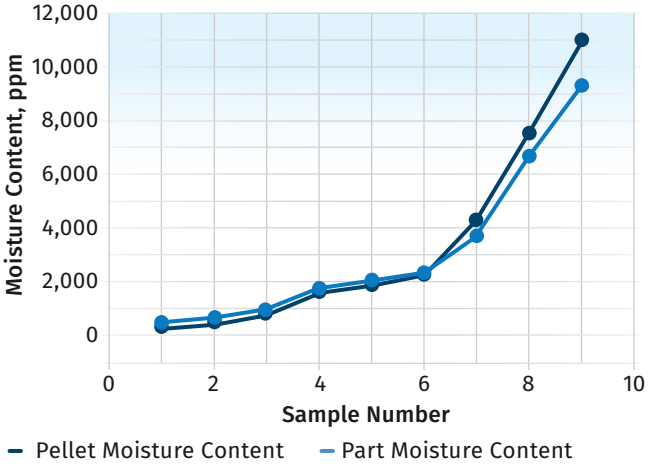
But there is a way out of this problem, and it involves exercising an improved level of control over either the temperature of the melt or the barrel residence time. This was done as part of this study and the results are revealing.

The evaluation of the parts molded at 570°F (299°C) — even with a moisture content of 0.114%, coupled with a residence time of seven minutes — showed an excessive reduction in average molecular weight as determined by intrinsic viscosity measurements. Good results were not obtained until the moisture content of the raw material was reduced to 0.06%. The concern here is that it may not be reasonable to reach these reduced moisture content levels on a consistent basis.

Using melt temperatures higher than necessary places greater stress on the integrity of the raw materials.

But a study was also conducted on the effects of moisture content in combination with lower melt temperatures and even an extended residence time. The melt temperature was reduced to 530°F (277°C) and at that reduced temperature parts were molded using the same 0.20% moisture content, which produced significant degradation at the higher melt temperature. At the lower melt temperature, the intrinsic viscosity tests showed less than a 2% reduction. Increasing the residence time from seven minutes to 10 minutes did not alter this outcome.

FIG 1 Moisture Content Change During Molding of Nylon 66



Where does the moisture in the nylon go during the molding process? As shown in this study, the answer is nowhere; it stays in the pellet.

THE PROBLEM WITH RUNNING TOO HOT

This study illustrates a common problem that exists in the world of processing, particularly injection molding: the use of melt temperatures that are higher than necessary and place greater stress on the integrity of the raw materials. The melting point of nylon 66 is 500°F (260°C). This raises the question regarding the selection of a melt temperature of 570°F (299°C). In this particular study, there was no need for this elevated temperature to facilitate mold filling. The plastic pressure required to fill the mold did increase by about 25%, but was still well below the maximum available pressure on the machine.

In addition, areas of the part that contained some tricky shutoffs were exhibiting some flash at the higher melt temperature and this disappeared when the melt temperature was reduced. And then, of

course, there are the economic considerations. Adding 40°F (22°C) of temperature to the melt requires additional energy. At the same time, it takes longer to cool the material to a temperature where it can be demolded, thus adding unnecessarily to the cycle time. So, there are multiple reasons for carefully selecting the melt temperature used to produce any part, and this is particularly important when processing materials that are susceptible to hydrolysis.

If molecular weight preservation in nylon is an interaction between moisture content, melt temperature and residence time, it is reasonable to inquire about material supplier recommendations for a maximum moisture content. The accepted value for unfilled nylon 66, for example, is 0.20% (2,000 ppm). How do we know this is the number? As it turns out, we have performed studies that confirm this number. These studies involve measuring the moisture content of the raw material as it enters the molding process and then measuring the moisture content of the corresponding molded parts.

There is a lot of mythology about what is happening in the barrel as the material melts and is conveyed forward to become the shot that produces the part. One myth is that some of the moisture in the pellets is removed from the system during melting and plastication, and exits through the feed throat. But, in a study that we conducted, it exposed that misconception.

We molded different samples of an unfilled nylon 66 at moisture contents ranging from a low value of 270 ppm (0.027%) to a high of slightly over 10,000 ppm (1%). Of the various samples, five moisture contents were below 2,000 ppm (0.20%), one was exactly at 2,000 ppm and three samples contained moisture content values above 2,000 ppm. The corresponding moisture content values for the parts molded from each of these samples were somewhat surprising. These results are shown in Figure 1.

Scan for more expert advice in materials.

Notice that for all the raw materials with moisture content values below 2,000 ppm the moisture content of the molded parts produced from those raw materials is nearly the same as that of the raw material. In fact, a close examination of the data points shows the moisture content in the molded parts is slightly higher than that of the associated raw material. This can be explained by the mechanism of solid-state polymerization which we referred to in the previous article.

Nylon, when exposed to elevated temperatures while in a very dry state, will build molecular weight. This reaction also produces a small amount of additional water as a ►

byproduct, and this additional water remains in the molded part. So, the idea that moisture is "squeezed out" of the pellets and exits through the feed throat is not supported by this data. In fact, the answer to the question, "Where does the moisture in the nylon go during the molding process?" is that it does not go anywhere. It stays in the material.

As the moisture content of the raw material samples increased toward 2,000 ppm, the difference between the moisture content of the raw material and the molded parts becomes progressively smaller, and at 2,000 ppm, there is no statistically significant difference between the moisture content of the pellets and the parts. However, notice that once the moisture content exceeds 2,000 ppm, the relationship between raw material and molded parts changes. Now the moisture content in the molded parts is less than that of the corresponding raw material, and the differential becomes greater as the moisture content of the raw material increases.

It is tempting to again invoke the notion of moisture exiting through the back end of the screw and out through the feed throat. But the other interpretation — which is supported by observations of reduction in the average molecular weight of the polymer — is that the moisture content in the parts is reduced because the excess moisture has been consumed by the chemical reaction that hydrolyzes the polymer. Molecular weight measurements for all the samples in this study confirmed that the average molecular weight remained satisfactory for all samples where the moisture content of the raw material was at or below 2,000 ppm.

However, it became excessive once the samples reached the 4,000-ppm level. That region between 2,000 and 4,000 ppm can be thought of as a sort of gray zone where the survival of the material will depend upon those other two parameters — melt temperature and residence time. Just this month, we evaluated some parts molded in an unfilled nylon 66 that had a documented moisture content of 4,000 ppm. The comparison of the molecular weight of the pellets and the parts showed that the material had survived very well. But this was dependent upon excellent control over the other two processing variables. PT

Nylon, when exposed to elevated temperatures while in a very dry state, will build molecular weight.

ABOUT THE AUTHOR Mike Sepe is an independent, global materials and processing consultant whose company, Michael P. Sepe LLC, is based in Sedona, Arizona. He has more than 45 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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EXTRUSION

Single vs. Twin-Screw Extruders: Why Mixing is Different

There have been many attempts to provide twin-screw-like mixing in singles, but except at very limited outputs, none have been adequate. The odds of future success are long due to the inherent differences in the equipment types.

By Jim Frankland

I'm frequently asked why the mixing or compounding performance of a counter-rotating parallel twin can't be duplicated on a single-screw extruder. Let me try to explain why.

First and foremost, the twin can essentially transfer the entire channel full of polymer from one screw to the other multiple times, permitting full-channel mixing. This can be done while imparting little shear to the bulk of the transferred polymer and very high shear to just a small segment of the polymer by simply changing the opposing channel depths or with mixing lobes. Additionally, the screws are run starved so there is available volume for such transfers. It's also done with very little pressure drop and resultant loss of output due to the intermeshing flights.

In single screws, the pressure drop through high-shear areas — necessary for intensive mixing — is a limitation due to the loss of output and elevation of melt temperature. By repeating that process multiple times, the twin mixing can be made quite intensive and complete without overheating. Regardless of the extruder type, intensive mixing with high shear is required to fully disperse additives or even other polymers as many materials are only partially miscible in one another or form agglomerates that require high shear to break them up.

Mixing in single screws is first limited by the channel(s) the polymer follows down the screw. The shear rate and resultant downstream velocity is maximum at the barrel or the top of the channel, and minimum or potentially zero at the screw root. Because the polymer strongly adheres to the barrel and screw surfaces after melting, the shear developed by the polymer rotating with the screw in the barrel is the moving force. Essentially, in a force balance on the polymer, the barrel is rotating around the screw and the moving surface of the barrel in contact with the polymer provides the transport. In the accompanying figure, these are shown as V_b and V_0.

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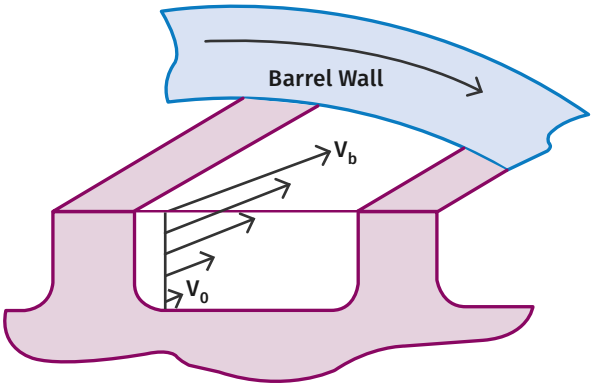
Mixing in Single-Screw Extruders



Mixing in single screws is first limited by the channel(s) the polymer follows down the screw. The shear rate and resultant downstream velocity is maximum at the barrel or the top of the channel and minimum or potentially zero at the screw root.

Some stratification of velocity also results in only partial "turnover" of the polymer in the channel. That alone makes it difficult to completely mix the contents of the screw channel. Additionally, the channel contents tend to stay in relatively the same radial position in the single-screw channel due to continuing shear thinning of the viscosity decreasing from the barrel to the screw root.

FLOW RESISTERS RAISE TEMPERATURE, LOWER OUTPUT

To try to overcome this limitation, various types of mixers and additional flights are used to offer some interruption and redirection of the polymer melt flow. However, these devices cause resistance to flow and reduce output as well as elevating melt temperature. All the polymer must flow through such devices repeatedly for uniformity of mix.

Twin screws can apply high shear in small increments through multiple changes in channel depth and/or mixing lobes, while subjecting the overall melt mass to limited shear. This is difficult and, in most cases, impossible with the single screw as it requires a tight clearance or restriction in the channel to develop the high shear rates.

Single screws must have essentially specific channel depths to reach their desired output and melt temperature. This limits the use of multiple high shear areas that are so useful in twin screws because of the screw-to-screw turnover that permits high shear on a small portion of the polymer by transferring the polymer to the other channel.

Mixing in single screws is first limited by the channel(s) the polymer follows down the screw.

WHAT THE MADDOCK MIXER DOES

There are many single-screw mixing and barrier flight designs that deliver some increment of mixing in single screws, although most primarily assist in melting by blocking passage of unmelt. Interestingly, one of the earliest and most prevalent mixers used with single screws is the Maddock-type mixer, which combines the two principles of the twin screw. One is the full "turnover" of the entire melt and the application of short-term high shear as the polymer passes over a barrier from inlet to outlet flutes.

I was fortunate enough to be involved in some of the early manufacturing of the Maddock mixers and testing at the Union Carbide lab in New Jersey. The features of twin-screw mixing were considered at the time in the design. The mixer concept was originally patented by Gene Leroy of Union Carbide and then further developed and popularized by Bruce Maddock. It featured complete turnover of the polymer and limited amounts of high shear.

Although quite effective in principle, it is limited to mostly a "one-shot" application because its inherent pressure drop reduces output and increases melt temperature enough that use of multiple sections was difficult. There are also spiral Maddock designs, but they only offer a slight improvement in pressure drop. Many of the other single screw mixers simply divide the melt at low shear, basically homogenizing the temperature without the high shear necessary for intensive mixing. PT

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

TOOLING

PART 2

How to Design Three-Plate Molds

There are many things to consider, and paying attention to the details can help avoid machine downtime and higher maintenance costs, and keep the customer happy.

By Jim Fattori

The order in which the parting lines separate in a three-plate mold is critical to the mold's function and the quality of the parts it makes. With that said, the parting line between the runner stripper plate and the A-plate needs to separate first, as shown in Figure 1. The runner remains attached to the runner stripper plate because of sucker pins. The purpose of this initial stroke is to break the gate and dislodge the runner drop(s) while the parts are still confined between the cavity and the core.

If the gate doesn't break first, it can cause a problem if the mold opens between the cavity and the core plates first. One such problem is distortion or even a fracture on the top of the part. Another problem is a higher gate vestige. The worst-case scenario is when the gate is so firmly attached to the part, it can pull it completely off the core and remain in the cavity, which obviously makes it impossible to eject. Initially, this parting line opening usually doesn't need to be any more than ⅛ inch to ¼ inch. That's why it is often referred to as the initial "break" and not the initial parting line opening — and why I call it "Parting Line 1A."

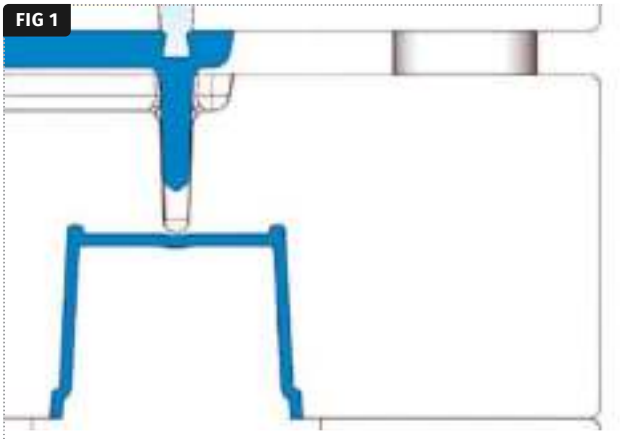
There are several methods available to ensure the mold opens at this correct parting line first. Some of them are urethane springs, die springs, latch locking mechanisms (both internal and external), plate retainers, roller pullers, friction pullers and plate locks. Some of these devices only separate the plates a short distance. Others separate the plates the full amount. And others simply retain two plates — forcing other plates to open first. They each have their own application and functioning method. It's just a matter of what you are comfortable with or have had good experience with.

The first parting line opening breaks the gate.

Sometimes the mold design and mold size enable you to use any of these various methods. But sometimes the mold design or mold size limits which methods are physically possible. The weight of the plates you want to retain must also be considered.

For example, friction pullers and roller pullers work well on small molds and MUD inserts, but I would never use them on large and heavy plates. Conversely, mechanical plate retainers and plate locks can handle very heavy loads, but are usually excessive for small molds.

FIG 1



Mold partially open at parting line "1A." Image: J. Fattori

TABLE 1 Coefficients of Static Friction

Materials Combinations		Surface Conditions	Coefficients of Static Friction
Bushing	Leader Pin		*μstatic*
Bronze	Steel	Clean and Dry	0.45
Bronze	Steel	Lubricated and Greasy	0.16
Graphite	Steel	Clean and Dry	0.1
Graphite	Steel	Lubricated and Greasy	0.1
Steel	Steel	Clean and Dry	0.65
Steel	Steel	Lubricated and Greasy	0.16

My personal preference for this initial opening has always been elastomeric springs. They are simple, reliable, nonmechanical, quiet and inexpensive. I like them more than die springs because there's no chance of a broken metal part getting trapped inside the mold.

These springs are typically available from mold component suppliers in the range of 70 to 100 Shore A durometer polyurethane. However, it is not uncommon for moldmakers to purchase urethane barstock and make their own custom springs. They may want a harder or softer material. Or they may want a length or diameter that's not commercially available.

And there's no law that says the springs have to be round. They can be any shape imaginable. There are two somewhat negative aspects about urethane springs. First, the material has a continuous use rating of only 150-170°F. The second is estimating how much force is required to repeatedly push the A-plate away from the runner stripper plate. Even though the initial opening does not have to be very long, the initial "breaking force" can be substantial.

A spring's compression is the only thing that controls its force.

DETERMINING SPRING FORCE

Determining how much spring force is required to ensure the proper initial parting line separation can be an educated guesstimate. The first thing you do is calculate the weight of the A-plate. Length × width × thickness / 1,728 in^3/ft^3 × 480 pounds per ft^3 for carbon steel will give you a good approximation of the weight. Let's assume your A-Plate is 12 × 12 × 6 inches. In this example, the A-plate weighs about 280 pounds. The formula for calculating the amount of force required to initially move an object at rest is the weight of the object times the appropriate coefficient of static friction.

Table 1 lists the coefficients of static friction for various leader pin bushing materials against a typical steel leader pin. Let's assume the mold has both hardened steel bushings and leader pins. The force required would therefore be 280 pounds multiplied by the coefficient of static friction. Doing the math: the force required for lubricated surfaces would be about 45 pounds, and the force required for dry surfaces would be about 182 pounds. It's amazing how a little bit of grease reduced the required force by more than 300%. Once the A-plate starts to move, the amount of force required to keep it moving will be substantially less — in many cases, about 15 to 30% less.

Table 2 states the approximate amount of force derived from a single 100 Shore A urethane spring of various diameters, various lengths and two different amounts of compression. Notice how ►

TABLE 2 100 Shore A Urethane Spring Force Values

Spring OD		Spring Length		10% Compression		Applied Force		15% Compression		Applied Force	
mm	in	mm	in	mm	in	kg	lbs	mm	in	kg	lbs
15	0.6	15	0.591	1.5	0.059	88	194	3.0	0.118	133	293
		20	0.787	2.0	0.079			4.0	0.157		
		25	0.984	2.5	0.098			5.0	0.197		
20	0.8	20	0.787	2.0	0.079	327	721	4.0	0.157	463	1,021
		25	0.984	2.5	0.098			5.0	0.197		
		30	1.181	3.0	0.118			6.0	0.236		
25	1.0	25	0.984	2.5	0.098	601	1,325	5.0	0.197	847	1,867
		30	1.181	3.0	0.118			6.0	0.236		
		35	1.378	3.5	0.138			7.0	0.276		
		40	1.575	4.0	0.157			8.0	0.315		
30	1.2	30	1.181	3.0	0.118	847	1,867	6.0	0.236	1,187	2,617
		35	1.378	3.5	0.138			7.0	0.276		
		40	1.575	4.0	0.157			8.0	0.315		

the length of the spring does not affect the applied force. Only the percentage of compression does. The amount a urethane spring extends beyond its bore hole when in the free state is basically the same as the preload of a die spring. It is in a compressed state when the mold is closed. Table 2 is for reference only because they will vary from one supplier to another. Therefore, use the springs ratings as suggested by the company you purchase them from.

A common mistake is to use an excessive amount of spring compression with the belief that it will ensure the plates separate properly. While that may be true, you need to consider the mold close settings on a molding machine. When a mold closes, it is typically at a fast velocity, but at a low pressure for the majority of the closing stroke. This is to reduce the cycle time but still minimize potential damage to the mold. At a very short distance away from the mold being fully closed, often between 0.050 inch and 0.100 inch, the speed rapidly decelerates, and the pressure increases — often to the maximum available.

Position springs close to the leader pin bushings.

Therefore, it is best that the spring does not protrude any further than necessary. To put it another way, it is better to use a shorter length spring with less total compression to obtain the same amount of applied force. This helps minimize the distance the mold is closed before going into high pressure — which helps prevent damage from something caught between any of the parting lines.

It is rarely a mistake to use what mathematically would be an excessive amount of spring force. In fact, in the previous example, we estimated it would take 182 pounds to get the A-plate moving under dry conditions. For a plate of this size, I would probably use two 1-inch diameter springs, about 1-inch long, with just 10% compression — only because 1-inch diameter springs are readily available.

From Table 2, the two springs would therefore have a total force of 2,650 pounds, which is almost 15 times more than the calculated minimum requirement. A better alternative would be to use four smaller diameter and shorter length springs that have a much lower compression length. That would enable the processor to have the two halves of the mold closer together before going into high pressure.

There is a minor downside to using excessive spring force. It has a direct effect on the amount of available machine clamp pressure. Let's think in terms of extremes for a moment. If you have four large springs with a compression rating of 2,500 pounds each, you reduce the amount of clamp pressure trying to keep the mold closed by 10,000 pounds or five tons. That's usually not an issue, but it is good to keep in mind in the event you have any leader pins that look like Figure 2 and the coefficient of static friction is ridiculously high.

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FIG 2

A rusted leader pin with a high COF. Photo Credit: J. Fattori

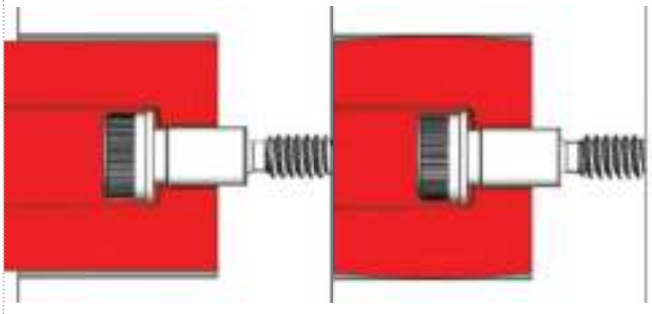
FIG 3

Mold damage from ball bearings. Photo Credit: J. Fattori

FIG 4

Best location for three-plate springs.
Photo Credit: Lawrence Mold & Tool

FIG 5



Urethane spring in the free (left) and compressed (right) states. Image Credit: J. Fattori

AVOID BALL BEARING BUSHINGS

There has been a recent influx of ball bearing bushings for guided ejector systems, and they seem to be gaining momentum in other areas of a mold. If you are considering using this type of bushing in the A-plate and/or a runner stripper plate in a three-plate mold to reduce the amount of friction and reportedly increase the life span of the bushings, I caution you against it, for two reasons. Neglecting the added cost of this type of bushing, over time, there is a chance the balls will come out of their race and possibly end up damaging the cavity, as shown in Figure 3.

The second and more important reason is because they work too well. That makes them a safety hazard. In a three-plate mold, these two plates float. If they have almost no static friction, a slight push can send them flying — potentially while an operator's hand is inside trying to remove a stuck runner. Springs should be positioned so they apply pressure to the plates evenly. Because they are trying to overcome the frictional forces between the leader pins and their bushings, it is best to place the springs near the bushings, as shown in Figure 4.

Minimize the amount a spring is preloaded.

Spreading the springs out as far as possible also helps reduce the chance of the plates cocking. When a urethane spring is compressed, it bulges outward. The bore hole that the spring is situated in must therefore be able to account for this expansion.

The shoulder bolt retaining the spring should also have sufficient clearance around the shaft of the bolt, as well as under the head, as shown in Figure 5.

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

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Top Shops Benchmarking Report:

Molding at the Margin

Plastics Technology TOP SHOPS

In a world of rising costs and uncertain market conditions, the ability to wring maximum profits from existing business was truly the mark of a Top Shop in 2022.

By Tony Deligio
Executive Editor

While the leaders of *Plastics Technology*'s annual benchmarking survey generated 69% more total revenue, 87% greater gross sales per machine and 59% higher gross sales per employee than the rest of the study's participants, it was the yawning gap in profit margin between the two groups of molders — 16% vs. 1% — that delineated the best from the rest in 2022.

"Margins are key for any business," explains Pete Aretz, owner of Top Shops honoree Pioneer Plastics Inc., Marinette, Wisconsin. "As a job shop, we focus on reducing waste, cycle time and labor where we can." This effort includes a tactic as simple, but effective, as scheduling out runs of the same material to decrease purging and downtime between jobs.

Noting that profits are only trumped by people and safety in terms of prioritization at Core Technology Molding Corp., Greensboro, North Carolina, Brandon Frederick says maintaining margins is fundamental for the newly named Top Shop. "Our strategy to protect margins starts with

Core Technology Molding quotes at least 75% of incoming jobs with advanced automation. Photo Credit: Core Technology Molding

clearly identifying the cost of goods sold (CoGS)," Frederick says. "Negotiating with suppliers to find out how we both can win, continuously training our staff and maximizing the use of our ERP system are keys."

For Plastikos and Plastikos Medical (both Erie, Pennsylvania), healthy profit margins are "vital" to success, explains Philip Katen, president and general manager. "Our profitability serves as the lifeblood to support our internal purchases and investments, including investments in our team, our equipment, our facilities, our technology and numerous continuous improvement projects that are in the works at any given time," Katen says.

SURVEY SNAPSHOT

Now in its seventh year, the annual, free and anonymous Top Shops benchmarking survey of injection molders gathers up and analyzes demographic data, performance indicators, and business and process strategies. The Intelligence unit of *Plastics Technology*'s publisher, Gardner Business Media, scores a selection of performance metrics from the questionnaire, and the highest scoring companies were named Top Shops for 2023 based on their 2022 operations.

In total, 17 companies were honored as Top Shops for 2023, hailing from 11 states, five countries and three continents, with winners' locations ranging from Australia to Canada, Europe to the U.S. and down into Mexico.

Top Shops, on average, molded more parts (82 million vs. 36 million) from more active tools (248 vs. 197), but did so with a similar number of machines (26 at Top Shops, 32 for the rest), which averaged roughly the same age — 10 years for honorees versus 12 for the rest. Where the groups diverged with regard to their presses was in machine size and utilization of hybrid units, with top shops deploying combination electric/hydraulic machines at a rate almost double that of other facilities.

An average of 76% of Top Shops reported running machines up to 100 tons in clamp force compared to just 56% for others. Although roughly three quarters of all survey participants utilized machines from 101-500 tons, only 6% of Top Shops have machines in the 501-1,000 ton range in their facilities, compared to 43% for others, and just 12% of Top Shops run anything above 1,000 tons, compared to 26% of other facilities.

In terms of materials processed, Top Shops used more polyolefins, PVC, engineering resins and bioplastics than the full slate of survey takers, but both groups reported utilizing recycled resin: 59% for honorees and 58% for others. Top Shops processed a lower mass of material — 4.2 million lb compared to 5.8 million lb — but from a greater variety of materials with an average of 35 different resins processed compared to 23.

> ***As a job shop, we focus on reducing waste, cycle time and labor where we can.***

Looking at value-added services, Top Shops were more likely to provide additive manufacturing, contract manufacturing and inventory stocking/logistics, but less likely to offer customers product design, product testing and shipping/packaging/labeling than the other survey takers.

While few Top Shops served the aerospace/commercial (23%) and aerospace/general aviation (29%) markets, this participation greatly outstripped the participation of the rest of the survey in those sectors, with just 8% winning business in each among the rest of the survey takers. Elsewhere, both saw pluralities in medical (53% for Top Shops and 54% for others), while fewer honorees worked in automotive (41% to 50%).

All the Top Shops were custom molders, while 8% of the rest of the survey takers represented a captive operation. Both groups came with an average of more than three decades in

PERFORMANCE METRICS

Hours/Week Open for Production

Top Shops	Others
124	102

Avg. Machine Usage Hours/Day

Top Shops	Others
17	14

Average Capacity Utilization

	Top Shops	Others
High	95%	85%
Low	29%	15%
Average	63%	53%

Avg. Mold-Change Time (minutes)

	Top Shops	Others
High	120	240
Low	6	2
Average	62	83

Finished Product First-Pass Quality Yield

	Top Shops	Others
High	99%	100%
Low	26%	15%
Average	91%	86%

Scrap Rate

	Top Shops	Others
High	4%	15%
Low	0.0080%	0%
Average	1.611%	4.957%

Order Lead Time (days)

	Top Shops	Others
High	60	60
Low	1	2
Average	20	21

On-Time Delivery Rate

	Top Shops	Others
High	100%	100%
Low	4%	50%
Average	90%	87%

Alex Aretz (left) and Ben Aretz inspect a mold at Pioneer Plastics. Family-run businesses were prevalent throughout 2023 Top Shops. Photo Credit: Pioneer Plastics

PlastiCert's business model is focused on low-to-medium volume jobs for complex components that utilize engineering resins. Photo Credit: PlastiCert

Plastikos operates whiteroom molding floors as a key differentiator for its business. Photo Credit: Plastikos

business (31 years for Top Shops and 33 for the rest), with Top Shops occupying slightly less space on average (62,000 ft^2 vs. 79,000 ft^2).

WRANGLING RESIN PRICES

Maintaining margins directly relates to managing costs, and the biggest cost for nearly all molders is resin. While 65% of Top Shops reported that average resin prices increased in 2022 (with a combined 35% saying costs decreased or stayed the same), fully 85% of other survey participants said resin prices increased with just 15% noting that they decreased or stayed the same.

At PlastiCert, Lewiston, Minnesota, Owner and President Craig Porter says the custom molder uses a combination of supplier and customer collaboration to achieve the best resin pricing possible. "Through use of our ERP system, our suppliers know that our order and forecast numbers are reliable, inspiring somewhat flexible terms and conditions," Porter says. "Our customers work with us to provide blanket orders and reliable forecasts, allowing us to make firmer resin commitments."

Communications with suppliers and customers can enable bulk buys. "Utilizing bulk purchase orders with release dates helps both Pioneer and our supplier know when and what materials we need," Aretz says.

"We utilize larger order quantities/bulk buys, including collaborating and partnering with our OEM customers to leverage their buying power where possible," Katen at Plastikos says. "They may have that power via a more holistic view of their larger supplier chain that includes multiple injection molding suppliers running the same grades of raw material for the OEM."

"Our business model is centered around long-term contracts and protecting the customer at all costs," Core's Frederick says. "One of the risks is cost transparency and, more often than not, we have to revisit raw material costs, but the ability to accu-

FINANCIAL METRICS

Total Revenue

	Top Shops	Others
High	$39,443,016	$42,000,000
Low	$393,000	$220,000
Average	$15,596,770	$9,239,267

Gross Sales/Machine

	Top Shops	Others
High	$6,600,000	$4,000,000
Low	$100,000	$800
Average	$1,061,116	$565,973

Gross Sales/Employee

	Top Shops	Others
High	$1,115,057	$800,000
Low	$59,564	$120
Average	$268,779	$169,399

Capital Equipment Investments

	Top Shops	Others
High	$3,183,873	$6,500,000
Low	0	$10,000
Average	$954,459	$939,370

Capital Equipment Expenditures, % of Gross Sales

Top Shops	Others
11%	10%

Profit Margin

	Top Shops	Others
High	35%	21%
Low	1%	-21%
Average	16.31%	1.14%

% Change in Sales '21 to '22

Top Shops	Others
+17%	+13%

rately forecast and keeping the supplier informed has proved to be invaluable."

Fully 88% of Top Shops access and use customer forecasts (with 81% of others also doing so), and 71% of 2023 honorees utilize customer surveys to guide their business compared to 39% of the remaining respondents.

In addition to locking in resin pricing where possible, Top Shops also help their customers settle on a material, or switch to a new one, based on extensive consultation. "Our customers are looking for PlastiCert to be their material and molding expert," Porter says, "and they recognize the added value of our expertise. With new customers, we work closely with them on mold design in conjunction with component design for molding, as well as resin selection and order-volume optimization."

"Our team is continually on the lookout for opportunities to identify alternative raw materials that may yield some savings," Plastikos' Katen says. "Our engineering team will collaborate with our strategic customers to sample and qualify those alternative raw materials via a formal, engineering continuous-improvement project." One such project recently netted one of Plastikos' global medical device customers $1 million in annual savings per production line, of which the company has five, resulting in $5 million in total savings per year.

PICKY IN PLASTICS

Such close customer collaboration dictates that Tops Shops are selective in the companies they seek to work with and the jobs they take on. When it comes to active customers (41 vs. 200), monthly quotes (11 vs. 45), and customer-retention rate (99% vs. 87%), Top Shops overall sought less ►

business from fewer clients but with better outcomes and greater loyalty.

At Pioneer Plastics, the goal of "focused growth" is achieved through the Entrepreneurial Operating System (EOS). "This system has guided us to be focused on our niche and not chase rainbows," Aretz says.

"At Core Technology we view our supplier customer relationship as a long-term strategic partnership," Frederick says. "Not everybody gets it right on the first try, but with sustainability and continual improvement, we are able to find and keep our long-term partnerships."

"Plastikos is very targeted and strategic in our custom selection to identify and work with those customers that strategically fit with our unique company culture, business vision, internal operation and related processes," Katen says. In addition to how it seeks new customers, the same strategic thinking applies to winnowing out customers, jobs and molds that are no longer a fit, a process Katen calls "pruning."

TOP SHOPS 2023

All-Plastics - Kerrville, Texas
Ant Packaging - Bangalow, New South Wales, Australia
Core Technology Molding Corp.- Greensboro, N.C.
Empire Precision Plastics - Rochester, New York
Form Plastik - Manisa, Turkey
J&O Plastics Inc. - Rittman, Ohio
Medical Components of America - Seguin, Texas
Microdyne Plastics - Colton, California
Perfect Fit Injection Moulding - Calgary, Alberta, Canada
Pioneer Plastics Inc. - Marinette, Wisconsin
Plastic Design International - Middletown, Connecticut
PlastiCert Inc. - Lewiston, Minnesota
Plastikos Medical - Erie, Pennsylvania
Plastikos Inc. - Erie, Pennsylvania
Saginaw Bay Plastics - Kawkawlin, Michigan
TSR Molds Inc. - Melbourne, Florida
Unicar Plastics S.A. de C.V. - Puebla, Mexico

THE GENERATIONAL VIEW

The survey found that 88% of Top Shops are family owned, compared to 75% of the rest of the respondents, a fact that some of the honorees view as a contributing factor to their high performance.

"Pioneer Plastics is a family business," Aretz says, "and one of our core values is to be dependable to all by treating everyone as your customer. If we want our employees to treat everyone like a customer, we had better treat our customer with the highest respect."

Core Technology, which is owned by Geoff and Tonya Foster, credits its family-like culture with keeping turnover at less than 2% during a "war for technical talent," Frederick says. In addition to increased medical benefits, the company has taken its employees on all-expense-paid trips, visiting Cabo San Lucas this year, with trips to the Dominican Republic, Jamaica and Orlando in past years.

"Plastikos and Plastikos Medical are a private, closely-held family business," Katen says, "and that business structure affords us with the ability to take a very long-term approach and view to our businesses ... As a multigenerational family business, the leadership team evaluates key strategic decisions from a perspective spanning generations rather than through the much shorter time frame lens that a publicly-traded, private equity or outside investor lead company would employ." PT

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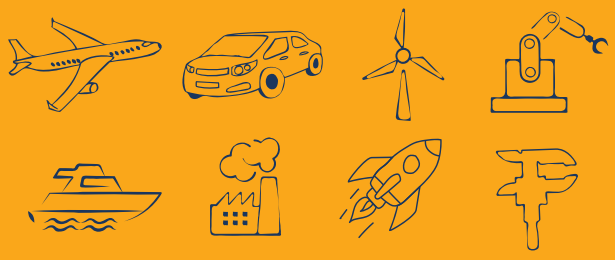

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How to Maintain Pelletizing Quality When Acid Attacks

Developments in the chemistry of polymers and additives have made corrosion a real problem in pelletizers. Here's how to ward it off.

FIG 1 Acid attack has caused serious damage on the cutting face of this pelletizer. Photo Credits: Maag Group

By Pierre Leroy and Margaux Pierens
Maag Group

Underwater rotary pelletizers are increasingly being attacked by acid. The growing use of biopolymers is one reason for this trend, as materials such as PLA may contain free lactic acid. However, the problem involves commodity resins too, as their chemistry continues to evolve.

Over the last five years, maintenance technicians here have been working with customers pelletizing polyolefins that have reported unusual local damage to pelletizer die plates and other components. Issues that were originally thought to be limited to a few isolated cases are now becoming widespread. The root cause turns out to be acids used or created during production, and also antioxidants or other additives to control tails that are injected into the cooling water.

It is better to anticipate corrosion issues before they trigger unplanned downtime.

At its worst, chemical attack can destroy a die plate and bring production to a halt (Figure 1). Especially in large-scale polyolefin production, where pelletizers may be expected to operate for months at a time, such unplanned shutdowns are extremely costly.

In the case of biopolymers, manufacturers and processors acknowledge there is a lot still to be learned, so corrosion problems are less of a surprise — and the scale is generally rather small. For polyolefin producers, on the other hand, unexpected corrosion can be very bad news. An unplanned shutdown to change a die plate typically takes 24 hours or more, and at 100 tons/hour this can have serious knock-on effects for the upstream refinery. Clearly, it is better to anticipate corrosion issues before they trigger unplanned downtime.

EVOLVING CHEMISTRY IS THE CAUSE

The problem lies in today's evolving polymer recipes and additive packages, as well as the growing popularity of biopolymers. These new products, undeniably more technical and complex, bring with them their share of production challenges. And where corrosion is concerned, these challenges often show up in the pelletization process — the link between polymer production and finished plastic products.

The key issue is that these new recipes may introduce acids in amounts that are sufficient to cause corrosion in key locations, while remaining difficult to detect in bulk materials.

Typically, cooling water circulating around the pelletizer remains neutral or alkaline, so manufacturers may not believe they have an acid problem. At the die plate itself, however, very local

acid attack can damage critical areas around the extrusion nibs, even when there is little or no change in the bulk pH.

The underwater cutting head, composed of a die plate on the extruder side and a knife holder and knives on the pelletizer side, forms a set of wear parts. Their performance depends mainly on their ability to support a predictable number of thermal and mechanical stress cycles, leading to equally predictable maintenance and production continuity. However, with the development of new polymers or additives, new constraints and phenomena are emerging.

Even in cases less extreme than that of Figure 1, the sharp edges of the extrusion nozzles in a new die plate (Figure 2) can become rounded (Figure 3), leading to loss of cut quality and substandard pellets. This, in turn, may shorten equipment life from years to months, and even force unplanned shutdowns. Accelerated wear also causes poor pellet quality, which manufacturers may address by adding chemicals to control tails. Ironically, this can make the problem worse as the additives contribute to corrosion of the die plate.

CHOOSING MATERIALS TO RESIST CORROSION

Back in 1979, leading pelletizing suppliers began to use tungsten carbide for the pelletizer nibs, which is the area through which the polymer is extruded during the process. This was a breakthrough in terms of equipment life, thanks to the extreme hardness of the carbide material.

As it turns out, however, in some circumstances the tungsten carbide can be vulnerable to acid attack. Tungsten carbide is not a homogeneous material; typically, microscopic carbide grains are embedded in a matrix of metal or ceramic to provide mechanical strength and toughness. Not all grades of tungsten carbide are created equal, and under the wrong conditions the granular structure represents a gateway to chemical attack.

The bulk of the die plate is traditionally made from stainless steel, and this too can be vulnerable to corrosion, along with the joints between the stainless steel and the tungsten carbide nibs. A solution is to make the die plates from superalloys such as Hastelloy or Inconel, and the extrusion nibs from grades of tungsten carbide chosen for their corrosion resistance. We also pay attention to the brazing process used to attach the nibs.

The resulting Hybrid Acid Resistant (HAT) die plate (Figure 4) combines standard stainless steel for strength with Inconel and high-performance tungsten carbide for ultimate corrosion resistance.

Thanks to the use of solid materials instead of surface treatment, the HAT die plate has been proven to significantly increase die-plate life while reducing shutdowns and off-spec pellets. In practice, the die plates can last up to 10 times longer, provided they're traditional equivalents under corrosive conditions and, in some cases, the improvement has been dramatic. One PLA manufacturer, for instance, was originally able to run for just five days before the die plate needed to be reground. With updated materials, the material supplier can now achieve six months before regrinding.

FIG 2 The cutting face of a new die plate. Note the sharp edges of the holes in the tungsten carbide nibs.

FIG 3 Cutting face showing accelerated wear due to local chemical attach, which has reduced the sharpness at the edges of the extrusion holes.

THE COMPLETE PELLETIZING SYSTEM

Of course, the die plate is only part — although a very important part — of the complete pelletization system. For instance, another key engineering decision is to make the cutting knives from a titanium carbide composite that is less hard than the tungsten carbide nibs. Enabling the knives to wear at a controlled rate makes them ►

QUESTIONS ABOUT PELLETIZING?

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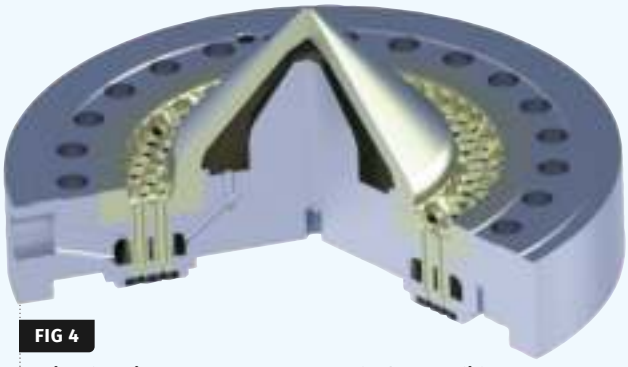

FIG 4 Die plate incorporates parts made from solid Inconel for maximum corrosion resistance.

FIG 5 Cutting-head system with central water injection.

self-sharpening and protects the costly die plate. An example is the Central Injection System (CIS) shown in Figure 5. With a die plate 1,500 mm in diameter and a central water injection system, this handles throughputs up to 100 tons/hour with up to 30% longer service life compared to traditional solutions. CIS includes a self-aligning knife holder with a grooved cone and sword-shaped knives. It is an effective solution for high melt index or peroxided polymers. Water is directed through the die plate toward the cutting face, improving pellet cooling and ejection. By making use of the existing process water supply, the CIS system contributes to reducing waste and water consumption.

Trace quantities of acids resulting from new polymers, new blends and new additives can cause expensive damage to pelletizer die plates and, in some cases, other equipment along the production chain. To reduce costly shutdowns, careful attention to materials choice can improve the corrosion resistance of die plates and other key items.

ABOUT THE AUTHORS: Pierre LeRoy has been head of engineering at Maag AMN since 2021. He leads a team of engineers tasked with choosing the optimal design for each customer's application. LeRoy's team drives quality by ensuring product performance, on-site installation, operators' training and technical assistance. Contact: *maag.com*

Margaux Pierens is the director of operations at Maag AMN, Normandy, France. As the founder's granddaughter, she grew up alongside the business before joining it permanently in 2018. Today, she ensures business continuity and development as the company has joined the MAAG Group in 2022.

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PART 2

How to Extrusion Blow Mold PHA/PLA Blends

You need to pay attention to the inherent characteristics of biopolymers PHA/PLA materials when setting process parameters to realize better and more consistent outcomes.

By Russell Mullins and Dr. Karson Durie
Danimer Scientific

In the current legislative climate of bans on petroleum-based plastics and consumer requests for sustainable alternatives, bioplastics offer a unique opportunity. In prior decades, there has been significant resistance to bioplastics because of cost as well as unique and often difficult processing characteristics. Now, however, the development of many polyhydroxyalkanoate (PHA)-based resins — often combined with polylactic acid (PLA) — has resulted in bioplastic solutions that are well suited to current market needs.

PHAs are a naturally occurring biodegradable material produced via bacterial fermentation, similar to brewing alcohol. During fermentation, when nutrients and food sources are optimized, the bacterial strains start making and storing PHA as a food source, eventually producing a peak amount of PHA.

PHA can be blow molded into various shapes, sizes and designs for many applications.

At this point, the PHA is separated from the cellular components and processed, resulting in a light, white powder that can be combined with other materials like PLA to produce processable and usable bioplastic resins. These materials are typically compostable in home and industrial environments, and degradable in soil and marine environments.

One of the opportunities to use PHA and its compostable characteristics is in blow-molded articles. The positive end-of-life scenarios offer one possible solution to the overabundance of plastic in the market. PHA can be blow molded into various shapes, sizes and designs for many applications, from personal use to food and drink storage.

Recently, many processors have been experimenting with running PHA/PLA blends in their blow molding operations with mixed success due to the blends' unique characteristics. However, proper attention to the inherent characteristics of PHA/PLA materials when setting the processing parameters can lead to better and more consistent outcomes.

When combining PHA with PLA, you will find that the processing requirements for the PHA will drive most of your processing strategies. PHA is hygroscopic and needs to be dry. It is sensitive to residence time and requires a warm (120-130°F) mold to crystallize.

At Danimer Scientific, most of our research effort has been with extrusion blow molding (EBM), which is the process covered here.

MATERIAL HANDLING

As noted, PHA is a hygroscopic polyester that will absorb environmental moisture. Having the material dry before processing will prevent degradation and melt thinning. A moisture content of less than 0.04% (400 ppm) is required. Recommended drying conditions are four hours at no greater than 170°F (80°C) with a desiccant dryer.

PURGING

It is recommended to purge the machine completely with LDPE to remove the previous resin and, after cooling the extruder to the process set points referenced on page 33, introduce the

To successfully extrusion blow mold PHA/PLA bottles you need to take heed of the unique processing characteristics of the material. Photos: Danimer

PHA/PLA blend. This procedure should get you into the production material without degrading the resin. PHA/PLA blends have an upper temperature limit of around 400°F and will rapidly degrade around this temperature.

Because PHA can degrade quickly under heat and shear, it is recommended that you purge fresh material forward anytime the machine is idled for more than five minutes before starting up again. It is not only the temperature of the melt that matters but also the residence time. High residence times will cause the material viscosity to decrease and can cause problems with machine startup.

At the end of production, the machine should again be purged clear of the PHA/PLA blend — using LDPE at process temperatures — before increasing temperatures to go to the next resin.

EXTRUDER TEMPERATURE SETTINGS

Once more, the PHA component will drive your temperature strategy. To achieve a stable and workable parison, you must keep your heat near the low end of processing temperatures for PHA.

Suggested conditions to start:

First Zone	310-320°F (155-160°C)
Middle Zone	310-320°F (155-160°C)
End Zone	300-320°F (150-160°C)
Head	300-320°F (150-160°C)
Mold Temperature	110-140°F (40-60°C)

The low melt temperature aims to achieve a parison with enough melt strength to hold together. You will find that PHA/PLA blends are sensitive to the smallest temperature changes, and viscosity will drop rapidly as melt temperature increases. We typically advise processors new to PHA/PLA blends to think of adjusting temperatures by two or three degrees at a time, not the usual five-degree changes.

EXTRUDER SPEED

The PHA component of the PHA/PLA blend requires a warm tool to promote timely crystallization.

While extruder speed is directly related to cycle time, it should be noted that PHA is a shear heating material similar to PVC (polyvinyl chloride). As production rates and extruder speeds increase, you will see temperature override in your extruder zones. If your machine has heat cool bands, you can employ those to keep temperatures inline or you can try to introduce some heat earlier in the extruder to reduce friction and shear heating.

It would also be helpful to look at your extruder screw design and avoid screws with higher compression ratios or very short, aggressive compression sections.

MOLD TEMPERATURE

This area requires particular attention. The PHA component of the PHA/PLA blend requires a warm tool to promote timely crystallization. If you process into a cold tool at 40-60°F, the parts will come out soft and pliable and then, over the next 60-90 seconds, become firm. What is happening is the part is crystallizing in your hand. The

cold temperature is retarding the crystallization rate. When working with PHA/PLA blends, crystallizing and cooling are different. Parts can be cold and not crystallized.

To aid the crystallization rate, keeping the mold at 110-140°F (40-60°C) is recommended. The strategy is to get the mold warm enough to promote crystallization yet cool enough to enable part ejection and handling.

Another reason to keep the tool warm is that most blow-molded PHA/PLA blends will stick to a cold mold surface, making it difficult to eject them.

Cure time before packaging may be required for PHA/PLA blow molded bottles.

PART HANDLING

An important part of any blow-molding process is how you handle the parts once molded. The handling of parts made from PHA/PLA blends will become more difficult as production speeds increase.

As cycle and crystallizing times decrease, the bottles will become softer and easier to damage. It may require some engineering and automation adjustments to enable some post-molding cure time before the parts are bulk packaged. You may also have to explore some forms of ejection and part holding as the mold opens to keep the bottles releasing consistently due to some variability in whether the bottles will stick to one side or the other or release cleanly.

Hopefully, this outline will provide some basis for developing a process for your parts. If you go at it slowly and methodically, you should be able to create a stable process and then improve from there. Remember that PHA/PLA blends are relatively new and different materials that require some new and different processing techniques. PT

Learn More About Biopolymers: This is Part 2 in a series on PHA/PLA processing. Part 1 covers injection molding of PHA and PHA/PLA Blends.

About the Authors: Russell Mullins is Danimer Scientific's special operations technical advisor and has more than 45 years of experience in plastics injection molding and product design. Dr. Karson Durie is associate director of Danimer's facility in Athens, Georgia, and earned a Ph.D. in chemistry from the University of Georgia. Contact: *229-243-7075*; *russellmullins@danimer.com*; *danimerscientific.com*.

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Top Ways Running Two Molds Simultaneously Can Impact Your Molding Efficiency

Monday, October 24th @11:00 AM ET

PRESENTED BY: Canon Canon Virginia, Inc.

The Canon Shuttle Mold System represents a true sea change for injection molding businesses. Most molding equipment and machine attachments are designed for specific or singular actions, which offers little flexibility for future needs. The adaptable Shuttle Mold System, however, not only provides twice the mold output on a single machine but so much more.

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Navigating the Bio-Revolution: Harnessing Bioresins and Beyond for Eco-Friendly Injection Molding with Optimized Hot Runner Technology

Wednesday, October 25th @11:00 AM ET

PRESENTED BY: HUSKY

Bioresins — sometimes called bioplastics, biopolymers and biomaterials — are at the foundation of a transformative shift in the injection molding landscape, enabling leading molders to navigate consumer trends, legislation and sustainability goals.

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Gravimetric Extrusion Control for Pipe and Tubing Production

Monday, October 30th @2:00 PM ET

PRESENTED BY: CONAIR

Consistent quality is paramount within the production of pipe and tubing applications. Additionally, significant material savings can be obtained by tightly controlling product dimensions with the correct process equipment. In this webinar, Conair will cover gravimetric control of an extruder and production line speed to ensure optimal quality and cost savings are achieved in your product run.

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PT Keeping Up With Technology

INJECTION MOLDING

App Helps Molders Find Spare Parts

Engel will launch a part-finder application during Fakuma 2023, Oct. 17-21, in Friedrichshafen, Germany, aiming to help processors identify spare parts using only a smartphone.

Users can identify spare parts using numerous methods, including the image-based spare parts search function. Molders can also take a picture of the part in question with a mobile device and define the image section to be used for the search. In addition, these images can be emailed to Engel, where the purchasing coordinator can then use the file in part finder to identify the needed component.

Besides this visual search, the smart software supports the molder with various advanced options, such as a key word and synonym search, as well as a smart parts list search.

Engel points out that the app can not only identify new parts from the latest machines, but it can be used to recognize dirty, worn or disfigured parts from older machines. In fact, the part finder's database includes injection molding machines that are up to 20 years old. If the finder is unable to identify or locate the part a user is looking for, Engel's customer service agents are available to help.

Once required parts are identified, they can be ordered with a single click, and the shopping cart feature can enable ordering of multiple parts. Once the order is placed, the application generates an email that can either be sent directly to Engel as an order or forwarded internally for approval.

Available free of charge as a feature of Engel's e-connect customer portal, part finder just requires a mobile device with online access or a computer with an internet connection. Users who are logged in can launch the web application while working in the customer portal.

FEEDING

Feeder Handles Poor Flowing, Sticky Powders

The NX Series feeder from Kubota Brabender Technologie is designed for poor-flowing, sticky powders as well as fibers and pellets. This unit combines the proven mechanical design of one of Kubota's most innovative gravimetric feeders with Brabender Technologie GmbH's proven load cells and motors.

The result is a medium-capacity feeder featuring a special negative angle wall hopper geometry and a diagonal agitator that prevents bridging and ensures optimal bulk material flow into the screw. In combination with other innovative components, mass flow is optimized and a uniform screw fill level is achieved.

The feeder is the first jointly developed product of Kubota Brabender Technologie. Brabender became a wholly owned subsidiary of Kubota in June 2022.

INJECTION MOLDING

Sustainability-Focused Technologies for Stack Molds

At Fakuma 2023 in October, Oerlikon HRSflow will display its previously introduced stack mold technology for efficient molding of thin-walled, ecologically optimized packaging. Patent-pending and available soon, the system features the Xd series nozzles, enabling high filling pressures. The stack-mold design enables a lower tonnage press to be used and Oerlikon HRSflow says the system is suited for processing PCR plastics and sustainable compounds.

OCTOBER 17-21

In addition, Oerlikon HRSflow will show a 72-cavity cap molding system utilizing its Vf nozzle series, which enables cycle times of 2.2 to 3.5 seconds and balanced fill. The design satisfies new Europe's single-use plastic directive, which mandates tethered closures for all beverage containers up to three liters in volume.

Specially developed for HDPE caps and closures, the Vf nozzles can fill part weights from 0.5 g to 8 g. The design features a special nozzle tip that enables optimum control in the gate area while improving cycle time.

Replaceable nozzle tips ease maintenance, and Oerlikon HRSflow says the hot runner geometries have been rheologically optimized. In addition, special inserts minimize color-change times.

FLEXflow technology will also be presented at Fakuma 2023. The servo-driven valve gate system is combined with a programmable control, enabling independent adjustment of the stroke and force of the needle position of each individual nozzle during the opening and closing phases for cascading injection processes.

INJECTION MOLDING

All-Electric Line Expanded

At this month's Fakuma 2023, Wittmann Battenfeld plans to bring minimum energy usage into maximum focus. For the EcoPower lines of hybrid and all-electric presses, the company will unveil the EcoPower B8X, which will be available in the European market in clamping forces from 550 to 1800 kN (approximately 60 to 200 tons) from Fakuma onwards. It will also expand its conceptual machine model — EcoPower DC, which draws its power supply solely from a battery as DC voltage source.

OCTOBER 17-21

Wittmann says the EcoPower B8X will be available in the U.S. market starting at NPE2024 (May 6-10; Orlando), in a size range from 60 to 330 tons.

Wittmann Battenfeld points to several specific upgrades made to the EcoPower B8X line, which it says provides further energy reduction over its predecessors. The injection unit, which can swing out, has replaced grease lubrication with oil lubrication, lowering resistance and adding to the press's flexibility. That flexibility is aided further via a range of additional injection unit sizes.

The company says the toggle-lever design has also been optimized to serve dynamic operations and greater service life, which in addition to faster injection units, has enabled short cycle times for the machines.

Regarding improvements to the toggle, the machine builder says the design has been optimized so that 15% less force is required to lock the clamp unit, reducing energy consumption by 3% to 7%, depending on the press size. In addition, the diameter of the bolt has been increased to reduce the surface pressure and result in a longer service life, with bushing changed to a hardened bronze.

The B8X control system now utilizes several in-house-developed system components, which enables a higher internal clock frequency, resulting in shorter response times to sensor signals and thus a higher reproducibility of parts.

INJECTION MOLDING

DC-Powered Press Showcased

Addressing the changing nature of energy supply, as well as an interest in greater energy efficiency, Dr. Boy GmbH & Co. KG will display a BOY 35 E at Fakuma 2023 that is supplied directly by a DC network.

OCTOBER 17-21

Boy notes that direct DC networks applied without transformation to AC power offer many advantages for injection molders, including lower losses due to conversion; reduction in wire cross-sections and the number of wires; reactive power-free operation of the machines; elimination of interference filters; and better utilization of braking energy.

INJECTION MOLDING

Press Line With Lower Carbon Footprint

At Fakuma 2023, Wittmann Battenfeld will display the latest in its EcoPower machine concept, which was introduced at K 2022 and seeks to directly utilize renewable energy without first having to pass the sustainably derived electricity through inverters, transformers and high-voltage power lines, which have their own carbon footprint and lead to power loss. At the fair, the company will take the concept further by having the 3-axis robot removing parts from the machine, drawing its power directly from the interim DC voltage circuit of the EcoPower.

OCTOBER 17-21

In addition to a smaller carbon footprint, Wittmann Battenfeld says that the use of direct current to operate an injection molding machine can help keep energy costs low, and the direct current energy can also be stored in conventional batteries to protect against voltage spikes and to increase energy security.

At Fakuma, this technology will be demonstrated on an EcoPower 180/750+ B8X. Running a single-cavity mold from the Austrian company Kunststofftechnik Grabher GmbH, the cell will produce a PP drainage body. The part will be removed by a modified WX142 robot in DC version from Wittmann, drawing power directly from the interim DC voltage circuit of the EcoPower. The technology will also return any surplus energy to the interim circuit whenever the axes are delayed. As part of the live presentation of the DC technology at the fair, the machine will not be plugged into the exhibition hall, rather it will be powered independently via a solar power storage battery consisting of salt battery technology supplied by Innovenergy. The battery has a total capacity of more than 45 kWh, which is more than sufficient for continuous machine operation throughout an entire 8-hour trade fair day.

EXTRUSION

Five-Layer, Polyolefin-Dedicated Film Line

The Polyblown 5-layer POD (polyolefin dedicated) series from Colines is designed for the production of polyolefin films and suitable for processing PCR. The production line has been recently redesigned and optimized.

Colines says the line is extremely energy efficient, pointing to low specific energy consumption rates that range from 0.32 to 0.38 kWh/kg (depending on the formulations).

Other notable features include a user-friendly graphical interface of the software; excellent control of film tension and winding speed, achieved with the use of brushless motors; a sturdy, ergonomically friendly design; extremely low thickness tolerances; and high production capacities.

The line is supplied with five extruders equipped with liquid-cooled motors; a 500-mm coextrusion die; a dual-flow air ring; internal bubble cooling; a capacitive noncontact film-thickness sensor; primary and secondary bubble-cage and collapsing frames with carbon fiber rollers; an embedded oscillating takeoff; additional secondary nip; and a new surface/gap/center winder. The line can run at a maximum width of 270 mm.

BLOW MOLDING

Robotic Bottle Unscrambler Debuts at Pack Expo

At last month's Pack Expo, Omega Design Corp. introduced a fully automatic robotic unscrambler that separates, orients and positions plastic bottles onto a conveyor or stabilizing pucks. The system is recommended for lines running complex or multiple shapes of bottles, jars, vials, tottles, jugs and tubes.

The system uses one or more pick-and-place robots of the multi-axis, parallel-kinematic type — also known as a Delta or spider robot. Each robot can handle up to 90 containers/minute. The integrated hopper minimizes footprint, and the dual-conveyor system is optimized for robotic handling, with intelligent infeed metering control to reduce recirculation of bottles.

A key feature is Omega's dual infeed system, which presents two containers at once — one on each conveyor — to the robot from a single hopper. This approach is said to yield "throughputs unobtainable by conventional methods," while also minimizing the machine's footprint. The system's flexibility enables increasing speeds by adding larger hopper capacity and additional robot modules.

The system has a 15" touchscreen controller, a Rockwell Automation Optix visualization platform and an Allen-Bradley PLC. Rapid pushbutton changeover with a limited number of change points helps speed setup and reduce downtime between product runs.

BLOW MOLDING

Compact, Affordable Robotic Palletizer for FHPC Bottles

Sidel, a supplier of PET stretch-blow molding machinery and complete filling/capping/packing lines, introduced at Pack Expo last month the RoboAccess Pal S, a compact and capable palletizing solution with improved agility, operability and compactness for food, home and personal care (FHPC) markets. This system is said to combine the compactness, mobility and affordability of collaborative robots (cobots) with the higher speed and payload capabilities of traditional jointed-arm robots.

Designed for low/medium speed packaging lines, the system runs at up to 12 cycles/minute (one to six cases per payload, depending on size). Payload capacity is up to 25 kg (55 lbs) with a vacuum gripper and 20 kg (44 lbs) with a clamping gripper. The system handles all major pallet sizes and pallet height up to 1,700 mm (67"). Average ROI is said to be one to two years (based on one operator working two shifts in Europe or North America). Delivery time is quoted as 10 weeks.

The compact unit has less than 12 m² footprint for two pallet stations and less than 8 m² for one station. Contributing to this compactness is the clamping head design with independent clamps and lightweight carbon-fiber construction, as well as a mobile physical curtain system that's said to occupy less space than light curtains. The system can be moved "effortlessly" in 15 minutes with "plug-and-play" features, because of the folding guarding system.

For safety, full pallet removal and new empty pallet supply are done in "hidden time" with full protection from the mobile physical curtain system isolating the operator from the robot working on the second pallet station. Changeovers are said to be fast and repeatable. The modular design enables various configurations from a large library of standard modules.

MATERIALS

HDPE Grade for Mono-Material MDO Films

ExxonMobil has developed an HDPE grade for machine direction orientation film (MDO) applications. Designed for recyclability (contingent upon availability of film collection programs), HD7165L can help processors create mono-material laminates to replace multimaterial laminate structures, such as food packaging.

HD7165L can help enable processors produce blown MDO-PE films with 60-70% HDPE for enhanced stiffness and high heat resistance when compared with films with a lower percentage of HDPE. Output rates in excess of 800 lbs/hour are possible, while bubble stability is maintained.

The company says MDO stretch ratios as high as 7:1, with very high stiffness (1% secant modulus as high as 200 ksi) can be achieved. HD7165L offers optical haze less than 10% and gloss higher than 60%. Where used as a print web of a PE-PE laminate, HD7165L offers high heat resistance, stiffness and printability.

In blown MDO-PE film applications, HD7165L offers uniform orientation, gauge stability and low gels for easy processability. Compared to a market reference HDPE grade, HD7165L delivers better shear thinning behavior and extrudability, higher melt strength for bubble stability and gage uniformity.

MATERIALS

ASA Grade for Small Medical Devices

INEOS Styrolution has introduced a grade of ASA designed specifically for small medical device housings and casings. Luran S MED 797S SPF30 is the latest member of INEOS Styrolution's ASA product family. It reportedly offers strong chemical resistance, UV resistance and impact strength.

Suitable for injection molding, Luran S is said to provide excellent flowability for easy processing. Luran S MED 797S SPF30, available in NR (Natur) and in white (WT000112), is said to show excellent chemical resistance against alcohols (IPA, ethanol, propanol) or alcohol-based disinfectants. It also shows good resistance against quaternary ammonium or glutaral-based disinfectants, making it a material of choice for clinical environments.

High impact strength, specifically at room temperature and at lower temperatures (5°C), contribute to a better protection of devices, such as avoiding cracking failures when a device drops to the floor. INEOS says this particular performance trait makes Luran S MED 797S SPF30 a viable alternative to standard ABS materials.

The Luran S grade is also available using renewable feedstock, based on a mass balance process certified under ISCC PLUS. Luran S ECO MED 797S SPF30 BC40 contains 40% renewable content resulting in a carbon footprint reduction of up to 52% compared to fossil-based Luran S.

MATERIALS

Automotive TPVs Formulated With Scrap

Teknor Apex's latest addition to its Sarlink line of thermoplastic vulcanites is RX 3100B. It was developed to help automotive OEMs achieve sustainability targets by incorporating up to 40% postindustrial recyclate, depending on the hardness. These multipurpose TPVs are well suited for injection molding, extrusion, overmolding and coextrusion with PP or other thermoplastic elastomers (TPEs). For these high-durometer grades, applications include the backbone or carrier for extruded seals, like in glass-run channels or boots, bellows and other underhood components.

The two new grades available, an 84 Shore A and 94 Shore A, are based on the existing Sarlink 3100 Series technology, but contain 25% and 40% recycled content, respectively. The materials are said to process and perform similarly to their virgin counterparts yet offer sustainability benefits such as reduced dependency on virgin petroleum-based plastic — which is well suited for OEMs looking to reach aggressive targets around the use of sustainable material content in vehicles. Sarlink RX 3100B TPVs are pre-colored black and can still be recycled in process or at the end of the product's life cycle. The use of PIR content vs. PCR is said to provide for a more controlled and consistent raw material stream that can be used in extrusion-grade TPVs without issue. Teknor Apex treats recycled feedstocks like prime raw materials, and they are subject to the same quality assurance testing and must meet relevant specifications for use.

Prices Bottom Out for Volume Resins?

Flat-to-down trajectory underway for fourth quarter for commodity resins.

By Lilli Manolis Sherman
Contributing Editor

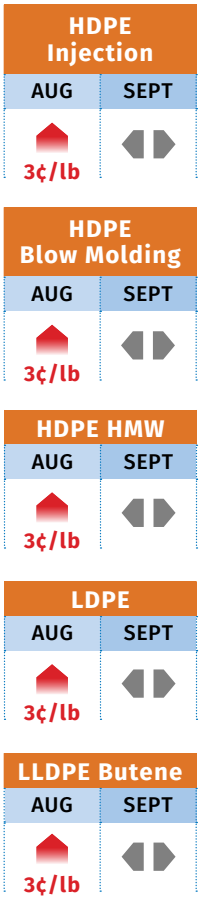
Prices of volume resins going into 2023's fourth quarter were a mixed bag, though a "bottoming out" somewhat characterized the overall market. Partially, that is due to price decreases across the board for most of the year until contract settlements in August, which saw prices move up for PE, PS, PVC and PET, and just a fractional decrease for PP, with more price hikes being attempted for September.

While prices of volume engineering resins continued to drop in the same time period — and some were expected to drop further — a lesser decline was expected. The temporary upward trajectory was primarily driven by higher prices of some feedstocks, such as benzene and ethylene, due to unplanned and planned production shutdowns.

As such, barring production disruptions during the hurricane season or other major event, the pricing trajectory for all volume resins appear to be somewhat flat to down. Slowed domestic and global demand, the lowering of plant operating rates, cost-cutting measures across the supply chain and, in some cases, more new capacity, lower feedstock costs and competition from lower-cost imports are all contributing factors.

These are the views of purchasing consultants from Resin Technology Inc. (RTi), senior analysts from Houston-based PetroChemWire (PCW), CEO Michael Greenberg of The Plastics Exchange, and Scott Newell, executive v.p. polyolefins at distributor/compounder Spartan Polymers.

Polyethylene Price Trends



PE PRICES FIRM UP

Polyethylene prices moved up 3¢/lb in August while suppliers were seeking another 5¢/lb for September, and appeared to be firming up heading into this month, according to David Barry, *PCW*'s associate director for PE, PP and PS; Robin Chesshier, RTi's v.p. of PE, PS and nylon 6 markets; and The Plastic Exchange's CEO Michael Greenberg. *PCW*'s Barry notes that while demand is showing a moderate improvement, it remains well below 2022 levels. "The exports market has been holding things up, but there were concerns about whether that trend would persist into fourth quarter," he says.

Suppliers appear to have created a sense of tightness, according to RTi's Chesshier, who notes that domestic demand is still not good, new capacity is still being brought on stream in fourth quarter by Shell, Nova and Baystar, along with concerns that this summer's record level exports will not continue. Reports The Plastic Exchange's Greenberg, "Producers (suppliers) continued to hold back material in favor of incremental export shipments at prices that rival some domestic sales."

Referring to supplier's concerted effort to ramp up PE exports, the key reason much of the new capacity was built, Greenberg ventures the possibility that before year's end, more polyethylene will actually be exported than sold into the domestic market in a given month. Overall, these sources see PE contract and spot prices staying firm going into the fourth quarter.

Market Prices Effective Mid-September 2023

Resin Grade	¢/lb
POLYETHYLENE (railcar)	
LDPE, LINER	85-87
LLDPE BUTENE, FILM	78-82
HDPE, G-P INJECTION	77-79
HDPE, BLOW MOLDING	72-74
HDPE, HMW FILM	78-80
POLYPROPYLENE (railcar)	
G-P HOMOPOLYMER, INJECTION	58.5-60.5
IMPACT COPOLYMER	60.5-62.5
POLYSTYRENE (railcar)	
G-P CRYSTAL	95-97
HIPS	105-107
PVC RESIN (railcar)	
G-P HOMOPOLYMER	67-69
PIPE GRADE	69-71
PET (truckload)	
U.S. BOTTLE GRADE	69.5-71.5

PP PRICES DOWN

Polypropylene prices dropped 0.5¢/lb in August in step with propylene monomer contracts for a decline of 19.5¢/lb since March, and are generally expected to be bottoming out, according to *PCW*'s Barry, Spartan Polymers' Newell and The Plastic Exchange's Greenberg. PCW's Barry reports that some market participants project a 5¢/lb increase for September propylene monomer contracts and PP. Meanwhile, PP suppliers are out with non-monomer price hikes of 3¢/lb (though one called for 2¢/lb for homopolymer and 4¢/lb for PP copolymer).

Polypropylene Price Trends

Homopolymer	AUG	SEPT
	▼ 0.5¢/lb	◀▶

Copolymer	AUG	SEPT
	▼ 0.5¢/lb	◀▶

These sources characterized the market as somewhat more stable. Says Spartan Polymers' Newell, "The broader market sector's sentiment is still bearish. Suppliers appear to have a better handle on a better supply/demand balance, even though plant operating rates are only in the low-to-mid-70s percentile. Most everyone appears to have given up on seeing a significant rebound in 2023 and are looking to cut costs." Going into August, PP domestic demand was down 6%, year-to-date, according to Barry, who did not see much chance for suppliers to implement non-monomer increases this year.

The Plastic Exchange's Greenberg is more bullish about the PP spot market, noting that spot market prices have firmed up as resin availability was becoming a bit strained. Still, he thinks most processors are comfortable with their inventories as they have built supply buffers during hurricane season. Newell estimates that spot prices were up by as much as 10¢/lb, though they had been heavily discounted earlier in the year.

PS PRICES UP

Polystyrene prices rose by 3¢/lb in August and suppliers were out with another 3¢/lb increase for September, according to *PCW*'s Barry and RTi's Chesshier. This is after dropping a total of 9¢/lb the two previous months. Both sources venture there was some potential for implementation for the second increase solely due to anticipation that September benzene contract prices would also move up. Barry reported that the implied styrene cost, based on a 30% ethylene/70% benzene spot formula rose to 40.3¢/lb in early September, up 4.4¢/lb from early August.

Polystyrene Price Trends

GPPS	AUG	SEPT
	▲ 3¢/lb	◀▶

HIPS	AUG	SEPT
	▲ 3¢/lb	◀▶

Still, Chesshier sees potential for a reversal of this upward trajectory as early as this month, citing continued lackluster demand domestically and plant operating rates that are still below 60%. "Lots of competition from both low-cost PS imports and domestic supplies," is how Barry characterizes the PS generic prime spot market going into this month.

PVC PRICES UP

PVC prices increased by 2¢/lb in August as suppliers implemented that month's increase and were aiming from another 4¢/lb price hike for September, according to Paul Pavlov, RTi's v.p. of PP and PVC and *PCW*'s senior editor Donna Todd. This is after dropping 2¢/lb in June and rolling over in July. Pavlov ventures that September and possibly this month would be a rollover owing to continued weak demand, ample supplies and raw materials cost stability. Todd initially ventured that suppliers would likely get 1¢/lb of the nominated September price hike. A continuation of higher PVC exports has led some industry sources to believe that all that matters anymore in determining domestic PVC prices is the export market, according to Todd.

PVC Price Trends

Pipe	AUG	SEPT
	▲ 2¢/lb	◀▶

Gen. Purpose	AUG	SEPT
	▲ 2¢/lb	◀▶

However, one unplanned and two planned ethylene cracker shutdowns going through September and into this month prompted an increase in ethylene prices, giving some support to PVC suppliers' price moves. Yet another is concern of a hurricane making a landfall in an area with ethylene or PVC plants, as indicated by one PVC supplier who justified the Sept. 4¢/lb increase as a "weather hedge."

PET PRICES UP, THEN DOWN

PET prices moved up 3¢/lb to 4¢/lb in August, based on raw material formulation contracts, particularly higher prices of paraxylene driven by higher crude oil octane values during the summer months, according to Mark Kallman, RTi's v.p. of PVC, PET and engineering resins. Still, he saw the potential of a 2¢/lb to 3¢/lb reduction within the Sept.-Oct. time frame, as octane values ease up along with continued ample domestic PET resin inventories and lower cost PET imports.

PET Price Trends

Bottle Grade	AUG	SEPT
	▲ 3-4¢/lb	▼

Editor's Note: Go to *ptonline.com* for pricing forecasts on ABS, PC, nylon 6 and nylon 66.

Plastics Processing Activity Held Steady in August

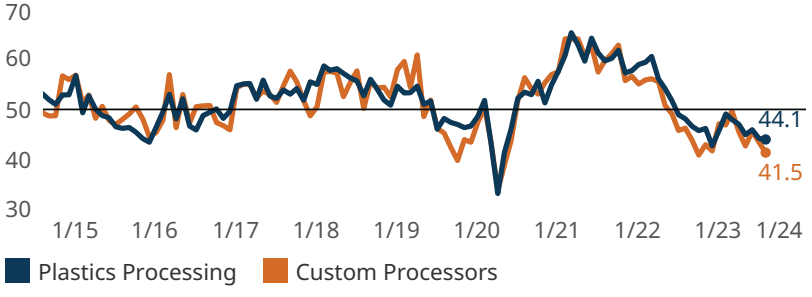
Monthly index indicates overall plastics processing activity stayed on its path of contraction.

By Jan Schafer

The Gardner Business Index (GBI): Plastics Processing closed July at 44.1, the lowest it has been in 2023. The index is based on survey responses from subscribers to *Plastics Technology*. Indices above 50 signal growth; below 50, contraction.

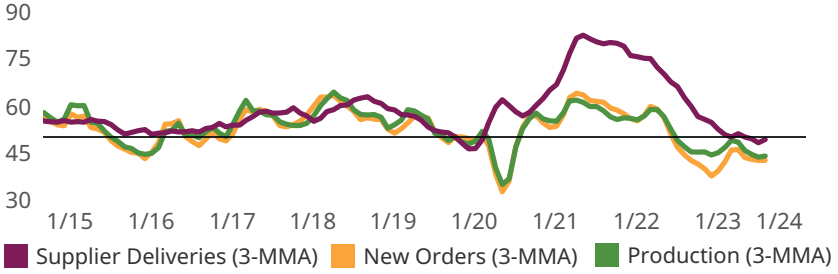
All six components contracted again in August, half contracting faster and the other half contracting slower than July. The component activity mixed bag is more encouraging than not given the nature of the components that are faring better this month. Employment, exports and backlog all contracted faster in August, reinforcing that they lag or are less dependent on new orders and production.

FIG 1 The Gardner Business Index (GBI): Plastics Processing



Plastics processing activity contracted in August at about the same rate as July for both total plastics processing and custom processing.

FIG 2 Mixed Bag for Components Activity



Some components contracted slower, others faster, in August. Components that contracted slower make for a more hopeful picture.

ABOUT THE AUTHOR: Jan Schafer is director of market research for Gardner Business Media, parent company of both *Plastics Technology* magazine and Gardner Intelligence. She has led research and analysis in several industries for over 30 years. She has a BA in psychology from Purdue University and an MBA from Indiana University. She credits Procter & Gamble for 15 years of the best business education. Contact: *513-527-8952*; *jschafer@gardnerweb.com*.

Numbers in Perspective

In the recent third-quarter survey by the Federal Reserve Bank of Philadelphia, forecasters revised GDP growth expectations to 2.1% this year and 1.3% next year, up from prior forecasts. These changes hold significant implications for plastics, with three key considerations.

By Perc Pineda
Plastics Industry Association

First, the sustainability of the robust labor market is in doubt. The 0.8% unemployment rate in plastics and rubber products manufacturing noted in April surged to 5.6% in August, signaling a slowdown in production, including a loss of 3,700 jobs. This mirrors the overall U.S. unemployment rate's increase from 3.5% in July to 3.8% in August.

Second, household spending resilience is questioned. Despite a strong labor market, signs of cooling persist. Concerns arise about the sustainability of consumer spending, given potential higher debt service payments as student loan repayments resume and interest rates remain high.

Lastly, plastics production this year is expected to lag last year. Plastics production serves as a leading indicator of manufacturing and retail activity, reflecting production, delivery lead times and inventory levels. Retailers have been building inventory since December 2022, growing from $768.2 billion to $782.8 billion in June this year. Strong household spending prospects for the remainder of 2023 will likely deplete existing inventory before translating into new orders and shipments.

ABOUT THE AUTHOR: Perc Pineda, Ph.D., chief economist of the Plastics Industry Association (PLASTICS), is an industry thought leader and PLASTICS' primary expert and spokesperson on the U.S. and global economy, industry research, statistics, trends and forecasts. He produces PLASTICS' two annual flagship publications — *Size & Impact* and *Global Trends* — and trademarked the Global Plastics Ranking. Read his views and insights on the economy and the plastics industry at *plasticsindustry.org*.

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TECHMER PM — DALTON, GA.

Compounder 'Walks the Walk' on Sustainability

Sustainability is one of Techmer PM's four pillars and guiding principles. And the company has recently earned third-party certification that ensures at least 99% of its waste is diverted from landfills.

By Jim Callari
Editorial Director

As retailers, brand owners and OEMs continue to push for more sustainable products, processors and compounders are making changes in their operations to make sure their products are up to snuff.

One such company is Techmer PM, a compounder that earlier this year received a Zero Waste to Landfill Certificate for its 45,000 ft^2 compounding operation in Dalton, Georgia. At that facility, Techmer PM formulates PP, polyester, nylon, PLA and other materials primarily for the synthetic fibers market.

In reality, the Georgia plant is one of three of the company's facilities that has been zero waste to landfill for more than two years. But the certificate, issued by Intertek, a leading Total Quality Assurance provider to industries worldwide, "demonstrates our leadership and proactive approach to environmental stewardship," says Kaan Serpersu, Techmer PM's product development and sustainability manager.

The certification confirms that Techmer PM has successfully implemented and maintained a comprehensive waste management system — ensuring at least 99% of waste generated within the organization is efficiently diverted from landfills and redirected toward sustainable alternatives such as recycling, reusing and energy recovery.

The company's sustainability efforts encompass all aspects of its operations, from manufacturing processes to administrative functions. With a focus on minimizing waste generation, Techmer PM has implemented innovative recycling initiatives, resource optimization strategies and employee engagement programs to foster a culture of sustainability.

Notes Serpersu, "Among the many things we've done to earn this certificate was getting agreements from our waste vendors that if they were picking scrap materials for us for recycling that they were truly going either to recyclers or for waste to energy. When we have our pallets picked up, we issue bills of lading so that we know how much waste is being picked up and how much of each waste stream is going where."

States Steve Loney, Techmer PM's director of marketing, "We've worked with Intertek on other certifications, like for our ISO 9001 certification, but we specifically sought the Zero Waste to Landfill as a way to demonstrate that Techmer is all about 'we do what we say we do, and we can prove it.'" Because Techmer PM runs a lot of color concentrates, any off-spec product isn't particularly appealing to recyclers because of the presence of pigment. These products are either reintroduced into the process or diverted to a waste-to-energy provider.

Techmer PM's employees at its plant in Georgia helped it earn a Zero Waste to Landfill Certificate. Photo: Techmer PM

But, adds Serpersu, "there are a lot of other practices that we've implemented that earned us this certification, little things that you might otherwise not think about. For example, any rags we use for cleaning our facility are sent to our cleaning service and returned, not discarded in the trash. Plus, a lot of the additives we used come in bags that can't be necessarily recycled, so finding an alternative solution for this, like waste to energy, is part of this process. Even the organic waste we generate gets collected by our site manager and repurposed as compost for his chickens."

The company plans on earning Zero Waste to Landfill Certification at its five other plants as well. Notes Serpersu, "Sustainability is one of our four pillars, and one of our guiding principles is being an environmental steward in industry."

Adds Loney, "We are the liaison between the brand owners, the processors and the designers. And part of that is helping them achieve their sustainability goals. Our Zero Waste to Landfill Certificate shows we're walking the walk, while at the same time implementing policies that are part of our strategic pillar and our values." PT

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