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TOP SHOPS

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Top Shops at 10 Years

The 2026 survey, based on 2025 operations, reveals injection molders' resilience in the face of rising resin prices and trade turmoil.

By Tony Deligio

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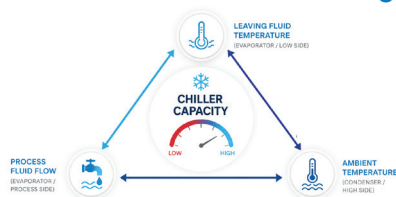


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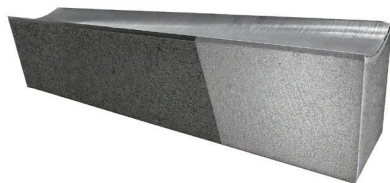


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The Truth About Chiller Capacity: Understanding the Chiller Capacity Triangle

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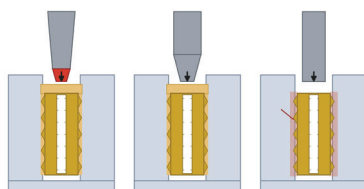


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Top Shops celebrates a decade of benchmarking in 2026. See story on pg 26 for list of honorees

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Giving the Power of Data to Your People

The once forgotten mountains of data made possible by Industry 4.0 have a new purpose — empowering your employees.

A year ago in this space, I wrote about people being a company's most important asset, as I reflected on 2025's *Plastics Technology* Top Shops. This time around, let's talk about a company's second most important asset — data — and how it can grant superpowers to that first asset.



Tony Deligio
Editor-in-Chief

Over the last few months in conversations with plastics professionals across various segments, and in articles within the pages of this publication, there is a latent realization of the incredible value of data. Today's AI moment follows on the heels of the Industry 4.0 push of the mid aughts — a manufacturing-wide movement that, like many attempted paradigm shifts, was perhaps ahead of its time but the fruits of which can be fully

appreciated today.

For me, Industry 4.0 was about making dumb machines smart. Picture a fan. In the past, it had two modes — on or off — and only one speed: full bore. Being on or off and the speed with which the blades rotated was in no way impacted by the greater environment around the fan, which sat idle or spun at full tilt in blissful ignorance. Now picture a smart fan. Using sensors to gauge ambient temperatures, and independent of human interaction, it turns itself on, and then given those environmental conditions, varies the speed with which it spins its blades. Another aspect of its intelligence is the ability to communicate with other smart machines. A fan cooling a motor can take signals from/communicate with that motor to anticipate and alter its workload.

Beyond uniform communication protocols and advances in sensors, what made all that possible? The collection and interpretation of data. Ultimately, it was more data than the systems of the day could use or meaningfully analyze and perhaps it was the realization of that shortcoming which dulled Industry 4.0's luster. Well, it's time to polish those Industry 4.0 capabilities to a brilliant shine.

Last month, I mentioned the framing for AI's current moment provided by Alicyn Rhoades, vice chancellor and associate dean for research and graduate studies at Penn State Behrend, Erie, Pennsylvania. Rhoades, whose institution is determining the best way to incorporate AI into its teaching and research, reflected on her own work as a researcher over the years and how she now views it through a new lens.

"My group has spent a decade studying the crystallization of nylon 6 and 66, generating data that companies wanted but couldn't incorporate," Rhoades says. "AI is changing that. R&D is more important than ever, because all the body of literature that polymer scientists have developed becomes useful. It's not there yet, and we're working on it, but AI has taken in literature we've developed and given me suggestions on what to do next, and I'm like, 'Holy cow! How did I not see that?'"

Within this issue, PT's Matt Stonecash reveals how chemical

company Kuraray is feeding AI tools its internal data to radically alter plant maintenance. As Kuraray's Charles Neal explains in Matt's piece: "We had to give ourselves permission to use our data in this way: I need to set my data free, and let it work for me," explains Neal.

Also in this magazine, Mario Haidlmair, leader of the eponymously named moldmaker, shares his company's vision, which is reliant on data, in a piece of sponsored content.

In the full interview, which is available online, Haidlmair lays out its digitalization program, which involves AI, big data and sensors collecting and sharing data.

"I don't know if you, if you've seen the movie *The Terminator* — Skynet controlling all — so we have the HiNet. All the information and the data go in there and will be processed and transformed and then sent out to our different hubs."



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Billion and Engel Announce Partnership

French injection molding machine manufacturer Billion SAS and Austria-headquartered Engel have entered into a strategic partnership, effective immediately, wherein Billion will remain the central point of contact for servicing existing Billion machines, while Engel assumes the role of recommended supplier for new equipment purchases. For customers, this means continuity and reliable planning for their existing fleet and future investment.

Billion will remain an independent company that will recommend Engel as its preferred machine supplier. Both being family-run businesses, the companies share a common set of values built around long-term, responsible decision-making for the benefit of customers, employees and partners.

A statement from Georg Kiesl, managing director at Billion SAS, laid out what the change means for Billion going forward. “We will no longer manufacture our own machines and will instead recommend Engel machines as the solution for new machine requirements. We will continue to provide the service and retrofit options our customers rely on.”

Customers can now benefit from Engel’s backing, including its global sales and service network as well as global manufacturing and supply chain capabilities. “Billion will be able to draw on Engel’s service network and technical expertise,” Engel noted.

The partnership also means that customers will be able to see Engel equipment at Billion’s tech centers. In addition to its existing sales office in Wissous, France the partnership gives Engel the opportunity to make use of Billion’s other facilities globally.



Arburg’s Mexican Subsidiary Under New Leadership

Julio Lopez has taken over leadership of Arburg S.A. de C.V. — the German injection molding machine maker’s subsidiary in Querétaro, Mexico. The 57-year-old takes over for Mario Rodríguez Navarro. Navarro was named managing director of

Arburg’s division in Querétaro in July 2023, when he replaced Guillermo

Fasterling. Fasterling helped establish and expand the subsidiary, which began operations in 2008.

Arburg notes that Mexico remains an attractive manufacturing hub for key industries that drive the plastics sector, including automotive, electronics, aerospace, medical, packaging and consumer goods. The country’s competitive advantages include lower costs compared to the U.S. and Canada, a qualified workforce, a strong industrial base and close integration with North American supply chains.



District Judge Rules for Oregon in EPR Lawsuit

District Judge Michael Simon has ruled in a case brought by the National Association of Wholesalers (NAW) against Leah Feldon, director of the Oregon Department of Environmental Quality (DEQ). NAW claimed that the extended producer responsibility (EPR) program established by Oregon SB 582, the Plastic Pollution and Recycling Modernization Act, was unconstitutional. The ruling for the defendant means that the act stands as-is, and all Oregon producers will be responsible for paying fees including NAW members.

NAW’s case centered around the dormant commerce clause and the due process clause. NAW argued that EPR discriminates against out-of-state businesses by holding them to Oregon-specific rules, and EPR fees are unreasonable and place too much of a burden on commerce. The court rejected these claims, finding no discrimination in purpose or effect that the fees were not disproportionate to the services provided and compliance costs on producers do not constitute a burden on interstate commerce.

NAW argued that the fee methodology created by the Circular Action Alliance (CAA) is confidential, preventing producers from challenging it, and that the CAA’s producer contracts lack procedural protections. The court rejected these claims, ruling that participation in the CAA EPR is voluntary and that the DEQ’s review of the methodology is sufficient.

The ruling lifts a preliminary injunction in February that paused enforcement of the act on NAW members. The act will now be applicable to all entities defined as producers selling into Oregon. The legal arguments and precedent established are likely to be referenced in other states, with similar challenges to EPR programs in California and Colorado.

ReBioCycle Demonstrates Closed-Loop Recycling of PLA Bioplastics from Mixed Plastic Waste

The EU-funded ReBioCycle project has demonstrated that polylactic acid (PLA) bioplastics can be recycled from mixed plastic waste and returned to virgin-quality material, marking a significant step toward circular packaging in Europe.

The sorting process was carried out at pilot scale in an operational environment, showing that recycling of PLA is technically viable beyond the laboratory. This provides a practical pathway for integrating bioplastics into existing waste streams and recycling systems as the industry faces increasing pressure under the EU Packaging and Packaging Waste Regulation (PPWR), which requires all packaging to be recyclable by 2030.



The project confirmed PLA can be effectively sorted using existing technologies and achieve suitable purity levels.

The recovered material was then successfully broken down into its core building block—lactic acid—using Torwash's hydrolysis technology. In the final step, TotalEnergies Corbion demonstrated that this recovered lactic acid can be repolymerized into recycled PLA with properties equivalent to virgin material.

Project coordinator Kevin O'Connor says the results demonstrate that circular solutions for bioplastics are already within reach. "We've connected the full value chain in a way that supports both regulatory compliance and the transition away from fossil-based to bio-based materials."

The results provide timely evidence that bio-based plastics can play a central role in a circular economy. "Demonstrating that recycling PLA from mixed-waste collection to new high-quality PLA material is a reality is a major step in fulfilling the ambitions of the PPWR in terms of packaging recyclability," says Maeleenn Ravard, regulatory and sustainability manager at TotalEnergies Corbion.

The consortium will focus on turning this technical success into market reality by developing new applications using recycled PLA, while scaling the process toward full industrial deployment.



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RJG Reveals iMFLUX Plans With Integration Complete

A little over a year after its acquisition of the company, RJG shared the synergies it sees between its sensor and process control technologies with iMFLUX's constant-pressure molding.

By **Tony Deligio**
Editor-in-Chief

Save a brief period when he struck out on his own as a consultant, Brandon Birchmeier has spent nearly all of his professional life going back to 2013 enmeshed in the development, application and refinement of iMFLUX's constant-pressure injection molding

technology. Now that injection technology and training supplier RJG — which Birchmeier joined in August 2024 — has fully integrated iMFLUX into its portfolio, he and the technology have come full circle. “Eight months after I joined RJG they brought on the iMFLUX technology,” Birchmeier says. “I got all my toys back.”

In 2013, Birchmeier was part of a team at P&G tasked with developing technologies to support the use of softer tooling steels, including aluminum, for one-and-done or limited-term molds that would enable faster lead times. The team quickly realized the inherent challenge of mixing the higher pressures of injection molding with the softer surfaces of aluminum and began investigating ways to reduce injection pressures. Eventually, the pursuit of soft tooling fizzled out while the research into lower-pressure molding heated up.

In those early years, the technology was completely internal to P&G, and what would eventually become iMFLUX marked the first instance of a third-party system taking over control of a molding machine's injection unit, including screw speed, to maintain constant pressure. That capability was based on two algorithms that are still in use today — Process Factor A (PFA) and Auto-Viscosity Adjust (AVA) — which will be rebranded as Smart Hold and Cavity Fill Time Compensation, going forward.

iMFLUX eventually moved beyond P&G's walls into the molding's public domain in 2017. By 2023, however, P&G shifted its plans for iMFLUX, transitioning to R&D and licensing of the technology. In 2025, RJG became the sole licensor of iMFLUX, and less than a year after that, RJG formally acquired the company, including its core technology and intellectual property portfolio.

An RJG spokesperson framed the acquisition as a logical progression of its place in the market. “RJG has spent decades helping molders see, understand and act on what is happening inside the mold,” the spokesperson told *Plastics Technology*, “and now by combining low constant pressure technology with cavity pressure sensing, RJG is taking the next step toward a process that can automatically respond when conditions change, based on trusted data from inside the mold.”

In an August 27 event at Tier 1 automotive supplier SA Automotive's facility in Owosso, Michigan, Birchmeier revealed what iMFLUX fully integrated into RJG's CoPilot injection molding control system would look like, collaborating in a technology demonstration with machine supplier Engel and simulation provider Moldex3D.

Using a 2-cavity door-panel tool supplied by Ford and SA's 2,500-ton Engel press, the demonstration's goal was to show the particular benefits of the convergence of RJG and iMFLUX's technology in sequentially valve-gated molds. As designed, the door panel tool featured eight valve gates each, opened sequentially, to fill out the more challenging aspects of the interior trim component including multiple weld lines, speaker grill details and the potential of “tiger striping”, when one flow front stalls out and another starts, creating striations that can result in a visual defect.

Birchmeier explained that in a conventional process, with injection speeds of 2.8 in./sec. and peak plastic pressure of more



These automotive door panels were molded utilizing iMFLUX constant pressure technology, enabling use of six valve gates vs. eight.

than 14,000 psi, there would be pressure swings since the valve-gate control and the machine control aren't in direct communication. In this process, pressure climbs until a new valve gate opens, then, as it temporarily becomes easier to fill, the pressure drops again.

With iMFLUX driving, Birchmeier says instead of pressure swings when the valve gates open, there are changes in injection speed, as process velocity reacts to the gate sequence in real time for true closed loop molding. There are no intermittent pressure peaks, greatly reducing the risk of tiger stripes, and less overall pressure is required — 11,000 psi — with injection speeds of 3.83 in./sec. In addition, by using iMFLUX, only six valve gates are needed to fill the part, vs. eight, with a peak plastic pressure in this scenario of 12,576 psi. Beyond true harmony between the molding machine and the valve-gate controller, Birchmeier says additional advantages include reduced peak injection pressure and tonnage requirements, aesthetic improvement (elimination of tiger striping and better grain transfer) and the ability to handle viscosity variation in off-spec or recycled resins.

A BETTER BUCKET

The first public demonstration of iMFLUX integration into RJG's CoPilot System came at K 2025. In a novel collaboration with tooling supplier StackTeck Systems Ltd. and Moldex3D, RJG molded five-gallon buckets. While the company normally displays highly intricate, precision components at shows, in Düsseldorf the humble bucket — with an important nuance — was the draw. The “commodity” application applied RJG's sensor technology and iMFLUX pressure control, which enabled it to be molded from various grades of very low-molecular-weight post-consumer recycled (PCR) high-density polyethylene (HDPE). Sourced from LyondellBasell, these grades originated as blown film and blow molding grades with melt flow indices (MFI) of around 0.7g/10 min. With a sensor at the top of the bucket's rim near the end of fill, RJG was able to create the parts in a StackTeck tool using a material that would normally be considered impossible to mold based on its flow characteristics.

MAKE THE MOLD MATTER

Birchmeier says it is the pairing of iMFLUX's

control algorithms with RJG's sensors and the CoPilot System that has the potential to eventually point towards autonomous molding. Molders can see a 30-50% reduction in pressure by applying iMFLUX, the company notes, which makes lower clamp forces and smaller machines a possibility, as well as less hot runner drops in the case of the door-panel mold. The process also enables part-weight reduction while eliminating flash and releasing trapped gas within a tool more gently, easing vent wear. Beyond those advantages, Birchmeier sees an overarching value to applying the technologies. “The biggest benefit is this: your mold

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matters," Birchmeier says. "Normally, the molding machine doesn't know or care what you put between the platens. Now the mold is part of the equation, and the algorithms become more powerful as mold feeds back data."

He notes that in what RJG calls Decoupled Molding, so named because the filling phase is decoupled from the packing phase (velocity control from pressure control), cavity pressure readings after the gate or at the end of fill tell machine when to transfer or switch phases. "It started as a binary response," Birchmeier says. "Cavity pressure gave us a better point to make the V-to-P transfer than screw position, but we were still using one point on the curve to make one decision. Today, we can use the cavity pressure curve dynamically, allowing the process to respond as conditions change."

The Smart Hold algorithm is a direct ratioed response to cavity pressure. At the end-of-fill sensor, as pressure climbs in the cavity, it is mirrored by machine pressure. "Once cavity pressure peaks out, it plateaus," Birchmeier says. "This makes your mold unflashable. It's one of the reasons RJG is integrating the two technologies. It allows us to take cavity pressure to the next level." He likens it to the step change in sensors in vehicles. While initially they would alert drivers to hazards or show them a location of a curb, they now take over driving itself, parallel parking the car or providing driverless capabilities, for instance. "What cavity pressure did for decoupled molding, it does even more for iMFLUX," Birchmeier says. "That's why it's such a great marriage."

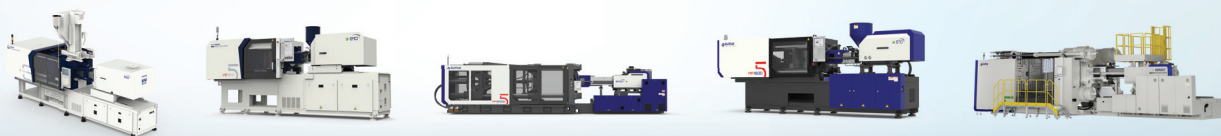
For the other algorithm that iMFLUX developed while it was still part of P&G — Cavity Fill Time Control (formerly AVA), which measures the melt's MFI using constant pressure — there are benefits as well, particularly as it relates to material selection. "We turn your barrel into a big rheometer," Birchmeier says. "It's so sensitive it can tell me when there are changes in the viscosity of the material, and we adjust." This allows the technology to compensate for big swings in material viscosity, opening doors to resins often passed over for injection molding. "If we can melt it, we can mold it," Birchmeier says, noting that when it comes to PCR materials, for example, many resin suppliers and compounders try to make them process just like virgin resins, driving up their cost. "We ask compounders, 'How would you reformulate if you didn't have to be so picky,'" Birchmeier says. "A lot of compounders sort out fractional melt, they don't want it in injection grades. We tell them, 'You don't have to sort it.'"

Starting at P&G and originally targeting packaging applications, including living-hinge closures, iMFLUX has new opportunities in larger parts, particularly if an existing process is pressure limited. "If you are velocity limited today, we can't really help," Birchmeier says, "but if you're pressure limited, we can help you." Balanced filling, which reduces stress, particularly around the gate, and is very good for grain transfer, with parts packing as the fill, could have another benefit, according to Birchmeier. "We want to bring back family molds," he says, enthusiastically. PT

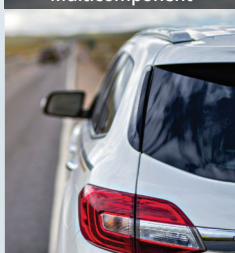
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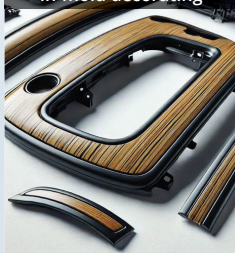
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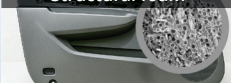
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By **Matt Stonecash**
Associate Editor

Polyvinyl Alcohol (PVOH) is a water-soluble polymer with adhesive and mechanical properties that open it up to a wide variety of applications. It's used in barrier films, protective

coatings, glues and paints, laundry pods and contact lenses. In the production of PVOH and its precursors, corrosion is a constant enemy.

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Keeping such a facility operational requires diligently adhered to and conservatively designed maintenance schedules to maintain mechanical integrity and reliability. The task is labor intensive. Even still, unexpected failures can result in costly downtime, especially as most systems are not redundant. A successful maintenance program must balance the mitigation of these failures against the cost of inspections and preemptive replacement.

New tools are leveraging AI technology to provide greater insight into equipment status, presenting an opportunity to transform reliability programs. Kuraray America (KAI) has seized that opportunity, implementing Pinnacle's failure prediction tool, called Newton, at its PVOH production facility in La Porte, Texas.

The PVOH business is a core to the company — it both supplies PVOH as raw material and uses it to manufacture polymer films

and the inner polyvinyl butyral (PVB) layers of laminated safety glass and windshields. The business unit supplies manufacturing in Europe and Singapore, as well as the U.S., so any interruption to production can have wide-ranging impacts. The company chose its La Porte site, a key PVOH asset, to test a promising new approach to reliability.

LETTING DATA OUT OF THE BOTTLE

"We were seeing a range of corrosion-related problems, things that reflect the age of the facility," says Charles Neal, general manager of the polyvinyl alcohol business at KAI. To trim the maintenance budget and get better operational effectiveness, the business partnered with Pinnacle to bring in the computational power of machine learning and Bayesian statistics for analyzing inspection results and other asset-health data.

The first step was freeing up data so it could be classified, mapped and loaded into Newton, moving away from the practice of keeping data bottled up. "We had to give ourselves permission to use our data in this way: I need to set my data free, and let it work for me," explains Neal.

Cognite, an industrial operations platform, was used to process data from operator rounds, distributed control systems (DCS), lab analysis and inspection reports. In the past, a transition of this kind would have required painstaking hands-on work to map data fields correctly and form a unified system. But Cognite is able to read reports and determine where each data point belongs, automating that process.

This mapped data stream is the input to Newton's analytics, which uses it to perform all the reliability and integrity calculations, and recalculates them every time there is a new inspection, the DCS reports a change in operating conditions or there is a new oil- or vibration-analysis result. Based on the results, the system forecasts future failures and impact on availability, so that the best value work can be identified.

FLEXIBILITY TO ADAPT TO CONDITIONS

According to Neal, the project has fundamentally changed how the company approaches maintenance.



KAI's Bayport PVOH facility in Texas.

Source: Kuraray America

“Before the change, you would identify a top 10 list of bad actors and spend the following year punching your way down that list. Now, that list is always changing in real time. As new data is collected, it’s being monitored by Newton, shifting those priorities.”

Between scheduled inspection intervals, a change in corrosion rate might previously have gone undetected until it led to a bigger problem. Besides continuously analyzing new data, the system can also spot unreliable data or identify where new data sources, such as a new sensor, are needed to make better predictions.

At first, maintenance costs actually went up. “We were teaching the plant how to tell us where it hurt, and once we knew where it hurt, we needed to go fix it,” says Neal. But now that the plant has learned to speak, it’s mostly quiet. “It’s run out of things to complain about.”

In addition to telling engineers where attention was needed, the model also illuminates where it isn’t. A better understanding of the condition of components allows more conservative approaches to be scaled back, eliminating superfluous inspections and freeing staff to work on tasks more likely to improve uptime.

AN EARLY WIN KEEPS THE SUPPLY FLOWING

In August of 2025, the system estimated that a heat exchanger in the vinyl acetate production loop had an almost 100% chance of a

failure in one of 200 tubes by the following March. Had the 22-foot tube failed, it would have required a week to lock out and shut down the system, a month to order and be shipped a custom-made replacement, followed by a week to unlock and start up. No one could have known at the time, but a stoppage in March would have been particularly inconvenient because supply disruptions related to the U.S. war on Iran meant that La Porte had to pick up production to support customers in Asia. Instead, the tubes were ordered ahead of time and the replacement was executed during the planned November shutdown.

That big save, along with consistent concordance between Newton and legacy systems, gave the company the confidence to fully transition, adopt and trust the system. “When we get divergence, it’s usually because the Newton model is reporting something that we wouldn’t have seen in our legacy system,” says Neal. Now the company is using Newton not only to plan maintenance but also to project capital maintenance expenditures.

Building on the success of the program at the La Porte facility, KAI plans to take it to the next facility in Bayport, with an assessment phase expected to be completed in September. Bayport is also a PVOH production facility, but the approach should be applicable to other types of manufacturing operations, wherever reliability engineers need data modeling to focus resources where they are most impactful. **PT**

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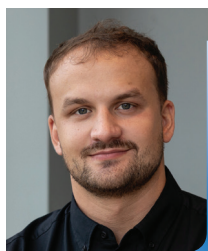
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MATERIALS

Drop-In Materials? A Strategic Approach — Part 3: Processing Considerations

The replacement material you've identified meets product specification but is its processing behavior and shrinkage compatible with the existing mold and process?



By Hunter Beaumont

The concept of having multiple “drop-in” materials for a given application is appealing from a supply chain and manufacturing robustness standpoint. However, finding the right drop-in material

is often more difficult and nuanced than it first appears. The process is typically simplified to focus on end-part performance. You try to find a resin within the same polymer family, apply a similar additive package and filler content and then seek out similar mechanical properties and a matching Melt Flow Rate (MFR). If the expected mechanical properties and regulatory requirements are met, the

material is considered a suitable replacement. Unfortunately, the material you find could be a drop-in replacement for the product specification, but not a drop-in replacement for the molding process. (Ed. Note: Part 1 of this series addressed mechanical performance, and Part 2 looked at temperature effects).

What is often overlooked is the need to fill the part in an existing mold, designed for another resin, and still achieve the specified part dimensions. A material that meets the product specification may not behave the same way during molding, even when its data-sheet properties appear similar. A true drop-in replacement therefore needs to be evaluated not only for end-use performance, but also for how compatible its processing behavior and shrinkage are with the existing mold and process.

A successful material replacement must satisfy more than the requirements of the finished part; it must also be moldable within an acceptable processing window. The hope is often

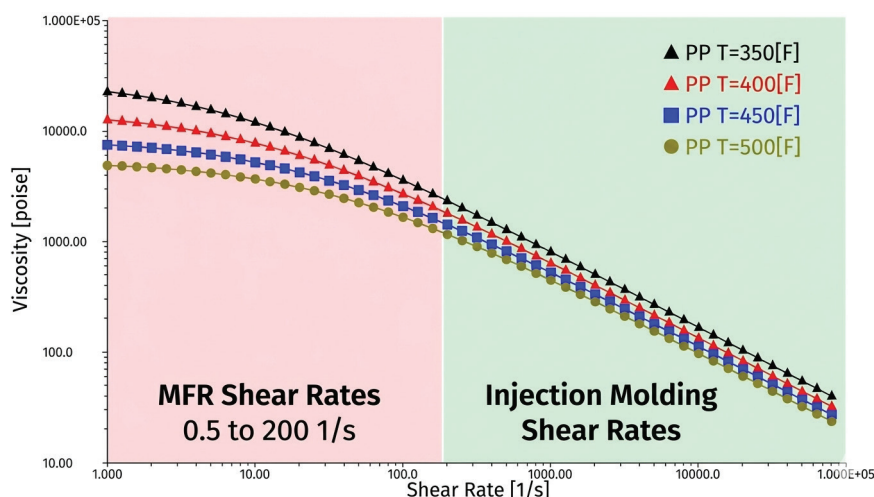
to minimize changes to an existing process, but assuming the original process can simply be copied may create unexpected manufacturing problems.

The material's viscosity and thermal behavior influence what machine is needed to run the process, the expected cycle time and the end part dimensions. But because datasheets often fail to capture true viscosity, or viscoelastic behavior, two materials that look nearly identical on paper can require substantially different processing conditions.

WHY MFR DOES NOT TELL THE WHOLE RHEOLOGICAL STORY

One of the first properties engineers typically compare when looking for a replacement resin is melt flow rate (MFR), also called melt flow index (MFI). This is a useful screening tool because MFR is related to the relative molecular weight of a resin. In general, higher molecular weight produces higher melt viscosity and therefore lower MFR. However, MFR should not be treated as a complete description of how a material will flow during injection molding.

FIG 1 The typical shear rates seen in a melt flow rate are much lower than in injection molding applications. Source: (all) Madison Group



The standard MFR test (Fig. 2a) measures the amount of material that flows through a die over a fixed period of time under a specified temperature and load. Injection molding, on the other hand, subjects the polymer to a much broader range of speeds (shear rates) and temperatures. The shear rates experienced through a runner and gate (for example, 10^3 to 10^5 s^{-1}) can be orders of magnitude higher than those present during an MFR test ($<10^2$ s^{-1}).

This difference matters because polymer viscosity is dependent on shear rate. A material that appears equivalent under the relatively low-shear conditions of an MFR test may behave very differently as the shear

rate increases during injection molding.

Capillary rheometry (Fig. 2b) provides a much better way to characterize this behavior. Like an MFR test, it measures the flow of molten polymer through a die, but it allows the material to be evalu-

ated across a range of shear rates and processing conditions. The resulting viscosity-versus-shear-rate relationship provides significantly more useful information for understanding how a material

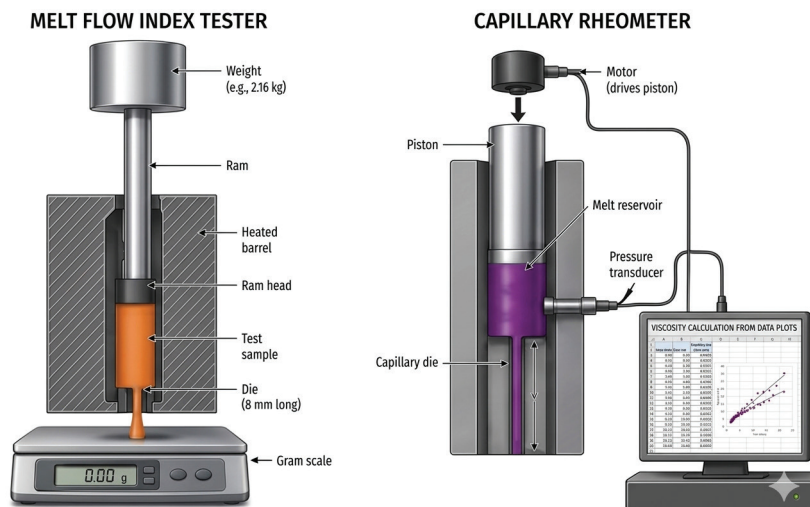


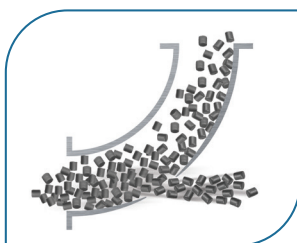
FIG 2A A schematic of a standard Melt Flow Index (MFI) tester, providing a single-point measurement of a low shear, weight-based flow rate. **FIG 2B** A schematic of a capillary rheometer. Unlike the MFI test, capillary rheometry is a more advanced method that captures the material's true viscosity profile across a wide range of higher shear rates and temperatures, closely simulating processing conditions such as those found in injection molding.



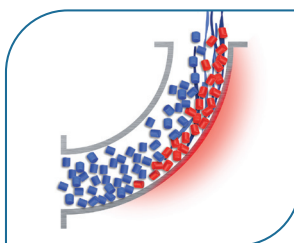
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2 PROBLEMS

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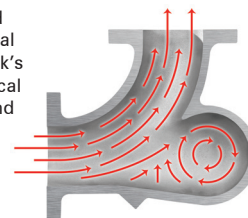


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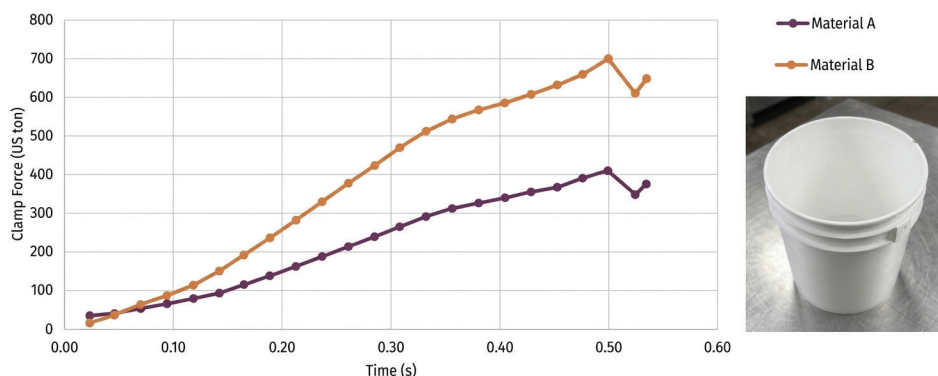


FIG 4 Clamp tonnage required to fill a 5-gallon bucket mold using two different 18g/10 min. MFR HDPE resins.



will behave in an injection molding process. MFR is valuable for narrowing down potential replacement materials but should not be used as proof that two materials will flow through a mold identically.

MOLECULAR WEIGHT DISTRIBUTION'S PROCESS IMPACT

Even when two materials have the same average molecular weight, their molecular weight distributions (MWD) can be different. Polymer resins are not made up of chains that are all the same length. Instead, they contain a distribution of shorter and longer molecular chains.

While materials with differing MWDs may display identical low-shear viscosity and MFR, their shear-thinning behavior diverges substantially at processing shear rates. Conversely, changing average MW alters the low-shear viscosity plateau (0), but high-

process beyond the available machine capacity.

Take the two high-density polyethylene (HDPE) materials in Fig. 4, both having an MFR of 18g/10 min. Based on MFR alone, they would appear to be equivalent from a processing standpoint. Yet the required tonnage for a five-gallon bucket was 400 tons for material A and 700 tons for material B.

Changing from material A to material B may result in a narrower processing window. This means that the molding process should be evaluated as part of the material substitution exercise rather than assuming it is something that can be automatically carried over from the incumbent resin.

THERMAL DIFFERENCES CHANGE MORE THAN CYCLE TIME

Being able to fill the mold is only part of the processing equation. Thermal behavior can also differ between materials that otherwise appear similar. Differences in melting behavior, glass transition temperature, crystallization behavior and thermal transitions can change how quickly a molded part develops a frozen layer and when it can be ejected. As a result, a replacement material may require a different cooling or cycle time when the mold and nominal processing temperatures remain unchanged, or the mold and melt temperatures may need changes to achieve similar cooling rates.

The consequences of thermal differences can extend beyond

Thermal Behavior of Three Nylon Grades

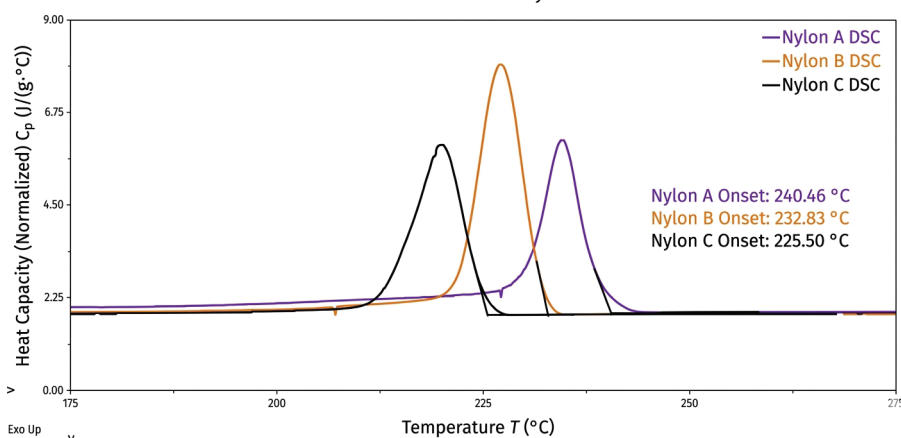


FIG 5 The cooling phase of a Differential Scanning Calorimetry (DSC) thermogram for three "datasheet-equivalent" nylon resins. The materials have differences in recrystallization during cooling such that Nylons B and C may need a longer cooling time to allow the part to fully crystallize and achieve the ideal mechanical properties.



FIG 6A The cracked boss feature encountered when using the replacement material.

cycle time. Figures 6a and 6b highlight an example where a water softener manufacturer was successfully molding a housing component using a glass-fiber-filled polyphenylene ether+polystyrene (PPE+PS) material until it had to switch materials due to regulatory changes. The replacement material actually had superior mechanical properties, but it would not pass their pressurized leak test due to a cracked boss feature.

Upon further inspection of the material's thermal behavior using differential scanning calorimetry (DSC) data, it was discov-

ered that the replacement material had a higher transition temperature. The replacement material cooled more quickly and restricted the pack time in the problematic boss region by 25% or about three seconds. The resulting difference in packing contributed to higher volumetric shrinkage in the thick boss and higher residual stresses that ultimately led to a cracking failure.

Material datasheets seldom include important thermal transition data that can be used to make comparisons when evaluating a drop-in material. The material's thermal behavior determines what is actually happening inside the cavity. Therefore, simply matching the programmed pack and cycle times is not necessarily enough.

SIMILAR MECHANICAL PROPERTIES DON'T GUARANTEE SIMILAR SHRINKAGE

Shrinkage is another area where a material substitution can create unexpected problems. While dimensions can be manipulated through variations in the cooling and packing strategies, the material itself also plays a major role.

Molecular weight, molecular weight distribution and thermal behavior can all influence the amount of shrinkage. These differences may not be obvious when comparing conventional datasheet properties. Two materials can have similar MFR, heat deflection temperature (HDT), tensile strength and modulus while producing different molded dimensions.

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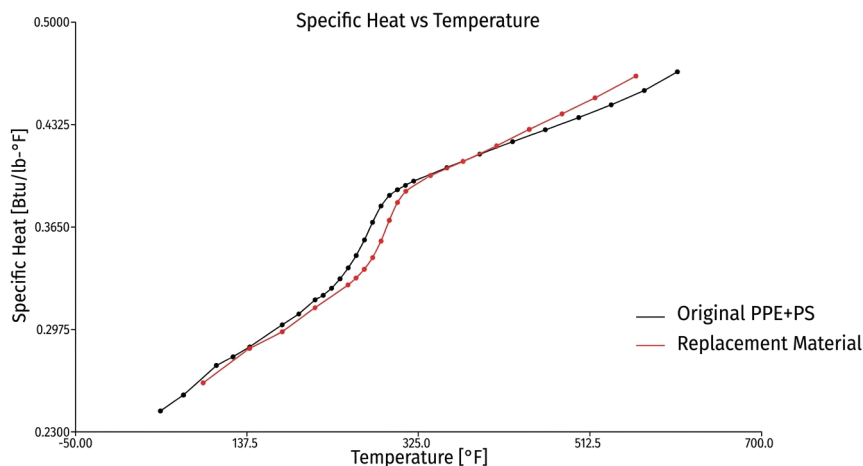


FIG 6B Highlighting the difference in transition temperature between the original material and the replacement material, which led to underpacking the boss feature.

This is especially important for semi-crystalline materials, where crystallization behavior can have a significant effect on volumetric shrinkage. Even within the same polymer family, different grades can produce different part dimensions because of differences in molecular structure and thermal behavior.

Differences in material shrink rates create a problem when trying to hold tight dimensions. The mold steel dimensions have

already been cut to intentionally compensate for the incumbent resin's shrinkage. A replacement material with a different shrink rate can therefore produce dimensions outside tolerance even if a new robust molding process is developed for the replacement material.

The problem can become more difficult if the replacement material narrows the processing window into a pressure- or tonnage-limited situation. Changing the packing pressure is one of the primary ways to manipulate the molded dimensions by compensating for volumetric shrinkage. However, if the replacement material requires substantially more pressure to fill, there may be insufficient

clamp force available to increase packing pressure without causing mold separation or flash.

A replacement resin should therefore be evaluated not only for whether it can fill the cavity, but also for whether it can produce the required dimensions within the available processing window.

Before committing to full-scale production trials, injection molding simulation and smaller-scale molding trials (such as

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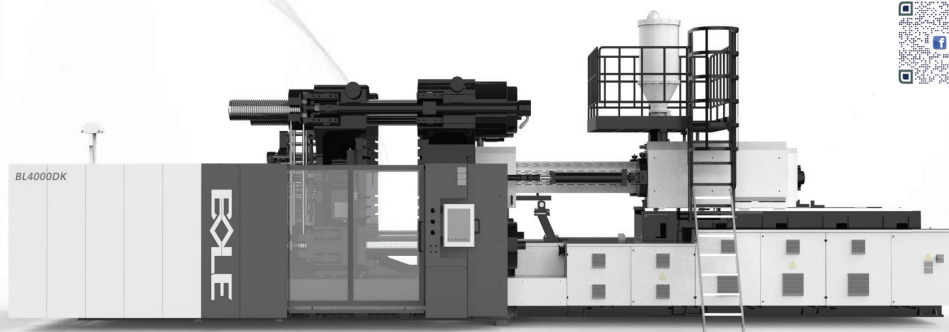


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shrinkage plaque testing) can be used to identify drop-in materials with shrink rates that are most similar to the original resin, to help determine which candidates are most likely to achieve the desired part dimensions. This data-driven approach can help narrow the list of potential replacements and ensure target dimensions are met without the need for lengthy and costly production mold trials or expensive mold modifications, saving both time and money.

The goal is not necessarily to find a material with an identical datasheet shrinkage value. It is to identify a material whose actual, molded, shrinkage behavior is compatible with the existing tool.

HOW SHOULD A DROP-IN REPLACEMENT BE QUALIFIED?

A practical evaluation should begin with the available material data. MFR is useful for screening, but viscosity data across relevant shear rates provides a better comparison of processing behavior. Understanding the thermal behavior of a material can help identify potential differences in cooling and shrinkage behavior, while measured shrinkage data can provide an early indication of dimensional risk.

Injection molding simulation can then be used to compare candidate materials before committing to extensive physical trials. Physical molding trials remain important for final qualification, but simple material characterization and simulation can

reduce the number of materials that need to be sampled and help identify the process changes that will be required.

DROP-IN MATERIALS DON'T ALWAYS = DROP-IN PROCESSES

The most important concept when replacing a resin is that similar datasheet values do not guarantee identical processing behavior. A successful drop-in replacement therefore requires looking beyond whether the new material can meet the product specification to how it will affect the molding process. Additionally, the replacement can be screened proactively through smart material testing and injection molding simulation to understand differences in viscosity, thermal behavior and shrinkage before committing to lengthy molding trials. This can save time and money, while helping prevent the assumption that a new resin can simply be run using yesterday's process. [DT](#)

ABOUT THE AUTHOR: Hunter Beaumont is a project engineer at The Madison Group, where he leverages his B.S. in plastics engineering technology from Penn State Behrend and his Certified Moldflow Analyst expertise to bridge the gap between design and manufacturing success. His primary role focuses on using CAE tools and industry experience to help Madison's clients transition their designs into manufacturable products that will perform well in the field. Using simulation tools like Moldflow, he helps clients avoid common design issues that lead to narrow processing windows and high failure rates. Contact: 608-231-1907; hunter.beaumont@madisongroup.com.



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EXTRUSION

Troubleshooting Single-Screw Extruders — Part 1

Here's how to troubleshoot extrusion processes efficiently — from interviewing operators to hypothesis testing — to minimize downtime and restore production quickly.

The goal of all troubleshooting operations is to restore the extrusion process to its original performance as quickly as possible. Troubleshooting can range from solving a very simple problem, such as replacing a malfunctioning barrel heater, to a very difficult



By Mark A. Spalding

flow problem that is complicated to diagnose. Collecting the proper information on machine performance can minimize the time required to restore the machine to its original performance while reducing the cost of the troubleshooting process.

The troubleshooter must be able to listen to the information provided and then sort the important facts from the non-relevant information. Typically, the information will be a collection of facts, ideas on the root cause and data that are not relevant to the problem.

If the process is operational and producing a high level of off specification product, then the manufacturing costs can be very high. Restoring the line to its original performance quickly will reduce costs by eliminating some quality control operations and labor wasted in making scrap product. Additional benefits include reduction in resin consumption, eliminating scrap due to off-spec product and decreasing energy consumption.

Moreover, if the line is inoperable due to the defect, the downtime of the line can be extremely costly, especially if the line is sold out. The goal would be to bring the line back to production operation as quickly as possible. Often, several different solutions will be possible. The best solution will be based on a combination of the cost of lost production, the time and cost to implement, machine owner acceptance and the risk associated with the modified process.

TALK TO THE OPERATORS

The first thing that a troubleshooter should do is talk to plant personnel and process operators about the defect. Interviewing the operator and having the operator assist in the diagnosis of the problem can speed up the troubleshooting process. In many

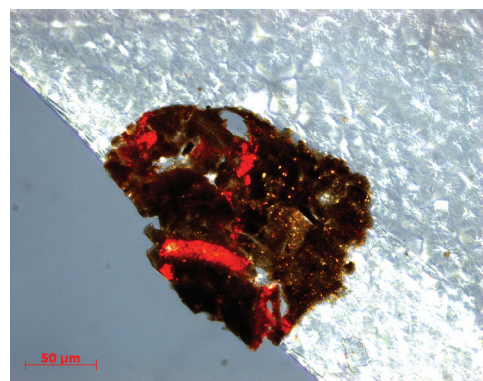
cases, the operators witnessed the event that caused the problem or can provide the recent history leading up to the failure. In some cases, the operator may have inadvertently caused the problem at hand.

After the interviews, the troubleshooter must verify the accuracy of the information. Verification of the information can be as simple as viewing computer fault information on a control panel to questioning events that are impossible to reproduce or verify. The information that is verified will become part of the basis for setting hypotheses on the root cause of the problem.

The troubleshooter should obtain the performance and modification history for the machine. This information is typically available from electronic data storage devices associated with the extruder, the machine owner, maintenance personnel and the operators. Other required data include the rate, screw speed, motor current, barrel temperature settings, and discharge pressure and temperature.



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Certain extrusion defects can be trickier to spot and complicated to troubleshoot. Shown here is a photomicrograph of an iron oxide particle on a film product.

Source: Mark Spalding

Additional sensor data are occasionally available on some machines including pressure measurements in the barrel, process rate via the gear pump rotation rate and sensors specific to a process. As a general practice, all instruments and sensors should be verified for accuracy.

The screw speed and motor current

values displayed on the control panel should be verified. For the screw speed, counting the rotations of the screw at the back of the gearbox for a time period should be performed to verify the speed displayed on the panel. Most displays show the screw speed within a 5% error, but for some processes the screw speed display has been in error by a factor of two.

Once the speed on the panel is verified, the panel speed can be used for all next steps. Verifying the motor current is easily performed by an electrician using a simple current meter. All mechanical and electrical components should be examined to verify that they are functioning properly. These components include the solenoid valves for water-cooling systems, cooling-water pumps, cooling fans, electrical heaters, thermocouples and other temperature sensors, pressure sensors and gear pump operations.

COMMON DEFECTS AND ROOT CAUSES IN SINGLE-SCREW EXTRUSION

Some of the most common root causes along with their defects are provided in Table 1. As shown in this table, several defects can occur from the same root cause, and a particular defect can be produced by several root causes. Once the root cause has been properly identified as the source of the defect, a technical solution must be devised that eliminates the root cause from the process. Often more than one solution exists. The best solution will depend on many factors including the economic conditions for the plant and product line, the cost the defect is creating at the plant, the cost and time for implementing the technical solutions,

Hypothesis testing is the fastest method to get to the root cause and a remedy.

and the risk associated with each solution. Plant personnel will ultimately decide on the best technical solution for their plant. The root causes provided in the accompanying table are just the start of a

longer list, but they are the most common causes.

Often, troubleshooting guides are provided by equipment manufacturers for common problems. These guides are helpful for many of the simpler problems associated with the equipment. Some resin manufacturers are excellent resources for troubleshooting processing problems that are specific to a resin. Subject matter experts or extrusion consultants are also resources for troubleshooting an extrusion process.

KEEP SPARE PARTS ON HAND

Spare parts for common components such as barrels, transfer lines and die heaters, thermocouples, pressure transducers, drive belts and fuses should be kept in stock. Since the goal is to maintain the line operation at all times, keeping these low-cost but necessary components in stock can reduce the amount of downtime due to simple failures. For operations where the resin is

TABLE 1

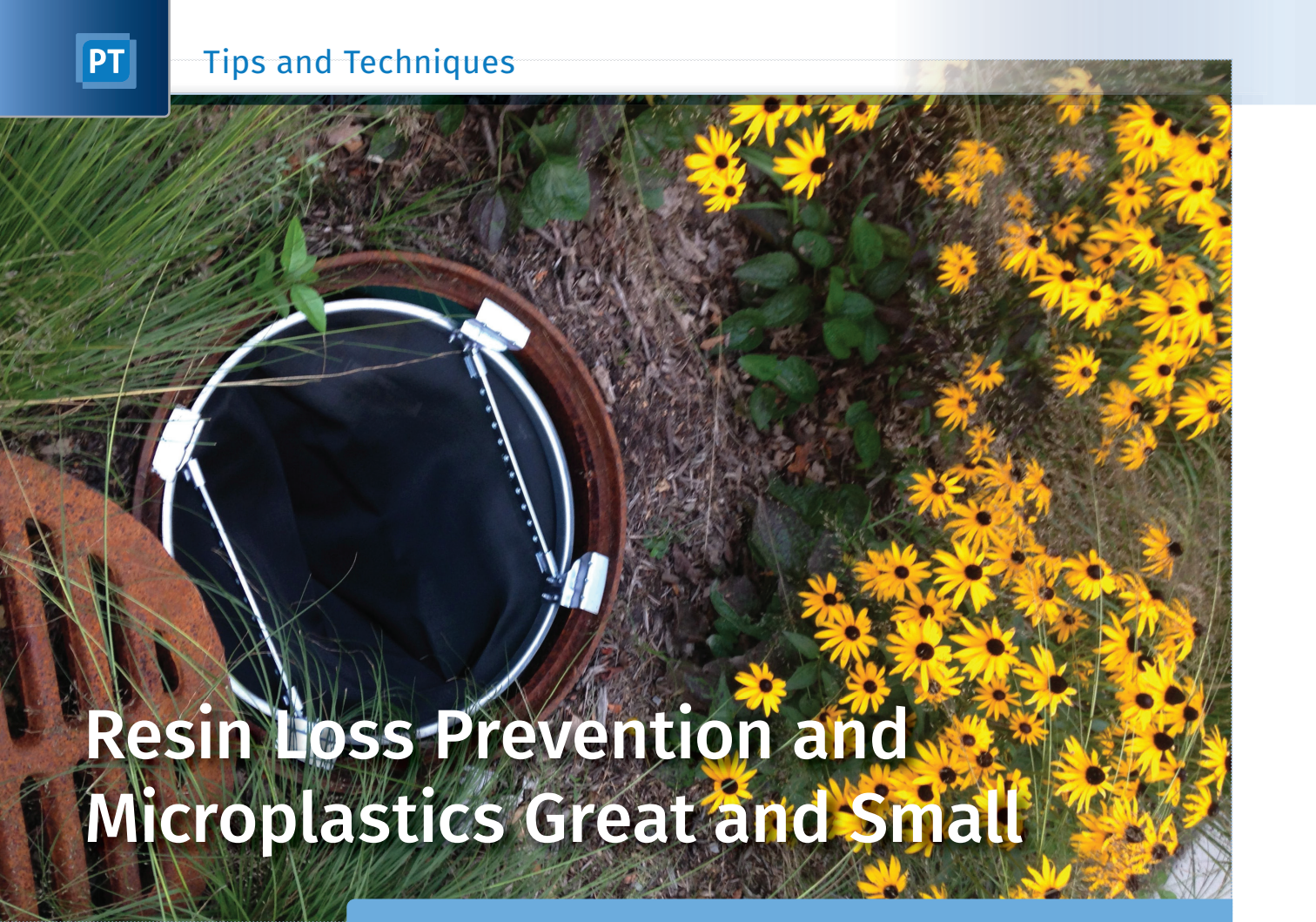
DEFECTS	ROOT CAUSES
Low specific rates, high discharge temperatures, resin degradation.	Blockage at the entry of a barrier section.
Low levels of resin degradation.	Moffatt eddies due to small flight radii in the metering section.
Air entrapment and splay (injection molding).	Low compression rate and ratio.
Flow surging, low specific rates and high extrudate temperatures.	Improper solids conveying due to improper barrel temperatures.
Flow surging, low specific rates and high extrudate temperatures.	High screw temperatures in the feed section.
Solid polymer fragments in the extrudate.	Process exceeded the melting capacity of the screw.
Solid fragments and/or degradation in the extrudate.	Improperly designed mixer.
Flow of resin out the vent opening.	Improperly designed vent diverter or damaged diverter.
Flow of resin out the vent opening.	Improper pump ratio for a two-stage screw.

abrasive or corrosive, a spare screw should be kept in stock. As the screw wears in the extruder and the performance decreases beyond an economic limit, the screw should be replaced with the spare screw, and the worn screw should be sent to a screw manufacturer for refurbishment.

With the plant interview information, verification of the data and the completion of the simple calculations, an experienced troubleshooter will develop a set of hypotheses for the root cause of the defect. After the hypotheses are established a series of experiments needs to be developed that accept or reject the hypotheses. Part 2 of this article will discuss hypothesis-setting operations and quickly determining the root cause to bring the line back on stream.

Hypothesis testing is the fastest method to get to the root cause and a remedy. Hypothesis testing with case studies will also be presented in Part 2 of this series. Following these procedures will allow the troubleshooter to identify the root cause and provide an acceptable technical solution, bringing the line back online in a timely manner. ^{PT}

ABOUT THE AUTHOR: Mark A. Spalding was a fellow in Packaging & Specialty Plastics and Hydrocarbons R&D at Dow Inc. in Midland, Michigan until his recent retirement. During his 41 years at Dow, he focused on development, design and troubleshooting of polymer processes, especially in single-screw extrusion. He co-authored *Analyzing and Troubleshooting Single-Screw Extruders* with Gregory Campbell. Contact: 989-802-3094; maspalding1@gmail.com.



Resin Loss Prevention and Microplastics Great and Small

Installed drain insert from FlexStorm for preventing pellets from entering storm sewers. Source: ADS

Practical containment measures are cutting pellet and powder loss on the plant floor, while researchers stretch to characterize ever smaller particles.

By **Matt Stonecash**
Associate Editor

Some fraction of the raw materials used in manufacturing, including plastic, escapes from the supply-to-waste management chain into the wild. All activities in this chain are sources of escaped plastic: from production, through manufacturing, distribution and use, to disposal (landfill/recycling/incineration). Plastic pollution is classified by size: macro (> 5 mm), micro (5 mm – 1 μ m) and nano (< 1 μ m). Raw materials for plastics processing fall in the micro range, and that's where producers, handlers and processors acting to prevent resin loss have focused their efforts.

BEST PRACTICES FOR KEEPING PLASTICS WHERE THEY BELONG

Advanced Drainage Systems (ADS), a large manufacturer of plastic pipe for water management applications, started looking closely at its resin handling and loss prevention practices beginning in 2019. Part of that process was conducting a self-assessment using a guide provided by Operation Clean Sweep (OCS). OCS is a voluntary industry program formed by the Plastics Industry Association to improve the management of pre-production plastic resin, managed in collaboration with the ACC's plastics division. It includes guidelines for best practices, engineering controls, education programs and a reporting framework for members. ADS then worked with a third-party auditor to assess pilot sites and lay out a three-year plan to implement new processes and equipment.

Pilot sites represented distribution centers, recycling centers and manufacturing sites of different sizes. ADS receives resin three ways: by rail car, bulk tanker and in trucks loaded with bulk (gaylord)

containers. Chakeyla Anderson, VP of Environmental Health & Safety at ADS, explains that gaylord-style containers can be the most significant source of loss. “Gaylord boxes could arrive in multiple different states. They could be damaged. They could be wet. The plastics liners inside can sometimes tear,” says Anderson. “That damaged container could lose up to 20% of its contents as it’s being moved.”

To counter this risk, ADS has implemented inspections to identify damage, moved to stronger liner bags used inside the containers and carefully chosen unloading sites with an eye toward containing any material that does happen to spill. If a spill does reach a storm drain, there is one last line of defense. FlexStorm, a company owned by ADS, makes filters designed to catch pellets in various configurations that are customized to fit each drain. Maintenance staff cleans them out regularly and replaces as necessary.

Bulk tankers are less susceptible to resin loss from damage, but there is still the opportunity for spills any time a connection is made. Housekeeping kits are stationed at unloading areas for immediate cleanup. Spills have been made a stop-work obligation, a cultural change that has been key to these responses, according to Anderson. “Today, there’s not a lot of hesitation to report, because [our employees] know it’s not punitive, it’s about taking the opportunity to make things better. When they’re open to talk through what needs to be done, they see change, they see capital investment.”

Rail car loading station for a recycling operation.

Source: Matt Stonecash

About 60% of ADS sites receive resin by rail. Vacuum systems

load resin into containers and silos for future transfer to pipe manufacturing. Each of these connections is a potential source of resin loss, as are the empty containers. “When you’re finished with the rail car there is always residual resin, so if those caps are open, you can be spilling all along the route,” says Anderson. Engineering controls prevent spills on site (for example trays lining the rail areas), and procedural checks prevent spills on the return journey.

ADS achieved OCS Blue status in 2022. This higher-level membership includes paying into a fund for research programs and a triennial third-party audit that includes at least 25% of a company’s facilities, in addition to meeting requirements and data reporting required of all members.

FORMALIZING AND VERIFYING LOSS PREVENTION PLEDGES

The OCS program has existed since 1992, but has grown and transformed significantly in recent years. The organization went international in 2010 and now has more than 6,000 member companies in 65 countries. The inclusion of third-party certification has been one of the most significant recent changes, along with the launch of OCS Logistics and OCS Rail programs.

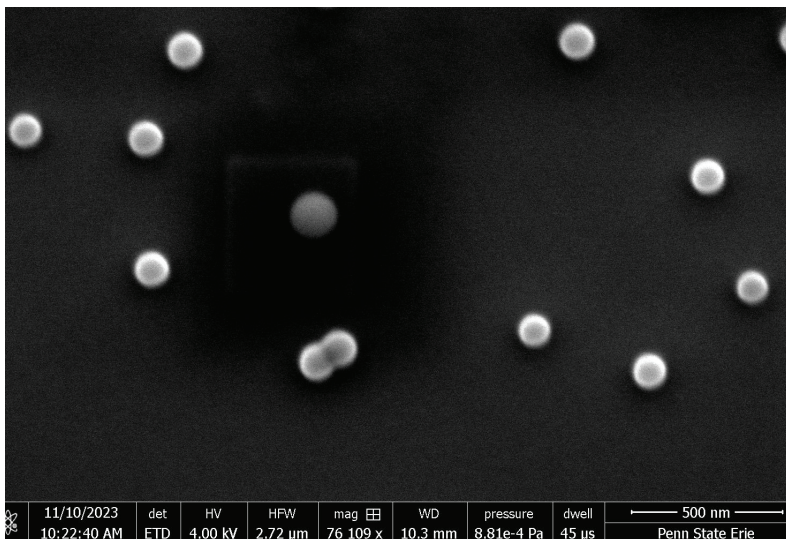
Reports from OCS members track progress (members have reported a 30% decline in resin loss since 2023) but also inform changes to the guidance provided and current opportunities for sharing knowledge. After the frequency of data reporting was increased to a quarterly basis, for example, it became clear that hurricanes and other storms were a significant root cause of incidents. “We gathered some of our members, from each segment of the supply chain, to talk about case studies and some of the best

practices they have developed,” says Charlotte Dreizen, senior director, sustainability & environment at the Plastics Industry Association. “Then we created a guide for preventing resin loss during natural disasters.”

For processors starting out on their loss prevention journey, Dreizen recommends a risk assessment that starts at the fence line. “Engineering controls and simple things like drain traps can be low hanging fruit,” says Dreizen. “Making sure any plastic that hits the ground is being blocked from making it into the water. Once you get those basics in place, we want to look at preventing spills in loading and unloading areas.”

For manufacturers working with resin in powder form, or using cutting or grinding operations that





SEM image from Penn State showing PS nanoplastics. Source: Penn State University

collection trays under discharge and loading valves whenever connections are made or broken. Because powder disperses more readily than other forms of plastic, it's especially important to clean up those spills immediately.

METHODOLOGY DEVELOPMENT AT THE OTHER END OF THE SCALE

It's a logical choice to begin at the large end of the scale. Microplastics in the macroscopic range can be visibly tracked, evaluation of prevention measures is straightforward and gains in terms of pounds or tons of prevented loss can be racked up quickly. As you move down the scale from micro to nano, the degree of difficulty increases. Smaller bits of plastic are common, generated as grinding dust, or from recycling wash processes, textiles and larger pieces simply breaking down in the

environment over time.

Commercial laser direct infrared (LDIR) systems use a quantum cascade laser to automatically image and chemically identify microplastic fragments from about 20-500 microns, with some studies pushing accurate identification down to roughly 10 microns. Below that size, detecting, identifying and quantifying

generate dust, the OCS manual recommends investing in properly designed and sized dust-collection equipment for every operation that can liberate or generate plastic dust, using filters matched to the type and volume of dust produced and cleaning/replacing on a set schedule. OCS also stresses making sure storage silos, tanks and containers are free of holes, cracks or leaks and placing



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is a real challenge. According to Xiaoshi Zhang, professor at Penn State Behrend, that's where things really get interesting.

"Our goal is to develop a reliable analytical workflow that everyone can use to understand more about this issue, whether they are working in the plastics industry and want to understand their processes, or working as an environmental scientist and trying to understand the impact," says Zhang.

Zhang's project, supported by funding from the ACC, is aimed at pushing the lower limits of reliable micro- and nano-plastic detection.

"When people study microplastics of size 10 micron (10^{-5} m) and above, they have a lot of success," says Zhang. At that level, researchers can image the fragment, identify the polymer using Fourier-transform infrared (FTIR) spectroscopy and then quantify the number of fragments. "But for now, at the nanoplastic scale, it's going to be very hard. That's why we want to do this."

The project is focusing on processes for analyzing plastic particles at around 100 nm (10^{-7} m), with the goal of extending reliable detection to even smaller sizes. A particle of that size is smaller than a pellet by about the ratio that a pellet is smaller than the RMS Titanic (269 m, at launch). These particles are too small to show up on conventional optical microscopy, which is limited by the wavelength of visible light, but can be imaged using ESEM (environmental scanning electron microscopy) and AFM (atomic force microscopy).

Using multiple test instruments for comparison and standardized samples of known concentration enables researchers to work toward test procedures that produce reliable results, consistently quantifying the amount of microplastics in each sample. With fragments so small, each step in the process of preparing and analyzing the sample can impact how many particles are ultimately retained and detected. The percent of material detected depends on the choice of solvent, the choice of substrate and the method used to transfer and deposit the particle suspension on to the substrate.

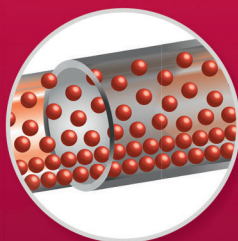
Zhang is preparing two papers for publication: one on the method for improving detection, identification and quantification; and another using

mathematical modeling to understand particle retention during sample preparation and identify conditions that can improve measurement sensitivity and reproducibility.

Producers, shippers and converters needn't wait on more science to get started on containment strategies. Straightforward changes and low-tech barriers can help seal up the fence line — and the rail line — against microplastics on the millimeter scale, where each dollar invested returns the most pounds of resin loss prevented. Different solutions will still be needed for understanding and remediation of particles too small to see or sweep. PT

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Top Shops at 10 Years



Plastikos's work in the medical field prompted it to automate more of its labeling operations for greater consistency.

Source: Plastikos

The 2026 survey, based on 2025 operations, reveals injection molders' resilience in the face of rising resin prices and trade turmoil.

By **Tony Deligio**
Editor-in-Chief

From Pennsylvania to Pakistan, *Plastics Technology's* Top Shops Benchmarking survey documented the rising resin costs and scrambled supply chains that were injection molders' everyday

reality in 2025. The tumultuous nature of business required constant contact between molders and their customers, as they shared running updates on everything from resin supplier price hikes to production delays driven by difficulty sourcing spare parts, and what all of that meant to the original job quote.

"Plastikos experienced significantly higher raw material prices across the board, both resin and for all of our packaging materials," explains Philip Katen, president and general manager, of Top Shops honoree Plastikos Inc., Erie, Pennsylvania. "This posed a significant challenge to communicate those price increases to our customers, along with working through the corresponding customer-specific agreed-upon price increase processes and timeframes. Those price increases were one after another after another. Fortunately, we had previously established processes to follow, which enabled us to navigate the changes reasonably well."

In addition to demanding transparency between molders and their customers, the challenging resin market required nimbleness. "We initially absorbed the increased resin costs for one month, while keeping our customers informed," explains Abdul Haseeb, director at Top Shops honoree RETAX Technologies, Punjab,

Pakistan. "After that, we had to pass some of the increase on. We also started sourcing from other regions and countries when we could find the same quality at better prices, while accepting some reduction in our margins."

While the frequency of the fluctuations in 2025 was jarring, their existence was to be expected, explains, Anthony King, president and CEO of Molding Services, Olney, Illinois. "Resin pricing has, as always, been a moving target," King says. "Frankly when we price a project, we make sure we have a buffer that can absorb a certain percentage of increases. Rarely have we passed increases to our customers, but when we have, our customer base has responded very positively. Again, we maintain a very close relationship with our supply base."

All survey respondents experienced higher resin prices in 2025, with 63% of Top Shops and 70% of others saying material prices increased, compared to lower resin costs for just 12% and 20%, respectively. Those higher resin costs crept into other expenses as well and dictated ongoing conversations with customers.

"The biggest challenge was managing inflation and raw material and shipping costs, while maintaining our margins," Haseeb says. "Pricing became increasingly unpredictable, so we had to shorten the validity of our quotations and be more cautious about the prices we committed to customers."

TOP SHOPS 2026

ams OSRAM, Warren, Pennsylvania
Auralites Inc., Weaverville, North Carolina
Flex, Aguascalientes, Mexico
Flotek Inc., Harvard, Illinois
Molding Services Inc., Olney, Illinois
Plastec, Monee, Illinois
Plastikos, Erie, Pennsylvania
Plastikos Medical, Erie, Pennsylvania
RETAX Technologies, Punjab, Pakistan
Zircon Plastics, Hulmeville, Pennsylvania

SURVEY SAYS

Now in its 10th year, the annual, free and anonymous Top Shops benchmarking survey of injection molders gathers 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, with the highest-scoring companies named Top Shops for 2026 based on their 2025 operations.

Our 2026 honorees hailed from four different states, lead by Pennsylvania with four calling the Keystone State home. Beyond that, there were three honorees from Illinois and one each for North Carolina and Michigan. International honorees fulfilled the survey from Mexico and Pakistan. Across the entire survey, we had questionnaires completed from Mexico and Canada, with a broad cross section of U.S. states, including three each from Connecticut and Michigan; two each from Wisconsin and Ohio, and single entries from Florida, Georgia, Indiana, Minnesota, Mississippi, Nevada and Pennsylvania.

RETAX garnered Top Shops honors from Pakistan. Source: RETAX

TARIFF'S TOLL

Just 12 days after his inauguration on January 20, 2025, President Trump announced sweeping tariffs on February 1, which took effect on February 4. Our Top Shops almost immediately had to recalibrate portions of their business in response, reacting to their own needs and those of their customers.

For Plastikos, Katen says the tariffs directly impacted two specific areas of its operations: capital equipment, including spare/replacement parts for its production workcells, and raw materials that are produced overseas. "Plastikos was forced to absorb the additional costs that related to the capital equipment purchases, which in some cases either delayed or at least forced us to re-evaluate some purchases and proposed investments," Katen says, adding that in most cases, its customers were willing to reimburse the company for the additional tariff costs that applied to the impacted raw material purchase. "However, that reimbursement approach added an additional layer of administrative work to track, invoice and ultimately follow-up on the corresponding reimbursement payments," Katen says. "Overall, we were able to adapt and manage the additional tariff costs reasonably well."

Trade-impacted supply disruptions felt in Erie were also experienced in Punjab. "Sourcing raw materials became more difficult in 2025," Haseeb says, noting that at one point, low-density polyethylene (LDPE) was in short supply across Punjab, forcing RETAX into some short-term production delays. "Fortunately, locally sourced materials were generally easier to obtain, so the overall impact on our business remained relatively low," Haseeb says.

At Molding Services, King says its procurement wasn't overly impacted by the trade uncertainties, thanks in part to its sourcing. "We have been very fortunate in our supply chain and its management," King says. "Our disruption has been very minimal. I primarily attribute that to maintaining an American supply chain and remaining very close to our suppliers."

Molding Services has several proprietary product lines that were also unscathed by the tariffs, but it knows of others negatively affected by eventual Supreme Court reversal or those initial duties. "The tariff reversal decision stalled several large reshoring projects," King says. "Although MSI has not been harmed, sadly we have customers who invested very heavily in reshoring, and it has been very devastating to their business."

Prompted by the interest in American sourcing, Plastikos reflected on the potential benefits of reshoring. "On the flip-side, I believe that Plastikos may have seen some positive effects of the tariffs in some cases due to the fact that we are a U.S. supplier when shipping our finished molded product to our customers' assembly operations around the globe," Katen says. "I cannot say with certainty that that was the case with respect to any specific production order given the lack of visibility into our customers' procurement processes, but anecdotally that appeared to be the case in some instances."





As part of its recent Impact Week, Plastikos employees volunteered around the Erie community, including the local Humane Society. Source: Plastikos

PARSING THE DATA

Regardless of what was paid for the materials, there was mostly full alignment between Top Shops and all our other entrants in terms of the types of resins processed in 2025. No one in either group ran liquid silicone rubber (LSR) and the highest percentage material for both came in engineering resins — 82% of Top Shops and 78% of other entrants. On the sustainable materials front, while both groups had healthy representation in processing recycled resin (36% of Top Shops and 43% of others), processing of bioplastics tied with polyurethane for the second-lowest resin being run, only above LSR's 0%, with just 9% and 13% of Top Shops and others utilizing those materials. In terms of total pounds of resin processed, Top Shops molded more from less with the average aggregate amount of pellets consumed coming in at seven times less than other entrants (1 million pounds vs. 7 million pounds).

In a similar efficiency vein, Top shops made nearly six times the total amount of parts from roughly half the number of active tools. In terms of injection molding machine fleets, there was largely parity in the average number of machines (29 for Top Shops and 22 for others), average machine age (11 and 14 years for Top Shops and others, respectively), and an overwhelming emphasis on horizontal style machines (Top Shops were 100% horizontal with only 4% of other entrants operating vertical presses). In the hydraulic vs. electric debate, Top Shops were less likely to operate fully hydraulic machines — 49% vs. 66% of fleet share — and more apt to have an all-electric plant floor (63% fully servo vs. 44% for the rest of the respondents). In terms of clamp-force profile, both groups have similar offerings until higher tonnages are considered, with Top Shops featuring less machines in the 501-1,000-ton range (18% of their machines vs. 38%) and presses exceeding 1,000 tons (9% of Top Shops' fleet vs. 17% for other respondents).

PACKING IT UP

In the portion of the survey which asks participants about

value-added services they provide, large majorities of Top Shops (82%) and other respondents (75%) noted they provide shipping/packaging/labeling to their customers (with 64% of Top Shops providing inventory stocking/logistics, vs. 38% of other shops). The detailed lot tracking requirements Plastikos and Plastikos Medical must provide its customers in the medical space mean those companies have provided those services for decades, although it has upgraded its capabilities there. "We invested significantly in our IT infrastructure and shipping/packaging/labeling software to create a more automated solution," Katen says. "It affords even better insight into those key functions and eliminates a number of previously manual data-entry steps that inherently were prone to human error."

For MSI, shipping/packaging/labeling has always been key, but it has a new twist in terms of who its shipping to. "MSI has always offered fulfillment services but now we're being asked to 'Direct Ship' MSI customers' finished product direct to MSI customers' customer," King says, noting that the company produces to product lines that span 15 SKU's where its customer never touches its product.

At RETAX, these services are also a given, although some customers remain skeptical about costs. "We provide packaging and labeling services," Haseeb says, "and they are important to some customers who prefer having everything handled by one supplier. However, some customers also assume specialist packaging companies will always be cheaper, which isn't necessarily the case."

EFFICIENCY FOR THE WIN

As ever, shops that were the most efficient in production, from changeover times to scrap rates, won the day as Top Shops. For Top Shops, average set-up time registered at 54 minutes, compared to 82 minutes for others, while mold-change time for honorees, at 48 minutes, was nearly half the 84 minutes of other respondents. Off the shop floor, Top Shops showed speed as well, with an average order lead time of nine days compared to 23 for others. Where there was a striking similarity for both was in average capacity utilization — 62% for Top Shops and 61% for others — with neither mark being particularly high.

"Some machines remained consistently busy, while others experienced more idle time than in previous years," Haseeb says. "We believe this was largely because businesses and consumers became more cautious about spending on new product development, making demand less consistent."

The view was similar from Illinois. "For 2025 MSI's capacity utilization has been the lowest we can remember," King says, noting that figure was impacted by its largest customer being acquired and moving production to its plants in Mexico. "That story reverberates heavily across our industry, but the good news is business is coming back to MSI plus other pieces of business which we did not previously have. So, long term after all offshoring smoke clears, MSI will be better for it." 

How Moretto's Technologies Redefine Production Flexibility

Plastics processors know that today's operational demands won't match tomorrow's. Rather than investing in fixed infrastructure that becomes obsolete, smart processors are increasingly adopting modular automation that reconfigures as needs evolve. Moretto's new lineup lets you build what you need now, adapt as you grow and protect your investment against market shifts.

DOLPHIN: AUTOMATIC MATERIAL SORTING

Centralized conveying systems depend on precise material-to-machine connections. The Dolphin automatic sorting unit uses independent pneumatic arms that change connections in less than half a second, removing the risk of human routing errors. A stainless-steel central pipe eliminates cross-contamination, making the unit suitable for medical, food, and optics applications. Configurations scale from 2 up to 36 sources and destinations, and each arm operates independently so a single failure does not stop the system.

MOBILUX: MOBILE DRYING AND CONVEYING

The Mobilux family pairs Moretto's X Comb high-performance dryers and OTX drying hoppers with compact mobile trolleys, letting processors dry resin off-line and roll the cart into position when needed. The CRX Comb Mobilux adds integrated closed-loop conveying to keep material in a controlled atmosphere. Adaptive airflow, a honeycomb rotor with Zeolite media and a pre-set library of 40 material specifications on the HMI allow operators to select material and throughput and let the system handle the rest. Models cover drying capacities from 5 to 50 pounds per hour.



Moretto's CRX Comb Mobilux

IN-LINE MOISTURE METER CONTROL

The Moretto Moisture Meter sits directly below the drying hopper and uses Power Peak patented technology for continuous, real-time moisture readings, catching issues before improperly dried resin reaches the process. It allows for an early warning detection, minimizes waste, reduces energy consumption and eliminates human intervention.

SILCONTROL: AUTOMATED AND SAFE STORAGE SYSTEM

Silcontrol is a tracking system which allows for matching the new delivered material with the right storage silo. For upstream storage, Silcontrol scans delivery barcodes, verifies incoming material against the correct outdoor silo, checks capacity and opens the right inlet valve automatically.

MOWIS: PLANT-WIDE SUPERVISION

Mowis ties the equipment together with a self-configurable supervision platform. Operators map their facility layout, monitor status, track material usage and adjust parameters remotely. Statistical algorithms and machine learning support predictive maintenance, and OPC UA communication connects Mowis to existing MES platforms.

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The Truth About Chiller Capacity: Understanding the Chiller Capacity Triangle

How much cooling capacity does your chiller actually have? Learn what impacts this very important, and variable, process parameter.

When people hear the term “10-ton chiller,” they usually assume the machine will always produce 10 tons of cooling. In reality, that is not how chillers work. A chiller’s actual cooling capacity changes depending on the operating conditions. The same machine might produce 10 tons in one application, but only six tons in another. Under ideal conditions, it might exceed 10 tons. That variability is why engineers cannot look only at the model number or nameplate. They must also consider the operating conditions.

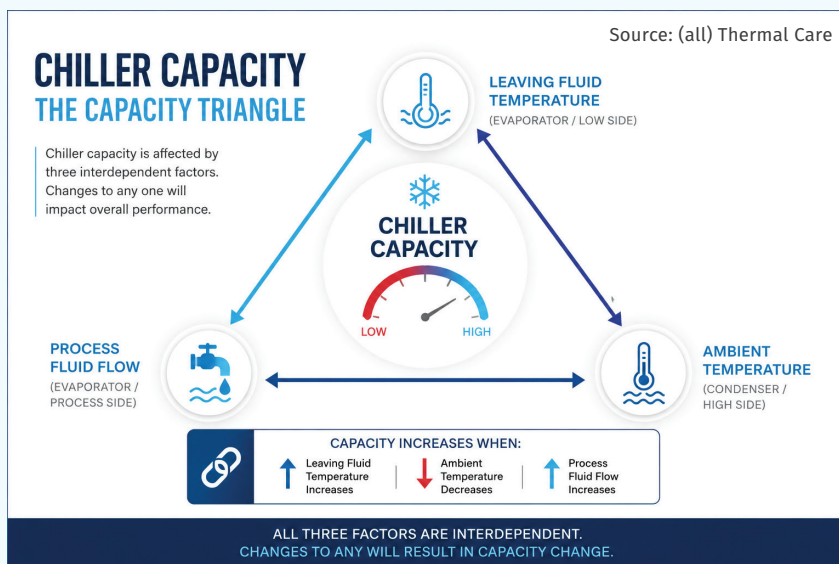
A simple way to understand this is through what we at Thermal Care call the “Chiller Capacity Triangle.” Much like the exposure triangle in photography, three main factors work together to determine how much cooling a chiller can actually provide. These three factors are Saturated Suction Temperature (SST), Saturated Discharge Temperature (SDT) and Process Fluid Flow. Changing one side of the triangle affects the other two and ultimately changes the chiller’s capacity and efficiency.

SST is connected to the evaporator side of the refrigeration system. In simple terms, SST is closely related to the leaving-fluid-temperature coming out of the chiller. If a process requires very cold fluid, such as low-temperature glycol, the SST must also be lower. The lower the SST becomes, the harder the compressor has to work. As compressor workload increases, cooling capacity often decreases while electrical power consumption increases. Conversely, a higher SST usually enables the compressor to operate more

efficiently and deliver better capacity.

SDT is connected to the condenser side of the system. On an air-cooled chiller, SDT is heavily influenced by the ambient air temperature outdoors. On a water-cooled chiller, it is related to the temperature of the condenser water entering the system. A chiller operating on a mild 75°F day will usually perform much better than the same machine operating on a 100°F day. Higher SDT increases the compressor’s workload, which reduces efficiency and lowers cooling capacity. Lower SDT generally improves system performance and reduces electrical usage.

The third side of the triangle is process-fluid flow. Flow refers to how much water or glycol moves through the system, usually measured in gallons per minute (GPM). Proper flow is important because it allows heat to transfer effectively from the process into



10-TON CHILLER

CAPACITY AT DIFFERENT CONDITIONS

Chiller capacity varies with ambient air temperature and leaving fluid temperature.

Chiller capacity varies with ambient air temperature and leaving-fluid temperature.

		AMBIENT AIR TEMPERATURE		
		75°F	95°F	115°F
LEAVING FLUID TEMPERATURE	50°F	12.0 TONS	10.8 TONS	9.7 TONS
	65°F	15.3 TONS	13.8 TONS	12.4 TONS
	80°F	18.1 TONS	16.4 TONS	14.9 TONS



Thermal Care
10-ton chiller.

the refrigeration system. If flow is too low, heat transfer suffers, and cooling performance drops. Properly optimized flow helps stabilize temperatures, improve heat transfer and maximize available capacity.

ALWAYS COMPARE CHILLERS AT THE SAME CONDITIONS

Because all three factors work together, it is very important to compare chillers under the same operating conditions. Two chillers may both be labeled as “10-ton” units, but if one rating is based on 50°F leaving water and the other is based on 65°F water with a lower ambient temperature, the comparison is not equal. The operating conditions completely change how much cooling the machine can provide.

Compressor horsepower is another area that often causes confusion. Many people assume that a 10-hp compressor should automatically produce 10 tons of cooling. In reality, compressor

horsepower is only one piece of the puzzle. Two chillers with the same compressor horsepower can produce very different cooling capacities, depending on how they are operating. A useful way to think about it is like a car engine. Horsepower matters, but fuel economy, terrain and driving conditions also affect performance.

OPTIMIZATION SAVES ENERGY

Optimizing a chiller for its actual operating conditions can result in major energy savings. Selecting the proper SST, designing around realistic ambient temperatures and maintaining correct process flow can dramatically reduce electrical power consumption. Lower power usage not only reduces operating costs, but it also improves long-term reliability and reduces wear on the refrigeration system.

Properly matching a chiller to the operating conditions helps ensure the best combination of capacity, efficiency and long-term performance. [DT](#)



CHILLER CAPACITY INCREASES:

- When flow increases while leaving fluid temperature and ambient temperature remain constant.
- When leaving fluid temperature increases while flow and ambient temperature remain constant.
- When ambient temperature decreases while flow and leaving fluid temperature remain constant.



CHILLER CAPACITY DECREASES:

- When flow decreases while leaving fluid temperature and ambient temperature remain constant.
- When leaving fluid temperature decreases while flow and ambient temperature remain constant.
- When ambient temperature increases while flow and leaving fluid temperature remain constant.

ABOUT THE AUTHOR: Mike Shupe is Vice President of Product Management at Thermal Care, a leading manufacturer of industrial process cooling equipment. With more than 18 years of experience in refrigeration and process-cooling systems, Mike specializes in chiller technology, heat transfer, energy efficiency and application engineering. He holds a degree in Mechanical Engineering from Northern Illinois University and works closely with customers and industry partners to develop innovative cooling solutions for manufacturing and industrial processes. Contact 847-966-2260; mike.shupe@thermalcare.com.

Time to Rethink Extruder Barrel Design?

Thanks to additive manufacturing, corrosion-resistant super alloys can be applied to the barrel precisely where they are needed.

For decades, extrusion barrel design has been constrained as much by manufacturing limitations as by processing

By Cheryl Sayer
Xaloy

requirements. Engineers often knew where corrosion protection, instrumentation and process features should be located, but

conventional manufacturing methods frequently dictated where they could be placed.

Additive manufacturing fundamentally changes that design equation.

This new approach to extrusion barrel engineering enables corrosion-resistant super alloys to be applied only where the process requires it. Rather than treating corrosion protection as a uniform requirement along the entire barrel, engineers can now strategically locate corrosion-resistant regions based on where corrosion resistance is actually required, such as the discharge end or locations selected for injection and pressure ports.

More importantly, additive manufacturing removes many of the manufacturing constraints that have traditionally influenced barrel design, creating new opportunities for customization, instrumentation and process optimization.

CORROSION IS RARELY UNIFORM

Every extrusion process creates its own unique thermal and chemical environment. Polyvinyl chloride (PVC) and chlorinated PVC processing may expose specific sections of the barrel to hydrochloric acid (HCl), while fluoropolymer applications can generate highly corrosive environments under elevated processing temperatures. Flame-retardant compounds, reactive additives and specialty engineering polymers each create their own corrosion profiles.

These conditions rarely exist uniformly throughout the barrel.

Instead, corrosion typically develops in localized regions where temperature, pressure, residence time and polymer chemistry combine to create aggressive processing conditions and where they have access to reach the backing steel.

Historically, however, barrel construction has generally

applied corrosion-resistant materials uniformly, regardless of where degradation actually occurs.

Additive manufacturing allows the corrosion-resistant alloy to be placed precisely where it is required, enabling barrel designs that are tailored to the application's actual operating environment.

ADDITIVE MANUFACTURING CHANGES THE SUPPLY CHAIN

Perhaps the most significant advantage of localized corrosion resistance is not simply where the material is placed, but how it is applied.

Traditional corrosion-resistant barrel manufacturing often relies on specialized alloys produced in specific diameters, lengths and geometries. Each barrel configuration may require unique tooling, dedicated inventory or long procurement cycles.

Additive manufacturing fundamentally changes this model.

Instead of depending on size-specific corrosion-resistant alloys, manufacturers can utilize versatile corrosion-resistant feedstock that is independent of barrel diameter, taper or overall geometry. The corrosion-resistant alloy is deposited directly where it is needed, allowing a versatile material inventory, that is not size or shape dependent to support a broad range of extrusion barrel designs.

This manufacturing approach significantly shortens lead times for both standard and highly customized barrels while providing greater responsiveness to customer requirements.

Whether producing a small laboratory extruder, a larger cable extruder or a specialized custom configuration, the manufacturing process no longer depends on obtaining corrosion-resistant material in a particular size or shape, or upsizing the stock due to limited material availability.

FREEDOM TO DESIGN AROUND THE PROCESS

One of the most exciting aspects of additive manufacturing is the design freedom it creates. Traditional manufacturing methods often require process features — such as pressure ports, melt temperature probes, gas injection ports, vent locations or

instrumentation — to be positioned around manufacturing constraints rather than optimal process conditions.

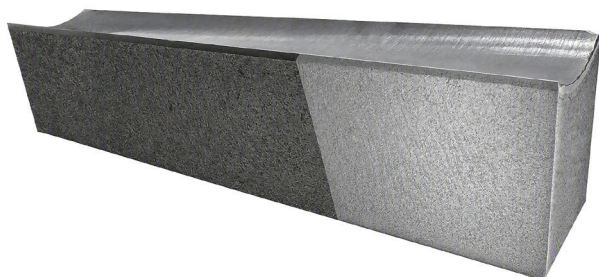
Localized additive manufacturing dramatically reduces those constraints.

Pressure transducers can be located where melt pressure provides the most meaningful process information. Melt temperature sensors can be positioned to improve process monitoring. Injection ports for additives, colorants, foaming agents, stabilizers or reactive processing chemistries can be incorporated where mixing efficiency and residence time are optimized rather than where conventional barrel construction allows.

This level of flexibility enables extrusion barrels to become application-specific process tools rather than standardized mechanical components.

Engineers gain greater freedom to design around polymer behavior, screw geometry and process performance instead of adapting designs to manufacturing limitations.

Additive manufacturing barrel segment showing localized corrosion-resistant alloy applied only where the extrusion process requires additional protection. Source: (all) Xaloy



SIMPLIFYING MANUFACTURING WHILE INCREASING DESIGN FLEXIBILITY

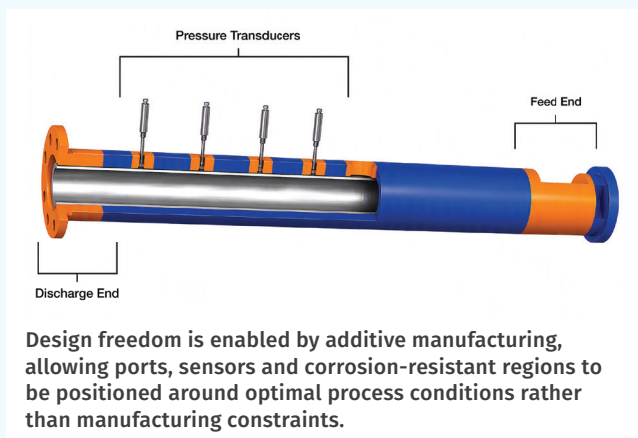
Another advantage of this manufacturing philosophy is scalability.

Because corrosion-resistant material is deposited directly onto the barrel during manufacturing, the technology is not constrained by the availability of preformed corrosion-resistant stock or standardized barrel dimensions.

The same manufacturing approach can be applied across a wide range of barrel diameters, lengths and configurations — from compact research equipment to some of the industry's largest production extruders.

Likewise, specialized geometries, barrel segments and other components can all benefit from localized corrosion protection without requiring entirely different downstream manufacturing methodologies.

This flexibility allows equipment manufacturers to standardize their manufacturing approach while simultaneously expanding the range of applications they can support.



ENGINEERING AROUND THE APPLICATION

The broader significance of localized corrosion resistance extends beyond corrosion protection itself. It represents a shift from designing barrels around manufacturing constraints to designing them around the extrusion process.

By combining additive manufacturing with strategically applied corrosion-resistant materials, engineers can optimize barrel construction for polymer chemistry, screw design, instrumentation, process control and future service requirements — all within a single manufacturing platform.

As polymer formulations continue to become more demanding and processors seek increasingly customized equipment, this application-driven approach provides a pathway toward smarter, more adaptable extrusion systems.

LOOKING AHEAD

The next generation of extrusion equipment will not simply use better materials — it will use materials more intelligently.

Localized corrosion resistance, enabled by additive manufacturing, allows corrosion protection to be applied exactly where it delivers the greatest technical benefit while simultaneously unlocking new levels of design flexibility. From reducing lead times through the use of versatile corrosion-resistant stock to enabling pressure ports, injection ports and process instrumentation to be located wherever the application demands, laser-clad additive manufacturing represents a new way of thinking about extrusion barrel design.

As additive manufacturing continues to mature, its greatest contribution to plastics processing may not be the components it produces, but the engineering freedom it creates.. 

ABOUT THE AUTHOR: Cheryl Sayer is Xaloy's chief technology officer and vice president of engineering, leading global engineering strategy, innovation and product development. With more than 20 years in the industry, she has held roles at TRW Automotive, Pall Life Sciences, Kortec, Milacron and Mold-Masters. She holds degrees in mechanical engineering (BS), plastics engineering (MS), and an MBA, and serves on the University of Massachusetts Lowell Plastics Engineering Advisory Board. Contact: cheryl.sayer@xaloy.com; xaloy.com.

Brass Insert Installation: Comparing Heat vs. Ultrasonic vs. Press-Fit

There are three ways to put a threaded brass insert into molded plastic. Here's what each one does to the part; where each earns its keep; and when to walk away from all three.

By **Alex Spurgeon**
founder of
U.S. HeatStake

A threaded brass insert is how you give a plastic part a metal thread it can keep. You mold the boss, install the insert afterward and the assembly now takes a machine screw that comes apart and goes back together for the life of the part — instead of a self-tapper chewing fresh plastic every time someone opens the housing.

The catch hides in two words: “install afterward.” That step covers three very different processes, and they are not interchangeable. I have watched a perfectly good insert design take the blame for a joint that failed only because the wrong installation method got bolted onto it. (The insert took it personally). Heat, ultrasonic and press-fit put the same brass in the same hole but arrive there in completely different ways, and the way they arrive decides how the joint behaves for the next 10 years.

WHAT INSERT METHODS ARE DOING

Pull-out strength and torque retention do not come from the brass. They come from plastic locked into the knurls, grooves and undercuts on the outside of the insert. If you can get plastic to flow around those features and solidify there, then you have created a mechanical interlock that resists both pulling out and spinning. Fail to get it there,

Figure 1 — What each method actually does to the plastic. Thermal and ultrasonic reflow softened plastic into the insert knurls for a mechanical interlock; press-fit relies on cold interference and leaves residual stress in the boss. Source: (all) U.S. HeatStake

and you have an expensive press-fit pretending to be more.

That is the whole game. Thermal and ultrasonic methods both reflow plastic into the knurls. Press-fit, on the other hand, skips the melt entirely and relies on interference alone. Figure 1 shows the difference where it matters — at the interface.

THERMAL INSERTION: THE WORKHORSE

In this process, a temperature-controlled thermode heats the insert by conduction. The plastic around the hole softens; the insert is pushed home; displaced material reflows into the knurls; and then a cooling stage locks everything in place before the tip retracts. Heat in, cool, retract.

Figure 1. What each method does to the plastic — and what drives the insert

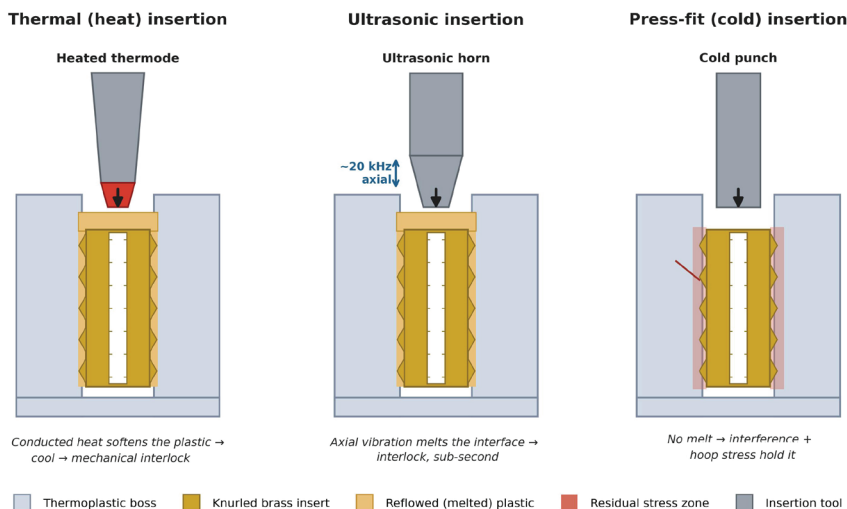


Figure 2. Brass insert methods at a glance

Attribute (higher = better)	Thermal	Ultrasonic	Press-fit
Pull-out strength	Favorable	Favorable	Weak
Torque / jack-out retention	Favorable	Favorable	Weak
Speed (short cycle/insert)	Fair	Favorable	Favorable
Low equipment cost	Fair	Weak	Favorable
Low residual stress	Favorable	Fair	Weak
Material tolerance	Favorable	Fair	Fair
Multi-insert in one shot	Favorable	Fair	Fair
Clean, flash-free finish	Favorable	Fair	Fair

Relative, application-dependent guidance — not measured values. Every row is framed so the greener rating is the better outcome (e.g. “low equipment cost” and “low residual stress” are positives). Validate against your own part, material and pull-test data.

Thermal insertion's strength is latitude. This process handles the broadest range of materials — amorphous and semicrystalline — and tolerates filled resins and awkward boss geometry better than alternatives. It will set several inserts in a single press stroke, and with a proper cooling stage, it leaves a clean, flash-free face. One important rule travels with it: the temperature is set by the polymer, not the press. Anyone quoting you a single, “We run everything at 250°C,” number has not met your material yet.

The trade-off with thermal insertion is time. Because the cycle includes both heating and cooling, it's rarely the fastest method per insert. If a high-volume line is gated by cycle, that matters. For nearly everything else — mixed materials, cosmetic surfaces, multi-insert patterns, lower volume — it's the safe default.

ULTRASONIC: FAST, FUSSY & WORTH IT AT VOLUME

Here the insert is driven by a horn vibrating around 20 kHz. Friction at the plastic-to-metal interface generates heat in a fraction of a second — the local plastic melts; the insert sinks; and the melt solidifies around the knurls almost immediately. The cycle is genuinely quick — sub-second per insert — which is why it wins on high-volume lines.

The cost of that speed, however, is sensitivity. Ultrasonic insertion likes amorphous resins — acrylonitrile butadiene styrene (ABS), polycarbonate (PC), PC/ABS — because they transmit and absorb the energy in a broad, forgiving window. Semicrystalline materials such as nylon, acetal and polypropylene dampen the vibration and have a sharp melt transition, so they take more energy and more setup to get right. The equipment cost is the highest of the three; the process is more sensitive to boss and insert design; and an over-driven cycle will mark or sink the surface. Reach for ultrasonic when cycle time is the real bottleneck at real volume — not because it is the shiny option on the

Figure 2. Brass insert methods at a glance — relative, application-dependent ratings across pull-out strength, torque retention, cycle time, equipment cost, residual-stress risk, material tolerance, multi-insert capability and cosmetics.

floor.

PRESS-FIT: CHEAPEST TOOLING, NOT ALWAYS THE CHEAPEST JOINT

Press-fit is the “cold” one. The insert is pushed into an interference hole at room temperature, and retention comes purely from the plastic squeezing back against the knurls — no heat, no melt, no cooling stage. An arbor press and a locating fixture will do it, which makes it the cheapest method to tool and the simplest to run.

Press fit also creates the weakest joint, and it carries the highest risk of trouble you only see later. Pushing metal into an undersized hole loads the boss in hoop tension. On brittle or glass-filled resins that stress finds a sharp corner and cracks it — sometimes on the bench, more often weeks later in the field. Pull-out and jack-out resistance are limited, and a joint that sees vibration or repeated load reversal can creep its way loose. Press-fit does have a real place: light-duty, low-torque fixings in tough, ductile materials where cost rules and the consequence of a marginal joint is low. Outside that lane, a molded-in insert or thermal installation is usually the safer call.

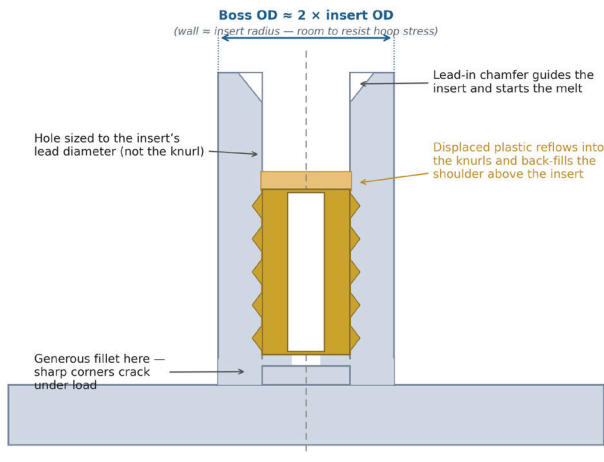
None of this makes one method “best.” It makes each one right for a different job. Figure 2 lays the trade-offs out so you can see them at once: thermal and ultrasonic both deliver strong, reflowed joints; ultrasonic buys you cycle time at the price of equipment cost and material fussiness; and press-fit trades joint strength for the lowest tooling cost on the floor. The ratings are relative and application-dependent — a starting point for the conversation, not a substitute for pull-testing your own part.

MATCH THE METHOD TO THE MATERIAL FIRST

Nine times out of 10, the method argument is really a material argument. Amorphous resins forgive you, while semicrystalline ones do not — a few degrees or a little energy in the wrong direction and you either fail to flow or start to degrade.

Glass and mineral filling change the rules again. The fibers do not melt with the resin, so they blunt ultrasonic energy and raise the cracking risk under cold press-fit. If you run 30% glass-filled nylon 66 the way you would run unfilled ABS and you will chase a “machine problem” that is really a materials problem. Thermal insertion copes best with filled grades, but even then you tune for it and you do not expect a glassy, cosmetic result. When in doubt, the resin picks the process before the press does.

And the honest exception, that's worth saying out loud: thermosets — phenolic, epoxy, BMC — cannot be heat staked or

Figure 4. Boss and hole design carries the joint**Figure 4. A quick decision aid for narrowing the field by joint requirement, volume and material.**

thermally inserted at all, because they do not soften when reheated. Knowing the difference between “won’t” and “can’t” is half the job.

THE BOSS CARRIES THE JOINT — DESIGN IT ON PURPOSE

Whichever method you choose, part geometry decides whether it works. Loose inserts that spin are usually a hole not a process problem. Figure 4 shows the features that earn their keep: a lead-in chamfer to guide the insert and start the flow; a hole sized to the insert’s lead diameter rather than its knurl; enough boss wall around the insert to take the load; and a generous fillet where the boss meets the wall so stress has nowhere sharp to concentrate.

There are two habits that prevent most field failures. First, never over-drive the insert to make it feel “solid” — more force or more energy past the point of full seating just dumps stress into the boss base. Second, validate before you ship. Pull a few samples to failure and cross-section one. You cannot see a hollow, a void or a cracked boss base from the outside, and a process that has not been sectioned and pulled is not validated — it is a guess that has

not failed yet.

HOW TO NARROW THE FIELD QUICKLY

If you want a fast first cut before you prototype, Figure 3 walks the main forks: do you need high pull-out and repeat torque; is cycle time the bottleneck at volume; and is the material weld-friendly. It is a starting point, not a finish line — filled resins, deep or thin-wall bosses, and regrind can all change the answer.

FIVE DEFECT SYMPTOMS AND WHERE TO LOOK FIRST

- Insert spins under torque — the hole is oversized, or there’s no reflow into the knurls (too little heat/energy)
- Boss cracked at base — press-fit interference too high, sharp internal corner, or a brittle/filled resin is being used
- Insert sits proud — there’s not enough heat, energy or seating force, or the hole is too tight
- Stringing or flash on the face — over-temperature or over-energy situation, or there’s no cooling stage on retract
- Joints fail weeks later in the field — locked-in residual stress present — cross-section & suspect cold press-fit first

THE SHORT VERSION

Pick the insert installation process that fits the part, the material and the volume — not the one machine the shop happens to own. Thermal for latitude, ultrasonic for speed at volume and press-fit for light-duty and low cost when the joint can take it. If you get the boss geometry right and pull-test before you commit, your insert will outlast the screw, the warranty and, quite possibly, the engineer who specified it. **PT**

ABOUT THE AUTHOR: Alex Spurgeon is the founder of U.S. HeatStake, a U.S.-based maker of precision impulse heat-staking and brass-insert installation systems for plastic assembly, headquartered in Roanoke, Indiana. A graduate of Indiana University Bloomington, Alex’s experience includes working in the automated machinery industry with skills in technical sales, mechanical and electrical design, CAD/CAM, product development, project management and more. Contact: (614) 549-0627, info@usheatstake.com.

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Haidlmair Aims To Remake Moldmaking with Speed, Technology and Efficiency

With a new facility under construction in Indiana, coming off its best fiscal year ever (topping Euro 100 million in revenue) and securing its largest single order (it built 170 tools in seven months), Haidlmair's CEO Mario Haidlmair shares his company's vision to be the world's most advanced moldmaker. Here is an excerpt.



Construction began on Haidlmair's newest facility, which will be located in Greensburg, Indiana, earlier this summer.

PT: In June, Haidlmair broke ground on a brand-new facility in Greensburg, Indiana; what prompted that move?

MH: The reason Haidlmair is going into the U.S. now and building the facility is a very simple one: speed. Transport time is costing us a lot of speed, and here in Europe, we are famous for being one of the fastest moldmakers. We also want to be one of the fastest moldmakers in the U.S. to serve our customers more quickly. In addition to that, we want to make things locally, with American people. Personally, I really love America, and I love the people, so the motivation was there to have something locally. [...]

Our goal is to be super productive, super fast and provide our customers the top quality that they're used to having from Austria but only made in the U.S. faster and better.

PT: What is Haidlmair's approach to new technologies? The company seems to be at the leading edge or have the goal of being at the leading edge. How do you approach assessing new technologies and deciding which ones to invest in?

MH: When it comes to manufacturing technologies, we are quite well equipped. In the past, including my father, we brought in some technologies that were not really made for moldmaking. For example, we have some laser equipment for texturing and for 3D printing that were not developed or intended for us or mold-

making in general. We modified these machines to fit our needs and to process different materials than they were made to process. I'm very proud of my team and the people who are working with them on this project.

PT: Some companies do simulations for mold design, but once the mold is made, they never know how well the simulation matched up to the actual molding in real life. Is that what you're talking about by closing the loop?

MH: Yes, exactly. So here at Haidlmair, you start with the design, the 3D file of the part, and then you have the molded plastic product in the end — this is the most important. The only thing the customer

wants is a perfect product. Then you would have to measure it manually, or you no longer have a 3D file of this product anymore.

Using the CT-scanning technology was the big game changer for us. Now we can have a look into the plastic. We see air bubbles, voids, glass fibers. We see everything that's inside the part. Using this knowledge, we can achieve better air vents, better cooling, and better product quality, which, in the end, also means faster cycle times and lower costs for our customers. I think that's the most important: our customers have lower costs with the same or even better product quality. This is our goal. This is why we are getting up every day — to give our customers unmatched experience and also a great advantage in the market for their products. That's important. **PT**

Read the full Q&A at short.ptonline.com/haidlmair26 or scan



THERMOFORMING

Feeding: Sidefeeder Geared for Compounding Recycled Materials

KraussMaffei Extrusion (KM) will present the ZSA UltraCycle, a sidefeed system for twin-screw extruders developed specifically for recycling, at Fakuma 2026, Oct. 12-16, Friedrichshafen, Germany. The sidefeeder reportedly enables direct processing of light, low bulk-density materials without the need for pre-compaction.

This is achieved, KM says, because the system compacts material *during* feeding. This simplifies the recycling process, reduces energy consumption and capital expenditure, and significantly increases the cost-effectiveness of processing, according to KM. Fluffy recycled materials typically pose challenges for conventional feeding systems due to their low bulk density of 10 kg/m³ or more, and their high volume, according to KM. These include thin-walled flakes, film scraps, or plastic fibers from consumer waste, as well as fibers from textile recycling.



At the heart of the new technology are two screws designed to ensure efficient material compaction. This allows even large quantities of light recycled materials with a low bulk density to be reliably conveyed into the feed zone of the twin-screw extruder without compromising gravimetric dosing accuracy. The result is consistent throughput, high recipe accuracy and stable process control, according to the machine builder.

INJECTION MOLDING

AI-Driven Virtual Assistant

Engel says its Engel Virtual Assistant (EVA) not only answers questions asked in regular, conversational language but, after operator confirmation, it can pass approved changes straight through to the machine control system. Engel notes that in their personal lives, most people already turn to AI by text or voice for everyday questions — now, that dialogue can happen on shop floor. Operators describe the issue, and once they confirm, EVA can carry out the approved actions to address the problem at hand.

Engel notes that every production environment is different, shaped by the machine, mold, material, production order and quality requirements, and it says EVA takes this context into account with its suggestions. EVA is available as an option for every new Engel and Wintec molding machine and as a retrofit for existing machines equipped with a CC300 or C3 control unit.



MATERIAL HANDLING

Vacuum Loader with Dust-Removal System

Wittmann's Feedmax Clean series of vacuum material loaders is now furnished with an integrated dust-removal system and is said to be especially suited for applications involving recycled materials. The Feedmax Clean 300, which will be displayed for the first time at Fakuma 2026, Oct. 12-16, Friedrichshafen, Germany, is available in two models with material throughputs of up to 80 kg/hr. This doubles



the maximum throughput previously reached with the unit.

Wittmann says the Feedmax Clean reaches extremely high separation rates in transporting recycled materials. During a normal conveying cycle, up to 80% of all particles with diameters below 1000 µm are removed, according to Wittmann. Dust particles and fines are continuously extracted from the plastic material during the conveying cycle, the company explains.

All material-contact components of the Feedmax Clean are made of stainless steel — with the exception of the optionally available glass section. Wittmann says the system is very easy to clean to facilitate changeovers.

MATERIALS

Resin Eliminates Antenna Split in Smartphone Middle Frames

SABIC has introduced Ultem DU762 resin, a specialty thermoplastic suited for smartphone middle frame applications. Compatible with non-conductive physical vapor deposition (PVD) sputtering processes, the material provides a high-gloss, metallic surface to improve the appearance of smartphones. This polyetherimide (PEI) material also features excellent chemical resistance for durability, light weight for usability and a balance of ductility and strength for structural parts.

Compared to titanium, stainless steel and aluminum, which require time-consuming machining, the new Ultem grade can be cost-effectively manufactured using high-speed, high-volume injection molding. It is also much lighter than metal options. Furthermore, as a non-conductive, metallized polymer, the SABIC resin eliminates the need for an antenna split in the middle frame. Using metal frames with plastic antenna splits can create a non-uniform appearance that impacts styling.



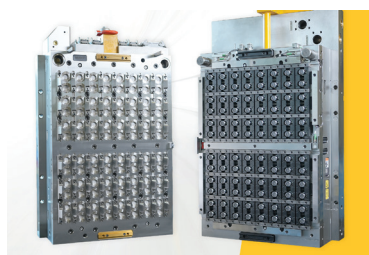
Another incumbent frame material, glass fiber-reinforced polycarbonate (PC) resin, typically uses non-conductive vacuum metallization (NCVM). This multi-layer process creates a thick coating that can accumulate along edges and corners, preventing a clean, sharp line. Furthermore, glass fiber in the PC resin can migrate, creating an uneven surface that affects gloss. In contrast, PVD metallization is simpler and produces a much thinner profile. Unreinforced Ultem DU762 resin is designed to promote a smooth, high-gloss finish and resists abrasion and cracking better than softer PC resins.

Additional features of Ultem DU762 resin include high heat resistance and robust resistance to sunscreen and other chemicals. Ultem DU762 resin is available globally.

TOOLING

Advanced Tooling for Beverage Closures

Husky Technologies says its new HyCap 4.0 tooling meets the changes needs of the closure market. The company notes that several new features provide



enhanced tool robustness for extended mold life, since in high-volume closure production, tooling

durability directly impacts productivity and operational efficiency. Here advanced material selection and precision-guided stack design promote long-term reliability. The integration of polymer bushings, which reduce steel-to-steel contact between core components, is a key innovation, according to Husky. This advance results in reduced wear and extended mold life, with lower risk of mechanical failure and improved consistency across millions of production cycles.

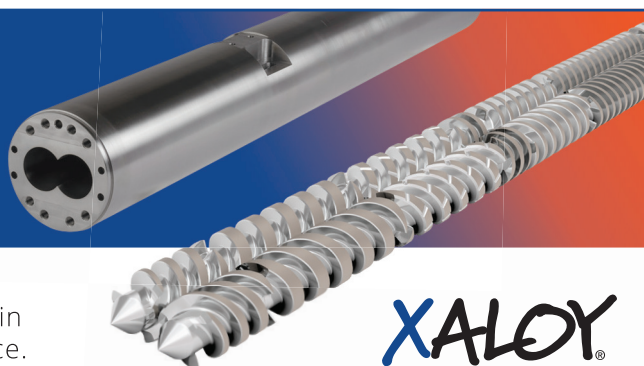
HyCAP 4.0 tooling also enables closure molders to switch between tethered and non-tethered closures with minimal changes to support a wider range of closure applications.

Husky says HyCAP 4.0 tooling helps reduce the total cost of ownership in closure production. From a durability standpoint, the system lowers overall maintenance and labor costs, spare parts consumption, production downtime and operational disruptions.

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MATERIALS

Glass-Like PET Packaging for Premium Beauty Brands

Indorama Ventures and Rebhan, a German manufacturer of cosmetic packaging, have collaborated to bring new polyethylene terephthalate (PET) packaging to the beauty and personal care market, combining luxury aesthetics with improved recyclability and more sustainable options.

Bringing together Indorama Ventures' expertise in specialty PET materials and Rebhan's packaging design and manufacturing capabilities, the collaboration has introduced Luxyclear EBM PET 5508. Designed for extrusion blow molding, the specialty PET grade provides a glass-like appearance to thick-wall cosmetic bottles while offering PET's lightweight, durable and shatter-resistant benefits with clarity and transparency.



According to Indorama, the solution is well-suited for premium beauty and personal-care products where both aesthetics and performance are essential.

In addition to the conventional virgin PET grade, Luxyclear EBM PET 5508 is also available in versions with up to 100% chemically recycled content or mass balanced certified renewable feedstock.

These options reportedly allow brands to reduce reliance on virgin fossil resources while maintaining the same premium clarity, performance and product quality.

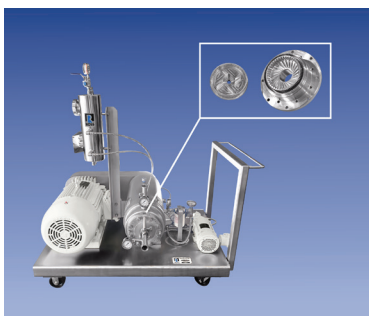
The material is commercially available to beauty and personal care brands across Europe, the Americas and Asia.

MIXING

Caster-Mounted Inline Ultra-High-Shear Mixer

The MegaShear Model HSM-706MS-50 from Ross is designed for ultra-high shear mixing applications requiring rapid particle-size reduction, emulsification and homogenization. Ross says this machine is ideal for processing liquids and semi-viscous materials for a variety of industries. The patented mixer features a high-performance rotor/stator generator capable of operating up to 7,200 rpm, delivering tip speeds of approximately 11,300 ft/min for what Ross calls efficient dispersion and uniform product consistency.

The mixer is powered by a 50-hp explosion-proof, inverter-duty motor for safe and reliable operation and precise variable speed control, Ross says. Product-contact surfaces are constructed of Type 316 stainless steel and polished to a 150-grit finish to support sanitary processing and ease of cleaning.



DRYING

Mobile Dryer With Graphic Color Display

At Fakuma 2026, Oct. 12-16, Friedrichshafen, Germany, Wittmann will show for the first time the Drymax basic 120 mobile dryer with a new graphic color display. Wittmann says this 3.5" thin-film transistor LCD color display provides more clarity, easier operation and improved process reliability.

The intuitive menu navigation is said to make setting the drying parameters easy, as all setting options are depicted by symbols to circumvent language barriers. All process-relevant parameters, as well as the current device status, can be viewed at a glance, Wittmann adds.



The Drymax basic 120 is designed out for dry air generation of 120 m³/hr and granulate throughputs of up to 75 kg/hr. To enable continuous provision of process air of high quality for drying, the Drymax basic 120 comes with two desiccant cartridges.

The duration and intensity of temperature-controlled regeneration are based on current demand to avoid excessive energy consumption, according to Wittmann.

THERMOFORMING

Thermoforming Machines To Boost Output and Versatility

Designed for productivity and versatility, the new FXL1000 thermoformer from WM Thermoforming Machines provides a 41.7" x 37" forming area and a 160-mm forming depth for both upper and lower molds. Depending on the stacker-conveyor setup, it scales production up to 33 cycles/minute using a 3-axis AB stacking robot.

The cutting press exerts 118 tons, representing a 24% increase in cutting power over competing models, according to the company. This combination yields a 40% increase in output while maintaining 100% compatibility with KMD90 and Sencorp 2500 tooling. A front-lateral mold-loading system supports seamless x mold integration and operational efficiency.

The FXL1000 integrates a suite of advanced technologies into industrial thermoforming workflows. At the forefront is WMind, a cloud-based suite that enables real-time machine data monitoring, smart analytics, predictive maintenance and configurable software agents from anywhere at any time. Form.AI acts as an intelligent 24/7 virtual assistant providing multilingual troubleshooting guidance.

MIXING

Solid-Liquid Mixing and Blending System Has No Moving Parts

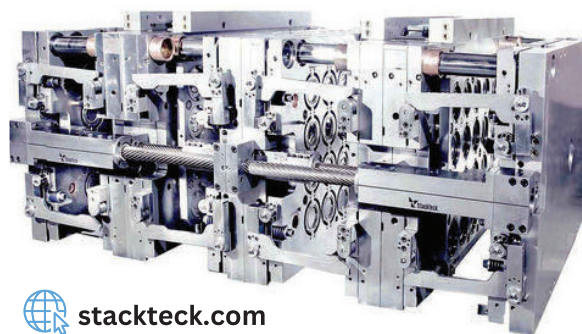
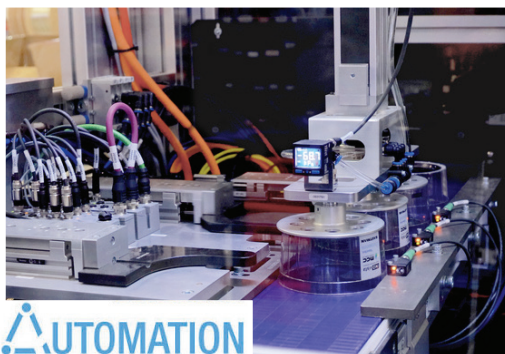
Flexicon has expanded its product line into solid-liquid mixing and blending with the FlexEducator liquid-mixing educator system.

With the FlexEducator, a centrifugal, twin-screw or rotary lobe pump drives liquid through a patented nozzle positioned upstream of the solid material inlet. This creates a strong Venturi vacuum that draws powder from the induction hopper above the inlet into the mixing zone, producing lump-free blending of solids and liquids while dramatically reducing batch times, according to Flexicon.

The FlexEducator has no moving parts, which virtually eliminates mechanical failure and minimizes maintenance, Flexicon says. Its sanitary stainless steel construction and full clean-in-place capability support hygienic operation. The design also virtually eliminates clogging during operation, providing fast and effective mixing for new or existing processing.



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MATERIALS

Distribution Partnership for Polyamide-Imide Materials

BARplast LLC has entered into a strategic distribution partnership with Toray Resin Co. for the TI-5000 Series of polyamide-imide (PAI) materials, further expanding its portfolio of performance polymers for customers across North America.

Through the partnership, BARplast will provide customers with access to Toray's TI-5000 Series, a family of high-performance PAI materials engineered for demanding applications requiring exceptional mechanical, thermal and tribological properties.

The TI-5000 family includes multiple grades developed for application-specific requirements. The portfolio comprises unfilled materials, glass- and carbon-fiber-reinforced grades for improved mechanical performance, and internally lubricated wear

grades containing polytetrafluoroethylene (PTFE) and graphite for low-friction dynamic applications.

The addition of TI-5000 further strengthens BARplast's growing portfolio of specialty and high-performance polymers, which includes polyether ether ketone (PEEK), thermoplastic polyimides, thermosetting polyimides, PAI and polyetherimide (PEI).

Customers will have access to advanced materials as well as BARplast's technical expertise, application development capabilities and local support.

"The addition of Toray's TI-5000 Series represents another important milestone in BARplast's strategy of providing North American customers with access to leading high-performance polymer technologies," says Miteya Rahane, vice president of BARplast LLC.



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LSR MOLDING

LSR Supports Coolant-Resistant Connector Seals for E-Mobility

Wacker Chemie AG is presenting Elastosil LR 3822, an oil-exuding liquid silicone rubber (LSR) with coolant-resistant properties, at Fakuma 2026. The material was specifically designed for e-mobility applications, with a focus on



connector seals and sealing elements in the cooling circuit of EV traction batteries. Molded parts made of LSR exhibit a low compression set and high resilience, making it possible to manufacture elements with high-sealing performance.

Elastosil LR 3822 offers processors a range of benefits. The crosslinked elastomer continuously releases silicone oil from its surface, creating a lubricant film that facilitates machine assembly of molded parts. The silicone is also durable and tear-resistant — after curing, it can be stretched by 270% without cracking or damage. The elastomer also provides low-temperature flexibility, retaining its elasticity at temperatures as low as 45°C.

Wacker Chemie says Elastosil LR 3822 is the first oil-exuding product of its kind to also offer high coolant resistance. Tests show that the silicone maintains most of its mechanical properties after being stored for 1,000 hours in a glycol-water mixture at 125°C. This is evident in compression set performance pressure stress, Wacker Chemie adds.

A Mostly Flat-to-Down Price Trajectory for Volume Resins

Upwards pricing for polystyrene and nylon 6/66 for now, with geopolitical and weather risks still looming.

Prices for nearly all volume resins were trending flat-to-down with the exception of polystyrene (PS) and nylons 6 and 66, with these increases attributed to spikes in feedstock costs and industry consolidation and despite lackluster demand and well-supplied markets. Still looming heading into fourth quarter is the uncertainty of the U.S.-Iran conflict and potential weather disruptions as the peak of hurricane season is entered. In addition,

By **Lilli Manolis Sherman**
Contributing Editor

Polyethylene Price Trends

HDPE Injection	
AUG	SEP
	

HDPE Blow Molding	
AUG	SEP
	

HDPE HMW	
AUG	SEP
	

LDPE	
AUG	SEP
	

LLDPE Butene	
AUG	SEP
	

there's uncertainty around the impact of tariffs and counter tariffs, particularly with Canada.

Below are the views of purchasing consultants from Resin Technology Inc. (RTi); David Barry associate director of polyethylene (PE), polypropylene (PP) and PS for Dow Jones Energy (formerly OPIS's PetroChemWire); Michael Greenberg CEO of Resintel, the market intelligence service of The Plastics Exchange (TPE); Scott Newell, executive VP polyolefins at distributor/compiler Spartan Polymers; and Mike Burns of Plastic Resin Market Advisors.

Entering September, Greenberg addressed the overall state of the domestic polyolefins market. "Domestic buyers were more reserved," Greenberg explains. "Processors continued to buy what they needed, but there was little urgency to build inventory ahead of month-end." He also noted that industry data shows both PE and PP inventories in comfortable positions.

Barry acknowledged the U.S. tariffs on Canada and subsequent counter tariffs. "Raw resin trading remains unimpacted for now," Barry says. "However, tariffs on

Market Effective Mid-September 2026

Resin Grade	¢/lb
POLYETHYLENE (railcar)	
LDPE, LINER	71-73
LLDPE BUTENE, FILM	67-69
HDPE, G-P INJECTION	71-73
HDPE, BLOW MOLDING	69-71
HDPE, HMW FILM	71-73
POLYPROPYLENE (railcar)	
G-P HOMOPOLYMER, INJECTION	63-65
IMPACT COPOLYMER	68-70
POLYSTYRENE (RAILCAR)	
G-P CRYSTAL	105-107
HIPS	111-113
PVC RESIN (railcar)	
G-P HOMOPOLYMER	53-55
PIPE GRADE	54-56
PET (truckload)	
U.S. BOTTLE-GRADE	73-75

finished plastic goods are creating friction, with some converters already facing immediate, large-scale order cancellations.

PE PRICES FLAT

August PE prices appeared to rollover, despite suppliers' previously nominated hikes of 5-10¢/lb for the month. Spot prices were flat-to-lower, according to Barry, Greenberg, Burns, and Kevin Mekaru, RTi's procurement director for commodity resins. This after dropping a total of 25¢/lb in the June-July time frame. Meanwhile, Dow and NOVA issued price hikes of 5-7¢/lb for September. "Producer price initiatives remain in place, though support is thin," Greenberg noted. "So far, no other producers have broadly followed with September initiatives, and the current spot market provides limited evidence that August increases will gain wide traction. The market is simply not tight enough, and buyers know it."

Barry says the market is in a pretty steady equilibrium in terms of supply-demand, partially due to an earlier uptick of exports to China, which now appear to have pulled back as prices there dropped recently. He saw a bit lower pricing for both spot resin and exports. Both he and Mekaru see a flat-to-down trajectory in the September-October time frame, with potential for a slight decrease as a build-up of supplier inventories was largely expected. "Pricing is unlikely to adjust lower until October/November and any events could potentially increase prices significantly," Burns says. "Strong domestic demand could be a leading factor in the event of a disruption. Domestic pricing should track lower with global prices." He says record production and below-average exports will favor processors ahead of 2027 contract negotiations.

PP PRICES DROP

August PP prices dropped 1.5¢/lb in step with propylene grade polymer (PGP), and there was market talk about a potential non-monomer price decrease, according to Barry, Greenberg, Newell and Mekaru. This comes after prices dropped a total of 15.5¢/lb in

the May-June timeframe, before moving up 3¢/lb in July. Generally, these sources saw the potential for a further decrease in September PGP/PP prices, barring major production disruptions. "A major index suggested that 3¢/lb of margin erosion would come out during August," Greenberg says, "but we do not see that transactionally. Perhaps some of the margin gains could consolidate towards the lower end of the range, though overall spot pricing remains firm aside from the PGP delta."

Newell notes that still looming are the Middle East conflict and weather risks. He also sees overall growth in PP through August to be closer to 2-3% of "real organic growth", versus the upwards of 6% recorded by the industry. He attributes the latter to the upswing in demand in the March-April time frame that included prebuying and unusually higher PP exports. Both Barry and Mekaru posit that the market going into fourth quarter is unlikely to sustain plant operating rates which had risen to the mid-80s percentage wise.

Polypropylene Price Trends

Homopolymer

AUG	SEP
 1.5¢/lb	

Copolymer

AUG	SEP
 1.5¢/lb	

Polystyrene Price Trends

GPSS

AUG	SEP
 7¢/lb	

HIPS

AUG	SEP
 7¢/lb	

PS PRICES UP

Prices of PS were once again on an upwards trajectory, as August prices were expected to settle between 5-11¢/lb higher, following a drop of 6¢/lb in July and increases of 33-34¢/lb between March and June, according to Barry and Brian Balboa, RTI's senior business unit leader for PS and polyvinyl chloride (PVC). Balboa thinks there will be another much smaller increase in September with October prices flat. The sharp July-August trajectory is solely linked to the August benzene contract price which settled at \$4.58/gal from July's \$3.64/gal — a 94¢/gal increase that translates to the 9-10¢/lb sought by PS suppliers. That's based off the fact that a 10¢/gal benzene price change typically equates to a 1¢/lb change in PS resin formulation. Balboa notes that part of the higher benzene price is due to a somewhat tighter supply resulting from lower imports from South Korea and Japan. Barry maintains that benzene is well supplied going into October, when PS demand typically drops. These sources feel PS prices could settle up closer to 7¢/lb, based on flat demand. Barry reports the implied styrene price was 2.7¢/lb lower going into September than the 50.3¢/lb four weeks prior.

PVC PRICES DOWN

Prices of PVC dropped another 1¢/lb in August, having fallen a total of 5¢/lb in the June-July time frame with flat pricing likely in September, according to Balboa. Barring a weather-related production disruption, he thinks prices going into October could be flat-to-down. Noting that without any new capacity added and loss of one of Westlake's PVC plants earlier this year, August was the third consecutive month in which suppliers' inventory was built up during the seasonal peak of the construction market. With the exception of the film and sheet sector — which showed a slight uptick in June — demand appears to be slightly down versus 2025. Moreover, competitive PVC exports from China are constraining domestic suppliers' PVC exports with uptick exceptions in January, March and July. Balboa saw data centers as one area that has been keeping "the market afloat" and is optimistic that industry data will show an uptick in demand for the fencing/decking remodeling sector.

PET PRICES FLAT-TO-DOWN

Prices of polyethylene terephthalate (PET) in August rolled over, after dropping in July by 1-2¢/lb, negating the June increase, according to Mekaru. He posits that another 1-2¢/lb is likely to come off in September, with flat pricing for October. This all linked to generally flat-to-lower raw material cost formulations, continued soft demand and a well-supplied market, which includes well-priced imports.

PVC Price Trends

Pipe	
AUG	SEP
	
1¢/lb	

Gen. Purpose	
AUG	SEP
	
1¢/lb	

PET Price Trends

Bottle Grade	
AUG	SEP
	
	1-2¢/lb

ABS PRICES DROP

Prices of acrylonitrile butadiene styrene (ABS) dropped 12¢/lb in the July-August time frame and were expected to drop an additional 5¢/lb in September, according to Tyler Wheeler, RTI's senior business unit leader for engineering resins. "Our previously forecasted price decline is taking place following the sharp increases in second quarter," Wheeler says. "Out of the 25¢/lb implemented increases, we see at least 15¢/lb coming off." He attributes this to lower benzene prices in July along with downward pressure from competitively priced imports from Taiwan, South Korea and China, with prices generally at about \$1.20/lb vs. domestic material at \$1.30/lb. Moreover, demand for ABS through August is roughly 3-5% lower than 2025

imports and pricing is more directly linked to benzene's price trajectory." He characterizes the market as balanced, noting that while demand for automotive appeared firmer in the second quarter, third-quarter demand was more of a mixed bag in terms of market sectors. He ventures PC prices by year's end will be up a total of 8-10¢/lb over 2025.

PRICES OF NYLONS 6, 66 FLAT-TO-UP

Prices of nylon 6 moved up 21¢/lb during second quarter and suppliers were seeking increases of 8-12¢/lb in September, citing higher feedstock costs, though their trajectory was trending lower, according to Wheeler. He sees this market as relatively stable and ventures demand year-to-date is up about 1%. Wheeler also suggests that there will be "healthy negotiations" that will lead to the latest price nominations ending up closer to 4¢/lb higher.

Nylon 66, for which prices moved up a total of 24¢/lb in second quarter, were on target by suppliers for an increase of 8-12¢/lb in September, but Wheeler sees implementation closer to 4-6¢/lb as more realistic. "I struggle with the latest increase nominations as the market is very well supplied, despite some production reductions by Ascend Performance in Pensacola, Florida, as every other domestic plant is running at high capacity." Overall, he saw the third quarter ending with relative stability and some price increases, despite lower feedstock costs. ^{PT}

year-to-date. He says the pricing trajectory for the rest of the year will largely depend on benzene contract settlements.

PC PRICES DOWN, THEN FLAT?

Polycarbonate (PC) prices dropped 7¢/lb in July, rolled over in August and were likely to remain flat through September, despite suppliers nominating a 5¢/lb increase, according to Wheeler. This comes after price increases of 14-16¢/lb in the April-May time frame due to rising costs for feedstocks benzene and acetone. "There's a bit of an equilibrium at play, as PC is not threatened by

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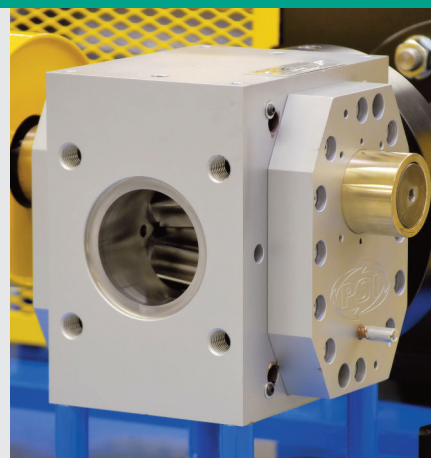
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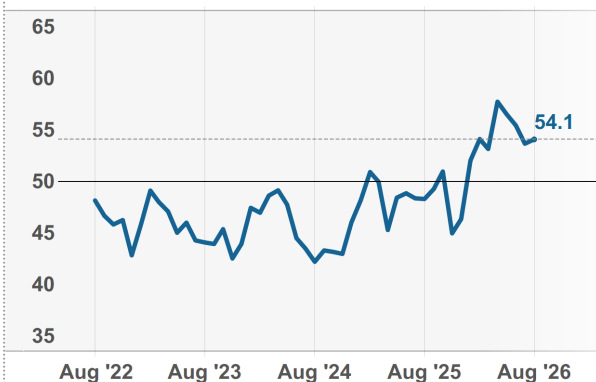


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Plastics Processing Index Rises After Three Months of Contraction

The GBI Processing Index rose from 53.7 in June to 54.1 in July, with its production component rising for the second consecutive month.

FIG 1 Plastics Processing Index



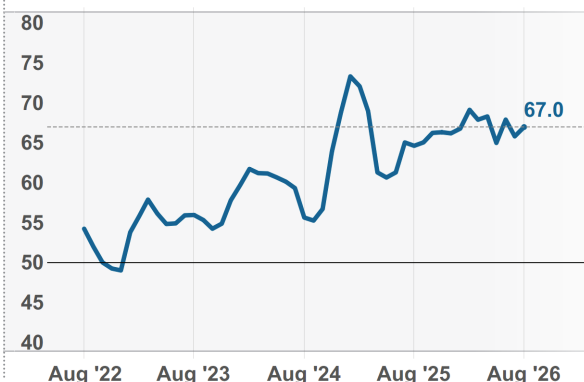
The GBI is an indicator of the current state of plastics processing. Over 50 is expansion. Under 50 is contraction.

FIG 2 Components Scorecard

	Change vs	
	Month Ago	Year Ago
Supplier Deliveries	▼	▲
Production	▼	▲
New Orders	▼	▲
Employment	▼	▲
Backlog	▼	▲
Exports	▼	▲

Shade = distance from 50 (darker shades are further from 50)
Direction = change (Pointing up is better)

FIG 3 Future Business Index



Numbers in Perspective

GBI Processing's Index rose from 53.7 in June to 54.1 in July,



By Perc Pineda

with its production component edging up for the second straight month to 58.2, confirming plastics conversions underlying growth. The GBI's employment component pull back from 51.8 in June to 50.0 in July, juxtaposed with the backlogs increase from 48.3 to 51.6, reflects the ongoing realities of U.S. manufacturing,

including higher production expectations and fewer workers, potentially contributing to rising backlogs.

Additional Federal Reserve indicators also point to improving conditions in plastics manufacturing. Plastics and rubber products manufacturing capacity utilization rose from 73.0% in July 2025 to 75.4% in July 2026. May's 75.9% reading marked the highest level of the past 12 months. Higher utilization, alongside the continued expansion in the GBI Processing Index, suggests that plastics processors are sustaining higher levels of production despite persistent labor constraints.

The uptick in other GBI components, particularly new orders and future business, is broadly consistent with resilient consumer demand. Real personal consumption expenditures (PCE) increased 0.4% in June before holding essentially steady in July, suggesting that consumer spending remains resilient despite recent moderation. Consumer spending also contributed to the economy's 1.5% annualized second-quarter real GDP growth, while the Federal Reserve Bank of Philadelphia's latest survey raised its third-quarter GDP growth outlook from 2.2% to 2.5%. Together, these indicators suggest that resilient consumer demand should continue to provide support for plastics processing, even as labor constraints and rising backlogs present near-term challenges. [PT](https://GardnerIntelligence.com)

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REHAU GROUP MURI BEI BERN, SWITZERLAND

Leading PVC Extruder Says Melt Pump Lives Up to Billing

MAAG's melt pump helps solve RPVC processing challenges for REHAU.

Melt pumps have typically been eschewed by extrusion processors of rigid PVC (RPVC) because the unplasticized, highly viscous material is heat and shear sensitive and tends to burn and degrade in any gaps or dead spaces.

By Jim Callari
Editor Emeritus

But about a year ago, MAAG Group introduced the extrex⁶ EC pump, designed to significantly reduce thermal stress on PVC

and eliminate the risk the material will degrade or hang up over bearings and gear journals.

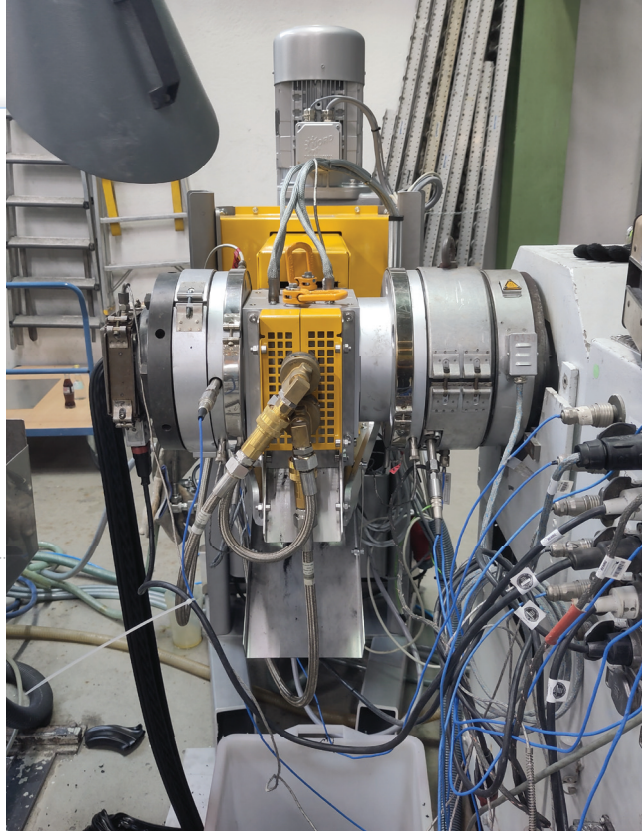
The pump was developed in partnership with global processor Rehau Group which, among other things, runs RPVC to make technical hoses, profiles, seals and other products for a myriad of applications. Rehau and MAAG tested the pump from 2022-2024 at the processor's technical center in Germany and put the machine into production at a plant in Spain early last year, where it has thus far lived up to its billing.

The inherent design of conventional melt pumps has made them unsuitable for RPVC extrusion. Melt pumps have tight, intermeshing precision gears, and the axial clearance between these gears and the pump housing subjects the material to high mechanical shear. This creates hot spots that can ultimately burn the polymer or turn it yellow or brown in color.

There is also the matter of dead zones in conventional designs. In melt pumps, the polymer itself lubricates the internal sliding bearings and gear journals. The material moves slowly in this lubrication process which — in the case of RPVC — results in the material charring. The result is process instability or, in a worst-case scenario, the bearings seizing completely.

But MAAG says the extrex⁶ was designed specifically to mitigate these issues. It has a gap-free design with no dead spaces, which reduces residence times, thereby preventing the material from adhering to and accumulating inside the pump. Maag says this significantly reduces the thermal stress on the PVC and eliminates the risk of degradation.

The two companies say the pump also helps make the extruder more efficient, offering energy savings of up to 20%, since the extruder can be designed to focus mainly on melting and mixing.



Rehau tested MAAG's pump for rigid vinyl at its tech center in Germany and now plans to incrementally deploy the units on other lines around the world. Source: MAAG Group

MAAG notes that because the pump stabilizes pressure, it also can help processors boost throughput significantly.

In operation at a Rehau plant in Spain, the two companies report that the extrex⁶ kept the temperature increase through the pump to 6°C. In runs using recycled RPVC, Rehau and MAAG report that pressure fluctuations at the die were minimized by the gear pump's constant output, resulting in what the companies call a "massive improvement" in the product quality of the profiles.

At the same time, the companies say, the motor load on the extruder decreased by up to 20%, promising a longer service life for the system and noticeable cost savings in the maintenance cycle. Pressure fluctuations at the die were minimized by the gear pump's constant output, resulting in a massive improvement in the product quality of the profiles.

Rehau plans to gradually add the extrex⁶ to other extrusion lines around the world. "The development of the melt pump into the current, near-production prototype was handled professionally and driven forward with great dedication by all involved," says Martin Schwanck, process engineer, at Rehau Industrial Solutions SE & Co. KG.

He adds, "After commissioning and training at our production facility, (we) were immediately able to operate the pump independently — thanks in part to the very clear instructions. The robust design and wide process window meant that operators quickly gained confidence in the machine and came to appreciate it as an important contribution to stabilizing production." PT



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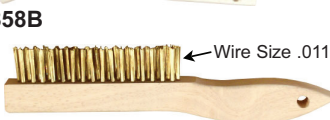
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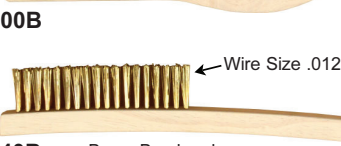
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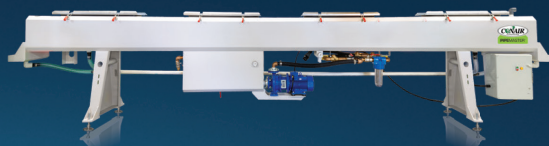
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