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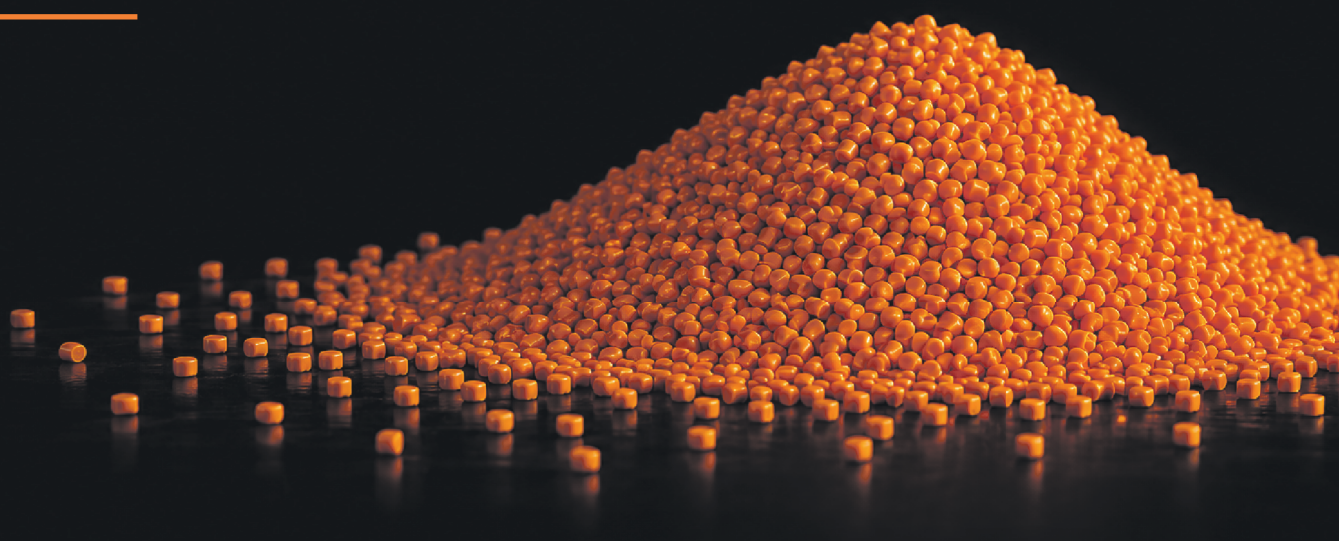
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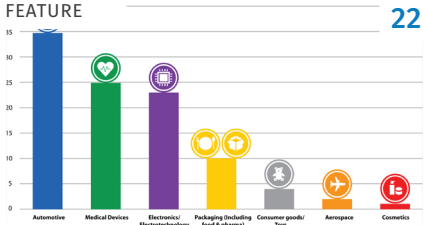
10 Steps for a Smooth Desiccant Dryer Installation

Here's how to properly install a desiccant dryer in 10 key steps — from inspection and rigging to electrical setup and startup — for reliable, long-term production.

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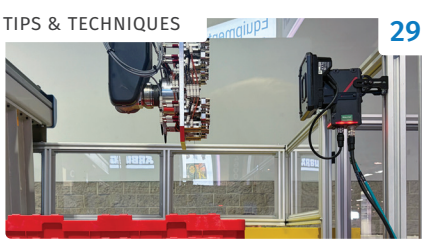


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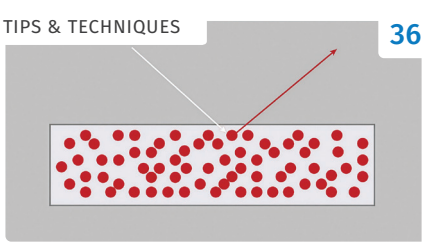


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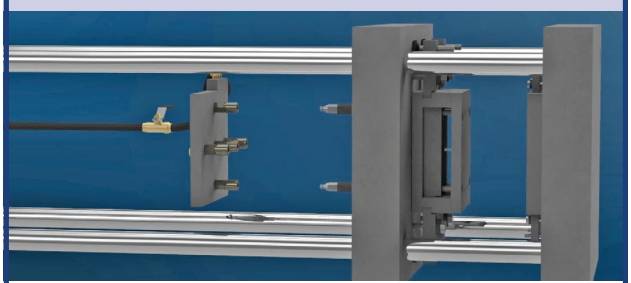
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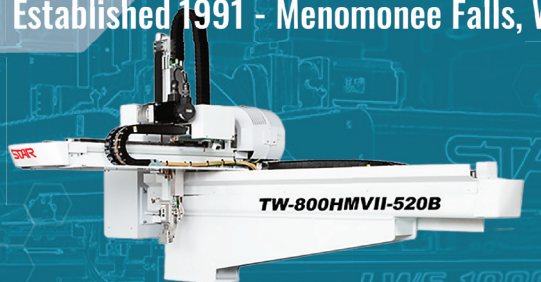
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Automation's Next Frontier

The next "robot" you install might be in your front office, not on your shop floor.

According to Merriam-Webster, automation, by definition, is "the use of machines, computers or technology to run systems and perform tasks with little or no human help." In the context of plastics processing, automation — in the form of discrete robots or connected systems like a boxing conveyor — has been most prevalent in the realm of production. Going forward, there will obviously still be advances in production automation. However, alongside those more tangible robotic displays on the factory floor will come automation of all the things that keep a plastic processor running that don't involve melting and forming pellets.



Tony Deligio
Editor-in-Chief



REVISITING THE THREE D'S

The Three D's — dull, dirty and dangerous — is the mnemonic device used to describe the types of tasks that traditional automation has targeted in manufacturing. As AI, and in particular agentic AI, takes on a greater role in office work, it won't necessarily be helping humans automate "dirty" or "dangerous" work, but some of it would certainly fall under "dull".

In my conversation with Arzana's Mason Vander Pol (article on page 12), he revealed the potential impact of automation's newest frontier on plastics processors. Arzana is seeking to automate front-office operations, including cost estimating, quoting and job scheduling, among others. Vander Pol noted that one of the first things his company must do with prospective customers is to disabuse them of the notion that deploying AI for this kind of work is akin to asking ChatGPT to run your business.

"This is no longer just access to information," Vander Pol asserted. "This is automation." In the case of Arzana, the human remains very much in the loop, reviewing the work the automation generates (but will not send without human approval). At the same time, the AI is capturing the vital tribal knowledge of the long-tenured cost estimator whose decades of experience enable him or her to take a napkin sketch of a proposed widget and make a back-of-the-envelope ball-park calculation of what it would cost to produce the part while accounting for the material, the size and cavitation of the mold and machine and clamp force that would be required.

This type of labor isn't dull, dirty or dangerous, but it could be considered intensive, inescapable and intellectual. Manually searching through past quotes to find comparable projects when quoting new projects is an obviously time-consuming and cerebrally-challenging task, but it's one that the best processors undertake on new quotes for their own benefit and that of their customers. Automation here promises to take that time- and brain-power-consuming job and winnow it down to a matter of minutes or hours vs. days or weeks.

"One of the value adds is time savings and an increased win rate for being faster," Vander Pol told me. "We have some customers whose estimators are also salesmen. That speed is freeing up their time to go pursue new sales or spend time with customers. You're not having to add a second estimator to take on more work, and you're capturing that knowledge to become more accurate in your future quoting."

For the most progressive processors, automation has never been about replacing people. Instead, it's meant giving your people more value-added tasks to take on. In tomorrow's plant, that could mean employees won't stack boxes or manually digest RFQs.



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Standalone Engineering Thermoplastics Company Launched After Merger

NexPoint Materials has announced its launch as a standalone engineering thermoplastics company following its acquisition from SABIC's Engineering Thermoplastics business by Mutares SE & Co. KGaA.

The new company operates an integrated manufacturing, technical and commercial network across Europe and the Americas. NexPoint offers a portfolio of engineering thermoplastics, with materials specified for demanding applications in the automotive, healthcare, electrical and electronics, building and construction, consumer and industrial markets. There are no planned product or grade changes in the Nexpoint portfolio.

NexPoint has introduced Sanjay Mishra as chief executive officer and Yasser Nyazi as chief finance officer. "Our ambition is clear; to build on our pioneering legacy and shape the future of materials through innovation and excellence." says Mishra.



NexPoint says it will continue to provide trusted products, technical expertise and responsive support with no disruption to ongoing operations, while increasing business agility and streamlining decision making.

The business says it is focused on maintaining reliable supply and customer support throughout the transition.

TaipeiPLAS Highlights Island's Exporting Prowess

TaipeiPLAS 2026 concluded on Sept. 19 at Taipei Nangang Exhibition Center, welcoming international buyers from 77 countries, including Japan, India, Vietnam, Indonesia and Thailand. The 20th edition of the show, which began in 1987 and shifted to a biennial schedule, drew more than 350 exhibitors across 1,360 booths over five days. Co-organized by the Taiwan External Trade Development Council (TAITRA) and the Taiwan Association of Machinery Industry (TAMI), the event facilitated 318 procurement meetings, while the two-day TaipeiPLAS Forum attracted nearly 470 participants, watching presentations on circular materials, applications in aerospace and robotics, AI-driven digital transformation and more. The TaipeiPLAS Award featured 21 finalist entries from 17 exhibitors, covering technologies from materials, products and machinery, while highlighting developments in smart manufacturing, energy efficiency and circular solutions. In addition to Taiwanese stalwarts like FCS, Chum Power, Jon Wai, Victor, Chen Hsong and CLF, the event featured global brands like Arburg, Conair, Maguire and Wittmann as exhibitors. The next TaipeiPLAS will take place in 2028; dates have not yet been determined.



ALPLA Adds Las Vegas Bottle Plant

Adding its second plant in the Western U.S., and its 19th production site in this country, global packaging giant ALPLA will start up a new plant in North Las Vegas, Nevada, next spring. Located within an existing ALPLA logistics center, the 140,000-ft^2 plant will begin extrusion blow molding bottles and create 36 new jobs locally. It will serve customers in food, beverage, health and beauty and home-care markets. With U.S. regional headquarters in Atlanta, Georgia, ALPLA North America has an existing site in the Western U.S. in Salt Lake City, Utah.

Based in Austria, ALPLA has around 25,500 employees at 206 locations in 45 countries. With €5.2 billion in revenue last year, the firm makes bottles, closures, preforms, tubes and other products.

Full-Scale CO_2 Storage Site Opens in the EU

Project Greensand, the EU's first full-scale facility for permanent CO_2 storage moved into operation Sept. 18 at the Port of Esbjerg, Denmark. The facility can store up to 400,000 tons of CO_2 annually, with capacity to expand to 4-8 million tons per year. The opening comes as the EU works toward capture and storage targets of 50 million tons annually by 2030, rising to 250-280 million tons by 2040.

Liquefied CO_2 is trucked to a dedicated terminal at Port Esbjerg. From there, it ships aboard Carbon Destroyer 1, the EU's first purpose-built CO_2 carrier, to the Nini West reservoir, a depleted oil field roughly 250 kilometers offshore. The Nini reservoir's integrity has been tested by the Geological Survey of Denmark and Greenland, and Greensand has received safety approval from independent verifier DNV. The CO_2 is injected approximately 1,800 meters beneath the seabed for permanent storage, and provide a foundation for future carbon capture projects across Europe. The site is ready to receive CO_2 from industries across Europe.

AI-Driven Scrap Reduction

Plus10.ai, an Augsburg, Germany research spin-off for AI-based production optimization, showcased its Parameter Recommender Hopper software in September during Arburg's TechXellence 2026 days in Rocky Hill, Connecticut.

Hopper is the company's online process parameter optimizer software that learns from the machine, raw material and process data to generate recommendations for optimally matched parameters to keep scrap and cycle time as low as possible. Instead of relying on manual "trial & error," Hopper provides situational recommendations for specific parameter adjustments, based on a virtually-learned ideal process and respecting validating windows.

"The fully integrated plus10 Hopper software into the Arburg Gestica was a highlight at the techXellence event," says Arburg's President/CEO Martin Baumann, "It does hit a requirement for our customer base in the U.S. Hopper learns and can improve a process over time and support customers' needs for consistently top-quality parts."



Key capabilities demonstrated at the event included:

- **Scrap-risk prediction:** Hopper's AI model predicts the likelihood of scrap in real time.
- **Context-aware parameter suggestions:** The system recommends process parameter adjustments based on both machine data and contextual information.
- **Automated documentation:** When a parameter is changed, Hopper generates corresponding documentation for traceability in regulated environments.
- **Reaction to raw material batch variations:** These are due to different drying, temperature, viscosity change or material batches. This feature also reportedly works with demanding engineering materials.
- **Flexible parameter application:** Hopper writes its recommended parameter adjustments directly to the machine controller. This can run either human-in-the-loop, with an operator reviewing and confirming each change,or human-on-the-loop, with Hopper applying validated adjustments automatically while the operator continues to monitor the process.
- **Fully integrated with Arburg's Gestica controller:** Hopper has a bi-directional data exchange with the controller.



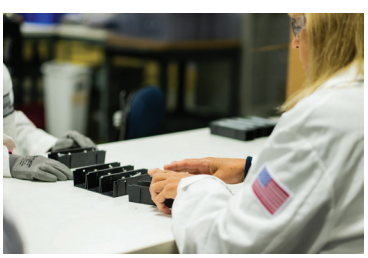
New Ohio Injection Molding Plant Opens

Velocity Group, Cambridge, Ohio opened a new 80,000-ft² plant which consolidates operations formerly in Byesville and Cambridge, and adds more than 25,000-ft² of production space and features 11 injection molding machines.

The newest additions to the production fleet include a vertical double-station press and a horizontal machine, both from LS Mtron. The vertical machine will add capabilities in advanced insert molding and overmolding. The horizontal machine will expand large-part molding capabilities.

Velocity has strengthened precision machining services with a new Swiss CNC lathe to support connectors, shafts, fittings and medical device applications. It also offers an FDA Class 7 clean room with two presses for medical device manufacturing.

The company has more than doubled its sub-assembly and assembly capacity for larger electromechanical assemblies and automation projects, including products comprising several hundred individual components.

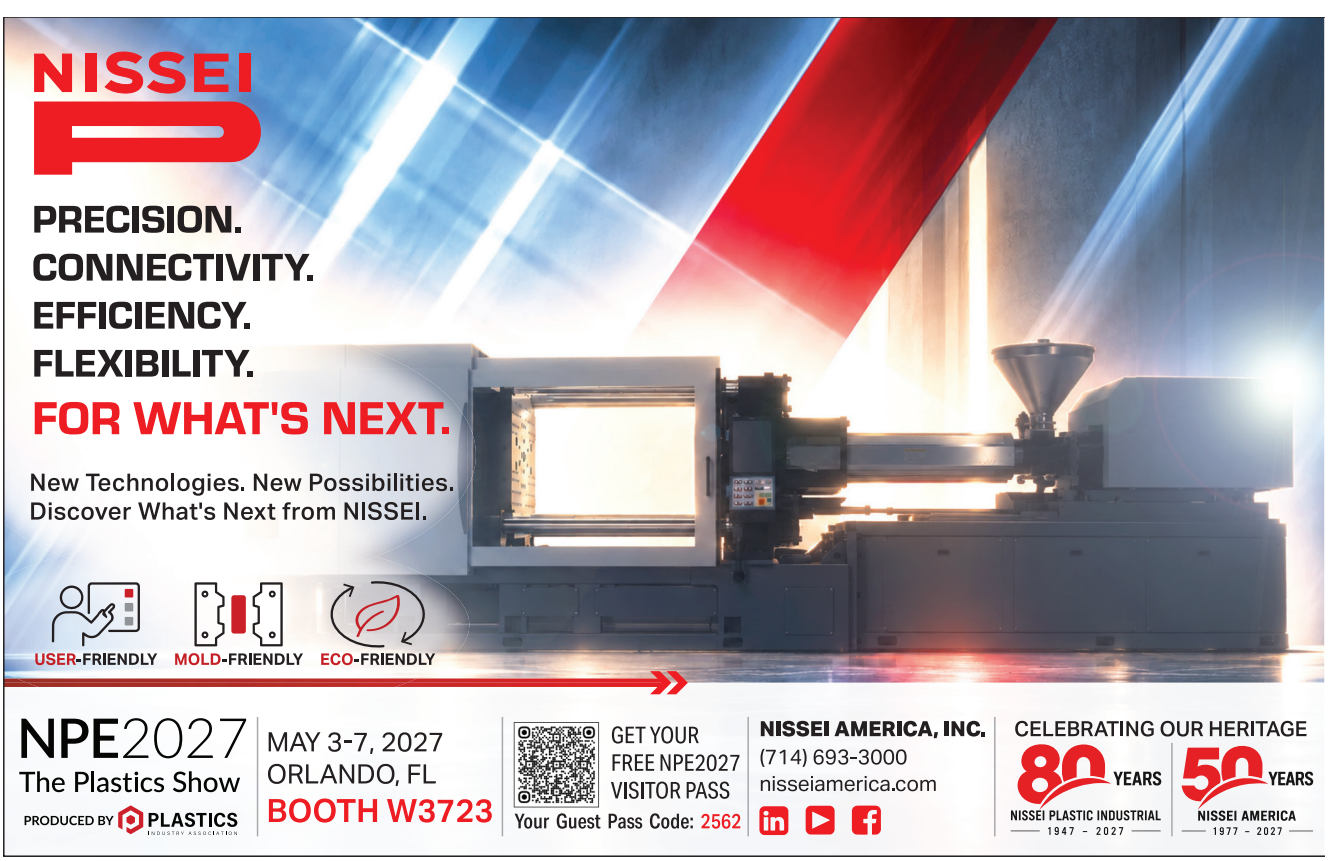


Plastics Machinery Orders Rise, Shipments Drop in Q2

According to the latest report from the Plastics Industry Association's (PLASTICS) Committee on Equipment Statistics (CES), new orders increased in Q2, but shipments, totaling $235.8 million, were down 14.8% from Q1 and 7.2% year-over-year.

Perc Pineda, PLASTICS' chief economist, noted that weakness in shipments reflects the normal lag between new orders and deliveries for capital equipment. In terms of sector sentiment, PLASTICS' CES survey found that in Q3, 35% of respondents expect improvement, while 35% anticipate deterioration. Over the next 12 months, 39% expect conditions to improve, while 28% anticipate deterioration.

Exports totaled $755.8 million and imports registered $275.5 million, resulting in a $480.3 million trade surplus, which is 24.1% higher than a year earlier. U.S. economic growth moderated in Q2, with advance GDP estimates showing 1.5% growth following 2.1% growth in Q1 of 2026. Real gross private investment in equipment, increased 27.7% in Q2 on an annualized basis, following a 4.7% increase in Q1, according to PLASTICS.



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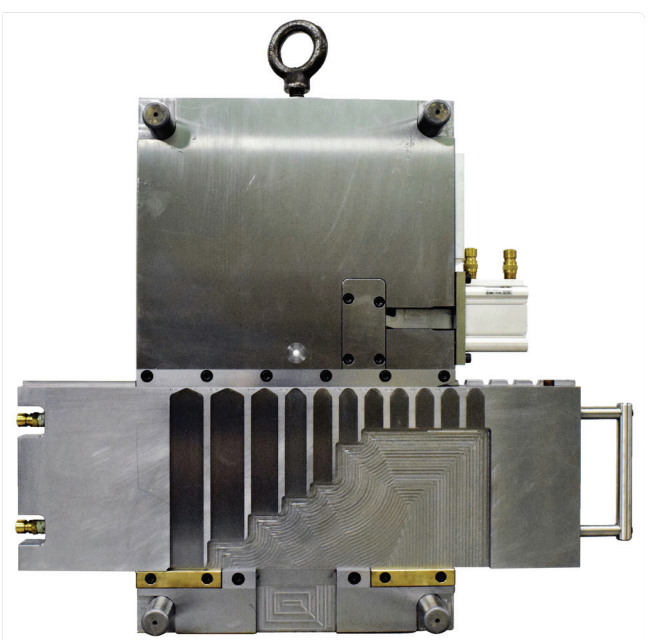
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Finding True Melt-Flow Rates for Injection Molding

Unlike melt flow indexing and capillary rheometers that were created for extrusion — a new patented process determines a resin's flow properties using an injection-centric approach.

By Tony Deligio
Editor-in-Chief

What if the method that industry used to characterize materials for injection molding looked more like injection molding? How would that change how resins are selected, tools and parts are designed and processes are run? Those questions and more flowed from an observation and subsequent ANTEC paper given years ago by John Beaumont, founder of the eponymous Beaumont Technologies, Inc. based in Erie, Pennsylvania. "Traditional isothermal capillary rheometers were designed for extrusion, not molding," Beaumont noted.



Beaumont's patented Moldometer is an indexable tool that enables different flow lengths and wall thicknesses of a given material to be tested to determine flow properties. Source: Beaumont Technologies

Beaumont wasn't the first to call out the misalignment between capillary rheometers and the melt-flow data assigned to various materials, contrasting with the actual processing conditions resins experience in injection molding. Beyond just observing this phenomenon, however, his company has taken steps to close that gap, applying a patented device, the Moldometer, to capture direct, nonisothermal data from real mold channels. This proprietary data is organized into Material Molding Maps through its Therma-flo software, showing how a polymer truly behaves in conditions that mirror injection molding.

Beaumont's patented device is an injection mold capable of high-speed data collection with 18 different sensors that feed proprietary software. The indexable mold's "cavities" go from thick to thin, with wall thicknesses from .4 to .2 mm, and various lengths. In addition to varying wall thickness, the system adjusts injection speeds, with eight different velocities. At the end of flow, the 18 sensors collect data on the melt's actual pressure and velocity gradients. This way, the tool gathers data on different shear rates for each material, as well as the impact of different temperatures and wall thicknesses. The device, unlike a capillary rheometer, accounts for the effect of the melt contacting a mold surface. As explained by Beaumont's Eric Bowersox at Penn State Behrend's Innovation and Emerging Plastics Technologies Conference earlier this year: "Molding viscosity is the measurement of a plastics melt's resistance to flow while flowing in an injection molding tool. With this, we see the impact of the creation of the flow front's frozen skin and the part cavity's wall thickness."

MELT MEETS THE MOLD WALL

In industry standard testing, material viscosity is measured using a constant, uniform temperature over time, eliminating a key factor present in molding. "The industry uses melt flow index and capillary rheometers to make decisions on polymers they use for products, but should they," Bowersox asks, noting that MFI (melt flow index) and capillary rheometers represent isothermal extrusion. "Isothermal meaning it doesn't see a mold; would the results be different if the melt saw a mold? The industry knows the prob-

lems with MFI. You need to look at application requirements and injection molding requirements. Melt flow is not intended to tell us how it's going to mold. What if we could build a test apparatus and see what the melt does when it hits a mold — see the effect of wall thickness."

MORE MATERIAL INSIGHTS

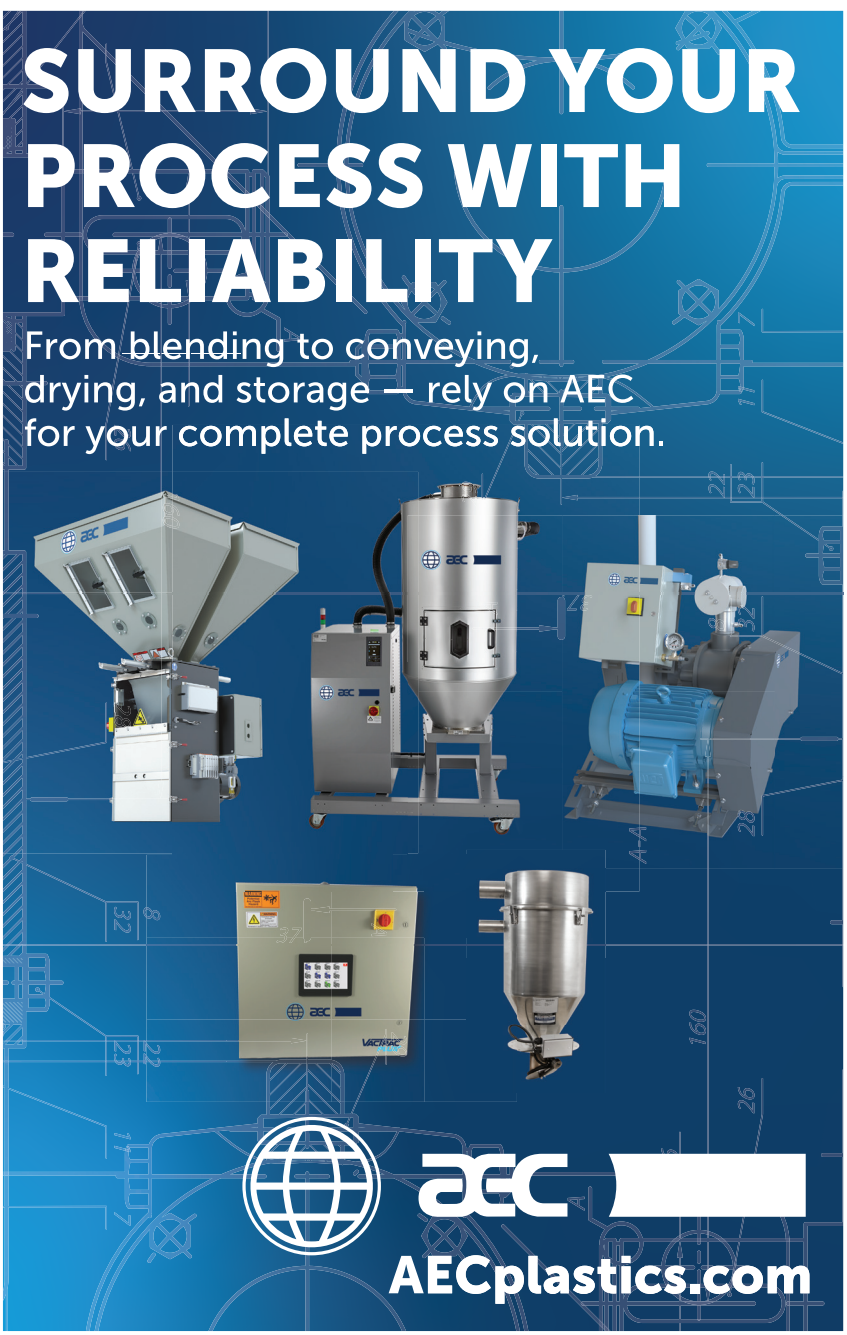
Beaumont says Therma-flo gives molders insight into pressure sensitivity of a melt and an understanding of how melt temperature affects flow, while also receiving guidance on injection velocity selection and data-driven mold-filling options. For designers, the software enables evaluation of wall thickness' impact on cavity pressure and gives them the ability to contrast different polymers for moldability — analyzing pressure, velocity and temperature interactions, while evaluating wall thickness sensitivity of a polymer and quantifying melt temperature effects on pressure. These maps enable molders and designers to contrast multiple polymers under identical conditions, according to Beaumont.

Beaumont says up to 93% of what's influencing flow in a mold is not realized with isothermal rheometers. This is because those tests miss the thermal exchange with the mold, the rapid phase change of the melt to solid boundary and the significant influence of wall thickness. This figure does improve as shear increases, but at best, it's still missing 40% of the data.

> ***"The industry knows the problems with MFI. You need to look at application requirements and injection molding requirements. Melt flow is not intended to tell us how it's going to mold."***

"Use of classic viscosity-vs.-shear-rate graphs hides the molding characteristics of polymers," Bowersox says. Beaumont's own experiments enabled it to see the effect of shear. The company tested two high-density polyethylene's (HDPEs) with MFIs of 0.3 vs. 6.9 g/10 min. Using 9,200 PSI to mold the part, the company found it only needed 20% more PSI to mold the HDPE with a 0.3 MFI at 0.02-inch wall thickness.

Bowersox also showed how two materials with the same published MFI experience a 100% difference in pressure at certain thicknesses. This kind of knowledge could enable molders to select a material with higher mechanical properties, enabling a thin-walled part design, without sacrificing performance. "Who can use this?" Bowersox asks. "If I'm a molder and I'm being sold a 'plug-and-play' replacement material, where the supplier says it's the same MFI, now I can test it." PT



Automating the Front Office

Arzana is helping plastics processors to deploy agentic AI on some of the more time-consuming, if vital, aspects of front office work, including cost estimation and quote preparation.

By Tony Deligio
Editor-in-Chief

Before any jobs are won, designs are finalized, steel is cut or parts are molded, a quote must be prepared. The cost estimators to whom that initial task falls are often among the most experienced employees at a molder or moldmaker. There are two sides to that experience "coin," however. On the one, decades of know-how enables these workers to quickly assess proposed part designs, leaning on learnings gleaned from past projects to approximate future work. On the other, that experience means they are also closer to the end of their career than the beginning, and they along with all that accumulated knowledge could be exiting the company's doors soon.



William Alexander (right) with an Arzana customer. Source: (all) Arzana

Helping manufacturers of all stripes with this predicament is Arzana, headquartered in New York with field offices in Appleton, Wisconsin and Okoboji, Iowa. William Alexander and Marshall Kools, who met at Stanford while studying computer science and machine learning, founded the company in July 2025. In addition to an alma mater and a field of study, Alexander and Kools share a background in manufacturing and the Midwest, hailing from Wisconsin and Iowa, respectively.

Their time at Stanford coincided with the meteoric rise of AI, and in that burgeoning field, they sensed an opportunity for the sector their families had grown up working in. "While [Alexander and Kools] were in school, AI started to take off," explains Mason Vander Pol, senior account executive at Arzana, "and they started working to bring back these AI capabilities to automate the office work that can kind of be a bottleneck for manufacturers as a whole. The thinking was, 'We can apply AI here because these are the pains that we've seen and these are what our people go through.' There's a serious value-add there."

AUTOMATING MANUFACTURING'S FRONT OFFICE

On its most basic level, Arzana describes itself as "building AI agents that automate the front office for American manufacturers." In the same way that robots revolutionized the production floor, Arzana's position is that its ability to leverage AI can similarly transform manufacturers' business operations by helping companies automate time-consuming front-office tasks like quoting, order entry and scheduling.

In addition to the efficiency to be gained by deploying AI to automate such tasks, Vander Pol says Arzana's approach addresses the potential loss of tribal knowledge in key roles. "In the shops we work with, the senior estimator is usually close to retirement," Vander Pol says. "You can't afford to lose those employees and their knowledge. What do you have them do — write down every-



Mason Vander Pol inspects a tool at Iowa Mold & Engineering.

thing they've ever done in a Google doc and try to give that to a young guy — that's not going to work."

ON-SITE ASSESSMENT

Instead of an exhaustive exit interview with retiring cost estimators, Arzana's model is to come on site to the manufacturer for an in-person visit by a team of Arzana engineers who train a unique set of agents on the company's historical data for a bespoke solution. "We're not training one large model," Vander Pol says. "We come in and give you a one-of-one model that's built off your data only and will automatically provide a line-by-line quote in minutes."

Starting with that visit, the model trains on a company's quote history; press and machine rates; purchase records; and other pertinent inputs captured on site. During a beta-testing phase, live requests for quotes (RFQs) are run and compared side by side with the estimator's own quote and the output graded line by line. In the rollout phase, any remaining feedback is addressed, the final customization is built and the system goes into production.

"The onsite visit also informs the scheduling aspects of Arzana's technology suite, according to Vander Pol. "Walking through the shop floor, marking down every work center you have and its capacity, seeing what jobs can go where and why they're going there," Vander Pol says. "Are you running three 8-hour shifts? Are you running Saturday? Then the program is able to automatically match jobs to machines and people."

Once deployed, the system prepares a new quote for experienced humans to review, creating a feedback loop for continuous improvement. "The model is ready for your estimator to check anything that they would override, and every override is used to retrain the model and capture that tribal knowledge that the industry is in fear of losing. You don't have to add a second estimator to take on more work, and you're capturing that knowledge to become more accurate in your future quoting."

Through this method the software becomes customized to the individual user and facility. "Then, we make it personal. It records how it got to this quote and injects that back into the tool to front load some of that tribal knowledge," Vander Pol says. "Where is the information coming from that's not in a spreadsheet — it's in these people's heads — so we're getting that information incorporated into the tool from day one."

In addition to the feedback loop as new quotes are assessed, Arzana's program closes the loop on completed quotes and cost estimates, reviewing any gaps with the final reality of the completed order. "Really that ultimate source of truth is when the real job-cost data lands," Vander Pol says, "matching up and ensuring shops are hitting their margins." Based on that feedback the quoting calculator can adjust for any jobs in the future that are similar.

EXPANDING AS NEEDED

Modular by nature, Arzana's office presence can be expanded as needed, according to Vander Pol. "As your company grows or you have turnover, you can add another agent and slowly build it out depending on what's the lowest hanging fruit at any given time," Vander Pol says. "Scheduling and quoting would be different, but they often go hand in hand — same with purchasing. We can take in your vendor list and when the bill of materials is drafted, it's one click and send all these quotes. When they land in your inbox, it updates the quote. It really can be every step of the way if you want it."

"Where is the information coming from that's not in a spreadsheet? It's in these people's heads — so we're getting that information incorporated into the tool from day one."

What Arzana isn't, is ChatGPT. "A lot of the industry's perception of AI is just ChatGPT," Vander Pol says. "So they're like, 'How is ChatGPT going to run my business?' No, this is no longer just access to information. This is automation. These are agents that when something lands in your inbox don't need to be prompted. They automatically read and generate quotes so that when you get to your desk on Monday morning at 8 o'clock, it's there and ready for your estimator to review and send." PT

Advanced Sorting Brings Change to Packaging Recovery

Growth in packaging outran waste management technology for decades, new strategies and AI tools could bridge the gap.

By Matt Stonecash
Associate Editor

Kent County, Michigan's municipal solid wastes are managed by its Department of Public Works, which operates four facilities: a landfill, transfer station, recycling center, and waste-to-energy plant. The system is comprehensive, but the capture rate of recyclables has stagnated as recyclable materials are often placed in trash bound for incineration or landfill.

"We've estimated that there's about 100,000 tons of recyclables in our waste stream, annually, and we're only capturing about 25,000 — the other 75% is going directly into the trash," says Darwin Baas, director of the Kent County Department of Public Works. Once that material has been delivered to the landfill, it's too late to recover it, explains Baas. So the department is working on setting up secondary capture points that catch materials that miss the bin. Past success with diverting metal from the waste stream has prompted the department to pursue other materials: cardboard and plastic.

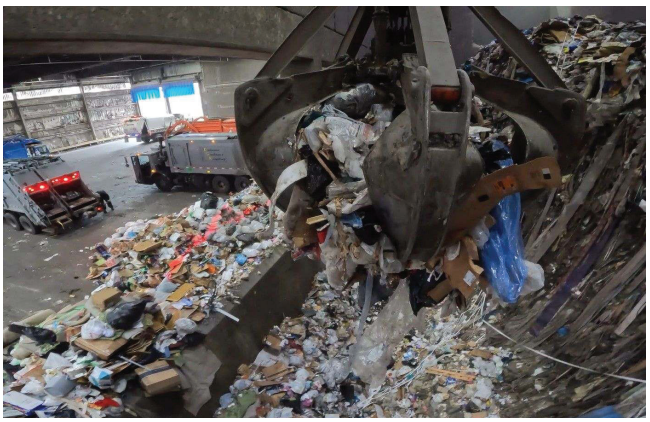
Recyclable packaging in the waste stream is not just wasted material, it also changes the thermal properties of the incineration process. The waste-to-energy system was installed in the 1980s, designed for the waste streams of that era. "We're designed at around 4,800 BTUs per pound, and trash today is combusting at 5,600 BTUs per pound", says Baas. The material burns hotter because the mixture contains more cardboard and plastics than it would have 40 years ago. As a result, throughput is reduced about 10%, or 30,000 tons. "If we could get back that 30,000 tons, that's 30,000 tons per year that can be processed here and doesn't have to be transferred out: you're not putting it back on the road just to move it from point A to point B without adding value," says Baas.

The department has invested in education programs to raise awareness about the recycling program, but that hasn't translated to increased recovery from homes and businesses. Baas believes they have now identified a technological solution. Working with AMP Robotics, Kent County is having an AMP One sortation system installed to divert recyclable material, aimed at improving recovery while also increasing throughput at the waste-to-energy facility.

AMP One is AMP Robotics' automatic, facility-scale sortation system built to recover recyclables from waste streams. The system uses AMP's AI-enabled computer vision to identify and characterize materials in real time. Inline pneumatic air jets then remove target materials from the stream. According to AMP, recovery rates are over 90% for target materials. At Kent County's waste-to-energy facility, the AMP One deployment will be sized to run about 25 tons of bagged municipal solid waste per hour, pulling cardboard (OCC) and rigid



Kent County, Michigan's waste to energy facility. Source: Kent County Department of Public Works



Contemporary municipal waste exhibits high cardboard and plastics content. Source: Kent County Department of Public Works



AMP One sorting system running in a facility in Portsmouth, Virginia. Source: AMP Robotics

plastics out of the trash stream before it reaches the combustor.

These diverted materials, which would have previously been incinerated, will then be sent to the recovery facility for a final sort then baled for recycling.

But the system's capabilities will also enable the county to study its approaches to material management, and investigate alternatives. So the new technology is not just providing capability, but information to inform future strategies: the county will study how and where materials should be diverted from the stream. That could even include changes to pickup, given the low effectiveness of home sorting.

"This is going to be a great platform to understand what it costs per ton, how clean the material will be, how much we can extract, and how that helps with overall throughput and our ability to process material — along with answering some of the deeper questions about what the's the best and right thing to do in this space, given that 75% of recyclables are not making in the container," says Baas.

Kent County and AMP are planning to have the new system installed and operational in 2027. PT

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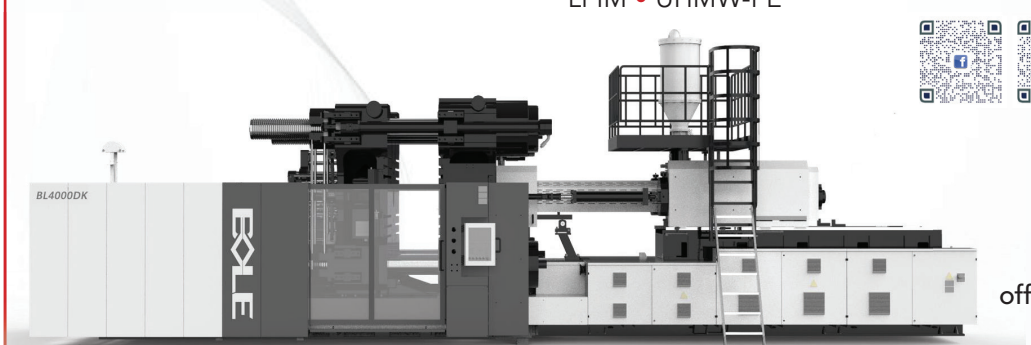


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INJECTION MOLDING

Design of Experiments for Injection Molding: Part 1

What is a design of experiments (DOE) and how can it help injection molders determine which process factors have the greatest influence on the part dimensions?



By Suhas Kulkarni

Design of Experiments (DOE) is a well-known and commonly used technique that was first introduced around 1918 by Ronald Fisher. He worked for the Department of Agriculture in the U.K. and analyzed large amounts of data from crop experiments. This led him to lay the foundation of modern-day statistics.

The definition of a DOE is very simple: Make a known change to an input, record the change in the output and analyze the effect of the change on the output. For example, as shown in Figure 1, if the packing pressure is changed from 4,000 to 8,000 psi, the part length changes from 1.726 to 1.735 inches. This is the most basic designed experiment, whose analysis indicates that changing the pack pressure by 4,000 psi will change the dimension by 0.009 inch. Here, there was one input, called a 'factor', and one output, called a 'response'. The factor was changed from a low to a high value, and so, in statistical terms, it is said to have been studied at two levels. If the data were collected at 4,000, 6,000 and 8,000 psi, there would be three levels. It is important to note that the response between the low and high levels is not necessarily linear and could follow a curve of any polynomial function. This would depend on the industry and the process involved. The technique is widely used in many fields, including pharmaceuticals, food and beverages, manufacturing, medicine and even finance.

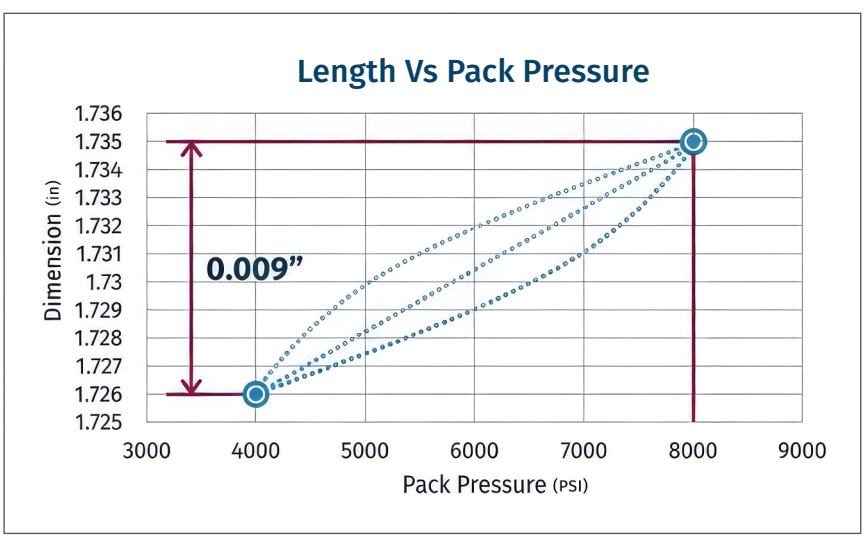


Fig. 1: Effect of pack pressure on part length. Source: (all) FimmTech

If there is one factor and two levels, we end up with two experiments, as in the example in Figure 2. Here, we are studying the effect of pressure on the length of the part. If we want to study the effect of another factor on the length of the part, such as cooling time, we will need to analyze the effect of pressure at both low and high cooling times. This will lead to four experiments. Similarly, as we add more factors, the number of experiments at two levels will double with each additional factor. In Figure 2, we can see that with four factors, we end up with 16 experiments.

The formula for calculating the number of experiments is:

Number of Experiments = (Number of Levels)$^{(\text{Number of Factors})}$

In injection molding, there are 13 main factors that affect part quality. These are shown in Figure 3 as the 11+2 inputs. When pack and hold are separated into two phases, we end up with 13 factors. For smaller gate sizes, pack and hold can be combined into one phase, giving us 11 factors.

If we want to study the effect of each of these factors on part quality, even at just two levels, the formula gives us 8,192 experi-

Scan for more expert advice in injection molding.

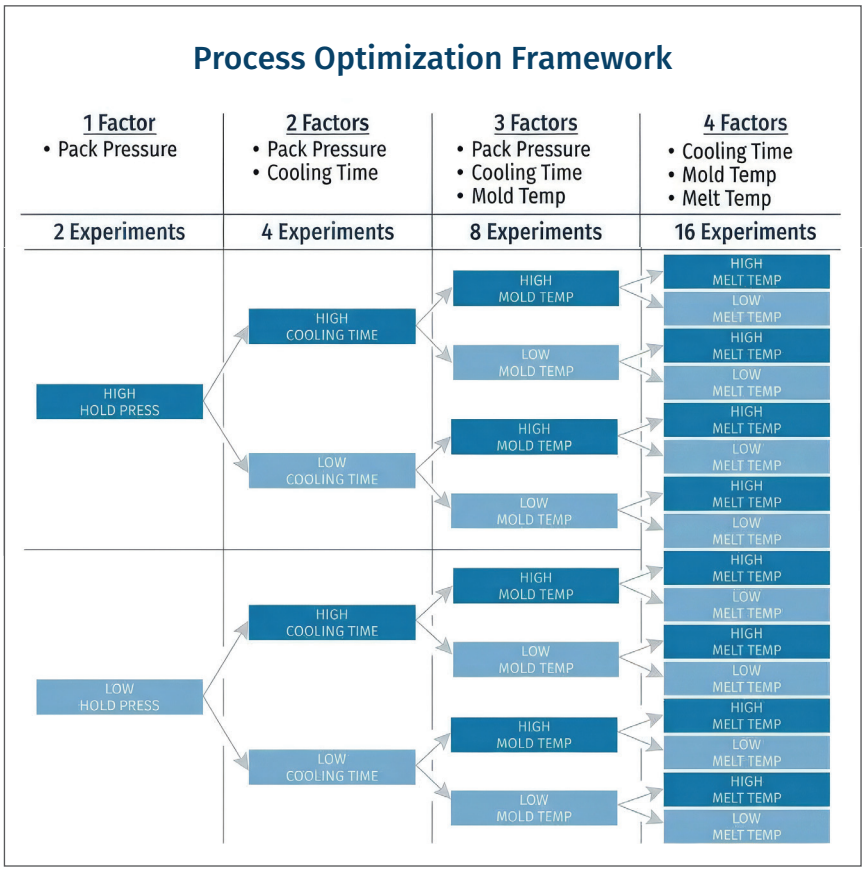


Fig. 2: Relationship between the number of factors and the number of experiments in a DOE.

ments for 13 factors. At three levels, we end up with 1,594,323 experiments! These numbers are impractical to work with, and therefore, we need a way to reduce the number of experiments. Statisticians use a technique called 'confounding' or 'aliasing based on orthogonal arrays', to reduce the number of experimental runs.

If we consider five factors at two levels, we have 32 experiments. Running all 32 experiments is called a 'full factorial design'. If we use confounding to reduce the number to 16 or eight runs, these are called 'fractional factorial designs'. The results from a full factorial experiment are generally more reliable for identifying the effects of interest than those from a fractional factorial experiment, because a full factorial design enables us to study all factor combinations. Therefore, the goal is always to run full factorial experiments whenever practical. However, as the number of factors increases, conducting the experiments and measuring the parts become tedious and time-consuming.

PRIMARY AND SECONDARY FACTORS

There are two cautions to keep in mind when using fractional factorial designs. First, as mentioned above, the fewer the number of runs, the less reliable the analysis may be. Second, statisticians need to know which factors are considered primary and which are secondary. Factors should be arranged in order of importance. Primary factors are those that, based on past experience and data analysis, are known to have a measurable impact on part quality. Therefore, it is important to have not only a knowledgeable statistician but also a domain expert involved in designing these experimental runs.

Since the majority of the readers here are molding personnel, let us focus on our domain, injection molding, and discuss how we can select the factors.

Figure 4 shows the relationship between pressure, volume and temperature of a plastic. This particular graph is for a polyester alloy from SABIC (ed. note: Xenoy was among the product lines sold to NexPoint Materials). It is called a PVT diagram. The graph shows that as the temperature of the plastic increases, its volume increases until it reaches a molten state. If we reduce the temperature of the melt, its volume decreases. This reduction in volume is called 'shrinkage'. Plastic melt is compressible, much like a ball of rubber bands. Therefore, applying pressure to the melt will reduce its volume. Thus,

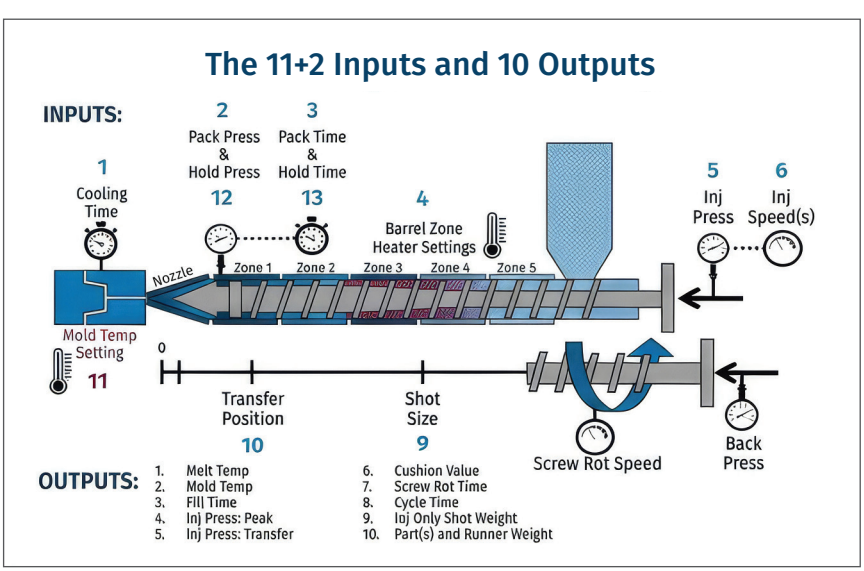


Fig. 3: The inputs and outputs of the injection molding process.

reducing temperature and increasing pressure both result in a reduction in volume.

If you visualize the injection molding process, this is exactly what happens to the melt. We inject the melt under pressure into a mold that is cooler than the melt, causing the plastic to cool. The resulting shrinkage is therefore influenced by both the pressure applied to the melt and the change in temperature.

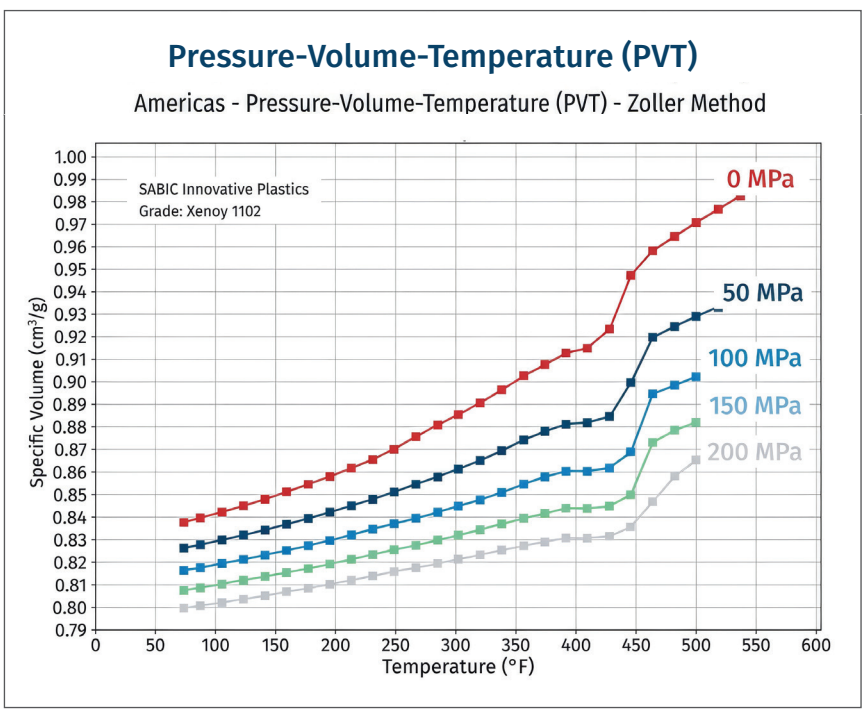


Fig. 4: PVT diagram for the polyester alloy, Xenoy 1102, formerly of SABIC.

During the DOE process, since we are investigating part dimensions, the PVT diagram plays a major role. Pressure, temperature and cooling rate therefore determine the final shrinkage and, consequently, the part dimensions. In Part 2 of this series, we will investigate each factor in detail, discuss their optimization and explain why we should or should not use them in a DOE. In this article, we will briefly discuss the top factors used for DOEs in injection molding. These are packing pressure, melt and/or mold temperature and cooling time.

Pack pressure packs the part out during the final stages of the filling process and is therefore almost always the most influential factor affecting part dimensions. Melt temperature is used for amorphous materials because the processing melt temperature range is wide, and changes in melt temperature can affect shrinkage. Mold temperature is critical for crystalline materials because it affects the formation of crystallites. Therefore, mold temperature is commonly used in DOEs when molding crystalline materials. Melt temperature ranges for crystalline materials are generally narrow, so changing the melt temperature may not produce a significant change in part dimensions. This is another reason why melt temperature is not widely used in DOEs for crystalline materials. Mold temperature is sometimes used for amorphous materials, but it generally does not produce a significant change in dimensions.

Cooling time, however, is used in DOEs for both material morphologies. The greater the part geometry is restricted by a core, the smaller the effect of cooling time on shrinkage. For example, a part with several holes or windows will be less affected by cooling time than a part with an unrestricted geometry. Consider a 6-inch plastic ruler with and without holes spaced evenly throughout its length. The ruler with holes will shrink less because the cores that form the holes restrict shrinkage. The ruler without holes will have a higher shrinkage along its length, since it's a single, unrestricted feature.

DATA NOT OPINIONS

Molders can generally predict which factors will have the greatest influence on part dimensions. However, these predictions are based on experience and are still opinions, not data. By performing a DOE, a molder can identify which factors have the greatest influence on the part dimensions. The analysis also provides the magnitude of each factor's influence. For a given part, the length may be affected by pack pressure, while cooling time may have no measurable effect. For the width, however, cooling time may have the greatest effect, while pack pressure may have no measurable effect. Only a DOE can show that in a quick and efficient manner. All decisions regarding process changes or tooling changes should be data-driven, and DOEs provide the data needed to make those decisions.

In Part 2 of this series, we will explore all the molding inputs and discuss which factors are widely used in DOEs. Part 3 of this series will discuss DOE results and their analysis.

ABOUT THE AUTHOR: Suhas Kulkarni is the founder and president of Fimmtech, San Diego, an injection molding service-oriented firm focusing on Scientific Molding. Fimmtech has developed several custom tools that help molders develop robust processes, and its seminars have trained hundreds of individuals. Kulkarni is an author of the best-selling book, *Robust Process Development and Scientific Molding*, published by Hanser Publications. Contact: *(760) 525–9053; suhas@fimmtech.com; fimmtech.com.*

EXTRUSION

The Setup Sheet That No Longer Works

Outdated setup sheets cost extrusion plants time and money. Here's how documentation gaps create floor-level workarounds, and how to close them before they become the new standard.



By James G. Wilson

Most plants have at least one setup sheet that doesn't quite run the product anymore. On paper, the setup looks complete; the temperatures and puller speed are listed and the vacuum, cooling notes, tooling notes and inspection points may all be there. But when the crew follows the sheet exactly, the line struggles. The product comes in close, but it doesn't settle the way it should, so experienced crews make practical corrections to protect the order and get a line settled.

A barrel zone runs a little hotter, a cooling valve gets opened sooner, a vacuum gets trimmed differently or the puller speed gets reduced to bring the product back under control. The run stabilizes, but the setup sheet stays the same. The plant starts operating with two versions of the same process: the process on paper, and the process on the floor.

The paper version shows the approved settings and gives the impression that the process is known and repeatable.

The floor version includes what people actually do to make the line run: the setting that gets changed, the valve that's opened farther, the vacuum trim no one writes down and the timing judgment that never made it back into the document.

At first, the gap may be small. One correction gets made during a difficult startup. Another follows a material change, equipment swap, tooling repair or maintenance event. Each one feels reasonable in the moment, and usually it is.

When the product is moving away from control, the operator's job is to protect the process, the order and the customer. If slowing the puller for a short time prevents scrap while the crew figures out what the line is showing, that may be exactly the right move, but a short-term recovery move can't quietly become the new standard.

If repeated corrections aren't verified and captured, the setup sheet slowly stops describing the current process and starts describing how the process used to run. Experienced people may still know how to make it behave, but the plant no longer has a shared, current agreement with the physics of the line. That doesn't mean the sheet was wrong when it was written. It may have been exactly right.

Setup sheets drift because processes change. Operators respond because they have to. If the sheet says one thing, and the product says another, the experienced operator will usually follow the product.

Materials vary. Tooling wears. Calibrators get repaired or replaced. Cooling systems age. Vacuum leaks develop. Puller belts wear. Maintenance fixes one condition and slightly changes another.

If the correction works but isn't returned to verification, the plant learns the adjustment without understanding the reason. The new setting becomes something people do because it works and after enough time, the correction becomes local habit. The floor adjusts, but the paper doesn't and the next crew inherits the gap.

This is especially hard on new operators who are told to follow the setup sheet. Experienced operators know it only gets the line close — which temperature changes, which cooling valve matters more, which speed is too optimistic and which note no longer applies. So the new operator follows the document and struggles. Startup takes longer and scrap increases. The supervisor steps in, makes the unofficial changes and the line improves.

From the outside, it looks like a skill gap. Sometimes it is. Often, though, the experienced operator is carrying the undocumented correction history of the line. If the setup sheet doesn't run the product, the problem starts before the trainee touches the line.

Plants also accumulate settings people become afraid to touch. A barrel zone runs hotter because someone learned years ago that the product behaved better that way. A cooling valve gets opened early because a veteran remembers the product pulling out of shape. A puller speed stays reduced because the tool "doesn't like" the original rate.

Scan for more expert advice in extrusion.

Some of those cautions are valid; others are old compensation that was never rechecked. The original condition disappeared, but the correction stayed. Eventually, the plant remembers the rule and loses the evidence behind it.

In extrusion, as in many converting processes, what we sell is time. A wrong



The paper version of a setup sheet shows the approved settings and gives the impression that the process is known and repeatable. The floor version includes what people actually do to make the line run. Source: J.G. Wilson

setup sheet increases first-hour scrap, delays the return to planned rate, creates shift-to-shift variation and makes capability look more person-dependent than it should be.

Material moves through the line at a rate. Labor, overhead, energy, tooling, maintenance and floor attention are tied to that movement. When the line has to run slower than the documented or quoted condition because the real process no longer matches the sheet, the plant is spending time it thought it had already sold. That matters economically.

That doesn't make a temporary puller-speed reduction wrong. It may be the correct recovery action. The plant still has to determine whether that move protected the process for the moment or exposed a new operating reality. A good recovery doesn't have to start cold.

LOOK BACKWARDS

Before treating an adjustment as a new standard, look backwards through previous production records in date order. Find earlier runs of the same product, especially those using the same material lot, material mix, tooling condition or other close operating conditions. Look for runs where the product held the correct weight, dimensions, quality and rate -- even if the final settings differed from the current sheet.

Those records turn history into structured recovery evidence. Read in sequence, they can show when the setup began to drift, whether rate loss appeared with a material change or whether one shift found a stable condition that never made it back into the document. That's stronger than memory alone.

Then ask the harder questions. What changed? Why is the correction necessary? Is the original setup outdated, or is the process compensating for an unresolved condition? Did material behavior move? Did tooling wear? Did cooling change? Did maintenance alter the system? Is the documented rate still realistic?

From there, the path is fairly clear. If the process has legitimately changed, the corrected condition has been verified, and the line is stable at the required quality and rate, update the setup sheet. If the sheet is still right, but the line is compensating for a defect, fix the condition instead. Updating the document would only make the workaround official.

Not every successful adjustment should become the new standard. Some reveal a better operating point while others hide a problem. Verification separates the two. What shouldn't survive is the middle ground where everyone knows the sheet is wrong but keeps handing it to the next crew anyway.

The floor doesn't care what the sheet says if the physics disagree. If the material needs more heat, the material will show it. If the cooling balance is wrong, the part will show it. If the puller speed is too high for the actual process window, the line will show it. That's why setup-sheet accuracy matters. Paperwork isn't the goal. Repeatability is.

SETUP FOR STABILITY

A good setup sheet helps the next crew start closer to stability. It reduces dependence on memory, protects lessons from prior runs, gives new operators a fair starting point and lets supervisors separate training gaps from documentation gaps. When the paper and the floor disagree, the floor will always win. The question is whether the plant learns from that disagreement or keeps handing the next shift an old story.

ABOUT THE AUTHOR: James G. Wilson spent over four decades leading extrusion operations across a wide range of materials, products and plant environments. His experience spans tooling, process development and plant leadership, with a consistent focus on helping teams understand what their processes are already telling them before issues appear as scrap, downtime or missed delivery. His book, *The Line Talks Back: Generating Practical Lessons in Plastic Extrusion from the Plant Floor Up*, is available on Amazon. Contact: jimwilson4567@gmail.com.



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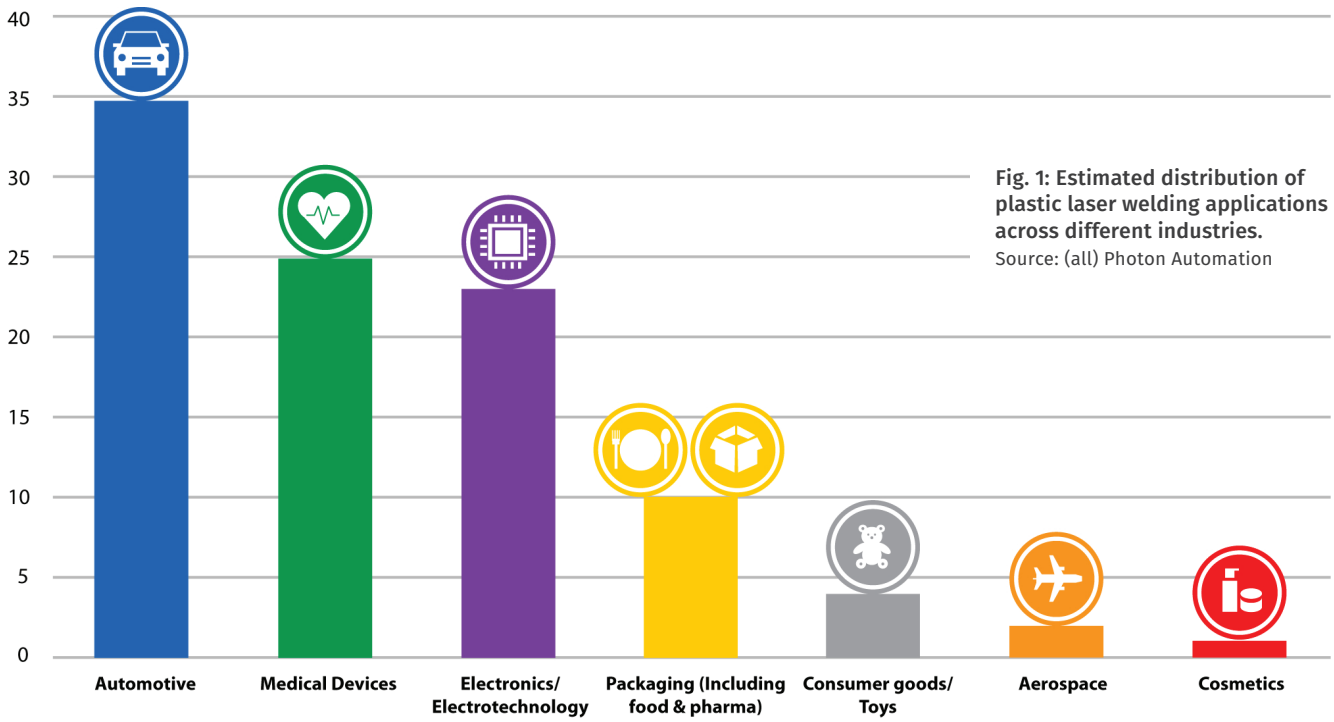


Fig. 1: Estimated distribution of plastic laser welding applications across different industries.
Source: (all) Photon Automation

Fundamentals of Plastic Laser Welding

Plastic laser welding can produce high-strength, reliable, hermetically sealed welds with excellent cosmetic appearance if you understand how it works and what it requires.

Dr. Najah George
Photon Automation Inc.

Plastics can be classified in several ways. Based on their origin, they are categorized as either natural or synthetic polymers. More importantly for laser welding applications, plastics are classified into two categories according to their behavior when heated: thermoplastics and thermosets.

Thermoplastics soften when heated and solidify upon cooling without undergoing a chemical change, allowing them to be repeatedly melted, reshaped and welded while retaining their fundamental properties. In contrast, thermoset plastics go through a permanent chemical change during curing and cannot be remelted or reshaped. Therefore, thermosets, such as epoxies, are not weldable using conventional laser welding, making this process primarily applicable to thermoplastic materials.

Laser welding of thermoplastics was first demonstrated in the 1970s, but its industrial use developed much later. In 1987, Hideo Nakamata of Toyota patented laser transmission welding, where the laser passes through a transparent upper plastic and is absorbed by

the lower plastic, generating localized heat at the interface to form the weld. As illustrated in Fig. 1, thermoplastics are used in a wide range of applications, including automotive sensor housings, lighting assemblies, battery components, fluid reservoirs, medical IV connectors, microfluidic cartridges, drug-delivery devices, surgical instruments, diagnostic housing and electronic enclosures. Plastic laser welding is also increasingly employed in pharmaceutical manufacturing, food processing equipment, cosmetics packaging, aerospace components and consumer products, where clean, precise and hermetic joints are essential for product performance, reliability and safety.

The increasing complexity of thermoplastic components has created a growing demand for reliable and high-precision joining technologies. Conventional joining methods, such as hot-plate welding, hot-gas welding, ultrasonic welding, vibration welding and adhesive bonding often suffer from limitations including large heat-affected zones, particulate contamination, surface marks, flash formation, long cycle times and inconsistent weld quality. These drawbacks make them less suitable for precision and contamination-sensitive applications. To overcome these challenges, laser welding has emerged as a non-contact joining technology capable of producing clean, strong, aesthetically pleasing and hermetic welds with minimal thermal distortion. These advantages have made the technology an attractive joining process for automotive, medical, electronics, aerospace and other high-value thermoplastic applications.

LASER THERMOPLASTIC INTERACTION

When a laser beam interacts with a thermoplastic, part of the incident energy is reflected (r), another part is absorbed (α) and the remainder is transmitted (τ), as expressed by:

$$r+\alpha+\tau=1$$

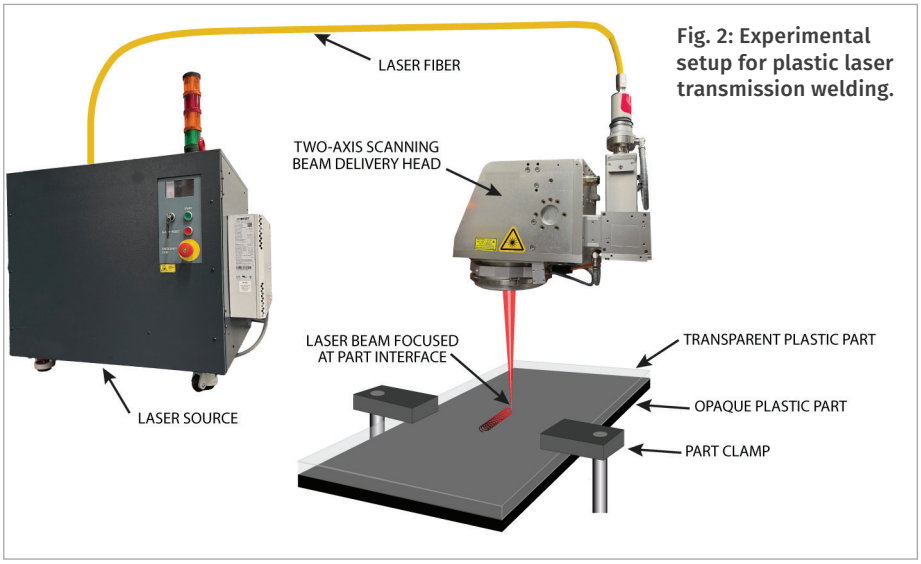


Fig. 2: Experimental setup for plastic laser transmission welding.

The relative proportions depend on the optical properties of the material and the laser wavelength. In laser transmission welding, efficient transmission through the upper component and absorption by the lower component are essential for generating heat at the weld interface.

The energy of each absorbed photon is given by:

$$E_{photon}=h\nu$$

Where E_{photon} is the photon energy, h is Planck's constant and is the laser frequency. When photons are absorbed by the thermoplastic, their energy is transferred to the material and converted into heat. As the absorbed laser energy increases the local temperature, the thermoplastic begins to soften and eventually reaches its melting temperature.

The ability of the plastic to absorb laser energy is determined by the Beer–Lambert law:

$$I(z)=I_0e^{-Kz}$$

Where I represents the laser intensity (W/m²), z is the penetration depth into the material and K is the total extinction coefficient (m^{-1}), which describes the attenuation of the laser beam within the material. According to the Beer–Lambert law, the laser intensity decreases exponentially as the beam penetrates deeper into the absorbing material. The absorption coefficient depends on the quality and the color of the plastic material. It is defined as the reciprocal value of the optical penetration depth (P_d).

$$K_{absorption}=P_d^{-1}$$

For this reason, optical penetration depth is an important factor that significantly influences the laser-transmission welding process.

PLASTIC LASER WELDING PROCESS

Plastic laser welding is a joining process used to bond thermoplastic components by applying laser energy to create a molten interface between two parts. As shown in Fig. 2, plastic laser welding can generally be performed using two approaches: direct laser welding and laser transmission welding (LTW). In direct laser welding, the laser beam is absorbed directly at the surface of a laser-absorbing thermoplastic, gener-

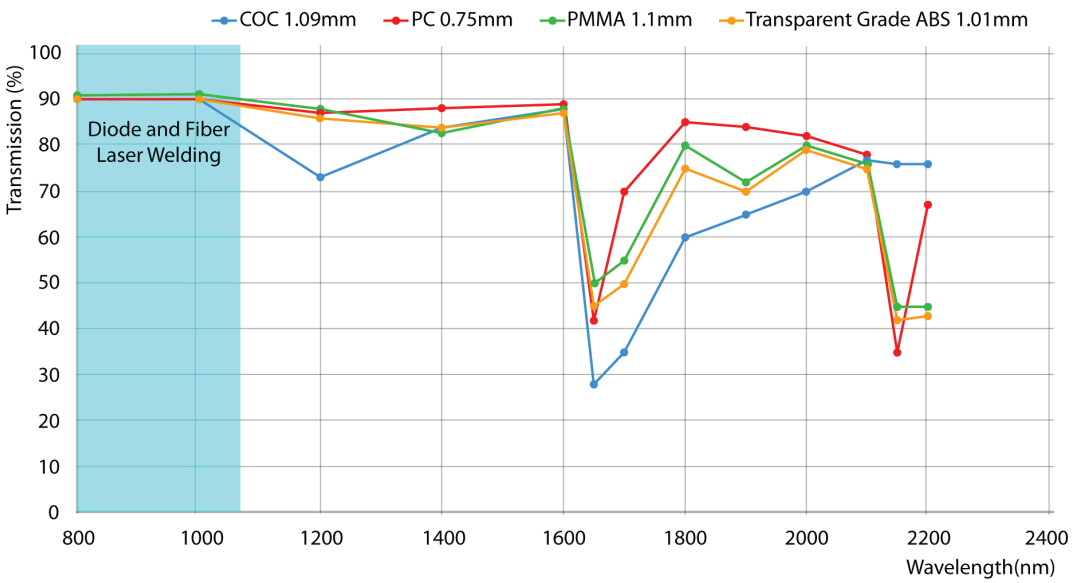


Fig. 3: Transmission spectra of COC, PC, PMMA and transparent-grade ABS across near-infrared laser wavelengths.

ating heat that melts the material. In contrast, LTW uses a laser-transparent upper component and a laser-absorbing lower component, allowing the laser beam to pass through the upper layer before being absorbed at the interface. Because laser energy is transmitted through the upper component prior to absorption, this process is referred to as laser transmission welding.

The most common joint configuration for LTW is the overlap joint, in which one thermoplastic component is positioned on top of another. The absorbed laser energy generates heat at the interface, causing the adjacent surfaces of both components to melt. Under adequate clamping pressure, intimate contact is maintained between the mating surfaces, allowing the molten materials to fuse together. Polymer chain diffusion occurs across the molten interface, creating a molecular bond between the two components. As the joint cools and solidifies, a permanent weld is formed.

LTW weld quality, including mechanical strength, hermetic sealing performance and cosmetic appearance, is governed by several key process parameters. Understanding and properly controlling these parameters is essential for optimizing the welding process and establishing robust welding conditions that support reliable, repeatable and consistent production. These key process parameters include:

LASER WAVELENGTH: Laser wavelength is a critical parameter in laser transmission welding because it must match the optical properties of thermoplastics. The upper component should transmit the laser beam with minimal absorption, while the lower component absorbs the energy and generates heat at the interface to form the weld. As shown in Fig. 3, cyclic olefin copolymer (COC), polycarbonate (PC), polymethyl methacrylate (PMMA), and a transparent grade of acrylonitrile butadiene styrene (ABS) exhibit approximately 90% transmission in the 800–1,080 nm range, making this region particularly suitable for LTW. Common laser sources operating within this range include diode lasers (800–980 nm), Nd:YAG lasers (1,064 nm), and fiber lasers (~1,070 nm).

MATERIAL COMPATIBILITY: The joining thermoplastic materials must be compatible to achieve proper molecular diffusion and fusion at the weld interface. In general, materials with similar chemical compositions and melting temperatures can be successfully welded, while incompatible materials typically produce weak joints or no weld at all.

MATERIAL CLEANLINESS: The mating surfaces should be clean and free of dust, oil, grease, moisture and other contaminants. Surface contamination can reduce heat transfer and prevent proper bonding, resulting in poor weld quality, reduced joint strength and inadequate hermetic sealing.

LASER SPOT SIZE, BEAM DISTRIBUTION AND SCANNING STRATEGY: The size and shape of the laser beam, as well as the area covered by the beam, determine how the laser energy is distributed and the area over which heat is generated at the weld interface. A larger beam diameter produces a wider weld seam, while a smaller beam diameter concentrates the energy within a narrower region. The weld width and the amount of molten material directly influence joint strength. For most applications, the preferred approach is using a galvanometer scanner (scanner welding system) with a small beam diameter, which enables high-speed beam steering along the weld path, reducing cycle time while improving process flexibility and repeatability. In addition, galvanometer scanners enable the laser beam to be tailored to different weld-seam widths and complex part geometries by adjusting the scanning pattern according to the component design. Therefore, selecting the appropriate beam size, beam shape, energy distribution and scanning strategy is essential for achieving the desired weld quality and mechanical performance.

INTERFACE GAP (AIR GAP): The interface gap between the transparent and absorbing thermoplastic components is one of the most critical factors affecting LTW. Since the process relies on heat conduction from the laser-absorbing lower

component to the laser-transparent upper component, the presence of an air gap significantly reduces heat transfer efficiency. A nonexistent or very minimal air gap is preferred to ensure efficient heat transfer and proper melting at the weld interface. Excessive gaps can lead to incomplete melting, weak fusion, reduced weld strength, poor hermetic sealing or even weld failure. Proper part fit-up, part flatness and fixture design are essential for minimizing the interface gap and achieving consistent, high-quality welds.

CLAMPING PRESSURE: Proper clamping pressure and fixture design are required to maintain intimate contact between the two thermoplastic components during welding. Good contact minimizes the air gap at the interface, improves heat transfer and enables the molten materials to fuse properly. Excessive or insufficient clamping pressure can reduce weld quality and joint strength.

COOLING OR CLAMPING HOLD TIME: After the laser beam is removed, the clamping pressure should be maintained for a sufficient period to enable the molten material to cool and solidify. This hold time helps prevent joint separation and ensures that the weld develops its full mechanical strength before the parts are released.

LASER FOR THE WELDING WIN

Plastic laser welding continues to advance as an enabling technology for joining thermoplastic components in modern manufacturing. A thorough understanding of the welding mechanism, material properties, joint design and process parameters is essential for producing high-strength, reliable, hermetically sealed welds with excellent cosmetic appearance. Ongoing developments in laser sources, beam delivery systems, process monitoring and automation are expected to further improve weld quality, manufacturing efficiency and process flexibility. As industry demand for lightweight, precision-engineered plastic products continues to grow, plastic laser welding will remain one of the most effective and versatile joining technologies for next-generation manufacturing applications. PT

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The Eyes of AI — Part 1 of 3: How Computer Vision Can Transform Safety in Plastics Manufacturing

From periodic safety walks to persistent visual awareness: real plant photographs show both the promise and the limits of AI-assisted hazard recognition.

By Cameron Kiani, MD, MPH
Amisana Solutions;
Karthikeyan Ponnambalam, Chandramouli Sangeetham,
Alterra Holdings Company

The opening in the gray drive housing is only a few inches wide. Around its rim, evenly spaced studs and tapped holes suggest that something was designed to cover it. Through the opening, an internal component is visible. A camera can record that scene instantly. The harder questions come next: Does the component move during production? Can an employee reach it? Was a guard removed for maintenance? What standard applies, and what should the plant do now?

That small opening captures both the promise and the limitation of computer vision in plastics manufacturing. Visual artificial intelligence can extend the safety professional's field of view, being able to find conditions that may emerge between formal inspections. But that system becomes credible only when it distinguishes what the image proves from what still requires a person, a tape measure, a safety data sheet or a machine-specific inspection.

WHY PLASTICS MANUFACTURING IS A DEMANDING VISUAL ENVIRONMENT

Plastics compounding combines heat, rotating equipment, conveying, blending, pelletizing, elevated access, material handling and changing formulations in the same operating environment. Operators move among extruders, mixers, platforms, packaging stations and utility systems, while maintenance and cleaning tasks can alter normal equipment states. The visual context can change by shift, product and task.

Traditional programs — training, procedures, inspections, guarding, lockout/tagout and worker reporting — remain foundational. Their weakness is not obsolescence, but that inspections only sample moments in time at the plant. A well-designed camera system can add reinforcement. It can look for stable visual signatures such as an open housing, a blocked ladder approach, an object stored near an elevated edge, material accumulating on a tread or a person entering a defined machine-access zone.

Computer vision does not create a new control level above elimination or engineering controls. Its value is more practical: by helping identify conditions that may emerge between formal inspections. If a person can enter a hazardous operating envelope, the preferred solution may be physical separation. If a machine opening exposes hazardous motion, the answer is effective shielding. If material repeatedly accumulates on a stair, the answer is to correct the release as well as clean the stair.

In that role, AI is a detection and feedback layer around the existing safety system. It can help engineers find where physical controls are missing; help identify environmental, health and safety hazards; recognize recurring patterns; and enable maintenance to document whether corrective actions should remain in place.

In this article, we use images that came from an operating plastics-manufacturing facility, which we then submitted to an AI-assisted workflow review. They are not presented as detections from a fully deployed autonomous camera network. The exercise demonstrates the workflow analysis without claiming a level of automation that was not used to capture these examples.

EXAMPLE 1 — BLENDER DRIVE HOUSING

- **What the image shows:** Figure 1 (before) reveals an opening in the drive housing that exposes an internal component. Material is visible at the base, and a high-pressure hydraulic line crosses the area.
- **Why this matters:** If the component moves and is reachable during operation, the opening may expose an employee to hazardous motion. The hose and material also affect accessi-

bility and housekeeping.

- **Corrective action:** First identify the component. If hazardous motion is accessible, restore the original cover or install a secure fixed guard (see Figure 1 proposal) . Route and protect the hose and clean the base.
- **Field verify:** Check motion, reach distance, operating state, energy sources and the component-specific guarding basis.

EXAMPLE 2 — BLENDER LADDER AND ELEVATED PLATFORM

- **What the image shows:** Figure 2 (before) shows a fixed ladder to access an elevated platform. No obvious self-closing gate is visible at the transition, and material is present near the elevated edge and on the structure.
- **Why this matters:** The image supports a fall/falling-object review, but perspective cannot establish the required dimensions.
- **Corrective action:** Measure the transition and provide compliant ladderway protection where required. Remove material from the edge and correct the release source.
- **Field verify:** Check rail extension, guardrail geometry, fixed-ladder height, installation date and any additional fall-protection trigger. See Figure 2 (proposal).

EXAMPLE 3 — SHOP-FABRICATED ACCESS STAIR

- **What the image shows:** In Figure 3 (before), the access system is visibly fabricated for the equipment, with an upper transition and material buildup on treads and steelwork.
- **Why this matters:** Custom access systems are common in older plants. Their classification and dimensions should not be guessed from a photograph.
- **Corrective action:** Clean and inspect the system, complete required landing protection, then compare measured geometry with the applicable access criteria. See Figure 3 (proposal).
- **Field verify:** Check angle, rise/run, tread dimensions, handrail geometry, structural condition and correct access-system classification.

EXAMPLE 4 — GAYLORD/BOX-DUMPING STATION

- **What the image shows:** See Figure 4 (before). The most evident visible hazard is the improvised support under the Gaylord/pallet. Loose timber and flattened cardboard are being used at the elevated docking interface. The surrounding station also requires review of personnel access to operating equipment.
- **Why it matters:** Improvised shimming can change load support and repeatability. Separately, a person who can enter an operating hazard zone may need physical protection from



FIG. 1: The before image shows a drive-housing condition. The proposal is an AI-rendered visualization of a secure fixed cover over the opening. Source: (all) Alterra



FIG. 2: Before shows a ladder/platform condition. The proposal is an AI-rendered visualization of protected ladderway access.

hazardous motion.

- **Corrective action:** Replace improvised shimming with a defined, repeatable docking/support arrangement. Secure the Gaylord/pallet position. Evaluate fixed-perimeter guarding and control access locations where hazardous motion can be reached. See Figure 4 (proposal).
- **Field verify:** Check the load path and pallet condition, docking geometry, operating envelope, hazardous motion, maintenance access and finalize engineered restraint/guard arrangement.

FROM DETECTION TO AN AI-VISUALIZED CORRECTION PROPOSAL

The value of the workflow is easiest to see when the detected condition is paired with a visual correction proposal. The **before** images are actual plant photographs. The **proposal** images are AI-rendered visualizations of how the physical correction could look. The open drive is covered, the ladderway is protected and the improvised Gaylord support is replaced by a controlled docking/support arrangement. They make the engineering recommendation visible rather than stopping at the finding.



FIG. 3: Image (before) shows an access system is visibly fabricated for the equipment, with an upper transition and material buildup on treads and steelwork. AI-generated proposal calls for enhanced safety features, notably improved treads.



FIG. 4: Improvised support under the Gaylord/pallet; loose timber and flattened cardboard are being used at the elevated docking interface. Proposal shows AI-rendering in which improvised shimming was replaced with a defined, repeatable docking/support arrangement.

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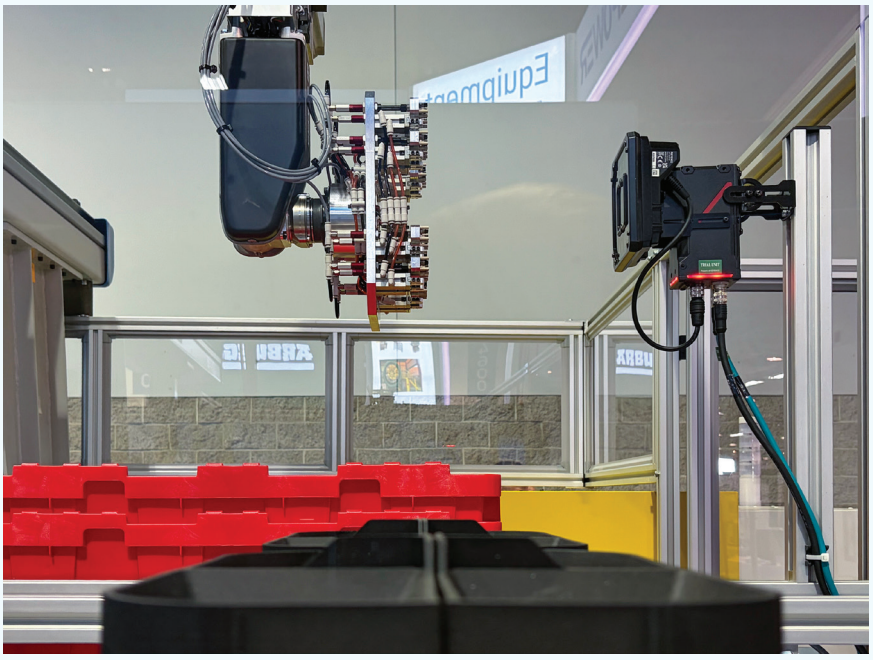
Robots and Vision: A Perfect Pair in Injection Molding

Robots paired with vision systems create production cells capable of protecting tooling, ensuring part quality and moving manufacturers closer to true closed-loop production.

By Jason Cornell
Sepro America

Peanut butter and jelly. Milk and cookies. Wine and cheese. Simon & Garfunkel. Some combinations are simply better together — greater than the sum of their parts. In the injection molding industry, robots and vision systems have become one of those combinations.

Independently, each technology delivers measurable value. Robots provide speed, repeatability and labor reduction. Vision systems provide inspection, verification and data. But together, they create intelligent molding cells capable of protecting tooling, ensuring quality and moving manufacturers closer to true closed-loop production.



The camera (at right) inspects the EOAT (end-of-arm-tool). Source: (all) Sepro

ROBOTS: THE INDUSTRY WORKHORSE

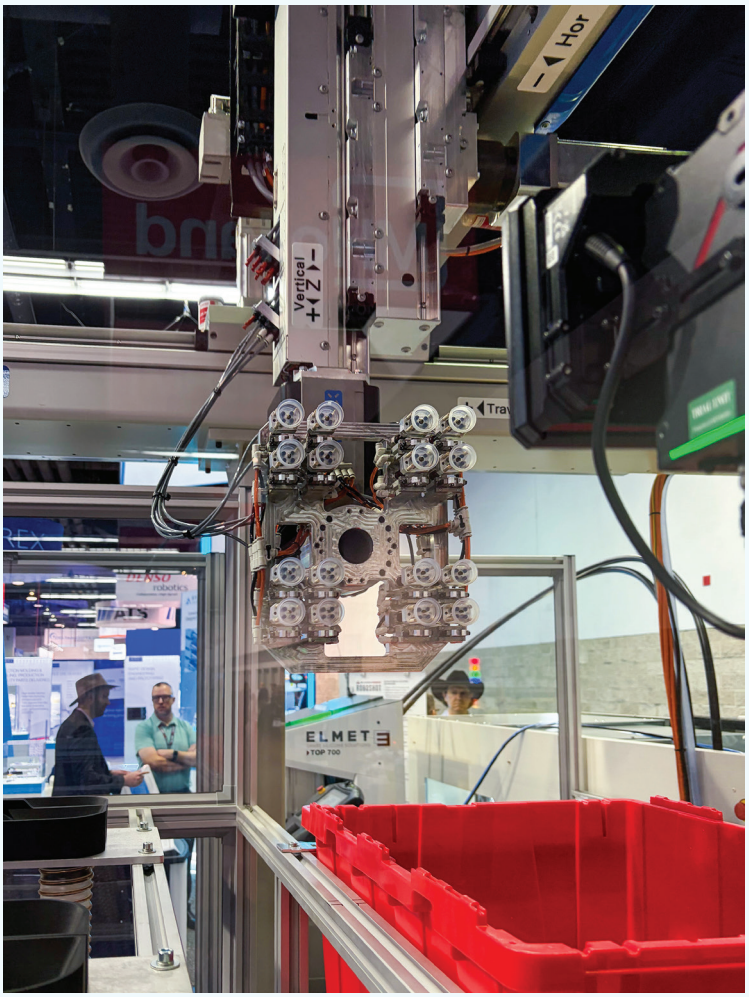
For decades, robots have been a mainstay in injection molding operations. Whether mounted atop a press or positioned alongside it, they are trusted for one primary reason: consistency. A robot does not vary its cycle time. It does not get fatigued. It does not take shortcuts.

Compared to manual part extraction, robots improve safety, reduce labor dependency and maintain stable cycle times. In high-volume production environments, that repeatability alone justifies the investment. Historically, robots' role was straightforward — whether it was extracting parts and separating runners; stacking or conveying parts; or performing simple secondary operations — but as the demands placed on molders today have evolved, automation must as well.

THE EVOLUTION OF VISION IN MOLDING SHOPS

My background is in robotics and automation rather than vision-system design. However, over the years I have interfaced countless vision systems with various robot platforms, and one trend is unmistakable: vision has moved from the quality lab to the press.

Early implementations of vision systems in molding facilities were commonly found in two places: mounted on top of injection molding machines to verify that parts were clear before mold



Customized EOAT can be designed to help with downstream vision inspection.

close or located in quality control labs for offline inspection.

In those days, cameras were seldom directly integrated with robots on the production floor. That began to change as manufacturers recognized the benefits of inspecting parts immediately and not downstream of the molding machine.

FROM DETECTION TO PREVENTION

Robots already confirm that parts and runners are clear of the mold. In many cases, that eliminated the need for vision to perform basic mold-clear verification. However, additional risks remained — a broken feature sticking in the mold, flash that could damage tooling, insert misalignment and short shots or incomplete fill. Integrating vision directly into the robotic process introduced a new level of protection and quality control.

Now, instead of discovering defects while in packaging or at final inspection, manufacturers can reject defective parts immediately and divert scrap press-side, which can be fed directly into a granulator to create a more efficient closed-loop process. The earlier a defect is detected, the lower its cost.

WHERE VISION AND ROBOTICS DELIVER THE MOST IMPACT

When integrated properly, vision systems can support a wide range of injection molding applications. In mold protection, they can confirm parts are clear prior to clamp close, while verifying that the ejectors have retracted and the cores are properly positioned.

In part inspection, vision systems can detect flash, short shots and surface defects, as well as provide color verification and inspect gate vestiges. For insert and assembly verification, vision systems can confirm insert presence and orientation, validate in-mold label (IML) placement and ensure assembled components are correctly positioned

Medical molding, insert molding and tight-tolerance applications especially benefit from integrated vision. When critical dimensions or component placement are involved, automated verification reduces risk and increases confidence. Defects are not acceptable — particularly in regulated or customer-critical industries. Operators, even highly trained ones, can become fatigued, while automated inspection systems do not.

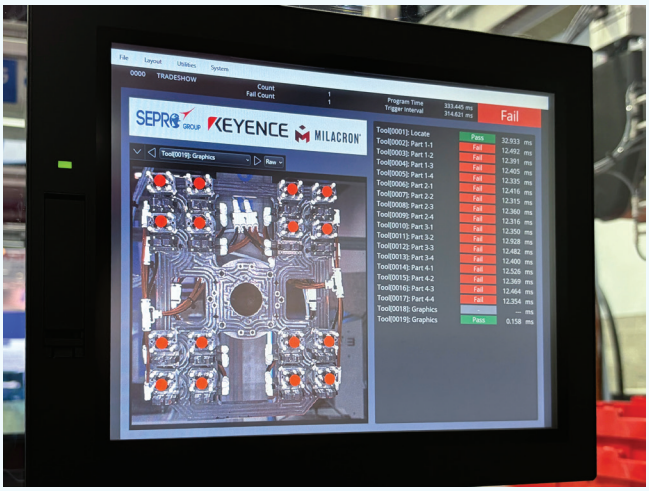
MOUNTING AND INTEGRATION FLEXIBILITY

One of the advantages of pairing robots with vision systems is flexibility in mounting and system design. In real-world applications, cameras have been mounted in a variety of locations, including on the robot kick beam, along the traverse beam, at the wrist of robot, integrated into the end-of-arm tool (EOAT), on downstream inspection tables or in standalone stations tied to robot handling. This flexibility allows molders to tailor inspection to their process rather than redesigning the entire cell around a fixed camera.

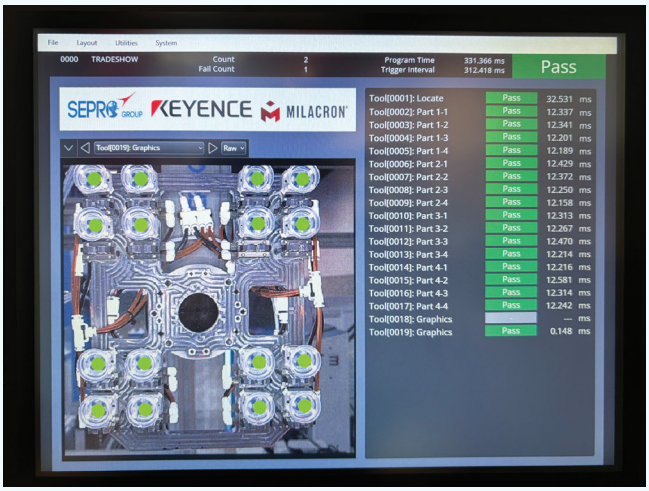
WHAT TO LOOK FOR IN A ROBOT FOR VISION INTEGRATION

Not all robots integrate equally well with vision systems. When evaluating compatibility, consider these control aspects. An open hardware architecture provides accessible digital and analog I/O, while Ethernet/IP or similar industrial communication protocols enable communication and expandability for additional devices. In terms of software flexibility, look for the ability to easily program and name I/O, have support for subroutines and a clean integration of vision pass/fail logic into the robot program.

Modern robot controllers have significantly improved in usability. What once required specialized programming knowledge can now often be configured through intuitive graphical interfaces. In many cases, if someone can navigate a smartphone interface, they can manage basic robot and vision settings.



Red denotes failed vision inspections of parts on the EOAT.



Green denotes passed vision inspections for parts on the EOAT.

WHAT TO LOOK FOR IN A VISION SYSTEM

From the vision side, flexibility and adaptability are critical. Key characteristics manufacturers should prioritize are an event-driven architecture, the ability to incorporate multiple cameras, flexible I/O connectivity (digital I/O, Ethernet, serial communication, barcode readers) and seamless integration with existing automation.

Event-driven systems are particularly well-suited for short-run and just-in-time production. By identifying a part via barcode or digital input, the system can automatically load the correct inspection criteria for that product. This reduces changeover time and supports high-mix manufacturing environments. Integrated data collection and SPC reporting also provide traceability by product ID — increasingly important in automotive, medical and consumer applications.

EASE-OF-USE AND COST TRENDS

In the past, powerful control systems often came at the expense of usability. Complex programming environments limited vision adoption to specialists. That barrier has eroded.

Both robot and vision platforms have become more intuitive, user-friendly and affordable, and those lower price points allow manufacturers to "dip their toes in the water" without committing to massive capital expenditures. Entry-level systems can be implemented at a single press and scaled as value is proven.

As hardware costs decrease and software becomes more accessible, the return on investment becomes easier to justify — particularly when scrap reduction, tool protection and labor savings are considered.

THE INDUSTRY'S DIRECTION

Vision integrated with robotics is moving toward greater in-process inspection with increased traceability, AI-enhanced defect detection and tighter integration with MES and plant-wide data systems. Rather than serving solely as inspection tools, robots and vision systems are becoming data generators — feeding information back into process-optimization strategies. For injection molders facing rising quality expectations and labor challenges, this pairing is no longer a luxury, but an increasingly competitive necessity.

FINAL CONSIDERATIONS

Implementing vision on the shop floor requires careful evaluation. Lighting, environmental conditions, cycle-time constraints and part geometry all influence feasibility. Fortunately, many experienced robot manufacturers and vision specialists can evaluate applications and determine whether integration makes technical and financial sense. Robots have long been the backbone of molding automation. Vision gives them eyes, and together, they create intelligent manufacturing systems capable of protecting tooling, ensuring quality and positioning molders for the next generation of production demands. Like peanut butter and jelly — some things are simply better together. PT

ABOUT THE AUTHOR: Jason Cornell is the western regional sales manager with Sepro America, specializing in robotics and automation solutions for the plastics injection molding industry. With extensive experience in Cartesian and articulated robots, sprue pickers and downstream automation, Jason has worked with molders and manufacturers to develop and implement solutions that improve productivity, consistency and overall process efficiency.

Throughout his 30-plus year career, Jason has held both service and sales positions, giving him valuable first-hand real-world experience with the equipment and applications he supports. This combination of technical and sales experience enables him to approach automation from both a practical and customer-focused perspective. Contact: 412-459-0450; jcornell@sepro-group.com.

10 Steps for a Smooth Desiccant Dryer Installation

Here's how to properly install a desiccant dryer in 10 key steps — from inspection and rigging to electrical setup and startup — for reliable, long-term production.

By Joseph Dziedzic
ACS Group

A new desiccant dryer is a significant investment. Turning that investment into consistent, high-quality production requires a properly aplanned installation. Whether you're adding a new dryer to an existing line or replacing an older system, a little preparation up front prevents a lot of possible headaches later.

From the day the crate arrives to the moment your dryer is running production, these steps help ensure a smooth installation and startup.

STEP 1: INSPECT BEFORE YOU UNCRATE

The very first step happens before you even open the crate. Walk around the shipment with the delivery driver and look for any signs of impact, such as dented corners, torn shrink wrap, punctured cardboard or shifted pallets.

If you notice damage, take photographs, note it on the delivery receipt and discuss it with the transportation company prior to signing. Contact your equipment supplier right away to advise them of the damage.

Once the crate is opened, do a second inspection of the equipment itself. Check for loose wiring, missing hardware or components that have shifted in transit. Cross-check what arrived against your packing list, including any electrical schematics and accessories.

STEP 2: PREP THE FLOOR AND SPACE AROUND IT

A desiccant dryer needs a stable, level home. The floor should be hard, flat in every direction and rated to support the full weight of the dryer, hopper and material load. Even a slight slope of more than a 2% gradient can cause premature wear on internal components and affect airflow inside the drying hopper.

Clearance matters just as much as footprint. Whether the dryer is floor mounted or machine mounted, make sure there is enough space to safely operate, inspect and maintain the unit. Allow room to open access doors and service panels, and ensure technicians can reach key components during routine maintenance.

Also verify that the environment itself is a good fit. Desiccant dryers are designed for clean, indoor industrial spaces, not dusty, corrosive or explosive atmospheres. If your plant has areas with



When mounting smaller dryers directly on a machine throat, make sure to properly support the equipment. Avoid mounting dryers on equipment with rapid cycling or excessive vibration.
Source (all): ACS

Dryer Installation Done Right

- Don't tie the exhaust into a shared duct with other equipment unless the shared duct is specifically designed for it. Mixing exhaust streams causes backpressure and can trigger nuisance alarms.
- Before startup, verify that each sensor is securely connected and reporting reasonable values in the control interface.
- Take the time to configure controls thoughtfully rather than accepting defaults. A well-configured dryer protects your material, uses less energy and gives your operators clear, actionable information when something needs attention.
- Document key parameters so they can be easily accessed if changes are made. Many modern dryer controls also include recipe or job-storage capabilities that can simplify future setups.
- Establish a routine preventive maintenance schedule from Day 1. Regular filter inspections, cleaning and system checks can help maximize performance, improve reliability and reduce unexpected downtime.



acid vapors, salt or heavy dust, choose a location as far from those conditions as possible.

STEP 3: VERIFY YOUR UTILITIES

Nothing stalls a dryer commissioning faster than discovering the incoming power doesn't match the nameplate. Before the electrician arrives on-site, confirm the following:

- Voltage, phase and frequency match the dryer's nameplate exactly.
- The power source is properly sized for the dryer's electrical requirements.
- A dedicated disconnect switch is installed within sight of the machine.
- A proper earth ground is available at the installation point.
- Any required auxiliary utilities, such as compressed air, cooling water or network connections, are available at the installation location.

STEP 4: PLAN YOUR REGENERATION EXHAUST

This is the step first-time installers most often overlook. As a desiccant dryer runs, it continuously regenerates its wheel or bed, and that process produces a stream of hot, moist exhaust air that must go somewhere safe.

Two rules make this simple. First, use an exhaust pipe rated for temperatures above 400°F because the discharge stream is hot enough to melt or deform lightweight ducting. Second, run the exhaust line with a slight downward tilt away from the machine so condensation drains rather than pooling and running back into the dryer.

STEP 5: GET THE RIGGING RIGHT

Desiccant dryers vary widely in size, from small hopper-mounted units that a forklift can move easily, to stand-alone floor units that require overhead cranes and lifting beams.

Whichever end of that range your dryer falls on, always lift using the manufacturer's designated lift points with rigging rated well above the machine's weight.

Move the dryer slowly and steadily. Rocking or dropping the dryer even a short distance can knock delicate internal components (thermocouples, seals or the desiccant wheel itself) out of alignment. Damage from rough handling isn't always visible. It usually shows up as a nuisance alarm weeks later.

STEP 6: PROPERLY INSTALL ELECTRICAL

The electrical connection should always be made by a qualified electrician who is familiar with applicable national, state and local codes. This is not the place to save time or money.

A good electrical hookup ensures that the incoming supply lands cleanly on the

Route the regeneration air discharge to a location where the hot, humid air won't blow across a walkway, land on a control panel, or fog up a nearby operator station.

main disconnect; the machine is grounded to an effective earth; and the appropriate branch protection (fuses or breakers) is installed at the mains' connection point per the wiring diagram supplied with the unit.

Once power is connected, briefly bump each blower motor to verify the rotation direction is correct. Reversed rotation is one of the most common installation day findings, and one of the easiest to fix by swapping any two-phase leads at the disconnect.

STEP 7: VERIFY SAFETY PROTOCOLS

Modern desiccant dryers are shipped with all safety guarding installed, but it's worth doing a walk-around before startup to confirm nothing was disturbed in transit. All fixed guards protecting the process heater and dehumidifier compartment should be securely fastened.

During installation, make sure connections between the dryer and the drying hopper are installed correctly.



Adjustable guards, like a hinged hopper access door, should open smoothly and latch cleanly.

Check that all safety labels and warning symbols are present and legible. Confirm the main disconnect accepts a padlock for lockout-tagout, and that padlocks and tags are available on-site.

This is also a good moment to have a brief safety conversation with the operators who'll be running the dryer about some of the following: where the emergency stop is; what the signal light colors mean; how to use the basic control functions; and which access doors are OK to open during operation.

Operators should also understand the unit's control functions and follow all safety precautions outlined in the operation manual. Once the dryer is fully loaded with material and operating, access doors should remain closed unless the unit has been safely shut down and proper procedures are followed.

STEP 8: VERIFY YOUR SENSORS BEFORE STARTUP

Before you press the start button, take a moment to confirm the machine can "see" itself. Modern desiccant dryers rely on multiple temperature probes to control the drying process, protect the blower and safeguard the material. If any of the probes aren't reading correctly, the dryer will either trip an alarm on startup or worse, run in an unsafe state.

On the controller's data screen, verify each probe reads a sensible ambient temperature before the dryer heats up. Values that read as open, negative or wildly high usually mean a loose connector or a damaged cable. Both are easy to fix now, and painful to troubleshoot after material is loaded.

STEP 9: CONFIGURE YOUR CONTROLS

Once the machine is powered, level, connected and verified, the controls are the last piece of the puzzle. Most modern desiccant dryers have a touchscreen interface that guides you through the basics: language, units, date and time, drying temperature, recipe storage and material selection guide.

If your dryer includes energy-saving features like throughput-matching modes, over-drying protection or scheduled start/stop timers, this is the time to enable and tune them for your process. Set alarm thresholds appropriate to your material, configure operator and maintenance passwords and enter the hopper capacity so throughput calculations are accurate.

STEP 10: RUN, TEST AND TRAIN

With the machine configured, run a first startup and watch it throughout the full warm-up. The process temperature should climb steadily to setpoint, all thermocouple readings should stay within reasonable ranges and the signal light should transition



from standby to running with no active alarms.

Once the dryer is running in a stable manner, take a few extra minutes to walk your operators through the essentials: how to start and stop the process correctly using the on-screen controls (not the main disconnect); how to read the dew point and process temperature; when to service the filters; and what to do if an alarm appears.

Always lift the dryer and drying hopper using the manufacturer's designated lift points, and always using rigging rated well above the machine's weight. Once the dryer is in position, take the time to level it properly with a bubble level in both directions. On models with pivoting casters, engage the brakes so the machine can't drift during operation.

SETTING YOURSELF UP FOR LONG-TERM SUCCESS

A good installation isn't just about getting a dryer running; it's about setting yourself up for years of reliable, energy-efficient production. The processors who plan their utilities, respect the airflow, level the machine properly and take the time to configure the controls the right way are the ones who spend the next 10 years running production instead of chasing problems. PT

ABOUT THE AUTHOR: Joseph Dziedzic is a senior product manager for ACS Group. He has worked in various engineering and sales roles throughout his career. Dziedzic was previously responsible for the ACS team of application engineers & technical sales managers and managed all quoting activity and after sales support. He has a BS degree in mechanical engineering from the University of Illinois and more than 38 years of experience in the auxiliary equipment industry. Contact: 847-273-7801; jdziedzic@acscorporate.com; acscorporate.com.



Digital Color Management for Translucent Plastics

Translucent plastics' reflectance curves vary depending on the background they're measured against, meaning the usual color-measurement methods can deliver contradictory or imprecise results.

By Jutta Albertin
Datacolor

Translucent plastics offer unique challenges to manufacturers because their reflectance curves vary depending on the background they're measured against. As a result, the usual methods used for color measurement can deliver conflicting or inaccurate results if the operator is unaware of their specific needs.

Despite these challenges, it's still possible to manage translucent polymers with an extremely precise digital color-management workflow. In this article, we'll explore simple practices to ensure accurate color measurement; how to optimize your workflow; strategies for minimizing waste; and other best practices that can help ensure your success and support greater profitability.

DIVIDE AND CONQUER

Traditional physical models are insufficient when working with translucent materials because they don't properly capture the way light behaves. Approximately 4% of the light is reflected from the surface of the material. The way it's reflected results in what we perceive as 'gloss'. Unlike opaque materials, however, some light is transmitted through translucent materials and might also be scattered

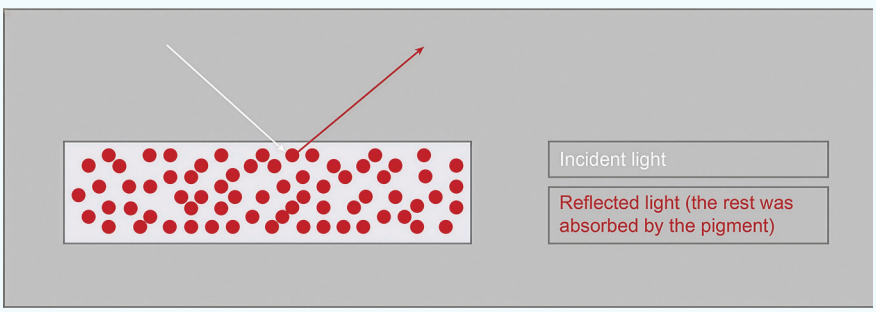


Fig. 1: Simple color measurement algorithms are based on one incident and one reflected light beam. This model works only for completely opaque layers. Source: (all) Datacolor

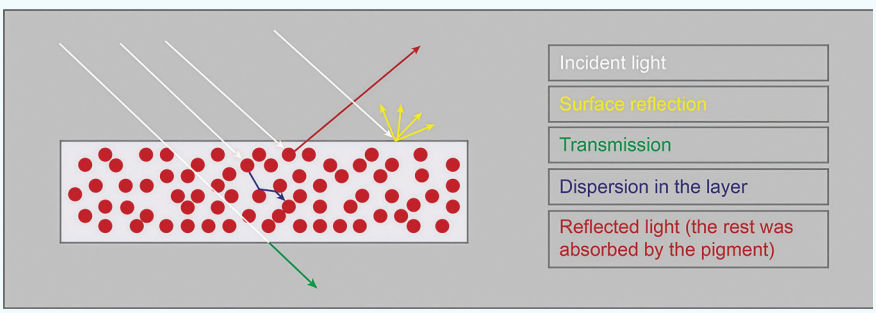


Fig. 2: The way light "behaves" in a translucent layer is much more complex. The better it can be described by the algorithm, the better the formulation results. The transmission component can only be determined by measurement over a contrasting background.

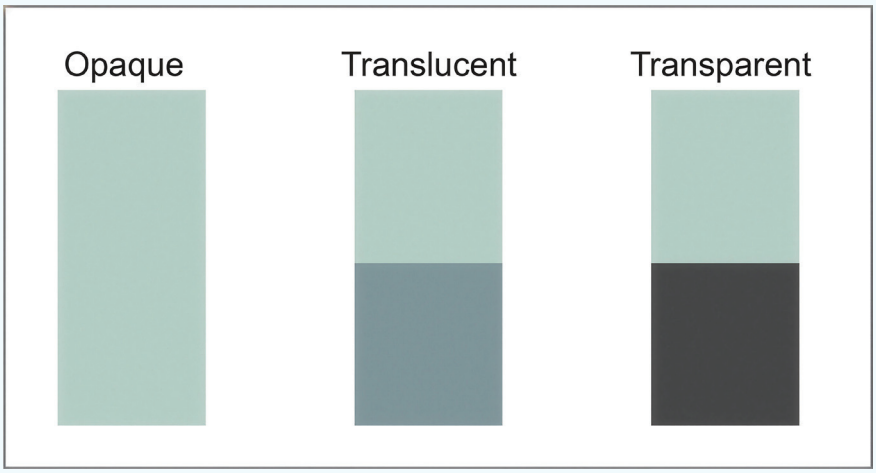


Fig. 3: Dual measurement requires color-management software with an advanced multi-flux algorithm capable of accounting for the complex light interactions in translucent polymers.

in multiple directions. Figures 1 and 2 show simplified examples of the difference.

When measuring only over one background color (usually white), digital color-management software can't differentiate between white pigment in the material and white coming from the background, which can lead to inaccurate color matching. A simple solution is a dual-measurement strategy in which reflectance measurements are taken over both black and white backgrounds, as shown in Fig. 3.

This approach enables the color management software to calculate recipes that accurately match both color and opacity.

INSTRUMENTATION AND MEASUREMENT CONSIDERATIONS

Edge loss is a challenge particular to translucent samples. In this scenario, the light from a spectrophotometer's xenon flash "escapes" from the edges. This causes less light to be captured by the sensor, as shown in Fig. 4. As a result, the pattern appears darker, causing measurement inaccuracies. This is a significant issue, especially for the thicker samples commonly used in the masterbatching process.

Edge loss can be minimized by reducing the thickness of the samples being measured. Another strategy is to use an instrument with a large aperture but a small measuring spot (such as a 25-mm aperture and an 8-mm spot). Note, however, that this strategy is only possible if you're able to deactivate automatic aperture detection.

The only way to eliminate edge loss completely is to make a round sample that precisely fits into the sphere of the spectrophotometer itself. Samples like these must be slightly smaller in diameter than the aperture, but larger than the measuring spot. This method only works when using an instrument with horizontal sample positioning, and requires a sample molded or punched to the exact size needed, such as those shown in Fig. 5.

COLOR MANAGEMENT WORKFLOW

The color-management process for translucent plastics begins with defining the target color, opacity (or contrast) and sample thickness. Thickness is critical. The thicker the sample is, the higher its opacity will become. To reach a specific opacity target, the pigment load must increase if the thickness decreases and vice versa.

Advanced color management software can provide multiple recipe options based on color standard differences, opacity, metamerism and price. This process is iterative, involving sample preparation based on the selected recipe, measurement of the sample and recipe correction until the desired match is achieved. The number of corrections is highly dependent on the reproducibility of the process and correction abilities of the software used.

Masterbatchers need to receive samples of the exact polymer(s) used by the customer, since the polymer type affects color and opacity, especially in translucent materials (see Fig. 6). Polymers aren't always totally colorless or transparent; they can also absorb and scatter light. Color matching results will therefore

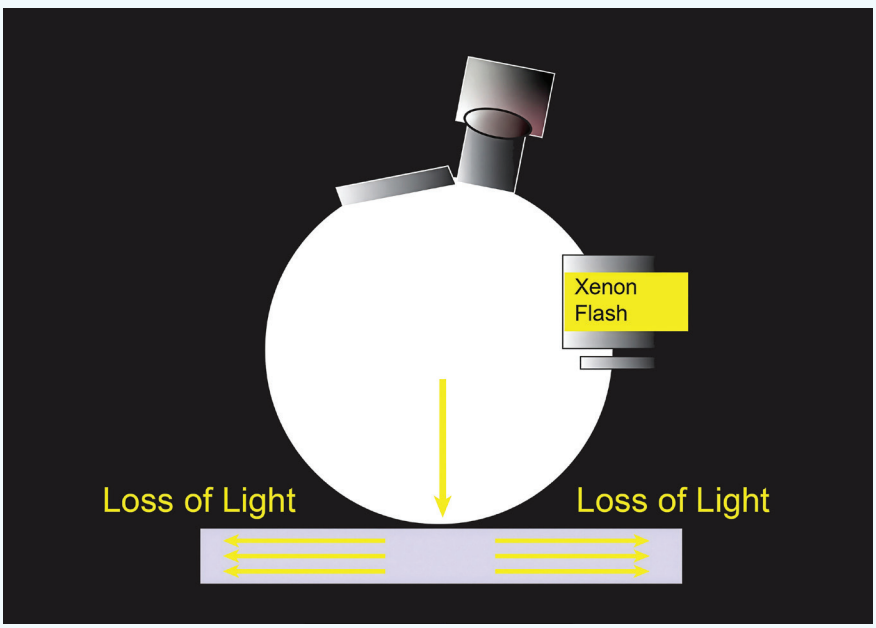


Fig. 4: Edge loss can lead to inaccurate measurements when calculating optical data.



Fig. 5: Samples punched to the exact size needed for measurement inside the sphere of a spectrophotometer represent the only effective method for eliminating edge loss.

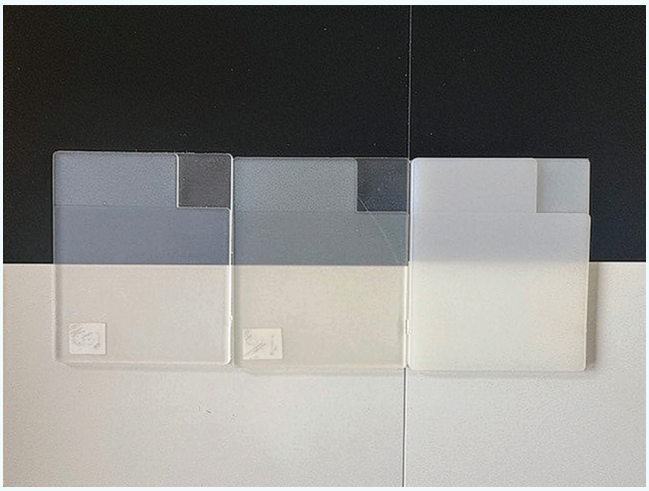


Fig. 6: Although all three of these polymers are technically the same type, the ways they reflect, absorb and scatter light vary considerably. To ensure precise color matching, it's critical for masterbatchers to work with samples that precisely match the polymers used by the manufacturer.

be much more accurate if unique optical data are calculated for each polymer, based on a small number of mixtures with white and black.

PIGMENT-LOAD OPTIMIZATION

Reducing the amount of pigment needed to achieve color goals can result in significant cost savings and environmental benefits. One cost-saving advantage of advanced color management software is its ability to optimize pigment load, allowing you to use the minimum amount necessary to achieve an opaque layer.

Operations that don't perform this optimization often use too much pigment, increasing costs without improving color or opacity. Although preparing calibration samples for this type of optimization must be very specific and accurate, the financial savings will justify the effort.

Polymers aren't always totally colorless or transparent; they can also absorb and scatter light.

BEST PRACTICES FOR SUCCESS (AND COST SAVINGS)

To ensure success with translucent polymers, your software should meet the following criteria:

- Uses an advanced algorithm capable of handling opaque, transparent and translucent patterns
- Has ability to optimize and minimize pigment load
- Ensures minimal steps to reach the desired color and opacity, which will enable significant cost savings and environmental benefits
- Has an intuitive graphical user interface (GUI) with the option to tailor workflows
- Feature special functions tailored to plastics workflows, including:
  - Calculation of masterbatch recipes
  - Exclusion of unsuitable color combinations
  - Recipe search and correction
  - An expert system to manage critical colorant properties such as fastness or heat stability
  - Robust data management, exchange and migration options

It's important to remember that color-management software is designed to augment, not replace, skilled colorists. Training your people will benefit your operation by ensuring reproducible processes; without a basic knowledge of color management principles, even the best formulation software won't deliver good results.

Set your colorists up for success by equipping them with the right tools for the tasks. A light booth, a regularly maintained measuring device and a fast PC are musts. In addition, integration with systems such as ERP, MES or LIMS will make production safer and faster while enabling extensive data analysis that can improve your processes over time.

A software maintenance contract is another great way to secure your investment in digital color tools. It will give you easier access to updates and upgrades, and expert help desk support when you need it. PT

ABOUT THE AUTHOR: Jutta Albertin held long-term strategic roles including European product manager for Computer Color Matching (CCM), where she developed and managed color-matching solutions across diverse markets, prior to joining Datacolor. In her current capacity, she also leads panel discussions on topics such as the color challenges of recycled plastics, reinforcing her status as a trusted industry authority. *www.datacolor.com*.

BLOWN FILM

Enhanced Bubble-Control System Boosts Efficiency

Hosokawa Alpine's retrofittable Bubble Control Diameter (BCD) system combines new sensor technology with a modern software architecture to ensure faster control processes, consistently high product quality and greater system availability. Sensors are now mounted directly on the moving support arms rather than on the frame of the calibration basket. This is said to enable them to be flexibly adapted to the respective process conditions and to detect changes in the film bubble with even greater precision. The system responds faster to process fluctuations, resulting in greater process stability, stable film bubble and more efficient production.



AUTOMATION

Standalone Robots Debut at Fakuma

Arburg unveiled standalone robot systems, including the rControl robot operating panel, at Fakuma 2026. According to Arburg, the systems are designed to be used independently of injection molding machines, enabling customers to scale flexibly when automation is required, or retrofit existing systems to use them for longer. As a demonstration at the show, a standalone, upstream cell — featuring linear Multilift and Yaskawa robots — displayed the interaction of several interlinked robots assembling and folding cartons and passing them along to a production cell injection molding dominoes.

Standalone variants are available for Arburg's Multilift select linear robot systems with payloads of 4-16 kg, as well as for Yaskawa SCARA and 6-axis robots that are 'Powered by Arburg'. The company says a standalone robot such as a Multilift Select is ideally suited to standard tasks and can be complemented by a Yaskawa 6-axis robot, for complex handling operations. For production cells featuring the company's Allrounder presses, Arburg is responsible for CE (European conformity) marking.

The new rControl operating panel enables the standalone robots to be programmed and controlled independently. Fitted with an enhanced control cabinet, including a controller and mobile control panel, the user interface is similar the Arburg's Gestica control system on its molding machines. Production processes can be controlled independently of the



SAFETY

Sensor Boosts Protection Around Cranes

Globeius now offers optional sensor packages for cranes operating in manufacturing plants carrying very heavy items such as molds and dies. The customized packages can help detect obstacles and hazards as cranes travel through the plant.

The sensor packages include proximity sensors in all directions that can prevent the crane from hitting any object and infrared sensors that can detect humans approaching the crane and trigger the vehicle to stop. Sensor layouts can be configured to meet customers' specific needs.

Industry-standard light beams are available to warn personnel of an approaching



vehicle. Sensors also can be switched on or off to accommodate particular applications. The sensors can be installed on new cranes available from Globeius or retrofitted to existing cranes.

Globeius cranes are available with lifting capacities of up to 55,115 lbs. Designed for use by a single operator, the cranes are built to simplify mold changes and maneuver in confined spaces, with a turning radius of 9". Cranes also can be operated remotely.

INJECTION MOLDING

New Container Mold, U.S. Facility Preview & Hot Runner Tech

Haidlmair, together with its subsidiaries FDU Hotrunner and Digital Moulds, exhibited at Fakuma as provider of injection molding technologies, including a new process for container molding. Active Mold presents new approaches to increasing process efficiency and productivity in container molding, enabling more precise process control, scrap reduction and improved repeatability.

The company also offered a first glimpse of its new U.S. subsidiary, which will begin operations in early 2027. With this new Greensburg, Indiana location, the Haidlmair Group is expanding its presence in the North American market and strengthening its ability to support local customers.

FDU Hotrunner introduced a new generation of its needle-valve technology at Fakuma. The new single-needle-valve nozzle significantly expands the process-related production window and enables safe, stable and high-quality processing of demanding and critical materials. FDU also presented a new cylindrical gate specifically developed for challenging gate areas. This enables the molding of engineering and filled plastics while ensuring high gate quality and process reliability.



The Digital Moulds subsidiary showcased its monitoring solutions for injection molding production as well with its innovative Mould Lifecycle Management Tool. These digital applications provide transparency across the mold's entire lifecycle, supporting condition-based maintenance and enabling data-driven decisions.

RESIN CONVEYING

High-Powered Vacuum Pump Boosts Accessibility, Performance

Advanced Blending Solutions (ABS) has launched the 40-hp Tranquility Vacuum Pump. The pump is the newest addition to ABS' Tranquility line, which previously consisted of 5-, 7.5-, 10-, 15- and 25-hp pump options, while introducing a fully redesigned platform with several features designed for easier maintenance, improved accessibility and enhanced performance.



The redesigned 40-hp Tranquility pump features single-side access for maintenance, which is said to make equipment layout much easier by requiring mandatory clearance on only one side of the pump. Its updated sheet metal framework and structural enhancements are said to improve overall rigidity, while separate access to the high- and low-voltage enclosures provides added convenience during maintenance.

Additional design enhancements include an external oil sight glass for easier monitoring and a larger fan to improve air circulation and cooling. Together, these updates provide a more accessible and robust platform designed to support the demands of larger material conveying systems.

With the addition of the 40-hp model, the Tranquility Vacuum Pump line now offers a wider range of horsepower options to meet the needs of plastics processors and their material conveying systems.

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THERMOFORMING

Large-Format Vacuum Former for North American Market

Formech's 824LF is a new large-format vacuum forming machine designed specifically to meet the demands of the North American market.

The 4824LF serves as an alternative to the Formech 1372, delivering what the company says includes significant upgrades in efficiency, control and material yield while transitioning to a native U.S. customary-sizing format.

Designed for a dedicated 48-x-24" (1220-x-610-mm) sheet size, the 4824LF is optimized directly for standard North American stock-sheet dimensions. This eliminates unnecessary trimming, significantly reduces material waste and streamlines pre-production preparation for processors and packaging producers, Formech says.

Engineered for both heavy-duty production runs and rapid prototyping, the 4824LF incorporates several major technological advancements over its predecessor, the 1372, including:

- **U.S.-Optimized Sheet Alignment**: A 4' x 2' sheet area matches standard North American sheet sizing.



- **Precision Zone Heating**: Advanced quartz heating elements with independent zone control ensure uniform heat distribution across complex tool geometries and challenging materials.
- **Intelligent Touchscreen Interface**: An upgraded programmable logic control (PLC) system allows operators to store multi-user recipe presets, enabling faster job changeovers and reduced setup times.
- **•Heavy-Duty Vacuum Power**: Enhanced vacuum power provides accurate detail definition when forming thick-gauge materials and high-depth tools.

INJECTION MOLDING

Fakuma Presence Highlights Efficiency

At Fakuma, Bole Europe presented two different approaches to energy-efficient injection molding — an all-electric FE 110 and a compact servo-hydraulic DK 200 two-platen molding machine. The FE 110 uses independent electric drives for precise control of individual machine movements, ensuring that energy is consumed only when it is required. The DK 200 is based on a two-platen clamping concept, enabling high clamping force along with compact machine dimensions. The reduced length of the clamping unit supports efficient use of available production space.

Working off a theme of "Less Energy per Good Part," the FE 110 and DK 200 demonstrated two ways to achieve this goal, with the FE 100 employing directly-driven electric axes for high precision, dynamic performance and accurate process control, while the DK 200 with a compact, two-platen is designed with energy-efficient servo-hydraulic drive technology.



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TOOLING

Novel Hot Runner Broadens Material Options

Oerlikon HRSflow says its STARgate HRS hot runner technology, which applies a diaphragm-based gate shut-off system for precise control of melt flow into the cavity, can now run a broader range of resins.

Initially, the pin-less valve-gate technology targeted polypropylene (PP) and recycled PP (rPP) packaging applications. Now it's able to process a broader range of materials including polymethyl methacrylate (PMMA), acrylonitrile butadiene styrene (ABS), polystyrene (PS), high- and low-density polyethylene (HDPE, LDPE) and filled polymers. The system is suitable for components ranging in weight from 40 g to 2.5 kg.



Compared to conventional hot runners, where melt flow is controlled by a pin that absorbs heat and must be cooled, the STARgate HRS diaphragm concept has no pin and optimized cooling, enabling cycle-time reductions of up to 20%. In addition, the free-flow design in the nozzle ensures smoother plastic flow at a consistent melt velocity while minimizing stagnation areas. This enables faster color changes, resulting in lower scrap rates.

Oerlikon HRSflow says its R&D has shown that part-weight reductions of up to 17% can be achieved with the technology. This is because more efficient and uniform filling enables wall thicknesses to be reduced, resulting in lighter parts.

The pin-less design eliminates the need for actuator installation space, which is typically positioned axially above the valve pins in conventional systems. This reduces the overall tool stack height.

At the Flow Beyond 2026 international summit held in Italy in September, the technology was used to mold a thin-wall 1.5-L bucket made of rPP in a two-cavity tool developed by Inmold Group. The 41g bucket had a cycle time of just 4.7 seconds thanks to the hot runner technology. In addition to Inmold Group, project partners included Engel and Guztech Polymers.

QUALITY CONTROL

Portable Spectrometer Connects Lab to Plant Floor

Spectura, the next-generation portable sphere spectrophotometer platform from X-Rite Pantone, is said to connect trusted color measurement with modern quality workflows. It reportedly helps manufacturers reduce color errors, accelerate decisions and maintain consistency from the laboratory to the production floor.

X-Rite Pantone notes manufacturers increasingly manage color across distributed sites, supplier networks and diverse materials while facing tighter tolerances and shorter approval cycles. Yet many production measurements still require manual data transfers before review, limiting visibility and slowing corrective action.

Spectura, on the other hand, reportedly brings laboratory-level measurement performance to a durable, portable platform. This new architecture integrates advanced optics, high-definition camera targeting, temperature-aware measurement, purpose-built accessories, secure cloud connectivity, NetProfiler integration and future application capabilities within a single platform.

Strong inter-instrument agreement with established X-Rite handheld and benchtop systems helps maintain alignment between established color standards and production results to reduce measurement variation and create a foundation for connected color quality management.



Secure cloud connectivity powered by X-Rite Color iQC is said to bring color and instrument performance data directly into digital quality workflows, reducing manual transfers. Quality managers can review production results in real time, identify issues earlier, reduce rework and collaborate across locations and suppliers.

Three models address distinct quality needs:

- Spectura S60 for portable color comparison.
- Spectura S62 for everyday quality control.
- Spectura S64 for tighter tolerances and agreement with Ci7800 benchtop spectrophotometers.

MATERIALS

Sustainable Compounds Target Electrical/Electronic and Automotive

TechnoCompound's new AbsorbXX product line of electromagnetic-shielding compounds reportedly provides a lightweight, easy-to-process alternative to metals. Primarily based on nylon 6 and recycled polypropylene (PP), they are carbon-fiber-reinforced and filled with carbon black. As a result, they are said to meet the stringent shielding requirements applicable to a wide range of components in the automotive and e-mobility sectors. Depending on the grade, they can achieve electromagnetic compatibility (EMC) shielding of up to 55 dB at frequencies ranging from 30 MHz to 1.5 GHz and beyond.

Two such products were introduced last month at Fakuma 2026.

TechnoMid GF 30 2 MH H (product code K052500059) is an advanced electrically insulating compound designed specifically for use in electromobility, containing 75% recycled content in the nylon matrix. With a comparative tracking index (CTI) rating of 600 V, it reportedly offers one of the highest tracking resistances (Group 1) of any electrically-insulating thermoplastic. Reinforcement with 30% by weight of short-glass fibers is also said to ensure high dimensional stability and excellent mechanical properties. Heat stabilization provides high resistance to thermal aging, enabling continuous operating temperatures of up to 150 °C. In addition, it has good resistance to oils, greases and solvents, which is typical of nylon 6.

TechnoDur PBT GF 7 1 HFFR V0 (product code 502339) is a new polybutylene terephthalate (PBT) compound containing 7% by weight of short-glass fibers and halogen-free flame retardants. It meets the stringent Class V-0 flammability requirements according to UL94 at 0.4 mm. Thanks to its very low fiber content, it offers high melt flowability and is therefore ideal for producing thin-walled molded parts with long flow paths, says TechnoCompound.



STATEMENT OF OWNERSHIP MANAGEMENT AND CIRCULATION

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November 2026: Flat-to-Down Price Trajectory for the Five Commodity Resins

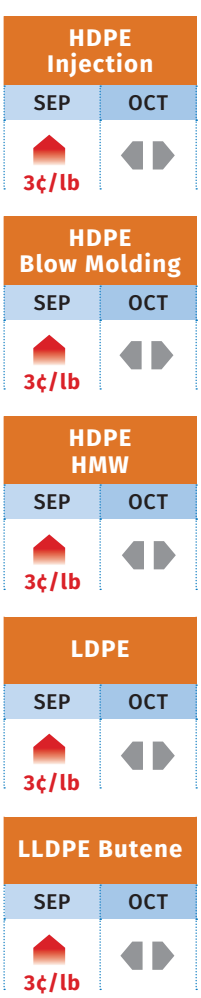
Typical fourth quarter demand slowdown could nix any price-increase nominations.

By Lilli Manolis Sherman
Contributing Editor

Heading into the final two months of 2026, prices for the five commodity resins are expected to be flat with some downward momentum for polypropylene (PP), polyvinyl chloride (PVC) and polyethylene terephthalate (PET) and possibly polyethylene (PE) and polystyrene (PS). The overall slowdown in demand — typical during the fourth quarter — could well hold off implementation of any price increase nominations. The volatility of crude oil prices and some derivative feedstocks due to the U.S.-Iran and extended Middle East conflict has been a key factor in price increase attempts as has been an increase in demand for exports.

Below are the views of purchasing consultants from Resin Technology Inc. (RTi); David Barry, associate director of PE, PP and PS for Dow Jones Energy (formerly OPIS's PetroChemWire/PCW); Scott Newell, executive VP polyolefins at distributor/compounder Spartan Polymers; and Mike Burns of Plastic Resin Market Advisors.

Polyethylene Price Trends



Market Effective Mid-October 2026

Resin Grade	¢/lb
POLYETHYLENE (railcar)	
LDPE, LINER	74-76
LLDPE BUTENE, FILM	70-72
HDPE, G-P INJECTION	74-76
HDPE, BLOW MOLDING	72-74
HDPE, HMW FILM	74-76
POLYPROPYLENE (railcar)	
G-P HOMOPOLYMER, INJECTION	61-63
IMPACT COPOLYMER	66-68
POLYSTYRENE (RAILCAR)	
G-P CRYSTAL	99-102
HIPS	107-109
PVC RESIN (railcar)	
G-P HOMOPOLYMER	53-55
PIPE GRADE	54-56
PET (truckload)	
U.S. BOTTLE-GRADE	72-74

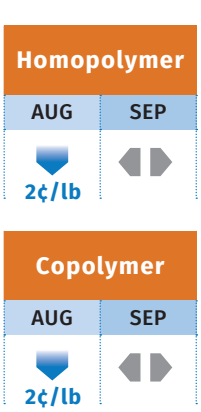
PE PRICES UP

September PE prices were expected to move up by at least 3¢/lb, as suppliers were out with increase nominations of 5¢/lb in September and October, according to Barry, Burns and Kevin Mekaru, RTi's procurement director for commodity resins. Higher PE exports demand was the key factor. Mekaru notes that exports rose 3% in August and it was anticipated that this might continue due to higher crude oil prices. Domestic demand remained flat, leaving Mekaru to posit that PE prices would remain largely flat in October and November.

Barry says that the Middle East situation, which has led to higher oil prices and been the main driver for exports demand, would have to remain the market driver as the sector enters the seasonal fourth quarter slowdown. "Buying activity from Asia was expected to slow as U.S. prices rose and a large amount of volume was already deep-sea bound," Barry says. He also notes that while prices in Latin America and Europe were higher, both markets remained slow. "Customers were wary of buying after energy-induced hikes due to fluctuations earlier in the year," Barry notes.

Going into October, export momentum

Polypropylene Price Trends





had already softened. As such, along with plenty of resin supply and supplier competition, Barry saw a buyer's market as processors head into 2027 contract negotiations. "Prices are not likely to adjust lower until November at the earliest," Burns says. "Continued lower oil prices trends, record production, below average exports and good weather are the essentials to bolster the resin processor's 2027 contract negotiation position."

PP PRICES DOWN

After dropping a total of 17¢/lb since May, PP prices dropped another 2¢/lb in September in concert with the propylene grade polymer (PGP) contract settlement of 43¢/lb according to Barry, Mekaru and Scott Newell. Very unusually, these sources point out, pricing of PGP did not respond to the surge in crude oil prices. They attribute this to a much healthier supply situation, noting that all PDH units creating on-purpose propylene are running well.

In general, these sources posit PGP and PP prices would trend flat to slightly lower in October and November. Still, Newell notes the continued geopolitical volatility and/or an unexpected PDH unit production shutdown are factors that could reverse the trend. These sources see domestic demand as lower with an uptick in exports, though not as high as those seen in March at the start of the Iran war.

With plant operating rates in the low 80s percentage wise, the experts see a buyer's market as processors go into contract negotiations. Heading into October, Barry reports, "Customer demand for U.S.-origin PP increased abroad as Asian offers disappeared in Latin America due to steep freight rates; however, most U.S. producers pulled their export offers last week to keep the domestic market balanced."

PS PRICES UP

PS prices rolled over in September after dropping an average of 6¢/lb in August, but suppliers were out with increases as high as 9¢/lb for October, driven by elevated crude oil prices and derivatives, according to Barry and Mekaru. The latter notes that spot benzene prices had climbed to $5.60/gal from $4.40/gal in late August. According to Barry, the surge in the pricing of aromatics — including benzene and styrene monomer — were due to high oil prices coupled with scheduled and unscheduled production shutdowns. Even with two PS plant closures, there is plenty of PS resin inventory as lackluster demand has continued. Flat-to-down pricing is projected for the October-November timeframe. According to Barry, going into October the implied styrene price, based on a spot formula of 30% ethylene and 70% benzene, was up 9¢/lb over the previous four weeks.

Polystyrene Price Trends

GPPS	
SEP	OCT
◀▶	▲ 9¢/lb

HIPS	
AUG	SEP
◀▶	▲ 9¢/lb

PVC PRICES FLAT-TO-DOWN

August PVC prices rolled over and suppliers had issued a 2¢/lb increase for September, according to Brian Balboa, RTi's senior business unit leader for PVC, attributing it to a large inventory draw in August. However, Balboa notes that plant operating rates are below 80%, and despite the earlier inventory reduction, supplier inventory levels are quite healthy, with no strong pull from the construction sector as it is already beyond the peak season. "Data centers represent the main pull in terms of the construction market," Balboa says, noting that suppliers might be able to get an increase of 1¢/lb implemented but generally flat-to-lower pricing is expected in October and November. Another contributing factor he cites is competitively priced Chinese PVC imports — both for resin and finished goods.

PVC Price Trends

Pipe	
SEP	OCT
▲ 1¢/lb	◀▶

Gen. Purpose	
SEP	OCT
▲ 1¢/lb	◀▶

PET Price Trends

Bottle Grade	
SEP	OCT
▼ 1¢/lb	◀▶

PET PRICES FLAT-TO-DOWN

September PET prices moved down 1¢/lb, after having rolled over in August and dropping by 1-2¢/lb in July. Based on projected feedstock formulation costs, Mekaru ventures October prices would be another rollover, with a 1-2¢/lb decline in November particularly if there is a reversal to elevated crude oil prices. Soft domestic demand will continue through the fourth quarter, Mekaru posits. He notes that PET imports will continue to be a factor in the domestic market and have not fallen as a result of slowed demand. However, they are not as attractively priced. "They are now more in parody with domestically produced PET, particularly due to higher container transport costs," Mekaru says PT

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Plastics Processing Index Eases but the Outlook Holds Steady

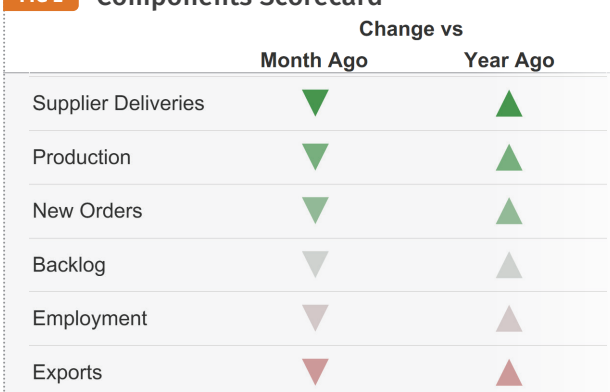
Production and the overall index slipped, but rising future expectations and solid auto demand suggest the market is still stable.

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



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

FIG 3 Future Business Index



Numbers in Perspective

The pullback in the GBI Plastics Processing Index to 51.1 in September, from 54.1 in August, does not by itself signal a turning point in the plastics processing outlook. Similarly, the production component declined to 51.7 in September from 58.2 in August, but this does not indicate the beginning of a downward trend. Monthly data can be noisy, and other GBI components point to continued stability. In particular, supplier deliveries and future business expectations among GBI participants increased to 62.0 and 67.5, respectively, in September, from 60.5 and 65.6 in August, supporting a stable outlook for plastics processing.



By Perc Pineda

It can be argued that the recent dip in the GBI reflects internal or external factors. Internally, the Federal Reserve's 25-basis-point rate hike on Sept 16, 2026, which brought the federal funds rate target to 3.75–4.00%, could weigh on plastics demand in interest-rate-sensitive end markets. Externally, ongoing geopolitical conflicts in the Middle East have pushed up global energy prices, including in the U.S., contributing to persistent inflationary pressures that were among the factors considered by the Federal Reserve in setting monetary policy.

The latest available end-market data provides some perspective. Light vehicle sales remained above a 16.0 million annualized rate from March through August, reaching 16.6 million units in August. Auto and light-truck assemblies also remained above a 10.0 million annualized rate in August, at 10.13 million units. For now, the September GBI reading, viewed alongside the latest available end-market data, points to continued stability rather than a clear shift in the plastics demand outlook.

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

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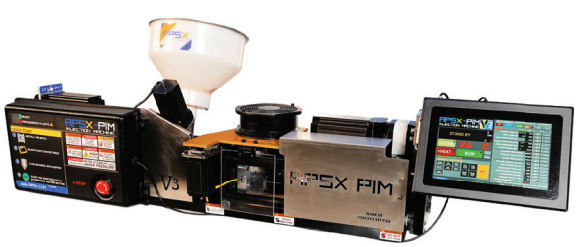
Model Rocket Maker Launches In-House Molding

LOC Precision utilizes benchtop plastic injection molding to produce rail buttons for high-power model rockets, with plans to bring additional parts in-house.

By Jim Callari
Editor Emeritus

Before a high-power model rocket can climb into the air, it first must travel along an aluminum launch rail until it's moving fast enough to continue safely on its own. To keep the rocket aligned during initial acceleration, small plastic rail buttons attached to the side slide through a T-shaped groove in the launch rail. Although rail buttons are relatively simple components, they perform an essential function: guiding the rocket along the launch rail during liftoff, making them required for every high-power rocket kit.

As a result, LOC Precision, located in Plymouth, Wisconsin, depends on a reliable supply of rail buttons for both the high-power rocket kits it manufactures and the replacement components it sells. Instead of continuing to purchase rail buttons, LOC Precision decided to make them. The company installed a benchtop plastic injection molding machine from APSX LLC, a Blue Ash, Ohio-based manufacturer of compact injection molding machines for prototyping, as well as low- to mid-volume production. By bringing production in-house, LOC Precision gained greater control over the availability of this small but essential component.



Model rocket maker LOC Precision installed a benchtop press from APSX to bring the production of rail buttons in-house. Source: APSX Inc.

"I know the cost of the plastic parts, and even after I pay someone a good hourly wage, I'm still getting them for half the cost," says David Barber, co-owner of LOC Precision.

For a manufacturer that does not require tens of thousands of parts at a time, this is where benchtop molding fits. The equipment provides many of the process capabilities of conventional injection molding, without the capital, floor space, utility infrastructure and production volume associated with a complete production system.

Barber first began searching for a smaller injection molding machine around 2017. At the time, most of the equipment he found was designed for higher-volume production and priced accordingly.

Although Barber estimates the business has grown more than 500% since he and business partner Jason Turicik acquired it in 2016, there was not a great deal of extra capital available to invest in expensive tooling and large-scale molding equipment.

"I was looking for small molding machines because everything else was industrial level," says Barber. "I don't do plastic injection molding for a living. I just need some of these parts." The original APSX-PIM, purchased in 2020, allowed LOC Precision to keep production in-house without committing to the expense and complexity of a conventional injection molding system.

LOC Precision more recently upgraded to the PIM V3. The new press is approximately 43-inches long, 10-inches wide, and 15-inches high, so it can be installed on a workbench or shop table. It features electronic temperature control, adjustable injection speed, cycle delay control, precision sensors, a touchscreen interface and an injection performance chart that displays pressure and volume over time. It can process a wide range of polyolefins and engineering resins utilizing aluminum molds.

LOC Precision's mold produces six rail buttons during each cycle. The machine is not operated continuously because the company does not need the parts in high quantities.approximately every other month, an operator comes in and runs the PIM for a full shift. The buttons are then moved into the company's automated packaging process, which further reduces the labor required to prepare them for kits or individual sale.

LOC Precision has heating and air conditioning, but seasonal conditions in Wisconsin still vary considerably. During more humid weather, Barber says he may slow the machine and lower the temperature slightly. During the colder winter months, he may increase the pressure or adjust the temperature upward. PT

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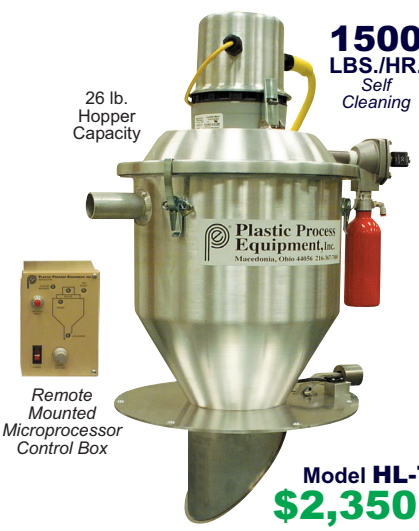
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