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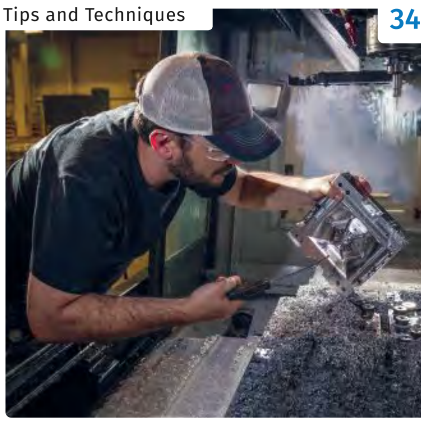

PT Web Exclusives — There's more on the web at *PTonline.com*

VIDEO: iMFLUX Chats with *Plastics Technology*

At the recent K 2022, *PT* Executive Editor Tony Deligio talked with Gene Altonen, chief technology officer at iMFLUX, about the company's booth display in conjunction with Milacron (eQ Series all-electric injection molding machine) and Haidlmair GmbH (Crinkle Box mini mold and FDU SLS nozzle), showcasing iMFLUX low-pressure molding and the ability to run a wide array of melt viscosities with the process adapting automatically to the different melt flows.
tinyurl.com/3sh4e68t

ARTICLE: Advanced Recycling: Beyond Pyrolysis

Consumer-product brand owners increasingly see advanced chemical recycling as a necessary complement to mechanical recycling if they are to meet ambitious goals for a circular economy in the next decade. Dozens of technology providers are developing new technologies to overcome the limitations of existing pyrolysis methods and to commercialize various alternative approaches to chemical recycling of plastics.
tinyurl.com/4fyx55bm

BLOG

Christina Fuges, editorial director of sister publication *MoldMaking Technology*, recently sat down with Injection Molding Solutions owner John Bozzelli and ALBA Enterprises president/CEO Rich Oles to discuss the importance of data in simplifying processes.
tinyurl.com/yks89jad

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Get to Know the Refreshed Plastics Hall of Fame

Nominations are open for the revamped Plastics Hall of Fame's Class of 2024

Have you checked out the new Plastics Hall of Fame? Wait — before we go there — did you even know there was a Plastics Hall of Fame?

Jim Callari
Editorial Director

If not, the Plastics Hall of Fame was founded in 1972 by Sid Gross, then the editor-in-chief of *Modern Plastics* magazine, in conjunction with the Society of the Plastics Industry, now the Plastics Industry Association (PLASTICS). Since then, separate ceremonies for living and posthumous inductees have been held every three years, coinciding with NPE. There are currently 216 inductees in the Plastics HoF, including 42 living. The Plastics HoF has always been virtual — don't confuse it with museums such as the Baseball Hall of Fame in Cooperstown, N.Y., or the Rock and Roll Hall of Fame in Cleveland.

For years the Plastics Hall of Fame was managed by the Plastics Academy under the leadership of Jay Gardner — himself an inductee. Gardner, however, passed away last October, and some changes followed. The HoF is now managed by a board of directors headed by Dr. Maureen Steinwall, herself a Hall of Famer after a celebrated career as head of injection molder Steinwall Inc. of Minneapolis.

Dr. Steinwall has assembled a team of more than 20 volunteers who serve on one of three committees: Events, Communications, and Nominations. Committee and board members include a veritable Who's Who of the global plastics industry, including Tim Womer, Gunther Hoyt, Ulrich Reifenhauser, Glenn Beall, Hideo Tanaka, Donna Davis, Bob Malloy, and Wylie Royce. I have the pleasure of serving as chairman of the Nominations Committee. Fellow plastics industry journalist Don Loepp, editor of *Plastics News*, is a member of the Communications Committee.

PLASTICS HALL OF FAME

NPE2021 was canceled due to Covid-19, so the Plastics Hall of Fame held its induction ceremony this past May in Chicago. Among the inductees was Wylie H. Royce (center) of Royce Global, flanked by Dr. Maureen Steinwall (inducted in 2015) and Tim Womer (inducted in 2012). Dr. Steinwall and Womer are board members of the restructured Plastics Hall of Fame. Photo: Plastics Hall of Fame

Moving forward, induction ceremonies will be held every 18 months, with the next ceremony to take place in Orlando, Fla., right before NPE2024. The board is also committed to making the Plastics HoF a more global entity.

Nominations for the Class of 2024 are being accepted now. On the Plastics HoF website (***plasticshof.org***), it says, "The Plastics Hall of Fame...is the ultimate recognition of a lifetime body of work of an individual whose dedication and exceptional achievements have contributed to the growth and prominence of the industry on a global scale."

If you know someone who you believe qualifies, download the nomination form and start the process. You can submit it online as well. PT

Canadian Project Shows Digital Watermarks Aid Sortation of Flexible Packaging

A pilot project in Canada demonstrated that “covert digital watermarks” (almost imperceptible to the naked eye) can dramatically improve sortation of films and flexible packaging, which cannot be handled effectively by conventional optical sortation technology. That’s the report from Digimarc Corp., Beaverton, Ore., which worked with Canada’s Circular Plastics Taskforce (CPT), participating converters and Pellenc ST, a French producer of intelligent optical sorting equipment and connected services (U.S. office in N.Y.C.). Accuracy of detection and sorting was 99% for films and flexibles in a mixed-waste sample that’s “characteristic of Canadian conditions,” says Digimarc, adding, “Remarkably, the results show consistent behavior no matter the type of material used, the form factor or the type of commingled waste.” Starting in 2023, CPT aims to implement the technology in Canadian separation facilities.

Looks Like This


©Digimarc Corporation
Performs Like This

Digimarc Recycle technology involving covert digital watermarks either printed on packaging or molded into the surface of rigid plastics has been used in large-scale sorting assessments over the past year, most notably as part of the HolyGrail 2.0 cross-industry initiative in Europe driven by AIM — European Brands Association and the Alliance to End Plastic Waste. The Canadian project was the first in North America. Using Digimarc Recycle technology, the covert digital watermarks can be read by a suitably programmed optical scanner that is interfaced with a cloud-based repository of product attributes such as brand, SKU, product variant, packaging composition, food/nonfood use, etc. The same information can be used to provide product-specific and location-based disposal instructions directly to consumers. Scannable data in the digital watermarks also can provide a comprehensive view of the post-purchase product journey for Producer Responsibility initiatives.

Sidel Opens New R&D Hub to Study Design for Recycling in PET Packaging

Sidel has opened a new R&D hub dedicated to PET recycling in Octeville, France. A small-scale PET recycling line there will allow Sidel to develop advanced knowledge about bottle-to-bottle recycling of food-contact PET bottles. The line includes washing, drying, pellet extrusion and solid-state polymerization. Sidel will use it to test recyclability of post-consumer PET bottles from different feedstocks, including additives, caps, labels, inks and glues.

Elkem Completes Expansion for High-Purity Biomedical-Grade LSRs and Other Silicones

Elkem recently held the grand opening of Elkem Silicones Advanced Specialties, its new production site in York, S.C., a specialized facility with a Class 8 cleanroom and packaging in Class 7 cleanrooms. It will be the company’s center of excellence for production of high-purity, biomedical-grade silicone material. It will produce liquid silicone rubber (LSR), high-consistency rubber (HCR), high-purity silicone gels, adhesives and dispersions marketed under the Silbione Biomedical brand.

Mold Opaque White PET Bottles – Without Pigment

At K 2022 in Düsseldorf, one of the sustainability-themed exhibits by Trexel was an opaque white PET bottle that can function as a light barrier for sensitive products like milk. The white color was provided by Trexel’s MuCell microcellular foaming technology, without the cost and environmental impact of color additives. This bottle was produced via cooperation with Husky, whose multilayer co-injection process was used to produce three-layer PET preforms with a foamed layer in the center. Nothing was added to the PET beyond inert nitrogen gas for foaming, so recyclability was not affected.

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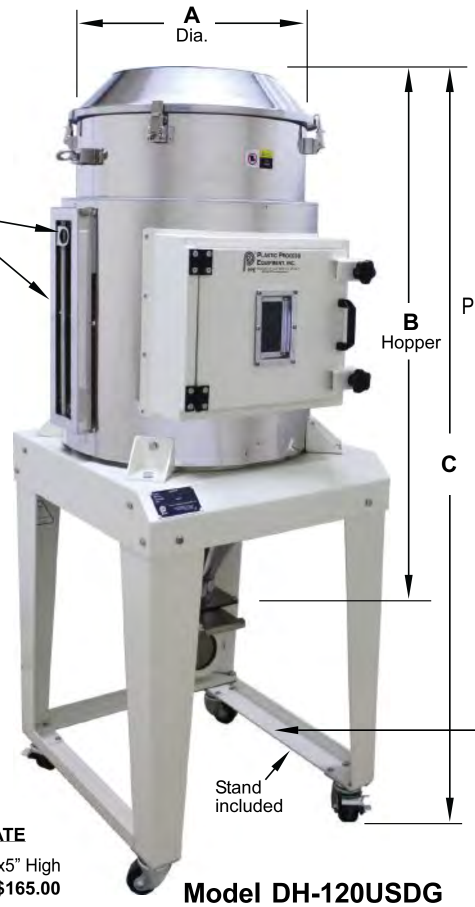

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Model DH-120USDG
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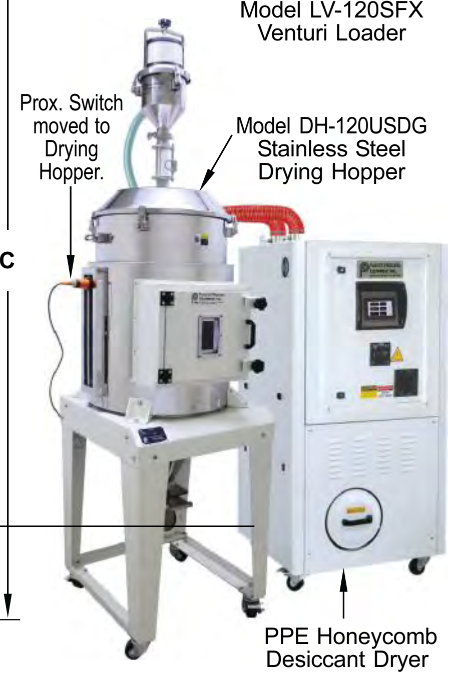

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DH-80USDG	$1,450.00	100	2-1/2"	2-1/2"	2-7/8" *	18-3/4"	38"	52-1/2"
DH-120USDG	$1,510.00	140	2-1/2"	2-1/2"	2-7/8" *	18-3/4"	51-5/8"	66"
DH-160USDG	$1,840.00	180	3"	3"	3-1/4" †	21"	50-1/8"	78-1/2"
DH-230USDG	$2,210.00	250	3"	3"	3-1/4" †	22-7/8"	57-5/8"	80"
DH-300USDG	$2,490.00	320	3"	3"	3-1/4" †	28"	59-5/8"	78"
DH-450USDG	$2,680.00	450	3"	3"	3-1/4" †	28-3/4"	70"	90"
DCCA0766	$240.00	* Spare Cast Aluminum Discharge Chute, 7-3/8" dia. Top Plate X 6-1/4" X 6-1/4", Bottom Plate - 2-7/8" Outlet						
DCCA1088	$265.00	† Spare Cast Aluminum Discharge Chute, 10" dia. Top Plate X 8" X 8", Bottom Plate - 3-1/4" Outlet						
DCCA0102	$2.00	Discharge Chute Sight Lens (plastic) 1" x 2-1/4"						

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Benvic Expands Range of Thermoplastic Compounds

Following a period of expansion and acquisition within the last four years, France's Benvic, known as Europe's leader in PVC compounds, has become a multi-material supplier with offerings that now include polyolefin and TPE compounds and a range of recycled and bioplastic compounds. Benvic has U.S. offices in Princeton, N.J., and manufacturing plants in Chesapeake, Va., and West Unity, Ohio.

PVC compounds remain the historical basis of the company, and its updated ProVinyl range of PVC compounds — rigid, plasticized, recycled and custom grades — is finding new uses in sectors as diverse as packaging, construction, electrical and medical.

A reworked and rebranded second group of materials is Xtended polyolefin compounds supplied from Benvic's recent purchase of parts of a Celanese site in Ferrara, Italy. These are primarily PP compounds for demanding applications such as food packaging or electrical cables.

The third leg of the Benvic portfolio involves both recycled and biopolymer materials. Benvic's French subsidiary Ereplast offers a growing number of recycled PVC grades.

The fourth sector is Benvic's Plantura range of biobased and/or compostable polymers.

Ascend Performance Materials Buys Majority Stake in Recycler

Ascend Performance Materials has acquired a majority stake in Circular Polymers, a California recycler of post-consumer materials including nylon, PP, and PET. The move secures a consistent supply material for Ascend's Redefyne 100% recycled nylons, recently launched at K 2022.

Circular Polymers, now renamed Circular Polymers by Ascend, reclaims post-consumer carpet via a unique technology and has redirected approximately 85 million lb of waste from landfills into new goods since 2018.

Old Fishing Nets to Child's Watering Can: Blow Molding rPE at K Show

At K 2022, Kautex blow molded a child's watering can made from recycled fishing nets. Kautex used a PE compound from Braskem, which worked with an unnamed third firm that specializes in mechanical recycling of plastic fiber waste. Kautex states that "the quality of the fishing-net PCR was so good, for example in terms of consistent viscosity, that the cans could be produced in a continuous blow molding process without the use of an accumulator head."

Kautex also concluded that "the project showed that so-called 'maritime waste' recyclates are ideally suited for applications in the garden sector, including playground equipment, garden furniture and tool sheds."

AlphaMAC All-Electric Extrusion Blow Molders Come to U.S.

AlphaMAC of Italy, a member of the Italian IMA Group, will be marketing its all-electric, continuous-extrusion shuttle blow molders in North America through IMA Dairy & Food, based in Leominster, Mass. (***imadairyfood.com***). AlphaMac was launched in 2019 and was acquired in 2020 by IMA Group, which owns a number of brands of automated packaging machines.

AlphaMAC (***alphamac.it***) builds only all-electric machines. Among its special features are 26:1 L/D extruders, which are said to provide more stable processing of high levels of regrind or PCR. The single-parison machines have B&R control interfaces and are said to offer very high specific energy efficiency up to 0.27 kWh/kg. They offer quick mold changes with a built-in support crane.

AlphaMAC offers single- and double-station shuttle machines for packaging with clamp force of 12 to 32 tons, stroke of 500 to 1000 mm, and dry cycle from 3 to 4 sec. A larger series (single and double station) for more industrial applications such as jerrycans ranges from 28 to 32 tons, 750 to 800 mm stroke, and dry cycle of 3.8 sec. The machine pictured is the Alpha 30S with 32-ton clamp and 750-mm stroke. It can produce containers up to 30 liters at up to 120 bph. It has an integrated quality-control station for "zero defect" production and a built-in robot arm for product takeout. Options include in-mold pressure control to detect holes or container malformation; weighing station with gross and net-weight measurement; horizontal deflashing; twin post-cooling stations; leak detection; multi-camera vision inspection for black specks and other esthetic defects; and a scanner to check neck ovality and diameter, handle shape and dimension, and detect flash in sunken handles or residual material inside the neck.

Industry 4.0 capabilities on AlphaMAC machines include remote monitoring and troubleshooting, including vibration monitoring for predictive maintenance; and data collection from the machine and auxiliaries such as the blending/feeding system and inline leak tester. Data presented includes machine status and alarms, OEE and fault analysis.

Testing Demonstrates Feasibility of Sorting PLA From Mixed Waste Streams

Tomra Recycling and Total Energies Corbion, a PLA producer, released results of testing to confirm that PLA can be sorted from other municipal plastic wastes. The tests were conducted in August on a Tomra Autosort system using near-infrared sensor technology. In the first test, two types of trays were correctly classified by the system as PLA. Then, partially crushed trays were run with a mix of background waste material. For test two, the machine was set to eject PET materials and sort PLA trays into the waste background fraction. In all cases, the Tomra system correctly identified PLA material, according to the company.

According to Total Energies Corbion, results confirm that PLA can be easily sorted from municipal plastics waste using existing sorting equipment, suggesting that the increased use of PLA will not negatively impact existing PET reprocessing.

New Illig Tooling Source for North America

Indianapolis-based Illig North America, subsidiary of Germany's Illig Maschinenbau, has entered into an official partnership with Grupo Interconsult SA de CV (GIC) of Mexico, the first certified Illig thermoform tooling partner in the Americas. This brings over 25 years of tooling design, manufacture and service to Illig customers in the U.S. and Canada. Before now, GIC had provided tooling and Illig machines only in Latin America.

At the recent K 2022, Illig North American managing director Conor Carlin noted that the two entities have collaborated for several years and the formalization of the relationship brings "World-class Illig quality to customers in North America." As the first and only Illig Certified Tool Partner outside of Germany, GIC meets the most rigorous standards for quality and performance. Said Humberto Peschl, president of GIC and Illig Latam (Latin America), "To achieve this certification, we spent several years training our people in Germany, mastering the Illig system, and continuously improving our capabilities. With our latest investment in a full quality-assurance laboratory, converters can be assured of the highest possible standards."

GIC has a complete Illig IC-RDK 80K 4-station form/punch/trim/stack machine available for testing. The company designs and develops from prototypes all the way through to production tools, including punch/die and stacking stations. GIC also offers a comprehensive refurbishment program for trim-in-place tool sets.

New Cap for Child-Resistant Pill Bottles Is Senior-Friendly & Saves Resin

"Pop & Click" is a novel child-resistant closure system from Drug Plastics Group, Boyertown, Pa. (***drugplastics.com***), that offers benefits in usability by seniors and other persons with limited finger mobility — and in manufacturing sustainability. Pressing on the dome in the center of the cap with a finger or knuckles or heel of the hand causes the "petals" on the circumference of the cap to release and lift up, freeing the cap. The cap can be replaced by pressing it onto the top of the bottle — no twisting or gripping is required. The closure system is ASTM tested and CPSC approved for child resistance.

Pop & Click Cylinders are available in sizes of 60, 100 and 120 cc for packaging pills, tablets, capsules and cannabis products. The cylinders have a special 38-mm finish and are blow molded of FDA-approved virgin or post-consumer recycled (PCR) HDPE. The exclusive closure is injection molded of FDA-approved virgin PP. They come standard with a molded TPE reseal liner that functions as a gasket to protect the package contents. A heat induction liner is optional.

The closures use almost 65% less resin than a standard two-piece, push-and-turn closure. Depending on size, the overall package uses 22% to 27% less plastic than standard designs, according

All-rPET Bottles with Glued-in Handles Save Material

KHS has a new option for stretch-blown PET containers with handles: Besides offering clip-in handles slotted into place mechanically, KHS exhibited at K 2022 a new 2.3-liter PET bottle with a glued-in handle. Both bottle and handle were 100% rPET. The company says this design, together with the preferential heating technology on its stretch-blow machines, provides 10% material savings vs. bottles with clip-in handles. Glued-in handles reportedly also require a simpler contour and increase efficiency in processing.

In addition, the clear PET bottle has a marketing advantage over translucent extrusion blow molded HDPE or PP handleware. And the lack of seams in the stretch-blown PET bottle reportedly contributes to excellent performance in rigorous drop tests.

The new bottle results from an 18-month cooperative project between KHS and Logoplaste Innovation Lab, a division of the Portugal-based Logoplaste Group, which has 63 bottle-making plants in 17 countries. Its three Innovation Hubs are located in Portugal, U.K. and Plainfield, Ill. The goal of the project was to design a bottle for home-care products with the smallest possible carbon footprint. The project drew on KHS's experience in selecting a suitable adhesive from prior projects.


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KraussMaffei Launches Two Additive Manufacturing Lines at K 2022

Long established in injection molding, extrusion and polyurethane reaction process machinery, KraussMaffei prepares to enter the industrial additive manufacturing market.

KraussMaffei's precisionPrint system features a resolution of 18-80 µm with a build volume of 250 × 250 × 400 mm (10 × 10 × 16 in.). (Photos: KraussMaffei)

By Tony Deligio
Executive Editor

Plastics processing machinery company KraussMaffei (KM) used a dramatic curtain-drop at its K 2022 show booth to literally unveil its first two additive manufacturing platforms — powerPrint large-format and precisionPrint small-format machines.

According to Michael Helneder, who leads the new AM division at the company, "Our mission is to provide additive manufacturing solutions that are matched to applications, machines and materials correctly the first time," noting that an end-to-end process that avoids potentially expensive and time-consuming optimization is a requirement for reliable industrialization of additive manufacturing.

The precisionPrint machine uses liquid resins in a UV laser-based additive manufacturing process, promising high dynamic resolution of 18-80 µm with a build volume of 250 × 250 × 400 mm (10 × 10 × 16 in.). The machine is built around a dual-tank system, automated build plate changer and a long-life 405-nm industrial laser. The company says the tank system allows separation of parts building and handling.

While the precisionPrint exhibit was static, KM's larger powerPrint system was running at the show, with samples of parts it has created for the foundry industry also on display. Described as an extruder-based gantry system, powerPrint runs standard resin pellets in a process called Fused Granulate Modeling (FGM) for components as large as 10 m³. The machine has a build volume of 2000 × 2500 × 2000 mm (79 × 98 × 79 in.).

For components as large as 10 m³, KM's powerPrint has a build volume of 2000 × 2500 × 2000 mm (79 × 98 × 79 in.).

There are two powerPrint sizes available with output capacities up to 10 or 30 kg/hr. Customers can specify the screw design, with extruder temperatures up to 400°C/752°F for processing even high-temperature thermoplastics, and nozzle sizes from 2 to 20 mm. The heated vacuum print table has 16 zones, and the entire system is surrounded by a heat-resistant enclosure.

Material drying is connected with the material supply by a vacuum supply system, which KM says allows for continuous production without operator intervention. Depending on requirements, multiple mounting surfaces can be configured with a preset printing-table temperature up to 140°C/284°F. The Printcore extruder printer head is guided by linear robots from KM with a maximum travel speed of 300 mm/sec.

The user interface is based on HTML5 working in standard slicer output files, which KM says makes data preparation and print-file creation easier. Data transfer from the pre-process system can be done wirelessly or via USB. The company says it will enter an intensive test phase with beta customers in 2023, after which the printers will be commercially available.

As Currier Grows in Medical Consumables, Blow Molding Is Its 'Foot in the Door'

Currier has added substantial capacity recently in both injection and blow molding for medical/pharmaceutical products, including several machines to occupy a new, large clean room.

By Matthew Naitove
Executive Editor

One often hears the medical market referred to as the medical "space." For Currier, its medical "space" is growing — both literally and figuratively. Driven by growing demand for plastic consumables in healthcare, the company (*currierplastics.com*) is remodeling a newly purchased 75,000-ft² building near its headquarters in Auburn, N.Y. Besides offices and warehouse space, its main feature will be a 25,000-ft² ISO Class 8 cleanroom to house both injection and blow molding machines. When it opens early next year, it will supplement Currier's existing 9000-ft² Class 8 cleanroom.

"Currier has become a leading provider for complex, precise consumables in several healthcare markets. This expansion will give us the place to grow more strong, valuable partnerships," says Ron Ringleben, v.p. of business development.

Adds Rob Knapp, sales and marketing manager, "While the focus of the new facility is driven by the demand in the healthcare space, this new facility will allow us to continue to support our key customers in other spaces like general packaging and amenities."

'It's kind of unique to have extrusion blow molding inside the cleanroom.'

'OUR FOOT IN THE DOOR'

Currier recently celebrated its 40th anniversary. Starting in 1982 as a custom injection molder, the firm added extrusion blow molding (EBM) in 1996 and injection stretch-blow molding (ISBM) in 2010. Early last year, it purchased its first injection-blow molding (IBM) machine. Currier used to have accumulator-head blow molders but got out of that area of blow molding. "Now we're looking at it again," Knapp says.

Currently, the firm operates 40 injection presses from 44 to 500 tons, plus 25 EBM machines, eight Aoki ISBM presses, and a Jomar IBM machine — for a total of 34 blow molders, which generate a majority of the firm's annual revenue, which has doubled since 2014.

"Medical is a big growth area for us," says Rob Knapp, Currier sales and marketing manager. "There are relatively few custom contract manufacturers out there in medical blow molding. So blow molding is our foot in the door with medical customers. Then we get their injection molding business."

Over the past three years, since the start of the pandemic, Currier has added five all-electric EBM machines (three Magic units for medical use and two Kautex KBB presses for nonmedical jobs), one Jomar IBM machine, and around 15 injection machines.

While Currier produces containers and caps for general packaging — such as consumer goods and hotel amenity bottles for

Currier's existing cleanroom houses injection molding and EBM machines, like this Magic unit. The new, larger cleanroom may also hold an ISBM machine.

shampoo, mouthwash etc. — along with some legacy business in electronic connectors, medical has become a major component of its business since 2017. Currier specializes in consumables for in-vitro diagnostics (IVD), point-of-care (POC) testing and life-science markets. These include injection molded sample cups and specimen tubes and caps for Covid testing, as well as blow molded bottles for reagents, cleaning solvents, pharmaceuticals etc.

'PCR is expensive and hard to get. We are trying to move some customers into PIR based on our own internally generated scrap.'

"Medical is a big growth area for us," says Knapp, "and there are relatively few custom contract manufacturers out there in medical blow molding. So blow molding is our foot in the door with medical customers. Then we get their injection molding business." Three large medical customers expanded from blow molding to injection with Currier in this fashion.

Inside the existing cleanroom, Currier operates five injection machines and the IBM press, as well as a Magic EBM machine. "It's kind of unique to have EBM inside the cleanroom," Knapp states. "We also have smaller Magic EBMs that are separately surrounded by clean tents." The new, larger cleanroom will have injection and EBM machines, and Currier may even move one of its Aoki ISBM machines in there to mold PET and PC parts. Automated assembly will be added to the cleanroom in the future. Seven additional injection presses outside the cleanroom are dedicated to medical/pharmaceutical work.

FACING TODAY'S CHALLENGES

The last three years have been trying for all manufacturers, Currier included. Supply-chain challenges were at the top of the list. "Last year, we were on allocation for some materials," recalls Knapp. "This year, we've had to deal with 10-15% increases in costs of pallets and boxes. Wood pallets were so hard to get that we almost had to shut down a manufacturing line."

While Covid brought staffing shortages for many manufacturers, Currier fared better: "We're in good shape with labor," says Knapp. "We eliminated temporary labor because it's too volatile. We increased wages to hold onto talent. We recently reintroduced Operator Level 1, 2 and 3 training, which we had paused due to Covid, to support the growth of our manufacturing team. This is helping to maintain good people."

Currier held six open interview sessions for prospective employees over a six-week period. From seven to 18 people showed up for each session. "Manufacturing jobs are a tough sell," Knapp notes. "It's good to show people that we're not your grandfather's factory anymore — our plant is clean, safe and largely automated."

One of today's challenges is relatively new but growing. "We get a lot of questions from customers about sustainability," Knapp reports. "It used to be all you had to do was provide a good product at a good price. We work with customers' engineering teams to ensure good quality, but now they have a whole team devoted to sustainability."

To help address questions related to ESG (environment, social, governance), Knapp points out, "Most of our machines now are all-electric, which saves energy. Most of our boxes are 100% recycled material. We are exploring returnable packaging — plastic totes. We have energy-efficient LED lighting. We make sure we're not wasting water. We make sure we're following proper labor regulations."

With regard to recycling, he adds, "There's a lot of movement into PCR (post-consumer recycle) but it's expensive and hard to get. We are using PCR on a day-to-day basis — 25% to 50% in some products, mainly larger HDPE bottles. Given the supply issues for PCR, we are trying to move some customers into PIR (post-industrial recyle) based on our internally generated scrap. We invested in large industrial granulators to reuse our production waste."

MATERIALS

PART 24

Tracing the History of Polymeric Materials

Here we focus on silicones, more properly known as siloxanes. This is a class of materials where no carbon is present in the polymer backbone.

By Mike Sepe

Almost all polymers are based on carbon. The backbone chemistry of our most common polymers — polyethylene, polypropylene, PVC, and polystyrene — is exclusively carbon with different pendant groups defining the properties of each material. The same is true of many other polymers like acrylic and ABS as well as elastomers like EPDM and nitrile rubber. Other polymers incorporate elements such as oxygen and nitrogen into the backbone to achieve higher levels of mechanical and thermal performance.

But there is a class of materials where no carbon is present in the polymer backbone. Instead, silicon is the essential backbone ingredient, coupled with oxygen, while the carbon that is present is relegated to the side groups attached to the backbone. This class of materials is referred to generically as silicones and more properly as siloxanes.

If you look at a periodic table, you can see that carbon and silicon appear in the same column. It has been known for some time that elements in the same column enter into similar types of chemical reactions. For example, the elements in the far right column of the table are referred to as the noble gases. Except under the most extreme lab conditions, none of these elements combine with other elements to form compounds and they are found in nature in pure form as gases. The next column to the left contains the halogens, elements that all combine with hydrogen to form acids and are present in compounds that are useful as flame retardants.

Given the knowledge of this pattern in the periodic table, it makes sense that silicon is capable of participating in reactions similar to those that involve carbon, which would mean that polymers could be produced with a backbone based on silicon. Historically, carbon has been readily available from the environment in various forms, including soot, charcoal, and even diamonds. In addition, hydrocarbons in the form of biomaterials and petroleum products provide a readily obtainable class of raw materials from which polymers can be produced.

Scan for more expert advice in materials.

Silicones (like these LSR baby bottle nipples) are organosilicon compounds that bridge the gap between organic and inorganic chemistries. Silicon belongs to the same family as carbon in the Periodic Table of the Elements, suggesting that both elements can engage in similar chemical reactions. (Photo: Arburg)

Silicon is the most abundant element in the earth's crust. But it was not isolated as a chemical element until 1823 when the great Swedish chemist Jons Jackob Berzelius processed a silicate-based mineral, potassium fluorosilicate, in the presence of excess potassium. He then heated this elemental silicon in the presence of chlorine gas to form silicon tetrachloride ($SiCl_4$). This became the starting point for producing the compounds that would eventually form the chemistry for silicone polymers.

But as is often the case, it was a long road. It would be more than a century between the work of Berzelius and the development of the commercial materials that we know today as silicone polymers. The process of developing silicon chemistry towards the production of organic materials was advanced by German chemist Friedrich Wohler, who made significant contributions in both organic and inorganic chemistry. In organic chemistry, he was the first to produce urea from ammonium cyanate, and in the process dealt a significant blow to the belief of the time that organic compounds could only be made by living organisms. In inorganic chemistry, he was the first person to isolate beryllium and yttrium in pure form. It is fitting, therefore, that he played a role in the early development of silicones, producing silane (SiH_4) and trichlorosilane ($SiHCl_3$) in 1857. Wohler was also the first person to use the term "silicone."

In 1863, Charles Friedel and James Crafts, two chemists well known to anyone who has studied organic chemistry, prepared tetraethysilane by reacting the silicon tetrachloride that Berzelius had discovered with diethyl zinc. Thus was created the first true organosilicon compound, bridging the gap between organic and inorganic chemistry. In 1872, Albert Ladenburg, who worked with Friedel, extended this work by reacting triethoxychlorosilane with diethyl zinc in the presence of sodium to produce an organosilane with multiple functional groups, opening the door to the possibility of polymerization. He continued to experiment with other combinations, introducing aromatic rings into the chemistry by reacting diphenyl mercury with silicon tetrachloride to produce trichlorophenylsilane in 1874.

A period of active experimentation in organosilane chemistry continued into the 20th century. A prominent figure in this story was Professor Frederic Stanley Kipping. Kipping and his colleagues at University College in Nottingham, England, devoted nearly half a century to researching the synthesis and properties of the materials that have become popularly known as silicones.

Silicon is the most abundant element in the earth's crust, but it was not isolated as a chemical element until 1823.

In 1901 he produced a material that today we would identify as poly(diphenyl siloxane) and revived the term "silicone" to describe this class of compounds. In 1904, he developed an important mechanism for forming the carbon-silicon bonds that were the key component for creating organosilane chemistry using the Grignard route, a well-known mechanism in organic chemistry that employs organometallic chemicals based on magnesium. This is a crucial part of the story of commercial development that would come later. Kipping and his teams published 57 papers on organosilicon materials between 1899 and 1944.

Despite Kipping's foundational role in the development of these materials, he was not optimistic that they would ever become commercially useful. He referred to them as "sticky messes" and in 1937 he gave an address to the Royal Society where he stated, "The prospect of any immediate and important advances in this section of organic chemistry does not seem to be hopeful."

But at about the same time that these words were being spoken, someone else had a very different viewpoint. Dr. Eugene Sullivan worked at Corning Glass Works in Corning, N.Y. Sullivan saw the potential for developing materials that would provide a property profile between the rigid and brittle glass and ceramics and the softer, more flexible, but less thermally stable carbon-based polymers that were being rapidly developed in the early part of the 20th century. English chemist J. Franklin Hyde began research into the feasibility of producing silicones at a commercial level. Sullivan hired Hyde in 1930 and in a relatively short period of time Hyde was using Kipping's Grignard process to prepare laboratory quantities of silicone polymers.

It had been recognized for some time that in motor windings, the incumbent material, phenolic, was limited in thermal performance and a solution was needed. By 1938, Hyde had produced samples of glass cloth impregnated with silicone resin. These were introduced at a meeting between Corning Glass Works and General Electric in this same year. This started the fast track to commercialization that would happen five years later. But another giant of the chemical industry would become involved in the process. And that story will be the subject of our next installment.

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INJECTION MOLDING

Understanding Flow Fronts and Defects

Flow-front behavior and corrections are key to solving many common molding problems — what is your process's flow trying to tell you about your part?

By Garrett MacKenzie

Plastics processing can be both simple and complex. Some issues require only a simple adjustment to correct a defect condition, while others might require multiple adjustments. Regardless of the relative complexity or simplicity, understanding flow-front performance and being able to make process adjustments are often key to any process correction. This article will identify various flow-front characteristics and will also provide solutions to correct related defects.

SHEAR & BURN DEFECTS

Shear is generally a sign of a flow front that is moving too fast. Symptoms of shear might be bubbles, splay or burns. It is important to identify at what point of fill shear is occurring. Does the defect have a direct correlation to a part area or a specific detail? Is shear occurring at the beginning, middle or end of fill?

Jetting and splay in a molded part could be alleviated by investigating how the material flow front moves through the part. (Photo: Garrett McKenzie)

Beginning-of-fill defects generally have a direct relationship to plastic flowing through a gate or drop. Fast flow through a small gate can lead to heat-related shear defects, and shear through a hot-runner drop might have a direct relationship to the drop's temperature being too cold.

Defects occurring during the middle of fill can point to several other potential causes. Passing around or through specific part details can certainly lead to unwanted shear events. It is also important to inspect the mold itself for burrs or damage that might be causing unexpected shear.

GAS TRAPS

Gas-trap defects are another common occurrence that can be caused by a fast-moving flow front. Conversely, it is also important to note that gas traps can also be caused by a flow front moving too slowly. A flow front moving too quickly towards a vented area can leave gases lacking adequate time to escape through specific vents. Flow fronts moving too slowly can lead to pressure in front of a flow front being too low to force gas through vents. Adjustments to injection speeds are the best way to determine which of these two are the specific cause. Faster injection increases pressure in front of a flow front. Lower speeds allow gas more time to escape through vents.

Understanding flow-front performance and being able to make process adjustments are often key to any process correction.

RELATIONSHIP TO VISCOSITY

The movement of any flow front has a direct relationship to the viscosity of the material. Each base material has its own flow-front characteristics. Heat plays an important role in flow-front performance. Higher temperatures lead to a thinner flow front, which results in faster fill times and lower pressures during fill and peak pressure at transfer. Lower temperatures are prone to slower fill times and higher pressures during injection and peak pressure at transfer.

OVER/UNDER PACKING OF DETAILS

Ribs, tabs and other details also can be affected by flow-front performance. The faster a flow front passes over this type of detail, the less plastic is packed into the detail during flow. Fast flow over a detail can cause shorts or burns, and a flow that moves too slowly can lead to overpacked and/or sticking part areas. An analogy to

help understand this process is to picture someone throwing a 5-gallon bucket of water towards a ditch. Quickly throwing the water toward the ditch will result in less water actually going into the ditch. Throwing the water more slowly toward the ditch, however, results in more water finding its way into it.

INJECTION PROFILING

Profiling injection is a great tool for establishing at what position a flow front is performing poorly, leading to a defect condition. Verify that the process itself has been decoupled first, yielding a 95-98% full part with no hold or pack added. Divide the required shot size by 5, creating 5 stages of injection. Identical injection speeds work best during this procedure. Set your injection speed at 0 one position at a time, starting with the inject position closest to transfer. Lay the resulting parts on top of each other as you change each profile speed to zero. This will help you to see precisely how the flow front moves, providing you with data to make injection-speed adjustments based on where the flow front would be during each injection stage.

Our molding predecessors taught us to think like plastic moves. Flow-front behavior and corrections are key to solving many common molding problems. Even complex molding issues can be corrected by changing flow-front action. Reviewing the flow front's movement will not only give us potential solutions to many of the defects we'll be forced to correct, but understanding the actions of a flow front can also be key to developing validated processes that will be free of scrap.

Understanding flow-front behavior can help molders address a variety of surface defects, such as weld lines. (Photo: Tony Deligio)

ABOUT THE AUTHOR: Garrett MacKenzie is the owner/editor of *plastic411.com* and a consultant/trainer in plastic injection molding. He has provided process-engineering expertise to many top companies, including Glock, Honda, Johnson Controls and Rubbermaid. Garrett also owns Plastic411 Services, which provides maintenance & training support to Yanfeng Automotive Interior Systems, IAC, Flex-N-Gate and other top automotive suppliers. Contact: *garrett@plastic411.com*.

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EXTRUSION

Extruder Alignment: Important, but Only Half the Equation

The other half? Aligning and supporting downstream equipment. Here are best practices.

By Jim Frankland

I wrote about the importance of extruder barrel alignment and how it should be done several years ago, but aligning the extruder barrel is not the whole solution. The downstream equipment must also be aligned and supported properly to maintain the properly aligned barrel.

After breaking a screw, a client of mine brought in a competent company to align the barrel. But the new screw lasted all of three weeks. Upon startup one day, the screw broke, and in the process also heavily damaged the barrel, requiring its replacement as well.

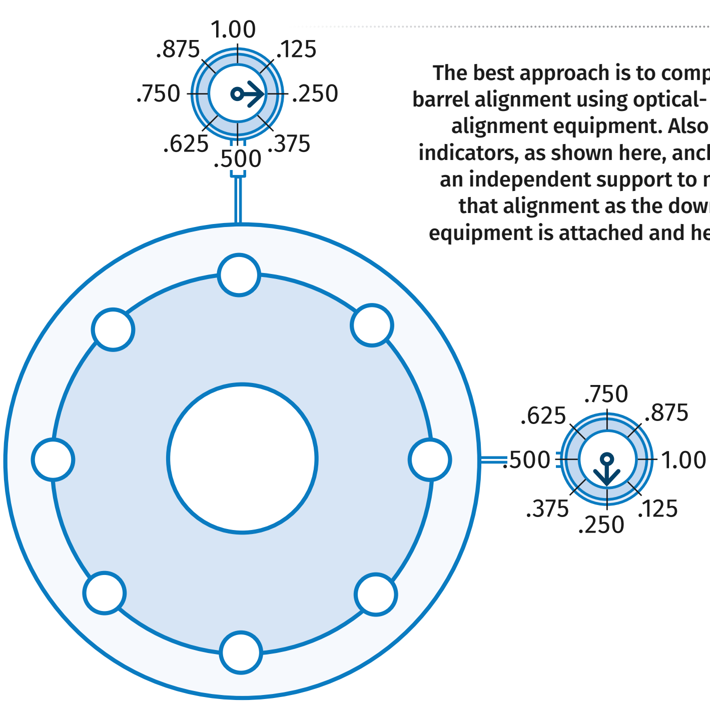
I was asked to be there for the startup with the new barrel and screw. The extruder was started and I immediately heard a grinding sound and noticed a large fluctuation of the drive amps. I had the extruder shut down immediately and asked how they had lined up the downstream components to the extruder.

The screen changer was a double-piston type and weighed about 4000 lb. Although it was supported in a stand on rubber casters, the floor was very uneven, and the installers had simply pushed the flanges close together and then used the bolts to pull the screen changer into its position on the barrel with no regard for its effect on the barrel alignment.

Barrel alignment is not just a matter of lining up the barrel itself, but maintaining that alignment after the whole system is assembled.

Next was the melt pump, which weighed about 1750 lb without the drive motor and reducer. Again, the unit was on a stand with rubber casters, but the installers had once more made no effort to align it. Instead, they simply pulled it into place against the screen changer and used the bolts to draw it into position. Finally the die was coupled to the melt pump with the same procedure on a similar stand.

I instrumented the extruder barrel flange with two dial indicators mounted at 90° to one another, as shown in the accompanying illustration. As the screen changer was loosened from the barrel, the vertical dial indicator showed a rise in the



The best approach is to complete the barrel alignment using optical- or laser-alignment equipment. Also put dial indicators, as shown here, anchored to an independent support to maintain that alignment as the downstream equipment is attached and heated up.

barrel of 0.255 in. and the horizontal indicator showed a lateral movement of slightly over 0.100 in.

Obviously, that totally destroyed the alignment of the barrel to the drive quill, and the resultant bending and repositioning of the barrel caused severe contact between the screw and the barrel bore. The point here is that barrel alignment is not just a matter of lining up the barrel itself but maintaining that alignment after the whole system is assembled.

The best approach is to complete the barrel alignment using optical- or laser-alignment equipment, then put dial indicators anchored to an independent support to maintain that alignment as the downstream equipment is attached and heated up. Not only will the mechanical attachment of downstream equipment affect the alignment, but the heating-up phase is also important, as the downstream components and the barrel itself can change position substantially as thermal expansion affects the entire assembly. The only way to determine if the alignment is being altered when completing assembly of the line is to instrument the barrel flange.

The only way to determine if the alignment is being altered when completing assembly of the line is to instrument the barrel flange.

This is a very simple procedure and should be used every time the downstream equipment is reinstalled on the barrel, even if the downstream equipment is mounted on steel rails. The longer the barrel and the heavier the downstream equipment, the more care should be exercised in reassembly of the line. In the case noted, it would have saved two screws and barrels, along with the associated downtime. Estimated total cost was in the hundreds of thousands of dollars.

Scan for more expert advice in extrusion.

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

“The project, installation and startup teams were fantastic.”

> Darryl Lawrence, LTM Plastics

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TOOLING

How Do You Estimate Cycle Time?

Molders price jobs based on *estimated* press time, and that is where you can either be very profitable or lose your shirt. But there's a new, free resource to help you out.

By Jim Fattori

The best place to start answering the question posed in the title is to restate what I said in my January 2022 column:

Many of you know the age-old saying in our industry that that we don't sell molded parts — we sell press time. That's not entirely true. The fact is, we sell *estimated* press time, and that is where a molder can either be very profitable or lose his shirt.

At the very start of any project, before a mold is even built, or before a molder receives an existing mold from a customer, the parts need to be quoted. The question is, "Who does your quoting?" From my experience, most jobs are quoted by a project manager — someone who has a basic or, better yet, a good understanding of molds and molding. Someone who has been around the block a few times.

Molders must be critical of estimated cycle times.

But I frequently see these experienced people getting on in age and eventually retiring to sunny Florida. Quoting is not something that's taught in any school I know of. So, it is often up to the retiring expert to train their replacement. That rarely works out well, and usually ends up being a baptism by fire — at the company's expense.

There are at least 14 different factors to be considered when estimating the cycle time. Instead of rehashing them here, they are well covered in my February 2021 column, "Get Better at Quoting Injection Molded Parts — Part 3." Of those 14 factors, only the cycle time is an estimate and, all too often, a guesstimate. Even if a flow analysis is performed, the cycle time is still a guesstimate.

While a flow analysis may be able to give a fairly accurate prediction of the required fill time and cool time, it cannot predict how well the mold, the machine and, in many cases, the operator, will function. It also can't predict how well the process will be established on any given machine – especially an older model.

Scan for more expert advice in tooling.

Therefore, the goal in quoting any injection molded part is to be very critical of the estimated cycle time and add a small percentage to cover any unforeseen issues without pricing yourself out of the job.

The overall cycle time of a mold is the combined times of the 11 components listed below.

- Mold-closing and lock-up time.
- Fill or inject time.
- Pack and hold (gate freeze or unfreeze) time.
- Screw delay or suckback before rotation time (pre-decompression).
- Screw recovery and plastication time.
- Screw decompression or suckback after rotation time (post-decompression).
- Cooling time.
- Cooling delay or idle time before mold-opening time.
- Mold-opening time.
- Part eject (and robot capture) time.
- Ejector (and robot) retract time.

I don't care how good you are, no one ever considers all these factors when estimating a mold's cycle time. I never did. But I knew they were important. So, I spent a fair amount of time writing an easy-to-use Excel program to help me estimate cycle time. I offer this program for sale on my website.

But for various reasons, I've decided to share it with my fellow *Plastics Technology* readers — for free. After writing the program, I tweaked it by entering the values of dozens of existing molds with known cycle times. As a reality check, I then had a few processing friends of mine do the same. Is it accurate? In most cases it is very accurate — maybe ±15%, which is often much better than most guesstimates.

But you be the judge. Search for this article on ***ptonline.com*** and download the program.

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Fattori's Cycle Time Approximator

Part Name: Widget | Material Type: Rigid PVC | Date: 11/4/22

			0 to 125 Tons	126 to 250 Tons	251 to 375 Tons	376 to 500 Tons	501 to 750 Tons	751 to 1,000 Tons	Estimate
Press Tonnage:				X					
Material Type	Crystalline	X	-1.50	-1.75	-2.00	-2.25	-2.50	-2.75	-1.75
	Amorphous		1.00	1.50	2.00	2.50	3.00	3.50	0.00
Shear Sensitive	No	X	-0.25	-0.50	-0.75	-1.00	-1.25	-1.50	-0.50
	Yes		0.50	0.75	1.00	1.25	1.50	1.75	0.00
Operation	Automatic	X	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Semi-Auto		5.00	6.00	7.00	8.00	10.00	12.00	0.00
Automation	Picker		1.00	1.50	2.00	2.50	3.00	3.50	0.00
	Robot		2.00	2.50	3.00	3.50	4.00	4.50	0.00
Runner System Type	2-Plate	X	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3-Plate		0.50	1.00	1.50	2.00	2.50	3.00	0.00
	Hot Runner		-0.50	-0.75	-1.00	-1.25	-1.50	-1.75	0.00
	Valve Gate		-1.00	-1.25	-1.50	-1.75	-2.00	-2.25	0.00
Mold Core Material Type	Ferrous Steel		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Stainless Steel	X	0.50	1.00	1.50	2.00	2.50	3.00	1.00
	Alum or BeCu		-0.50	-1.00	-1.50	-2.00	-2.50	-3.00	0.00
Cams / Slides Travel Length	< 2" Stroke		1.00	1.25	1.50	1.75	2.00	2.25	0.00
	2 - 4" Stroke		1.25	1.50	1.75	2.00	2.25	2.50	0.00
	> 4" Stroke		1.50	1.75	2.00	2.25	2.50	2.75	0.00
Unscrewing	Rack & Pinion		3.00	3.50	4.00	4.50	5.00	5.50	0.00
	Hydraulic Motor		4.50	5.00	5.50	6.00	6.50	7.00	0.00
Fill Time (95-99%) - Shot Size	Small	X	1.00	1.50	2.00	2.50	3.00	3.50	1.50
	Medium		2.25	2.75	3.25	3.75	4.25	4.75	0.00
	Large		3.50	4.00	4.50	5.00	5.50	6.00	0.00
Gate Freeze - Gate Size	Small	X	1.25	1.50	1.75	2.00	2.25	2.50	1.50
	Medium		3.50	3.75	4.00	4.25	4.50	4.75	0.00
	Large		6.75	7.00	7.25	7.50	7.75	8.00	0.00
Screw Retract - % of Barrel	5-25%		1.50	2.00	2.50	3.00	3.50	4.00	0.00
	26-50%	X	3.00	3.50	4.00	4.50	5.00	5.50	3.50
	51-75%		4.50	5.00	5.50	6.00	6.50	7.00	0.00
	76-99%		6.00	6.50	7.00	7.50	8.00	8.50	0.00
Cool Time - Thickest Wall Section	.040" - .060"		2.00	2.50	3.00	3.50	4.00	4.50	0.00
	.061" - .080"		4.00	4.50	5.00	5.50	6.00	6.50	0.00
	.081" - .100"		7.00	7.50	8.00	8.50	9.00	9.50	0.00
	.101" - .120"	X	11.00	11.50	12.00	12.50	13.00	13.50	11.50
	.121" - .140"		16.00	16.50	17.00	17.50	18.00	18.50	0.00
Eject & Retract (Pins or Stripper)	< 2" Stroke	X	0.75	1.00	1.25	1.50	1.75	2.00	1.00
	2 - 4" Stroke		1.00	1.25	1.50	1.75	2.00	2.25	0.00
	> 4" Stroke		1.25	1.50	1.75	2.00	2.25	2.50	0.00
Ejection Actuation Method	Press KO	X	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Bolts or Chains		1.00	1.25	1.50	1.75	2.00	2.25	0.00
	Hyd. Cylinders		1.50	2.00	2.50	3.00	3.50	4.00	0.00
Open, Clear & Close	Hydraulic	X	3.50	4.50	5.50	6.50	7.50	8.50	4.50
	Toggle		3.00	4.00	5.00	6.00	7.00	8.00	0.00

The approximate cycle time is: 22 seconds

This spreadsheet is a simplistic method of approximating the cycle time of an injection molded part. It can be used as a reality check or to compare with the results of flow analysis or the prediction of someone with years of experience.

Directions: Enter an "X" in the orange cell to the left of the Press Tonnage Range you expect to use. Then enter an "X" in the light-blue cells for each applicable aspect of the part, mold and press you are estimating. The "X"s that are entered at left are for example purposes only.

If you are not using any automation, cams or unscrewing mechanisms, just leave those blue cells blank. If necessary, you can modify the time values in any of the cells to better suit the part, machine or process you are approximating. If the part has a wall thickness less than 0.040 in. or greater than 0.140 in., you should consult the material supplier. Being able to fill out thin-walled parts or eliminating voids in thick-walled parts requires careful consideration.

Source: InjectionMoldConsulting.com

How to Improve Quality with Offline Inspection and Analysis

Automated sample testing with a light table detects the smallest contamination in flakes, micro granulates and sample test sheets.

SIKORA's new automated light-table system for enhanced offline inspection and analysis of plastic samples. (Photos: SIKORA International Corp.)

By Alexander Nguyen
SIKORA International Corp.

Quality requirements for manufacturing and processing of plastics are continuously increasing and becoming more complex. In addition to continuous online monitoring of the production process by pellet inspection and sorting systems, periodic offline sample testing of material is required in order to ensure consistent quality from the raw material to the final product.

Manual light tables, or early versions of automated visual inspection devices, were accepted standards in the plastics industry. However, these methods posed challenges for the operator, as the quality of their inspection was determined by their focus and vision.

Offline inspection and analysis provide material manufacturers and processors with key information on contamination, the causes of contaminants, and on their own production process.

A technology developed to combat these challenges combines the advantages of manual visual inspection with automated material sample control. The automatic light-table system automatically detects and visually displays contamination from 2 mil (50 µm) size and evaluates it statistically. The contamination is clearly identified and located, and follow-up inspections are possible at any time. The system is more precise, faster, reproducible and reliable than the previously accepted standards. As such, it has been shown to contribute significantly to quality control and efficient process optimization.

Moreover, the system offers a broad range of applications. Flakes, micro granulates and sample test sheets can be inspected on the sample tray. The tray has a width of 11.6 × 8.3 in. (295 × 210 mm). Approximately 0.22 lb (100 g) of pellets can be inspected and analyzed per run, which corresponds to up to 3300 pellets with a size of 0.16 × 0.16 × 0.16 in. (4 × 4 × 4 mm). In addition to its analysis potential for determining root causes and process control in laboratory settings, the system is suitable for incoming goods inspection due to its quick (within seconds) automatic analysis, as well as for outgoing goods in order to compare the quality with customer requirements.

MEETING CHALLENGES OF QUALITY STANDARDS

Quality standards in the plastics industry present great challenges for manufacturers and processors. Inspecting and analyzing raw material before it enters the production process is an industry standard, designed to protect the end-user from any contaminants that can compromise the integrity of the final product.

To ensure the highest quality of their materials, some plastic manufacturers use online inspection and sorting systems. The online systems inspect the material, detect contaminants, colored anomalies and inhomogeneities in the ongoing production process, and they will then automatically sort out contaminated material. The online systems have optical and possibly X-ray abilities to find and sort out contaminated product.

Additionally, systems for periodic sample testing, incoming goods inspection and analysis of plastic material are often used. This offline inspection and analysis provides material manufacturers and processors with key information on plastic contamination and the causes of contaminants, as well as on their own production processes. Therefore, optical testing is essential for advanced production lines processing plastics.

Plastics, as they are used in the medical sector, aerospace or automotive industries, require very high quality standards as well as reliable control and processing. Contamination may occur during different steps of the plastic product production process.

During pellet extrusion, for example, black specks can occur in the material due to temperature peaks. If the contaminated pellets enter the production process, the absolute purity of the final product is no longer guaranteed — sometimes with severe consequences. During the production of medical tubing, contaminants in the raw material can lead to a full loss of production. Before production may start again, the whole production line must be shut down, cleaned and restarted. The purity of the plastic pellets is also critical in injection molding plants. Contaminated material can clog hot runners, which has the potential to necessitate the mold being shut down, removed and cleaned.

QUESTIONS ABOUT TESTING?

Learn more at PTonline.com

Navigate to Testing under Processes at the Top Navigation Bar.

MANUAL LIGHT TABLES & AUTOMATED OPTICAL INSPECTION SYSTEMS

Established technologies for sample testing, inspection and analysis of plastic material include manual light tables and automated optical inspection systems.

Manual light tables are commonly used in the industry for visual sample testing and incoming goods inspection of plastic material. The material to be inspected is illuminated from under a clear table and manually inspected for contamination by an operator. This time-consuming method can take anywhere from 10 min to over 30 min, depending on what the pellets are being inspected for.

The accuracy of locating and discarding contaminated pellets depends on the individual operator. A person's ability to find contaminated pellets on a light table could be limited due to factors such as personal feelings, experience, and available time on that particular day, which can influence the results and repeatability of the test. Reflective and highly transparent pellets further complicate manual visual inspection, because contamination in the pellets can be difficult to see. Additional limits include the detectable sizes of contamination for the human eye as well as their classification into size classes.

Operator manually inspects pellets on a light table.

Alternative offline optical inspection devices available on the market feed the sample material through a hopper and channel it into an inspection area while pictures of the contaminated material are taken successively. Direct comparisons of the contaminated pellets to the pictures taken, as well as a follow-up inspection, are not possible. These alternative optical systems are designed differently from the newly developed automated light table and do not have a method or software capabilities to match up the pictures with the actual contaminated pellets.

As such, the user would have pictures of the contaminated pellets but not the pellets themselves to review. In contrast, after examination of the pellets, the automatic light table will have a picture of each contaminated pellet that can be directly correlated to the contaminated pellet. That individual pellet can be removed from the tray and inspected further as needed. This ability with the automated light table will give the user the possibility of finding the root cause of the contamination.

HOW IT WORKS

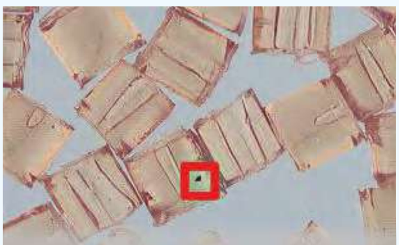
The combination of a visual light table and automatic sample testing, better known as an automated optical inspection system, allows for direct comparison and follow-up inspection of the contaminated pellets. The operator places the test material on a sample tray. The automatic light table transports the tray with the material through the inspection area, which is equipped with a CMOS line-scan color camera.

The inspection takes place automatically and within seconds. The automatic optical inspection system contains a projector that illuminates the contaminated material directly on the sample tray. Simultaneously, it is displayed and marked on the monitor, including information on the size and area of the contamination. By analyzing the images, contaminants such as black specks and discoloration, starting from 2 mil (50 µm) size, are automatically detected, visualized and analyzed. The system can be used with transparent, translucent or colored/opaque material. A recent user of the new system said, "Our operators are very pleased that the system has reduced their eyestrain and eliminated the uncomfortable position of looming hunched over the light table. The standardized method of inspection with the system brings us confidence that nothing is being overlooked."

During production of medical tubing, contaminants in the raw material can lead to a full loss of production.

The automatic optical inspection and analysis system contains software for detection, visualization and evaluation of contamination. The software includes an image gallery of detected contaminations, as well as statistics regarding their size, area and number. Furthermore, previously inspected material can be imported for follow-up analysis or compared with other prior sample tests with regard to amount of contamination or color deviation.

Examples of discoloration in flakes detected by optical technology.

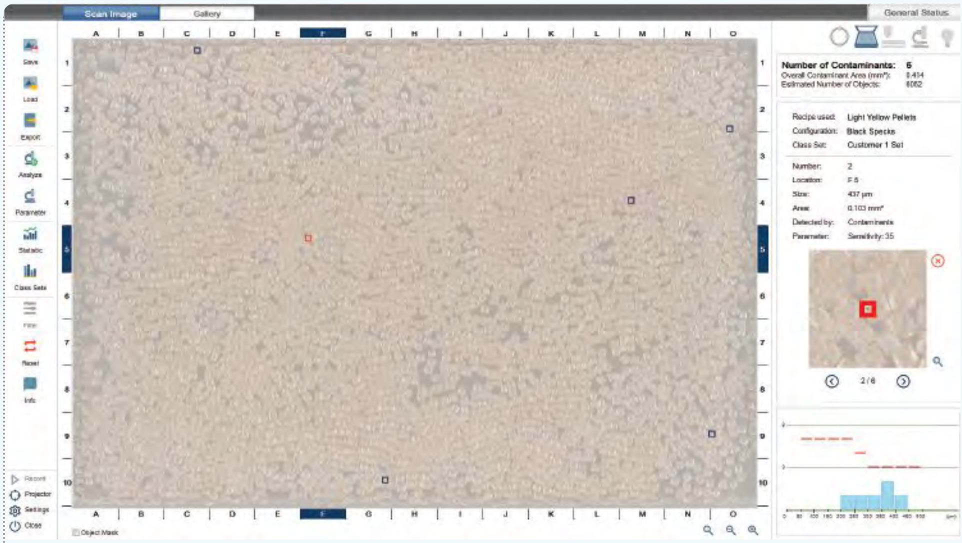


Black speck in a pellet is one type of contamination detected by optical technology.

The inspection and analysis system can be integrated into the company network via a LAN interface to export and process collected data. The data provides the users with comprehensive information about the process and the material quality. For example, by establishing a central and constantly updating database, conclusions regarding sources and causes of contamination are possible. On this basis, existing processes in the company or at suppliers can be optimized to ensure comprehensive quality control. These automated systems are appearing in manufacturing facilities, compounding plants and at recyclers. They give the operators in these industries a quick look at the quality of their pellets.

Another similar automated system allows the user to detect metallic contamination inside of non-transparent, colored and transparent plastic material. During production of the plastic pellets, chips or flakes of metal can become imbedded in the pellets. This metal contamination can present major difficulties within the medical, electronics and automotive industries.

Like a medical X-ray, this system sends an X-ray through the pellets to find any metallic contamination inside the pellet. The pellet material and the metal absorb the X-rays at different levels. The metallic contamination embedded into the pellet absorbs more X-rays than the plastic material surrounding it. The X-ray receiver measures the amount of X-rays absorbed by the material and the metallic contaminant. The system's software can analyze and determine that a metallic particle is present in the pellet. Individual metal-contaminated pellets can be removed from the sample tray and magnified offline for a closer look. At the same time, they are marked by a pointing system with lighted crosshairs on the sample tray. A clear location



Color camera image of pellets show marked contaminants with selected pellets highlighted in color and zoomed-in.

Detected contamination is highlighted in color. Pellets that are selected on the monitor are visualized on the sample tray by crosshairs.

of the contamination and follow-up inspection are always possible and allow for new insights regarding quality assurance, quality control and the production process.

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EXTRUSION | PRINTING | CONVERTING
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How Additive Manufacturing Can Help, not Hinder, Injection Moldability of New Designs

Four cost drivers — design for moldability, mold-base size, internal componentry, polish/custom finishing — dictate the financial and processing success of a molded part design. Learn how 3D printing can assist this process, while also understanding its potential pitfalls.

By Rob Young
Protolabs

Ten years ago, there was a broadly accepted and well-defined route that a product developer might travel to take a product from concept to actual part. Generally, that path would include 2D and 3D drawings of the components and their assembly, which would go through various prototyping stages in low-cost, low-volume manufacturing methods like CNC machining or cast urethane molding. Then the design would go into a more robust prototype rapid-tooling process and finally off to production.

Today, this is still a common and viable route, but thanks to technological advances in 3D printing materials and processes over the last decade, product developers now have far more real-world, engineering-grade options to consolidate and accelerate the early stages of product development. This has been a game changer for tech innovators over the years, but it also features some potential hidden pitfalls.

While injection molding remains the undisputed champion of high-volume plastics manufacturing — and is likely to hold that position for the foreseeable future — 3D printing is rapidly making up ground in early-stage plastics manufacturing. Due to the different manufacturability constraints that exist with each respective process, part designers and molders can sometimes experience a disconnect between where they are in the process and how they want to manufacture a part.

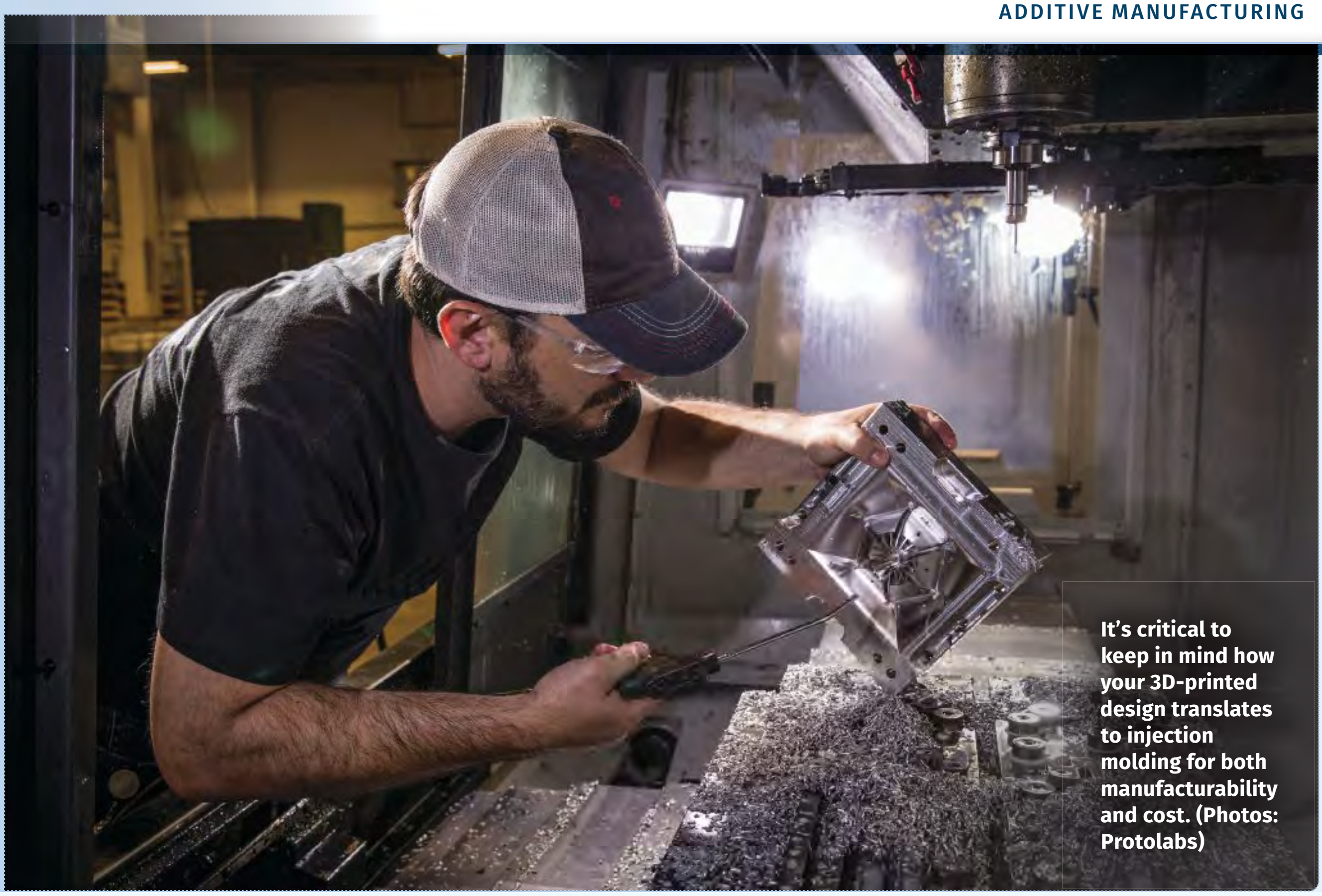
When comparing potential manufacturing processes against criteria like price and lead time, there are many things to keep in mind. Each process requires different processing times, different types of materials and, most importantly, different part-design requirements and considerations. This article specifically covers part-design cost drivers. But first, let's talk about a common cross-process design challenge that we at Protolabs see every day as one of the world's largest injection mold manufacturers.

Virtually all moldable parts can be printed, but that isn't true the other way around.

DESIGNING FOR MOLDABILITY: A CAUTIONARY TALE

Dexter is an engineer. He has an ingenious design solution to convert a five-part housing into two parts and save hundreds of thousands of dollars on tooling costs in production. Dexter designs the parts and sends them to his favorite 3D printing company to print the parts in SLS so he can do fit/form/function testing prior to tooling up the parts. When he receives his shipment, he's ecstatic to find that his parts work wonderfully, and should be a perfect functional solution to his design problem.

Now that he's ready to start moving into tooling stages, he quotes the parts for injection molding and *bam!* He's told none of



It's critical to keep in mind how your 3D-printed design translates to injection molding for both manufacturability and cost. (Photos: Protolabs)

them is moldable. Dexter hangs his head in shame, walks back to his desk and starts to redesign the parts for moldability. This all-too-familiar tale represents the first of the four major cost drivers that this article will lay out. It is also arguably a root cause for many other cost drivers as well.

NOT STARTING WITH THE PROCESS IN MIND

Dexter started with the solution in mind but didn't consider the process. As 3D printing has become more and more popular — for good reason — many product developers are implementing it in stages that previously might have been completed in a different process. This is perfectly fine, if you keep in mind that 3D printing has far fewer design constraints than injection molding. The solution is to start by designing your part for molding, then take those moldable part designs and print them. Virtually all moldable parts can be printed — but that isn't true the other way around. When you try to mold a part designed exclusively for 3D printing, your best-case scenario is that the manufacturer probably had to include many costly mechanical components in the mold in order to accomplish it. The worst-case scenario is that it just can't be done.

Keep in mind that 3D printing has far fewer design constraints than injection molding.

MOLD-BASE SIZE

Our second cost driver is the base size of the mold. This is a common point of confusion in the manufacturing process, as it isn't always evident how large or small the mold base is. For example, you might be able to make a 1 × 1 in. (25.4 × 25.4 mm) part in a straight-pull mold within a 4 × 4 in. (101.6 × 101.6 mm) mold base. Add an undercut to that part, requiring a side-action cam in the mold, and suddenly you might be into a 10 × 10 in. (254 × 254 mm) or larger mold base. In this case, base size and componentry drive mold cost. A single side action might add more than $1500 to the mold cost, so you should use best practices in design, such as pass-through cores, to help you save on space and components.

INTERNAL COMPONENTRY

We touched on this in our first two cost drivers, but outside of improper design and mold size, internal componentry is the key cost driver in an injection mold. What types of internal componentry? As we previously discussed, side-action cams are an obvious example. Some other examples include pick-out inserts, bolt-in inserts or steel core pins. Cams or inserts will typically increase your overall mold price by $1000 to $2000 per component, so keep that in mind in your designs. ►

Custom mold finishing helps bring cosmetic enhancements to molded parts.

POLISH OR CUSTOM FINISHING

Our last cost driver is polish or custom finishing for the mold. Most manufacturers will offer a range of finishes to choose from for your tools, including in-house, SPI or Mold-Tech equivalent, and they all have varying degrees of additional costs associated with them. In-house finishes will usually be the cheapest and are sometimes automated or come with the tool as milled.

These are great for prototype parts to test fit/form/function but might not carry the aesthetic properties needed for a production part. SPI or Mold-Tech equivalent finishes tend to be more expensive, so a good way to save time and cost is to wait to put these cosmetic finishes on the mold until after your design is finalized. Follow these tips, and you're ready for production, regardless of whether and how you utilize additive manufacturing in developing your injection molding part and process.

ABOUT THE AUTHOR: Rob Young is a product leader for injection molding at Protolabs. He has more than eight years of experience in digital manufacturing and specializes in on-demand production and supply-chain optimization for Industry 4.0. Young worked in applications engineering before holding multiple leadership roles working with customers. He came to Protolabs after working with early-stage startups at the Ina Mae Rude Entrepreneur Center and Center for Innovation Tech Incubator in Grand Forks, N.D. Contact: rob.young@protolabs.com; (877) 479-3680; **protolabs.com**.

Keeping Up With Technology

PRODUCT FOCUS **Additives**

ADDITIVES

Flame-Retardant Synergist Masterbatches

New masterbatch forms of its Adins flame-retardant additives were launched at K 2022 by Tolsa S.A. These additives act as synergists with halogen and halogen-free flame retardants. They are reportedly are suitable alternatives to antimony trioxide, whose safety is under regulatory study due to toxicity and carcinogenicity concerns. Tolsa has started to commercialize new masterbatches for EVA, TPE/TPU and CPE in wire and cable.

ADDITIVES

Copolymeric Flame Retardants for E/E Uses

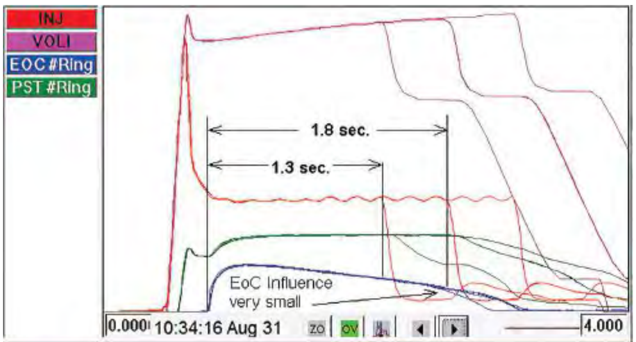
The first of a new line of advanced copolymeric flame retardants for consumer electronics and appliances from FRX Innovations is said to expand the capabilities of the company's Nofia family of non-halogen polymeric flame retardants and needs no drying prior to processing. Nofia CO6010-EX polyphosphonate fills a gap in the current portfolio by targeting a growing need for PC, PC/ABS, and PC/ASA in applications where neither brominated flame retardants or perfluoro butyl sulfonates can be used.

Besides no drying requirement, unlike previous Nofia grades, this new range also boasts much lower initial color. The exceptional heat distortion and physical properties of Nofia flame retardants have long been desirable in UL 94V-0, or VTM-0 formulations, but now processing reportedly is simpler, impact resistance is improved, and the new material offers the ability to meet the bluer shades of white required for certain brands of electronic equipment and electrical appliances. Like other Nofia products, CO6010-EX is said to provide improved resistance to chemical cleaners and permanence when compared with standard non-polymeric, phosphorus-based flame retardants.

INJECTION MOLDING

New Graph Interpretation Course for Injection Molders

RJG has introduced a three-day Graph Interpretation Course for injection molding in support of the Decoupled Molding process the company trains for and supplies equipment for. Designed for technical and non-technical personnel involved in thermoplastic injection molding, the new course provides both classroom and hands-on training, covering practical applications that introduce the principles of Decoupled Molding and the curves associated with such processes.



Areas covered include how graphs work, graph scaling, overlays and templates, cycle graphs, summary graph data, bar graphs, alarms or limits for abnormal cycle detection, and identifying mold, machine and process issues using curves. RJG recommends that attendees have a basic understanding of the injection molding process.

INJECTION MOLDING

AI-Based Injection Molding Assistant Launched

LS Mtron Injection Molding Machines has introduced artificial intelligence (AI) based Molding Assistant and Smart Weight Control. The AI Molding Assistant reportedly can reduce the time to stabilize the initial molding setup by learning and imitating the behavior of highly skilled molding specialists via AI. It can learn optimal conditions when setting the initial molding process, and once programmed, it can set and repeat the optimized molding process.

Smart Weight Control uses the machine's software to calculate and then correct weight differentials. A real-time weight scale can be added to log the actual part weight into the machine's AI system.

BLOW MOLDING

Energy-Saving Accumulator-Head Machine

At K 2022, ST BlowMoulding SA of Italy introduced the AX 880 accumulator-head blow molder. Unlike the company's ISIT and TA Series accumulator-head machines, the new model has an all-electric clamp; it also has electro-hydraulic parison push-out, along with the company's trademark adiabatic extruders. These extruders are said to generate gentle plasticating without melt overheating, so no cooling fans are needed. On the contrary, double-layer thermal insulation on the barrel reportedly cuts heat losses by 90% compared with a conventional extruder. The new machine thus reportedly outperforms the maximum energy-efficiency class 10 under Euromap 46.1 (< 0.29 kWh/kg processed), even among large industrial extrusion blow molders.

The new machine is offered with clamp capacities of 80 or 100 metric tons and accumulator heads from 10 to 25 liters. The series will also include two smaller models (AX 440 and AX 560) and one larger (AX 1313). All have the electric clamp, in which locking force is electronically checked and tuned on every cycle to ensure repeatability and consistency. The clamp is adjustable to accommodate molds with a wide range of stack heights. Parison push-out utilizes a variable-speed pump without hydraulic accumulator to push out the parison directly.

An optional feature on the AX Series (ER version) is rollout of the upper deck for simultaneous changeover of the head tooling and the mold. It clears the area above the clamp for mold handling from the top and moves the extrusion head to one side for easy and safe access. The AX Series also introduces Automatic Head tooling Changeover (AHC), described as a "revolutionary" device for quick changes with no tools, no screws to be loosened and tightened, and no human effort. The operator stands at a safe distance and presses a few keys on a portable keypad to control each step of the sequence.

BLOW MOLDING

Small Electric Shuttle Debuts

At K 2022 Uniloy Inc. introduced the UCS10.ED, a double-station, 10-metric-ton model that completes the all-electric UCS.E series of continuous-extrusion shuttles, introduced last year, which runs up to 30 m.t. This is the smallest in the series; it can make products from 50 ml to 5 L in two to six cavities. On display was a Coex 3 version configured for three-layer coextrusion with a head designed and built by Uniloy in a 20/60/20 configuration to save color masterbatch cost and provide flexibility in processing PCR. Together with Uniloy extruder screws, the head allows for up to 100% PCR in the middle layer.

The new model boasts one of the smallest footprints on the market, Uniloy says, and allows easy access with wide safety doors for setup, maintenance, and changeovers. The machine, with electric-driven 2D takeout system and linear conveyor, can be shipped as a single body, without disassembling the frame.

The UCS.E series includes a new control system with Uni-Smart interface and Industry 4.0 connectivity via OPC-UA communications protocol.

EXTRUSION

Crosshead Die Features Single-Point Concentricity Adjustment

Guill Tool & Engineering has introduced an extrusion crosshead that uses micro-fine single-point adjustment screws for precise concentricity adjustment. One adjustment bolt controls 360° of adjustment with precision of concentricity reaching 0.008 in. or finer per revolution. This single-point concentricity adjustment is reportedly a unique innovation for extrusion of thin-walled jacketing and precision tubing. Features of the crosshead include a patented cam-lock deflector for quick change-overs, a residence time of 1 min at 0.5 lb/hr material flow, optimized usage with extruders measuring ½ in. and ¾ in., and a max die ID of 0.250 in.

Additionally, the new crosshead not only accepts both vacuum and micro-air accessories, but is also suited to pressure and sleeving applications. Fluoropolymer designs are available upon request.

COMPOUNDING

Next-Generation Pelletizers

Bay Plastics Machinery Inc. (BPM) unveiled what it calls the next generation of pelletizing technology at K 2022 in Düsseldorf. Two new products were on display.

First was BPM's new AXP (HD) system, designed for heavy-duty pelletizing applications. Offered in 12-in. and 16-in. cutting widths, the HD series features:

- Larger motors that provide more robust cutting for engineered resins and heavily glass-filled materials.
- A push-pull bed-knife holder to enable users to easily adjust the bed-knife gap so that the cutter is consistent from end to end.
- Larger-diameter rolls and bearings that reduce deflection across the cutting width.
- An optional gearbox that lets users engage both upper and lower feed rolls.
- Feed-roll air cylinders that are larger than standard so users can apply more clamping force as needed.
- An optional rotor-coupling drive that lets the rotor remain free of belt load with higher horsepower options.

BPM lso debuted the BT25X benchtop pelletizer for lab applications. It uses industry-standard AC motors and drives — the same as BPM's full production models. It features a streamlined version of the Safe Torque Off (STO) function found in full production models, so it is even safer to operate. A wider speed range enables slower or faster production than previously available, plus the BT25X now can run in batch or continuous mode. A lockable rotary disconnect has also been added as a safeguard when performing maintenance procedures.

Prices Flat for PE; Down for PP, PS, PVC; Up for PET

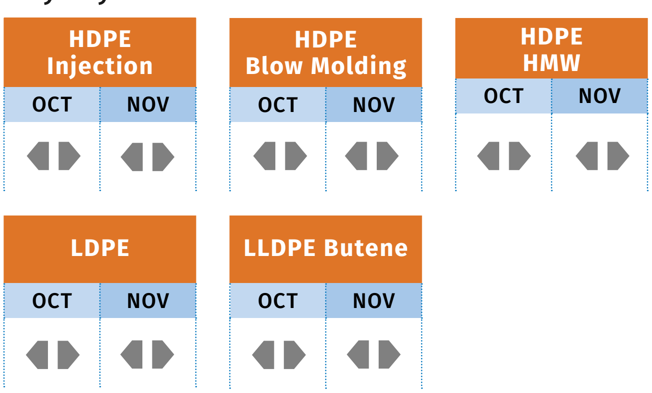
Prices for both polyolefins and PS seemed to be bottoming out as production rates were lowered.

By Lilli Manolis Sherman
Senior Editor

A halt in the pricing plunge for PE, PP, and PS appeared to be shaping up going into November, owing primarily to suppliers reducing their swollen inventories by throttling back production rates and, in the case of PE, multiplying attractive offers for exports and the domestic spot market. Still, first-quarter 2023 looks to be a buyer's market for all five major commodity resins.

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

Polyethylene Price Trends



Market Prices Effective Mid-November 2022

Resin Grade	¢/lb
POLYETHYLENE (railcar)	
LDPE, LINER	82-84
LLDPE BUTENE, FILM	75-77
NYMEX 'FINANCIAL' FUTURES	39
NOVEMBER	38
HDPE, G-P INJECTION	74-76
HDPE, BLOW MOLDING	69-71
NYMEX 'FINANCIAL' FUTURES	38
NOVEMBER	38
HDPE, HMW FILM	74-76
POLYPROPYLENE (railcar)	
G-P HOMOPOLYMER, INJECTION	53-55
NYMEX 'FINANCIAL' FUTURES	53
NOVEMBER	38
IMPACT COPOLYMER	55-57
POLYSTYRENE (railcar)	
G-P CRYSTAL	96-98
HIPS	104-106
PVC RESIN (railcar)	
G-P HOMOPOLYMER	75-77
PIPE GRADE	77-79
PET (truckload)	
U.S. BOTTLE GRADE	81-83

PE PRICES FLATTEN

Polyethylene prices for October appeared to hold even and were expected to be generally flat for the last two months of the year, according to David Barry, PCW's associate director for PE, PP, and PS; Robin Chesshier, RTi's v.p. of PE, PS, and nylon 6 markets; and The Plastic Exchange's Michael Greenberg. Reporting on one longtime market watcher's projections, Barry noted, "Don't expect any big price swings for several months." Meanwhile, suppliers notified customers they were postponing their increases of 5-7¢/lb from October to November, though these observers saw this move as mainly an effort to halt any further decline.

Contract prices fell a total of about 11¢/lb in the third quarter, with more dramatic price drops in the spot market. As October approached, spot prices began to stabilize. Going into November, Greenberg put it this way: "Spot PE prices were holding firm for three weeks in a row. Even as PE spot levels have seemingly found a floor, buyers continue to enjoy good availability for most grades near these yearly lows." He did note that some more niche grades, such as injection molding LDPE, EVA, POE and rotomolding resins had been in tighter supply, and have good underlying demand if better supplies surface.

Among contributing factors to the improved PE market balance, PE suppliers, after several years of high production rates, throttled back plant utilization rates to the low 70s percentile, in addition to offering lower-priced exports and spot material to bring down their high inventories.

Both PCW's Barry and RTi's Chesshier ventured that this relative stability might be shaken up within the first quarter, due to the substantial new capacity being brought on stream by Shell and Baystar, the new 50/50 joint venture between Borealis and Total Energies. Combined production will represent a 10% increase in annual domestic capacity. Noting that early 2023 will remain a buyer's market, Chesshier said that suppliers will face further challenges from lower global demand. As Barry put it, "The export packaging pipeline was viewed as a likely bottleneck for producer export sales in the coming months. Prices in Asia were softening as well-stocked Chinese producers lowered offers to stimulate demand and Southeast Asian markets followed the softer trend."

PP PRICES DROP SHARPLY

Polypropylene prices in October were on the way down by double digits, as propylene monomer contracts were expected to settle 9¢/lb to 11¢/lb lower, along with an expected margin contraction of 4¢/lb to 5¢/lb, according to PCW's Barry, Spartan Polymers' Newell, and The Plastic Exchange's Greenberg. The market was characterized as very well supplied, amid continued lackluster demand, despite suppliers throttling back plant operating rates to a low of 70%

For the November-December timeframe, these sources noted signs that prices were bottoming out, with flat to slightly lower pricing expected. "I think we have some visibility of a bottom forming with a little bit of further drop," said Newell. Barry saw potential for further price reduction in the fourth quarter, noting that demand in the global PP market was down and China was becoming a regular exporter of PP, the latest competitor for U.S. suppliers. At the same time, he ventured that it was possible that November-December propylene monomer prices would not drop any further. He did not anticipate any further margin contraction, though he said that could play a factor in 2023 PP price negotiations behind the scenes.

While suppliers have throttled back production, these sources say there is a lot of material to be had and that heavily discounted spot deals were on the table. There was also substantial new capacity coming on stream, with ExxonMobil starting up its new plant and Heartland Polymers readying its monomer and PP units. Greenberg confirmed that some PP suppliers were offering deeply discounted railcars for larger orders as they aimed for better positioning in first-quarter 2023. He reported that there was good ongoing demand for packaged truckloads from processors that had drawn down their stocks and now required more material, and from others waiting for late railcars to arrive.

Polypropylene Price Trends

Homopolymer	
OCT	NOV
15¢/lb	

Copolymer	
OCT	NOV
15¢/lb	

PS PRICES DOWN

Polystyrene prices in October looked to be heading down by 4¢/lb, bringing the total three-month drop in prices to 40-43¢/lb, and they could bottom out for the last two months of the year, according to both PCW's Barry and RTi's Chesshier. Both noted that demand was down but that suppliers had stayed on top of things by lowering production rates.

While an uptick in benzene contract prices of about 40¢/gal was expected in November, these sources predicted that PS suppliers might opt to give up some margin due to high volumes of imported PS. According to PCW's Barry, one resin distributor described the price gap between imported and domestic resin as "unsustainably large." RTi's Chesshier ventured that PS tabs could remain flat this month but may rise if benzene prices move up again. Meanwhile, the implied styrene cost based on a 30/70 formula of spot ethylene/benzene fell by nearly 2¢ to 36.2¢/lb going into November. Implied styrene costs have been hovering in the mid-30s since late August, according to Barry.

Polystyrene Price Trends

GPPS	
OCT	NOV
4¢/lb	

HIPS	
OCT	NOV
4¢/lb	

PVC TABS CONTINUE SHARP DECLINE

PVC prices in October were expected to drop another 5¢/lb following a cumulative drop of 15¢/lb in the previous three months. Moreover, similar decreases were expected for the last two months of 2022, which would bring the total decline in the second half of this year to 30¢/lb, according to Mark Kallman, RTi's v.p. of PVC and engineering resins and PCW senior editor Donna Todd.

The latter reported that PVC prices are forecasted to be flat in January, followed by a 2¢/lb drop in February and flat again in March, for a total decrease of 32¢/lb over nine months.

Both sources noted that falling PVC export prices have continued the downward pressure on domestic prices, along with increasing supplier inventories. However, Kallman reported that suppliers have exported a substantial volume of PVC and that Formosa had planned a shutdown of its Louisiana plant through November, which would perhaps result in a more balanced market. He noted that with the exception of wire and cable — the "most resilient market sector" — PVC demand is off in nearly all categories.

PVC Price Trends

Pipe	
OCT	NOV
5¢/lb	

Gen. Purpose	
OCT	NOV
5¢/lb	

PET PRICES UP, THEN DOWN

PET prices in October were on the way up by 3¢ to 4¢/lb based on an upward blip in feedstock costs, but were expected to drop again on the order of 1-2¢/lb in November-December. This would follow a decline of about 23¢/lb between July and September, according to RTi's Kallman. He characterized domestic demand as slower and the market as well supplied, with attractively priced exports continuing to arrive at a steady pace.

PET Price Trends

Bottle Grade	
OCT	NOV
3-4¢/lb	

Plastics Processing Contracts Again

October's reading marks four straight months of contraction.

By Jan Schafer
Director of Market Research

The Gardner Business Index (GBI) for Plastics Processing closed October at 45.9, down from 46.7 in September. The index is based on survey responses from subscribers to *Plastics Technology*. Indices above 50 signal growth; below 50, contraction.

All but one component contracted in October, including employment (just barely). The last time employment contracted was August 2020. New orders and backlogs contracted at faster rates, while exports and production contracted at about the same rates as in September.

Supplier deliveries continued to lengthen at a slower rate, landing in more typical pre-pandemic territory, suggesting supply-chain pains may be easing.

Overall business activity for custom processing again contracted more than total processing, closing October down almost three points at 41.

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

Gardner Business Index (GBI): Plastics Processing

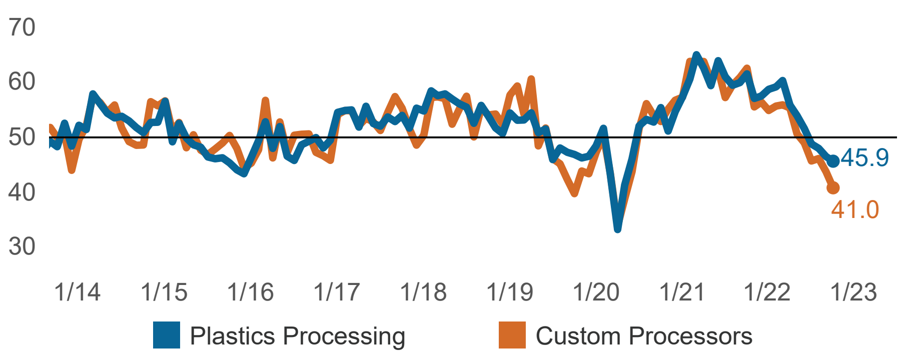


FIG 1

Plastics processing activity contracted again in October — slightly for overall plastics processing, which includes captive operations, and even more so for custom processors.

Key Components Contract

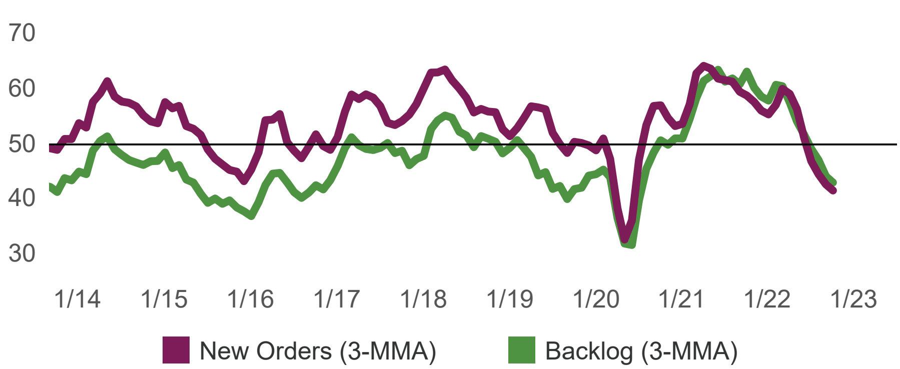
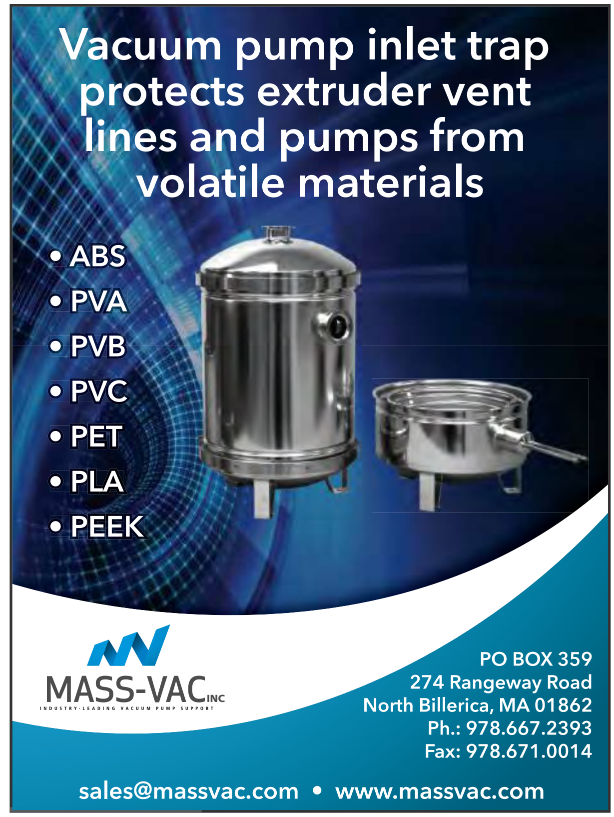


FIG 2

Four components contracting in September grew to five in October — most strongly in new orders and backlogs (3-MMA= three-month moving average).

SPECIAL SERVICES

EXTRUSION AUXILIARY EQUIPMENT



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PT Plastics Technology

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GROUPE PLASTIVALOIRE — AUBURN HILLS, MICH.

Warpage Waylaid Via Simulation

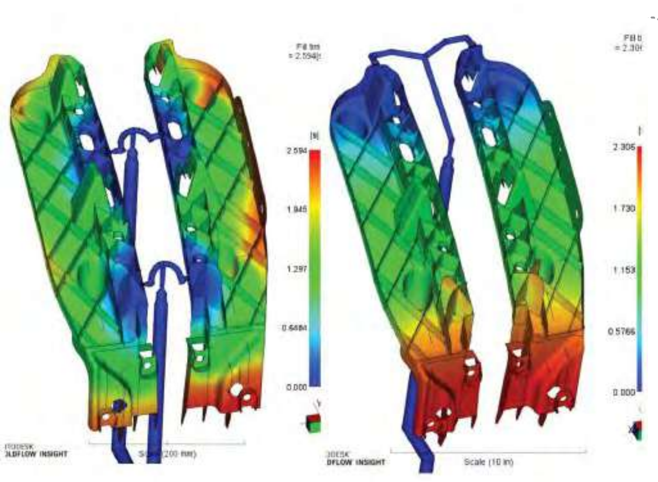
The mold was intended to produce a front-end automobile bracket. But the tool's real output was problems, until flow and warpage simulation provided solutions.

By Tony Deligio
Executive Editor

"That job was a headache from day one because we did not do a Moldflow analysis on it ourselves," explains Bill Hamilton. "Instead, we had the manifold supplier do it."

Tooling manager for Groupe Plastivaloire's North American operations, Hamilton works out of the Auburn Hills, Mich., office but he oversees operations at its nearby New Baltimore, Mich., facility which has 39 injection molding machines, as well as the Danville, Ky., plant, with 21 presses.

Groupe Plastivaloire specializes in large, complex molds, primarily for automotive parts, and molding components as large as bumpers and as small as air-duct actuators. Because of the high volume of molds built annually, Hamilton and his team now rely on simulation consulting expert CAE Services to provide upfront Autodesk Moldflow Insight analysis and consultation for projects. Groupe Plastivaloire undertook Moldflow analyses on more than 100 molds last year, but that wasn't always the case.



At left, the original design with two gates that ultimately led to unacceptable warp; at right, the revamped design with a single gate that met spec. (Photo: CAE Services)

Hamilton explains that before an acquisition brought three of the four plants under Groupe Plastivaloire in 2020, he worked for the former TransNav as a toolroom manager. TransNav had one seat of Moldflow software at the time, but Hamilton never fully trusted it, and the company eventually stopped using it in-house. Instead, it relied on its hot-runner suppliers to perform Moldflow analyses that Hamilton says were mostly effective but failed at times to address cooling or warpage issues.

When Hamilton was promoted to his current position at what was still TransNav, he was suddenly overseeing production of many more tools, and he reconsidered his Moldflow opinion. In retrospect, Hamilton said his previous mistrust of simulation results derived from the fact that his former company at times performed incomplete analyses that didn't apply all the software's capabilities.

At the urging of his new boss, Groupe Plastivaloire director of engineering Tim Nixon, CAE Services was called in to provide not only Moldflow analysis but also consulting for molds being designed and built. Nixon had longstanding experience with Mark Solberg and CAE Services. "As we started working with Mark and his team," Hamilton says, "we saw excellent results because they were doing a much deeper dive into the projects than I had seen done before."

Solberg explains that flow analyses conducted at manufacturing facilities and not by a simulation expert like CAE often look only at the fill pattern based on gate locations and ignore potential packing, cooling and warpage issues. To adequately address these, CAE builds a full runner/manifold system analysis.

Back to the headache-inducing tool. Based on the manifold supplier's Moldflow results, Plastivaloire built a mold with two gates for the automotive bracket. "When the mold was sampled, the parts were warped, so we tried to fix it," Hamilton recalls. "So much work was put into this project and we still had about 4 to 6 mm of warpage."

Enter CAE and a complete Moldflow analysis, which noted that since the part was being molded from glass-filled PP, the material would exhibit greater flow by entering the mold cavity lengthwise so the glass strands could align. CAE suggested changing to a single gate on one end of the part versus gates on both ends.

The molded parts prior to CAE Moldflow Analysis were exhibiting nearly 6.0 mm of overall warpage. After CAE's recommended gate-location and part-design changes were made, the simulation forecast deflection of 1.3 mm. Sampled parts exhibited just 1.1 mm of warpage, staying within spec.

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