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Building a Medical Molding Group

Founding Family's Second Generation Breaks Ground for Growth at Plastikos

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

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6915 Valley Avenue
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Phone 513-527-8800
Fax 513-527-8801
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Will You Be Ready for the Next Disruption?

Lessons learned from the ongoing coronavirus pandemic should help businesses navigate through the next disruption.

Jim Callari
Editorial Director

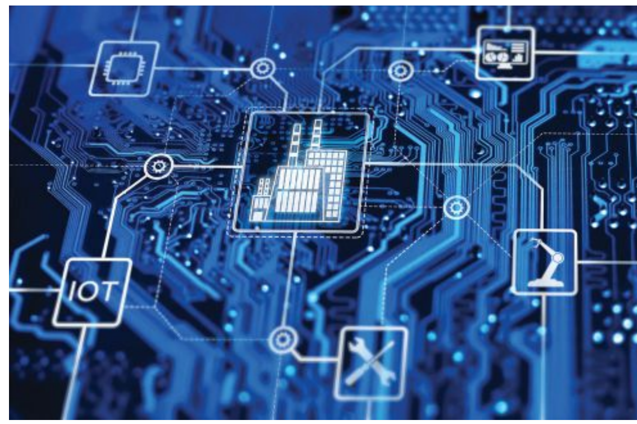
It happened that fast. Like a push of a button, a flick of a light switch or a bolt of lightning. The COVID-19 pandemic hit our shores and spread to dramatically impact our personal and professional lives. Our essential industry—up and down the supply chain, from materials to presses to tooling to auxiliary equipment to processors themselves—was among those that responded heroically, ramping up production to meet needs not only for PPE, but for everyday products used for packaging that were suddenly and almost literally flying off grocery store shelves.

We covered a lot of these yeoman efforts here in the print magazine and on our website. They include stories of companies adding machines, changing the configuration of existing machines to make products they never would have imagined possible before, and in some cases laying the foundation to expand into altogether new business as a result of new opportunities.

In this space last month, I talked about how we'll be addressing these themes in the upcoming months, either in print, online, or both. We kicked off this coverage this issue with an article on digital manufacturing, p. 28. (When you've finished reading it, visit the *Plastics Technology* website, ***ptonline.com***, for additional reporting on how a molder utilized a recently installed ERP system to ramp up production of sanitizer bottles by 4.3 million in just three months.) Next month, we'll examine advanced automation, then additive manufacturing (though the lens of an injection molder that has added 3D printing capacity for production), cross-training, and reshoring, among other topics.

I know these topics are not altogether new to you, but my suspicion is that you will be looking at them more carefully as part of a business and technology strategy that you've likely revisited many times since the emergence of COVID-19, and we want to help jump start you through the process.

Speaking of which, I'd like to make you aware of two additional resources that you might find useful. This summer, the Association for Manufacturing Excellence (***ame.org***) released a white paper, *A Manufacturing Marshall Plan*, that maps out exactly how today's companies can prevent post-pandemic



supply-chain disruptions, advance their manufacturing productivity and reskill their workforces.

Said AME, "*A Manufacturing Marshall Plan* advocates for reshoring, nearshoring and LeanShoring" (a term AME trademarked), "together with an increased focus on Industry 4.0 innovations and enhanced educational and training offerings to create a stronger workforce. These three actions will provide companies and their communities with a distinct competitive advantage while also boosting productivity and improving sustainable resilience in a fast-changing competitive manufacturing world."

According to the white paper, the coronavirus pandemic is taxing the efficiency and cost benefits of a globalized supply chain. And it recommends a switch to a more robust domestic supply chain and advanced manufacturing base, which could reduce dependence on the increasingly fractured global supply system.

You can download the white paper by visiting ***short.ptonline.com/AMEpaper.***

More recently, I received a report from quick-turn, "digital manufacturing" specialist ProtoLabs, based on a survey of its customers. The report, *Product Development and the Supply Chain: How to Survive a Pandemic with Digital Manufacturing,* reveals how the pandemic exposed supply-chain deficiencies—challenges that many customers say were mitigated by embracing additive manufacturing technology. Visit the ProtoLabs' website (***protolabs.com***) for more on this study.

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PLASTICS Creates Carteaux Award to Honor 'Outstanding Plastics Professionals'

The Plastics Industry Association (PLASTICS) has created an award named after former CEO Bill Carteaux, and will present it for the first time at the upcoming NPE2021: The Plastics Show, in Orlando May 17-21. The William R. Carteaux Leadership Award will be given to an industry professional who has achieved distinction working for the betterment of the plastics industry. Carteaux ran the association from 2005 until December 2018, when he passed away at age 59.

Eligible candidates must work for a company that is a member of PLASTICS and must "personify the values Bill Carteaux made the hallmarks of his career—unity, dedication, perseverance and selflessness," said PLASTICS. They can be nominated by their peers, family, or friends. The Plastics Academy, which administers the Plastics Hall of Fame, will form a Screening Committee, with officers of PLASTICS making the final selection. Nominations will be accepted through Feb. 15; they can be emailed to Jay Gardiner, president of the Plastics Academy.

Braskem America and Encina Collaborate on PP Recycling

Braskem and Encina Development Group plan to develop a long-term relationship enabling production of recycled polypropylene. Based in The Woodlands, Tex., Encina is focused on transforming plastic waste into renewable chemicals and fuels from post-consumer plastics via proprietary catalytic pyrolysis. The company aims to break ground on a facility in Houston in the second half of 2021. Once completed, the facility is targeted to process 350 million lb/yr of post-consumer plastic waste, converting it to more than 180 million lb/yr of recycled chemicals. The plant will be designed to expand to 700 million lb/yr of incoming plastic waste in future phases.

As part of the collaboration, Braskem will work closely with Encina to develop the necessary logistics, product quality and certifications for recycled propylene monomer that Braskem will use to produce new PP materials. States Mark Nikolich, Braskem America CEO, "As the North American leader in PP, Braskem is actively looking to purchase sustainable propylene feedstock that will allow us to increase both recycled and renewably-sourced products in our portfolio."

Nordson Selling Screw, Barrel Business

Nordson Corp. has agreed to sell the screws and barrels product lines from its Polymer Processing Systems (PPS) division to Altair Investments. Altair is a Chicago-based private-equity firm focused on investing in niche manufacturing companies.

Novel Single-Extruder Line For Direct Long-Fiber Thermoplastics

Dieffenbacher has built what is said to be a first-of-its-kind extrusion line for "direct" inline-compounded, long-fiber thermoplastics (LFT-D). It reportedly will be the highest capacity line of its type and will enable molding of higher volumes of thermoplastic components than previously possible. The extrusion line will be packaged with a hydraulic press from Dieffenbacher's Fiberpress series for delivery to an undisclosed U.S. customer in 2021.

This new system, developed collaboratively by Dieffenbacher's Composites and Recycling business units, is said to be unique in that it will produce LFT-D extrudates using only one twin-screw extruder. Recycled polymers from post-consumer and post-industrial streams will be used as the raw material, such as HDPE, LDPE, PP or PET in powder, chip or pellet form. Adjustments of the dosing equipment and L/D of the extruder barrel reportedly will enable the plant to efficiently and economically produce thermoplastic components from 100% recycled material.

As Dieffenbacher explains, a typical LFT-D line consists of a two-stage extrusion process requiring one extruder for melting the polymer and a second extruder for mixing the fiber into the pre-melted polymer. "In this project, a second extruder is not required. Melting, fiber incorporation and cutting/mixing can be done within one machine," says Marco Hahn, director of sales for the Composites Business Unit.

As with Dieffenbacher's two-stage extrusion machine, the melt is extruded through a nozzle at the end of the extruder onto a conveyor belt. The extrudate is then picked up by a robot and placed in the lower mold half of the vertical press.

The Dieffenbacher line is supplied with a 2500-m.t. Fiberpress. The U.S. customer will be producing large non-automotive parts. Asked about the line's output capacity, Hahn says it depends on the final product size and working scheme, but it will be in the range of about 300,000 to 400,000 parts/yr.

Antiviral Additive Reportedly Kills Coronavirus on Plastics in Auto Interiors

In response to COVID-19, automotive Tier 1 molder and compounder CpK has developed an antiviral additive for auto interiors and other applications.

By Lilli Manolis Sherman
Senior Editor

The R&D team of Ontario-based Tier 1 automotive interiors company CpK has developed a patent-pending additive, Forti-VI, that reportedly can kill 99.9999% of SARS-CoV-2 virus on material surfaces in less than 60 min. The company has three facilities in Ontario and is vertically integrated with a plastics compounding plant within that group. Explains head of R&D Dr. Gregory Farrar, "We produce our own flexible PVCs, TPUs, and TPOs, and about 50% of all R&D activities are dedicated to developing novel materials and carbon-fiber composites."

The company has not publicly disclosed the chemistry of the additive, as the patent process takes about 16 months to complete. However, the company will sell the additive—a first such commercial venture for CpK. "We can supply the additive at any time," says Farrar. "Because we cannot control the manufacturing of other companies, they will also require regulatory approval for their end products."

NO FREE RIDE FOR COVID-19

To date, CpK has produced pelletized masterbatches for testing with injection-grade resins such as PP and PC/ABS. "Our core business is to produce our own flexible polymers, so that remains our primary short-term focus," Farrar notes. "We have the R&D capability for doing the masterbatch work but lack the scale-up equipment, so our preference is to provide the additive to the market in powder form. Our plan is to supply this to many potential customers, including interior-trim component suppliers. We ourselves make only instrument panels, doors and consoles; so for a car to truly contain an anti-viral cabin, we need to work with other companies within our industry."

> *CpK and a Canadian University had to contract a biosafety lab to test this new antiviral additive.*

CpK developed the anti-viral plastics project in response to the coronavirus global pandemic and a "call to action" from Fiat Chrysler Automobiles (FCA). Knowing that customers would be concerned about the interior safety of their vehicles, FCA created the "Healthy Cabin Initiative," challenging its suppliers to find ways to reduce the risk of coming into contact with the COVID-19 virus in automobile cabins. CpK's R&D team was tasked to create materials for car interiors that showed anti-viral activity. CpK was able to invent, test, and apply for a patent within 90 days of the project kickoff.

The CpK team invented cast skin materials for the Dodge Challenger and Charger. Explains Farrar, "This was no simple task, but our team had experience inventing novel materials in the past. Not only did CpK have to discover which materials could actively attack the DNA of coronavirus, we also had to navigate the stringent and timely quality

FCA's "Healthy Cabin Initiative" challenges its suppliers to find ways to reduce risk of coming into contact with the COVID-19 virus in automobile cabins.

and testing requirements for new auto-interior materials. A single test such as UV resistance and heat aging can typically take up to 21 days to complete, but we were able to have prototype parts sent to FCA within a month of kicking off the project."

One of the challenges the team faced was anti-viral testing. Most Canadian labs don't have the infrastructure to handle Biosafety Level 3 viral pathogens like SARS-CoV-2. CpK was able to contract the ImPaKT Facility at Western University's Schulich School of Medicine & Dentistry in London, Ont., to collaborate and perform testing. The ImPaKT Facility is a one-of-a-kind CL2+/CL3 facility with advanced in vivo imaging capabilities, which allow researchers and industry to develop tools and methods to better understand the progression of infectious diseases, identify effective antimicrobial agents, develop diagnostic reagents to characterize hidden reservoirs of pathogens, and achieve early and accurate detection of infections. CpK is uniquely structured to meet a challenge like this as it has the ability to develop, test and manufacture raw materials; use those raw materials for injection molding and foam-in-place instrument panels, doors and consoles; then do final assembly and ship the finished product to the customer.

COULD PROTECT MASS TRANSIT, MEDICAL DEVICES & FLOORING

According to Farrar, the additive has many applications outside of automotive. "Our patent has 80 claims, with the majority of the focus outside of automotive. It could be used for public transit (buses, subways, planes, etc.), commercial spaces (flooring, door handles, etc), and in medical devices." The company is undertaking the approval process from Canada's PMRA and the U.S. EPA for use in auto-interior components. Says Farrar, "This ensures that we have enough data to support our product claims. Given that we have been testing on the SARS-CoV-2 strain directly, we don't feel that there will be any issue with our data. Most labs do not have this virus strain, so the lab we chose was strategic." PT

MATERIALS

PART 3

Tracing the History of Polymeric Materials

In this series we delve into a discerning look back into the history of our industry and how we all got here.

By Mike Sepe

John Welsey Hyatt's moldable material, the first true thermoplastic, was based on the mercurial cellulose nitrate. An application such as billiard balls made from a material that was flammable and sometimes explosive was obviously problematic. The impact involved in the game produced a sound similar to a gun being fired, not a desirable quality when playing billiards in western saloons where everyone was armed. The addition of camphor as the preferred solvent for controlling the mechanical properties of the material did nothing to reduce the hazards associated with the material.

But Hyatt and his brother, Isaiah, recognized the potential of the new material to compete with rubber. In the 50 years between the time natural rubber was first dissolved in solvents and used to produce waterproof clothing and the time of celluloid's invention, rubber had gone from a curiosity to a material on a fast track for the development of new markets.

In 1822 the world requirement for rubber was 31 tons; by 1870 it had grown to 9100 tons. While this was minuscule in comparison to what would happen as the automotive industry began to adopt rubber for tires at the turn of the century, this initial level of growth gave rise to an organization of rubber producers that succeeded in colluding with each other to establish very high prices for the material and products made from it.

One of these products was dental plate blanks for making dentures. The Hyatt brothers tried to interest the rubber companies in using celluloid. While in today's world we think of rubber and plastics as closely related, in the 1870's the rubber industry saw the new thermoplastic as a significant threat to its dominance in the market. To introduce celluloid to the dental practice, the Hyatts had to compete rather than cooperate with the rubber companies. To make products from celluloid, John Wesley Hyatt created several different processing methods for forming the material, including compression molding and ram extrusion.

But probably the most important processing method invented by Hyatt was the device specifically designed for making dental plates. This machine consisted of a cylinder that tapered at one end to a nozzle. This cylinder was surrounded by a jacket filled with oil and heated with gas. The opposite end of the cylinder contained a piston and a screw that could be turned with a lever to force molten material through the heated nozzle. In other words, an injection molding machine.

Probably the most important processing method invented by Hyatt was the device specifically designed for making dental plates.

The competition between the rubber cartel and the nascent thermoplastic industry centered on dental hardware. Both materials possessed drawbacks that would doom them to failure in our modern era. Rubber dentures tasted of the sulfur used to cure the material; celluloid tasted of the camphor used to control its viscosity and mechanical properties. Celluloid promised to break the rubber oligopoly and bring prices down dramatically.

But celluloid was susceptible to warping at the elevated temperatures associated with hot drinks, an obvious performance problem that the rubber industry was only too happy to exploit. And whenever the rubber market appeared to be threatened by the new material, the rubber cartel circulated rumors about health concerns with celluloid, shades of today's scare tactics regarding the public perception of plastic materials. But unlike today's negative publicity, these attacks came from within the polymer industry.

Despite the challenges facing celluloid, some New York investors showed an interest in backing its development on the condition that Hyatt move his operation from Albany to the New York City area. The new plant was established in Newark in 1872. Three years later the well-known volatility of the material was on full display when the factory caught fire and burned to the ground in a matter of a few hours.

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Despite this setback and the publicity fallout ensured by the rubber industry, celluloid found a market as a substitute for the materials traditionally used in jewelry such as bone, marble, tortoiseshell, horn, and ivory; and in personal-care products such as combs and backings for brushes. A very successful application was found in shirt collars and cuffs. The moldability of the material allowed it to be pressed against a fabric to replicate the pattern of the cloth onto the surface of the white polymer. It could then be shaped into less expensive substitutes for actual linen collars and cuffs. This, of course, led to apocryphal and perhaps true stories circulated by the rubber industry about people getting too close to a fire or touching a cuff with a lit cigarette or cigar with disastrous consequences.

Celluloid, the first true thermoplastic, had the drawback of extreme flammability. It was used for the first film stock, which caused quite a number of movie-theater fires when film jammed in hot projectors.

Rayon, a fabric based on nitrocellulose formed into thin filaments, was another creation of the late 19th century that highlighted the hazards of this early polymer when used in clothing articles. The original rayon was so flammable that it garnered the wryly humorous and not so politically correct name "mother-in-law silk." The name rayon persists today and the material is still based on cellulose, however, it is processed in a completely different manner and is no longer flammable.

The conflict between the utility and the volatility of chemistries based on cellulose nitrate took other forms. One of the early uses for collodion, the form of cellulose nitrate dissolved in ether and alcohol, was as a film for protecting glass photographic plates. Alexander Parkes had conceived of the idea of making a self-supporting structure that could produce photographs without the need for the glass plate. Through a series of developments over the next four decades, a chemistry for a self-supporting film with the needed mechanical properties based on collodion was developed by George Eastman and his colleagues using advances in chemistry that had originated within Hyatt's Celluloid Company.

Of course, these histories are never as simple as they first appear. Eastman applied for his patent on flexible film in March of 1889 and it was awarded a month later. However, in 1887, an Episcopal priest named Hannibal Goodwin, a man with no scientific training or education in chemistry, had approached the Celluloid Company, a neighbor of his church, for help in replacing glass slides for his regular lectures on religious subjects at his church in Newark, New Jersey. His efforts produced a workable film made from celluloid and he filed a patent for it two years before Eastman filed his. However, for reasons lost to history, the patent was not issued until 1898.

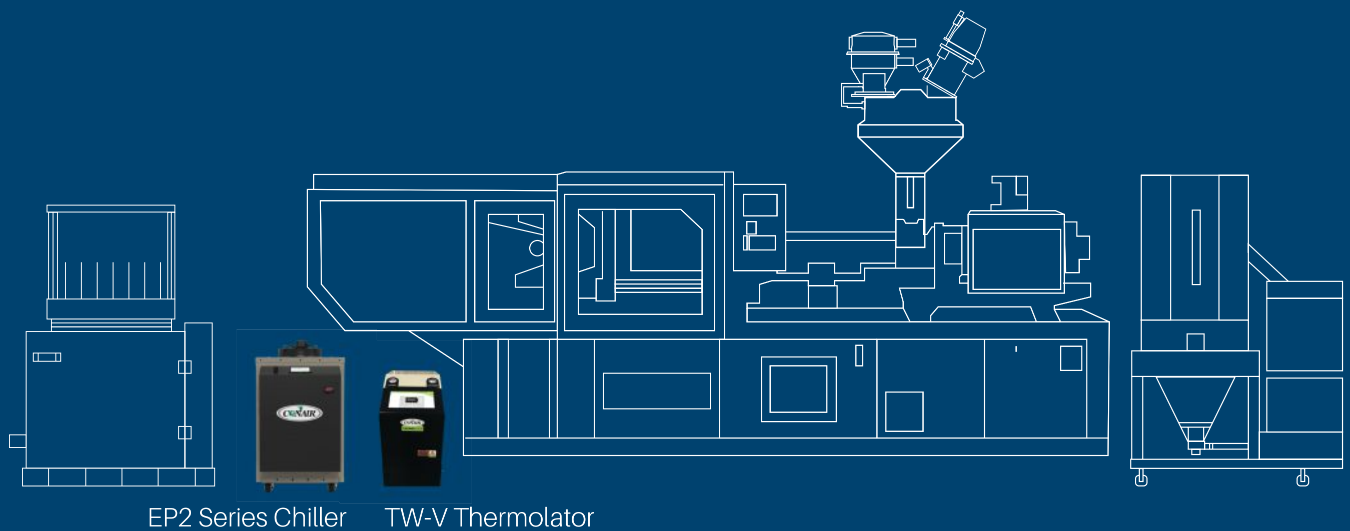
This brought about the inevitable lawsuit. Goodwin sued Eastman for a share of the profits that Eastman's company, Eastman Kodak, had been making on the sale of their film for almost a decade. While Eastman came from humble beginnings, by this time he was the one with the economic resources, and he kept the suit tied up in court until 1914. In the interim, Goodwin had sold the company he had founded, Goodwin Film and Camera Company, and had died in 1900. But the suit was decided in Goodwin's favor, to the benefit of his heirs and the company to whom he had sold the patent rights.

The celluloid film was adopted by Thomas Edison and others as the material of choice for moving pictures as the 19th century drew to a close. The flammability of cellulose nitrate was once again evident. The early years of cinema are full of incidents in which bright, hot projector lights ignited film that had jammed in the projector. Early theaters frequently went up in flames, killing many either in the fires or the associated panic. The 1919 comment from Supreme Court Justice Oliver Wendell Holmes, Jr. about shouting "Fire!" in a crowded theater was likely related to the fact that these occurrences were very much on the minds of people at that time.

The early years of cinema are full of incidents in which bright, hot projector lights ignited film that had jammed in the projector.

Cellulose-based materials represented an important first step in the history of polymers, and we will come back to them in a later installment. While they represented an ingenious manipulation of a naturally occurring chemistry, they still did not represent a true synthetic material. In our next article, we will discuss that development.

ABOUT THE AUTHOR Mike Sepe is an independent, global materials and processing consultant whose company, Michael P. Sepe, LLC, is based in Sedona, Ariz. He has more than 40 years of experience in the plastics industry and assists clients with material selection, designing for manufacturability, process optimization, troubleshooting, and failure analysis. Contact: *(928) 203-0408 • mike@thematerialanalyst.com*.



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INJECTION MOLDING

Improve Quality & Productivity With Advanced Screw Design

Most molders are still running with screw designs that haven't changed much in 30 years. But they don't need to.

In November as part of its Tech Days webinar series, *Plastics Technology* hosted a session on "Establishing & Maintaining a Robust Molding Process," in which I participated. During this webinar there was a short discussion on new injection molding machines, which spurred a conversation about screw design and melt uniformity, one of my pet topics within the molding industry.

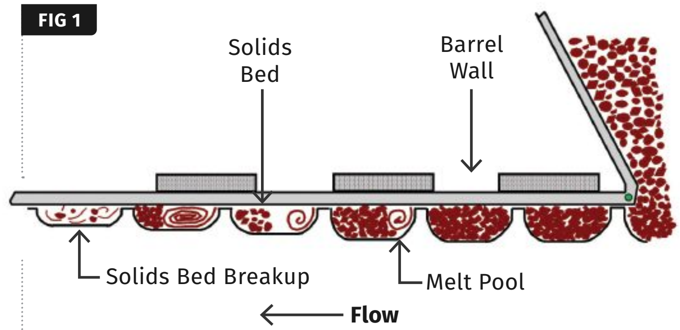
By John Bozzelli

One striking comment during this webinar was made by Mike Durina, a respected injection molding innovator who runs his own company, MD Plastics. Mike noted that most molders are still relying on "general-purpose" screw designs that go back 30 years. With all of the technical improvements that have been made on machines over that time, *nothing* has been done to improve melt uniformity. We still use "general-purpose" (GP) screws, which well-known screw designer Bob Dray wisely has called "no-purpose" screws. That is, they do *not* melt plastic uniformly. Processing with a uniformly melted plastic would seem like a high priority, but it has seen little if any attention. This needs to change.

Why is melt uniformity important? Well, you would be hard-pressed to name a single common molding/part problem that melt *non*-uniformity does not cause or exacerbate. To name a few:

1. Weak weld lines;
2. Part failures/performance issues;
3. Warping;
4. Non-uniform filling;
5. Marbling (color swirls/blotches);
6. Resin degradation, black specks;
7. Long color-change times;
8. Short shots;
9. Frequent screw cleanings;
10. Longer cycles.

FIG 1



Melt model of a general-purpose injection screw.

So what does it take to get melt uniformity? Start with a melt model of a GP screw, shown in Fig. 1. As shown, all of the pellets often do not melt, and the resulting solids-bed breakup provides for poor mixing and degradation (as well as causing the problems listed above). Also, it is common for the plastic in areas where the flights mate with the root diameter to stagnate and degrade. Figure 2 shows the typical polymer degradation often seen when a screw is pulled for cleaning or repair. While I do not have actual stats, my experience is that a minimum of 50% to 80% of all machines running today exhibit this problem. Even if it is only 25%, it still rates as a major problem in our molding industry. Why does the industry put up with this? Do *you* have to put up with this?

The fact is that the industry does not have to use GP screws. There are solutions, but be careful who you talk to. When anyone begins to ask machine suppliers and most screw manufacturers about these problems, the knee-jerk response is, "Try our barrier screw." Proceed cautiously. Figure 3 shows a typical barrier type screw *after* it was purged. Note the green polymer is still in the barrier flights.

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Since this is after purging, you can understand that this material stays there during production and will degrade with time. You will get even more degradation and black specks. So, if barrier screws are not the answer, what is?

Back in the late 1980s I was fortunate enough to have worked on a company-sponsored research program to solve problems of mixing color concentrates into natural resins. After spending one-and-a-half years and over $200,000 on around 10 different barrier screw designs that did *not* work, we developed a melt-uniformity screw (Fig. 4). It was not a barrier screw. This "melt uniformity" screw passed rigorous instrumental requirements for color distribution and uniformity. Further we trialed it in seven different production machines making complex parts for six months. The results were impressive (see the table accompanying this article at ***ptonline.com***).

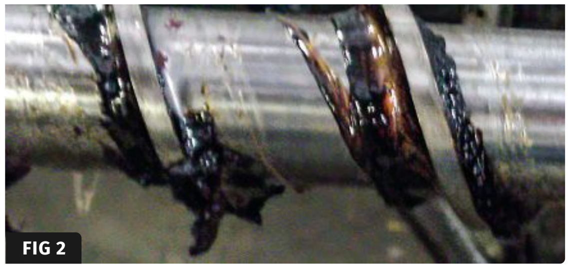

FIG 2

Degraded polymer at junction of flight and root diameter of a general-purpose screw indicates dead space.

FIG 3

In this barrier screw, note green polymer still in the barrier flight, even after purging. This indicates dead space. (Photo: Joe Cascarano)

FIG 4

Melt-uniformity screw.

The data speaks for itself. Replace your general-purpose screws with melt-uniformity screws. You will save time, make your life easier on the shop floor and make significantly more money.

Not convinced? Mike Sepe, a noted materials expert and fellow *Plastics Technology* columnist, actually purchased one of these screws when he worked for a molder. He wrote about his experience in an April 2012 column. Check out what Sepe has to say about it: "When we put in the new screw the melt temperatures were reduced by 60° F and the backpressure came down from 300 psi to 75 psi hydraulic. The problems with color incorporation and unmelt disappeared; the cycle time was reduced; and the periodic screw cleanings stopped. The screw paid for itself in seven months and started a revolution within the operation that eventually saw general-purpose screws replaced with mixing screws throughout the plant. The number of 'material problems' and 'processing problems' that simply disappeared was a revelation."

Only one major problem: Today, I cannot find a shop to make this design properly. Believe it or not, I took a print to a screw shop in Michigan and their response was, "No, we will not make it. A high-school student could do a better design." Seriously, if anyone knows of a good small shop that makes screws, let me know. I need to replace what I have.

ABOUT THE AUTHOR: John Bozzelli is the founder of Injection Molding Solutions (Scientific Molding) in Midland, Mich., a provider of training and consulting services to injection molders, including LIMS, and other specialties. Contact *john@scientificmolding.com*; *scientificmolding.com.*

TOOLING

PART 2

Get Better at Quoting Injection Molded Parts

Follow these detailed tips to get you the jobs you want. Here, we factor in the costs of scrap and regrind, along with energy and certain additives.

Add a scrap factor to your material cost estimate. Runners must be collected, reground and stored in inventory—all of which costs money. How much regrind can you use?

Last month, in our first installment of this series on how material costs influence job quoting, we focused on the base polymer and colorants. Two more factors that should be considered when quoting a molded part are scrap and regrind, which are not synonymous. No one molds perfect parts on the first shot—especially if the part is clear, translucent, or light colored. Generating scrap is inevitable. There are also dozens of rejectable issues during production that generate scrap, such as flash, shorts, warp, burns, scratches, dirt, etc.

By Jim Fattori

Therefore, you should add a scrap factor when quoting parts. If you are molding flower pots, that scrap factor will be very low. If you are molding medical, automotive or optical parts, that scrap factor could be very high. The amount to use is usually a judgement call based on experience.

My hat goes off to any molder who has gathered data on past scrap rates for different types of parts, molds and materials, and prudently applies them to their quotations.

My hat goes off to any molder who has gathered data on past scrap rates for different types of parts, molds and materials, and prudently applies them to their quotations.

Most molds have a cold-runner system. The runners need to be collected, ground up, and stored in inventory. Did the request for quotation specify the amount of allowable regrind that can be used, or is it "virgin only"? UL Standard 746D, "Standard for Polymeric Materials—Fabricated Parts," states, *Parts shall not be molded from material that contains more than 25% thermoplastic regrind by weight, that has been dry blended by the molder with the same grade of virgin material, unless the results of a separate investigation indicate acceptable performance for the specific part.*

My opinion, and that of many of my colleagues is that, if allowable, a molder should use 0% or 100% regrind—nothing in between. The reasons are beyond the scope of this article, although John Bozzelli provided the rationale in his December 2014 column, "Another Way to Deal with Regrind." It is important to understand how to maintain a good molding process, as well as to know the potential effects regrind has on the physical properties and function of the parts. This can be a liability issue, and therefore should not be taken lightly.

It takes a lot of labor to grind up parts and runners, and it takes up a lot of valuable floorspace—especially for custom molders that run all sorts of materials in a wide variety of colors and fillers. Regrind also poses a risk for cross-contamination with other materials. Even your best material handler can't tell the difference between an unmarked box of reground black PS and reground black nylon. Picture a new material handler dumping 100 lb of black nylon regrind on top of a partial gaylord of black PS regrind. Now picture the foreman seeing what he did. Solution: Have the material handler get a shop vacuum and suck the nylon and an inch or three off the top of the gaylord in order to get rid of the contamination. I've seen it happen, and I just shake my head.

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On occasion, the weight of the runner is even more than the weight of the parts. Even if 100% regrind is allowed, you may soon be looking for a scrap dealer to take the unused regrind off your hands for pennies on the dollar— about what it costs just to grind it up. Still, it is the preferred alternative to increasing the size of the local landfill. The best you can hope for is to be able to use the regrind in a different part. In this scenario, I still factor the scrap cost into the piece price and reap the benefit of using it somewhere else.

Another source of scrap is "wet" material. Hygroscopic materials not properly dried but inadvertently or unknowingly processed anyway are considered wet material. This renders most materials completely unusable—ABS being the exception. In Part 1 of this series I discussed adding a profit margin to the cost of the raw material. This is another reason for adding that margin, but this one is specific to hygroscopic materials.

If an opened bag or box of hygroscopic material is stored in a humid environment, it can literally take days to dry.

When you request a price for a hygroscopic material, ask for the price based on it being packaged in foil-lined bags—*not* gaylord boxes. This might cost a few cents more per pound. Material suppliers produce hygroscopic resins in a dry condition. If they immediately package the material in a bag or a box that has a vapor barrier, such as aluminum, it remains dry until it is opened. In many cases, the material does not need to be initially dried.

However, once it is opened it will start to absorb moisture. Depending on the humidity and the length of time, it will then need to be dried. Continually opening 55-lb bags of material takes a little more labor, but it is a good insurance policy against getting wet material and rejected parts. Even an unopened gaylord box of material can absorb enough moisture during a production run that it can begin to produce rejectable parts before the gaylord is empty, if it is not dried. What many molders don't realize is if an opened bag or box of hygroscopic material is stored in a humid environment, depending on the amount of moisture absorbed, it can literally take days to dry it sufficiently. Not hours—days.

DRYING COSTS MONEY

Drying material consumes a fair amount of electricity to keep those heaters running all day. The same is true for mold-temperature controllers, oil heaters, and other auxiliary equipment. The initial cost of the dryer, like all capital equipment, is usually factored into the facility's overhead. However, you should factor in the cost to run job-specific equipment. Your maintenance department can calculate these costs per hour, which you then add to the intended machine's hourly rate when quoting the part.

Another part-cost factor that is rarely taken into account by molders is the thermal conductivity of the base resin. Thermal conductivity is the primary variable on how much heat is required to melt the material in the barrel. It doesn't matter if your shop has hydraulic or electric molding machines: They both use electric heater bands to help melt the material. Hot-runner molds use that much more electricity.

Without getting too technical, it takes about twice as much electricity to melt semi-crystalline materials such as PE, PP, and nylon as it does to melt amorphous materials such as PC, acrylic or ABS. Therefore, it would be smart to add a small upcharge for processing semi-crystalline materials. Note: It doesn't matter what the weight of the part is, or what the size of the machine is. Base the added cost on the throughput of the material in lb/hr, which is equal to the number of shots/hr times the shot weight in pounds.

WHAT ABOUT ADDITIVES?

Does the material have any abrasive fillers, such as glass? When you run an abrasive material, such as a 33% glass-filled nylon, gate wear in the mold should not be your only concern. Everything from the vacuum hose in the gaylord all the way to the sprue bushing in the mold will also be subject to wear. The first thing to go will probably be your shot-size repeatability because the seat on the non-return valve is worn out. The next thing to go is the screw, and then the barrel. A non-return valve is not too expensive, but a screw and barrel can cost you thousands of dollars—especially in downtime waiting for one to arrive from the supplier—assuming it even has one in stock. Therefore, you would be remiss if you did not factor in an additional cost for molding abrasive materials, as well as having a spare non-return valve and screw available.

Grinding scrap costs money for labor, energy and floorspace. Keeping regrind of different resins and colors segregated and uncontaminated adds complexity.

Factor the cost of energy to run dryers into your job costs.

Does the material have a flame retardant or other additive known to leach out during processing? If so, that's another cost factor that should be taken into account. Production may need to be shut down at least once per shift to clean the parting line of the mold. Additionally, the entire mold will need to be disassembled to remove the buildup of sticky outgassing from the vents, ejector pins, etc. at a much shorter-than-usual preventive-maintenance interval. A mold running g-p natural ABS can go 100,000 to 200,000 cycles before it needs a PM to clean the vents, pins, etc. The same mold running an ABS with a flame retardant, an oddball colorant, or some other additive may require the PM interval to be only 25,000 to 50,000 cycles.

The last two material and colorant costs you need to capture are those incurred during startup and color changes. It can take a lot of time and material to switch from a dark color to a light color—especially in a large machine. Purging compound is not cheap. And if you have to pull and clean the screw in order to avoid black specs in a clear part, that will cost you several hours of press time and labor hours from the maintenance department.

It would be smart to add a small upcharge for processing semi-crystalline materials.

When you combine all these small costs, they can add up to a very large cost, which most molders don't take into account when quoting a job. More importantly, to get those desirable long-running jobs, you need to know which costs are relevant and which aren't. When you take into account all of the details, you end up knowing your true costs and true profit with much greater accuracy. The best part about precision part quoting is that you won't get upset if you lose a job to a lower bidder. You will simply feel sorry for the molder that doesn't know how to quote.

In summation, the following part-weight and material-cost factors should be taken into consideration when quoting a molded part:

- Part volume;
- Type of material: amorphous or semi-crystalline;
- Specific gravity of the material;
- Annual quantity of parts to produce;
- Material cost based on order quantity;
- Material cost per part—not per pound;
- Material margin;
- Potential material cost increases;
- Material abrasiveness;
- Material additives;
- Colorant cost based on order quantity;
- Colorant margin;
- Colorant letdown ratio;
- Color-matching sampling costs;
- Minimum material order quantities;
- Labor cost for colorant feeding or blending;
- Scrap factor;
- Reject factor;
- Auxiliary equipment power-consumption costs;
- Runner weight and allowable regrind percentage;
- Labor and storage costs for scrap conversion;
- Startup and color-change costs.

Many of you are probably saying to yourself, "I estimate five jobs a day. I don't have the time to take all of these factors into consideration." I completely understand. However, I recommend you throw away your dartboard and start to write a spreadsheet program to make the task quick and easy. Most ERP and MRP software programs include a module for quoting parts, though I have yet to see one that takes all of the costs I mentioned into consideration. That often leads to underbidding low-volume jobs and overbidding long-running jobs. It's unfortunate that writing your own program is currently the best way to go, but the profitability and livelihood of your company may depend on it. PT

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

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By Tony Deligio
Senior Editor

Keeping It in the Family: Medical Molder Grows with Second Generation at the Helm

Evolving from a two-man moldmaking company in a rented garage to three unique businesses, including a new medical injection molding unit, with 185 full-time employees, Micro Mold, Plastikos and Plastikos Medical enter their fourth decade family-led and poised for growth.

Time, distance and life experience often conspire to alter perceptions once thought immutable. When he left Erie, Pa., in 1995 after graduating high school and headed to Chicago and Northwestern University, Philip Katen believed his exit from his home city was final, leaving behind the lake and his father's moldmaking and injection molding business—save visits—for good.

That same summer, Plastikos, the injection molding operation cofounded in 1989 by his father, Timothy Katen, along with Gary McConnell, Bill Fogleboch and David Mead, moved into a brand-new facility sized to accommodate up to eight machines. That company began life in a rented business incubator in Erie with just a single injection machine.

Plastikos was Katen and Mead's second collaboration. Their first launched in November 1978 with the founding of moldmaker Micro Mold in a rented garage before they built their own facility in 1984.

While Philip Katen earned a double major in industrial engineering and economics from Northwestern over the next four years, Plastikos continued to grow, more than doubling its space to accommodate 16 machines. In August 1999, Katen took a consultant job with Deloitte upon graduating from Northwestern, working within its Strategy and Operations practice. In 2003, as part of the firm's Scholars program, Katen enrolled in Duke University's Fuqua School of Business, where he set about earning his MBA.

Plastikos has 27 whiteroom and 10 cleanroom molding machines, while Plastikos Medical has another 10 cleanroom molding machines.


Plastikos Medical's cleanroom molding floor operates in a lights-out fashion for two of its three shifts.

That's when Katen's coursework and consulting job led him to see Micro Mold and Plastikos in a new light. Not as the shops where he and his brother had swept floors, cleaned machines, inspected and packed parts, and cut the grass in high school or on breaks from college, but as the kind of dynamic and exciting business opportunity that he helped clients build at Deloitte.

"Business school, more than anything, brought out a bit of that entrepreneurial spirit in me," Katen says, "and I saw the opportunity that the companies had, and what a unique and extremely rare opportunity it is for anybody to be able to work for your family company—to play a direct, impactful role." Katen and his father began to lay out a path for him to come back to Erie and Plastikos. Throughout that time, the company continued to expand, adding space for a third time and growing to 27 injection molding machines.

Long before business school had opened his eyes to the career opportunity he had at home, Katen says his father defined a route Philip and his brother Ryan could take if they ever wanted to join the family business, including education at a college or trade school coupled with relevant job experience.

"After school, my dad made it clear to my brother and me that you had to work somewhere else for at least a couple of years in order to gain the experience of working for another company, other managers and bosses," Katen says, "and also in a field that would yield valuable experiences and insights that would be applicable back at the company." After completing his MBA and commitment to Deloitte, Katen moved back to Erie in January 2007, starting full-time work at Plastikos on Feb. 1, 2007.


Micro Mold started life in 1978 in a rented garage in Erie, Pa.


In 2019, Plastikos expanded with the addition of Plastikos Medical; that unit will break ground on another expansion in the Spring of 2021.

Katen's brother Ryan took a very similar path. Four years younger than Philip, Ryan attended Purdue University in West Lafayette, Ind., earning an undergraduate and then a masters degree in industrial engineering. Upon graduation, Ryan immediately went to work for medical-device manufacturer Boston Scientific in upstate New York. After a few years of hands-on manufacturing experience there, he also came back home to rejoin the family companies in late 2006, just before Philip returned to Erie.

At this time the company began its shift into more medical molding, starting with non-cleanroom and whiteroom work of Class I and Class II medical-device components, while building toward cleanroom operations, including the addition of a small 300-ft^2 certified ISO-7 cleanroom on the main molding floor in 2009-2010. That same year, Tim Katen and David Mead retired, more than three decades after starting Micro Mold in that rented garage in 1978. The elder Katen remains involved to this day, sitting on the companies' boards and consulting with his sons on a regular basis.

CLEANROOM COMMITMENT

The push to increase medical business came to a head in 2014, when Plastikos initiated a major 17,000-ft^2 expansion, that included a 10,000-ft^2 ISO-7 cleanroom with 10 injection machines, as well as a dedicated quality lab, toolroom, mold storage, office and meeting space spread across two floors. At that time, Plastikos' molding machine fleet grew to 37 total presses—27 whiteroom machines plus the 10 in the cleanroom.

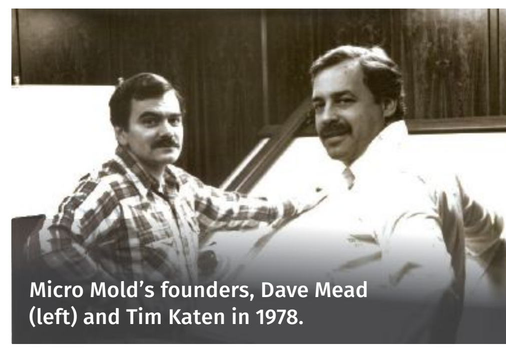
Seeking even more medical customers, the company launched Plastikos Medical, designing and building a new, standalone 25,000-ft^2 facility and business with a 12,000-ft^2 ISO-7 cleanroom molding floor that could accommodate up to 10 machines. This business officially began production right after Labor Day 2019 under Ryan's leadership, with five cleanroom molding machines. Five additional machines were added from late 2019 through November 2020, with the ninth and 10th presses—all Arburg's—scheduled to start up in mid-December. Rob Cooney, manufacturing manager at Plastikos, who joined the company in 2002 after graduating from Penn State's Plastics Engineering program, is the third partner in that business along with the Katen brothers. All three went to the same high school in Erie, with Cooney between Philip in Ryan in age.

In business just a little over one year, Plastikos Medical is already finalizing a Phase II expansion plan, with architectural and engineering design on a 24,000-ft^2 addition slated to be completed last month. The new space will accommodate up to an additional 15 ISO-7 cleanroom molding machines that will be added over the next three to five years. Groundbreaking is anticipated for the spring of 2021, and completion a year later.

STAYING A STEP AHEAD

While its customers only require ISO-8-certified cleanrooms, all of Plastikos' cleanrooms are certified to the higher ISO-7 level, and Philip Katen says they're often operating closer to an ISO-6 level. "The benefit there is you've got a much cleaner environment, much more pristine air, with significantly less particulate, and thus a dramatically lower risk of contamination to the molded components and the finished end device—which our customers in the medical-device space love, because that's just a lower component of risk in their overall risk analysis and supply chain."

Left to right: Philip Katen, Rob Cooney, Ryan Katen and Tim Katen in the company's conference room.



Micro Mold's founders, Dave Mead (left) and Tim Katen in 1978.

In addition to standard ISO-13485 medical-device certification, Plastikos Medical is also certified for two biocontamination-related substandards with independent lab verification. It's another step that goes beyond what customers require but also tries to anticipate future needs. The same philosophy informs Plastikos' expansions.

"The strategic plan is to always stay at least one or one-and-a-half steps ahead of our customers, their growth and their demands, so that we're supporting them every step along the way and never leave them high and dry or in a pinch," Katen says. "So keeping that production capacity ahead of where they need to be today and then continuing to grow into that reserve capacity is in direct support of our customers' growth."

LIGHTS-OUT OPERATION

While Plastikos Medical plays an outsized role in the group of companies' growth, it has an undersized impact on its payroll. Micro Mold and Plastikos have 23 and 155 full-time employees, respectively, while the newest unit has just seven full-time workers, with some support from the main molding site as needed. A largely lights-out operation, Plastikos Medical has staff on hand for only one of three shifts, so no one is there for 14 hr or more per day, with weekend operations completely unmanned.

To achieve this, Katen says the company takes automation "to another level." In addition to all the machines featuring Arburg's integrated, three-axis multi-lift robots with custom end-of-arm-tools, Plastikos Medical also deploys RJG's cavity-pressure sensors and eDart quality-monitoring systems, plus integrated process-monitoring software, custom automated boxing/packaging systems, and automated material-handling systems that the firm developed over the years, among other Industry 4.0 technologies.

At the end of the day, the lack of people also means a lack of dirt and dust. "Lights-out increases quality assurance, including dramatically reducing the risk of contamination by not having people there, since people are your number one vector for particulate contamination," Katen says. "If nobody is there for hours on end, the risk of any kind of contamination within the cleanroom during those lights-out production hours is effectively zero."

FINISHED BASEMENT

People and contaminants aren't the only things that are scarce on the production floor. Something you'll never see in Plastikos and Plastikos Medical's molding rooms is auxiliary equipment. From the beginning, both facilities were designed to keep utilities, material handling and resin drying off the main floor, residing instead below the presses in a basement area. At Plastikos, utilities are all located in a tunnel running directly below the machines, with ceilings high enough to stand comfortably.

In the 2014 expansion that included the larger ISO-7 cleanroom, the company took the concept further, upgrading from a utility tunnel to a full basement underneath the new molding floor, featuring 8- to 9-ft ceilings. At the brand-new medical facility, the basement has been made even larger, extending its height to 10 ft from floor to roof deck, with even more material lines, colorant lines, regrind feeds, equipment and utilities.

"That strategy enables us to add more press capacity to the same building footprint, which benefits our customers first and foremost," Katen says. "Taking the equipment off the molding floor and putting it in the basement also yields a much cleaner—and, you could argue, safer—work environment on the molding floor. You don't have those additional components or additional pieces of equipment that could potentially contaminate the cleanroom space."

PICKY PARTNERS

Plastikos' rise over the years, like any business, is fueled by winning new business, but the manner in which the company takes on new customers is as strategic as anything it does. Before Plastikos agrees to work with a new customer, it first considers its existing ones.

"We're very selective, arguably as selective as our customers are," Katen says. "So even at dinners with new prospective customers, I'll share with them that we're also strategically evaluating you, analyzing to make sure the prospective business opportunity is a good fit, as much as we know that you're evaluating and critiquing us."

That level of scrutiny is seen as a responsibility that Plastikos has to its existing customers, particularly long-term ones, according to Katen. If an ill-fitting project added in haste goes sideways, everyone feels the impact. "We know that it takes a lot of work, a lot of talent, a lot of know-how and expertise to serve our existing customers," Katen says, "and if we were to bring in the 'wrong' new customer—one that for whatever reason didn't 'fit' well—then very quickly that can take away key limited resources—precious resources—and consume a disproportionate amount of that engineering talent, technical talent, tooling talent that's in short supply and key to our collective success with our customers."

That exacting evaluation extends to the parts Plastikos is asked to mold. "We're very selective in terms of what the parts look like, what kind of devices do they go into: Is it a good fit in size, geometry, and material? Does it complement our expertise, know-how and experience, or not? And in some cases, if it's something new, but not way out in left field, then definitely we're quite interested to learn more and evaluate internally if we think it's a viable project that may expand our knowledge and capabilities."

A SECOND CHANCE

Entering its fourth decade with a second generation at the helm, Plastikos exists today despite a brush with extinction during the painful recession of the early 1980s, when Katen's father told him "a stiff breeze" could have wiped out the fledgling company. "He's relayed the story that the bank really should have foreclosed on Micro Mold in those early years, but gave them one more chance and believed in them," Katen says. "Ultimately, their accountant, their banker and insurance agent went to bat for Tim and Dave, and they were given that extra chance and just enough time. They were able to find a way against the odds to pull it out and turn it around." More than 40 years later, as the company grows and enriches Erie, the optimism of those early allies seems prescient. PT

Plastics Processors Waking Up to the Digital World

The ongoing coronavirus pandemic could force plastics processors to revisit technologies previously overlooked, many of which will be on display at May's NPE2021 show. In part one of a series on emerging trends and technologies to explore during the triennial event, we look at digital manufacturing.

Dashboards are becoming managers' go-to solution for remote access to a broad range of realtime information, tracking progress and monitoring performance. Outside the plant, dashboards can be accessed on a laptop, tablet, cellphone, or any smart device.

By Pierre Maillet
CyFrame International Enterprises Inc.

Think back to last January. The economy was booming, machines were running day and night, 401k's were soaring and our biggest concern was finding additional labor. Fewer than 12 months later there are a whole new set of priorities and concerns. We discovered how vulnerable life and business can be, learned to adapt and improvise, and opportunistically embraced new approaches for getting things done.

At home, the kitchen table was transformed to accommodate distance learning for our children. We gave the internet a workout with online ordering of everything from household supplies and groceries to pizza. And we gained a whole new appreciation for social gatherings with family and friends over the web.

But changes on the home front could not compare with what was transpiring at the office, on the production floor, and throughout the plant. We learned that such populated environments created health risks, from which no one from the general manager to the machine operator was immune. We learned what it was like to work from home. And companies that weren't prepared discovered—often the hard way—that collaborating with coworkers, customers and suppliers was challenging, to say the least.

GOING DIGITAL

Today, just as before, plastics processors are focusing their attention on new equipment and technologies to boost production speed and capabilities. We look forward to once again attending trade shows to investigate new production equipment and to eagerly embrace technology advances that could give our business an edge while mingling with our long-time suppliers. But what was that edge in recent months, and what did we discover?

Plastics processors need business systems and communications systems that can accommodate what promises to be a lasting trend to key staff working from home much of the time.

While plastics processors have implemented many improvements in the past year, digital tools have, for the most part, been greatly underutilized or altogether ignored. Offering tremendous benefits and a high return on investment, the digital world leverages the collective and seamless interaction of web-based collaboration, IT-PLC real-time production tracking, integrated business applications, and online B2B customer-portal capabilities.

Digital tools have, for the most part, been greatly underutilized or altogether ignored.

While many industries have readily embraced digital B2B (business-to-business) tools and practices, these past few months have exposed some serious gaps for plastics processors. Despite crippled supply chains, and sometimes being understaffed, plastic processors supplying test kits, mask shields, ventilator parts and other parts were considered essential service providers and remained operational throughout the pandemic.

During this time many learned that the B2B communication capabilities they had in place (if any) were quickly overwhelmed by the massive volume and rendered largely ineffective. Consequently, many reverted to emails, text messages, phone calls, as well as other manually intensive processes. The result was unreliable connectivity, limited information access, delayed responsiveness and total frustration.

For plastics processors, weathering the storm was just the beginning, and "business as usual" no longer exists. *Agility* and *responsiveness* are the new keywords; and long-term survival will depend on embracing the new tools, ideas and business practices that support this new paradigm. We're living in a digital world. The days of spreadsheets, paper-based scheduling, manual inventory, face-to-face meetings and other inefficient business-to-business practices are on their way out. Plastic processors who make the investment in new IT-Web technologies will emerge from the pandemic with a competitive edge.

Aside from the internal collaboration and operational benefits to the company, demonstrating digital aptitude and commitment will become a key differentiator in the customer's eyes. In fact, for many manufacturers evaluating suppliers, this is nothing short of a game changer. Customers recognize the value of seamless communication, reliable connectivity, and online access to realtime information from your shop floor.

And so, if your interest in the digital era has been limited to that cellphone in your pocket, now is the time to get up to speed. Here are some things to consider to help get the ball rolling in your company:

- *Working Remotely:* The home office has its advantages for the employee and company alike. Contrary to what one might expect, studies show that working from home increases productivity. On average, remote employees work 1½ more days each month than their office-based counterparts. That comes to more than three additional workweeks a year. From the company's perspective, this agile work strategy is shown to increase employee satisfaction, reduce attrition and unscheduled absences, and cut down on wasted meetings, time lost in traffic and expenses tied to unneeded office space.

Creating a remote work environment doesn't have to be complex or costly. It does, however, require the appropriate IT infrastructure. A reliable web-based, integrated business-system architecture will provide realtime information access across the board.

While every job isn't suited for the home, it can be ideal for a number of front-office functions. For example, internet access allows the entire customer-service and accounting team to be ►

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moved offsite. In addition, sales, marketing, purchasing and human resources are likewise remote-office candidates. What's more, all internal systems such as order entry, production planning and monitoring, inventory management, purchasing, invoicing and accounting should be accessible remotely.

Similarly, dashboards allow business owners and managers to remotely access a broad range of realtime information, track progress, and monitor performance. Outside the plant, dashboards can be accessed on a laptop, tablet, cellphone, or any smart device. And while you're at it, use the technology to modernize the shop a little—production dashboards can be displayed on a large shop-floor monitor to exhibit realtime machine production schedules.

Integrated business systems are becoming indispensable for order entry, scheduling, production monitoring, inventory control, shipping and invoicing.

According to experts, future biological threats remain a very real possibility. As living beings, we are always susceptible to new viruses, antibiotic-resistant bacteria and related attacks on our health and wellness. Consequently, mandatory masks, social distancing and remote work will likely become standard global operating procedure throughout the foreseeable future. Now is the time to begin creating a long-term remote-employment strategy that will sustain your business and allow you to operate effectively whether your employees are across the hall or across town.

• *Prospecting and Selling*: For some time now, the days of jumping on a plane or in the car to visit prospects have been slowly disappearing. Business travel is costly and can exert a mental and physical toll on those on the front lines. But the biggest contributor to this trend are the advantages, variety and widespread availability of today's robust Customer Resource Management (***salesforce.com***, Pipedrive, etc.) and collaborative meeting tools.

WebEx, GoToMeeting, Microsoft Teams, Zoom, Facetime and similar web-based meeting tools make selling inexpensive and effective from the home or office. These virtual-meeting applications support screen sharing, videos and remote demonstrations. At the same time, any required physical samples can be shipped easily to the prospect in advance of the meeting by courier.

Quotes can be instantly emailed and/or displayed in the client area of your website. Similarly, these quotes can be built-in and automated within your internal business software for a faster turnaround. Automated quoting improves efficiency and allows your sales team to send out more quotes each week, resulting in more orders.

• *Vendor-Managed Inventory Orders*: Imagine if your customers had stock in consignment and you maintained that stock ready to ship—you would not have been so vulnerable in recent months! Consider a website upgrade to support B2B consignment capabilities. Such abilities allow customers to create usage reports for consigned inventories and automatically generate invoices in your internal system.

These and related functions can be fully integrated into the internal systems of vendors or plastics processors. Accessing the B2B area of your website allows customers to place orders based directly on weeks of usage calculated on their historical consumption. Imagine the impact such a relationship will have on customer loyalty.

• *Online Order Tracking:* A digital environment allows one's workforce to concentrate on areas core to the business by empowering customers to, in some instances, service themselves. We've all placed an online order and sat anxiously awaiting its arrival. We logged onto the UPS or FedEx websites, entered the tracking number, and watched the progress throughout fulfillment and delivery. From order entry to scheduling, production, shipping, delivery, and invoicing—the process allows customers to not only place online orders, but to monitor the status of a given job through each step. Online tracking is convenient for the customer and saves time on phone tracking the status of orders.

For plastics processors, weathering the storm was just the beginning, and business as usual no longer exists.

Providing customers with on-demand order-status access isn't particularly costly or complex. Making the process work, however, does require seamless and reliable integration of B2B websites with internal business systems.

• *Problem Tracking:* Just as with online order tracking, problem tracking is another residual benefit of a business-centric website. Providing customers with a means to track ticketed problem reports reduces service-center calls. Many ticketing systems can be linked to internal systems to generate problem reports, track the quality-assurance (QA) measure that must be implemented, and respond quickly. The process also disseminates production QA test information to resolve issues.

Customer-support systems are available online and can quickly solve problems in an efficient and organized manner. Take a closer look at your current QA process. Do unresolved issues fall through the cracks? Are customer complaints on the upswing? Is the process automated and available online?

Creating a remote work environment doesn't have to be complex or costly.

- *Scheduling Production Staff*: Prior to the pandemic, many plastics processors were faced with an ongoing shortage of qualified production staff. To make matters worse, experienced workers have been quarantined, further limiting the number of available programmers, machine operators, schedulers and similar resources.

Coordinating shifts and calling in operators requires agile scheduling—especially in these times. Leveraging a web-based tool to identify and schedule staff based on their qualifications and your production needs is vital to the business. Take a step back and look at how this is being done. What is your current process for determining need and scheduling operators?

A NEW ERA OF BUSINESS

As you oil up your equipment and get back to work, your thoughts are likely consumed with employee safety, cash flow, production, recalculating forecasts and so on. But you should also find some time to think about where, when, and how you can begin leveraging today's digital tools.

While most industries have embraced the digital era, many plastics processors have been slow to adopt its tools, practices and methodologies. The challenge starts at the foundation by having integrated business systems that incorporate key elements such as web-based architecture and built-in B2B capabilities.

To us as humans, as a society, and as a business, 2020 has been a stark reminder of just how vulnerable we are. With no form of digital business process communication and remote capabilities, plastics processors who insist on holding onto traditional approaches are at a disadvantage in planning and generating critical orders and delivering products to customers. The business landscape is changing, and digitally savvy plastics processors will be best positioned to reap its advantages. PT

ABOUT THE AUTHOR: Pierre Maillet is president of CyFrame International Enterprises Inc. He is a CPA with a degree from the University of Ottawa. Prior to joining CyFrame, he worked as a software applications specialist for Hewlett Packard and as an IT Management Consultant for KPMG International. In his current role, Maillet helps tooling/plastic manufacturers improve production efficiency and profitability. Contact: *855-693-0999*; *pm@cyframe.com*; *cyframe.com*.

Use Rheology and Flow Simulation to Troubleshoot Extrusion Processes

Let's take the mystery out of rheology by showing how the wealth of information it provides can be used by processors to solve real-world production problems.

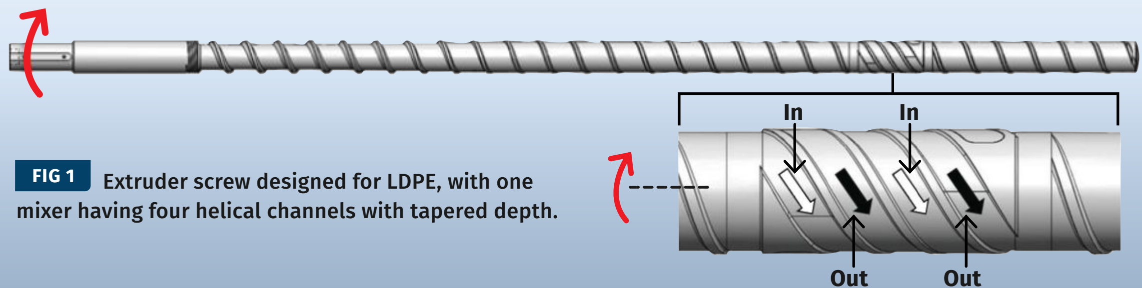


FIG 1 Extruder screw designed for LDPE, with one mixer having four helical channels with tapered depth.

By Olivier Catherine
Cloeren Incorporated

Rheology is the science related to how materials flow. Its usefulness is well known by most extrusion and injection molding equipment designers. For example, viscosity curves as a function of shear rate and temperature are used to calculate pressure drop in an extrusion die and, ultimately, to dimension the flow channel for a particular set of processing conditions.

Many processors are still mystified by rheology. Let's try to dispel the mystery by showing how the wealth of information it provides can be used by processors to solve real-world production problems.

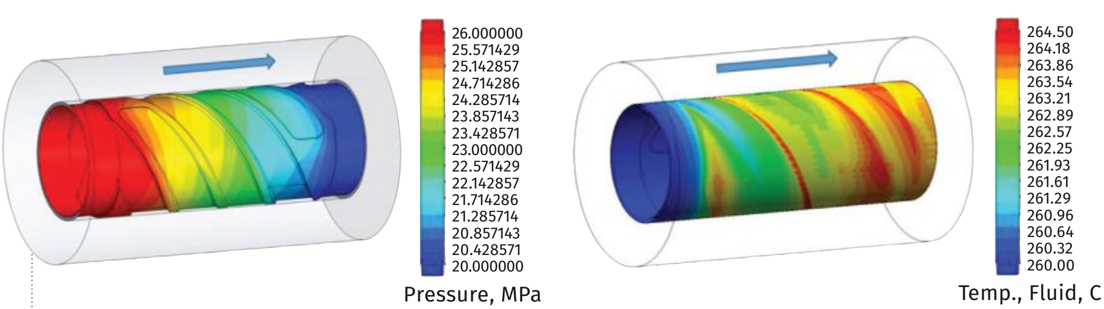


FIG 2 Predicted pressure field and melt temperature through the mixer for LDPE. The outlet pressure was set to 20 MPa (2900 psi) and the inlet melt temperature to 260 C (500 F).

QUESTIONS ABOUT EXTRUSION & RHEOLOGY?
Learn more at PTonline.com
Visit the Extrusion and Testing page under the Processes Tab.

SHEAR THINNING AND MELT TEMPERATURE

Polymer melts are non-Newtonian fluids and exhibit a decrease in viscosity at an increasing shear rate. This viscosity decrease is called shear thinning, and it depends on polymer structure and molecular-weight distribution (MWD). For instance, a linear polymer like LLDPE will tend to shear-thin much less than a polymer with long-chain branching like LDPE. Understanding how a given polymer grade shear-thins can help processors understand many extrusion issues, and therefore it is critical to learn how to "read" a viscosity curve. In particular, the shape of the viscosity curve as a function of shear rate has an effect on the flow distribution from an extrusion die, the melt pressure through a die, and melt temperature at the tip of a screw.

To illustrate the last point, we calculated melt-temperature predictions with Computational Fluid Dynamics (CFD) in the mixing section of a single-screw extruder for two polymers with comparable viscosity, but vastly different shear-thinning behaviors. The screw and its mixer (Fig. 1) were designed and optimized for LDPE, which is a very shear-thinning polymer due to long-chain branching and broad MWD. Figure 2 shows CFD results for the LDPE grade; pressure through the mixer and resulting melt temperature change due to shear heating. The model predicts a pressure drop of about 6 MPa (870 psi), and a temperature increase of about 4° C (7.2 °F) at the outlet of the mixer.

The same screw and mixer were used to process a metallocene LLDPE (mLLDPE) grade, with a melt-flow index (MFI) relatively

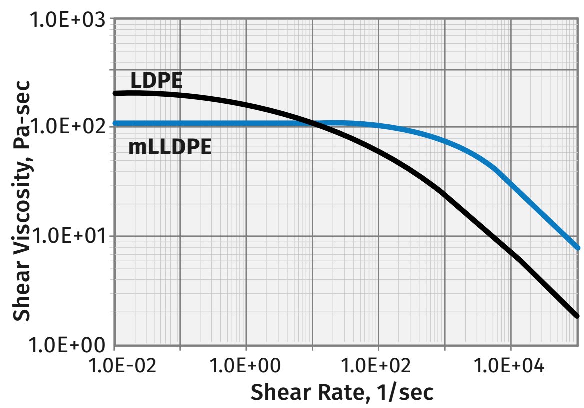


FIG 3 **Viscosity curves for LDPE and mLLDPE.**

comparable to that of the LDPE. Figure 3 shows a comparison of the viscosity curves for both grades with similar viscosity overall, but very different shear-thinning characteristics. Because mLLDPE shear thins less than LDPE, its viscosity at high shear rate is much higher. The mixer generates high shear rates (about 3000 sec^{-1} over the undercuts) at regular processing conditions. Consequently, Fig. 4 shows that the mLLDPE polymer flows very differently in the mixer and results in an unrealistic pressure drop of 19 MPa (2755 psi), and temperature increase of about 11° C (19.8° F).

Because mLLDPE shear-thins less than LDPE, its viscosity at high shear rate is much higher.

This example illustrates that it is important to know the shape of the viscosity curve in the extrusion process when dealing with issues of controlling the melt temperature. Shear heating is driven by viscosity and shear rate. The shear flow in extruder screws generates a substantial contribution to the melt temperature, the other factor being the conductive heat transfer from the extruder barrel. Changing resins with significant differences in shear thinning, even with similar MFI values and from the same "family," like these polyethylene grades, can lead to significant differences in melt temperature and pressure and extruder torque at the same processing conditions.

MELT FLOW INSTABILITY

In this case, a sample of highly filled polymer of unknown composition was analyzed to design a die for a relatively thin sheet with process parameters specified by the processor. Because of the nature of the filled compound, a capillary rheometer was chosen to investigate the material.

With this technique, the pressure drop in a capillary die is measured for a set of flow rates. Knowing the capillary geometry, the pressure drop can be converted into shear stress at the capillary wall, and the flow rate can be converted into apparent shear

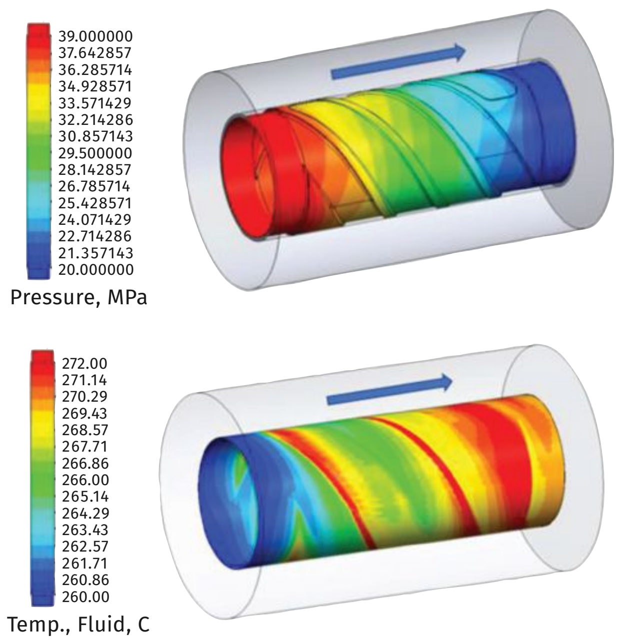


FIG 4 **Predicted pressure field and melt temperature through the mixer for mLLDPE. Outlet pressure was set to 20 MPa (2900 psi) and the inlet melt temperature is set to 260 C (500 F).**

rate. Viscosity can be determined by the ratio of shear stress to shear rate. In this example, the measurements were performed from high shear rates to low shear rates. Figure 5 shows the recorded pressure measurements over time. On the same graph, we plotted the equivalent apparent shear rates.

The pressure measurements show very interesting patterns:

- For high apparent shear rates from 2000 to 200 sec^{-1}, the flow is slightly erratic and unstable, as shown by the slight instability in pressure measurements.
- For apparent shear rates of 100 and 80 sec^{-1}, we observed a stick-slip phenomenon on the extruded strands, which corresponds to the massive pressure oscillations recorded with the rheometer.
- At apparent shear rates of 60 sec^{-1} and below, the flow and the pressure measurements are completely normal.

In this example, we were able to establish a stable/unstable flow processing window for this atypical material. Based on the die gap and requested outputs, we were able to make recommendations ahead of the equipment being manufactured. However, if a flow instability is observed in a given process, this type of analysis can be done to establish a stable/unstable flow processing window.

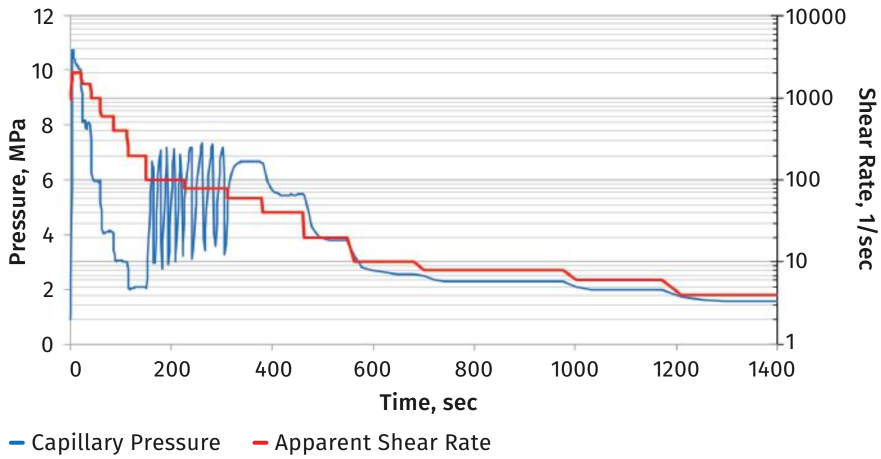


FIG 5 **Pressure measurements as a function of time at several different shear rates from a capillary rheometer, showing severe flow instability for a highly filled compound.**

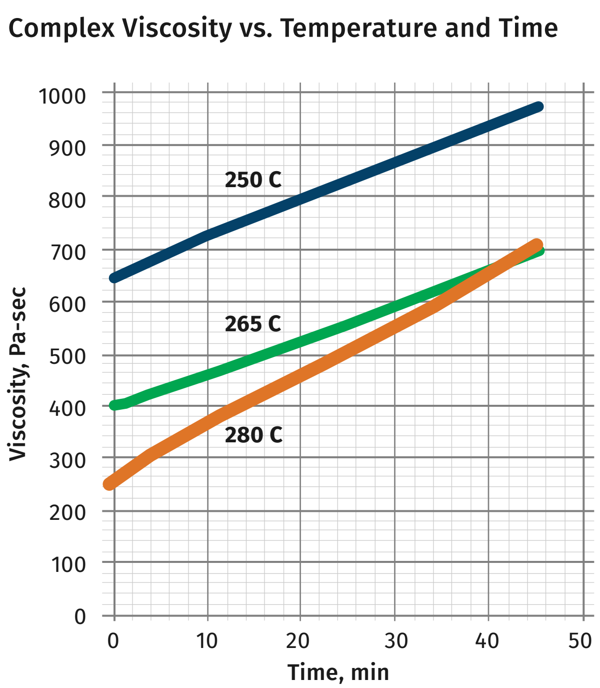


FIG 6 **In these rotational viscometer experiments with a nylon 6 film resin, viscosity tended to increase over time at all temperatures, due to gels; but the increase was more rapid at the highest temperature, suggesting an upper limit to the processing window for this resin.**

THERMAL DEGRADATION

Some materials are prone to degradation during extrusion, due to temperature sensitivity, oxygen or moisture content, or other factors. PVC, PVdC, TPUs, some nylons and polyesters are examples of materials that can exhibit thermal degradation issues. Rheology can be used to determine how thermally stable a specific material is in relation to a process.

In addition, it may be useful to determine the specific process residence time. Figure 6 shows a third example, involving nylon film extrusion. In this process, the material was run a little too hot, and gels were visible in the film. To confirm the effect of temperature on material stability, we ran time-sweep measurements at 250, 265 and 280 C for 45 min in a rotational rheometer. We found that the viscosity of this material increased over time at all three temperatures, which indicates a tendency for the material to crosslink, even in an inert nitrogen atmosphere. While viscosity growth is detected over time for all three temperatures, it is clear that the growth rate is dramatically increased at 280 C, indicating that perhaps it would be good to avoid running the material at this temperature or higher.

Rheology is usually associated with viscosity curves for a given material. However, it can provide so much more useful information that is critical to equipment designers, product-development engineers, and processors. Through some examples, we illustrated how shear-thinning can impact extrusion performance and particularly melt quality and melt temperature for a given extruder configuration.

Another aspect where rheology can be used to troubleshoot an extrusion process is when dealing with melt-flow instabilities, such as melt fracture. This was shown in an example of a highly filled formulation for which a die was to be designed and manufactured. Without this characterization, costly design mistakes would probably have occurred. Finally, understanding the thermal stability of a material under specific conditions (type of atmosphere, temperature, and time) is possible through time-sweep experiments. The data will help determine the extrusion processing window of temperature or residence time. PT

ABOUT THE AUTHOR: Olivier Catherine has nearly 20 years of experience in plastics as an expert in polymer processing, rheology and process modeling. He is currently corporate scientist for Cloeren Incorporated in Orange, Tex., where he focuses on die designs and implementing new rheological tools and flow-simulation capabilities. Catherine graduated in France from Cemef/Mines Paris Tech in 2001, earning an M.S. in Materials Science. Contact: *409-951-7632*; *ocatherine@cloeren.com*; *cloeren.com*.

Is Your Ultrasonic Welder Up to the Challenge of Medical Processing?

New technology meets the industry's requirements for repeatable, consistent welds in smaller and more intricate medical components. Follow these tips to make sure your equipment meets these market demands.

Rinco's Electrical Motion 20kHz benchtop welder with generator and controller is used to weld a medical stethoscope.

By Stephen Potpan
Rinco Ultrasonics USA

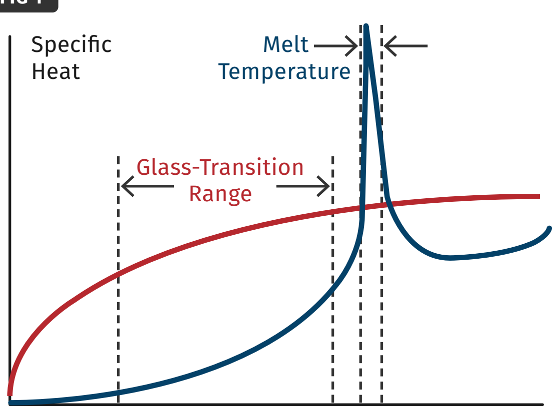
Used in a wide range of medical devices worldwide—including drug-delivery devices, orthoscopic surgical instruments, chest drains and catheters—ultrasonic welding is assuming a growing role in the medical industry as devices become more complex and sophisticated. These devices are increasingly composed of plastic parts that are smaller and lighter and may contain other components that place additional requirements on the joining process. While more traditional fastening methods can be considered, processors are finding that ultrasonic welding offers significant advantages.

To meet the high standards of the medical industry, ultrasonic welding manufacturers are developing a unique technology that meets all the requirements for repeatable and consistent welds in these smaller and more intricate systems, including technology for cleanrooms. This means the highest levels of quality for welding results, well-chosen materials for tools and absolute process control thanks to recording software for validation purposes and quality-assurance monitoring. Expert project management is based on certifications in accordance with ISO 13485 and ISO 9001.

> ***Processors are finding that ultrasonic welding offers significant advantages.***

Increasing demand for faster deliveries and highly complex welding applications has led welding manufacturers to bring on new capacity. Suppliers have transferred ultrasonic tooling in-house in order to assume complete control of documentation, testing, and other key program functions for their medical customers.

FIG 1



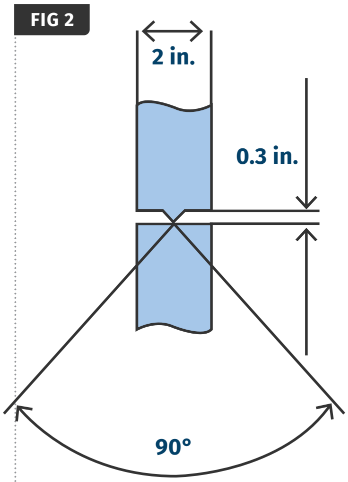
Graph illustrates glass-transition range over time for amorphous (red) and semi-crystalline (blue) materials.

QUESTIONS ABOUT ASSEMBLY?
Learn more at PTonline.com
Visit the Post-Processing Page under the Processes tab.

MATERIALS, PART DESIGN PLAY KEY ROLES

Among the key technical considerations in joining of medical devices are materials, process parameters, and part design. Amorphous materials such as ABS, PS and PC tend to be much easier to weld due to their melt-point characteristics. They tend to soften and gradually pass through their rigid state to the glass transition, then into a rubbery state followed by the true molten state. Their solidification is also gradual.

FIG 2



Common energy-director design for semicrystalline materials. Quick buildup of heat causes the energy director to melt and create a molecular bond between the two parts.

Meanwhile, semicrystalline materials such as nylon, PP and PE have a very sharp melting point, which requires more energy to achieve. The solidification is just as sharp (Fig. 1).

After identifying the material for the application, the parts need to be designed with the proper joint. such as a shear joint for a hermetic seal after welding, or a simple energy director to bond the two parts together (Fig. 2). The ultrasonic welding supplier can evaluate the appropriate ultrasonic tooling design for the application, based on the material to be used and the function of the end product.

Ultrasonic welding of today's complex medical devices, with their many internal components and ergonomic design requirements for the comfort of the doctor or surgeon, also makes the tooling more complex. Applications need not only fit the parts but also have the right amount of output amplitude to allow the material to melt.

TROUBLESHOOTING HORN ISSUES

Figure 3 shows a typical complex ultrasonic horn consisting of a large mother horn and 13 extender horns (commonly known as a composite horn). The extender horns are contour milled to match the part detail and each extender is timed into the correct position to allow for proper contact on the part.

There are numerous troubleshooting issues that could arise when utilizing this type of horn for medical parts:

- One common horn issue is marking on the parts, which could range from small scuff marks to material discoloration. Part marking could be the result of dimensional changes in the molded parts or the addition of additives in the molding process. Processors are advised to check part dimensions and molding conditions.
- Another issue could be part-to-horn alignment. For all horns, the alignment between the horn and the part and fixture are critical. If the extenders on the composite horn are out of alignment, tool realignment could be necessary. Check the extenders and make the proper adjustment.

If the generator is producing a horn fault or a frequency error, check for loose stack components or a broken stud.

- Horn face damage caused by wear or damage to the face contacting the fixture with no part present can also cause marking or component failure. Uncoated (raw) aluminum horns will release aluminum oxide and cause black residue on the parts, most commonly seen on white and light colored parts. This can be addressed by having the aluminum horn chrome plated or hard-coat anodized to stop the aluminum oxidization.

RESOLVING NOISE PROBLEMS

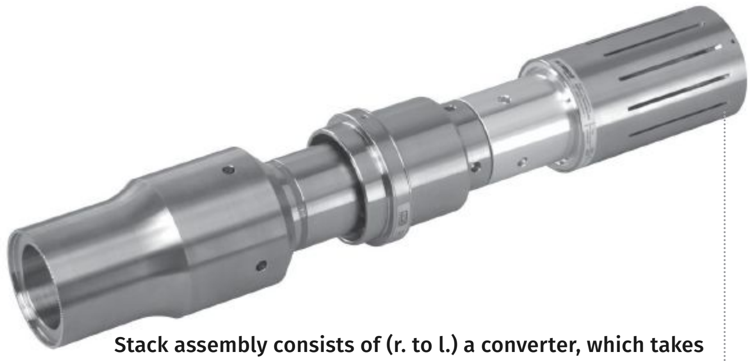
While typically the horn could run for some time with no issues, it may slowly develop high-pitch noises. This may indicate that it's time to check the stack assembly, which consists of the converter, booster and the horn (Fig. 4). Removing the stack and each component is the starting point.

FIG 3

This multi-element horn, comprised of a mother horn and several extenders, is designed to weld a medical stethoscope.

Next, look at the mating studs (threaded rod between each component) to see if they are loose or cracked. They can be removed and wiped down with rubbing alcohol and then blown off with clean, dry compressed air. Using rubbing alcohol and a nylon brush to clean out the threaded stud hole is also recommended. The mating surfaces can also be blown off with clean, dry air. If any of the mating surfaces show any marking or small scratches, a light sanding can be done using 600 grit wet/dry paper. Remember to sand lightly to avoid divots and making the mating surfaces unparallel. In extreme situations, machining the mating surfaces may be necessary.

Noise issues can also be tied to stack components that are not torqued to the manufacturer's specifications. A loose stack assembly or an over-tightened assembly can cause noise issues. A sound enclosure would be recommended if the noise originates from the welder and is uncomfortable to the operator. Noise problems are prevalent in larger parts and in applications that have



Stack assembly consists of (r. to l.) a converter, which takes electrical energy from the generator and converts it to mechanical movement; the booster (middle component) which adjusts the mechanical movement from the converter; and the customized ultrasonic horn.

brass inserts being ultrasonically inserted into a plastic housing.

If the generator is producing a horn fault or a frequency error, check for loose stack components or a broken stud. If the horn is in the home position (not touching the part), determine whether an ultrasonic test can be done. If so, press the test button on the generator to see if the horn runs in air. If not, disassemble the stack components and try again. If the generator errs again during the ultrasonic test, try a spare horn and see if the issue resolves itself. If not, the issue could be with the converter or booster.

If the spare horn works, then the original horn should be checked for cracks or damage to the horn face. Cracks sometimes are easy to spot while others can happen internally. If the horn doesn't run and there are no signs of cracks, then the horn needs to be further tested by a horn analyzer. The horn analyzer can better tell if the horn is cracked. For example, a 20-kHz horn with a reading of 19,750 Hz would be evidence that the horn is cracked. Another way to diagnose a cracked horn is by using a chemical and dye system.

> ***Noise issues can be tied to stack components that are not torqued to the manufacturer's specifications.***

TACKLING EXCESSIVE HEAT

Heat buildup can be caused by a dirty-running horn, the part material, or a poor horn design. Most heat buildup issues come from the speed of the application, since the ultrasonic process is based on friction, which causes heat and allows the plastic to melt and then bond. Heat buildup can be reduced by changing to a more forgiving material. A new horn design can also be considered.

Added cooling usually resolves a heat issue. Clean, dry compressed air can be blown on the horn face and mating joints of the stack assembly. Typically, just 3-5 psi of compressed air is enough to reduce heat in the horn and stack. Keep in mind that if the heat issue is not addressed over time, it will travel to the converter and eventually cause internal components to fail. A good rule of thumb on air cooling: If the horn is in the home position, the ultrasonics are off (end of weld cycle), and the horn is too hot to hold by hand, then it needs to be air cooled. In some extreme conditions, chilled air can be used.

Improper horn rework can also cause many different issues. If a horn has been machined to rework a worn face or for a slight modification due to part change, it is very important to have the proper equipment to do a horn scan. Any modifications to a horn can cause issues with uneven amplitude across the horn face, thus increasing or decreasing the horn's running frequency. These issues could cause failure of other components in the stack and welding system. It is highly recommended to have the manufacturer make the modifications and rework so proper steps are taken to ensure that the horn is running properly and efficiently. PT

ABOUT THE AUTHOR: Stephen Potpan is on-site manager for Rinco Ultrasonics USA Inc. in Danbury, Conn. He has over 34 years in the ultrasonic welding field, specializing in plastics materials and joint design. Potpan has worked with a large medical company to design test cartridges for rapid microbial identification and detection, which have been tested on the International Space Station. His background also includes stints with multiple manufacturers in the surgical instrument business, along with Tier 1 and 2 automotive suppliers. Contact *(203) 744-4500*; *spotpan@rinco-usa.com*, *rinco-usa.com*.

Keeping Up With Technology

PRODUCT FOCUS **Compounding**

MIXING

Double Planetary Mixers Granulate and Dry

The Ross Double Planetary Mixer is recommended for high-precision mixing, granulation and vacuum drying—all in a single vessel. Powders and granules are gently blended by two rectangular planetary blades that rotate on their own axes while orbiting the mixing zone on a common axis.

Atomizing spray nozzles enable controlled and spill-free addition of liquids as the mixing blades continuously ensure uniform composition and temperature throughout the batch. As a result, granulation and drying reportedly can be completed in significantly shorter times than with conventional, non-vacuum granulators and dryers.

Optional features for sanitary and sensitive mixing applications include flush discharge plugs or valves, covers for use with the portable mix vessels during transport and controls integrating the mixer with auxiliary equipment such as vacuum pumps, heating/cooling units, load cells, etc.

FEEDING

Precise Twin-Screw Feeder

The Model TSF twin-screw feeder from Best Process Solutions, Brunswick, Ohio, is designed for precise batching and weighing. Its compact dual-helix design combines fast, high-volume filling with accurate dribble flow at the end of the cycle.

Two separate screw helixes—1½ in. and 4 in. diam.—are mounted on an 18 × 22 in. hopper. They are rated at 17 ft^3/hr and 283 ft^3/hr, respectively, at max. rpm with 100%-efficient conveying and no slippage, the company states. The TSF is recommended for batching to weigh hoppers; low loss-in-weight, scale-monitored flow; low loss-in-weight batch applications; and recipe-type batching by multiple computer-controlled units.

INJECTION MOLDING

Vertical Injection Machine Offers Lower Profile

Nissei Plastic Industrial Co. has added the TWX300RIII36V machine with 300-ton clamp to the TWX-RIII Series. (A 220-ton model was introduced earlier, see June '19 Keeping Up.) Its lower profile is due to a new servohydraulic, two-platen clamp mechanism, which has shortened its height 10% compared with its predecessor. The compound-type clamping mechanism consists of a high-speed cylinder, high-pressure clamping cylinder and half-nut mechanism, which replace a conventional cylinder that controls both high-speed clamping and high-pressure clamping with one cylinder. The new clamp mechanism has reduced the mold-mounting height to roughly 40 in. throughout the machine series. Nissei notes that the lower height eases product takeout, robot placement and maintenance, and accommodates lower ceilings.

Nissei says the clamping mechanism is resistant to temperature change, helping it generate consistent clamping force. The dual design also reportedly reduces the required amount of hydraulic oil by 52%. The machine helps molders find the optimal, lowest clamping force required, and for mold protection, it can detect foreign objects during mold close, preventing mold damage from the misalignment of insert workpieces.

The machine's design allows it to be converted to a three-stage mold-mounting face, and the three-tiebar, wide turntable has ample daylight, allowing the machine to accommodate more complex and larger molds or higher cavitation tooling. Turntable and ejectors are servodriven, allowing faster cycles and high precision, preventing insert misalignment. The presses come with shot sizes of 201 to 314 cm^3. The TACT IV controller has a 15-in. color LCD touchscreen that allows two windows to be arranged vertically.

INJECTION MOLDING

Packaging Press Range Extended

Building on its two-platen "duo" platform, Engel is introducing the "duo speed" line of machines for applications like buckets and storage containers. Engel says dry-cycle times between 2.35 and 3.4 sec. make these the fastest two-platen machines on the market. The line launches with four tonnages—550, 770, 1000 and 1250 tons—with further sizes planned for the future. The machines will make their North American debut at NPE2021 (May 17-21 in Orlando, Fla.).

Across all sizes, duo speed machines are said to be shorter than comparable presses. Platen geometry has been optimized for uniform clamp-force distribution.

For greater energy savings, the machines use Engel's ecodrive servohydraulics on the clamp plus a servo-driven screw. Accumulators speed injection and use demand-driven charging to further improve energy efficiency. The duo speed comes with a barrier screw and sliding-ring nonreturn valve that are optimized for running PP and HDPE. Engel says this addition to its packaging portfolio allows it to offer machines specialized for everything from thin-walled packaging and caps/closures to large, thick-walled containers.

PURGING

Purging Compounds for Thin-Wall Polyolefin Packaging

A new series of purging compounds that boast high efficiency for purging thin-wall polyolefin packaging in both single-face and stack tools with hot runners has been added to the Ultra Purge product line from Chem-Trend. Ultra Purge 100X is designed to purge the machine "on the fly," meaning no machine settings need to be changed and no soak time is required during the purging process.

As a result, 100X compound is said to help reduce machine downtime when performing dark-to-light color changes for all polyolefin resins. Users typically see a 50-75% reduction in downtime and associated scrap vs. purging with virgin resin or regrind, the company says. Ultra Purge 100X also removes carbon buildup from hot runners, screws and barrels.

Chem-Trend cites the case of one customer that previously took 4 hr to change from blue to white using commercial purge compounds. In a trial with 100X compound, downtime was cut to 90 min, a 63% reduction.

Prices Up for Major Volume Resins

Blame global plant outages, leading to tighter feedstock and resin supplies and higher feedstock costs. Add in some 'catch-up' resin demand.

By Lilli Manolis Sherman
Senior Editor

Prices of nearly all volume resins appeared to be on the way up, with pricing leverage largely held by resin suppliers, at least for the short term. Major drivers of this trajectory included global plant outages, planned and unplanned; tighter feedstock and resin availability; and what industry sources characterized as "catch-up" resin demand after the second quarter's COVID-19 shutdowns.

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

PE PRICES FLAT TO HIGHER

Polyethylene prices were flat in November, but suppliers aimed to push through a December 5¢/lb increase, according to Mike Burns, RTi's v.p. of PE markets, as well as *PCW* senior editor David Barry and The Plastic Exchange's Greenberg. According to Burns, drivers included a December *force majeure* at Braskem-Idesa, the largest producer of LDPE and HDPE in Mexico, and increased global prices for LDPE and HDPE due to import demand in China after production problems in Iran and reduced North American exports during third quarter. Both Burns and Barry originally saw good potential for PE prices this month to drop by as much as 5¢/lb in a buyers' market. Noted Barry, "I think it will be pretty hard for suppliers to hold on to the 19¢/lb they gained up until November, and there were some good deals on the spot market." These sources noted that after the third quarter's demand surge, demand flattened out and supplier inventories were beginning to recover.

Greenberg described spot PE buyers as holding out for a substantial price decrease that did not develop. "Many processors have been banking on major price relief in order to refill their coffers; and while some small discounts have come through, it has not been enough to excite restocking demand."

Polyethylene Price Trends

HDPE Injection

NOV	DEC

HDPE Blow Molding

NOV	DEC

HDPE HMW

NOV	DEC

LDPE

NOV	DEC

LLDPE Butene

NOV	DEC

Market Prices Effective Mid-December 2020

Resin Grade	¢/lb
POLYETHYLENE (railcar)	
LDPE, LINER	111-113
LLDPE BUTENE, FILM	94-96
NYMEX 'FINANCIAL' FUTURES	38
JANUARY	38
HDPE, G-P INJECTION	116-118
HDPE, BLOW MOLDING	109-111
NYMEX 'FINANCIAL' FUTURES	43
JANUARY	43
HDPE, HMW FILM	123-125
POLYPROPYLENE (railcar)	
G-P HOMOPOLYMER, INJECTION	69.5-71.5
NYMEX 'FINANCIAL' FUTURES	52.5
JANUARY	58
IMPACT COPOLYMER	71.5-73.5
POLYSTYRENE (railcar)	
G-P CRYSTAL	103-105
HIPS	105-107
PVC RESIN (railcar)	
G-P HOMOPOLYMER	95-97
PIPE GRADE	94-96
PET (truckload)	
U.S. BOTTLE GRADE	53

PP PRICES REBOUND

Polypropylene prices in November moved up a net of 5¢/lb: 2¢ in step with propylene monomer and 3¢ of margin increases. Moreover, suppliers also announced another 4¢/lb margin increase above where monomer prices might go for December, according to Scott Newell, RTi's v.p. of PP markets, confirmed by *PCW*'s Barry and The Plastic Exchange's Greenberg. Newell ventured that prices would increase by another 2¢ to 5¢/lb, noting, "This was not expected to be the trajectory of PP prices, but some key factors turned out to support suppliers' price initiative and essentially kept them in the driver's seat." He cited strong recovery in demand from consumer products, rigid packaging, BOPP, nonwovens and automotive, along with supply tightness in both resin and monomer.

Polypropylene Price Trends

Homopolymer

NOV	DEC
5¢/lb	

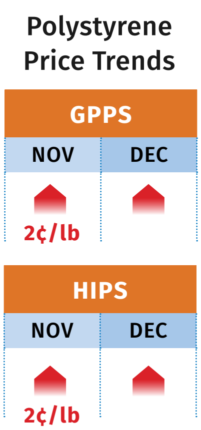
Copolymer

NOV	DEC
5¢/lb	

Barry reported in the second week of December that monomer supply constraints were more apparent, with spot prices soaring and PP suppliers struggling to keep up with demand. He noted that some industry sources projected that propylene and PP supply will remain tight well into first-quarter 2021. Reported Greenberg, “Upstream PP inventories remain at the lowest levels since we began tracking fundamentals 15 years ago, so tightness persists.” All three sources ventured that PP imports were becoming more attractive due to the domestic supply crunch.

PS PRICES UP

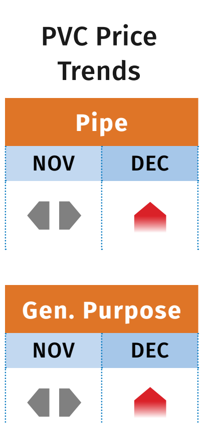
Polystyrene suppliers implemented their 2¢/lb increase in November and were seeking 7¢ to 10¢/lb increases for December and were expected to get most of it, according to both Robin Chesshier, RTi’s v.p. of PE, PS and nylon 6 markets, and *PCW*’s Barry. Driving the increases were global feedstock price increases based on supply tightness due to planned and unplanned outages in Asia and the Middle East. PS prices in January were likely to be flat.



“The dynamics changed from a down to an up market due to these global shortages, with styrene monomer increases pulling up PS prices,” noted Chesshier. Barry said the implied styrene cost based on a 30:70 ratio of spot ethylene/benzene was at 30.4¢/lb going into December’s second week, up 9.4¢/lb over the previous four weeks. Both note that domestic production grew by about 8%, while demand was flat.

PVC PRICES FLAT FOR NOW

PVC prices were flat in November, after a net 16¢/lb in price hikes through October 2020, the result of hurricane production disruptions, according to both Mark Kallman**,** RTi’s v.p. of PVC and engineering resins, and *PCW* senior editor Donna Todd. Most major suppliers issued a 3¢/lb December increase; but with the exception of pipe converters, who had raised their prices in the fall and supposed they could do it again if need be, other processors balked at the idea of accepting another increase, according to Todd.

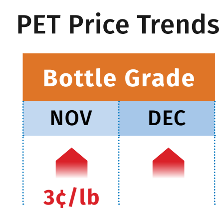


Citing tight supplies, Kallman ventured that while suppliers could push through some of the new increase through in December, this was mainly a strategy to influence new-year contract negotiations. Domestic PVC demand was up by 3% through October, but Kallman noted that things were starting to slow down. He expected PVC prices this month to be flat and possibly a bit lower.

PET PRICES MOVE UP

PET prices were in the low-50¢/lb range for spot truckload business delivered in the first week of December, up from 50¢/lb in November, according to *PCW* senior editor Xavier Cronin. He expected December prices for noncontract spot business to be flat, as PET demand from bottle, container and packaging manufacturers is decreasing due to tapering end-of-year production runs. Yet PET suppliers appeared to have leverage going into the new year. Noted Cronin, “January will be a busy month for U.S. PET resin producers, as demand skyrockets from the holiday lull for PET bottles, due in large part to COVID-19-related demand for bottled water and beverages and PET packaging used for countless other consumer goods.”

ABS TABS UP



Prices of ABS moved up a total of 15¢/lb between September and November and there was potential for another 3-5¢/lb being implemented in December or this month, according to RTi’s Kallman. In addition to price increases in feedstocks, the key driver has been faster-than-anticipated recovery of demand since the third quarter for appliances and electrical/electronic equipment, as well as automotive. This led to escalation of ABS imports and domestic resin production.

PC PRICES ON THE WAY UP

Polycarbonate prices were flat through fourth quarter, but suppliers came out with increases of 9¢/lb for December, though it was more likely that they would be implemented this month, according to RTi’s Kallman. He noted that PC demand picked up pace in automotive, but also in construction, appliances and E&E sectors. Higher feedstock costs were also a factor to some degree.

PRICES UP FOR NYLONS 6 & 66

Nylon 6 prices were on the way up at the fourth quarter’s end as suppliers sought increases of 10¢/lb for December, which appeared to have potential for success based on higher prices of benzene and caprolactam, coupled with increased demand from automotive and the fiber/textile sectors, according to RTi’s Chesshier. She ventured that if feedstock prices and demand continue to move up, another price increase would not be surprising this month.

Nylon 66 prices were mostly flat in the fourth quarter, but suppliers were seeking increases in the 14¢ to 20¢/lb range in December, which were expected to go through by this month, according to RTi’s Kallman. In addition to increased feedstock costs, the hikes were driven by increased demand from automotive, which left some suppliers struggling to meet lead times, particularly for some compounds. An unplanned “hard” shutdown due to a power outage at a Florida plant of Ascend Performance was expected to further tighten supply.

Processing Expansion Cools in November

Industry growth slows after quickening expansion over the prior four months.

The Gardner Business Index (GBI): Plastics Processing, calculated from monthly survey responses of *Plastics Technology* subscribers, dipped in November to 51.3. New orders and employment activity fell sharply, with both reporting their first contractionary readings since June. (Values below 50 indicate a contraction in month-over-month activity; the farther away a reading is from 50 indicates how broadly the industry experienced the reported change.) Despite the contraction in new orders, production activity expanded slightly.

By Michael Guckes
Chief Economist/Director of Analytics

Business-activity data provide by custom processors, in particular, told a similar story. New-orders activity indicated a slowing expansion for a second month; this was closely followed by production activity, which showed a similar slowing. Despite these recent changes in new orders and production, backlog activity has been unchanged, with recent readings circling closely around 50 (a neutral reading of "no change").

Latest supplier deliveries continue to signal challenges to supply chains and logistics. Supplier deliveries are closely tied to order-to-delivery times, which increase as delivery times lengthen. The fourth quarter will be made worse as seasonal package-delivery demand and vaccine distribution compete for more of the transportation industry's already diminished capacity.

Michael Guckes is chief economist and director of analytics for Gardner Intelligence, a division of Gardner Business Media, Cincinnati. He has performed economic analysis, modeling and forecasting work for more than 20 years among a wide range of industries. He received his BA in political science and economics from Kenyon College and his MBA from Ohio State University. Contact: *(513) 527-8800*; *mguckes@gardnerweb.com*. Learn more about the plastics processing Index at *gardnerintelligence.com*.

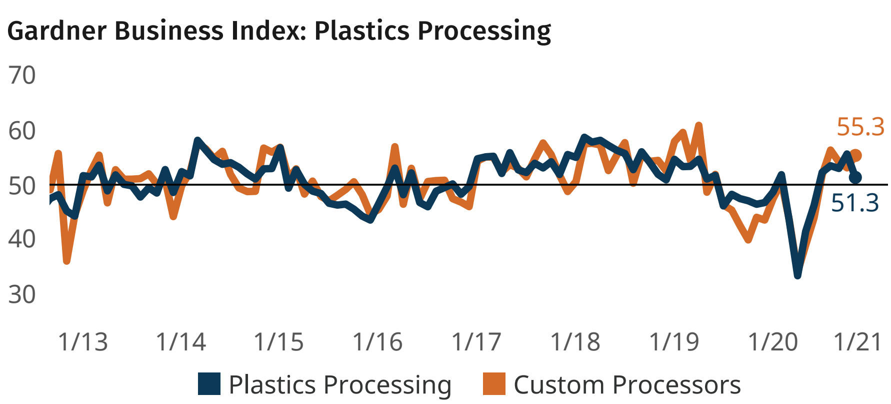


FIG 1

The Plastics Processing Index fell by more than 4 points due to a significant slowing of new orders and production activity. The Index reported some of the most challenging supply-chain conditions in history.

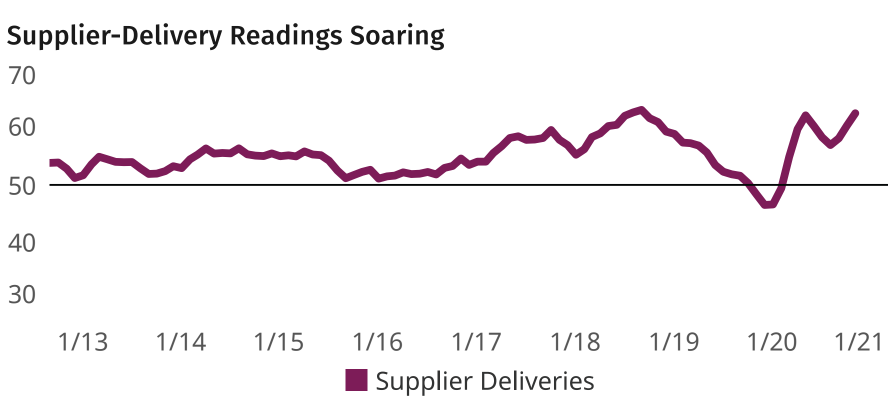


FIG 2

Supplier-delivery readings during October and November were some of the highest ever recorded in the history of the Index. An influx of seasonal package deliveries and vaccine distribution on already-strained carriers during the fourth quarter will only worsen supply-chain conditions, further encumbering production.

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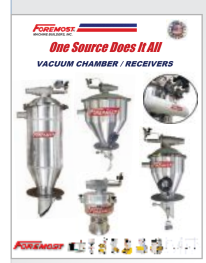

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INTERTAPE POLYMER GROUP — TREMONTON, UT

New Die-Cleaning System Boosts Efficiency for Film Processor

IPG's investment in Schwing's cleaning system impacts processor's bottom line by getting dirty film dies back into production quickly.

Spiral-mandrel section of blown film die (not an IPG die) before entering Schwing cleaning oven.

By Jim Callari
Editorial Director

Time is money. Downtime is lost money. Perhaps nowhere is this adage more relevant than in extrusion. And within extrusion, it is most appropriate in operations that run around the clock. So, when it came time to select a system to clean blown-film dies, the shrink- and stretch-film segment of Intertape Polymer Group (IPG) went looking for a system that would do the job as quickly as possible, critical for its 24-7-365 operations.

IPG is a recognized leader in film-based, pressure-sensitive and water-activated tapes, as well as polyethylene and specialized polyolefin films, protective packaging, engineered coated products and even machinery for packaging. Headquartered in Montreal and Sarasota, Fla., IPG employs approximately 3500 with operations in 31 locations, including 21 manufacturing facilities in North America, four in Asia and one in Europe.

Clean spiral-mandrel section of blown film die (not an IPG die) after cleaning in Schwing oven.

At its plant in Tremonton, Utah, IPG makes a range of shrink and stretch films with up to seven layers on four blown-film and one cast-film line. Don Flint, processing technician at the Utah plant, recalls that in 2019 the company began steps to replace its gas-fired burnout oven, which IPG says had become inefficient and labor-intensive. IPG looked at alternative cleaning technologies—notably dry-ice blasting—before settling on technology offered by Germany's Schwing Technologies (Schwing North America is in Princeton, N.J.).

IPG opted for Schwing's VacuClean system. This is a thermal-cleaning oven that heats up dies slowly and uniformly under vacuum for even heat penetration, reportedly with no hot spots, flames or burning. It's a three-phase system (heat-up/melt-off, pyrolysis and controlled oxidization) that is said to provide complete cleaning while eliminating any damage from exothermic reaction, such as hot spots and burning.

IPG runs the VacuClean on dies of 32 to 48 in. diam, about four times/yr. It also uses it to clean screen packs and cast-film feedblocks. Compared with its previous cleaning system, the Schwing unit has "cut downtime in half, at least," Flint says. Adds Holland Butler, maintenance manager at IPG's Utah facility, "The VacuClean electric system is more efficient than our previous gas-to-burn oven. Plus, our previous gas system required a lot more labor after the cleaning cycle to do additional cleaning and reassembly. All told, this took seven to 10 days. With VacuClean, once the dies are cleaned, our operators just need to dust them off and reassemble. The labor is much less; the dies are clean out of the oven. The entire process takes about 48 hr."

IPG also gives kudos to Schwing in customer service and support. Says Flint, "We send them run data and they evaluate water-flow pressure setpoints and burn data to help us ensure the process is optimized."

Notes Andrew Dickinson, sales manager for Schwing North America, "We have spoken to blown-film processors that send their dies out for service cleaning and wait for two to three weeks or more. All this downtime can cost companies hundreds of thousands of dollars per year." On average, says Schwing, most of its customers achieve a return-on-investment time of 1.5 yr or less.

Schwing says the VacuClean system is also more environmentally friendly than other ovens. Dickinson elaborates, "VacuClean uses an efficient, electrically heated package with very low operating cost. A full cleaning cycle will only cost a few dozen dollars in electricity and water per run. There is no gas required. The built-in catalytic converter eliminates pyrolysis fumes. There is also no contamination of cooling water." PT

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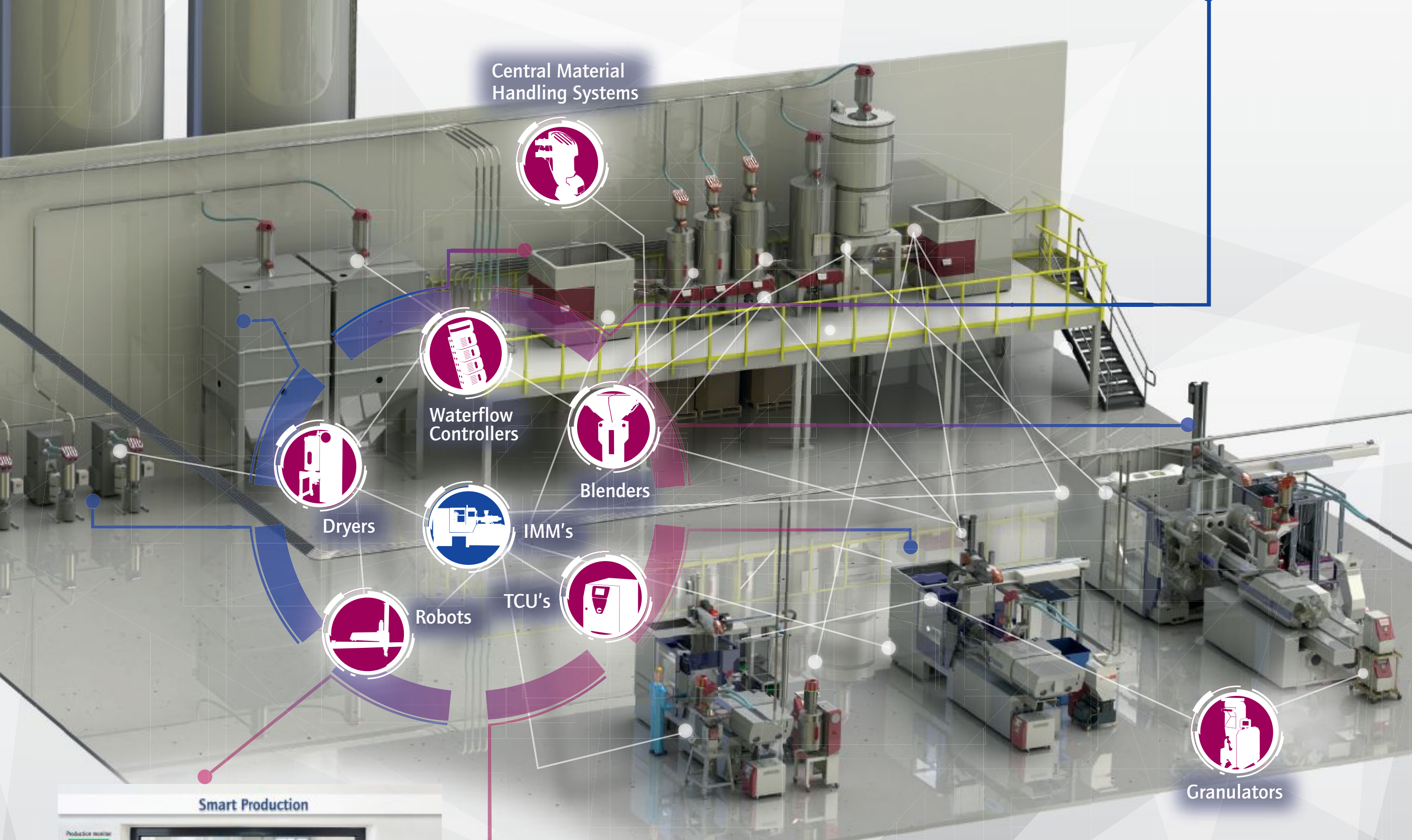

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