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Plastics Technology

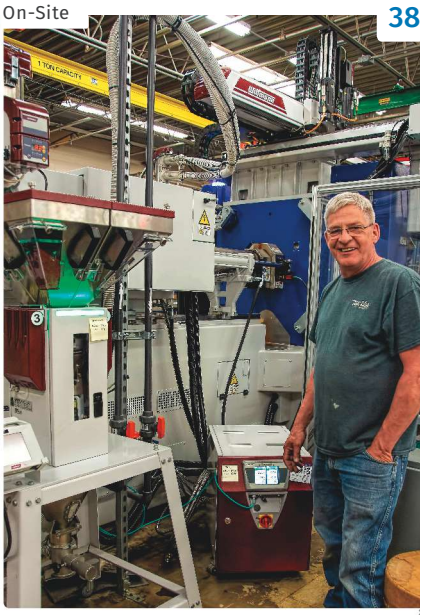
Cover Story

Trash as Value: Turning Ocean Waste Into Viable Products

So-called "ocean plastics" is a global problem, but a wide range of companies across the entire supply chain have put in the time, money and R&D efforts necessary to make capturing and converting the material into a sustainable business. But demand must follow.

By Heather Caliendo, Senior Editor

On-Site



Industry 4.0 Gives DMT a Sharper Edge

Leading maker of blade sharpeners boosts productivity in captive molding with cutting-edge connectivity.

By Matthew H. Naitove, Executive Editor

Tips and Techniques

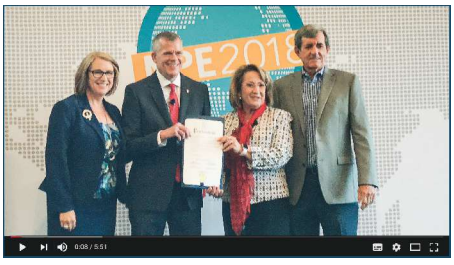
An Engineering Approach to Mold-Cooling Circuit Design

The Energy Density vs. ΔT/in. relationship is an important step forward in pursuit of a science-based approach to cooling-circuit design. Here's why.

By Philip M. Burger
Burger & Brown Engineering

There's more on the web at *PTonline.com*

NPE on TV



A confetti cannon, Orange County's mayor, and Plastics Industry Association President and CEO Bill Carteaux were just some of the elements of the NPE2018 opening ceremony. If you couldn't make it to Orlando or just missed the event, check out the video on *PT*'s YouTube channel. ***youtu.be/PnRk9ml_h6U***

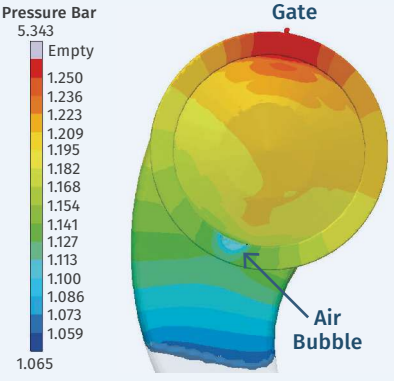
BLOG: NPE2018 Reporter's Notebook

Working his 16th NPE, *Plastics Technology* Executive Editor Matt Naitove will share the latest from the big show in these pages as well as on *PT*'s blog. Online he has updates on 3D printing of LSR, the rise of dashboards, and more from the Orange County Convention Center. ***tinyurl.com/yddtn4an***

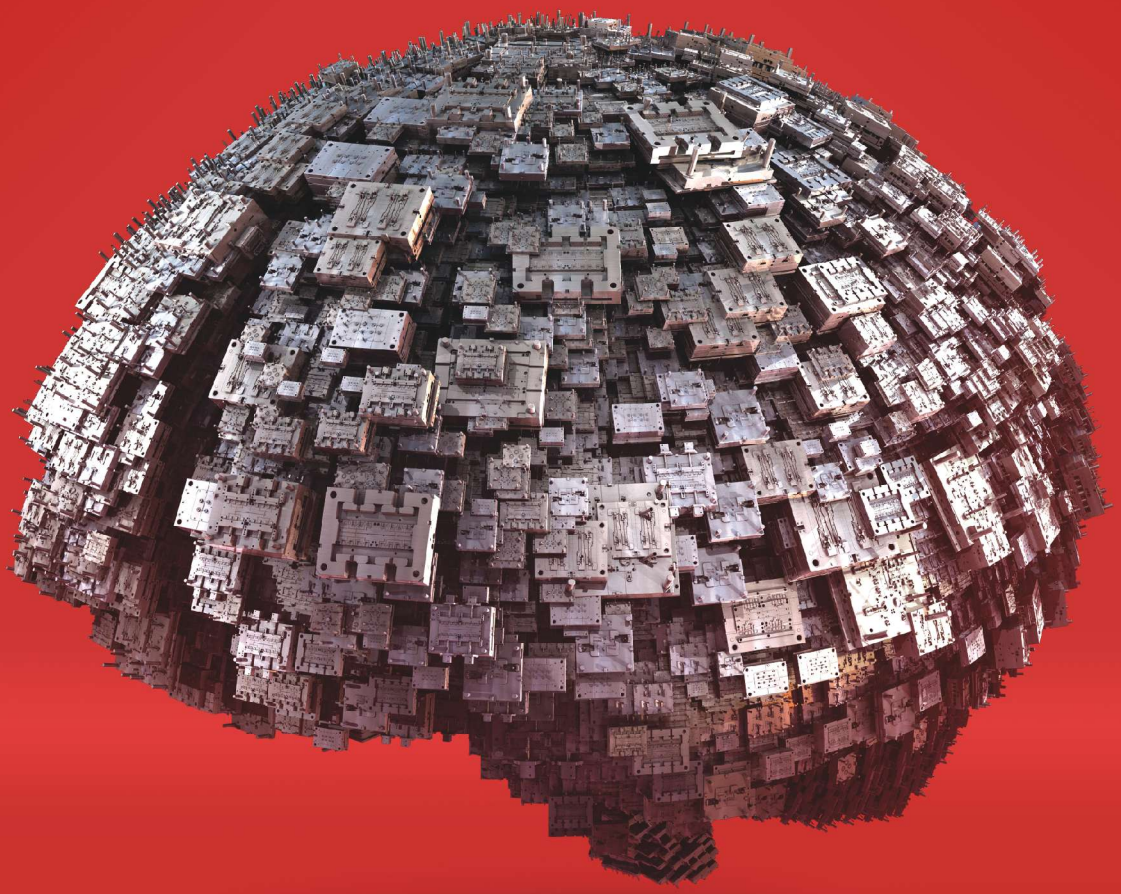
Stay up with our video reports by subscribing to our YouTube Channel: ***short.ptonline.com/yfZBD0uY***

ON-LINE FEATURE: Smart Simulation Gets Smarter...by Learning

Sigma Plastics Services breaks down the new technology of Autonomous Optimization. The software tests multiple variables like gating, venting,



and cooling by performing hundreds or thousands of simulations. It then learns which combinations help achieve objectives for injection pressure, cycle time, warpage, and more. ***tinyurl.com/ybcsmlxl***



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Registration Opens for Extrusion 2018 Conference

Industry-leading—and first-of-its-kind—annual conference devoted to all things extrusion is coming to Cleveland in September.

Jim Callari
Editorial Director

Polybagged along with this issue is the full conference brochure for *Plastics Technology*'s Extrusion 2018 Conference, to be held Sept. 18-20 at the Huntington Convention Center in Cleveland. If you extrude film, sheet, pipe/profile/tubing, or compounded pellets, I strongly encourage you to take a close look at the technical program and list of exhibitors. Once you do, I'm confident you'll want to register to attend *Plastics Technology*'s fourth event devoted to all things extrusion.

Our first three extrusion conferences were held in Charlotte, N.C., with attendance growing each time to roughly 500 last year. But Cleveland and the surrounding area is an extremely strong market for extrusion and is within a day's drive from many other cities strong in extrusion, such as Detroit, Cincinnati, Pittsburgh, Chicago, New York and Toronto.

Our annual Extrusion Conference—the first of its kind—is distinctive in that it brings together the entire extrusion community under one roof. The program is set up so that no matter what you are extruding—film, sheet, tubing, profiles, pellets, etc.—there will be plenty there for you to learn. Over the past three years, attendees have told us time and again that they came away from the event with information and tips they can put in place immediately to make their operations more productive. And the networking opportunities—with roughly 70 of the world's top minds in extrusion as speakers and an anticipated exhibit area of 80 companies—are unprecedented.

The program will kick off on the afternoon of Tuesday, Sept. 18 with a session on what we've been calling General Extrusion. Those technical presentations will focus on topics relative to *all* types of extrusion processors—resins, additives, blending, drying, conveying, foaming, reclaim, controls, filtration, training, simulation, screw design, and so on. We will have additional General Extrusion sessions on the mornings of Wednesday, Sept. 19; and Thursday, Sept. 20; followed by concurrent breakout sessions after lunch on those two days, packed with presentations to give you the opportunity to hone in on your specific process. We have four of these concurrent sessions: Cast/Blown Film, Sheet, Pipe/Profile/Tubing, and Compounding.

> ***Attendees have told us that they came away from the Extrusion Conference with information and tips they can put in place immediately to make their operations more productive.***

The focus of each presentation will be on new developments, best practices, troubleshooting, processing tips and techniques—practical, hands-on material patterned after what we present every month in print and online.

There will be ample opportunity for you to network with the sharpest minds in the extrusion business during scheduled breaks, receptions, and luncheons in the tabletop exhibit area packed with suppliers of the goods and services you rely on every day to run your business.

Begin the registration process by logging on to *extrusionconference.com*. And don't forget to book your hotel, as rooms fill up fast. The official conference hotel is Marriott Downtown at Key Center.

Your time and money are precious. But if you are involved in extrusion of any type, the Extrusion 2018 Conference is the place to be. I hope you can make it. In the meantime, please feel free to direct any questions you might have to me at *jcallari@ptonline.com*.

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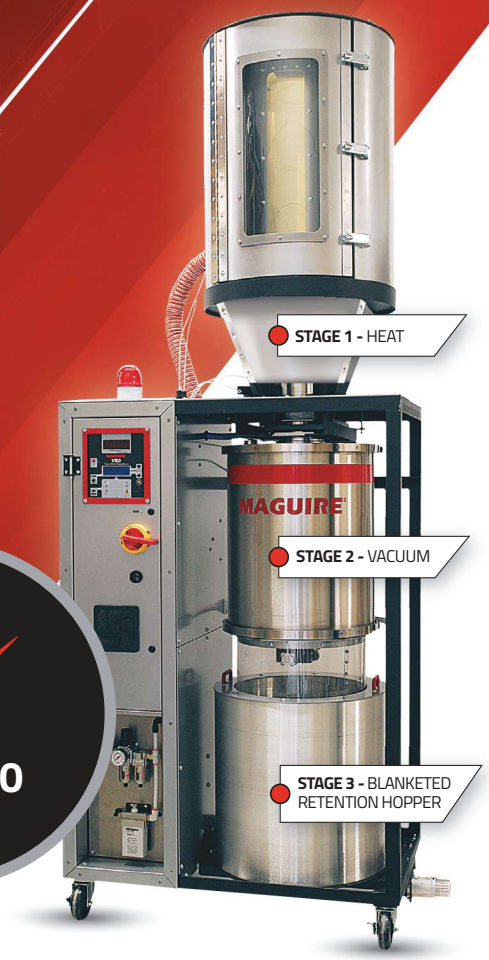

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Wittmann Battenfeld Celebrates 10th Anniversary with Launch of New Machines

Last month, Wittmann Battenfeld celebrated the 10th anniversary of Wittmann's acquisition of the Battenfeld injection machine business at the company's headquarters in Kottingbrunn, Austria. A highlight of the event was the announcement of a new machine line and expansions of several other press series.

• A prototype of the new servohydraulic VPower vertical press line was displayed in a 160-metric-ton version. Other models of 120, 200, 250, and 300 m.t. are planned. Key features include a "substantially reduced" footprint; low, ergonomic working height; servo-electric rotary table; easy conversion of the injection unit from vertical to horizontal, and open design for easy integration of automation systems. The first machines are due to go on sale this fall, in time for the Fakuma 2018 show in Germany.

• The company is supplementing its EcoPower Xpress 400 with a new 500-m.t. model. These are both high-speed, all-electric machines tailored for packaging and thin wall molding. It's available now.

• A larger, 400-m.t. model of the SmartPower servohydraulic line will be available this year. Current sizes are 25 to 350 m.t.

• The company is building larger models of its MacroPower hydraulic two-platen presses, including MacroPower XL 1100 and 1600 units and the largest in the series, MacroPower 2000, the first of which was completed in January. The first MacroPower 2000 two-component version was shown at the anniversary celebration.

860-496-9603 • wittmann-group.com

Davis-Standard Buys Brampton Engineering

Davis-Standard LLC, Pawcatuck, Conn., has acquired Brampton Engineering, Brampton, Ont., a global supplier of complete blown film systems that include "pancake"-style coextrusion dies, air rings, winders, control systems, and a variety of other products. The purchase marks Davis-Standard's second move in recent years to expand its presence in blown film. In 2015, the company purchased Gloucester Engineering from investment firm Blue Wolf Capital.

More recently, D-S bought Maillefer International Oy of Finland and Switzerland. Maillefer is a global leader in wire, cable, pipe and tube production technologies.

860-599-1010 • davis-standard.com

Sytrama Plans U.S. Robot Assembly At New Michigan Plant

At last month's Plast 2018 show in Milan, Italy, representatives of Sytrama told *Plastics Technology* that the maker of injection molding robots would move its U.S. headquarters from New Castle, Del. (sharing space with sister company Negri Bossi), to Canton, Mich., largely to be closer to automotive customers. What's more, Sytrama plans to begin U.S. assembly of robots at the new 32,300-ft^2 facility, which it plans to occupy by the end of this year or early 2019.

302-328-8020 • sytrama-usa.com

Negri Bossi Puts a New Spin on Microcellular Foam Molding

More details are available on the FMC Foam Microcellular Molding Process from Negri Bossi of Italy (U.S. office in New Castle, Del.). FMC was introduced in Europe at the FIP 2017 show in France last year and in North America at NPE2018 in May. FMC is an alternative to the MuCell microcellular foam process from Trexel, Wilmington, Mass. (***trexel.com***), which Negri Bossi also offers. Whereas MuCell involves injecting nitrogen gas into the melt through a port in the injection barrel, FMC injects the gas into a channel in the center of the screw. Gas is introduced at the back end of the screw, behind the feed section, and enters the melt through a series of "needles" in the metering section of the screw during the plasticating stroke. Although a special screw is still required, no modification of the injection barrel is necessary. Negri Bossi also claims that FMC allows use of the full shot capacity of the machine and imposes no limit on the plasticating stroke.

As was demonstrated at NPE, Negri Bossi has applied FMC to foaming both thermoplastics and liquid silicone rubber (LSR). In the latter case, foaming offers potential savings of costly raw material and the possibility of achieving new levels of softness.

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PTi Opens Technology Development Center

Processing Technologies International LLC (PTi) has opened a Technology Development Center (TDC) at its Aurora, Ill., headquarters, a demonstration center for product development and process trials using production-scale sheet lines. The TDC showcases the company's most innovative sheet extrusion lines and helps processors with product development.

The 15,000 ft² TDC houses two demonstration sheet extrusion systems, including PTi's High-Vacuum Twin-Screw Extruder sheet extrusion system, featuring Luigi Bandera's patented dryerless technology that allows PET to be processed without drying and crystallizing. The second line features PTi's Super-G HighSpeed Extruder, which delivers improved melt quality as a result of Super-G Lobe screw technology and can be integrated with all of PTi's advanced G-Series Configurable roll-stand configurations.

The TDC lines offer outputs ranging from 2300 lb/hr for the HVTSE dryer-less system to 3000 lb/hr for the Super-G HighSpeed, so trials and training can be conducted at typical production rates. Blending, silicone coating, and multiple-up winding can be incorporated.

The new facility is part of PTi's recent $10 million plant expansion in Aurora in response to growing demand for sheet extrusion equipment. The company increased overall plant capacity by 50% and added 40,000 ft² of primary manufacturing and office space and up to 40 new jobs.

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PolyOne Acquires PlastiComp

It was just two years ago that PolyOne Corp., Avon Lake, Ohio (***polyone.com***), made two acquisitions that positioned it for "next-generation" composites development in the thermoplastic and thermoset arenas. The company now has strengthened its position with the acquisition of PlastiComp, an advanced engineered materials innovator and producer of specialty composites.

Since its foundation in 2003 by industry veteran and composite pioneer Stephen Bowen, the Winona, Minn.-based specialty compounder (***plasticomp.com***) has steadily grown through its ability to replace metal and lightweight products with unique and complex long-fiber thermoplastic (LFT) composite formulations. Such formulations are based on fiberglass, carbon fiber and hybrids of the two. Inherent benefits of LFT-based materials include high strength and stiffness, design freedom, fatigue endurance, corrosion and wear resistance, EMI shielding, and recyclability.

PlastiComp's 50 employees and its design and production facility in Winona join PolyOne as part of the Specialty Engineered Materials segment. Through its Complet product line and design capabilities, PlastiComp serves global customers in a wide range of demanding applications, including medical devices, robots and drones, marine, and outdoor high-performance equipment.

MachineSense & Siemens Partner on Power Quality

At NPE2018 in May, Baltimore-based MachineSense LLC (***machinesense.com***) demonstrated its Power Analyzer product on the Siemens' MindSphere IoT platform. The companies say MachineSense Power Analyzer is the first vertically integrated IIoT (Industrial Internet of Things) solution in Siemens' MindSphere Platform that offers power-quality monitoring, energy management, predictive and preventive maintenance, and machine utilization as a MindSphere Application.

MachineSense announced at the show that it has joined the global MindSphere Partner Program as a Silver partner, which will provide MachineSense's technical staff access to Siemens' MindSphere curriculum and to other MindSphere ecosystem partners. These partners can complement the capabilities of MachineSense and Siemens, based inAlpharetta, Ga. (***industry.usa.siemens.com***).

MachineSense's Power Analyzer series is designed to help diagnose everyday electrical issues and present them in a way that can be easily understood by plant maintenance and management alike, regardless of experience of electrical components and related issues. "The technology is one of the most comprehensive series of vertical IIoT products for power quality, predictive and preventive maintenance, energy monitoring, and machine utilization available for factories and commercial buildings," says MachineSense co-founder Conrad Bessemer.

MindSphere is the cloud-based, open IoT operating system from Siemens that connects products, plants, systems, and machines, enabling businesses to harness the wealth of data generated by the Internet of Things with advanced analytics. MindSphere Application Centers have been designed to develop new business models, digital solutions and services, and industrial applications in focused verticals using MindSphere.

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Topas COC Resins Now Part of Polyplastics USA

Engineering thermoplastic resins supplier Polyplastics USA, Farmingdale, Mich., has absorbed its affiliate Topas Advanced Polymers Inc. (TAP USA; previously located in Florence, Ky.), adding Topas's cyclic olefin copolymer (COC) resins to its existing portfolio of acetal, PBT, and PPS. Polyplastics has held an ownership stake in TAP GmbH for over a decade, and the merger is a key milestone in Polyplastics' efforts to build a strong market presence in the Americas. "We plan to leverage and further enhance TAP GmbH's global leadership position in COC," said Lindsey Deal, president of Polyplastics USA, and Timothy Kneale, president of TAP USA, in a joint statement.

859-888-1307 • polyplastics.com

Eastman Completes Tritan Expansion, Plans Additional Capacity

Eastman Chemical Co., Kingsport, Tenn., has completed an expansion for Tritan copolyester. Its new plant at Kingsport is fully operational, and the company has another expansion of copolyester production underway at this site. This is slated for completion in third quarter and will increase PETG and PCTG capacities by approximately 25% of the Kingsport specialty copolyester total capacity. PETG and PCTG are known by the trademarks Eastar, Spectar and Aspira, among others.

800-327-8626 • eastman.com

Industry Bracing for Possible Shortage of Nylon 66

Industry concern over potential nylon 66 supply shortages in the next three years is based on two factors: fast-growing demand in the automotive industry—which reportedly accounts for over 50% of global nylon 66 demand—and strains on capacity for producing a key feedstock, adiponitrile (ADN), used in the production of primary nylon 66 component hexamethylene diamine.

Cliff Watkins, director of applications development for resin distributor PolySource, Independence, Mo. (***polysource.net***), recently shared his analysis of this issue. "First, we as an industry need to educate our customers and specifiers that the supply chain of nylon 66 is under extreme, long-term pressure," he states. "The seven *force majeure* declarations made across the U.S. and Europe in the first two months of 2018 underscore the snug relationship between supply and demand. The nylon 66 shortage we face today is the result of a structural lapse in supply not keeping up with demand—not in polymerization or compounding, but in the fundamental intermediate ADN. Manufactured in four high-volume plants, three in the U.S. and one in France, ADN supply is forecasted to lag demand dramatically, for at least three years."

The good news, Watkin says, is that "recently announced investments in new ADN capacity show positive signs that producers have realized that the current situation is untenable." He points to expansion and debottlenecking projects announced by Butachimie (a joint venture of Solvay and Invista), Invista, and Ascend. In the latter case, Houston-based Ascend Performance Materials (***ascendmaterials.com***) completed its first ADN expansion of 100 million lb at the end of 2017, and will have an additional 80 million lb by year's end. A further expansion of 360 million lb will be realized by 2022.

Nonetheless, Watkins says all this will not be sufficient to meet market demand until 2021, at the earliest. In the meantime, "Nylon 66 resin and compounds are skyrocketing in cost, while manufacturers that rely on nylon 66 for their products struggle to meet their supply needs, at any price. Nylon 66 demand will quickly outpace supply by more than 220 million lb, and some nylon 66 consumers will be forced to consider an alternative, because nylon 66 will simply not be available—regardless of price. Moreover, if demand continues at the current rate, it is possible that the gap could escalate as high as 600 million lb in the next couple of years."

RTP Boosting Capacity

RTP Co., Winona, Minn., expects to significantly increase its production capacity by year's end. The company announced last fall that it would reopen its Dayton, Nev., compounding plant, which was shuttered in 2001. The plant is undergoing significant upgrades, including updated mechanical and electrical systems, new energy efficient lighting, and recirculating water chillers. The company is also adding new capacity for high-volume compounding at Portage, Wis.

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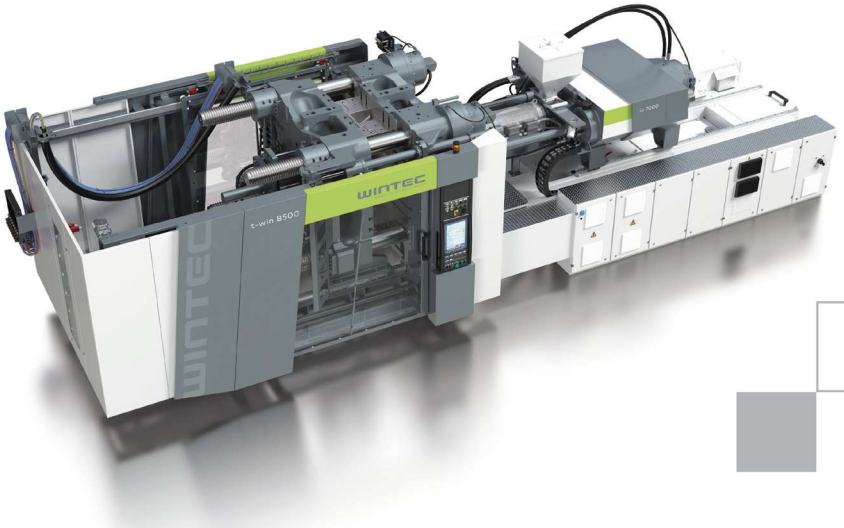

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News Highlights from NPE2018

Developments in Industry 4.0, multi-layer preform molding, automation, LSR processing, and PP were among the major newsbreakers at May's show. And one film processor finalized purchases of 13 new lines.

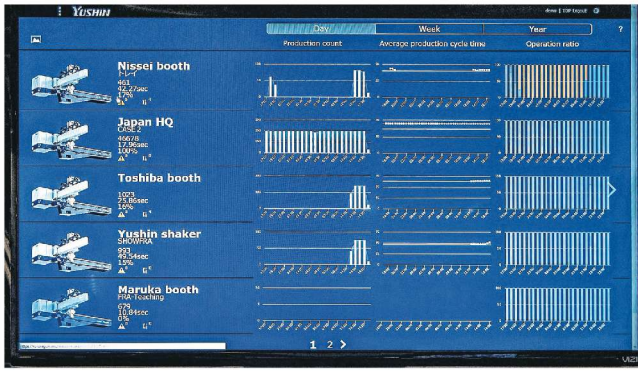
By Matt Naitove, *Executive Editor*
Jim Callari, *Editorial Director*
Lilli Sherman, *Senior Editor*

NPE2018 set records for exhibit space (1.2 million ft²), number of exhibitors (2180), and probably the amount of technological innovation on display. An announced attendance of 56,034 (up 1.7% from NPE2015) confirmed registered attendees from almost 19,000 unique companies. A dozen editors at *Plastics Technology* and sister publications of Gardner Business Media have reported literally hundreds of pages of news in NPE2018 pre-show issues and five Show Daily issues distributed at the Orange County Convention Center in Orlando, Fla. But for the latest word on new technology at NPE2018, here's a brief selection of some of the more intriguing developments, and stay tuned for our post-show roundups in August and September.

'SMART DATA': THE RISE OF THE 'DASHBOARDS'

For North American plastics processors, NPE2018 offered the broadest exposure yet to the bundle of trends and technologies known as Industry 4.0 or the Industrial Internet of Things (IIOT). The timing was right: The week before the show saw the release of the first standard for digital interfaces based on the OPC UA (Open Platform Communications Unified Architecture) machine-to-machine communication protocol that is the basic platform for emerging Industry 4.0 technologies. Euromap 77, a standard for data exchange between injection molding machines and MES (manufacturing execution systems) computers was released on May 4 by Euromap, the European Association for plastics and rubber machinery manufacturers (***euromap.org***). It allows machines from different manufacturers to be easily connected in one network for monitoring and production data acquisition, management of production jobs, and transfer of whole datasets for machine settings.

Husky is exploring varied applications for PET bottles made from co-injected three-layer preforms. The middle layer can introduce barrier protection or, as in these examples, decorative effects, enhanced by varying the layer thickness to "fade" the color.



One sign of the incoming wave of Industry 4.0 technologies was injection and blow molding machines, MES systems, robots, and auxiliaries that send production data to the cloud for retrieval anytime/anywhere in the form of easily digestible "dashboards" of essential data. Two examples here: Milacron's M-Powered display and Yushin's dashboard of real-time data from robots around the show and even in Japan.

One sign of how this new standard is already being realized was the appearance of production-data "dashboards" all over the show. Under the banner of "Smart Data, not Big Data," suppliers of injection and blow molding machines, process-monitoring systems, MES systems, and even robots and other auxiliary equipment showed their latest efforts to avoid overwhelming users with masses of data by displaying quick snapshots of crucial data—job production totals, time to job completion, good/bad part counts, cycle time,

OEE (Overall Equipment Effectiveness) statistics, and color-coded machine status. Such data are uploaded to the "cloud" so as to be available to computers and mobile devices anywhere, 24/7.

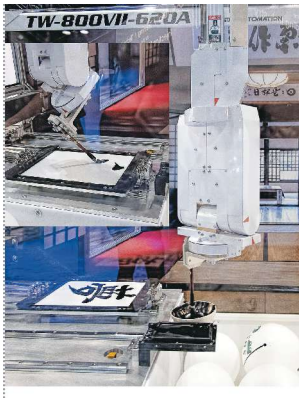
INJECTION MOLDING NEWS

Multi-layer injection molding of barrier containers and PET bottle preforms was highlighted by Milacron Inc. (***milacron.com***) and Husky Injection Molding Systems Ltd. (***husky.co***). Husky displayed examples of how sandwich molding of three-layer PET preforms can be used for other functional and decorative purposes. For example, the center layer could incorporate, instead of a gas barrier, a thermochromic pigment that would signal when a bottle is cold or warm. Fluorescent pigments could be used to make the bottle appear a different color when subjected to UV light. Other decorative effects are possible by continuously varying the thickness of the pigmented middle layer during injection of the preform, so that blown bottles show a transition from clear to colored or between two colors.

Another area of technological innovation displayed at NPE was LSR molding. Negri Bossi, (***negribossi.com***), molded a ping-pong paddle using three materials—PBT for the basic structure, TPE for a soft-touch grip, and LSR in two colors for the resilient faces of the paddles. What made this particularly interesting was the injection of nitrogen gas for microcellular foaming of the PBT and the LSR. In fact, Negri Bossi said it could differentiate the resiliency of the two paddle faces by foaming one face and not the other.

Two-color LSR egg cup was molded at Sigma Plastic Services booth using a single-barrel Arburg injection press and a single Elmet pumping system. T-coupling visible here diverted a small stream of LSR to a second static mixer and pneumatic piston pump, where the second color was added.

There were at least three demonstrations at NPE of LSR/LSR molding in two colors and/or durometers in the same part. As previously reported, two other examples were shown by Arburg (***arburg.com***). Another was conducted at the booth of Sigma Plastic Services, Schaumburg, Ill., which simulated the process in its Virtual Molding software (***virtualmolding.us***). What was special about this application was that two-color LSR egg cups were molded on a single-barrel Arburg machine with a single Elmet metering system. Shown for the first time in the U.S., this application used a T-coupling to divert a side stream of LSR to a second static mixer and a side-mounted pneumatic piston pump that delivered the second color.



Star Automation programmed a servo robot to paint Japanese calligraphy (inset) after carefully loading the brush with ink and rinsing the brush between demonstrations.

'ARTISTIC' ROBOT

Previous NPE shows have featured robots playing basketball and miniature golf. An imaginative display this year was a robot from Star Automation (***staraautomation.com***), using a new three-axis servo head to do Japanese calligraphy. The robot carefully loaded the brush with ink, painted the figure, and then rinsed the brush.

Yushin America (***yushinamerica.com***), put together a complex cell just to demonstrate the versatility of robots for accomplishing multiple tasks in one molding cycle. The cell combined two injection presses, each with a servo linear robot, plus a seven-axis collaborative robot (cobot). The end product was a "shaker cup" for making milk shakes and other mixed beverages. The two presses molded a PP cup and a lid with a flip-top closure attached by a living hinge. The two parts were threaded; the robots each used a servo wrist to unscrew the parts from the molds. The robot that demolded the cup also placed an in-mold label in the mold beforehand and presented the cup to a pad printer after molding. The second robot unscrewed the lid, closed the pour spout, placed information cards inside the cup, and then screwed the cup and lid together. Finally, the cobot placed the assembled product on a conveyor.

An imaginative display this year was a robot using a new three-axis servo head to do Japanese calligraphy.

BLOW MOLDING: THEY SAID IT COULDN'T BE DONE

Jomar Corp. (***jomarcorp.com***), may have opened some eyes to the unsuspected capabilities of injection-blow molding. At NPE, Jomar molded polycarbonate LED bulbs on its new IntelliDrive 85S servohydraulic injection-blow machine. Molded eight-up in 11.5 sec, the bulbs had only slightly visible gate marks and parting lines—something not supposed to be possible with this process, according to Jomar sales manager Ron Gabriele. He credits both the know-how of Jomar's processing team and the skills of the toolmaker, Lenape Mold in Millville, N.J. ►

Another interesting development was highlighted by W. Muller USA (***mullerheads.com***). The company has found that plasma spray coating of amorphous metal onto the flow channels of its extrusion blow molding heads greatly speeds color changes. According to Jens Schlueter, general manager, the coating penetrates the surface of the steel and reduces the tendency of plastic to stick to the metal. Because the plasma is a gas-phase process, it penetrates even the smallest flow channels in the head.

Jomar injection-blow molded PC LED bulbs with high cosmetic quality said to be unprecedented for this process.

The coating was tested at a customer in the U.S. who has two identical shuttle machines in two different plants, both with Muller heads, one plasma coated and one head uncoated. In molding 1-gal HDPE jugs with a view stripe, the coated head required a total of 45 min to make the transition from blue to red and back to blue. The uncoated head required 75 min to make the same transition, Schlueter reports. He says the coating adds 10-15% to the cost of the head.

3D PRINTING LSR

Distributor RDAbbott, (***rdabbott.com***) showed off a system for 3D printing with LSR, developed by Dow Silicones (previously Dow Corning), Midland, Mich. (***consumer.dow.com***), and German RepRap, a maker of industrial 3D printers (***germanreprap.com***). Called Liquid Additive Manufacturing (LAM), the system injects liquid A and B components from two pressurized tubes into a pump that maintains a 1:1 ratio. The pump feeds a head under x-y motion control, which and lays down a continuous bead, similar to FDM or FFF-style 3D printers. The system deposits layers as thin as 0.2 to 0. 35 mm thick, which are fully cured by a heat lamp, a whole layer at a time. The system uses Dow's Evolv3D LC 3335 LSR material, which produces a 44 Shore A hardness without post-cure and 46A with post-cure. The LAM 3D printer reportedly produces parts with 100% of the tear strength of injection molded samples, 90% of their tensile strength and hardness, and 85% of their elongation. Applications in development include honeycomb custom orthotic shoe soles.

The patent-pending printer was introduced last year; it can print at 10 to 150 mm/sec. Dow is developing additional grades in other Shore hardnesses, expected later in the year.

New plasma metal coating of flow channels in W. Mueller's extrusion blow molding heads allows as much as 40% faster color changes at modest extra cost.

FILM PROCESSOR'S SPENDING SPREE

In extrusion, a leading PE film processor grabbed the biggest headlines. At NPE2018, Sigma Plastics Group (***sigmaplasticsgroup.com***), Lyndhurst, N.J, closed deals on 13 new film lines and four recycling systems. The firm said six new Optimex FFS lines it ordered from Windmoeller & Hoelscher (***whcorp.com***) will be up and running at its Republic Bags plant by the end of the summer, producing blown film for form-fill-seal sacks. This installation marks Sigma's first foray into the FFS market. The lines will produce about 45 million lb/yr of film, printed and gusseted.

Meanwhile, Sigma's McNeeley Plastics plant has ordered two W&H Varex II blown film lines—a three-layer and a five-layer system. The latter will be equipped with W&H's Turboclean resin-purging and quick-changeover system and a Filmatic S winder with reverse-wind capability. This investment will support McNeely's expanding business in converter-grade films. In early May, Sigma started up a five-layer Varex II line at its ISOFlex plant.

Sigma also announced it has ordered two high-output five-layer polyolefin-dedicated (POD) lines from Reifenhauser for its BJK plant, both equipped with the machine builder's Ultra Cool IBC and Ultra Flat patented in-line flattening system. Sigma also bought another two lines from Reifenhauser (***reifenhauserinc.com***) for its Allied Extruders division: a three-layer high-output system and a five-layer POD line. Both lines will also be equipped with Ultra Cool and Ultra Flat technology.

Sigma also announced it had bought three Davis-Standard film lines: one 2.5-meter cast hygiene-film line and two five-layer agricultural blown stretch-film lines. The cast hygiene line is the second of its kind purchased by Sigma in the last three years. It will be engineered for A/B/A structures with in-line printing capabilities. The five-layer ►

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stretch lines will include Davis-Standard (***davis-standard.com***) Optiflow LP dies and vertical oscillating haul-off technology.

What's more, Sigma added four high-output recycling lines from NGR Plastics Recycling Technologies (***ngr.at***). The four S:Gran 125 machines will reprocess more than 4 million lb/month of film scrap. The new recycling lines represent an investment of nearly $3 million and will be installed at plants in Pompano Beach and Jacksonville, Fla.; Spartanburg, S.C., and Nashville, Tenn.

MATERIALS: PP STEALS THE SHOW

In materials news, polypropylene advances shined at NPE2018, with at least four resin suppliers introducing new generations of PP that redefine the material's application spectrum. New and enhanced polymerization processes and catalysts have resulted in unique PP grades for injection molding, extrusion and thermoforming. Enhanced properties range from higher impact, stiffness and melt strength to high clarity and gloss, along with a broader temperature-resistance profile and superior processing.

Exxon Mobil Chemical (***exxonmobilchemical.com***) launched the new Achieve Advanced PP family, which is based on new proprietary catalyst, process and application technology and is said to allow customers to rethink what is possible in a range of applications:

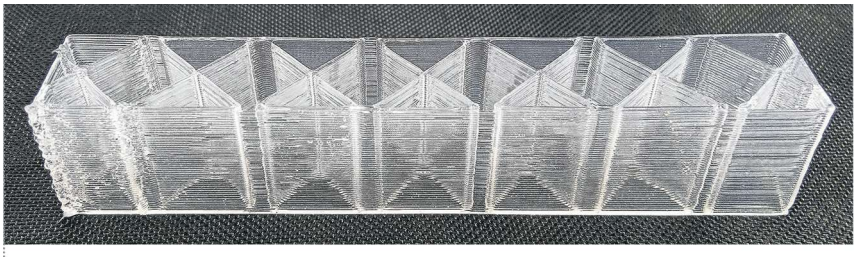
- *Automotive*: Achieve Advanced PP8285E1 is a high-crystallinity, high-impact copolymer (ICP) said to offer 35% higher impact and 20% improved toughness (low-temperature ductility) vs. standard ICPs, enabling injection molding of components that are tougher and lighter, durable and safe. Plastomer loading can be reduced by up to 50% for cost-saving opportunities. It boasts increased opportunity to use PP for efficient designs in conventional and "new-energy vehicles." It can be used neat or in compounds for interior components such as instrument panels, door-panel trim and pillar trim, and exterior parts such as bumper fascia and wheel-well liners.

At NPE2018, PE film processor Sigma Plastics Group closed deals on 13 new film lines and four recycling systems.

- *Appliances*: PP7123KNE1 is reportedly suited to eye-catching appearance parts for appliances such as vacuum-cleaner covers as well as lids and door handles. It boasts superior gloss and stiffness and is said to be a good replacement for standard ICPs or over-engineered ABS. Other applications include cosmetics, electronics and toys.

- *Medical packaging, labware, electronics, automotive and industrial*: PP1605 is a homopolymer injection molding resin based on Exxpol metallocene technology, designed for medical, electronics, automotive and other applications requiring cleanliness. It is touted for its lower volatiles and extractables and better clarity than conventional homopolymers.

- *Packaging*: PP6282NE1 is a high-melt-strength (HMS) homopolymer for extrusion, sheet and thermoforming that is said to provide uniform wall distribution and remarkably rigid containers, cups and tubs for the retail and service industry. Exploiting its HMS qualities, designers can deliver stiffer packaging and gain economic benefit from excellent processability. Opportunities exist to downgauge wall thickness by up to 15% and increase line speeds by 7% for higher output. Packaging made with this material is microwavable, dishwasher-safe, reusable, and widely recyclable.



Liquid Additive Manufacturing (LAM) is a new process for 3D printing LSR. This part was printed in Dow LSR on a German RepRap LAM machine. Resilient honeycomb structures are being explored for custom orthotic soles of footwear.

- *Nonwovens*: PP6035G1 and PP6936G2 are two very high-MFR, metallocene-based homopolymers that reportedly set the benchmark for highly comfortable melt-blown nonwovens, allowing brand owners to provide outstanding barrier properties and up to 15% higher fabric strength that can be tailored to meet the needs of diapers, wipes, and feminine-care products.

A new and growing portfolio of PP compounds that deliver a soft feel combined with excellent scratch performance in unpainted, low-gloss automotive interior components was showcased by SABIC (***sabic.com***). These compounds boast luxurious haptics and finishes that consumers demand—even in lower-priced vehicles. These injection molding grades can help automotive OEMs and tier suppliers reduce costs by as much as 50% through the avoidance of secondary operations such as applying soft-touch paint, fabric, foam or other surface coverings.

Indian automaker Tata Motors is the first OEM to use one of the new PP compounds, which was selected for parts with a soft feel and high-end appearance in the steering-column cover and speedometer cluster top for Tata's 2017 Tiago hatchback, which was showcased at NPE2018. Tata eliminated the need for expensive paint systems, saving about 30% while achieving the same level of performance and aesthetics.

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At NPE2018, Sigma Plastics Group purchased 13 film extrusion lines, including six from W&H. L-R: W&H's Peter Steinbeck and Sebastian Huennefeld; Sigma's Mark Teo; W&H's Andrew Wheeler; Sigma's Alfred Teo; and David McKinney of ISOFlex.

In addition to providing an attractive matte surface with excellent scratch resistance, good impact performance and low shrinkage, these SABIC materials also boast good sound-damping capacity and are UV-stabilized to prevent fading and color shift. The portfolio includes several grades of glass-reinforced PP.

Asahi Kasei North America (***akplastics.com***) introduced what it termed a "game-changing" family of glass-reinforced PP. This family of compounds, available in 30%, 40% and 50% glass loadings, is based on a uniquely designed PP matrix that provides excellent rheology for molding big parts. The Thermylene P6 family is based on standard technology, whereas the P7 to P10 families are based on enhanced technology. Further enhanced technology is used in P11, which outperforms P10 in creep resistance at higher temperatures.

Thermylene P11 is said to deliver unprecedented strength and stiffness at elevated temperatures, expanding the performance envelope for conventional glass-reinforced PP design and opening opportunities for thin-wall molding of interior and exterior automotive parts. The company sees P11 compounds as a step in the direction of replacing glass-filled nylon 6 and 66, or glass-filled PBT in car and truck applications that require extreme load-bearing and creep resistance, such as front-end modules, instrument-panel (IP) central control modules, and brackets. Potential non-automotive applications include filter housings and furniture.

Braskem America (***braskem.com***) launched Prisma 6810, said to be a first-of-its-kind clarified PP block copolymer for thermoforming applications such as refrigerated deli containers, cold blended drink cups, and meat and seafood trays. This material reportedly provides an exceptional balance of characteristics not typically seen in single-resin solutions: the toughness of an impact copolymer, stiffness comparable to a homopolymer, and clarity approaching a random copolymer. The 2 MFR copolymer has a flex modulus of 190,000 psi, tensile strength of 4300 psi, and a no-break (NB) notched Izod impact strength according to ASTM D256A.

At NPE2018, custom sheet extruder Impact Plastics (***impactplastics-ct.com***) showcased its new 903D PP sheet produced in partnership with Braskem, utilizing Prisma 6810 resin. The company's sheet was run on a high-efficiency thermoforming machine from Germany's Gabler Thermoform (***gabler-thermoform.com***), touted as the world's biggest tilt-bed machine. Said to be setting new standards in the thermoforming world, the Gabler M100, with a forming area of 1130 x 550 mm, reportedly offers up to 50% higher output rates than other machines on the market.

Four high-output recycling lines from NGR Plastics Recycling bought by Sigma at NPE2018 will reprocess more than 4 million lb/month of film scrap.

Gabler ran a 70-mm diam. PP drink cup on a 90-cavity tool produced by Marbach Tool & Equipment (***marbach.com***) at speeds in the range of 32 cycles/min. Impact Plastics noted that typical ICPs in their natural state are characterized by a cloudy or milky appearance, but with its 903D PP sheet, consumers can now experience the same properties as typical ICPs, even at low temperatures, without sacrificing clarity and aesthetics.

PREDICTIVE MAINTENANCE OPTIONS GROW

The Component Analyzer from MachineSense LLC (***machinesense.com***) tracks the trend health and operating conditions of rotating industrial machinery components 24/7 in order to help processors become more efficient by virtually eliminating reactive mainte-

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nance procedures and unplanned downtime. Component Analyzer senses machine vitals using its patented machine-wearable sensors for preventive and predictive maintenance. Its compact multi-sensing system taps abnormal vibration, machine utilization, ambient operating conditions, bearing health, and sensor installation.

Component Analyzer is both a hardware and a software solution. MachineSense uses powerful analytic software licensed as Crystalball, to understand the data and then reassembles that data into dashboards. The software is accessible through a web browser or mobile app, so users can connect 24/7/365 from any desktop computer, laptop, tablet or phone with an internet connection. Visualization of valuable operating metrics is delivered through easy-to-understand dashboards. Users can quickly scan through the status of many machines to identify potential issues that need to be examined in more detail. Thresholds can be set that trigger notifications be sent to technicians when there's an issue or they can simply rely on the system to issue the baseline established warning when a component or a machine is approaching a fault.

Polypropylene advances shined at NPE2018, with at least four major resin suppliers introducing new generations of the material.

Component Analyzer is capable of three different modes of analytics: a real-time quick view, which is available locally with a mobile app; quasi real-time predictive machine health and an historical view of the machine health issues, both available in a "cloud" database app. Historic data is available through equipment performance trend lines. And a streamlined overview dashboard delivers a clear summary of the analytics for all monitored equipment, neatly organized by department and location.

MachineSense also released a series of LoRa (long-range) sensors. This technology will extend their reach to long-distance and outdoor applications where access to power and Wi-Fi is often an issue. The new high-end wireless sensors will measure vibration, vacuum, pressure, temperature and energy in real time, much like the company's existing sensors, but by using the LoRa technology this IP67 grade sensor can be extended from the typical 15-30 ft distance for Bluetooth Low Energy technology to as far as 6.2 miles line-of-sight distance.

The new sensors will integrate with MachineSense's existing predictive maintenance and analytics products, including Power Analyzer, Vacuum Pump Analyzer and Component Analyzer. PT

INJECTION MOLDING

Safety First: Know the Compatibility of Different Resins

Certain materials don't play well together when mixed. So it's best not to. Here are some guidelines.

By John Bozzelli

Because of the growth of the plastics industry, there has been an uptick in number of new hires for processing plastics over the last few years. With new employees comes the challenge of training—not only on company policies and processing duties, but on safety. With that in mind, this column will focus on a topic I feel does not get sufficient attention. In fact, it is a topic on which most of us do not have all the details needed. In my experience, searches on the internet certainly proved inadequate. That topic is the mixing of different resins in the barrel, hot runners, and hot tips.

This is an issue whenever you change jobs to a new mold with a different resin. *Are the two resins compatible or do they react with one another?* No matter how hard you try to purge the previous resin from the system, small amounts will remain on the screw flights. Purging compound may help, but even a small residual amount of the previous resin can provide a catalytic effect. For example, if you accidently mix acetal (POM) with PVC, you and the rest of the people on the shop floor will have an extremely unpleasant emotional and physical experience. Small amounts of either of these two resins catalyzes the decomposition of the other polymer to gases.

Threaded Bolt Holes for End-Cap Bolts

Shown here is the front zone of an injection molding machine barrel blown apart by resin decomposition gases.

The resulting acrid odor is well known to Crusty Sr., my archetype of the grizzled processor. Find someone who has some experience processing PVC or acetal; ask about his or her experiences. You will hear true stories of hoppers being blown to and through roofs, endcaps blown through walls, etc. The gases produced upon resin decomposition generate extreme pressures, which can and do blow injection molding machine barrels into shrapnel. The accompanying photo shows the front zone of a machine barrel that blew into pieces. Imagine the damage if it had hit someone! This may not happen often, but it does occur, and you need to be aware its possibility. The question of resin compatibility is not well publicized and rarely comes up out on the shop floor. So, any time you purge to change resins, you need to ask the question: Are these resins compatible or do they react like PVC and acetal?

I've developed a list of plastics that I know could possibly react with one another. My bet is there are others that I do not know about. If you know of any others, please let me know. Here's my list:

- Acetal with PVC or CPVC.
- Ionomer with acetal, PVC or CPVC.
- TPV with acetal, PVC or CPVC.

No matter how hard you try to purge the previous resin from the system, small amounts will remain on the screw flights.

If the same machine barrel and screw must process both these resins, disassemble and clean them properly before resuming processing. Even small residues can be hazardous.

Of course, safety in injection molding extends beyond material compatibility. High temperatures and pressures of 20,000 to 45,000 psi are needed to melt and inject plastic into complex shapes. While these machines are built robustly to handle these temperatures and pressures, it's best take a serious look at the equipment on a regular basis and not assume all is OK. Do you review the machine/mold upon startup or during production to make sure these pressures and temperatures do not reach out and touch you or a coworker? For example, does the nozzle tip mate properly with the sprue bushing? Is a temperature zone overriding? Are you sure all is OK *before* you look down into the hopper?

Who is responsible for your safety? Look in the mirror. PT

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*.

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EXTRUSION

PART 2

A Simple Way to Evaluate Your Screw Performance

A hand-held calculator and some basic equations can help determine whether your screw is up to snuff.

By Jim Frankland

Single-screw performance is one of the most critical but least understood factors in processing. To be an expert takes some very specialized training and experience. However, to understand the basics of single-screw performance requires only a simple hand-held calculator.

In June's column, we simplified extruder screw output using the drag-flow equation for a screw having a standard-pitch metering section. The calculation was simplified to:

$0.02258\ (D^2)HN = \text{Output (in.}^3\text{/sec)}$, where:

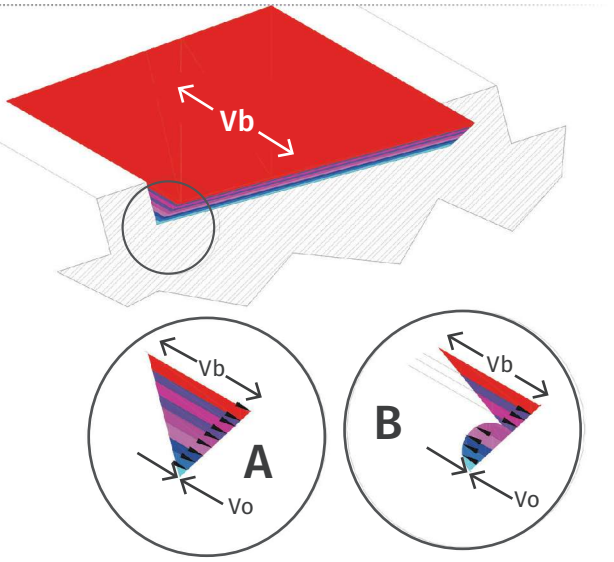
D = Screw diameter, in.
H = Channel depth, in.
N = Screw rpm

The result (in.^{3}/sec) can be converted to lb/hr by multiplying 130 × melt specific gravity of the polymer. In June, we also showed the full formula if the pitch is other than standard. With these calculations, remember that these outputs are for open discharge or no head pressure.

When I'm asked to evaluate the performance of a screw, the first thing I do is see how its *actual* performance stacks up to its calculated drag flow. It's unusual for a screw to significantly exceed the calculated drag flow unless the metering section is very short or the feed section is grooved. So, the calculated drag flow is generally the maximum output that would be expected.

If the actual output is very close to the calculated and is stable, you can assume the screw has a balanced design. That is, the feed, melting and pumping sections are all working properly to achieve output of the metering section. If the output is well under the drag flow, then there is a series of things to check and the first is the effect of the head pressure. When there is head pressure—as in an actual extrusion operation—the output is generally less than the drag flow.

In the accompanying illustration, *A* shows pure drag flow where the velocity at the top of the channel equals the velocity of the barrel relative to the screw and the bottom is zero velocity as the resin is stuck to the screw; while *B* shows the effect of head pressure. The drag flow is still there, but the head pressure is causing a backward flow near the bottom of the channel. The net flow is a combination of the drag flow minus the pressure flow.



In this illustration of an "unwrapped" screw channel, A shows pure drag flow where the velocity at the top of the channel equals the velocity of the barrel relative to the screw and the bottom is zero velocity as the resin is stuck to the screw; while B shows the effect of head pressure.

The effect of head pressure is a less exact calculation than the drag flow for several reasons. First, it depends on the polymer viscosity in the metering section; and second, there is usually a pressure at the beginning of the metering section that can offset the head pressure just like two pressures in a pipe. Neither of these variables is easy to determine precisely, even with advanced computer simulation.

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As a result, pressure flow is an estimate based on a viscosity from shear-rate/viscosity curves at the specific melt temperature, and an assumption of the pressure at the beginning of the metering section. Estimation of the viscosity can be pretty accurate if you know the exiting melt temperature and have the shear-rate/viscosity data for that polymer. Estimation of the pressure at the beginning of the metering section, on the other hand, involves quite a few variables and takes experience.

Pressure development in the screw is proportional to the screw speed, section length, viscosity, flight pitch, and diameter; and is inversely proportional to the square of the channel depth. Even with considerable experience, it's difficult to determine much more than an approximation of the pressure entering the metering section without pressure transducers placed along the barrel. As a result, it's typically ignored and the discharge or head pressure is used to calculate the pressure flow.

The calculation for the effect of head pressure is again based on the work done at Western Electric in the 1950s and is still widely used today:

$F_p \pi D H^3 P W (\sin \Theta)^2/(12L\mu)$ = Pressure flow

For most screws, W (percent of channel) is 0.9 or 90%, since most flights are 10% of the pitch; and F_p is 1.10 for standard pitch, except for very deep screw channels, essentially cancelling each other. This, then, simplifies the equation to:

$\pi D H^3 P (\sin \Theta)^2/(12L\mu)$ or $0.02163 D H^3 P/L\mu$, where

D = screw diameter, in.
H = Channel depth, in.
P = Head or discharge pressure, psi
L = Metering-section length, in.
μ = Viscosity, lb-sec/in.^{2}

It's unusual for a screw to significantly exceed the drag flow unless the metering is very short, or the feed section is grooved.

Since most viscosity data is expressed in PaS or poise it can be converted by:

1 poise = 0.0000145 lb-sec/in.^{2} and 10 poise = 1 PaS.

Then the other terms can be in English units.

As an example of how to use this, let's take a 3.5-in. screw turning at 100 rpm with a head pressure of 30 psi. The screw has a standard pitch (3.5) and standard flight width (0.35 in.); the metering length is 30 in., and the channel depth is 0.150 in. The viscosity is 10,000 poise at the shear rate in the channel and the discharge temperature. So:

$(0.02258) D^2H N-(02163) D H^3 P/L\mu$ = Net output, in.^{3}/sec
4.149-0.176 = 3.973 in.^{3}/sec

Multiply by 130 × melt specific gravity for LDPE:

3.973 × 130 × 0.75 = 387.4 lb/hr

The complete formula shown above can be used where the flight pitch, flight width and F_p are greater due to exceptionally deep channels.

In this example, the actual screw output was 375 lb/hr. That's close enough to the calculation that you can assume the screw is performing basically as it should for this application. However, if the actual output is, say, 250 lb/hr, then there is something causing the screw to perform below its calculated net flow. It could be a feeding issue, a melting issue, or poor screw design for the particular polymer, resulting in a screw design that is not balanced throughout. PT

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

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Trash as Value:
Turning Ocean Waste Into Viable Products

Method offered the world's first bottles made with a blend of recovered ocean plastic and post-consumer recycled plastic in 2012.

So-called "ocean plastics" is a global problem, but a wide range of companies across the entire supply chain have put in the time, money and R&D efforts necessary to make capturing and converting the material into a sustainable business. But demand must follow.

Developing nations like Haiti don't have trash disposal. So, any plastic trash within 30 or so miles of the coastline will probably end up in the ocean. Envision is collecting ocean-bound plastics in Haiti.

By Heather Caliendo
Senior Editor

Plastic pollution in the ocean is an international crisis. Estimates are that more than 8 million tons (16 billion lb) of plastics enter the ocean each year, according to the Ellen MacArthur Foundation (EMF). On the current track, there could be more plastics than fish (by weight) in the ocean by 2050.

If there's one thing we all can agree on it is that no one wants plastics in the ocean. The world's attention is on this issue and everyone has a role to play. According to Steve Russell, v.p. of the plastics division for the American Chemistry Council (ACC) in Washington, D.C. (***americanchemistry.com***), to fix plastic pollution, we need to solve the right problem. Most of the plastics currently in the ocean are from

poorly managed municipal solid waste on land, with about 50% coming from growing economies that do not have systems in place to collect and manage the waste.

There are many companies partnering with governments and nonprofits to prevent waste from reaching the ocean. One big initiative looking to tackle plastic debris specifically from Southeast Asia is Closed Loop Ocean, of which ACC is a partner. Closed Loop Ocean, an initiative of Closed Loop Partners, N.Y.C. (***closedlooppartners.com***), in partnership with Ocean Conservancy of Washington, D.C. (***oceanconservancy.org***), is designed to fund waste infrastructure solutions in Southeast Asia, with a focus on investments to improve collection, sorting and recycling markets, particularly across the plastics value chain. At the Our Ocean 2017 conference, Ocean Conservancy and its partners—including the Trash Free Seas Alliance, Closed Loop Partners, ACC, PepsiCo (Purchase, N.Y.), 3M (Maplewood, Minn.), Procter & Gamble (Cincinnati), and the World Plastics Council—announced an initiative to raise more than $150 million for a new funding mechanism to prevent plastic waste from leaking in to the ocean.

"It's an exciting time in this space, as there is a lot of interest and motivation to do something. Folks are looking to address this urgent need."

"It's an exciting time in this space, as there is a lot of interest and motivation to do something," Russell says. "Folks are looking to address this urgent need."

And there is plenty of movement happening in this area—most particularly, efforts that seek to extract value from the waste plastic. You might have seen the terms "ocean-bound plastic" or "recycled beach plastic," which are general terms to describe the processes to make a new product out of plastic that was captured before it reached the ocean.

It's not just a feel-good initiative—though there is that component—or a question of impressive technological breakthroughs, which have indeed been achieved; these companies are also seizing a business opportunity on the sustainability front. The concept is proven but the demand needs to follow for this to become a sustainable business.

CAPTURING OCEAN-BOUND PLASTIC

In 2011, Method, a San Francisco cleaning-products maker, joined forces with HDPE recycler Envision Plastics, Atlanta (***envisionplastics.com; oceanboundplastics.com***), to produce prototype bottles out of a novel and new plastic material, ocean PCR (post-consumer recycle). A year later, Method launched its liquid-soap bottles made from 100% post-consumer HDPE, 10% of which was collected from the beaches of Hawaii.

The package captured the imagination of the world. Sandra Lewis, director of business development with Envision Plastics, says the company received all kinds of outreach from people wanting to produce their own ocean-plastic product. "How sad is it that everyone is so excited and wanting to participate, and I had to keep telling them no, over and over again," she says.

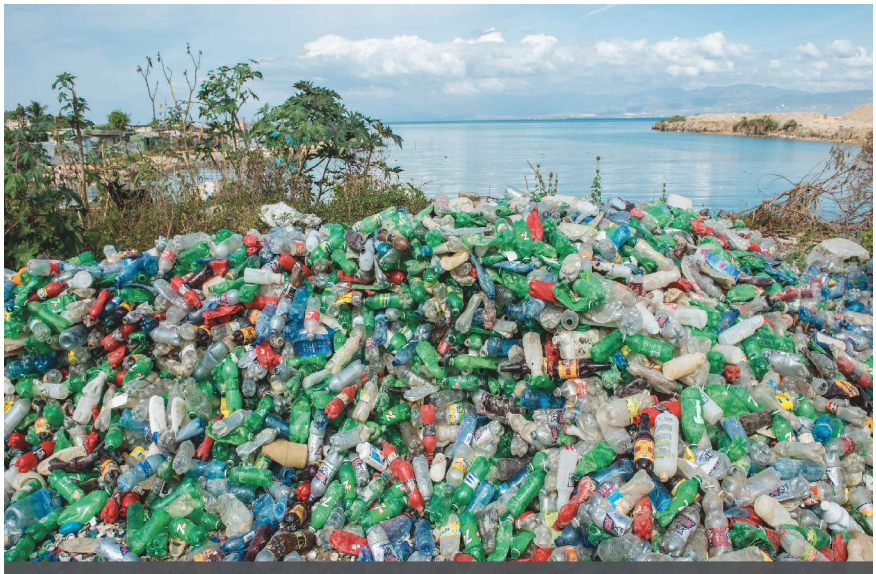
But while the Method package was a proof of concept that the material from the beach could be repurposed into a package, there's a host of obstacles that come with it. The Method process was limited by collection, processing and degradation issues from the plastic that was gathered on the beach itself. In addition, because of the different types of plastic mixed together, ocean plastic is a gray resin, which can be limiting in the packaging market that often seeks colors. It seemed like this might be a one-off project for Envision.

The world's first bottle using Envision's proprietary OceanBound Plastic at 100% content. The container sports a silver metallic, pearlescent-effect finish made possible with compounding expertise by Techmer PM.

But then Envision considered a study by the University of Georgia that researched how much mismanaged plastic waste is making its way from land to the ocean. The study found between 4.8 and 12.7 million metric tons (10.6 to 28 billion lb) of plastic entered the ocean in 2010 from people living within about 31 miles of the coastline. In addition, it emerged that the mismanaged waste and solid-waste disposal was the biggest contributor. For instance, developing nations like Haiti don't have trash disposal. So, any plastic disposed of within 30 miles or so of the coastline will probably end up in the ocean.

Suddenly Envision had a "light-bulb moment." Says Lewis, "If we can go into communities and intercept plastic before it reaches the beach or shorelines, we can overcome all those obstacles that were preventing us from helping people who want to use ocean plastic. Getting it before means we don't have quality problems."

Envision chose to go straight to at-risk areas around the world to recover the plastics before they enter the ocean. At-risk areas are defined as places where there's no formal waste system in place for a population living around 30 miles from the coastline. The key is to intercept the plastic before it reaches the beach or enters a waterway.



In 2017, Dell launched the first laptop packaging trays with 25% recycled ocean-plastic content. Photo: Dell

The company partnered with those on the ground in the at-risk communities to gather HDPE packaging. Envision created a proprietary scorecard to qualify the on-the-ground partners. For example, the partners must abide by set environmental, safety, social and human-rights standards. Envision goes on-site to make sure they know how to properly sort the plastic and load it into containers.

Haiti is one of the countries Envision is working with and there are about 9000 registered collectors who are paid to gather the HDPE material. This showcases that the ocean-bound plastic initiative benefits more than just the ocean, Lewis says. Envision also has a third-party auditor that goes in every country to verify that the collectors are complying with its standards.

Between 4.8 and 12.7 million metric tons of plastic entered the ocean in 2010 from people living within about 31 miles of the coastline.

THE PROCESS

Envision tracks the material all the way through and immediately inspects the bale when it is received, with no compromise on bale specifications that Envision requires for PCR material gathered from the U.S.

Envision keeps the ocean-bound plastic separate from its domestic PCR supply to continue to trace it. After that, it is handled just like standard PCR reprocessing: After bale breaking and hand sorting to ensure there aren't contaminants, the material is ground into flake, which then passes through an extensive washing process. From there, the material is extruded, filtered and pelletized to eliminate all contaminants. The final step is putting the material through Envision's patented devolatilization process to remove odor and absorbed chemicals. The ocean-bound material comes out a very high quality and doesn't have an odor, Lewis says. The material even has a new name: OceanBound Plastic. "All the obstacles we had before—the bad quality, gray color—are eliminated with this process," Lewis says.

One recent development for Envision is a bottle produced from 100% ocean-bound content, a reported world's first. The bottle is made entirely from Envision's OceanBound Plastic and features a silver metallic, pearlescent-effect finish. Envision collaborated with materials designer and colorant supplier Techmer PM, Clinton, Tenn. (***techmerpm.com***), and blow molder Classic Containers, Ontario, Calif. (***classiccontainers.com***), make such a product possible.

Steve Loney, director of market development for Techmer PM, said that Primal Group, a brand that provides natural personal-care products, was launching a new product range and wanted the bottles to convey a message of sustainability by repurposing waste material. "They basically wanted to create a 100% ocean-bound plastic bottle," Loney says. "In the past, it hadn't been 100% ocean-bound, but we were able to overcome some challenges to produce this beautiful silver metallic bottle."

Techmer PM faced several obstacles, as Primal Group wanted a specific color and reflective finish on the bottle, designed for their new plant-science-inspired personal-care range, ViTA. Typically, an extrusion grade of polyethylene would be needed in the masterbatch as a carrier for the colorant. "But that wasn't an option in this case because of wanting a truly 100% ocean-bound package," Loney says. "We made some design changes and manufacturing changes for us to overcome it."

The high-viscosity OceanBound Plastic supplied by Envision Plastics is a fractional-melt resin that makes it difficult to incorporate the colorant's metallic particles without shearing them and ruining the ultimate visual effect. Working with officials at Envision's Chino,

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Calif., facility, Savvas Roubanis, a sales engineer at Techmer's Rancho Dominguez, Calif., plant, led the efforts to devise a solution using Techmer PM's proprietary dispersion technology.

"Compounding of the recipe required additional process design to assure the metallic and pearlescent-effect pigments could be smoothly compounded into Envision's OceanBound Plastic," Roubanis says. "In the end, we were able to fully disperse and develop the color and its appearance to the approval of the Primal Group."

OCEAN-BOUND PLASTICS SUPPLY CHAIN

Envision Plastics also worked with Dell Technologies, Round Rock, Texas, on its first ocean-bound plastic packaging pilot in 2017 using the material as part of a new global packaging system for the Dell XPS 13 2-In-1 laptop. For this project, 25% ocean plastic gathered from Haiti was mixed with other recycled HDPE from sources like bottles and food-storage containers.

In 2017, Dell pledged to increase the annual use of ocean-bound plastic 10-fold by 2025. The company also committed to open-source its supply chain to encourage and enable broad usage of ocean-bound plastics.

In 2017, Dell pledged to increase the annual use of ocean-bound plastic 10-fold by 2025.

During the 2018 Re-focus Sustainability & Recycling Summit at NPE2018, Oliver Campbell, Dell's director of worldwide procurement & packaging, detailed the ocean-bound plastic supply chain and emphasized that it could be applied to other industries. "I really want to stress that this is not a novelty or a vanity-type project," Campbell told *Plastics Technology*. "We took a cold business eye to it about how to solve multiple problems—how to use ocean plastic, intercepting plastic before it goes into the oceans, and how to make it economically feasible. We believe we've done that."

Campbell says that Dell will expand use of ocean-bound plastics to the rest of its XPS NB line this year. And in 2019, Dell plans to use the material in additional products. While the initial project focused on Haiti, the company is shifting to Southeast Asia, specifically Indonesia and India, due to how much marine debris is accumulated there, as well as a cost benefit. "Many people believe that sustainability costs more, and we are here to say that if it's done correctly, it costs less and can also be a brand advantage," Campbell says. "This is something customers love and a big win for planet."

To expand on the ocean plastic project, Dell and Lonely Whale, an ocean conservation group based in N.Y.C. and Seattle (***lonelywhale.org***), have formed a collaborative and open-source initiative

called NextWave (*nextwaveplastics.org*), together with General Motors, Detroit; Trek Bicycle, Waterloo, Wis.; flooring company Interface, Atlanta; sustainable furniture company Van de Sant in The Netherlands; office-furniture design company Humanscale, N.Y.C.; skateboard company Bureo, Ventura, Calif.; and furniture company Herman Miller, Zeeland, Mich. NextWave convenes leading technology and consumer-focused companies to develop a commercial-scale ocean-bound plastics supply chain.

NEEDING A HOME FOR THE MATERIAL

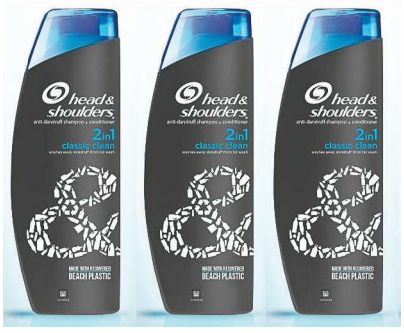
Envision felt so sure of the potential for ocean-bound plastics that the company committed to collecting 10 million lb of HDPE from at-risk zones over the next two years. "Instead of just little one-offs and one-time runs with a little bit of ocean plastic, we decided that we're making this commitment in an effort to bring comfort to brands, so they can commit too," Lewis says. "We're approaching the one-year mark and we are right on track, close to having to collect and recycle 5 million lb, but we have sold only about 10% of that."

Ocean-bound plastic costs more than both virgin and domestic PCR. But Lewis says if more companies expand use of the material, it will eventually get cheaper.

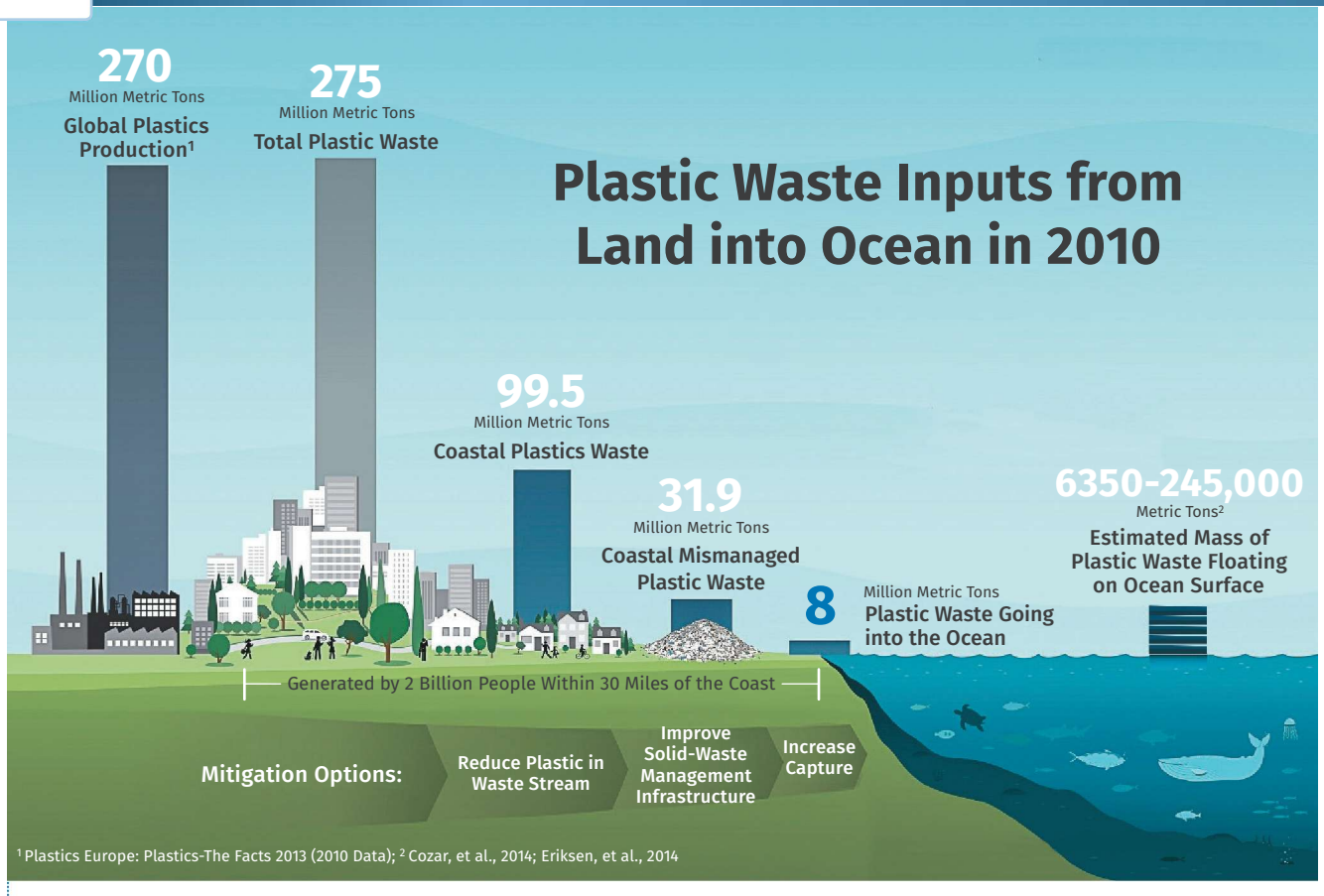
"There's definitely interest out there, but it takes time for companies to make changes and adopt it. We do have a lot in works and are optimistic," she says. "But we also have a little bit of anxiety about it as we have stuck our necks out there and made the commitment. We have put a lot of money in it, but more importantly, this program has created jobs. I can't even think about it not being successful come a year from now when our two-year commitment is over when we have done 10 million lb. If the world doesn't value that, we can't keep doing it."

P&G INITIATIVE IN EUROPE

TerraCycle, Trenton, N.J. (*terracycle.com*), specializes in reprocessing hard-to-recycle waste such as coffee capsules, cigarette ►



P&G partnered with TerraCycle on this Head & Shoulders shampoo bottle made from 25% beach plastic, and on this "Fairy Ocean Plastic" bottle made completely from combined PCR plastic and ocean plastic.



The 192 countries with coasts bordering Atlantic, Pacific and Indian Oceans and the Mediterranean and Black Seas, produced a total of 2.5 billion metric tons of solid waste. Of that, 275 million metric tons was plastic, and about 8 million metric tons of mismanaged plastic waste entered the ocean in 2010. Graphic: Lindsay Robinson/University of Georgia.

butts, and industrial waste. TerraCycle collects, converts and sells more than 100 waste streams in over 20 countries around the world that were originally destined for landfills. It was only natural for the company to venture in the beach waste space. Sarah Teeter, the company's global project manager of beach plastic, says TerraCycle offers unique recycling solutions to give these waste streams a second life. TerraCycle engages with organizations that are already conducting beach cleanups.

Previously, material gathered by these groups would be landfilled because of contamination of the material through exposure of the elements.

"We're working with NGOs (nongovernmental organizations), municipalities and other beach cleanup efforts, and instead of sending material to landfill we are offering a free recycling solution for a more circular option," she says.

The recovered material is shipped to one of TerraCycle's warehouses where the staff manually sorts non-compliant items that are considered contaminants, such as organic matter, flexible plastic bags and films, rope, and fishing nets. Once that work is complete, the rigid plastic waste is sent to another processing facility where it is separated by type, cleaned and converted into a usable new format.

Teeter says that P&G came to TerraCycle in late 2016 with the intention to raise awareness of the marine debris epidemic. The company hoped to recycle plastic that came from beaches into a limited-edition Head & Shoulders shampoo bottle offered in France. "We thought it was doable to collect beach plastic to convert the material into viable resin that could be used for the Head & Shoulders bottle," Teeter says. "Since then we have been able to build up a global network of collectors and a successful supply chain to produce a viable resin with this material. There were a lot of technical challenges along the way that we were able to overcome thanks to our in-house R&D group and the technical teams within P&G and their their bottle molders."

> ***"Instead of just little one-offs and one-time runs with a little bit of ocean plastic, Envision decided that we're making this commitment in an effort to bring comfort to brands, so they can commit too."***

For this project, TerraCycle and P&G worked with Paris-based waste-management company Suez for the different stages of processing, including mechanically sorting the material to separate HDPE, PET, etc. The plastics are shredded, washed and dried to ►

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Unilever's REN Clean Skincare partnered with TerraCycle to create a new 100% recycled bottle containing 20% reclaimed ocean plastic.

produce a clean regrind. The beach-plastic HDPE regrind is then blended with virgin HDPE and additives. The result is a shampoo bottle made from 25% beach plastic, which was launched in 2017. The Head & Shoulders bottle was awarded the United Nations Momentum for Change Lighthouse award in 2017 for its efforts in tackling the global issue of beach plastic waste.

That beach-plastic bottle is just the start. Since then, P&G announced it will introduce 25% recycled plastic across 500 million bottles sold annually for its hair-care brands. P&G also launched its second ocean-plastic package, the "Fairy Ocean Plastic" bottle made completely from ocean plastic and other PCR. The company again partnered with TerraCycle on that project.

Virginie Helias, v.p. of global sustainability at P&G, says that one of the reasons the consumer-products company launched such an ambitious plan was to increase the awareness of recycling. She also said the extra cost associated with producing this material is not passed on to the consumer.

"There's no cost to pass on to consumers because we want to do something for the environment and it's very important to appeal to the mainstream audience," she says. "It's the number-one shampoo bottle and it's not a niche initiative. There is an increased cost in collection and a very manual process with extra cleaning and processing cost, but we are taking it on."

As this initiative is launching in Europe, P&G wants to bring the beach-plastic packaging to North America as well, but there needs to be more supply. "As supply comes available, we will be able to do it in regions such as North America, Western Europe and Asia," Helias says.

TerraCycle's Teeter says Unilever of the U.K. is also interested in bringing the ocean-plastic story to its REN Skincare brand. The company's new 100% recycled bottle contains 20% reclaimed ocean plastic, which Teeter says is a "natural fit" as the product's ingredients are from the ocean. This package is also easily recyclable. Additional products in the range, including hand and body lotions, in the new hybrid recycled/ocean-plastic packaging will be phased in across REN Clean Skincare's full global distribution by early 2019.

"We hope to see this incorporated in many different products at different scales," Teeter says. "There is a lot of material out there, so while this might seem like a drop in the bucket, it is one solution to the large problem of marine debris." PT

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DMT/Acme United • Marlborough, Mass.

By Matthew H. Naitove
Executive Editor

Industry 4.0 Gives DMT *a Sharper Edge*

Leading maker of blade sharpeners boosts productivity in captive molding with cutting-edge connectivity.

Bob Parkhurst, DMT maintenance manager, appreciates the convenience of loading the setup recipes for the injection machine, robot, blender, and TCU with a single command, thanks to Wittmann 4.0 connectivity.

"If it's got an edge, we'll sharpen it." That, in a nutshell, is the business model of Diamond Machining Technology (DMT), a division of Acme United Corp. The company considers itself the quality and technology leader in diamond sharpening tools for knives, scissors, woodworking implements, wire cutters, skis, ice skates, snowboards, and any other metal object that requires a sharp edge. Its sharpening "stones" are, in most cases, precise metal sheets of metal with electroplated nickel and diamond particles of various sizes. These metal sheets are insert molded onto polycarbonate bases.

In 1985, when injection molding replaced laminating of the metal grinding surfaces onto plastic, DMT gained a major increase in quality and productivity. In the past year, DMT honed its injection molding technology to a finer edge with the purchase of a new machine, robot and auxiliary equipment in a cell that embodies key elements of Industry 4.0.

The age of "Smart Factories," or Industry 4.0, is still in its infancy. Many of the essential building blocks—standard communication interfaces between "smart machines"—are still being developed. At May's NPE2018 show, numerous equipment vendors showed North American processors the steps being taken on what will no doubt be a long path forward. DMT has taken some of those steps itself, becoming a pioneer among U.S. processors—all the more remarkable for a shop with only three injection machines—and has experienced significant benefits in uptime, efficiency, troubleshooting, and faster product changeovers.

> ***"We immediately saw the value of having all the equipment talk to each other—how could we pass that up?"***

JOINING 'TEAM EDGE'

DMT is a 40-year-old business that got a shot in the arm when it was purchased by Acme United Corp. in 2016. Based in Fairfield, Conn., Acme is a $140-million global company with over 400 employees (***acmeunited.com***). Among its diversified businesses are several brands of knives, scissors, shears, axes, and other cutting implements. DMT, therefore, was a logical addition to Acme's "Team Edge" group of companies.

Located in a 28,000-ft^2 plant in Marlborough, Mass., DMT (***dmtsharp.com***) employs 25 to 30 people in metal stamping, electroplating, and finishing the metal sharpening surfaces, as well as injection molding and packaging. It molds glass-filled polycarbonate for the ribbed backing of the metal sharpening plates, and black ABS for the holder of a double-sided sharpener. DMT also molds some products with talk-filled PP.

As explained by Mark Bettke, senior director of operations and manufacturing, flatness of the sharpening surface is a key quality spec, which is why DMT uses glass-filled PC for its hardness and stiffness. "Our flatness spec is ±0.001 in. over the entire surface, which can be up to 40 in.^{2} on a large, double-sided stone. Our sharpeners are the flattest in the world."

"And to get that requires very consistent shot size, packing, and process temperatures," adds Stan Watson, technical director and a 31-year veteran at DMT. With a high glass content and thick walls (about 0.140 in.) in the ribbed backing structure, we don't make it easy for ourselves."

The need for molding precision and consistency accounts for DMT's preference for all-electric molding machines, going back to its second machine purchase 18 years ago. Besides being more precise, Watson credits electric machines with lower energy consumption and discharging less heat into the plant air.

After the acquisition, Acme United urged DMT to update its injection machines, which were then 16 and 31 years old. The first step was several months of research into machines and vendors by DMT personnel. "We visited four machine builders," Watson recalls. "We looked into everything, including maintenance, parts and service. We also talked to our outside vendor of plastic parts about how it felt about its equipment.

DMT is the first U.S. molder to implement Wittmann 4.0 with the company's latest Unilog B8 press control as the integration hub. Here, Bob Parkhurst (r.) and Mark Bettke, DMT senior director of operations & manufacturing, stand by the B8 control on a new EcoPower 300 all-electric press. The large screen shows injection, hot-runner, TCU, and blender data. Parkhurst holds a key with an embedded chip that gives access to control functions.

"The more we researched, the more we became interested in Wittmann Battenfeld, because they could supply the whole system, with machine, robot, and auxiliary equipment." DMT was impressed particularly by Wittmann's expertise in robot end- ►

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of-arm tooling (EOAT) and its Wittmann 4.0 program for networking all its equipment together to share data and integrate the various controls. "We immediately saw the value of having all the equipment talk to each other—how could we pass that up?"

DMT personnel made multiple visits to Wittmann Battenfeld's U.S. headquarters in Torrington, Conn. (***wittman-group.com***), including three days of training on use of the machine and robot. DMT visited another Wittmann customer to gain further insight, and Wittmann offered other customer contacts as well.

Mark Bettke and Stan Watson (l.), technical director, with samples of DMT's sharpening products.

Finally, with the installation last August of an EcoPower 330-ton all-electric press, W-833 Cartesian robot, chiller, TCU, dryer, blender, and hopper loader, DMT became the first U.S. company to install a Wittmann 4.0 system using the company's latest Unilog B8 injection machine control as the hub for integrating the cell components. Wittmann Battenfeld has over 30 U.S. customers using various elements of Wittmann 4.0, but DMT is the first with the very latest technology.

IMPLEMENTING 4.0

Like most molders to date, DMT has implemented just some parts of the overall Wittmann 4.0 ecosystem. One is the integration of data and settings for the robot, blender, and TCU with the Unilog B8 press control. Bob Parkhurst, DMT's maintenance manager, likes the large B8 touchscreen, which Wittmann Battenfeld customized for his firm. It shows on one screen all barrel and hot-runner temperatures, cooling time, pack/hold settings, blender settings, and TCU temperatures.

Parkhurst likes that he can now see key process data on one screen and not have to walk around the cell to examine screens on the robot, blender, or TCU. (The central chiller and dryer, which supply all three injection presses, are not integrated with the Unilog B8 control.) He can also see data and modify settings on all the cell components from a computer in his office.

DMT diamond sharpening product, showing the front sharpening side (top), consisting of a metal plate that is insert molded onto a glass-filled PC backing (bottom).

Also valuable is the ability to load the setups for the machine, robot, blender, and TCU together as one recipe when a mold is changed, which happens up to three times a week. That saves considerable time, Parkhurst says.

Overall, Watson adds, "The Wittmann 4.0 system makes me feel more secure. If something goes wrong, I'll know it right away. For instance, if the TCU is running at 180 F instead of 220 F, the machine controller will flag that right away. In the past, we might have made a few hundred reject parts before we noticed that. Or if the TCU springs a leak and loses pressure, that flashes on the screen of the injection machine. Before, we wouldn't have known it was happening until we saw the water on the floor."

> ***"The Wittmann 4.0 system makes me feel more secure. If something goes wrong, I'll know it right away."***

Bob Parkhurst at the Unilog B8 control of a new Wittmann Battenfeld EcoPower 300 electric press. One feature of Wittmann 4.0 enables Wittmann service personnel to access the controller remotely to diagnose problems without waiting for a technician to visit the plant.

Watson and Parkhurst also appreciate the ability to have the TCU automatically suck the water out of the mold as part of a shutdown for a mold change. "That way, we don't forget to empty the water from the mold and have a mess on the floor when we unplug the cooling hoses," Watson explains.

Another element of Wittmann 4.0 is remote service capability. "We can let Wittmann Battenfeld remotely access our machine and find what is causing a problem, instead of waiting for a technician to come visit us," says Watson. "They can diagnose the issue in minutes rather than us losing a day."

Diamond-plated metal inserts ready for overmolding with a glass-filled PC backing.

Parkhurst notes that this came in handy twice already. In one case, the machine was programmed to stop for a regular maintenance cycle. "We didn't know it was due, so we weren't sure why the machine had stopped. But Wittmann Battenfeld was able to find the cause immediately. After performing the maintenance, were quickly back up and running."

In another case, Parkhurst recalls, a safety switch caused the machine to stop. Again, Wittmann service personnel were able to look at the controller remotely and find the problem in a minute. "We made an adjustment to get the machine operating again, and we were back up in less than an hour. Wittmann sent us a replacement part, which arrived the next day."

Bettke says DMT's maintenance staff is starting to use Wittmann Battenfeld's QuickLook app on their mobile phones, which provides another level of connectivityd and convenience by showing cycle time, number of parts produced, machine status, alarms, and more.

ROBOTS WORK FASTER & SMARTER

Wittmann Battenfeld's ability to supply complete systems has proven especially valuable to DMT in the case of robots. "We get better support there than from other vendors. When we came to Wittmann, they were very keen to shave off cycle time with more efficient robot programming and more capable EOAT," says Watson.

> ***"We can let Wittmann access our machine remotely to find what is causing a problem, instead of waiting for a technician to come visit us."***

He notes, for example, that in the past, loading two inserts for a double-sided sharpener into each side of the mold and removing a finished part required multiple robot entries and exits from the mold area. Wittmann Battenfeld designed three-headed EOAT that places both inserts and removes the finished part in one in/out cycle. The net result was reducing the mold-open time from 85 sec to just 10 sec.

Watson cites other cases where the new Wittmann robot and EOAT drastically reduced mold-open time:

- From 83 sec to 14 sec;
- From 58 sec to 12 sec;

- From 51 sec to 10 sec;
- From 39 sec to 8 sec.

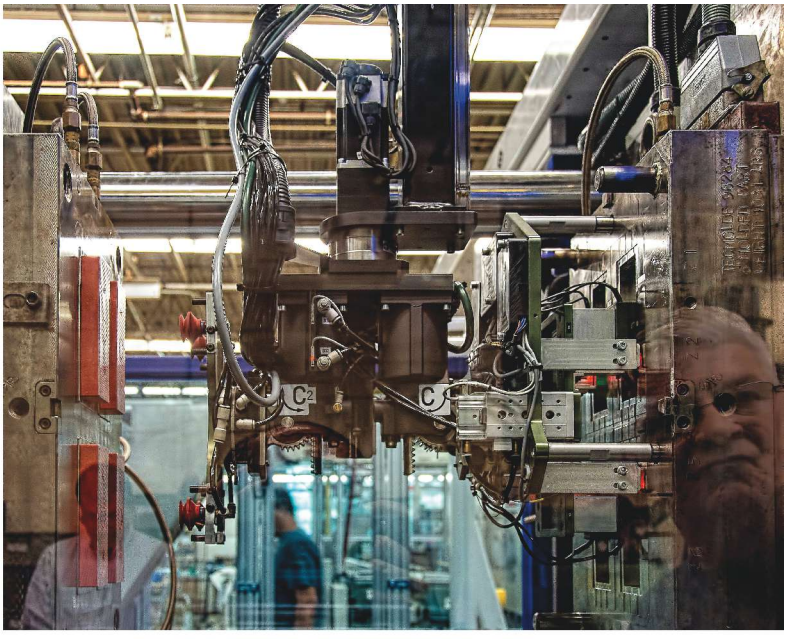
Apart from the time savings, there are other benefits: "We use all hot-runner molds," Watson notes. "Too long a mold-open time leads to nozzle drool. If we lower the nozzle temperature to prevent drool, we get other problems, like non-fills or freeze-off."

More capable robot EOAT has slashed mold-open times by around 80% in several cases.

The new robot grabs the metal sharpener inserts magnetically, then deposits them in a docking station and then re-grabs them with more critical alignment. The robot uses sensors to ensure that it has grabbed each insert, and only one insert at a time, rather than two that may have stuck together. The robot's electric eye also checks for precise insert positioning in the mold and halts the machine if it detects an error. "We have a tolerance of only 0.0005 in. on a side for positioning the insert," Parkhurst says. DMT's molds have one, two, four, or eight cavities.

The robot places the finished parts on a conveyor or in totes. It keeps count of the number of parts per box. If desired, the robot can be switched to "QC mode," whereby it places parts in a QC bin for checking.

Watson likes another aspect of the robot programming, using Wittmann's R8.3 Teachbox: "We can block out certain areas—tiebars, mold, conveyors, guards—where the robot is not allowed to enter. In the past, if we made a mistake in programming a robot, we could get a crash, which was very unpleasant."



Wittmann W-833 robot with multi-headed EOAT saves time by placing metal inserts (r.) and removing finished parts (l.) in the same in/out cycle. Sensors in the EOAT confirm precise placement of the inserts.

Bettke says DMT is thinking about replacing its first injection machine, the 1985 Nissei, with a Wittmann Battenfeld vertical press, which will have its own Wittmann 4.0 integrated cell. According to Watson, the 4.0 system is "fairly intuitive" and easy to use, once you understand the basic principle. PT

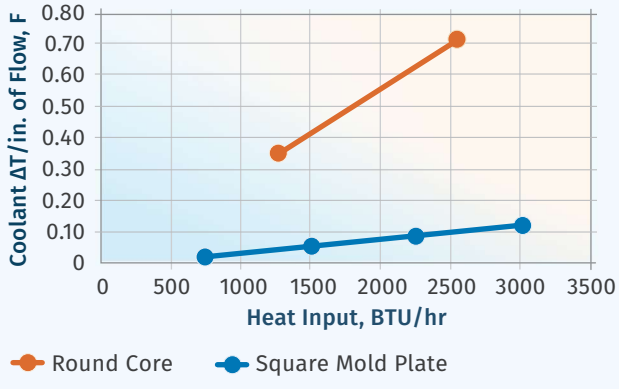
An Engineering Approach to Mold-Cooling Circuit Design

The Energy Density vs. ΔT/in. relationship is an important step forward in pursuit of a science-based approach to cooling-circuit design. Here's why.

By Philip M. Burger
Burger & Brown Engineering

In a November 2015 feature in *Plastics Technology* ("Improve the Cooling Performance of Your Molds"), Burger & Brown Engineering discussed techniques for determining the cooling-capacity requirement for an injection mold. We demonstrated how to calculate the required cooling energy for a part based on shot size, cycle time, material properties, processing temperature, and safe ejection temperature. We also demonstrated a method of calculating the required coolant flow rate based on an estimated change in coolant temperature (ΔT) as it flows through the mold.

FIG 1 Coolant ΔT/in. vs. Heat Input (Coolant 75 F @ 1 GPM)



This shows an early attempt at understanding the relationship between heat input and ΔT/in. We plotted data from our round core and square mold plate with similar heat inputs but very different cooling-circuit geometry. The much shorter core cooling circuit produces a much higher ΔT/in. value.

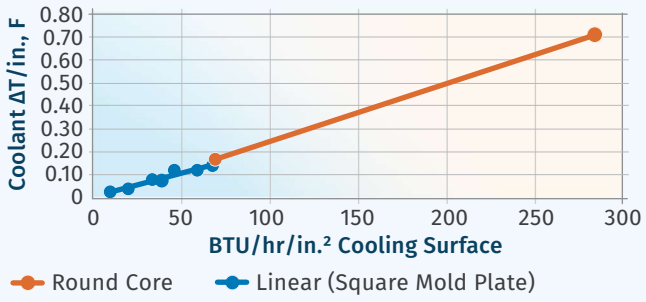
That article ended as follows: "The foundation of designing cooling circuits is a good ΔT estimate." We also offered the suggestion, "Processors can conduct internal studies of cooling-circuit ΔT to develop a sound basis for future designs." We felt then that this conclusion left a lot to be desired and begged for a sound science- and engineering-based approach to predicting ΔT.

Since then we have been busy thinking about and studying the ΔT issue. We have spoken before about our "mold simulators" that pump electrical energy into steel mold-shaped components. While we pump heat into our "molds" we also pump water through cooling circuits just like in a real mold. One simulator is a 12-in. square mold base with drilled cooling passages. The other is 1.5-in. diam. core that can be cooled using a baffle or a bubbler tube. We measure the coolant flow rate, coolant temperature, and steel temperature to within a tenth of a degree. All the sensors are connected to a data-acquisition system that feeds the data to a laptop. The measurements are converted into thousands of values in an Excel spreadsheet. Over the past few years we have spent hundreds of hours conducting experiments, changing variables, and studying the data. We are now prepared to tell a story about coolant ΔT.

Energy Density also influences mold temperature and is useful in predicting the temperature.

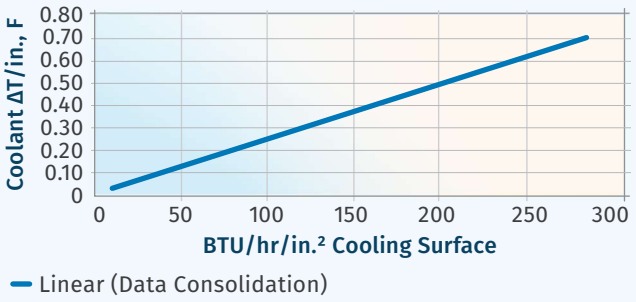
Graphical presentation of data sometimes reveals a novel way of thinking about relationships between variables. Our studies accurately measured the heat input to the mold, simulating molten polymer being injected. This energy flow is represented by the letter Q (BTU/

FIG 2 Coolant ΔT/in. vs. Energy Density (Coolant 75 F @ 1 GPM)



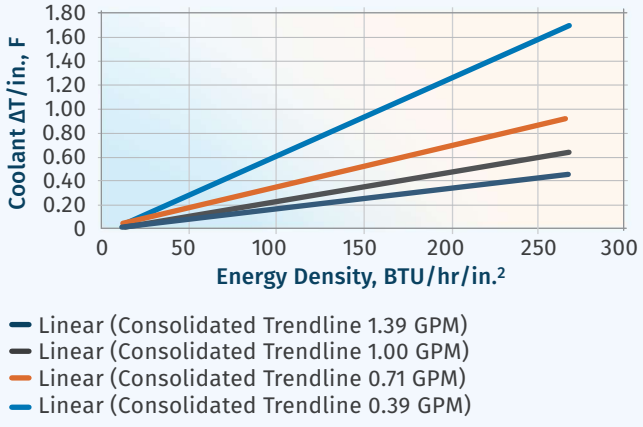
In graphing the relationship between Energy Density and coolant ΔT/in. of flow, we plotted Energy Density on the horizontal axis and coolant ΔT/in. on the vertical axis of a typical X-Y graph. This time the plots from two very different types of cooling circuits showed a remarkably linear relationship. The Energy Density with the round core was much higher than the square mold, but the two trials showed a clear linear relationship between Energy Density and ΔT/in.

FIG 3 Coolant ΔT/in. vs. Energy Density (Coolant 75 F @ 1 GPM)



Here we used a trend line that provides a user-friendly tool for estimating ΔT/in. based on the easily calculated Energy Density value. For example, an Energy Density value of 80 BTU/hr/in.² would produce a ΔT/in. value of about 0.20 °F/in.

FIG 4 Energy Density vs. Coolant ΔT/in. (Consolidated Round Core Baffle and DME Square 0.44 in. Diameter 75 F Coolant)



Expanded studies used new data from our core simulator and standard mold base. The studies were conducted at four different heat inputs and four different coolant flow rates. These results confirm our belief that the Energy Density vs. ΔT/in. relationship is an important step forward in the pursuit of a science-based approach to cooling-circuit design.

hr). We measured the total increase in temperature (ΔT) of the coolant as it passed through the cooling circuits. We divided the ΔT by total length of the cooling circuit to create a value of ΔT/in. We understood that there was a relationship between heat input and ΔT/in. Figure 1 shows an early attempt at understanding the relationship. We plotted data from our round core and square mold plate with similar heat inputs but very different cooling-circuit geometry. The much shorter core cooling circuit produces a much higher ΔT/in. value.

Clearly cooling-circuit length alone does not fully describe the power or capacity of the circuit. We knew that all the heat being removed by the coolant must pass through the walls of the cooling circuit and into the coolant flowing through the circuit. Thus, the true expression of heat transferred into the coolant has to involve the area, not just the length, of the cooling circuit. It must also involve energy flow, Q (BTU/hr) along with circuit area, A (in.²). We named this value Energy Density and it is described as the energy flow divided by cooling-circuit area:

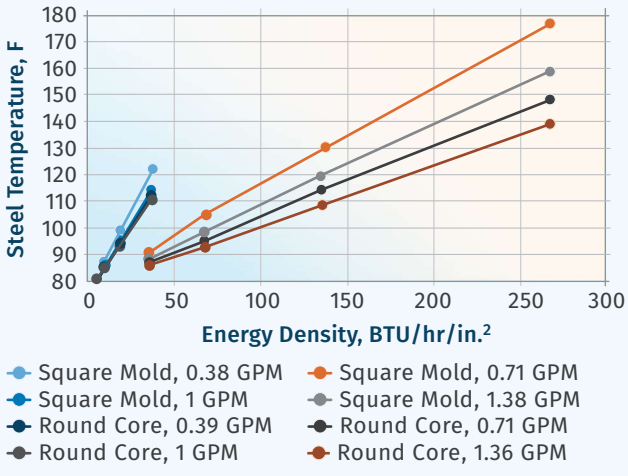
Energy Density = Q/A in BTU/hr/in.²

Our next step was to graph the relationship between Energy Density and coolant ΔT/in. We plotted Energy Density on the horizontal axis and coolant ΔT/in. on the vertical axis of a typical X-Y graph. As in Fig. 1, we included data from our round core and square mold plate as separate plots on the same graph. This time the plots from two very different types of cooling circuits showed a remarkably linear relationship. The Energy Density with the round core was much higher than the square mold, but the two trials showed a clear linear relationship between Energy Density and ΔT/in. Figure 2 shows this interesting finding. At this point we felt we were onto something meaningful and useful.

Figure 3 shows a further refinement of this data, using a trend line that provides a user-friendly tool for estimating ΔT/in. based on the easily calculated Energy Density value. For example, an Energy Density value of 80 BTU/hr/in.² would produce a ΔT/in. value of about 0.20 °F/in.

Calculating the Energy Density value is as simple as determining the BTU/hr that must be removed to cool your part and dividing that value by the area of the cooling circuit. Let's say you need to remove 1500 BTU/hr to cool the part and the cooling circuit has an area of 20.6 in.² (7/16 in. diam. × 15 in. long). The Energy Density value would be: ►

FIG 5 Energy Density vs. Steel Temperature, °F (Round Core with Baffle and DME Square Mold; 75 F Coolant)



Energy Density also influences mold temperature and is useful in predicting that temperature. In our experiments mold temperatures responded linearly to Energy Density, but the mold geometry makes a difference in the temperature response.

1500 BTU/hr/20.6 in.² = 72.8 BTU/hr/in.²

This Energy Density value would result in a ΔT/in. value of about 0.18 °F/in.

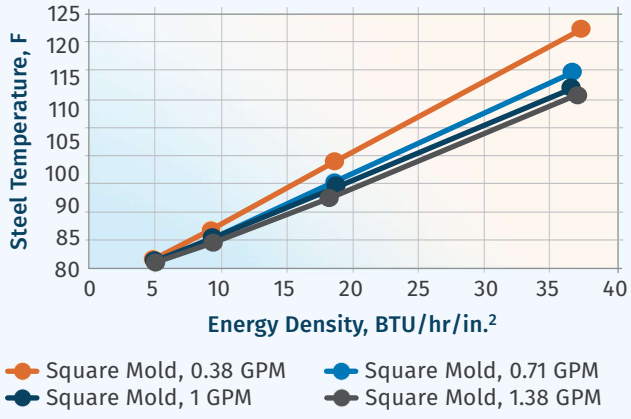
Figures 1, 2, and 3 are based on data generated with a coolant flow rate of 1 GPM and coolant temperature of 75 F. We expanded the studies using new data from our core simulator and standard mold base. The studies were conducted at four different heat inputs and four different coolant flow rates. These results are presented in Fig. 4. We believe the Energy Density vs. ΔT/in. relationship is an important step forward in the pursuit of a science-based approach to cooling-circuit design.

Based on what we have studied, we believe the Energy Density vs. ΔT/in. relationship probably applies to a broader range of mold geometries.

It would be interesting to conduct similar studies at elevated coolant temperatures, but it is our belief that the Energy Density vs. ΔT/in. relationship wouldn't change much. Even if the mold and coolant are hotter, heat must still be removed to cool the part. With a substantially hotter mold, more heat will be transferred to the environment by conduction to platens, natural convection, and radiation, perhaps skewing the ΔT/in. value a little lower than the graph would predict.

Energy Density also influences mold temperature and is useful in predicting that temperature. In our experiments, mold

FIG 6 Energy Density vs. Steel Temperature, °F (DME Square Mold; 75 F Coolant)

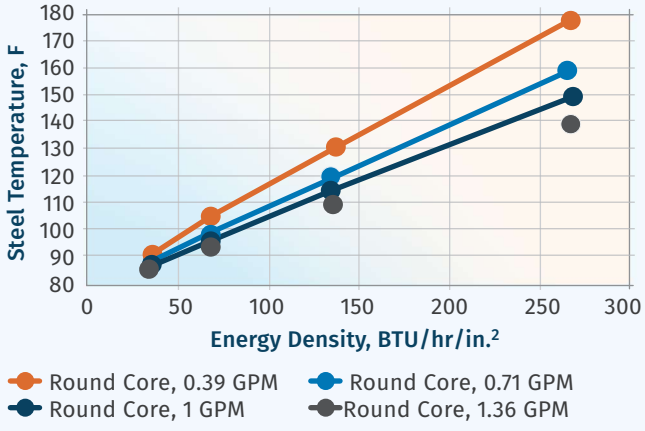


Like Fig. 5, this demonstrates the importance of designing a cooling circuit with adequate area to achieve an Energy Density value that produces the desired mold temperature.

temperatures responded linearly to Energy Density, but the mold geometry makes a difference in the temperature response. Figures 5 and 6 illustrate this difference and clearly show the importance of managing Energy Density in the design process. In other words, one should design a cooling circuit with adequate area to achieve an Energy Density value that produces the desired mold temperature.

We must caution that these studies have been conducted with limited mold geometries. Based on what we have studied we believe the Energy Density vs. ΔT/in. relationship probably applies to a

FIG 7 Energy Density vs. Steel Temperature, °F (Round Core with Baffle; 75 F Coolant)



Cooling a core can be a challenge due to a smaller cooling circuit area. For example, our 1.5-in diam. round core simulator with a 7/16 diam.cooling circuit has an effective cooling area of only about 8 in.². This results in high energy density values and greater difficulty controlling core temperature. This shows measured steel temperatures based on four values of heat input and four different coolant flow rates.

broader range of mold geometries. We have examined cooling data from molds running in our own molding shop and find good agreement between shop-floor data and our Energy Density research.

Here is a step-by-step procedure explaining how an engineer or designer would use the Energy Density method to design a cooling circuit with a desired (or required) heat-removal capacity for the thick-wall cap shown in Fig. 8.

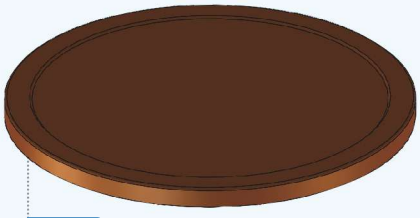


FIG 8 Using this thick-wall cap as a reference, we created a step-by-step procedure for how an engineer or designer would use the Energy Density method to design a cooling circuit with a specific heat-removal capacity.

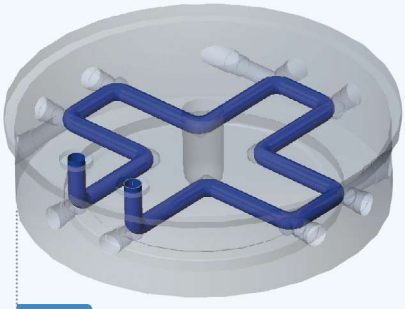


FIG 9 Our calculations assumed that 45% of the cooling for this part is accomplished by the cavity with a single cross-drilled cooling circuit, as shown here.

1. Calculate the amount of heat that must be removed by the cavity side of a mold to cool a single-cavity HDPE cap. Its weight is 19.4 g (0.043 lb.) running on a 12-sec cycle.

The heat capacity: C = 0.60 BTU/lb.-°F.

The latent heat value: H_L = 119 BTU/lb.

The processing (melt) temperature is 450 F and the safe ejection temperature is 150 F.

The required change in temperature, ΔT = 450-150 = 300 °F. BTU/shot = W × ((C × ΔT) + HL) = 0.043 × ((0.60 × 300) + 119) = 12.86 BTU/shot.

BTU/hr = BTU/shot × shots/hr.
Shots/hr = 3600 sec/hr ÷ 12 sec = 300 shots/hr.

The letter Q is used to represent energy flow, BTU/hr.

Q = 12.86 BTU/shot × 300 shots/hr = 3857 BTU/hr.

We will assume that 45% of the cooling for this part is accomplished by the cavity with a single cross-drilled cooling circuit as shown in Fig. 9. Our cooling circuit must be able to remove 0.45 x 3857 BTU/hr = 1736 BTU/hr.

2. Calculate cooling-circuit surface area based on a circuit of 0.339-in. diam. × 21.1 in. long. A = π × d × L = 3.1416 × 0.339 in. × 21.1 in. = 22.47 in.²

3. Calculate Energy Density, DE = Q/A, BTU/hr./in.²
Energy Density = 1736 BTU/hr/22.47 in.² = 77.26 BTU/hr/in.²

4. Estimate ΔT/in. using the calculated energy density and the 1 GPM line on Fig. 4. The value is about 0.19 °F/in.

5. Calculate total coolant ΔT: ΔT = ΔT/in. × L = 0.19 × 21.1 = 4.01 °F

6. Calculate required coolant flow rate using the expression:

   - GPM = Q/(500.4 × ΔT).
   - GPM = 1736 BTU/hr ÷ (500.4 × 4.01 °F) = 0.87 GPM.
   - Check to be sure that flow will be turbulent considering the circuit diameter and coolant temperature.

7. Note that the Energy Density value calculated in Step 3 is also useful for estimating mold temperature based on Figs. 5-7.

Having studied and understood this example you might have some questions. We anticipated a couple:

• We used a 1 GPM line on the graph to calculate a required cooling flow rate of just 0.87 GPM. What gives? The heat input comes from the molten plastic or resistance heaters in the case of our lab simulation. Not all the heat goes to the coolant. Some heat transfers to the mold and the surrounding environment, depending on mold temperature. The ΔT/in. value is influenced only by the heat that makes its way into the cooling circuit.

• If you wanted to design your cooling circuit to have lower Energy Density or ΔT/in. values, what can you change? Make the cooling circuit longer or larger in diameter, or add additional circuits—in other words, create more cooling-circuit area. You can also pump more water through the circuit; but as we have discussed many times, more flow yields diminishing returns after the transition to turbulent flow. In the case of our example circuit and the choice of 1 GPM as the flow rate, we are already at a Reynolds number of nearly double the minimum for turbulent flow. More flow wouldn't accomplish much. PT

ABOUT THE AUTHOR: Phil Burger, P.E., founded Burger & Brown Engineering Inc. in 1978 and served as president until 2005. Burger & Brown manufactures engineered products related to mold cooling and in-mold sensing and holds 10 patents for its products. Burger currently works part-time for the firm and has most recently developed an educational program called Scientific Cooling that was launched in October 2013. Contact: *(816) 878-6675; pburger44@gmail.com; smartflow-usa.com.*

EXTRUSION

Gear Pump & Screen Changer for Rigid PVC

PSI-Polymer Systems Inc., Conover, N.C., introduced its first-ever screen changer and gear pump designed specifically for rigid PVC extrusion at NPE2018. Target areas for the two new products include sheet and profiles. Generally, the devices can be used with PVC formulations that can tolerate melt-temperature variations of 10-15° F.

Screen changers are generally not applied to rigid PVC processes because of flow transitions in the sealing areas exposed to the melt stream. As resin travels over these transitions and steps, shear heat is introduced, which can trigger localized burning of the material. But PSI has developed an Expansion Plate Screen Changer (ESC) that reportedly solves "the chemistry issues relative to heat, flow and thermal conductivity" for PVC processes tolerant of 10-15° F swings in melt temperature.

The screen changer requires a momentary shutdown for screen changes. This eliminates the need to disassemble the die, which on short runs results in high scrap rates. To change screens on the ESC, the PLC control electrically heats the expansion spacer bars, which separate the body halves above and below the slide plate between the body halves. The spacers are far from the bore to avoid raising the melt temperature. The expansion of the spacers pushes the bodies apart, freeing the slide plate to move unimpeded.

Once the new screen pocket is in position and the spent screen is outside the body, shop air or a cooling fluid is directed through the spacer plates, cooling and contracting the steel. This effectively shrinks the body halves back against the slide plate, recreating a seal through intimate steel-on-steel contact.

The ESC has chrome-plated flow bores that run straight through the screen changer to eliminate hangup areas. The unit has no mechanical seals, so galling is eliminated. Moreover, the upstream and downstream bodies are identical. These interchangeable halves are field repairable—if a body surface in contact with the slide plate gets scratched, the body can be surface ground by a local machine shop and placed back in service. Components are made from stainless steel. The bodies have electric heating standard and can be jacketed for more consistent heat transfer.

Processors of rigid PVC generally avoid melt pumps, according to PSI, due to heat generated in the axial clearances of the gears and lubrication zones in the bearings. But PSI's Chlorinated Gear Pump (CGP) is said to be ideal for thermally sensitive polymers and brings all of the benefits of gear pumps—die-pressure stabilization, increased output, and extruder-pressure reduction—to rigid PVC sheet and profiles.

The new design utilizes modified components and improved heat transfer to reduce temperature excursions that can trigger carbonization/degradation of sensitive materials. The gear-pump body and side plates are jacketed for steam or oil heat transfer. These media travel through the entire pump in a single pass. Dual extended gear shafts aid in conductive transfer of heat out of the high-load areas of the gears. Heat transfers outward from the bearing journals into the cooler seal journals and then through the seals into the jacketed side plates. Seals are contained within and are integral to the side plates for best conductivity. Cooling channels in the body wick heat away from the bearing ODs to control heat buildup. Large, jacketed side plates provide additional heat transfer from the bearings.

Bleed material used for lubrication of the bearings and gears (approx. 0.01% of flow) is evacuated from the process flow via internal ports to outside the pump in a constant bleed.

828-468-2600 • psi-polymersystems.com

EXTRUSION

Device Measures Surface Energy on Films

The Surface Analyst from BTG Labs, St. Bernard, Ohio, is a hand-held tool used for inspecting flexible packaging film that reportedly reduces waste, rework and recalls that result when poorly prepared substrate surfaces lead to printing or sealing failure. In 2 sec, the Surface Analyst measures the surface energy of a film surface and determines if it is properly prepared for adhesion.

Dyne pens and inks have been the industry standard for inspecting film surface tension. They are used to help converters understand their films' surface energy and interfacial tension before and after surface treatment. One reason for their sustained use has been that they are inexpensive, but BTG claims dyne inks are chemically destructive to the materials they inspect, resulting in wasted product.

With a push of a button, the Surface Analyst quantifies the quality of the film surface. To acquire the measurement, the unit uses patented technology to deposit a highly purified drop of water on the surface of the film and then measures the contact angle—a direct correlation to surface energy. Typical inspection points within film and flexible packaging manufacturing include:

- *Monitoring incoming material from suppliers.* Manufacturers need a baseline understanding of the condition of a film's surface prior to it entering their production process. Measurements by the Surface Analyst give manufacturers the ability to monitor supplier specifications.
- *Determining the effect of surface aging.* Material surfaces deteriorate over time. The Analyst determines the optimal amount of time that a surface can be kept in storage before the surface is no longer fit for adhesion.
- *Defining optimal surface-treatment levels.* The Surface Analyst allows manufacturers to quantify the effectiveness of their surface-treatment processes, such as flame and corona treatment. Manufacturers also use the measurements to determine the optimal level of treatment to avoid damaging the material surface from overtreatment and undertreatment.
- *Monitoring daily production processes.* Over time, processes slowly drift out of spec. The Surface Analyst is used to monitor production processes to ensure the line is working at its highest level of efficiency.

513-469-1800 • btglabs.com

COMPOUNDING

Small-Batch Extruder for Medical Compounds

The Medical E Line Extruder from Germany's Dr. Collin was displayed at NPE2018 equipped with a strand die, medical-grade belt take-off, and a strand pelletizer. The machine is sized for small-batch production, R&D, and product development. It runs at low processing temperatures, which is critical for certain additives used in medical compounding. The Collin Medical Lines are characterized by high accuracy, cGMP/FDA validated production, GAMP5 validation and excellent and quick cleaning. The machines are manufactured to customer requirements.

+49 8092 / 2096-0 • drcollin.de

COMPOUNDING

Quick-Change Pellet Classifier

Trendelkamp, Alpharetta, Ga., introduced a new masterbatch pellet classifier with quick-release screens at NPE2018. The TK-K pellet classifier requires no tooling for screen removal or replacement, easing material and color changes. The unit features a unique oscillating movement that prevents pellet bounce and can efficiently classify a variety of sizes and shapes. Multiple versions are available for collecting oversize, undersize, and properly sized pellets. Throughput ranges are available from 770 to more than 11,000 lb/hr.

770-931-9199 • trendelkamp.com

MATERIALS

High-Impact, FR-PET

A specialty UL 94V-0 flame-retardant PET compound that exhibits high durability and high chemical resistance has been introduced by PolyVisions, Manchester, Pa. DuraPET FR, is a graft-modified PET compound designed for molded housings and enclosures in medical devices and lab instrumentation; it is also suitable for film and sheet extrusion.

The new compound boasts temperature resistance from -40 F to over 180 F. PolyVisions designed it with enhanced chemical resistance to withstand continuous exposure to germicidal cleaning compounds that destroy the properties of other commonly used thermoplastics. It is reportedly easy to mold due to its low shrinkage and excellent heat stability and is currently used in parts weighing from 20 lb to less than 1 oz. According to the company, molders have been able to use it in molds designed for PC/ABS and other materials.

PolyVisions also announced a version of DuraPET FR made from recycled PET. The company claims that its reactive extrusion process allows it use post-consumer regrind PET for up to 90% of the formulation.

717-266-3031 • polyvisions.com

BLOW MOLDING

New 2D & 3D Blow Molders From Italy

During the recent Plast 2018 fair in Milan, Italy, ST Blow Molding showed off its latest hydraulic accumulator-head machines at its plant in Monza, Italy. The company introduced the model ASPI 150.3 Duo, which has a single extruder and head that feed two independent 22-ton clamps. Like the ASPI 400 model exhibited at NPE2018 in Orlando, Fla., this unit is designed for 3D suction-blow molding of long, complex shapes, but it can also be used for conventional 2D molding.

Also new is the ISIT 200 for 2D blow molding, the smallest unit in the series (22-ton clamp). The unit shown had a 4 L accumulator head. This series uses a three-platen clamp, in which force is applied to the rear of each platen by a crossbeam. This is said to avoid unbalanced application of clamping force and also accommodates oversized molds.

+39 039 2706234 • st-blowmoulding.com

INJECTION MOLDING

Negri Bossi Launches New Range of Mid-Sized Presses

At last month's Plast 2018 show in Milan, Italy, Negri Bossi (U.S. office in New Castle, Del.) introduced additions to its Nova range of injection machines. The company already had introduced the Nova e all-electric line—in Italy about a year ago and at the recent NPE2018 show for North America (see May Keeping Up). That double-toggle series comes in sizes from 50 to 450 metric tons. The new Smart Flex 2 double-toggle clamp has generous tiebar spacing and a moving platen that rides on linear bearings. Its new Tactum control accepts multi-touch commands and is ready for the company's Amico 4.0 wireless remote service access. What's more, Nova e presses boast higher injection speeds—300 mm/sec standard and up to 600 mm/sec on smaller models—for packaging and medical markets. (The company has prototyped up to 1000 mm/sec.)

At the Milan show, Negri Bossi brought out the Nova s and Nova i lines. Nova s (pictured) is a servo-hydraulic series; Nova i is a hybrid version (electric clamp and screw drive, plus hydraulic accumulator for injection and carriage movement). Both have a new X-design toggle clamp from 700 to 1150 m.t. This toggle design is said to be unusually compact, with "best-in-class" tiebar spacing, up to 16% greater stroke than earlier models, and "vastly increased" platen speeds. Replacing the Vector series, the new models also boast up to 35% faster injection and over 15% greater injection-pressure capability.

The new Motus controller has a 21.5-in. screen with multi-touch capability, including swipe, scroll and zoom functions. It is also fully customizable and is ready for remote service access.

A new automatic filtered lubrication system is closed-loop and reportedly leak-free. This is said to be unusual as a standard feature.

Negri Bossi says the new machines will enable it to enter new market areas. Both larger and smaller models will be added in future.

302-328-8020 • negribossi.us

AUTOMATION

Six-Axis Robot Fits In Your Hand

Mecademic, Montreal, displayed a six-axis industrial robot small enough to fit in your hand at last month's ATS East show in N.Y.C. The Meca500 handles payloads up to 500 g (1.1 lb) with what the company calls "unmatched accuracy" of 0.005 mm. There is no proprietary programming language to learn, only a simple set of instructions, says Mecademic.

Available since 2016, the Meca500 has been used for testing, inspection, micro-assembly, dispensing, and transfer of materials in confined spaces.

514-360-2205 • mecademic.com

BLOW MOLDING

New All-Electric Blow Molders at Plast 2018 Show

At the recent Plast 2018 show in Milan, Italy, two suppliers introduced additional all-electric blow molding machines.

Meccanoplastica (***meccanoplastica.com***) brought out the HE-480/D, a mid-size double-sided shuttle machine with 13-ton clamp, carriage stroke of 480 mm, and 90-mm extruder. It's designed for containers up to 5 L. At the show, it produced 3 L containers with two heads at 580/hr. This model fits between HE units for up to 2 L and up to 10 L.

Meanwhile, Magic MP (***magicmp.it***) introduced an all-electric shuttle with very long stroke—up to 1600 mm. Model ME-L50/D-1600-T50 has twin 55-ton clamps and up to six heads with 230-mm center distances. With a double head, it can produce 2 + 2 jerrycans of 15-30 L on 400-mm center distance.

Magic also showed off a new all-electric, one-step injection-stretch-blow machine for PET. The MTM 170 completes the MTM series that was launched three years ago with the MTM 152. The new, larger model handles up to 14 cavities for small 10-ml bottles.

The other news from Magic is the forthcoming opening next month of Magic North America's new headquarters in Canton, Mich. The firm's current office is in New Castle, Del. The new facility It will stock spare parts and have a showroom with machines for customer demonstrations and trials. The new phone number is ***313-209-9107***; email ***support@magicnorthamerica.com***.

ADDITIVES

Additive Blends Neutralize Odor and Control VOCs

Three new additive blends that target odor and VOC control for use in automotive, packaging, or recycled applications were unveiled at NPE2018 last month by Struktol Company of America, Stow, Ohio. These products can range from simple odor-mask/lubricant blends designed to disguise odors to complex neutralizer-plus-absorber blends intended to deactivate specific odor-causing species and fix low-molecular-weight volatiles in plastic resins and compounds. All are said to be effective at low loading levels and can be easily added into most processes including compounding, direct extrusion, and injection molding.

- RP 17 is a combination lubricant and odor-neutralizing mask that was originally designed to reduce odors in wood-filled plastic compounds. It has been modified for use in a variety of thermoplastic resins and compounds that require the multi-functionality of lubrication, mold release, and odor reduction. It can be used in recycled applications and auto interior compounds.

- RP53 is a blend of odor-neutralizing chemistries that is recommended for difficult, high-odor compounds containing problematic species such as mercaptans, amines and phosphites. It can be used in a variety of thermoplastics but is primarily targeted to polyolefins in both recycled applications and auto interiors.

- RP 59 is a blend of odor-neutralizing chemistries and VOC absorbers intended for difficult, high-odor, and high-volatile-content compounds. It can be used in a variety of thermoplastics but is primarily targeted to polyolefins. It is reportedly very effective in packaging applications to not only reduce or eliminate odors in the polymer but also absorb odors coming from the packaged contents.

800-327-8649 • struktol.com

THERMOFORMING

New Packaging Formers

At the recent Plast 2018 show in Milan, Italy, WM Thermoforming Machines of Switzerland demonstrated its new FC 780 E IM2 continuous thermoforming machine. This unit has vacuum and high-pressure forming with steel-rule cutting in the forming tool plus an additional in-line cutting press and in-line stacking. This unit is similar to the model exhibited recently at NPE2018 in Orlando, Fla., except that it is fully electric servo-powered—including the clamp frame (unlike the model at NPE). The additional servo axis is said to make the machine more flexible, as well as suitable for use in a clean room. For example, it allows height adjustment of the tooling of up to 370 mm on top and 250 mm on bottom—or vice versa—for a total adjustability of 620 mm. Electric servo drives recover energy from braking to feed back to the motor to power acceleration.

This model takes a max. mold size of 780 × 580 mm and has a max. draw depth of 130 mm. WM eliminates the usual vacuum pump in favor of multiple venturi stages, thereby greatly reducing maintenance. Further maintenance savings are achieved by eliminating linear transducers in favor of absolute encoders, which are said to be more precise and reliable.

This machine also uses new black ceramic heaters that are said to yield 10-12% energy savings with PET and 12-15% savings with PP. Remote service is available from Switzerland, whereby WM technicians can directly access the thermoformer control via the internet. WM machines are shipped on a single frame so that there is no reassembly needed at the customer's plant and machines are said to be ready to run the first day.

Another recent development from WM is the Twist series, launched in 2016, which is a new version of the company's FT series of continuous formers with in-mold trimming and a tilting lower platen. The Twist version eliminates mechanical cams in favor of servo motors with dual encoders that read the programmed and actual positions and make realtime adjustments so that the two match.

WM sources say the firm has been active in Mexico and its first U.S. machine installations have taken place in the last few months.

+41 91 6407050 • wm-thermoforming.com

MATERIALS

PC/ABS & Polyester TPE Compounds Leap Cost & Performance Barriers

Two reportedly unique compounds have been developed by Nova Polymers Inc., Evansville, Ind. NC8020TC is a new PC/ABS with improved chemical resistance. The company is testing the material, which is positioned to bridge the gap between PC/PBT and standard PC/ABS. It is available in custom colors.

Nova TPEE polyester elastomer is a new TPE compound that is a blend of copolyester resins with an acrylic modifier and a proprietary mix of additives, which is said to allow the company to use lower-cost feedstocks, offering a 15-20% cost savings over comparable materials. This TPE compound boasts UV resistance and flame retardance for applications such as automotive air dams, front-end fascias, and other parts that require maximum ductility coupled with excellent mechanical properties. In many cases, the properties can be adjusted to meet specific customer requirements.

800-226-5143 • novapolymers.net

AUTOMATION

New Grippers for Cobots

Two companies recently came out with innovative grippers designed particularly for the new breed of "collaborative" robots, or "cobots."

Piab in Hingham, Mass. (***piab.com***), introduced the Kenos KCS gripper that reportedly "can handle just about anything, anywhere, at any time." It combines Piab's proprietary pneumatic COAX technology for highly efficient vacuum ejection with an easily replaceable "technical foam" pad that molds itself around any surface or shape. Standard ISO interface adapters enable the unit to attach to any cobot type on the market, Piab says. The body is made of a lightweight 3D printed polymer material. A quick-change system allows the same unit to be fitted with a special gripper for plastic bags.

Piab Kenos KCS vacuum gripper with soft foam head—here shown gripping an egg.

Meanwhile, the new firm of Purple Robotics introduced its first product, the PR10 dual electrical vacuum gripper for cobots. Purple Robotics (***purple-robotics.com***) is a Danish firm recently established by veterans of Universal Robots, a Danish pioneer in the cobot field. With its double-grip function, the PR10 can handle several items in a single operation. Unlike standard vacuum grippers, it requires no external air supply, so there are no cumbersome air hoses to manage, and the gripper is unaffected by changes in line pressure or the cleanliness or availability of external air. The gripper reportedly can be installed in less than 30 min with no prior training.

Purple Robotics PR10 dual electrical vacuum gripper.

Purple Robotics has signed two U.S. distributors, Olympus Controls, Tualatin, Ore. (***olympus-controls.com***), and Thinkbot Solutions, Austin, Texas (***thinkbotsolutions.com***). Nick Armenta, automation engineer at Olympus Controls, says, "The PR10 is a one-size-fits-all solution that eliminates the barrier to entry that is typically caused by customers' unfamiliarity with pneumatics. A single package that can be bought off-the-shelf and quickly deployed without any engineering is a huge benefit for our customers."

ADDITIVES

New Color Effects for PET Packaging

At NPE2018, unusual color effects for PET packaging were showcased by Penn Color, Doylestown, Pa. The newest additions to the company's Penneffex portfolio of colors and effects include bicolor, thermochromic and phosphorescent effects for PET beverage bottles.

Developed in collaboration with Husky Injection Molding Systems, Bolton, Ont. (***husky.co***) and designed and engineered by P.E.T. Engineering S.r.l. in Italy, (***petengineering.com***), these proprietary pigment compounds are introduced in a multilayer preform and bottle structure. Penn Color developed a proprietary pigment masterbatch that reportedly will not cause delamination when using thermochromics or fluorescents in the middle layer. New glow-in-the-dark special-effect masterbatches used in the middle layer and new brushed-metal special effects for the outer layer were also displayed. According to a company official, its focus on developing new bottle concepts will soon expand to formulations for HDPE bottles with installation of a three-layer HDPE blow molding line at Penn Color's new R&D center.

215-345-6550 • penncolor.com

ADDITIVES

High-Performance Lubricants For Automotive and Construction

At NPE2018, a new family of high-performing lubricants and dispersing agents based on "non-food" crude rice-bran wax, was introduced to North America by Clariant Corp., Charlotte, N.C. Tested on automotive parts made of engineering resins including PC, nylons, and TPU, they reportedly offer better shaping flexibility, improved mechanical properties, and enhanced surface finish at efficient dosage levels comparable to those for lubricants based on montan wax. Another key advantage is that there is no yellowing. These products are also suited to applications in E/E and building/construction.

502-295-4106 • clariant.com

Mixed Bag for Prices of Volume Resins

Prices are up for PP, PET and nylon 66; flat-to-down for most others.

By Lilli Manolis Sherman
Senior Editor

Lower prices of some key feedstocks coupled with improved supply-demand balance resulted in a flat-to-lower pricing trend for PE, PVC, PS, ABS, PC and nylon 6. Tight supplies and higher prices of other feedstocks and their intermediaries resulted in an upward pricing trajectory for PP, PET and nylon 66.

These are the views of purchasing consultants from Resin Technology, Inc. (RTi), Fort Worth, Texas (***rtiglobal.com***); CEO Michael Greenberg of the Plastics Exchange in Chicago (***theplasticsexchange.com***); and Houston-based *PetroChemWire* (*PCW*, ***petrochemwire.com***).

PE PRICES FLAT TO LOWER

Polyethylene prices in May were a mixed bag for the first time in years. Two suppliers offered a decrease of 3¢/lb for LLDPE and no change on other grades. Dow announced a 4¢/lb increase for June, while other suppliers postponed their 3¢/lb price hikes. Mike Burns, RTi's v.p. of client services for PE, predicted that June prices would be flat, with a good chance of that trend continuing into this month and beyond.

Flattening of PE prices was apparent in secondary markets. *PCW* reported that spot PE prices were mostly unchanged amid sluggish trading activity by the end of June's first week. "Export volumes were limited as suppliers waited for a clearer view of domestic demand and inventories."

The Plastics Exchange's Greenberg reported that while the market has been awash in butene LLDPE and injection-grade HDPE, film and injection grades of LDPE were more difficult to source, at least at prices agreeable to processors.

Polyethylene Price Trends

	MAY	JUNE
LDPE	◀ ▶	◀ ▶
LLDPE Butene	▼ 3¢/lb	◀ ▶
HDPE Injection	◀ ▶	◀ ▶
HDPE Blow Molding	◀ ▶	◀ ▶
HDPE HMW	◀ ▶	◀ ▶

PP PRICES UP

Polypropylene prices moved up 5¢/lb in May in step with propylene monomer contracts, while another 2¢/lb was tacked on to reinforce suppliers' margins. Spot monomer prices were surging by as much as 6-7¢/lb, so industry sources figured another PP price hike was likely for June. "We see June prices going up 5¢/lb or more, in step with propylene contracts," said RTi's Scott Newell, v.p. of PP markets. The runup of monomer tabs was driven by higher oil prices, propylene supply tightness at refineries, and reports of production outages at dedicated propylene plants.

Newell ventured that July PP prices could be flat, and perhaps lower, if June proves to be the peak for monomer tightness. "I think there could be a lot of demand destruction for PP if these prices are sustained. Expect to see imports increasing." He said PP demand was generally good, starting in April, after lagging for six or seven months. *PCW* reported spot PP prices as flat to higher as supply remained tight due to strong domestic demand and three production outages.

Similarly, Greenberg characterized the spot PP market as challenged by scarce supplies and rising prices: "While some buyers'

Polypropylene Price Trends

	MAY	JUNE
Homopolymer	▲ 7¢/lb	▲
Copolymer	▲ 7¢/lb	▲

Market Prices Effective Mid-June 2018

Resin Grade	¢/lb
POLYETHYLENE (railcar)	
LDPE, LINER	101-103
LLDPE BUTENE, FILM	84-86
NYMEX 'FINANCIAL' FUTURES	48
JULY	48
HDPE, G-P INJECTION	103-105
HDPE, BLOW MOLDING	93-95
NYMEX 'FINANCIAL' FUTURES	50
JULY	50
HDPE, HMW FILM	110-112
POLYPROPYLENE (railcar)	
G-P HOMOPOLYMER, INJECTION	83-85
NYMEX 'FINANCIAL' FUTURES	57
JULY	57
IMPACT COPOLYMER	85-87
POLYSTYRENE (railcar)	
G-P CRYSTAL	109-111
HIPS	115-117
PVC RESIN (railcar)	
G-P HOMOPOLYMER	83-85
PIPE GRADE	82-84
PET (truckload)	
U.S. BOTTLE GRADE	75-77

initial response might be to wait out this cycle, there are some real supply issues that could help keep PP prices elevated for a while."

PS PRICES DOWN

Polystyrene Price Trends

GPPS	
MAY	JUNE
▼ 4¢/lb	◀▶

HIPS	
MAY	JUNE
▼ 4¢/lb	◀▶

Polystyrene prices dropped 4¢/lb in May, and RTi's Kallman expected flat-to-slightly upward movement in June and July. He cited a bit of cost pressure from benzene, up only 6¢/gal in May, and butadiene, up 7¢/lb. However, ethylene contracts settled lower in April and May and were likely to sink lower in June. At the same time, he foresaw more upward pressure in August, due to stronger demand for PS during its normally strong season, including some pre-buying for hurricane season and some tightness in benzene and styrene monomer. Going into June, *PCW* reported that spot GPPS and HIPS prices were down 4-5¢/lb after peaking in early April. Feedstock costs were steady, with the implied-styrene-cost formula (based on 70% spot benzene/30% spot ethylene) was flat at 32.6¢/lb.

PVC PRICES FLAT

PVC prices were flat in May, driven by very low ethylene contract costs that were likely to fall another 2-3¢/lb, which would reduce the cost of making PVC by 1-1.5¢/lb, according to RTi's Kallman. However, spot ethylene prices bottomed out at 12¢/lb and were up 3.25¢/lb by the end of May.

PVC Price Trends

Pipe	
MAY	JUNE
◀▶	◀▶

Gen. Purpose	
MAY	JUNE
◀▶	◀▶

PCW reported that late-settling April ethylene contracts settled 1.5¢/lb lower, at 26.75¢/lb, and May contracts dropped 0.75¢/lb to 26¢/lb. "Resin buyers were trying to discern how the settlements will affect their PVC prices, as a drop of 2.25¢/lb in ethylene could imply a reduction of about 1¢/lb in PVC pricing." However, both *PCW* and Kallman noted that suppliers' stance was that low ethylene prices cannot be sustained and that domestic demand picked up nicely in April-May, as did exports, a trend likely to continue into June and the third quarter. Kallman noted that suppliers have been running their plants at very high rates due to very low feedstock costs.

PET PRICES UP

PCW reported increases in domestic bottle-grade PET prices in May by 3-5¢/lb to the mid-70¢/lb range (delivered Midwest), driven by rising oil and PET feedstock prices. Average U.S. PET feedstock costs in May were up 2.4¢/lb from April to 61.28¢/lb, according to one calculation used by large-volume PET suppliers and buyers to invoice May deliveries. *PCW* predicts that prices of PET (prime, offgrade and rPET) are likely to increase by another 1-3¢/lb in June-July, driven by "skyrocketing" consumption of carbonated soft drinks and bottled water. This projected price increase also assumes that crude oil prices will rise or stay at current elevated levels.

PET Price Trends

Bottle Grade	
MAY	JUNE
▲ 3-5¢/lb	▲

Meanwhile, U.S. PET import prices stood at 72-74¢/lb (delivered duty-paid to the West Coast), up 2-3¢ from April—a rise attributed directly to anti-dumping duties on PET imports from Brazil, Indonesia, South Korea, Pakistan, and Taiwan.

ABS PRICES FLAT

ABS prices remained fairly stable through the second quarter, following the 5¢/lb increases in January. Suppliers' efforts to push through price hikes of 6-7¢/lb failed as feedstock prices retreated and competition rose from cheaper ABS imports, according to RTi's Kallman. Noting that the market is now more balanced, he ventured that prices would hold level at least through June, with some upward potential late in the third quarter.

PC PRICES GENERALLY STEADY

Polycarbonate prices were generally flat through the second quarter, following the implementation of January increases of up to 14¢/lb, with independent compounders and secondary suppliers implementing similar increases in February-March, according to RTi's Kallman. There were some new price-increase attempts announced for May, but implementation was at best mixed, leaving Kallman to characterize overall PC pricing as steady.

Further, he foresaw PC prices remaining mostly flat through the third quarter. "Keep your eyes on prices of benzene, propylene and lower-priced imports," he noted. He described demand as good on a global level and domestic automotive demand as good but not as strong as in 2017, with a reduction in Asian imports through June.

NYLON 6 FLAT; NYLON 66 UP

Nylon 6 prices remained flat from March through May, as benzene prices bottomed out at $1.90/gal and moved up to only $1.96/gal in May, according to RTi's Kallman. Potential for some upward pressure is possible this month, as benzene oversupply will be finished and prices could firm up. Nylon 6 plants are operating at high rates as there is increasing industry talk of substituting for nylon 66 due to the latter's higher prices.

Nylon 66 prices were largely flat through May, after moving up 15-20¢/lb in the first quarter, driven by a global market that became very tight, according to Kallman. "We had seven *force majeure* actions on intermediates through the first two quarters. Recovery will be long—supply is tight globally. He anticipates upward pricing pressure in the third quarter due to supply tightness and possible price increases for butadiene and propylene monomer. PT

Fifth Straight Month of Growth for Processing

May's Index comes in at 57.1 amid indications that processors are making longer-term investments to increase production capacity.

The Gardner Business Index (GBI): Plastics Processing came in at 57.1 for May, lower than April's 58.1 reading. For the first five months of 2018, the Plastics Processing Index averaged 57.3, representing the fastest five-month period of growth in the Index's history. The index is calculated based on monthly surveys sent to subscribers of *Plastics Technology* magazine.

By Michael Guckes
Chief Economist

The latest reading is up 2.3% from the same month a year ago. However, the reading from May 2017 was the highest reading in all of 2017. The latest result was driven higher by supplier deliveries, production, and new orders. Employment, backlog, and exports all pulled the index lower. All components of the index experienced growth during the month.

May's rising sub-indexes for employment and supplier deliveries and slower growth for new orders and production indicate that the current business cycle, which was initiated by a surge in new orders growth in early 2017, is showing signs of initial maturing. When the rate of new orders initially increases, manufacturers can make limited but immediate changes to increase production. However, to sustain increased production levels, or achieve significantly higher production, manufacturers typically must alter their supply chains and increase hiring, which often happens months after the initial new orders surge. The latest survey results for employment and expected capital spending indicate that the industry is making longer-term investments to increase production capacity.

The May index for only custom processors, while robust at 59.9, fell from the prior month's all-time high reading of 62.4.

Michael Guckes is the chief economist for Gardner Intelligence, a division of Gardner Business Media, Cincinnati. He has performed economic analysis, modeling, and forecasting work for nearly 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*.

Gardner Business Index: Plastics Processing

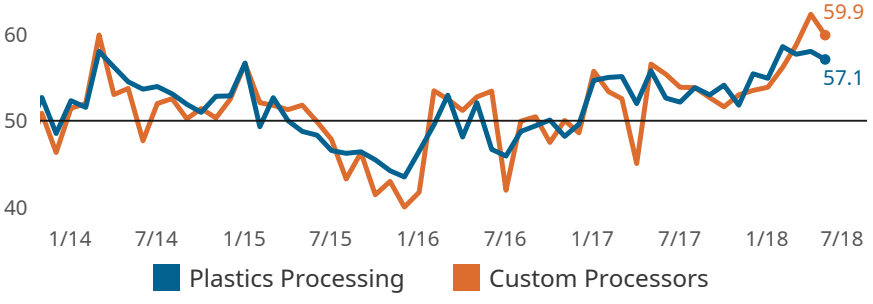


FIG 1

The Plastics Processing Index has registered several exceptionally high readings in 2018, with an average level of 57.3. No other five-month period in the index's history has experienced such positive conditions.

Gardner Business Index: Plastics Processing—New Orders & Backlog (3 MMA)

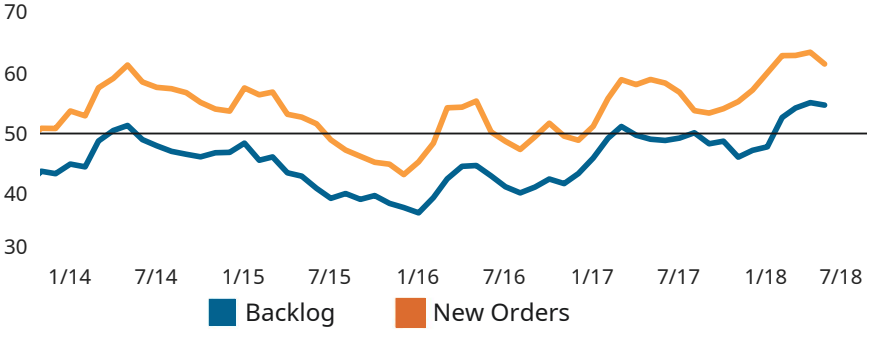


FIG 2

Consecutive months of strong growth in new orders has resulted in unprecedented backlog growth. As companies make significant long-term investments to increase production output, we can expect to see backlogs decrease while employment and supplier deliveries increase.

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Packaging Market to Remain Strong

Analysts project revenues for packaging and container industries to increase 10% this year.

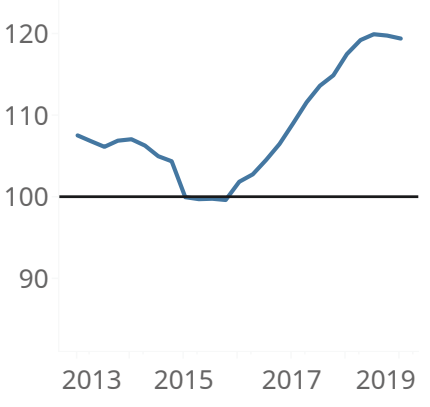
By Michael Guckes
Chief Economist

The packaging industry started off 2018 very strongly, according to first-quarter financial results provided by publicly traded packaging and container manufacturers. The packaging industry in general has experienced tremendous growth since 2016, and the first quarter of 2018 continued that trend.

Gardner Intelligence's review of 24 publicly traded U.S. packaging and container firms indicates that first-quarter 2018 real (inflation-adjusted) revenues grew 10.1% from a year ago. (Gardner Intelligence applied a 2.5% annual deflator to forecasted values.)

FIG 1

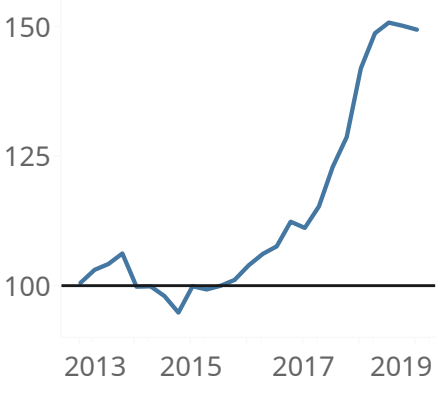
Indexed Wall Street Actual And Projected Revenues (In Inflation-Adjusted Dollars)



Trailing 12 Months.

FIG 2

Indexed Wall Street Actual and Projected Earnings (In inflation-adjusted dollars)



Trailing 12 Months.

Executives at one large packaging firm stated to investors during its first-quarter 2018 shareholders meeting that its latest financial results were bolstered in part by the ability to push through higher prices and volumes. According to the latest available actual and forecast data from Wall Street analysts, the packaging and container industry is expected to experience revenue gains of just under 10% during calendar year (CY) 2018. Next year's expectations from these same analysts show marginal revenue change in 2019 following 2018's strong gains.

Earnings expectations in CY 2018 and 2019 largely follow the same trajectory as revenues. Earnings growth during CY 2018 is projected at an impressive 54% before turning slightly negative the year after. Although projections for revenue and earnings are very encouraging for 2018 and 2019, actual capital-expenditure growth during CY 2017 was just 1.8% over CY 2016. This may have been due in part to poor revenue and earnings performance in 2015 and 2016, along with subdued free cash flows during 2017.

If the lack of investment in 2017 was in fact a reaction to the struggles experienced in the prior years, then 2018 and beyond may see above-average spending on investments. Among the 19 firms in our study that had reported their first-quarter 2018 capital expenditures at the time of this article's publication, capital spending was up 3.9% compared with Q1 of 2017. By comparison, capital spending among these same firms was down 1.3% from 2016's fourth quarter to that of 2017.

Among other sources pointing to an upbeat 2018 is The Association for Packaging and Processing Technologies (PMMI). According to PMMI's April 2018 Business Indicator Report, survey data provided by OEMs and end users investing in packaging equipment indicates significant optimism about 2019 equipment investment in every end market examined. Survey respondents were most optimistic about the chemicals, food and durable-goods markets. Following behind these top three were pharmaceuticals, beverages and personal care. None of the six end markets reported in the PMMI survey indicated contraction for 2019.

ABOUT THE AUTHOR: Michael Guckes is the chief economist for Gardner Business Intelligence, a division of Gardner Business Media (Cincinnati, OH US). He has performed economic analysis, modeling and forecasting work for nearly 20 years among a wide range of industries. Michael received his BA in political science and economics from Kenyon College and his MBA from The Ohio State University. *mguckes@gardnerweb.com*

infoNET

This is *Plastics Technology*'s online listing for plastic processing equipment builders, material suppliers, auxillary manufacturers and more.

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Wittmann Battenfeld

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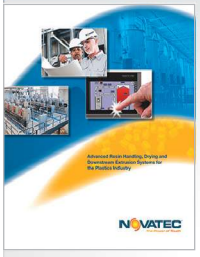

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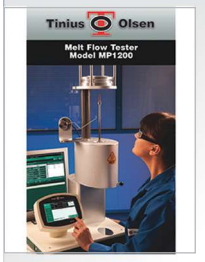

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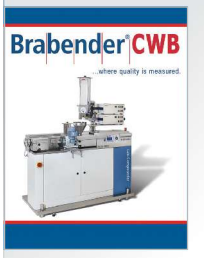

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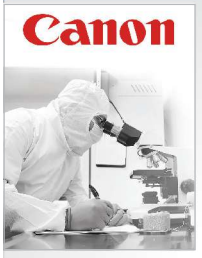

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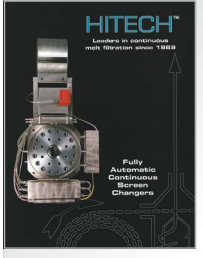

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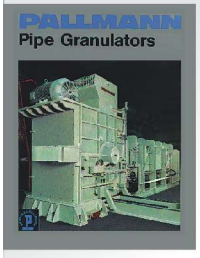

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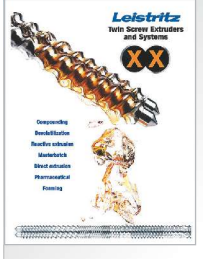

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CH3 SOLUTIONS— DALTON, GA.

'Intelligent' Cooling Helps Molder Improve Productivity, Profitability & Quality

Cost-effective and user-friendly process-cooling system gives custom molder the ability to do more with less.

By Jim Callari
Editorial Director

Founded in 2015, CH3 Solutions is a "proven startup," committed to the "pursuit of doing things better" in all aspects of its business. When relocating in 2016 to a 90,000 ft² facility in Dalton, Ga., to accommodate rapid growth, the custom injection molder (***ch3solutions.com***) decided to implement a better approach to process cooling. It had three main goals:

1. Gain control over cooling-water temperatures and flow rates when producing millions of high-quality floor tiles per year. Traditional process cooling made it difficult to produce smooth, flat tiles with consistent coloration.
2. Maximize operational efficiencies and improve profit margins, dictating reductions in energy, maintenance and chemical-treatment costs.
3. Minimize water waste, improving its ecological footprint.

Custom molder CH3 Solutions reevaluated its cooling needs when it relocated to a bigger plant in 2016. Its decision to go with Frigel's Intelligent Process Cooling System paid off handsomely, says Rodney Davenport, the molder's vice president.

As a small business, CH3 Solutions required a cost-effective and user-friendly process-cooling system that would allow it to do more with less. The cooling system also needed to run with maximum uptime to ensure peak productivity and ongoing customer satisfaction. After reviewing options and cost-benefit analyses, CH3 Solutions chose to implement the Intelligent Process Cooling system from Frigel North America, E. Dundee, Ill. (***frigel.com***).

Frigel's scientific approach to process cooling included a detailed assessment of CH3 Solutions' processes and unique molds, paying attention to the method used to produce floor tiles. The cooling-system supplier also considered the molder's rapid growth. From there, it custom-designed and installed a system offering:

- *Better central cooling*: An Ecodry 3DK closed-loop adiabatic central cooler efficiently and cost-effectively delivers clean cooling water to machine-side units at each production cell. The Ecodry unit reuses water, which drastically reduces water consumption compared with an open-cooling tower. It also allows free cooling during cooler months of the year, saving energy.
- *Precise machine-side temperature control*: Seven Microgel Chiller/TCUs and one Turbogel TCU provide the required temperature, pressure and turbulent flow to each individual process and mold. In all, CH3 Solutions operates eight production cells.
- *Control system with remote monitoring service*: When needed, Frigel's technical experts can remotely assist with cooling challenging molds and manage a wide array of system parameters to ensure peak performance.

The modular Ecodry central cooler features a single set of pipes and a bolt-on pumping system, allowing for easy system expansion. In addition, CH3 Solutions can add compact, mobile Microgel units to new production cells as production capacity expands.

CH3 Solutions' thorough analyses of process-cooling systems paid off. The Frigel Intelligent Process Cooling system quickly demonstrated the ability to help the company achieve production and business goals with less water use, lower energy consumption, reduced chemicals use and costs, faster mold changeovers, and less need for routine maintenance. The system also provided the molder with a way to overcome the challenge of consistently producing high-quality floor tiles in large volumes, further enhancing its reputation as an industry leader.

Says Rodney Davenport, CH3 Solutions v.p., "As a technology-driven company, we wanted more out of process cooling. We also strive to eliminate waste in every aspect of our business. We chose Frigel for process cooling. For us, it's been awesome, and we plan to be partners with Frigel for years to come." PT

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