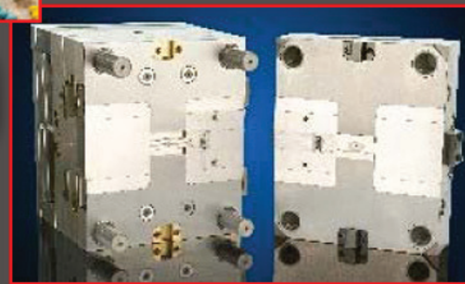
Spring 2014 | No. 95



MOLDING VIEWS

Brought to you by the Injection Molding Division of the Society of Plastics Engineers

In This Issue:

This Month's Features:

Chair's Message

Greetings!

As I sit down to write this message, there are three feet of snow on the ground and we aren't expecting to reach temperatures above zero today. While I'm an avid winter sports fan I'm like most people and I'm ready for spring. Winter is often used as a time of reflection on the past year, and establishing what we would like to change in the upcoming year. Spring is often a time for placing our new resolutions into action.

This spring SPE is helping the plastics industry jump into action by hosting its Annual Technical Conference (ANTEC) at the Rios All Suites Hotel & Casino in Las Vegas. The conference will be held from April 28-30. (click here to register)

Chair's Message Continued

Our Technical Program Chair, Adam Kramschuster, and the ANTEC paper review team (Peter Grelle, Raymond McKee, and Pat Gorton) have assembled an excellent three-day program that introduces attendees to the new leading technology that will shape our industry in the near future. Session topics include process control, simulation, materials and foam molding. Additionally, we are continuing with our tutorial sessions that allow attendees to discuss issues they experience every day and introduce methods of finding practical solutions to those problems.

In addition to the numerous presentations, there will be a new SPE plastic part design competition at ANTEC. This year the design competition, titled “Plastics for Life”, is assembling numerous plastic parts that highlight proper plastic part design, and/or use innovative technology to manufacture them. This competition will be a great way to highlight the innovative and quality work your company does every day. Barbara Spain is organizing the competition this year and can be contacted if you wish to enter your plastic part.

I want to end this message by saying thank you to the many people that have helped me during my tenure as your chair. It has been a truly great experience interacting with our membership and the board. I look forward to starting in my new role as past-chair this next year and helping the injection molding division move forward to better serve our members.

Best Regards,
Erik Foltz

Industry Events Calendar

Click the show links for more information on these events!

March 2014

25-26: Successful Plastic Part Design: The Fundamentals Revealed!
Gurnee, IL
www.4spe.org

May 2014

6:
AutoEPCON 2014
MSU Management Education Center
www.4spe.org

June 2014

10 — 11:
Decorating and Assembly: New Technology
Ypsilanti, MI
www.4spe.org

amerimold 2014 THE EVENT FOR MOLD MANUFACTURING

11-12: Amerimold 2013
Novi, MI
http://www.amerimoldexpo.com/zones/general-info

Webinars

BE UP-TO-DATE WITH THE LATEST INFORMATION.
VISIT OUR WEBINARS.

Injection Molding Design — Solving the Jigsaw Puzzle of Manufacturability, Cost and Time

What To Do When Experiencing Color Streaking, Degredation and Contamination

Scientific Troubleshooting of Common Injection Molding Defects

Choosing the Best Hot Runner for Your Application Husky Injection Molding Systems

Beware - The Hidden Costs of "Good Enough" - Making Smarter Investments in Your Injection Molding Facility

Proper Planning in Screw/Barrel Design Will Improve Profits

In-Machine Mold Cleaning, Part Deflashing, Deburring and Surface Preparation Using Dry Ice

Call for Trainers

The Society of Plastic Engineers Injection Molding Division is searching for trainers in the injection molding industry.

We would like to help promote training opportunities within our membership.
If you are interested in training please submit the following:

- **Up to a 30 minute video showing your teaching style/method**
- **Description of topics covered**
- **Description of your teaching style**

For more information contact:
Jeremy Dworshak
SPE IMD Board Member

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Moisture Absorption and Its Effect on Long Term Stiffness

Bob Dealey, owner and president of Dealey's Mold Engineering, Inc. answers your questions about injection molding.

Bob has over 30 years of experience in plastics injection-molding design, tooling, and processing.

You can reach Bob by e-mailing molddoctor@dealeyme.com

Q: **I work in engineering for a manufacturer and marketer of electrical cable racking, duct and bore spacers used in below ground applications for electrical distribution. We presently mold these spacer's and devices from 40% glass filled type 6 Nylon.**

Moisture absorption and its effect on long term stiffness is a concern. I've researched alternative materials but have difficulty in comparing properties apples to apples. The problem is identifying common properties to directly compare alternative materials. I'm interested in evaluating Polypropylene. Any suggestions on how I could proceed?

A: The issues of directly comparing plastics are well known. The producers of plastics, while publishing accurate and meaningful data, often choose to show the material in the best light. Additionally, not all properties are evident in all plastics. Some plastics are flexible, others stiff. They can be hard or soft, have a wide range of softening temperatures and/or absorb moisture at different rates and levels.

The first property you would logically compare would be "stiffness". Unfortunately, conventional property listings for plastics do not include stiffness as a measured property.

The flexural strength of a material is defined as its ability to resist deformation under load and is a property reported in some manner and might be utilized for comparison.

Ask the Experts: Bob Dealey Continued

For materials that deform significantly but do not break, the load at yield, typically measured at 5% deformation/strain of the outer surface, is reported as the Flexural Strength or Flexural Yield Strength.

Comparing a generic "neat" Nylon 6 to Polypropylene (Homopolymer), Nylon has about a 2 to 1 advantage in Flexural Strength, 85 MPA for Nylon 6 and 40 MPA for a generic Polypropylene. Obviously Nylon 6 is then the stiffer of the two. The Flexural Modulus (the ratio of stress to strain in flexural deformation) favors Nylon 6 with a reported value of 2.3 GPa, compared to 1.5 for Polypropylene or a 50% advantage to Nylon 6.

Researching a generic 43% glass fiber Nylon 6 I find a "Flexural Strength-Yield" of 2.31x103 kg/cm$_2$. I could not locate a generic 43% glass filled Polypropylene but one 30% glass filled Polypropylene I located reported a 2.81x103 kg/cm$_2$ "Flexural Strength-Yield".

As for moisture absorption: Nylon 6 has a listed value at 0.90% for 24 hours; the Polypropylene does not have a value listed as the material is not known to have moisture absorption issues.

One could conclude from those examples that a comparable glass reinforced Polypropylene should perform relatively equivalent in the application.

To be sure that we haven't missed something, such as environmental temperature exposure, creep or other application peculiarities, a test sample and evaluation program should be the next step to insure a successful material switch. I expect a high confidence level of successful molding glass filled Polypropylene in an existing mold used for glass filled type 6 Nylon.

The exact grades of materials currently used and under consideration, are unknown to me and I used examples of material properties that I had access to in my library. This is not always the best practice as properties can vary widely within product offerings and from manufacture to manufacture.

Good luck with your project.
Bob Dealey

Cavity ID's vs. Flow Group ID's

Cavity ID's are used to help distinguish one cavity from another cavity. This becomes more important when looking at such things as part quality, mold maintenance data, and short shot analyses. They are often put into the molds without much thought given to them. But new troubleshooting techniques bring to light some very important aspects of cavity ID's.

The first important point to make is their location within the cavity relative to the gate. Our recommendation would be as close to the gate as possible. So when evaluating the parts from your short shot analysis you will be able to see the cavity ID's.

Second, avoid putting cavity ID's on EJ pins. Pins tend to get moved around during routine mold maintenance, and what was once cavity 3 may not be cavity 6 thus making it more difficult to accurately track historical data.

Third, if using a cold runner system, we would recommend putting the same cavity ID markings on the cold runner itself near the gate. This way you know which gate is feeding which cavity and how the runner is oriented in the mold when looking at your data.

And fourth, we recommend using Flow Group ID's versus traditional cavity ID's. Please read on…

$$\Delta P = \frac{8Ql\eta}{\pi r^4}$$

Figure 1

The science behind Flow Groups comes from fundamental plastic flow principles along with the pressure drop equation (**Figure 1**). Using Flow Groups will help you see through much of the noise by separating variations into "steel" vs. "viscosity" variables based on the pressure drop equation itself.

Figure 2 shows short shot data from a 16-cavity mold using conventional cavity ID's numbered 1 through 16.

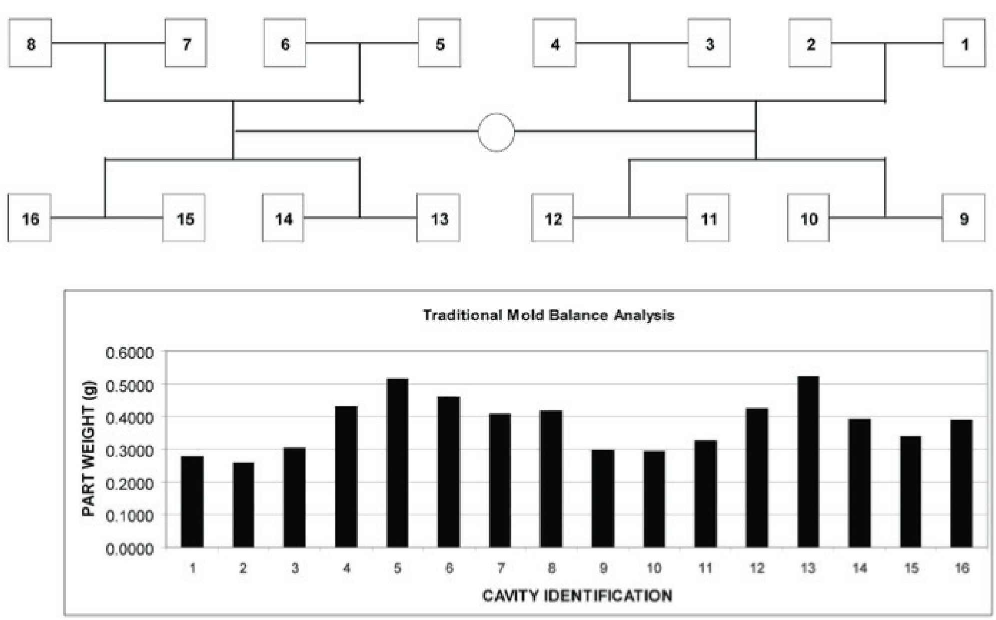
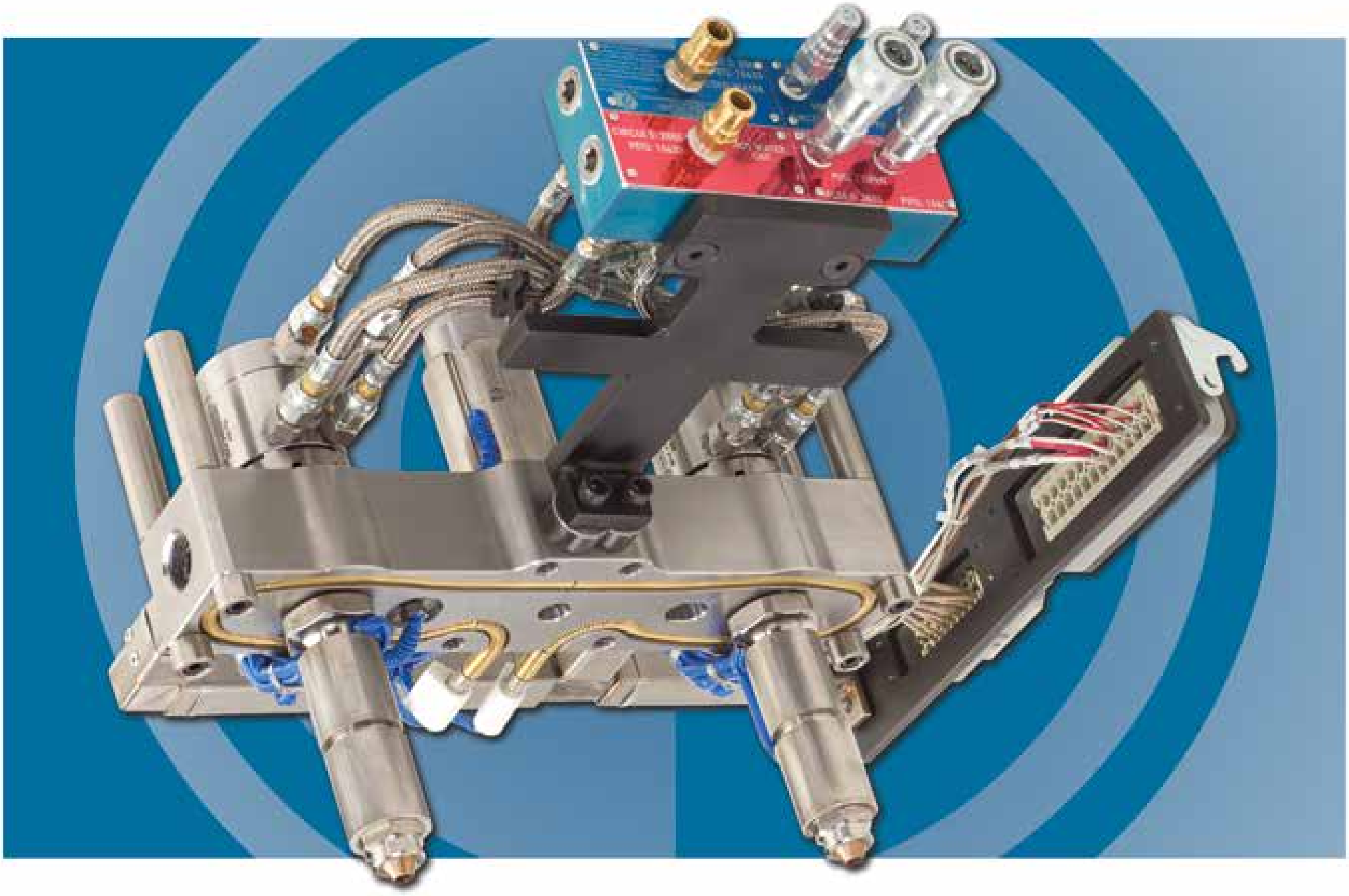


Figure 2



WHO'S BRINGING NEW LEVELS OF PERFORMANCE TO COMPACT HOT RUNNER/MANIFOLD SYSTEMS?

At Plastic Engineering & Technical Services, we are.

We define performance. For nearly 30 years, we've helped our customers to produce more efficiently, with lower cycle times and lower per unit costs.

Our new compact stainless steel, modular unitized system features flexible heaters that can be utilized on multiple designs, so you don't have to stock custom bent heaters. Our new drop heaters provide more uniform heating and feature smaller pockets and no clamps. They have in-line flow restrictors for better process repeatability, and no over-pressurizing the cylinders. It all adds up to a reduced sized hot runner system, shorter heating times and better tool performance.

We deliver value. We complement our hardware with leading-edge analytical tools, including Moldflow® and MOLDEX3D software. We'll work with you on design issues and optional gating solutions before the mold or hot runner manifold system is ever built. Use us for the mold flow analysis and the manifold build, and we'll do whatever it takes to make your hot runner/manifold system work to your complete satisfaction.

We're committed to your success. Find out more.

Call us today at 248.373.0800 or visit us at www.petsinc.net.

PLASTIC ENGINEERING & TECHNICAL SERVICES, INC.

Performance. Value. Delivered.

Tips of the Trade Continued

The data shows a calculated variation of 51%. From here you can see there is a great deal of variation, but no rhyme or reason as to what is causing the variation.

Figure 3 was created using the same data but now we are looking at it according to Flow Group ID's. This allows us to easily identify a pattern in which the cavities in the A & D Regions were the heaviest cavities in all Flow Groups. We then kept asking the question "what would cause this to happen?" until the root cause was found, which ultimately led to identifying a variation of .006æ" (.152 mm) in one half of the primary runner. The larger primary runner was on the left side of the sprue (Regions A & D), which correlates with the data according to the pressure drop equation.

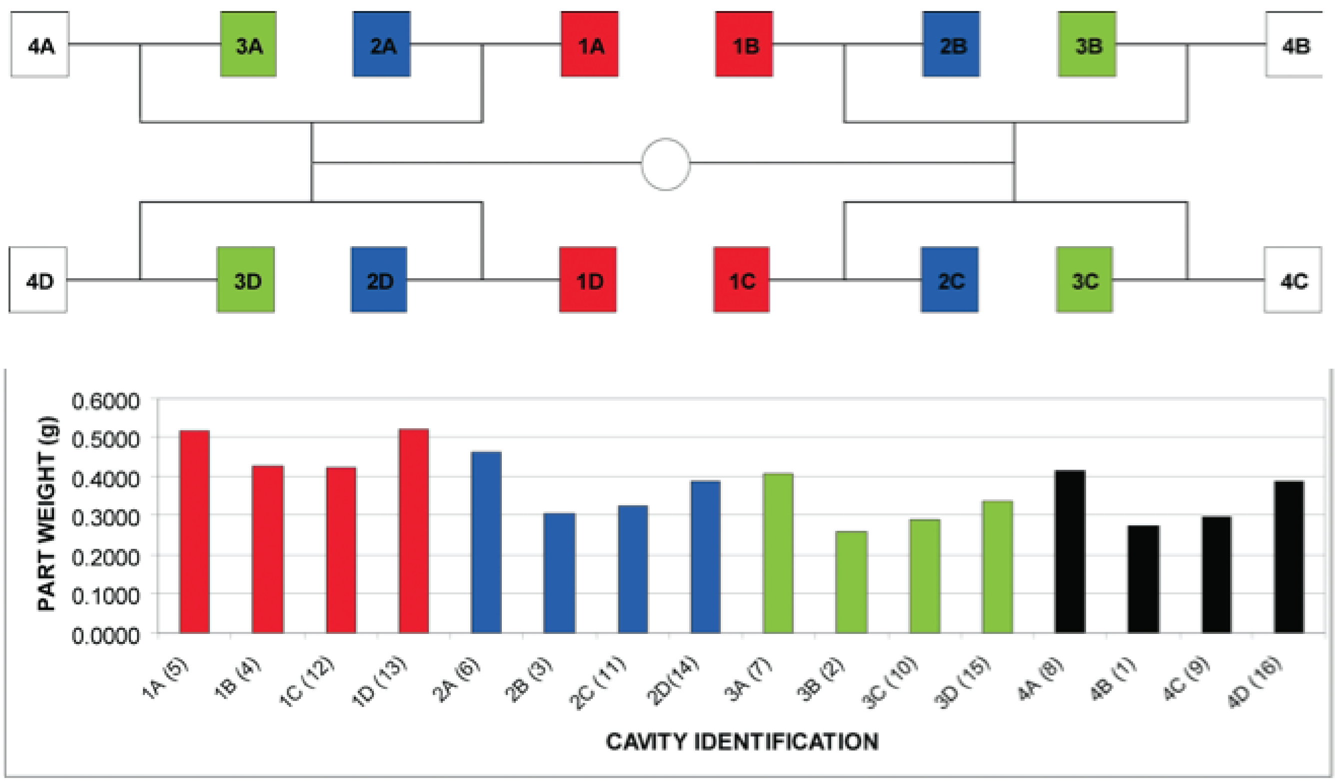


Figure 3

For more information on this month's tip contact:

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www.Beaumontinc.com

By Steve Broadbent
ENGEL MachinerY North America

Expansion Molding: New Method for LSR Micro-Molding

X-melt or expansion molding technology was originally developed to fill thin-wall parts that require extremely fast injection rates.

X-melt technology enables the molder to achieve much faster injection rates than are mechanically possible by the injection machine. (If that sounds impossible, read on.) Recently the scope of X-melt has expanded to include low pressure micro-molding using liquid silicone rubber (LSR).

How and Why it Works

X-melt is expansion molding. It relies on the inherent compressibility of plastic melts and uncured LSR. In essence, the procedure is to first accumulate the shot volume in front of the screw and then move the injection screw to its final forward injection position while the material is held in place by cold-runner

Feature: Expansion Molding Continued

(hot-runner for thermoplastics) valve-gate nozzles. The LSR is compressed using this pre-injection stage to create a spring or stored energy. The amount of energy is determined by the X-melt pressure—the set pre-injection pressure—and the size of the cushion or spring in the injection unit. Unlike other liquids that are not compressible, LSR is 5% to 7% compressible, depending upon the material durometer and supplier. The LSR is held in this compressed state for a set time to allow the LSR material pressures in the injection unit and cold runner to stabilize. After this set X-melt time has expired, the valve gates are opened and the material is released to expand spontaneously into the cavities. As the molded parts fill, the pressure reaches an equilibrium point at which filling stops, and the valve gates are closed.

The green line on the graph in **Figure 1** indicates the injection pressure. This indicates the X-melt pressure of 2800 psi and an x-melt holdup time of 1.6 sec. It also shows the rapid pressure drop as the material is released into the cavity. The bottom of the curve is the point of equilibrium or residual pressure. Since a traditional hold pressure or time is not used with X-melt technology, this becomes the hold sequence. The white vertical line on the graph indicates the point in the cycle that the valve gates are closed. The point of equilibrium can be increased or decreased by raising or lowering the X-melt pressure set-point and also by increasing or decreasing the cushion length. This effectively raises or lowers the hold pressure of the process. The valve-gate timing can be increased or decreased to adjust the hold time of the process.

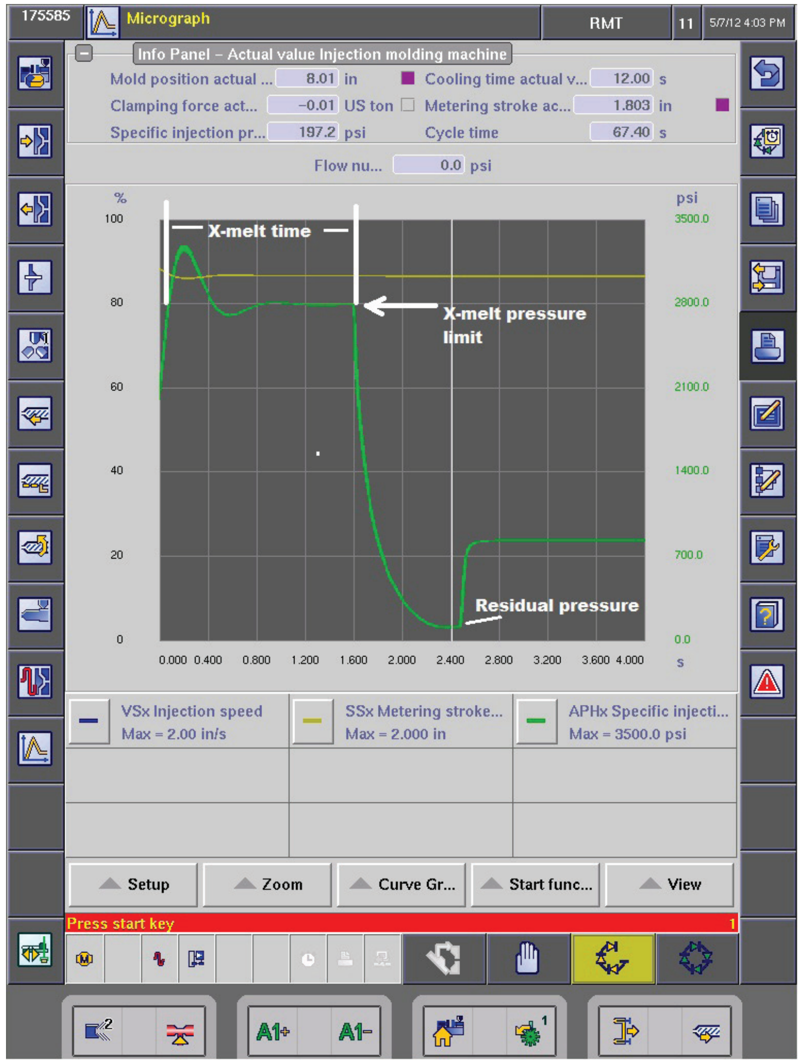


Figure 1:
The green line on the graph indicates the LSR material pressure. The X-melt pre-injection pressure is 2800 psi, held for 1.6 sec to allow for pressure stabilization throughout the shot. Pressure drops rapidly as material is released to expand into the cavity, until it reaches an equilibrium residual pressure where filling stops, and the valve gates are closed.

The result is a process that is no longer dependant upon screw position for accuracy. The premise of X-melt technology is fixed pressure + fixed orifice = repeatable flow rates.

Why is This Impoartant?

Consider a micro-molding application using a 12 mm diam. injection screw and a shot size of .010 g. This would result in a total injection stroke of 0.0031 in., which may be difficult enough to repeat, but then also consider the dependency of an exact metering stroke and exact material pressure during metering. Consider that a change in screw position of only 0.0005 in. would amount to over 15% variation in total shot size. Since X-melt is dependant upon achieving a set pressure and opening the valve gates or injection nozzle for a set time, screw position is no longer important.

This also eliminates variations due to fluctuating metering pressures. In many micro-molding applications, opening and closing the metering valve mounted on the feed throat introduces more material than the total shot size. Exact metering has always been a challenge in LSR micro-molding, often requiring specialized equipment. Since the standard process is a position-dependant process, metering must be included in each cycle to ensure a consistent starting point for injection. X-melt technology is not dependant upon screw position, so we can mold several shots before requiring a metering cycle. This means longer metering cycles and more screw rotations, resulting in a more homogeneous mixture and better color dispersion.

Case StudyCASE

In a recent case study, X-melt technology was compared with a standard injection process using LSR in a four-cavity injection mold. The machine used for the study was an Engel e-victory 80/30 US hybrid tiebarless machine (**Figure 2**). The machine featured a servo-electric injection unit and a servo-controlled hydraulic system for clamping and ejector functions. The plasticizing assembly was a standard LSR injection screw (18 mm diam.) and water-cooled barrel. The only machine requirements for X-melt are servo-driven injection and an X-melt expansion molding software package. The mold selected was a four-cavity, valve-gated, cold-runner mold supplied by Roembke Manufacturing and Design. The part was a medical umbrella valve with a weight of 0.1280 g. The total shot weight was 0.5119 g. Although X-melt is capable of much smaller shot sizes, the first goal of the study was to compare the X-melt technology to a stable

Figure 2: An Engel e-victory 80/30 hybrid tiebarless machine was used for this study. X-melt is a software add-on that requires no hardware modifications. The software can be turned off when not needed.

Standard Shot to Shot consistencey

1	0.5146	11	0.5151
2	0.5153	12	0.5152
3	0.5154	13	0.5154
4	0.5154	14	0.5149
5	0.5148	15	0.5148
6	0.5149	16	0.5148
7	0.5154	17	0.5146
8	0.5159	18	0.5148
9	0.5157	19	0.5150
10	0.5158	20	0.5151
		Mean	0.51515
		Upper	0.51590
		Lower	0.51460
		Range	0.00130
		Deviation	0.126%

Figure 3: Shot weights for 20 random samples from a run of 100 shots using a standard LSR injection process.

Feature: Expansion Molding Continued

conventional injection process. The second goal was to show significant improvement with the X-melt technology.

The study was conducted by running 100 shots and selecting 20 random shots for a weight study. For conventional injection, the total range of 0.0013 g and 0.126% deviation from mean indicate a very stable and repeatable process (see **Figure 3 page 14**).

The second part of the study was to repeat the 100 shots with the X-melt function turned on. As you can see from the results in **Figure 4**, there was a significant improvement in shot-to-shot consistency. The overall range was reduced from 0.0013 g to 0.0004 g and deviation from the mean of went down from 0.126% to 0.039%.

To better explain these results, we need to understand the results from each part of the trial. The standard-process part weights had a range of 0.004 g. These results actually show the repeatability of the screw position. The range of 0.004 g means the screw position varied 0.0006 in. from the mean. This is the effective epeatability of the injection machine used for the study. The size of the shot will not have an impact on this repeatability, but as the shot size decreases the range will become a higher percentage of the total shot size. For example if the shot size were reduced to 0.250 g, the range of 0.0004 g would mean deviation from the mean of 0.8%. Since the X-melt tech-

X-Melt Shot to Shot consistencey

1	0.5120	11	0.5120
2	0.5119	12	0.5121
3	0.5118	13	0.5118
4	0.5119	14	0.5118
5	0.5117	15	0.5120
6	0.5118	16	0.5118
7	0.5119	17	0.5118
8	0.5121	18	0.5117
9	0.5118	19	0.5118
10	0.5118	20	0.5117
		Mean	0.51186
		Upper	0.51210
		Lower	0.51170
		Range	0.00040
		Deviation	0.039%

Figure 4: Turning on the X-melt process, with no change in machine or mold produced much more consistent shot weights.

nology does not rely on screw-position repeatability, the percentage of deviation from the mean remains the same regardless of the total shot volume.

X-Melt Capablities and Limitations

To fully understand X-melt technology we must understand its capabilities and limitations. The above study shows the capabilities of X-melt for molding LSR shot sizes up to 0.5 g. The process has been tested with shot sizes as small as 0.015 g with very similar results in the percentage of deviation from the mean.

The limitations should be discussed in two terms, theoretical and practical. The theoretical limitations are the maximum shot volume a specific injection unit is capable of when using the X-melt technology. The 18-mm screw used on the test machine has a maximum injection capacity of 28.68 g. At 4000 psi, the material reached a maximum compression of 6%. This means a maximum filling capacity of 1.721 g. At this point the equilibrium pressure would be at 0 psi, but to maintain sufficient residual pressure only 85% of the maximum filling capacity can be used. Thus, the theoretical shot-size limit with the X-melt technology on the test machine would be 1.463 g. The practical limit can be described as the point at which the X-melt technology no longer shows a significant advantage. As discussed earlier, when using a standard position-controlled injection process, the shot size has no impact on repeatability of the screw position. This means that as the shot size decreases the same range in screw position results in an increase in the percentage of deviation from the mean. The inverse is also true, as the shot size increases the same range in screw position will result in a smaller percentage of deviation from the mean. The shot size used for the case study was 0.5119 grams and the standard process resulted in a 0.126% deviation from the mean. If the shot size was increased to 1.03 g with the same range, the results would be 0.063% deviation from the mean. This would no longer be considered a significant improvement over the X-melt technology. The practical limit of X-melt technology for the test machine would be shot sizes over 1.1 g.

Advantages of X-Melt

In addition to increased shot-to-shot consistency, as demonstrated by the case study above, the advantage of the X-melt technology is that it is a software addition to a standard LSR injection molding machine. This means that it can be turned on or off as needed. We indicated the practical limitation of X-melt on the test machine would be shot sizes up to 1.10 g, but with the X-melt software turned off the machine could run a standard injection process with the maximum shot capacity of 28 g. This would not be the case for machines designed specifically for micro-molding. Typically machines developed for micro-molding are designed with very small injection screws or plunger injection systems. These machines have very defined injection volume limits that cannot easily be changed without physically altering the machine. The advantage of X-melt technology to the molder is a production machine that can also be capable of micro-molding or single-cavity prototype molding instead of a very costly specialized machine that has limited uses.

Metering performance is also improved when using X-melt technology versus a standard injection process in micro-molding. A standard injection process with a shot size of less than 0.2 g may use an injection stroke of only 0.003 to 0.006 in., depending on the screw diameter. This means virtually no screw rotation during metering: The signal for metering may last less than 1 sec, which causes no mixing of material in the screw and very little material movement through the static mixer. If a third stream for color is added to the LSR process, the color dispersion would be very poor. With X-melt technology, several cycles can be achieved before metering is required. This allows for a more stable metering sequence, resulting in better mixing of material and better dispersion of third-stream components.

Getting to Know Your IMD Board Members
Pete Grelle

Pete Grelle is currently owner/president of Plastics Fundamentals Group, LLC, a company specializing in training. He was employed twenty (20) years with the Dow Chemical Company in both the Engineering Thermoplastics and Automotive Business Groups as a Senior Technical service and Development Engineer. Prior to working for Dow, Pete was employed as a Senior Development Engineer at the Monsanto Company in St. Louis, Mo., as a Senior R&D Engineer at Olin Corporation, East Alton, IL. and as a Technical Service and Development Engineer at Wellman Engineering Resins in Johnsonville, SC. He received his B.S. degree in Plastics Technology and an M.S. degree in Plastics Engineering from the University of Massachusetts at Lowell.

Pete has received four (4) US and International patents in plastics product design, and has authored and co-authored forty (40) publications in the areas of injection molding, plastics part design, plastics materials, structural foam injection molding, recycling, and plastics process technology. He is the recipient of four (4) Best Paper Awards from the Society of the Plastics Industry (SPI), the Society of Plastics Engineers (SPE), and the Society of Automotive Engineers (SAE). Pete received the 2000 SPE Injection Molding Division Engineer of the Year Award, the 2001 SPI Structural Plastics Division Industry Recognition Award, the 2006 SPE Honored Service Award, and the 2011 and 2013 SPE Detroit Section Star Awards.

Pete has been a member of SPE since 1972 and has been an SPE volunteer for a total of twenty-eight (28) years. He is the current president of the SPE Detroit Section, and since 2010 has also served as Chairperson for the SPE Detroit Section Material Auction and as Technical Co-Chairperson for the 2012 and 2013 TPO Conference. He has been a member of the SPE Injection Molding Division Board of Directors since 1991, and has served as the Division Chairperson, and currently is the Division's Technical Director. From 1991-1994, Pete was also a director on the SPE Rochester, New York Section Board of Directors. A native of Lawrence, MA, Pete is married and lives in West Bloomfield, MI.

By Mark Yeager
Principal Engineer/Engineering Consultant
Bayer MaterialScience LLC

Balanced Filling in Thermoplastic Medical Molding

If molten plastic behaved like a simple fluid, there would be little need to worry about balanced filling during molding. The melt would fill the cavities like water, and the way the mold filled would have little or no influence on the properties of the molded parts. In reality, molten plastics are complex, viscous, and highly compressible fluids. How the mold fills can affect physical characteristics of the part such as size, strength, and appearance. Balanced filling can reduce part variations and improve part quality, both important in medical molding.

Multi-Cavity Balancing

Balanced filling in plastic molding can refer to filling in multi-cavity molds or filling within a single part cavity. Balanced filling in multi-cavity molds typically involves designing the runner system (hot or cold) so each cavity fills at the same time and at about the same temperature. When they fill at the same time and temperature, cavities tend to pack to the same density and are likely to shrink to the same size as the material solidifies.

In unbalanced multi-cavity molds, the ideal processing conditions for the early-filling cavities may be different than for late-filling cavities. The processing settings on the press end up being a compromise. This narrows the processing window and makes quality control more difficult. Cavities that fill first are more prone to flash and core deflection, while late filling cavities can exhibit non-fill and sink.

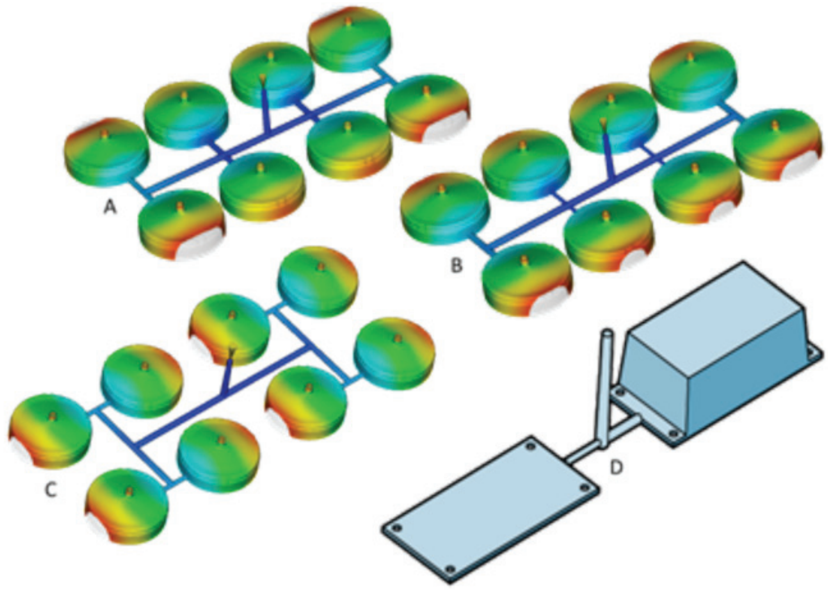
Two- and four-cavity molds tend to be naturally balanced. The distance from where the plastic enters the mold to the gates at each of the parts is the same. When the four-cavity layout is extended to eight cavities as in **Figure A**, an imbalance occurs. The runner distance to the outer four parts is longer than to the inner four parts. The flow simulation in **Figure A** shows the inner parts completely filled, while the outer parts still have the grey area yet to fill.

One solution is to use filling simulation to adjust the runner diameters to balance filling to all cavities. In **Figure B**, the diameters of the short runner segments feeding the inner four parts were reduced to restrict filling. When properly adjusted, all of the parts fill at about the same time.

This method of balancing runners, often called artificial balancing, has been used successfully for decades. It generates compact runner layouts (reducing regrind generation) and corrects many of the problems associated with unbalanced runners. Problems can occur when the restricted runners become too small to deliver adequate packing to the inner parts.

Artificially balanced runners are designed for a specific set of processing conditions. Changes to the filling speed or melt temperature can throw off the balance. Some molders attempt to balance flow by adjusting

Figures A, B, C, D



the gate size. This is not recommended. Differences in gate sizes can lead to variations in packing, material shrinkage and part cosmetics. Gate balancing is also much more sensitive than runner balancing to changes in processing conditions.

An alternative eight-cavity runner option (**Figure C**) branches the runner segments to produce a geometrically balanced runner system. Because the flow distance to each cavity is the same, the parts should fill in a balanced fashion. In reality, runner systems that branch more than once usually fill the inner cavities ahead of the outer cavities.

The reason involves the way the hot shear layer in the runner segments splits at branching intersections. Dr. Beaumont of Beaumont Technologies, Inc. discovered that as flow in the runner splits at the first runner branch, the hotter shear layer near the runner wall hugs the inside-corner side of the runner. The cooler core material goes to the opposite side. After the split, the melt flowing within the runner then has a hot side and a cool side. When the flow splits again at the second runner branch, the melt on the hot side fills the runner going one way and the melt on the cooler side fills the opposite runner. The hotter material follows the inside corners to fill the inner cavities. Because melt viscosity is temperature dependent, this temperature difference within the runners creates a filling imbalance.

To remedy this, Dr. Beaumont devised inserts that modify the runner branch intersections and rotate the hot and cool sides 90 degrees, so equal amounts of hot and cool material enter each part cavity. This MeltFlipper® technology can be purchased and licensed from Beaumont Technologies, Inc.

Feature: Balanced Filling in Thermoplastic Medical Molding Continued

Family molds (molds producing different parts geometries at the same time) often exhibit flow balancing problems, particularly if the parts are significantly different in size or shape. In the example in **Figure D**, the molder wanted to produce the box and lid at the same time to save molding costs and to ensure a perfect color match between the mating parts. If nothing was done to balance the flow, the smaller lid would fill ahead of the larger box. Increased packing in the lid could cause a variety of problems including flash and a gloss difference. More importantly, reduced shrinkage in the highly packed lid could affect the alignment of the screw holes in the lid with the holes in the box. By reducing the diameter of the runner to the lid, the flow can be restricted, so both parts fill at the same time.

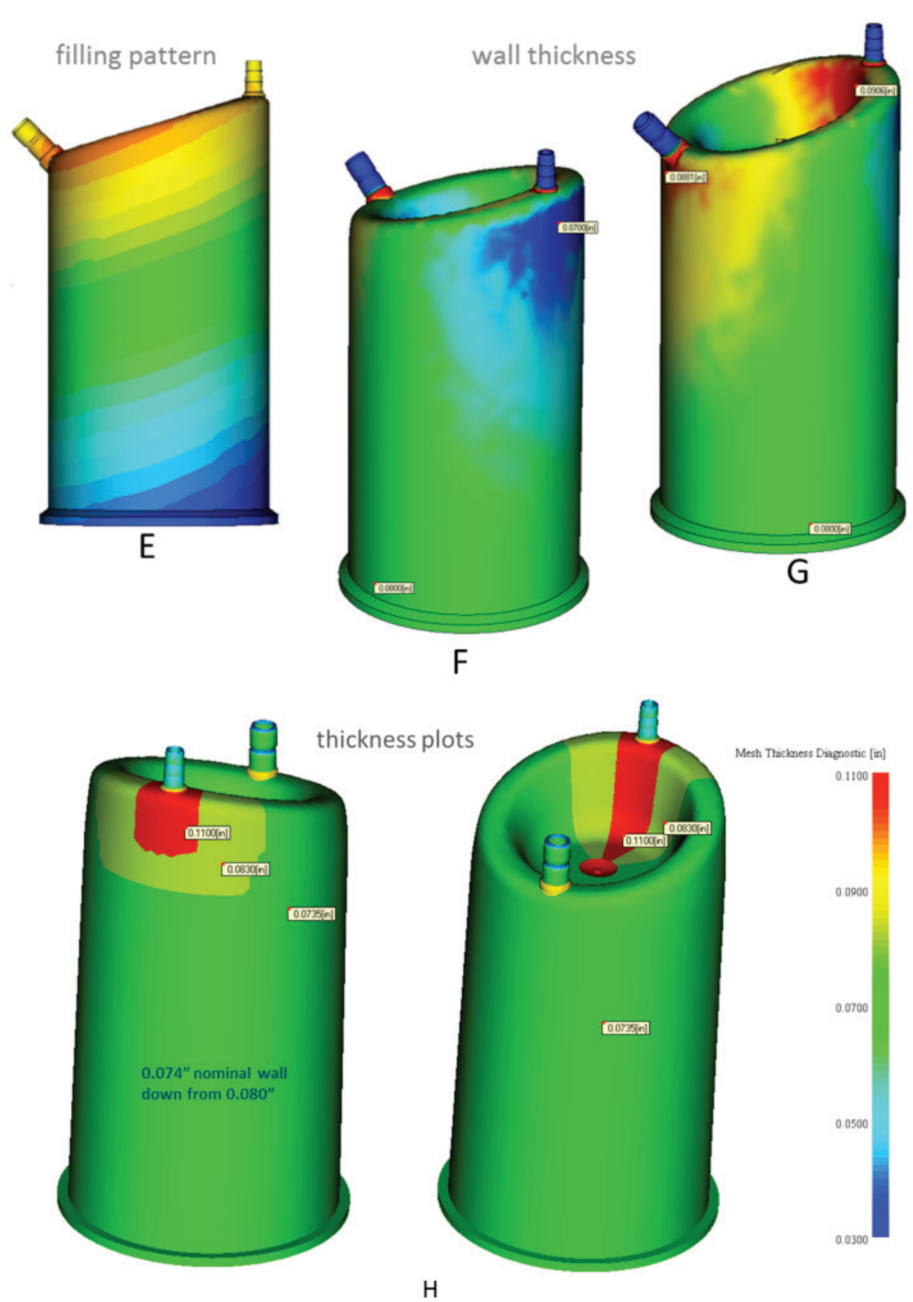
Part Balancing

Flow imbalances within a single part cavity can also create problems. The logical place to gate the medical part shown below is in the middle of the recessed pocket at the closed end. Because the flow length over the taller side is longer, the flow front lags behind on that side (**Figure E)**. The resulting filling imbalance is probably not enough to cause flash or packing problems, but it is enough to flex the main core that forms the inside of the part.

The thickness plots in **Figures F** and **G** show the predicted wall thickness variations caused by the core deflection. The core bends toward the taller side causing the red areas to get thicker and the blue areas of the main body to get thinner. Deflection occurs at the upper, unsupported end of the core. Core deflection alters the part wall thickness but can also cause filling and demolding problems as well as fatigue failures in the core.

Design permitting, wall thickness adjustments can balance filling around the main core and greatly reduce core deflection. **Figure H** shows the part with flow leaders added to balance filling. Flow leaders are areas of

Figures E, F, G, H



increased wall thickness which are intended to improve part filling. In this example, flow leaders were extended from the gate up toward the highest tubing port and partially down the other side. The thickness of the red flow leader was increased from the original nominal wall thickness of 0.080 inches up to 0.110 inches. The yellow-green regions represent the blending area where the thickness tapers down to the new nominal wall thickness. In thickening the longest flow path, the flow leaders also reduced the pressure needed to fill the part. This allowed the nominal wall thickness to be reduced from 0.080 inches to 0.074 inches resulting in weight and cost reduction.

The flow leaders change the original angled flow front (**Figure E**) to a straighter flow front shape that better balances the melt pressure around the core. This reduces the predicted core deflection by over 70 percent.

As a general rule, parts should fill such that the flow front reaches the part extremities at about the same time. This reduces the required filling pressure and provides more uniform packing and shrinking throughout the part. Gate placement can play a key role in balancing filling. For example, a rounded part would have a shorter flow length and require less filling pressure when gated from the center instead of at the edge.

Not every part needs to be or should be balanced. The penalty for providing balanced flow may outweigh the gains. If filling is straightforward and free of potential problems, then the cost and complexity to add a center gate may not be justified. In the case of long, narrow parts, it is often preferable to gate at one end to align the polymer chains and reduce warpage. Cosmetic constraints may also restrict the gating options. That said, the matter of part balancing should at least be considered.

Summary

Balanced filling can improve the quality and consistency of molded medical parts. Runner balancing in multi-cavity molds improves the chance that all cavities will fill and pack the same way. This broadens the processing window and improves cavity-to-cavity consistency. Flow balancing is particularly important in family molds, which produce parts that differ significantly in size or shape. Runner balancing is highly recommended for multi-cavity molds.

Flow balancing within parts can be achieved with flow leaders or gate placement, and can reduce problems such as core deflection, excessive filling pressure or localized over or under packing. In some instances, the benefits of balancing flow within parts may not be worth the costs or performance penalties. This needs to be evaluated based on the specific part performance and molding requirements. While not always required, the merits of flow balancing within parts should always be considered.

*For more information contact **Mark Yeager**, Principal Engineer/Engineering Consultant, Bayer Material Science LLC, Pittsburgh, PA. Visit http://info.hotims.com/45608-162*

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By Paul Kuklych,
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How Injection Mold Design Effects Part Quality

Injection mold design must play its role in the injection molding process to ensure part quality repeatability during the life of a mold tool. To make a quality part at the optimum cycle time good mold design is vital. An injection mold tool must be able to effectively manage clamp tonnage, cavity pressure, part ejection and heat transfer dynamics. One way to help achieve this is by the use of a one-piece core.

What Is A One-Piece Core?

A mold tool with a one-piece core is shown in **Figure 1** for a 20-litre storage tub. Compare this to the more common two-piece core design which is shown in **Figure 2** for the same part. A two-piece core has a core insert fitted to a pocket in the core plate and is easier to make than a one-piece design. A one-piece core is made from a single block of steel and includes the core plate and the core insert as one solid body.

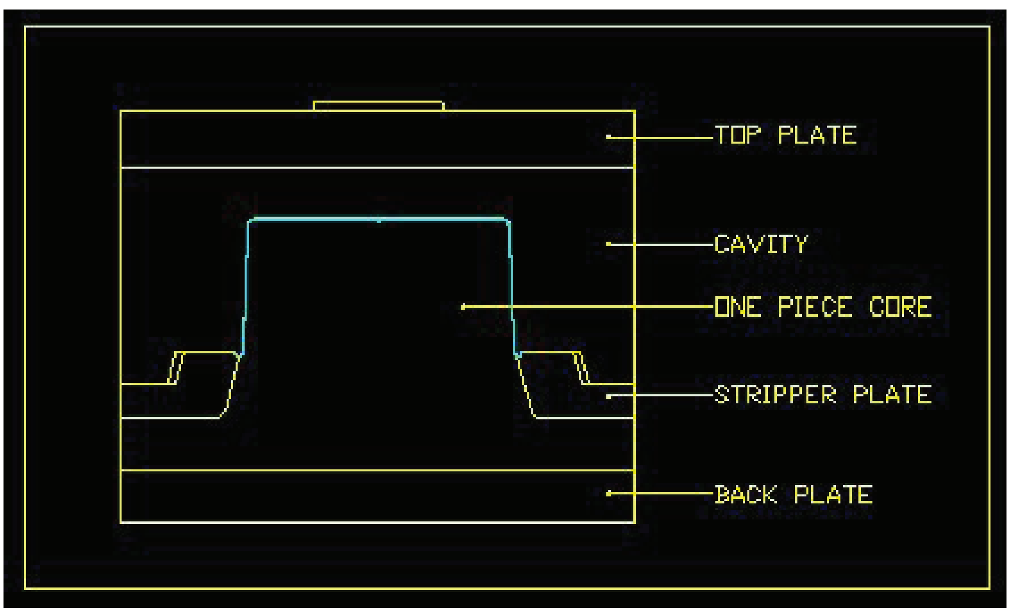

Figure 1: Mold tool with one-piece core for a 20-litre tub

Feature: How Injection Mold Design Effects Part Quality Continued

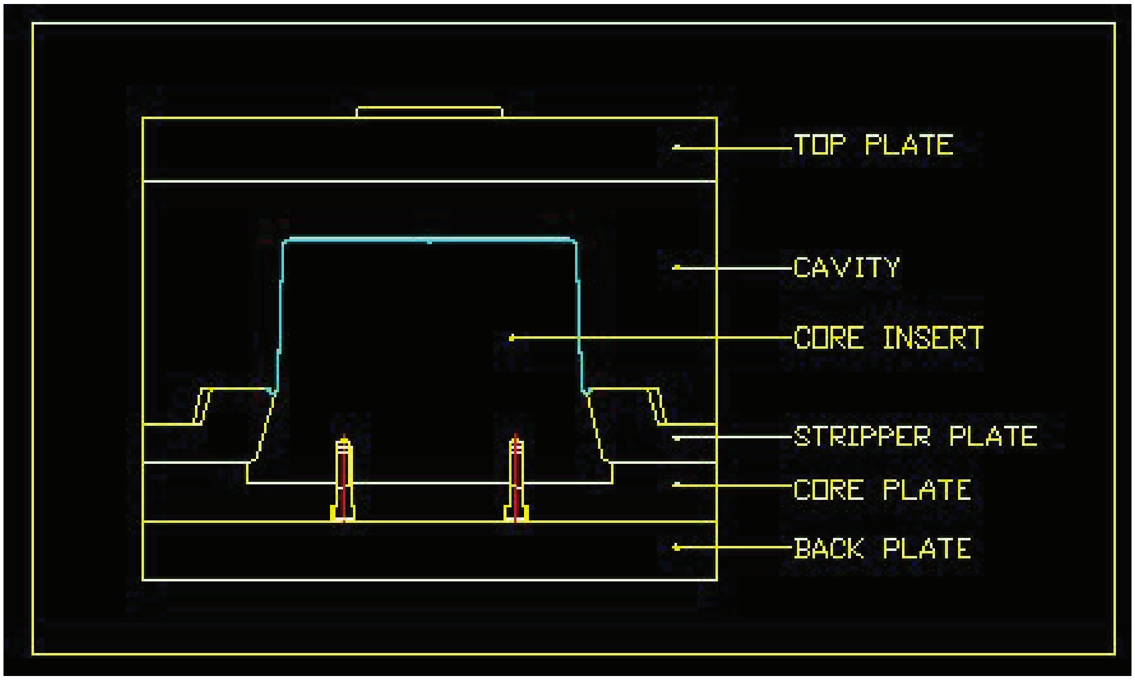

Figure 2: Mold tool with two-piece core for a 20-litre tub

Benefits of a One-Piece Core

In my experience, the main benefit of one-piece is to minimize part wall thickness variation by eliminating core shift and reducing core deflection (see below for definitions of these 2 terms). A one-piece structure is naturally stronger than a two-piece structure that is held together with bolts that can stretch and move under the enormous lateral loads generated by the cavity pressure inside a mold tool.

Keeping wall thickness variations to a minimum means quick mold start-up times, consistent part quality, optimum cycle times and longer mold tool life.

What Is Core Shift?

Core shift happens when a core insert moves inside the pocket of a core plate. It is very difficult to fit a core insert into a pocket with straight sides with zero clearance especially for non-circular shaped pockets. A clearance of 0.0005 inches per side (0.01 mm per side) means a core insert can move 0.001 inches (0.02 mm) and that means part wall thickness will also change. Although this is a small amount, combine this with any core deflection and you might find you are suddenly having problems making quality parts due to changes in mold filling flow patterns. Wall thickness variation can also cause part fails in the field when wall thickness becomes thinner and therefore weaker on one side of a part.

The main issue with core shift is in cases where a stripper plate is fitted around a core insert as in **Figure 2**. Any amount of core shift will damage the parting line surfaces between the core and stripper plate leading to premature part quality issues such as flash.

What Is Core Deflection?

Core deflection happens when a core is literally bending under cavity pressure. Deflection is more likely to happen with:

- Tall parts especially with thin walls

Feature: How Injection Mold Design Effects Part Quality Continued

- Parts with different wall thickness on opposing sides
- Worn mold tool interlocks
- Uneven tie bar stretch on molding machine
- Worn machine platens

When to Use a One-Piece Core

One-piece cores are frequently used in the thin wall molding industry because thin walls and long flow lengths require extremely high cavity pressures to make a quality part. High cavity pressures exert huge lateral forces on a core and these forces will shift and deflect a core given the right conditions regardless of the clamp tonnage applied. For example, a 2 cavity mold tool making a 500 ml thin wall tub with a 0.019 inch wall (0.50 mm) and a two-piece core design made parts with a 12% variation in wall thickness. By comparison, a new mold tool with a one-piece core design made the same parts with wall thickness variation within 5%. This improved cycle time, part quality and reduced the amount of clamp tonnage required resulting in less wear and tear on both the mold tool and molding machine.

As other injection molding industries such as automotive and electronics are under constant pressure to make parts thinner and lighter, the use of one-piece cores for the right application would greatly benefit productivity.

Tall parts that are gated from the bottom will also benefit from a one-piece design. Tall parts are more prone to core deflection than shorter parts.

Multi cavity molds should use one-piece designs. To get full productivity from multi cavity molds the mold filling balance must be close to perfect in all cavities. That means all cavities must fill at the same rate or productivity and quality will suffer. Even a small wall thickness variation can prevent this from happening.

Compared to multi cavity molds, single cavity molds can tolerate a much larger degree of wall thickness variation before productivity is affected. So single cavity molds can make use of a two-piece design when easier to manufacture.

Having said the above, any mold tools which must work 24/7 will benefit from a one-piece core design because wear and tear will be minimal which translates into lower maintenance costs and minimize production interruptions.

Disadvantages of a One-Piece Core

A one-piece design will be slightly more expensive to make than a two-piece design. The extra cost is due to the extra time that is required to make a one-piece core. And although longer cutting tools will be required in some cases, they can still be made using standard machine tools.

Another disadvantage is a higher material cost. The weight of the

Feature: How Injection Mold Design Effects Part Quality Continued

raw steel block for a one-piece core is more than the sum of both pieces in a two-piece core design for the same application.

Both of the points above relate to a higher mold price for the injection molder but this should be insignificant when the productivity benefits of a robust design are understood.

Additional Comments

A one-piece core design can bring great benefits to injection molding part quality and productivity, however, the rest of the mold design must be just as robust in order to achieve this. In other words, cavity blocks, stripper plates, back plates, support pillars and interlocks should be the right shape and size to complete a mold design that can withstand the expected clamp tonnage and cavity pressures for the life of a given mold tool.

Finally, solving part quality issues can be difficult at the best of times, that's why long term, solid relationships between mold designer, toolmaker and injection molder is vital. Relevant feedback to the mold designer and toolmaker on the performance of any modified tool design will only benefit all three parties in future projects.

About the Author

Paul Kuklych *has worked in various roles in the toolmaking and plastic injection molding industry over the past 22 years. He started with machining and toolmaking then progressed to mold trial qualification, now spend most of his time doing mold design and troubleshooting work. Owner and author of www.improve-your-injection-molding.com, Paul can be reached at +61 3 95211911 or e-mail paul@improve-your-injection-molding.com*

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Effects of Molecular Weight Changes on the Foaming Behavior of Thermoplastic Polyurethane (TPU) and its Acoustic Properties

This paper investigates the effects of molecular weight changes on the foaming behavior of thermoplastic polyurethane (TPU) and its acoustic properties. In order to vary the molecular weight of TPU, the additional melt extrusion processes are introduced and the foam samples are manufactured via injection foam molding technology. The effects of each additional extrusion process on the molecular weight changes are examined by analyzing heat-cycle and rheological behaviors. In addition, the cellular morphologies and acoustic properties of injection molded samples are evaluated and their relationships with molecular weight changes are discussed. The foaming behaviors are varied significantly due to reduced molecular weights and different foam structures result in different acoustic performances. In general, the foamed samples from the processed TPU resin are able to achieve higher acoustic absorption coefficients.

Introduction

It is well known that TPUs are linear segmented block copolymers of alternating soft and hard segments. The soft segments (SS), consisting of long polymeric chains of a macro-glycol (polyether and polyester type), are flexible and weakly polar. The hard segments (HS) are processed by the reaction between diisocyanate, e.g. diphenylmethane-4,4'- diisocyanate (MDI) and the chain extender, e.g. butanediol. The hard segments are rigid and highly polar. At working temperatures, thermodynamic immiscibility of hard and soft segments results in phase separation and consequently a micro-domain structure [1]. Such a structure was first proposed by Cooper and Tobolsky [2] and is responsible for the unique properties of TPUs [3, 4]. The hard segment domains behave as multifunctional tie points functioning both as physical crosslinks and reinforcing fillers whereas the soft segments form the elastomeric matrix responsible for material flexibility. As a result, TPUs show a high flexibility even at low temperatures, good abrasion behavior, low compression set and high resistance against oil, fat, and solvents. These properties lead to the use of TPUs in many applications in the automotive, chemical, and medical industry [4, 5].

It is well accepted that foaming technology improves the efficiency of manufacturing process and results in a product with a host of desirable properties. The technology results in significant weight reduction, which reduces material cost of the final product, and other additional advantages, such as a reduced residual stress, a reduced cycle time, a lower processing temperature, better dimensional stability, faster filling, and improved filler dispersions [6-11].

Traditionally, acoustic foams have been made of thermoset materials via chemical cross-linking to form open-celled porous structures. Recently, thick foam structures with large closed-cells have been developed and their cell sizes were typically 6 to 8 mm [12]. In this study, the authors showed that the acoustic absorption coefficients improved at certain frequency range as the cell sizes increased [12]. According to Suh et al., the foam structure with 6.3 mm of average cell size was able to accomplish nearly 0.9 of acoustic absorption coefficient at 800 Hz [13]. Jahani et al., also studied the acoustic behavior of thermoplastic by varying the air-gap within the structure [14]. The changes of air-gap thickness led to the changes of frequency where the maximum acoustic absorption peak occurs and the magnitude of absorption coefficient. When the voids were smaller than 1mm, the open-celled porous thermoplastic structure required fairly large thickness, which was approximately 25 mm, to achieve effective acoustic absorption [15].

As aforementioned, the existing thermoplastic foam structures for acoustic applications require high thickness and very large cell sizes. In this research, the objective was to investigate the effects of molecular weight changes on both foaming behaviors and acoustic properties as an effort to develop an acoustically optimal foam structure with a smaller product thickness and fine cell morphology. This TPU by developing its acoustic functionality.

Experimental Procedure

Materials

Pellethane® 2355-75A from Lubrizol was utilized as TPU for this research study. Its density was 1.19 g/cm^3 and the melt flow was 28g/10min at temperature of 224°C. For a physical blowing agent, N2 gas from Linde Gas was employed.

Extrusion

As an effort to vary the molecular weight of TPU material, the resin was extruded via a twin-screw extrusion system from Leistritz which has the screw diameter of 27 mm with L/D ratio of 40. Based on the number of melt extrusion process that TPU experienced, the resins were divided into three types, as received TPU (AR-TPU) that did not experience any additional melt process, processed once (PR-01), and processed twice (PR-02).

Injection Foam Molding

The injection foam molding process was conducted with using a 50-ton Arburg 27°C injection molding machine from Arburg, which was equipped with MuCell® system from Trexel. The barrel temperature was set at 200°C while the mold temperature was maintained at 30°C. The injection of TPU/gas matrix was conducted at two folds with two flow rates, 20 cm^3/s for the first 70 vol% of shot size and 50 cm^3/s for the rest. The blowing agent content was 0.5 wt%. After the injection cycle was completed, the mold was opened in certain degrees to induce the foaming and the degree of mold opening was varied from 0, 4, and 6 mm.

Crystallization and Melting Analysis

The non-isothermal crystallization and melting behaviors of AR-TPU, PR-01, and PR-02 samples were examined by a differential scanning caloriemeter (DSC), Q2000 from TA Instruments. To investigate the non-isothermal crystallization behavior, the sample was heated at rate of 10°C/min from 20°C to 230°C. Then, the sample was cooled at different cooling rates at -90°C and finally it wasmheated again at 10oC/min to 230°C. Since the crystallization behavior of TPU is significantly affected by cooling rate from melt, the effects of two different cooling rates of 10°C/min and 30°C/min were evaluated as well.

IMD Best Paper Continued

Rheological Analysis

The shear viscosity properties of AR-TPU, PR-01, and PR-02 samples were measured by using an ARES Rheometer from Rheometric Scientific. The samples were heated and the frequency sweep test was followed. In addition, the time sweep experiments were conducted at a low frequency of 1Hz and a strain of 5% in order to measure the complex viscosity as a method to study the isothermal crystallization behavior.

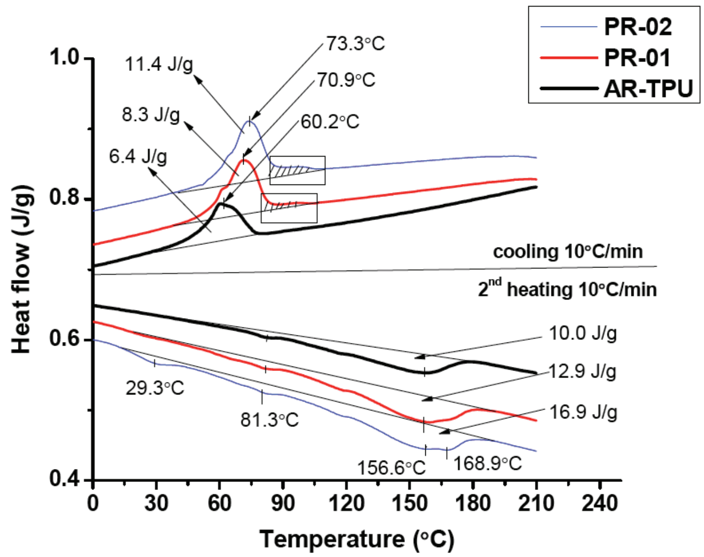
Acoustic Properties

Acoustic properties such as acoustic absorption coefficients of injection foam molded samples were measured by using an impedance tube system from BSWA. These tests were conducted based on ASTM E1050 and the acoustic absorption coefficients were measured the frequency range from 100 to 1600 Hz

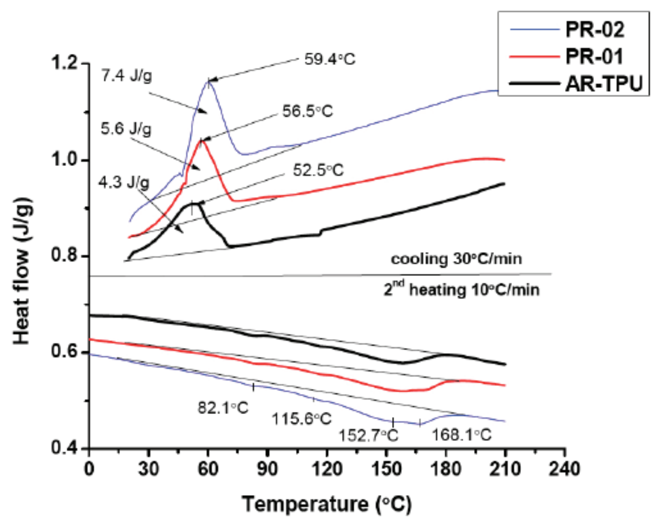
Results and Discussion

Crystallization and Melting Behaviors

Figure 1 shows the crystallization behaviors of three different types of TPU at 10°C/min cooling rate (a) and 30°C/min cooling rate (b). In both cases, the melting peaks became broader as TPU experienced more melt extrusion steps because the melt processing of MDI based TPUs resulted polydisperse systems, which formed both short and long HS lengths [16, 17]. When TPU samples were cooled, more processed TPU samples achieved earlier on-set crystallization points. In addition, the faster crystallization rates were obtained as the samples were more melt processed. Therefore, inducing more melt extrusion processes made TPU matrix to form micro-crystallites easier and faster.



(a)



(b)

Figure 1: Non-isothermal crystallization behaviors at (a) 10°C/min and (b) 30°C/min cooling rates

Rheological Behavior

The crystallinity of the HS also heavily depends on the melt viscosity of TPU [16, 18]. According to **Figure 2 (a**), the shear viscosity reduced significantly as TPU was exposed to more melt processes. The reduction of shear viscosity was mainly due to decreased molecular weights of TPU by the broad distribution of the lengths of HS, which was exhibited in the afore mentioned DSC results. The complex viscosity also decreased as the number of melt,process was increased based on **Figure 2 (b**). In addition, this low viscosity could increase

IMD Best Paper Continued

the mobility of longer HS lengths that fold and coil to form micro-crystallites. Therefore, the earlier increase of complex viscosity for the processed TPU samples was observed, which also confirmed the faster crystallization observed in DSC result above.

Foaming Behavior

For all three different degrees of mold opening, 0, 4, and 6 mm, the cellular morphologies of injection foam molded samples exhibited common trends depends on the number of melt processes of TPU resins. According to **Figure 3,** the cell sizes dramatically increased from AR-TPU to PR-01 for all three cases. This means that the cell density of PR-01 became significantly lower than that of AR-TPU. As it was explained earlier, the melt strength of TPU deteriorated by smaller Mw (i.e. shorter HS sequence lengths) as TPU experienced the additional melt processes. In the case of PR-01, the lower melt strength became a dominant factor, which determined the overall foaming behavior, and it provided desirable circumstance for cell growth, rather than cell nucleation. This resulted the foam structure with larger cells and a lower cell density. On the other hand, PR-02 was able to achieve the morphology with very fine cell sizes, which was even smaller than those of AR-TPU, and very high cell density. This drastic change in the foaming behavior was because the molecular structure of TPU became more favorable to form the micro-crystallites with shorter HS. These micro-crystallites provided possible heterogeneous nucleation sites, which helped the cell nucleation mechanism to be predominant in the overall foaming behavior. Consequently, the foaming behaviors of processed TPU were determined by the battle between lower melt strength and forming of micro-crystallites in the molecular structures of TPU.

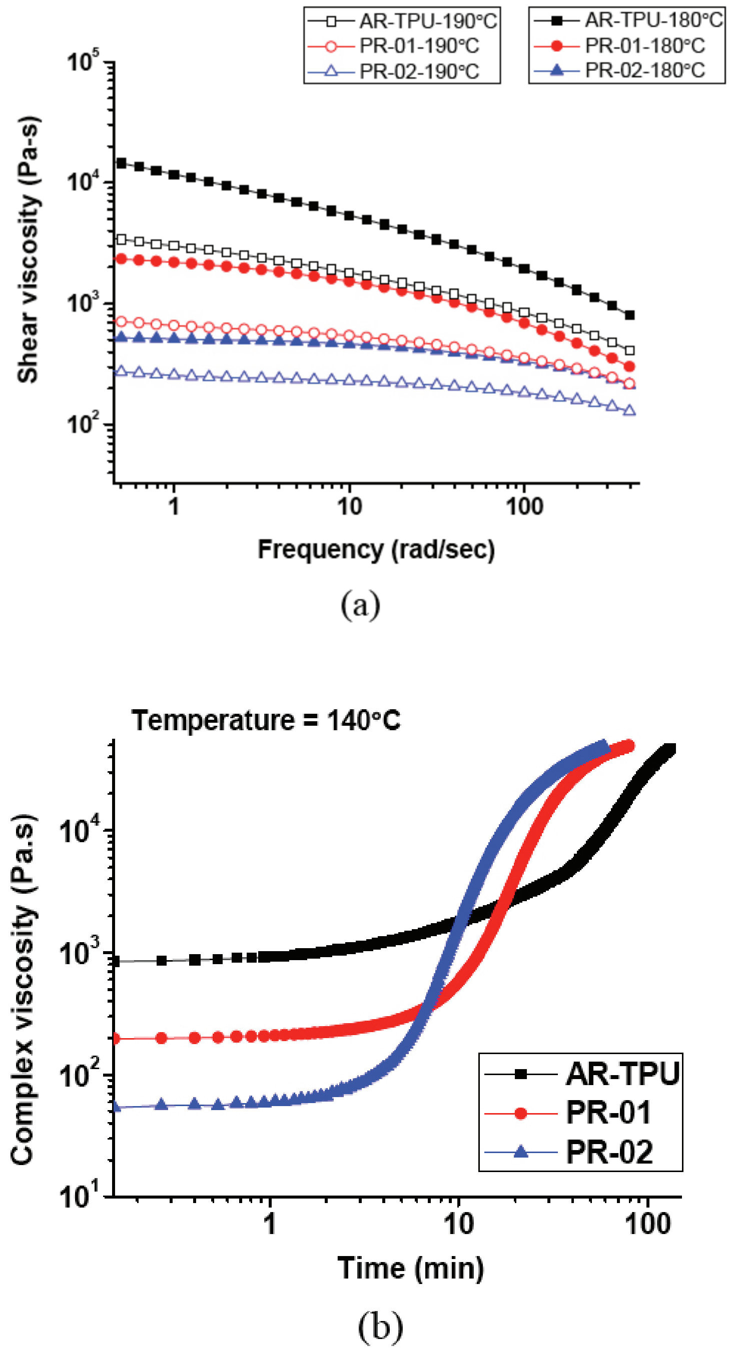


Figure 2: Rheological behaviors of TPU samples (a) shear viscosity and (b) complex viscosity

IMD Best Paper Continued

Acoustic Behavior

In terms of acoustic behavior of foamed samples, the acoustic absorption coefficients were measured from the frequency of 100 Hz to 1600 Hz and **Figure 4** shows the acoustic absorption coefficients of the injection foam molded samples with the mold openings of 4 mm (a) and 6 mm (b). In the case of 4 mm mold opening, the processed foamed samples were able to achieve higher acoustic absorption coefficients than that of AR-TPU. Although there were some improvements observed at specific frequency range for PR-01 over PR-02, the overall performances of both resin types did not vary significantly. For 6mm mold-opening foam samples, the overall acoustic absorption behavior of PR-01 deteriorated than that of AR-TPU whereas the acoustic absorption of PR-02 improved again, which was higher than AR-TPU and the absorption of PR-02 became more effective over the broader frequency range. Therefore, the foam structure with very high cell density and small cell sizes was preferred to improve the acoustic absorption

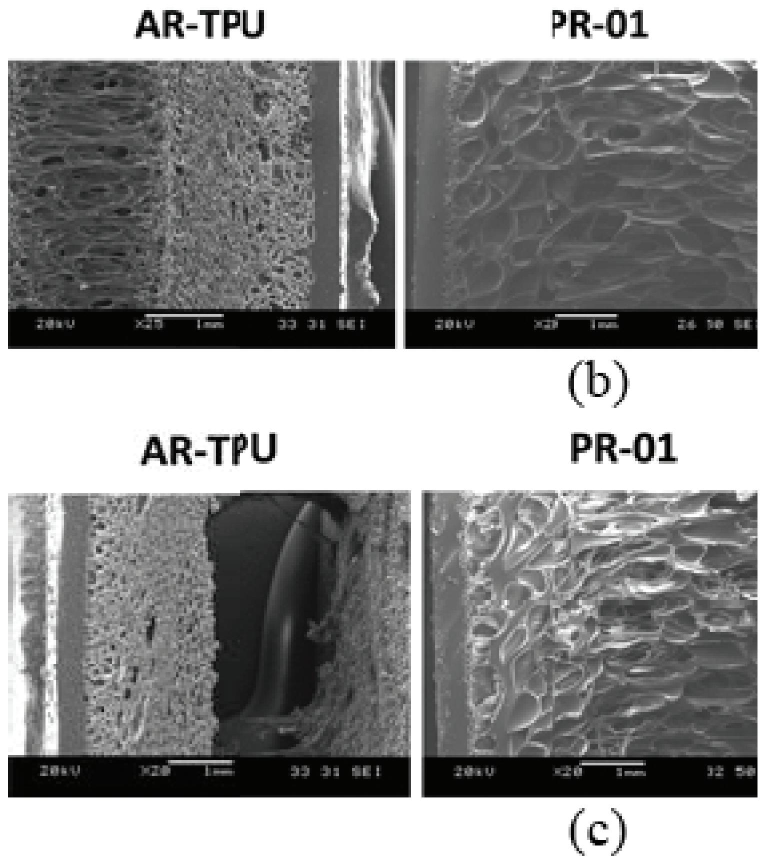


Figure 3: Cellular morphology of injection foam molded TPU samples with (a) 0 mm, (b) 4mm, and (c) 6 mm of mold openings.

behavior and this structure was more effective than the foam structure of AR-TPU, which also had small cells and a considerable thickness of hollow core.

Conclusion

This paper investigated the effects of molecular weight changes on the injection foaming and acoustic absorption behaviors of TPU. In order to change the molecular weight of TPU, the additional extrusion processes were introduced and the sequence length of HS became shorter. This change in molecular chain structure of TPU reflected on its crstallization and melting behaviors by exhibiting earlier on-set crystallization, faster rate of crystallization, and broader melt peaks. In adition, the rheological behaviors supported the results obtained in DSC via showing reduced shear and complex viscosities for the processed TPUs as well as their faster cyrstallization trends. These changes in molecular weights of TPU ultimately led to vary the morphology of injection foam molded samples dramatically. PR-01 samples had larger bubbles with lower cell density than both AR-TPU and PR-02 whereas PR-02 samples obtained smaller cells with higher cell density than the other two types of TPU. There were two dominant factors which determined the overall foaming behaviors and they were reduced melt strength and formation of micro-crystallites. The reduced melt strength became predominant for PR-01 case whereas the formation of micro-crystallites overpowered the effect of lower melt strength in the case of PR-02. The foam structure of PR-02, which had high cell density and small cell sizes, achieved similar acoustic absorption coefficients for 4mm of mold opening and significantly higher performances for 6mm of mold-opening case.

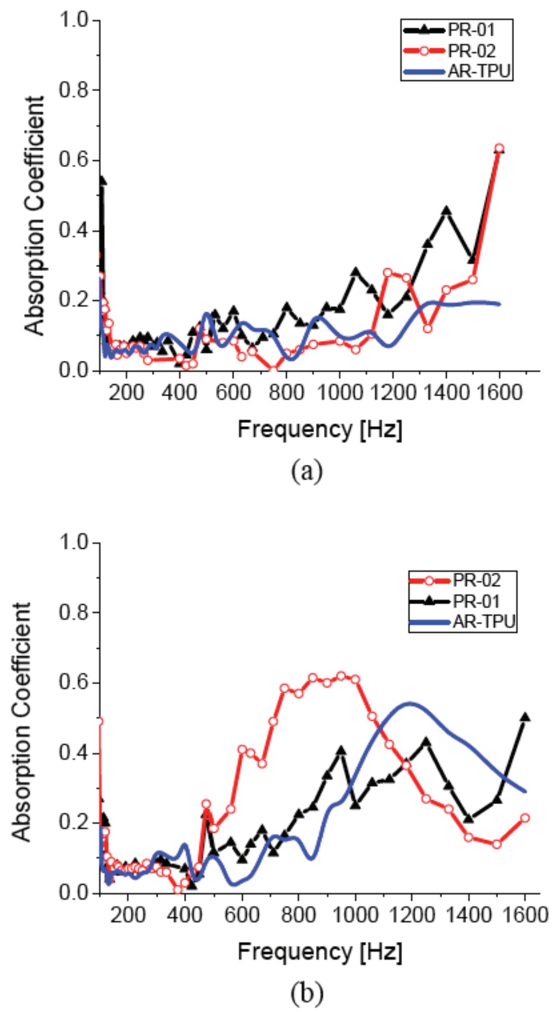


Figure 4: Acoustica absorption coefficients of foamed samples with the mold openings of (a) 4mm and (b) 6mm

Acknowledgement

We greatly appreciate the financial support provided by the Consortium for Cellular and Micro- Cellular Plastics (CCMCP). We also gratefully acknowledge the materials supplied by Lubrizol.

IMD Best Paper Continued

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IMD Board of Directors Meeting

January 31, 2014

Orlando, FL

Submitted by Hoa Pham, Secretary

Welcome

Chair Erik Foltz called the meeting to order at 9:10 AM ET. He welcomed all attendees to the teleconference meeting, and thanked Tupperware for hosting this meeting.

Roll Call

Present were:

Erik Foltz (Chair), Susan Montgomery; Jim Wenskus; Peter Grelle; Hoa Pham; Adam Kramschuster; David Kusuma; Jeremy Dworshak; Srikanth Pilla; Raymond McKee; Rick Puglielli; David Okonski; J ack Dispenza;Kishor Mehta;Tom Turng; Brad Johnson;Nick Fountas; Lee Filbert and Larry Schmidt

Guests were:

Barbara Spain (SPE Staff)

Absent were:

Mal Murthy (Emeritus)

This constituted quorum.

Opening Remarks

Mr. Billy Eubanks, Vice President of Tupperware TPS Products & Global Procurement welcomed the Board. He emphasized the need to educate the public on the benefits of plastics and to correct misconception or misperception of the harm that plastics pose, such as the controversy about bisphenol in Polycarbonate.

Approval of September 20, 2013 Meeting Minutes

Motion: Hoa moved that the September 20, 2013 meeting minutes be approved, as written and distributed. Kishor seconded and the motion carried.

Financial Report – Jim Wenskus, Treasurer

Jim presented the financials from July 1 to December 31, 2013. The rebate from SPE was received, and bills have been paid. Newsletter sponsorship has been good. The Board discussed the impact of the China TOPCON financials. Overall, the financial state was in good standing to allow the Board to continue funding the IMD

IMD Board of Directors Meeting Continued

Scholarship.

Motion: Jack moved that the Board make another payment to fund the IMD Scholarship. Peter seconded and the motion carried.

Action Item: Jim to send in and record this payment.

ANTEC Technical Program Committee Report — Adam Kramschuster, Chair

The ANTEC Conference will be held in Las Vegas, from April 28 – April 30. Early registration ends on February 28, 2014.

Adam reviewed the sessions for the IMD technical program on each of the conference days. He called on the Board to assist with moderators. There will be a joint session with the Mold Making Division on Tuesday afternoon. Discussions were made to prepare the Board meeting during ANTEC to allow membership at large to participate. Adam will invite nominees of the three best papers to the IMD Reception.

Technical Director Report –— Peter Grelle, Chair

ANTEC Technical Papers

Peter presented the trends of IMD papers with regards to paper sources, paper types, geography and the APQ index. This trend data showed that the total number of papers decreased since 2005 but seemed to level off. The quality of the IMD papers has increased steadily. Compared to 2013, the number of papers from industry decreased sharply. Geographically, the number of papers from Europe and Canada increased significantly.

TOPCON Update

For 2014, the next TOPCON is the Penn State Erie Conference to be held in June. Brad Johnson organizes this conference.

Injection Molding Webinar

Pete reported that he has been organizing the Injection Molding Design webinar. He has lined up some presenters, and will contact additional presenters.

Education Committee — Erik Foltz

Erik announced that Pat Gorton resigned from the Board due to personal reasons. Susan Montgomery will be Chair of this Committee.

Pinnacle Award— Erik Foltz

Pat was the Chair-Elect and responsible for organizing the submission for the Pinnacle Award. However, with his resignation, the submission was not completed. SPE HQ provided the extension and Erik would follow-up.

Action Item: Erik to follow-up on the Pinnacle Award submission to meet the extended timing.

IMD Board of Directors Meeting Continued

Councilor Report — Brad Johnson

Brad reported that the SPE presented some policy and bylaw changes:

- *Policy 030 on Topical Conferences* — the new policy defines the compensation for the SPE and the expected services. This policy will take effect on July 30, 2014. The Thermoforming Division and the South Texas Section (PolyOlefins Conference organizer) objected to this policy.
- *Policy 014 on Division Formation* — this policy will have additional requirements to maintain active status as a Division, such as communication to members a least three time per year.
- *Policy 002 on Procedures to Calculate Rebates* — changes are made to the annual performance requirements.
- *Bylaw 7.4.6 on Appointed Members of the Executive Committee (EC)* — the change will provide the President more latitude to appoint members and non-SPE members to the EC.

For Antec 2014 in Las Vegas, young professionals can expect to experience many targeted activities. In addition, the Race to Antec event is open to all. Details are available at the SPE ANTEC website.

IMD Membership Committee — Nick Fountas

Nick reported that the majority of IMD membership remains primarily in the US, and is predominantly professionals. The membership in China showed some increase since the China TOPCON in December.

Engineer-Of-The-Year Award Committee — Kishor Mehta

Kishor reported that the Committee had elected Susan Montgomery as the recipient of this award. The Board congratulated Susan, and she thanked the Board.

SPE China TOPCON — David Kusuma, Tom Turng

David reviewed the statistics for the China TOPCON, which was held in Shangahi, China on December 11 – 12, 2013. The technical program had good papers and presenters, as well as keynote and plenary speakers. The joint session on bioplastics was conducted with the Medical Plastics Division. Tom led the panel discussion.

Although the conference had a successful technical program, the financial aspect was not positive. The projection for sponsorships was overreaching and thus the plan was not achieved.

Post-conference analysis was conducted to gather lessons learned and to develop ideas for future conferences. The consensus was that the conference created a momentum worth continuing. We gained 120 new SPE members, and plan was underway to start setting up a Chinese section.

The Board thanked David and Tom for their contributions and efforts in organizing this first IMD conference in China.

Communications Committee — Adam Kramschuster

Newsletter

Adam reported that the newsletter would add a new column for Technical Tips starting with the Spring 2014 edition. The contacts made on the Injection Molding Division LinkedIn group helped in getting articles.

IMD Board of Directors Meeting Continued

The schedule for the upcoming newsletter materials is:
- Spring (March 2014) – February 10
- Summer (July 2014) – June 10
- Fall (November 2014) – October 10

IMD Website

The website is ready to launch at http://www.injectionmolding.org/wordpress/. Adam requested approval of $200 to obtain high quality stock images. The Board approved the expense under miscellaneous line item. Adam also requested Board members to champion specific content on the website, such as awards, training, resources, etc. Adam will send a note to the Board.

Social Media

The IMD Facebook page has been more active. Adam requested Board members to contribute more content to this page.

Hoa, who oversees the IMD LinkedIn page, also reminded the Board to visit and contribute to this page.

Call For Trainers — Jeremy Dworshak

Jerry followed-up on the presentation by Umberto at the previous meeting. He requested and received the Board's agreement to continue searching for trainers to present to the Board. The objective is to develop an electronic catalogue of trainers that members can access when they need training.

Nominations Committee — Hoa Pham

Since Chair-Elect Pat Gorton resigned, the Board was left with a vacancy for Chair 2014-2015. After discussions about the best practice of vetting Board members through different roles on the Board before becoming Chair, Hoa nominated candidates to fill the role of Chair and Chair-Elect.

Motion: Kishor moved that the Board approve the nomination of Adam Kramschuster to be 2014-2015 Chair. Srikanth seconded and the motion carried.

Motion: Kishor moved that the Board approve the nomination of David Okonski to be 2014-2015 Chair-Elect. Pete seconded and the motion carried.

Hoa presented the nominees for Board officer roles:
- Treasurer: Jim Wenskus
- Technical Director: Pete Grelle
- Secretary: Srikanth Pilla

Motion: Hoa moved that the Board approve the nominees for Board officers as presented. Kishor seconded and the motion carried.

Hoa presented Susan Montgomery as the nominee for the IMD Councilor for a three year term 2014 – 2017.

Motion: Hoa moved that the Board approve the nominated candidate for posting on the general ballot to be elected as Councilor of the IMD, as presented. Jeremy seconded and the motion carried.

IMD Board of Directors Meeting Continued

Hoa presented the candidates for Board Directors:

- Jack Dispenza
- Michael Uhrain
- Hoa Pham
- Brad Johnson

Motion: Hoa moved that the Board approve the nominated candidates for posting on the general ballot to be elected to the Board, as presented. Raymond seconded and the motion carried.

Action Item: Jack, Michael, Brad and Susan to provide a short bio to Hoa for the general ballot.

Awards — Tom Turng

The Board agreed to continue with awards as done in the previous year. For 2014, The Board approved to present speakers' certificates. Tom will print the certificates and provide them to the TPC for distribution to moderators.

Action Item: Tom to arrange for award plaques and print certificates for speakers.

HSM & Fellows — Erik Foltz

Erik reported that Tom Turng agreed to be Chair of this Committee. The Board welcomed Tom to this role.

IMD Historian – Hoa Pham

Hoa reported that the transition from Larry Schmidt was complete. Hoa will be distributing a copy of the history to the Board.

New Business — Erik Foltz, All

Connecticut Chapter: Rick announced that the Connecticut Chapter had a new President, and they would be organizing a local event. The Board is welcomed to attend.

Injection Molding Machine: Dave Okonski announced that GM had an injection molding machine that they wanted to donate. The machine is warehoused in El Paso, TX.

Old Business — Erik Foltz, All

None

Next Meeting

The next Board meeting will be during ANTEC 2014 in Las Vegas. Adam will confirm date, time and location.

Adjournment

Motion: Ray moved that the meeting be adjourned. Jeremy seconded and the motion carried.
The meeting adjourned at 3:35 PM ET.

IMD Leadership

DIVISION OFFICERS

IMD Chair
Erik Foltz
The Madison Group
erik@madisongroup.com

Chair-Elect
Pat Gorton
Energizer
pgorton@energizer.com

Treasurer
Jim Wenskus
wenskus1@frontier.com

Secretary
Assistant Treasurer
Nominations Comm.
Chair Historian
Hoa Pham
Avery Dennison
hp0802@live.com

Technical Director
Peter Grelle
Plastics Fundamentals Group, LLC
pfgrp@aol.com

Past Chair
Susan E. Montgomery
Priamus System Technologies
s.montgomery@priamus.com

Councilor, 2011 - 2014
Brad Johnson
Penn State Erie
bgj1@psu.edu

BOARD OF DIRECTORS

TPC ANTEC 2014
Communications Committee Chair
Adam Kramschuster
University of Wisconsin-Stout
kramschustera@uwstout.edu

TPC ANTEC 2015
Raymond McKee
Berry Plastics
raymond.mckee@berryplastics.com

TPC ANTEC 2016
Education Committee Chair
Jeremy Dworshak
Steinwall Inc.
jdworshak@steinwall.com

TPC ANTEC 2017
Rick Puglielli
Promold Plastics
rickp@promoldplastics.com

TPC ANTEC 2018
Srikanth Pilla
Clemson University
spilla@clemson.com

TPC ANTEC 2019
2013 China TOPCON Chair
David Kusuma
Tupperware
davidkusuma@tupperware.com

TPC ANTEC 2020
David Okonski
General Motors R&D Center
david.a.okonski@gm.com

Membership Chair
Nick Fountas
JLI-Boston
fountas@jli-boston.com

Engineer-Of-The-Year Award
HSM & Fellows
Kishor Mehta
Plascon Associates, Inc
ksmehta100@gmail.com

Reception Committee Chair
Jack Dispenza
jackdispenza@gmail.com

Awards Chair
Lih-Sheng (Tom) Turng
Univ. of Wisconsin — Madison
turng@engr.wisc.edu

Lee Filbert
IQMS
lfilbert@iqms.com

Michael C. Uhrain IV
Sumitomo
michael.uhrain@dpg.com

EMERITUS

Mal Murthy
Doss Plastics
Dosscor@GMAIL.com

Larry Schmidt
LR Schmidt Associates
schmidtlra@aol.com

IMD New Members

The Injection Molding Division Welcomes These New Members...

Juan Alonso Acosta Garcia
Tjong Andie Adithya
Deepesh Agarwal
Akash Agrawal
Manaf Said Al Saqlawi
Mohammad Al Zyout
Oleg Aleksandrov
Krystal Alexander
Federico Ampudia
Lai Hsin An
Yuxian An
Daniel E Anderson
Rhea Arcilla
Amardeep Singh Arora
Puneet Arora
Selvaraj Arulsamy
James A. Awald
Robert William Baiko
Durgesh Bakshi
Narasimhan R. Balaji
Tyler Allan Balley
Todd Nelson Banach
Deepanjan Banerjee
Christopher Barden
William C. Barker
Christopher Edward Barks
Shelly Barlow
Timothy J. Bauer Jr.
Martin Baumert
Abrahan Bechara
Robert Beck
Peter Bejin
Burak Bekisli
Daniel Bendixon
Rayshawn L. Bentley
Brian Beringer
Shivaprasada Bhat
Arup Ranjan Bhattacharyya
Hemal Bhavsar
Bhavesh Bhojani
Nathan Bird
Jeremy C. Bleim
Hugh w Bohan
Michael Bohnsack
Nripati Bose
Gregory P. Boston
Janelle Boucher
Michael Bouldin
Doug Bowen
Charles Richard Bradley
Trevor Brinks
Joseph Brodner
Chad Brown
Michael T. Buckle
Sezen Buell
Shelby Buell
Zhefeng Cai
Mitchell Cain
Ricky Alan Calhoun
Camilo I. Cano
Andrew Canton
Hector M. Cantu
Huanhuan Cao
Justin M Carter
Jorge Castaneda
Andrew J. Catton
Kanchan Chakraborti
Ashutosh Chakraborty
Hiren Chandarana
Kuchibotla Chandrasekhar
Eric Chang
Fan Chaoyang
Alex B. Charlton
Rohit Chaudhari
Lu Chen
Pei-Rong Chen
Yi Chen
Wan Chen
Shelly Chen
Daniel Childs
Qin Chunxi
Justin Matthew Claus
Doug Clouser
Colin A. Cook
Charles O. Cornell
Brittany L. Crall
Jake R. Crouse
Doug Culbertson
Matthew James Curran
Jeremy Curtin
Dillon X. Da Costa
Robert Dam
Marisely De Jesus Vega
Oscar De la Paz
David R. Demers
Sameer Desai
Mousumi Desarkar
Craig D. Doescher
Alexander Dokuchaev
Shengge Dong
Hu Dongdong
Rajoo Doshi
Brian Douangratdy
Rebekah Du Barry-Rackal
Jason Dunn
Joseph Dyer
Robert Eckert
Brian Edinger
Reza Eghtesad
Joerg Ehmann
Mohamed Hassan El-Hofy
Tom Ellefsen
Ahmed El-Taleb
Lem Eng Hwie
William L. Evans
Kyle Joseph Evans
Michael Faison
Yindong Fang
Andre Faria
Bi Fenglei
Matthew Ronald Ference
Jonathan Ray Fowler
Ashley Jo Fox
Paul France
Helmar Franz
Bill Frayer

IMD New Members Continued

Himie Freeman
Dean Froney
Jesse L. Gadley
Robert Galland
Michael Gallegos
Gary Gao
Xiang Gao
Rocio Garay
Naveen Garg
Jose A. Garza
Greg Gaudet
Sylvester R. Gayekpar
Marc-André Gélinas
Anthony Genova
Bruce Gervason
Joseph Michael Giamo
Jonathan T.B. Gilligan
Vinit Gindra
Luis Giraldez
Bryan Glaser
Jeremy Gledhill
Dave Gnepper
Bharat Gohill
Mark Grantham
Jeffrey E. Greene
Mike Griffin
Tracy Gu
Zhuo Guan
Alex Guan
Chen Guoxiang
Anvit Gupta
Vineet Gupta
Sumeet Gurnani
Zoltan Gyetvai
Nicole Haas
Vincent P. Haibach
Zhang Haijiao
Zhao Hailli
Liu Haitao
Jason Hammerback
Pierce Hanson
Mohtasinul Haque
Roman Igor Haraja
Jim Harty
John J. Headrick
John Charles Headrick
Lihong Herman
Julia A. Hershey
Martin Höer
Andrew Holden
Georg P. Holzinger
Samantha Yue Hong
Run Hong
Ronald Horn
Ryan K. Howard
Timothy A. Howie
Bo Hu
Yan-Mao Huang
Wayne Huang
Jonathan Hummel
Zach K. Humphreys
Brian Keith Hunt
Anwar Hussain
Mark Husted
Charles H. Hutchinson
Hee-seok Hwang
Hussein M. Ibrahim
Albert Ichsan
Mahammed R. Ismail
Wee Chuen Jack
Ross Jackson
Christopher Jackson
Mehul Javeri
Quenton Jeffries
Dan Jepson
Shi Jia
Ji Jiajin
Ping Jiang
Sun Jianguo
Zhang Jiapeng
Songguo Jin
Sha Jin
James F. Johnston
Ross Jones
John Jorgensen
Lauren Joshi
Ungyeong Peter Jung
Munsub Jung
Hemal Juthani
Lei Kai
Sudhir Kalia
Vincent Kang
Bipin Karani
Amod Karkhanis
Venkata Durga Prasad Karlapalem
John Kathiniotis
Vimal Katiyar
James Kegelman
Dipali Kelekar
Ketan J. Khambhatta
Tariq Hasan Khan
Rohit Khanna
Mukul Khanna
Arvind Khebudkar
Robert Killebrew
Edward Kim
Jongryang Kim
Tae-Young Kim
Clayton Kirschner
Raymond E. Kirton
Levi Kishbaugh
Grams Kolleh
Bryan Kraft
S. Krithikumar
Stefan Kruppa
Paul Kuklych
Jayanarayanan Kumar
David W. Lai
Sandra L. Lail
Chin Ming Lam
Jose Landers
Richard Langlois
Peter Laszlo
Gary M. Lawrence
Luke Lehman
Rhys Lenney
Marco Lenzen
Jeffrey Lenzen
Markus Lettau
Martin Leung
Wen Li
Likai Li

IMD New Members Continued

Christine Li
Julie Li
Yuelin li
Chenjun Li
Wang Li
Sayali Ulhas Limaye
Heshan Lin
Ron Lintz
Thomas S. Lipe
Jeff Littlefield
Robert Littleton
Haichao Liu
Jiasheng Liu
Yiming Liu
Yuejun Liu
Yu-Hsiu Liu
Haifeng Liu
Mauricio C. Londono
Ivan D. Lopez
Sergio Lopez
Keith Loritz
Juan Jose Wong Lovedo
Xuhui Lu
Aaron Michael Lulf
Janet A. Lynch
Simon Macpanas
Michael Magaletta
Rathanawan Magaraphan
Jack Magree
Paul Maguire
Sarin Mahalley
Sylvain Major
Ferenc Majzik
Yanming Man
Stephen Mancey
Sinan Mandwee
Tim Manley
Carla Isabel Martins
Ahir Mathkar
Lokanath Mati
Siobhan Matthews
Daniel McCullough
Sean M. McEwan
Joseph P. McFadden
Brian T. McGuirk
Steven James McMan
James Abe McQuown
Gary Alan Meade
Su Mei
Daniel Men
Ian James Menego
Lisa Meng
Marion Metz
Jerry Meyer
Vasili Mihalev
Adam J. Miller
Rob A. Miller
Mark Miller
Inki Min
Maria A. Mindroiu
Shashibhushan Mishra
David Gerald Mitchell
Chad Mitchell
Hank Moeller
Praveen Mokkapati
Mohmedtanzim Akil Momin
Uruzmahendi Akil Momin
Paul Jorge Moniz
Joseph Monteleone
Joydeep Mukerjea
Paramashiva Muniswamy
Shivprasad Naik
Jayesh Nair
Nava Narkis
Sanjay Nawander
Ricardo Nesrala
Vanessa Cerejo Neto
Rita Nicolas
Sanjay Nimkar
Yaming Niu
Bridget Elizabeth Nyland
Victoria M. O'Brien
Daniel James Opfer
Stefano Osellame
Saosamprathna Oudom
Tom Overbaugh
Dino Owen
Carmen Pacho
David G. Packard
R.K. Pal
Jun Hyung Park
Jon Pate
Anup Patel
Hardik Patel
Girish Patel
Vishal Patel
V. M. Patil
Abhijit G. Patil
Niraj Pavagadhi
Steven Pax
Roxana Paola Perez
Tim Peterson
Lori A. Peterson
Terry Petkovic
Aniko Petrik
James Pica
Brian Polly
Quentin F. Polosky
Andrew Pritchard
Miguel Pulgaron
Kyle Qian
Will Qiang
WeiBo Qiu
Yangfa Qiu
Rick Quinn
Sean Rainsford
Atul Raja
Rahul Rajadhyaksha
Eben Solomon Rajan
Subramanian Siva Ramachandran
Anthony D. Rampino
B.S. Rao
Andrea Rapetti
Matt R. Ratcliff
P.B. Raut
Attila G. Relenyi
Natasha Reuss
Nadja Katharina Elisabeth Richter
Paul C. Roche

IMD New Members Continued

Alec Braden Roerig
Adam Roth
Al H. Rouwenhorst
Paul Rowe
Austin Wayne Russell
Wannes Sambaer
Graeme Sands
Juan Diego Santamaria
Michael A. Saraiva
Aniruddha Sarin
Soumen Sen Sarma
Stephen Sawdon
Gagan Saxena
Erik Michael Schaefer
Diane M. Schaupp
Bryan Schaupp
Andrew C. Scherer
David J. Schmidt
Joe Schulcz
Daniel Schultz
Jason Ryan Schultz
Riley David Schultz
Christoph Schumacher
James E. Schwarz
John Schwend
Michael John Scott
Bob Seals
Surmeet Singh Sethi
Laurie J. Shafer
Prajwal Shah
Yogesh Shahane
Sulaiman Shahin
Zhang Shan
Yang Shanshan
Qinsi Shao
Sun Shaojun
Uri Shaul
K.P. Shenoy
Pu Shi
Ashish Shinde
Li Shuangcheng
Sukdeb Sil
Brian Sills
Devon Smith
Matthew Shane Smith
Paul J. Smith
Shawn Smith
Greg Smith
Joel Smith
Joshua S. Smith
Chris Smith
Shlomo Snir
Randi M. Solomon
Mangesh Sonar
Vikram Kumar Soni
Anne Souêtre
Anurag Srivastava
Dan Stainer
Matt Stevenson
Nicholas D. Stocker
Timothy Michael Stout
Bradley Stroup
Sumit Sukumar
Greg Summers
Shih-Po Sun
Naren Swami
Anandhan T.
Tejas Talati
Ai Ting Tan
Chen Tao
Grant Taylor
Daniel Teixeira
Stanley Teoh
Amol Terker
Chad Lee Terrill
V. S. Thaha
Rahmi Thomas
Zach Thompson
Jamie Thomson
Birten L. Todd
Corey Townsley
Daniel Treffer
Thanh Xuan Truong
Vito Tsai
Gerardo Uranga
Ravikumar Vadlamudi
David S. VanVoorhis
Janos Varga
Muthuraja Vayadurai
Saul Roberto Villarreal
Perfecto Villarreal
Varthanan Vishnu
John Charles Vlahakis
Scott Voisin
Mark Voyle
Tom Waldron
Brian Jeffrey Walker
Alex Wang
Haitao Wang
Henry Wang
Min Wang
Tinglan Wang
Xinyu Wang
Mayukh Warawdekar
Brad Warren
Reid Webster
Jason Weiss
Dinesh Welukar
Jia Wen
Hu Wenxiu
Florian Wenzel
Paul A. Wheeler
Andrew Wielgus
Jeremy Williams
Bryn Frank Williams
Brendan B. Wilson
Tom Winenger
Fred Wise
Laye Wong
Russell Wong
Steve T. Wong
Bill Wu
James Wu
Weiming Wu
Chen Xin
Lin Xionghua
Albert Xu
Pan Xun
Shimeles K. Yai
Clark Yan
Thomas J. Yang
David Yang

IMD New Members Continued

Kongpheng Yang
David Yang
Weimin Yang
Xiaorui Yang
Xu Yang
Matthew P. Yanik
Igor Yi
Steve Yin
Chao Ying
Liu Ying
Tyler V. Young
Trisha A. Young
Daniel Gerald Youngers
Hui Wen Yu
QingHui Yuan
Zhang Yunlong
Boldizsar Zakarias
Qingyu Zeng
Panpan Zhang
Su Zhang
Ling Zhao
Kai Zheng
Gu Zhiqi
Jiao Zhiwei
Jian Zhou
Haidi Zhou
Zhiqiang Zhu
Liu Zhulin
Albert L. Zoller

...from 33 countries:

Australia
Austria
Bangladesh
Brazil
Canada
China
Colombia
Dominican Republic
France
Germany
Greece
Hong Kong
Hungary
India
Indonesia
Ireland
Israel
Italy
Mexico
New Zealand
Oman
Pakistan
Portugal
Russia
Singapore
South Korea
Spain
Taiwan
Thailand
Trinidad
United Arab Emirates
United Kingdom
U.S.A.

...representing more than 360 organizations including:

3M Co.
A&M Tool Inc
Adams Manufacturing
Advanced Tooling Tek (Shanghai) Ltd.
AdvanTech Plastics LLC
Air Products
Alcom Electronicos
Alok Industries
Alok Masterbatches Ltd.
Americhem (Suzhou) Co. Ltd.
Americhem,Inc.
Ampacet Corp.
AMSA Inc.
Amway
Anrhus & Shuzos Co.
Ansa Polymer
Apollo Plastics Corp.
Apple Inc.
Arburg Inc.
Asahi Kasei Plastics North America Inc.
Ascend Performance Materials
ATK Sporting Group
Autodesk
Aztec Plastic Co.
Badger Meter
Bahwan Engineering
Bard Electrophysiology
Basell Polyefins India Pvt. Ltd.

IMD New Members Continued

BASF
BASF India Ltd.
Bayer MaterialScience
Bayer MaterialScience (Shanghai) Management Co. Ltd.
Beijing U. of Chemical Technology
Berry Plastics Corp.
Bespak
BMS Co.
Boston Scientific Corp.
Bowco Industries Inc.
Branson Ultrasonics Corp.
Braskem
Bull Engineered Products
C. R. Bard Inc.
Cabot India Ltd.
CAD Tools Co.
CADFEM Engineering Services (I) Pvt. Ltd.
Canon Bretagne
CareFusion
Carolina Technical Plastics
Cascade Engineering
Case Western Reserve U.
Cégep de Thetford
Celanese Engineered Materials
Charlie Headrick LLC
Chevron Phillips Chemicals Asia Pte. Ltd.
Chevron Phillips Chemicals International Inc.
China Synthetic Resin Association
Chung Yuan Christian U.
CIPET
Circuitronix
Citadel Plastics
Cobalt Niche
Commercial Vehicle Group Inc.
Comtec IPE
Consolidated Metco Inc
CoreTech System (Moldex3D) Co. Ltd.
Croda Chemicals (India) Pvt. Ltd.
Custom Resins
Danaher Specialty Products
Dankook U.
Darter Plastics Inc.
Demag Plastics Group
DENSO Manufacturing Michigan Inc.
DenTek Oral Care Inc.
Dept. of Printing Technology
Die Mould Equipment & Supplies NZ Ltd.
Diversified Plastics Inc.
D-M-E
Dollplast Machinery Inc.
Dolphin Products Pty. Ltd.
Donaldson Europe b.v.b.a.
Dow Chemical International Pvt. Ltd.
DSM Engineering Plastics
DSM India Pvt. Ltd.
Dukane IAS (China) Co. Ltd.
Duke Plasto Technique Pvt. Ltd.
Dunastyr Technical Service
E.I. DuPont India Pvt. Ltd.
East China U. of Science and Technology
Eaton
Eaton's Cooper Power Systems
Edwards Lifesciences
Eleme Petrochemicals Co. Ltd.
Energizer Personal Care
Engel Machinery
Enplast Americas
Entec
Environmental Express
Ermanno Balzi srl
Ester Industries Ltd.
Exponent
ExxonMobil Asia Pacific R&D Co. Ltd
ExxonMobil Chemical Co.
Fast Heat Inc.
Faurecia
FCI USA LLC
Federal India Trading Co.
Fédération des Plastiques et Alliances Composites
Ferris State U.
Ferromatik Milacron India Pvt. Ltd.
Fine Organics
Fine Research & Development Centre Pvt. Ltd.

IMD New Members Continued

Florida Institute of Technology
Ford Motor Co.
Friatec AG
GE India Technology Center Pvt. Ltd.
GE Plastics
Geometric Ltd.
Gleason-K2 Plastics Division
Gojo
Gopher Sport
Gordy Plastics
Gotta Go Gotta Throw Inc.
Greene Tweed & Co.
Guangdong Industry Technical College
Haitian International Holding Ltd.
Haitian Russia
HCG Engineering
Hennepin Technical College
Hil Ltd.
HPCL -Mittal Energy Ltd.
HPM North America Corp.
Huf North America
Hunan U. of Technology
Husky Injection Molding Systems
ICIPC
iMIG Systems
Imperial Industries
Improve Your Injection Molding
Indian Institute Of Technology — Bombay
Indian Institute of Technology — Guwahati
Indian Institute of Technology — Roorkee
Indian Oil Corp. Ltd.
Indofil Chemicals Co.
Indofil Industries Ltd.
Industrial Molds
Injection World Magazine
Instituto Pedro Nunes
Intersphere Industries LLC
Invibio
IPEX Technologies Inc.
IVP of Missouri
J&J Supply Chain
Johnson Controls
Kendall
Kettering U.
Kevin Process Technologies Pvt. Ltd.
Kihomac Inc.
Kingfa Science & Technology Co. Ltd.
Kongsberg Automotive
Kraft Foods Group
Kraton Polymers International Ltd.
Kraton Polymers LLC
Kraton Polymers Trading (Shanghai) Co. Ltd.
KraussMaffei Technolgies GmbH
Larsen & Toubro Ltd.
Leoplast
Liteon Mobile
Logoplaste
Loritz & Associates Inc.
Lubrizol Advanced Materials Inc.
Lubrizol Specialty Chemicals (Shanghai) Co. Ltd
Lubrizol Specialty Chemicals Manufacturing (Shanghai) Co. Ltd.
Luxor Writing Instruments Pvt. Ltd.
Mahindra & Mahindra Ltd.
Maine Cernota & Rardin
Manika Moulds Pvt. Ltd.
Marplex Australia Pty. Ltd.
Maruka USA
Marvin Halpern Plastics Inc.
Master Lock Co.
Materials and Design Solutions
McFadden CAE Services
Mead Johnson Nutrition
Mead Westvaco
Medtronic
MEP Shanghai Limited
Merck
Mesa Industries
MGS Manufacturing Group
microPEP
Milliken Asia Pte. Ltd.
Milliken Chemical & Textile (India) Co. Pvt. Ltd.

IMD New Members Continued

MIS of America
MM Aqua Technologies ltd.
Mold Masters Injectioneering
MoldMasters
Montel Plastics Ltd.
Montrose Molders Corp.
Moog Inc.
Multiflo Instrument Pvt. Ltd.
Mutual Industries Ltd.
Nesplas, S.A.
Neutrex Inc.
New Era Polyset Engineering Pvt. Ltd.
Nexeo Solutions
Nice Plastic Industries Ltd.
Niigata Machine Techno
Nike Inc.
Nilkamal Limited
Nissei ASB Pvt. Ltd.
Nordson India Pvt. Ltd.
Noren Products Inc
North Caronlina A&T State U.
Norwex China
Novation Industries
Nypro Healthcare
Oerlikon Balzers
Ohio State U.
Olcott Plastics
Oldcastle Enclosure Solutions
Oxylane Group
Package Engineer & Development Services LLC
PackSys Global (India) Pvt. Ltd.
PCP Chemicals Pvt. Ltd.
Pentair
Petrochemical College, Chulalongkorn U.
PGI Technologies
Philips Respironics
Philmac Pty. Ltd.
Pine Technical College
Pittsburg State U.
Plaskolite
Plastic Process Equipment
Plastic Products Co. Inc.
Plastics Forming Enterprises LLC
Plastikos Inc.
Plex Systems Inc.
Pliant Plastics
Polaris Industries
Poly-Cast Inc.
Polyform Technologies
Polyman Pty. Ltd.
PolyOne Distribution
PolyOne Magyarorszag Kft.
Precision Molded Plastics Inc
Preforms Plus Inc.
Premier Equipment
Premold Corp.
Priamus-Uniplast International Pte Ltd.
Primaplas Pty. Ltd.
Princeware international Pvt. Ltd.
PT Advance Stabilindo Industry
PT Sayap Mas
PVS Plastics
PVS Plastics Technology (Shanghai) Co. Ltd.
Qenos
Rajoo Engineers Ltd.
Rajshree PolyPack Pvt. Ltd.
RAM Polymer Systems
Raycap Inc.
Rediant Global Tech Solution
Reedy International
Reliance Industries Ltd.
Reliance Worldwide Pty. Ltd.
Repsol YPF SA
ResMed Ltd.
RJS Quinn
Robert Bosch GmbH
Roche Management Group
Romar Engineering
Romsons Scientific & Surgical Industries Pvt. Ltd.
RTP Co.
Runipsys North America
S+S Inspection Inc.

IMD New Members Continued

SABIC (China) Research & Development Co. Ltd.
SABIC Innovative Plastics
Saint-Gobain
Samtec Inc.
Sangeeta Poly Pack Pvt. Ltd.
Sanwariya Processors Pvt. Ltd.
Sapona Plastics LLC
SCF Processing Ltd.
Science City
Shanghai Fujitech Plastic Co. Ltd.
Shanghai Fusion Trading Co.Ltd.
Shanghai Sonner Machinery
Shanghai U.
Shawnee State U.
Shure Electronics (Suzhou) Co. Ltd.
Siemens
SK Chemicals
SK Chemicals America Inc.
Smitty's Supply Inc.
SMR Automotive Australia Pty. Ltd.
Solvay Specialition India Pvt. Ltd.
Solvay Specialty Polymers
Sonner
Sonnex Packaging NIG Ltd.
Stihl Inc.
Studio CNC
Sturgis Molded Products
Styron (Hong Kong) Limited
Styron (Shanghai) Limited
Sumitomo Demag
Sunwell Global Ltd.
Sycamore Sourcing Solutions
Sylvin Technologies Inc.
Tata Chemicals Ltd.
TCL Hofmann
TE Connectivity
Tec Air Inc.
Techmer PM LLC
Techno Polymer America
Teknor Apex Corp.
Terumo Medical Corp.
Tervis
Tessy Plastics Shanghai Co. Ltd
The Madison Group
Thermofisher Scientific
Thermoflex LLC
Tipco Industries Ltd.
Trexel
TRW Automotive OSS
U. Nacional de Colombia
U. Birmingham
U. Duisburg-Essen
U. Florida
U. Massachusetts - Lowell
U. Minho
U. North Texas
U. South Australia
U. Wisconsin — Stout
U. Wisconsin — Milwaukee
Vertellus Specialty Materials (India) Pvt. Ltd.
Victaulic
Vitalo
Washington Penn Plastic Co.
Wearwell
Wells Manufacturing
Wells Vehicle Electronics
Wesco Services
Western Plastics
Whistle Stop Plastics Ltd
Wise Plastics Technologies
Wittmann Battenfeld
Wittmann Robottechn Kft
Worcester Polytechnic Institute
WPT
Wuyi U.
Xaloy Inc
Xiamen U.
XPRO India Ltd.
Z-Form Kft
Zhengzhou U.

Membership Application

Society of Plastics Engineers Membership Application

13 Church Hill Road, Newtown, CT. 06470 USA
Tel: +1 203-775-0471 Fax: +1 203-775-8490
membership@4spe.org www.4spe.org

European Member Bureau
Tel: +44 7500 829007
speeurope@4spe.org www.speeurope.org

Applicant Information: (please print)

My Primary Address is home_____ or business_____ (check one)

Name ________________ ______ ___________________________
First MI Last

Phone Number_________________________ Home___ Work____ Cell___

Organization Name____

Job Title____

Address ____

Address ____

Email(Required Field)____

Address ____

Alternate Email ____

City________________________State__________________________

Date of Birth____________________ Graduation Date*_________________

Zip/Postal Code______________ Country_______________

Gender: Male _____Female_____ *Required for Student Membership

Membership Types (please check one)

_____ Student $31 **_____Young Professional $99** **_____Professional $144(**includes $15 new member initiation fee)
Choose up to 2 Member Groups on the back of this application.

_____**Professional +2 Additional Member Groups** $**164** Choose up to 4 Additional Member Groups on the back of this application.

_____**Professional +4 Additional Member Groups $184** Choose up to 6 Additional Member Groups on the back of this application.

Payment Information: PAYMENT MUST ACCOMPANY APPLICATION-NO PURCHASE ORDERS ACCEPTED

Amount_____________ Check Number__________________ Cash ________________

Credit Card Information (Check One) American Express_______ Visa_______ MasterCard________

Credit Card Number____ Exp. Date__________ Security Code________

Name On Credit Card____ Amount____________

By signing below I agree to be governed by the Bylaws of the Society and to promote the objectives of the Society. I certify that the statements made in the application are correct and I authorize SPE and its affiliates to use my phone, fax, address and email to contact me.

Signature____ Date________________

Recommended by______________________________ ID#________________________

The SPE Online Membership Directory is included with membership. Your information will be automatically included.
______ Exclude my email from the Online Membership Directory.
______ Exclude all my information from the Online Membership Directory.
______ Exclude my address from 3rd party mailings.

Dues include a 1year subscription to *Plastics Engineering* magazine-$38.00 value (non-deductible). SPE membership is valid for twelve months from the date your membership is processed.

Member Groups

Technical Area of Interests(Divisions)

A Technical Area of Interest gives you access to up-to-the-minute, specialized, technical information and an international community of colleagues in your area of interest. It enhances your membership by providing more targeted, practical advice, from proven experts and professionals currently working in your field.

Please circle choice(s) below:

None

Additives & Colors Europe - D45
Automotive - D31
Blow Molding - D30
Color & Appearance - D21
Composites - D39
Decorating & Assembly - D34
Electrical & Electronic - D24
Engineering Properties & Structure - D26
European Medical Polymers - D46
Extrusion - D22
Flexible Packaging - D44
Injection Molding - D23
Medical Plastics Technical Area of Interest - D36
Mold Making & Mold Design - D35
Plastics Environmental - D40
Polymer Analysis - D33
Polymer Modifiers & Additives - D38
Product Design & Development - D41
Rotational Molding - D42
Thermoforming - D25
European Thermoforming - D43
Thermoplastic Materials & Foams - D29
Thermoset - D28
Vinyl Plastics - D27

Geographic Locations(Sections)

A Geographic Location connects you to your local plastics colleagues and your local industry. Please circle choice(s) below:

None
Alabama-Georgia-Southern
Arkansas
Australia - New Zealand
Benelux
Brazil
California - Golden Gate
California - Southern California
Caribbean
Carolinas
Central Europe
Colorado - Rocky Mountain
Connecticut
Eastern New England
Florida - Central Florida
Florida - South Florida
France
Hong Kong
Illinois-Chicago
India
Indiana-Central Indiana
Iowa
Israel
Italy
Japan
Kansas City
Korea
Louisiana-Gulf South Central
Maryland-Baltimore-Washington
Mass-New Hampshire-Pioneer Valley
Mexico-Centro
Michiana
Michigan-Detroit
Michigan-Mid Michigan
Michigan-Western Michigan
Middle East
Mississippi
Missouri
Nebraska
New Jersey - Palisades-New Jersey
New York
New York-Binghamton-Scranton
New York-Rochester
New York Mid-Hudson
North Carolina-Piedmont Coastal
Ohio-Akron
Ohio-Cleveland
Ohio-Miami Valley
Ohio-Toledo
Ohio-Firelands
Oklahoma
Ontario
Oregon-Columbia River
Pennsylvania-Lehigh Valley
Pennsylvania-Northwestern Pennsylvania
Pennsylvania-Philadelphia
Pennsylvania-Pittsburgh
Pennsylvania-Susquehanna
Portugal
Quebec
Southeastern New England
Spain
Taiwan
Tennessee-Smoky Mountain
Tennessee-Tennessee Valley
Texas-Central Texas
Texas-Lower Rio Grande Valley
Texas-North Texas
Texas-South Texas
Turkey
United Kingdom & Ireland
Upper Midwest
Utah-Great Salt Lake
Virginia
Washington-Pacific Northwest
West Virginia Southeastern Ohio
Western New England
Wisconsin-Milwaukee

Special Interest Groups(SIGs)

Special Interest Groups are where like-minded Plastics professionals come together to explore the emerging science, technologies and practices that will shape the plastics industry. There is no charge for membership. Choose as many as you would like. Please circle choice(s) below:

Advanced Energy Storage – SIG 024
Alloys and Blends – SIG 010
Applied Rheology – SIG 013
Bioplastics – SIG 028
Composites Europe – SIG 026
Extrusion Europe – SIG 025
Failure Analysis and Prevention – SIG 002
Joining of Plastics and Composites – SIG 012
Marketing & Management Division – SIG 029
Nano/Micro Molding – SIG 023
Non-Halogen Flame Retardant Tech-SIG 030
Plastic Pipe and Fittings – SIG 021
Plastics Educators – SIG 018
Plastics in Building and Construction – SIG 027
Process Monitoring and Control – SIG 016
Quality and Continuous Improvement – SIG 005
Radiation Processing of Polymers – SIG 019
Rapid Design, Engineering and Mold Making – SIG 020
Thermoplastic Elastomers - SIG 006

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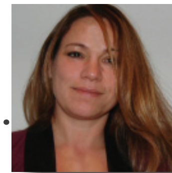
Message from the Publisher



Think spring!

Many of us have had the most severe and cold weather this winter. The thought of spring seems a far distance to many of us yet spring will be upon us soon.

There are many SPE events coming up this spring and it's not too late to register!

- Extrusion 2014 "Continuous Compounding" March 11–13
- GPEC 2014 March 12–14
- Antec 2014 April 28–30

For more information on these shows and other events visit www.4spe.org..

Thank you to all of article contributors and sponsorship supporters this month. Without your help and support this newsletter would not continue. Our next issue is the Summer edition and contributors and sponsorships are available. For more information or to be a part of the summer issue please e-mail PublisherIMDNewsletter@gmail.com

Thank you all, stay in touch!

Heidi Jensen PublisherIMDNewsletter@gmail.com

A big thank you to the authors and sponsors who supported this month's issue.