

News



The Society of Plastics Engineers

ENGINEERING PROPERTIES
& STRUCTURE DIVISION

March 2009

Best Student Paper 2008

Each year, the Engineering Properties & Structure Division is proud to present the John O'Toole Award recognizing the best student paper.

The award for 2008 was presented to Tyler Skiba and

Nicholas Tooney from Penn State-Erie for their paper *Material Warpage Response Characterization via Strategic Placement of High and Low Shear Laminates*.

The paper is reprinted in this issue starting on page 5.



EPSDIV Board members presented a plaque to the winners of Best Student Paper at ANTEC 2008. Seen left to right are Prof. Sadhan Jana, Dr. Jeff Gillmor, Prof. Brian Grady, and students Tyler Skiba and Nicholas Toomey.

Hear Top Keynote Speakers at ANTEC 2009

EPSDIV is expecting an exciting year at ANTEC 2009. The meeting will be co-located with NPE and convenes June 22-24 at McCormick Place in Chicago.

We have scheduled 12 sessions of podium presentations including over eight keynote speakers presenting leading-edge research work conducted in academia, government and industry in the US, Asia and Europe.

With more than 60 additional podium presentations, an updated view on the state-of-art in research and development in the plastics industry will be presented.

New sessions include Membranes and Environmental Materials, and joint sessions are scheduled with Alloys & Blends and Flexible Packaging

We hope that you will find ANTEC 2009 a rewarding experience for networking and learning.

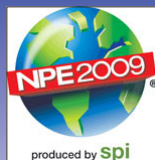
Submitted by: S.C. Josh Wong and Kevin Kit, TCP Chairs

VOTE !

Ballots for the election of the EPSDIV Board of Directors and a Councilor are included inside this issue, see pages 11 - 14

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Keep up with leading-edge technology by attending ANTEC 2009



*Meet us in Chicago
June 22-24*

Another Successful TOPCON and Preparation for ANTEC 2009



Chairperson Jeff Gillmor

In this month's chair report, I just wanted to make a couple of comments about our Topcon and plans for the technical program at this year's ANTEC in Chicago which will be held from June 22–24th.

Topcon 2008

We completed another successful Topcon held in Wilmington, Delaware this past October 13th and 14th. It was entitled *New Approaches in Polymer Characterization: Nanocomposites, Block Copolymers, and other Structured Materials*.

The technical program, which was put together, by one of our EPSDIV board members **Brian Landes**, was top of the line and included both invited speakers and contributed talks from leaders in their particular field of science.

I want to especially thank again our technical program chair **Brian Landes**, **Kevin Kit** for doing an excellent job as chair of the conference, and both **Don Hollenbeck** and **Roger Corneliussen** from the Philadelphia section for all of the local arrangements. I also wanted

to thank the rest of the Topcon committee: **Don Witenhafer**, **Jun Lee**, **Laura Nettleson (SPE)**, **Leslie Kyle (SPE)**, **Keisha Walters**, **Oomman Thomas**, **Donna Davis**, and **Luyi Sun**.

Winner Recognized

EPSDIV sponsored best poster award during our poster session where a \$500 award was given to a student from Princeton, **Jacob Tarver**, for his poster *An Investigation of Electrochromism in Water-Dispersible Polyaniline*.

We will shortly be working on plans for our next Topcon in 2010 and we will share details about the conference as they evolve.

Technical Program ANTEC 2009

Our TPC and co-chair **Josh Wong** and **Kevin Kit** put together a great technical program for ANTEC 2009 which includes 60 abstracts. They

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have many joint sessions planned and many invited speakers that are all top in their field.

— Jeff Gillmor, Chair

Recap: Topcon 2008

By all accounts, the EPSDIV 2008 Topcon was a great success. We had six invited talks, 13 contributed talks, and 13 posters under the title of *New Approaches in Polymer Characterization: Nanocomposites, Block Copolymers and other Nanostructured Materials* on October 13-14 in Wilmington, Delaware.

The quality of all of the talks and posters was very high, and the technical program chair, **Brian Landes**, should be commended for putting together a very nice program.

This Topcon was co-sponsored by the Philadelphia Section, and they did a wonderful job with the local arrangements. In particular, I'd like

to thank **Don Hollenbeck** and **Roger Corneliussen**.

Financially, the meeting was a modest success. We had 54 attendees and six exhibitors, resulting in gross revenues of \$10,250. After expenditures of \$7,791, EPSDIV realized a revenue of \$860 while the remaining revenues were shared with the Philadelphia Section and SPE.

I'd like to thank **Don Witenhafer** for recruiting exhibitors and the rest of the EPSDIV Topcon Committee for their work and advice over the last 18 months: **Jeff Gillmor**, **Luyi Sun**, **Jun Lee**, **Keisha Walters**, and **Oomman Thomas**.

— Kevin Kit, 2008 EPSDIV Topcon Chair

Changes in SPE Operations Loom



Don Witenhafer

At the last SPE council meeting, **Ken Brainey** was elected President-Elect, **Russell Broome** was elected Senior Vice President, and **Brent Strong** was elected Vice President. I want to extend my congratulations to all of them.

We also approved a rather austere

budget for the upcoming year that will unfortunately result in staff reductions. We all need to make an effort to increase our membership.

This year we are trying to save money by not holding a winter council meeting on a trial basis. We will see how it works out.

I also want to alert our members that SPE is planning to use the internet and all of its capabilities to

streamline our operations. Internet council meetings are being considered which should hopefully offer us the opportunity to become much more of a truly worldwide organization. Virtual technical conferences are planned. Individual networking via the internet is being considered and encouraged. Stay tuned. This could be a major change in how we operate.

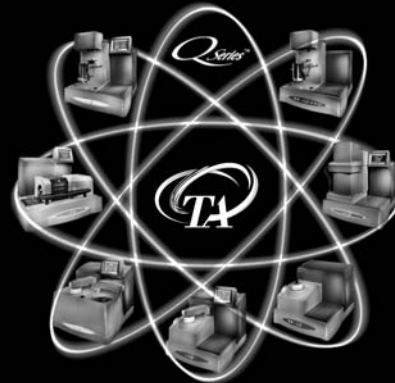
— *Don Witenhafer, Division Councilor*

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Treasurer's Report



*Emmett Crawford is the EPSDIV
Treasurer for 2008/2009*

ACCOUNT BALANCES AT 7/01/2008

Citizens Bank	8753.12
SPE Investment Plan	30180.62
Overall Total	\$ 38933.74

CASH FLOW 7/01/2008 – 2/13/2009

INFLOWS

SPE Rebate	2514.56
Interest	661.55
ANTEC Sponsorships	5250.00
Total Inflows	\$ 8426.11

OUTFLOWS

BOD Meetings	407.28
TOPCON Expenses	739.78
Newsletter	535.00
Councilor Travel	1268.46
Teleconferences	389.20
Total Outflows	\$ 3339.72

NET CHANGE **\$ 5086.39**

ACCOUNT BALANCES AT 2/13/2009

Citizens Bank	13177.96
SPE Investment Plan	30842.17
Overall Total	\$ 44020.13

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MATERIAL WARPAGE RESPONSE CHARACTERIZATION VIA STRATEGIC PLACEMENT OF HIGH AND LOW SHEAR LAMINATES

Tyler Skiba and Nicholas Toomey, Penn State-Erie, The Behrend College, Erie, PA

Abstract

During the injection molding process, non-symmetrical melt conditions are developed in a runner system. In this research, melt rotation technology is utilized to control the position of the melt conditions. The results characterize the effects on warpage that non-symmetrical melt conditions at various positions have on multiple materials and compares them to the effects produced from mold temperature variations. Injection velocity is also analyzed to determine the injection rate's influence on shear-induced warpage.

Introduction

This paper presents a study on controlling the warpage of an injection molded part by strategic placement of differently sheared laminates. The research is a continuation of the 2006 ANTEC paper, "Controlling Warpage through Melt Rotation Technology". The data from the 2006 study presents results that are not currently understood concerning the warpage of certain semi-crystalline materials.

Warpage of injection molded parts is the effect of shrinkage variations leading to residual stresses which serve to warp the part [3]. Shrinkage variations have typically been credited to side-to-side variation in mold temperature; anisotropic shrinkage resulting from flow-induced orientation; and global shrinkage variations, shrinkage variations in different regions of the part, attributed to differences in wall thickness, mold temperature, melt temperature, and melt pressure [1]. Warpage can also be affected by temperature variations of the melt within a cavity. Melt rotation technology can be used to control the position of the temperature variations developed by the high and low shear conditions acting on a material as it flows through the melt delivery system of a mold. This research defines the significance that shear has on warpage in select amorphous and semi-crystalline materials. The results of this study advance the ability to control warpage issues through positioning high and low sheared laminates within the runner system.

Background & Theory

Within circular pipes such as a fully round runner system, turbulent flow only occurs at Reynolds numbers over 2300 [2]. Reynolds number considers both the

velocity and viscosity of a fluid, as well as, the channel the fluid is traversing through. Considering the relatively high viscosity of commercial polymers, typical Reynolds numbers that occur in injection molding are less than ten, resulting in laminar flow, even during passage through small, restrictive gates [3].

$$Re\# = \frac{Velocity \times Diameter(FlowChannel)}{Kinematic\ Viscosity} \quad [1]$$

There are two primary sources of melt temperature increase evident in injection molding. The least dominant is pressurization of the melt during mold filling and packing [1]. It is responsible for a relatively small temperature increase in comparison with frictional heat originating from shear [1]. Shearing occurs because the polymer laminates are flowing at different velocities with respect to each other and the cold mold wall of the melt delivery system. The rate of change in velocity is more formally known as shear rate.

As melt flows through a runner, the velocity is assumed to be zero at the mold wall interface due to the formation of a frozen outer layer. The velocity profile increases to a maximum at the center of the melt. With different velocities within the melt stream, the greatest change in velocity occurs directly inside the frozen layer. This will be the position of the greatest shear (figure 1). The least shear occurs at both the frozen layer where the velocity is zero throughout the thickness and at the center of the melt stream where the change in velocity decreases to zero.

As the flowing polymer is sheared, the frictional forces occurring as the laminates slide past each other at different velocities introduce heat. With varying degrees of shear occurring throughout the cross-section of the melt stream, the amount of heat gained through friction also varies depending on the radial position within the melt stream, creating a temperature gradient. The highest temperatures occur directly inside the frozen layer where the shear rate and friction are the highest. Since the shear rate decreases to zero at the center of the melt stream, this area can be expected to have the lowest temperature due to a lack of frictional heating. Areas exposed to higher degrees of shear will ultimately possess lowered viscosity due to both the increased temperature caused by friction and the shear-induced orientation of the polymer chains [3].

Continued on page 6

The shear variation within the melt stream has been deemed responsible for filling imbalances in a geometrically balanced runner [3]. As the flow stream branches from the primary to the tertiary runner, the laminates separate. Laminar flow causes the highly sheared laminates to remain on the side of the runner closest to the sprue, while the lower sheared laminates from the center of the melt stream are forced to the runner wall furthest from the sprue, creating side-to-side thermal variations within the tertiary runner (figure 2)[3]. Cavities formed by laminates with higher shear history will fill first since these laminates possess the lowest viscosity, causing a fill imbalance [3].

Ultimately, the asymmetric conditions developed in the melt delivery system continue into the part-forming cavity. Different regions within the same cavity will contain material processed under different melt conditions. Regions of the cavity formed by more highly sheared material can be expected to shrink more than the regions formed by less sheared material due to the increased temperatures and higher orientation acquired from shear [3]. Differential shrinkage causes residual stresses that act to warp the part. Figure 3 depicts the expected warpage of a flat part molded with the highly sheared laminates positioned on the top or bottom of the part. Positioning of differently sheared laminates can be obtained through the use of melt rotation technology, which utilizes the laminar flow conditions seen in plastics processing in order to rotate and segregate laminates of different shear history. Although, the actual distribution obtained through use of this technology is not as depicted in figure 3, which shows the ideal placement of the laminates. Figure 4 presents a more accurate depiction of the position of differently sheared laminates.

If an observed warpage is a functional or aesthetic concern, the warpage can be countered by strategically positioning the asymmetric melt conditions. This grants much broader process and design window for the injection molder [1]. The asymmetric melt conditions developed in the melt delivery system undoubtedly have a significant impact on the molded product. This phenomenon is poorly understood in the plastics industry. Warpage and filling issues caused by varying degrees of shear within melt stream have commonly been misdiagnosed as problems with non-uniform cooling of the part forming cavity or issues with the cavity geometry [1].

A previous study conducted in 2006 titled "Controlling Warpage through Melt Rotation Technology" attempted to utilize strategic placement of laminates with different shear history to control the direction in which a rectangular plate warped [1]. This study revealed puzzling results which currently are not understood. The specimens were molded with the high and low shear laminates segregated to either the cavity or core half of the mold, through the use of melt

rotation. Warpage should be toward the side of the cavity processed with the highly sheared material, as this side will undergo more shrinkage due to the increased temperatures and orientation obtained by the increased degree of shear. Samples molded of an amorphous resin, acrylonitrile butadiene styrene (ABS), warped in the expected direction [1]. On the other hand, samples molded of a semi-crystalline resin, polybutylene terephthalate (PBT), warped opposite of the expected direction [1]. Considering that semi-crystalline polymers undergo much higher volumetric shrinkage due to their inherent tendency to form dense crystal structures when cooling, warpage toward the cooler, lower sheared side is unexpected and unexplained.

This current study is a continuation of the predecessor. A new form of the melt rotation technology, the iMARCTM, was employed to obtain a more desirable distribution of the high and low sheared laminates. Also, a broader array of polymer resins were molded in the same manner as the previous study to determine if the unexplained warpage of the PBT is characteristic of all semi-crystalline resins or strictly isolated to PBT. Further the study contrasted the effect of the positioning of high and low shear material on warpage to that of changing the relative temperature of the core and cavity halves of the mold.

Procedure

A two-cavity mold was designed utilizing a 3 mm parabolic runner system. The cavities are 25 mm wide x 111 mm long x 1.5 mm thick. An insert was designed that contains two iMARCTM melt rotation insert packages, a portion of the runner, and two fan gate inserts. The melt rotation inserts provide 180 degrees of melt rotation capability, which will allow for high and low sheared laminates to be placed on the top and bottom of the rectangular parts.

The materials examined were High-Impact Polystyrene (HIPS), Polybutylene Terephthalate (PBT), High Density Polyethylene (HDPE), Polypropylene (PP), and Polycarbonate (PC). A two-stage process was established for a high and a low injection velocity. Adequate time was granted to allow each process to stabilize. The parts were processed using a Demag Ergotech 50-120h/80v multi injection molding machine.

The effects of varying injection speed, mold temperatures from the cavity side to the core side, position of high and low sheared laminates, and combinations of these three process variables were evaluated. When varying side-to-side mold temperatures, a difference of 22.2 °C was used for the set values. Initial start-up parameters were determined through hold pressure and gate freeze studies. The lowest possible hold pressure, which filled the part, and short cooling times were chosen to maximize warpage. Mold temperatures were closely monitored to ensure that

Continued on page 7

the desired temperatures were acquired. Prior to collecting samples, mold temperatures were recorded on each mold half using an Omega HH21 microprocessor thermometer. The actual difference in mold temperatures when varying side-to-side mold temperatures was approximately 8.3 °C. A total of five parts per run were collected for measurements. These parts were hung vertically by their runners for at least 48 hours to eliminate external factors that may affect warpage and grant adequate time for warpage to occur. Warpage measurements were acquired using an Avant inspection system manufactured by Optical Gauging Systems. The parts were fixed at the end of the fan gate using a fixture that has 3 mm parabolic runner geometry. Warpage measurements were taken relative to a horizontal reference plane. The reference plane was established at the edge of the rectangular molded sample directly adjacent to the gate at the fixed end. From this plane warpage measurements were taken at the end of fill by measuring the vertical distance from the horizontal reference plane. The measurements were averaged and compared for each material.

Results

Figures 5, 6, and 7 represent the warpage measurements for each of the resins evaluated. In general, the molded parts naturally warped in the direction of the bottom. Thus, warpage toward the bottom is given a positive value, while warpage toward the top is given a negative value.

From the measured warpage of the samples molded under different processing parameters, the effect of each process parameter can be isolated and compared to the other parameters. Figure 8 illustrates the effect of switching the placement of the highly sheared material on warpage at different velocities. The indicated warpage values in figure 8 are positive if the warpage is away from the highly sheared material and negative if the warpage is toward the highly sheared material. The given data were calculated from the range of warpage values when shifting the high shear laminates from the top to the bottom at the same mold temperatures for both high and low injection velocities. At the low injection velocity and same mold temperature, HDPE had a measured warpage of 10.472 mm with the high shear on the top and -6.670 mm with the high shear on the bottom (figure 5). This correlates to the shear effect on warpage at the low injection velocity being 17.142 mm in the opposite direction of high shear (figure 8).

The data in figure 9 illustrate the effect of varying mold temperatures on the warpage of the five materials with the position of the high shear at the top. Positive values indicate warpage toward the hotter side of the mold which was the case with all of the resins. The given data in figure 9 were calculated from the range of warpage values with the high shear staying constant at the top while varying the

mold temperatures and injection velocity. At the low injection velocity, HDPE had a warpage of 14.062 mm when the high mold temperature was on the bottom and a warpage of 11.583 mm when the high mold temperature was on the top (figure 5). This correlates to the effect of a 2.479 mm shift in warpage due to varying side-to-side mold temperatures (figure 9).

Discussion

The study presents quantifiable data on the affect on warpage due to the relative position of high and low sheared laminates within the part-forming cavity. Each resin has a unique response to the positioning of differently sheared laminates. The degree of shear acquired during passage through the melt delivery system is directly induced by the speed at which the polymer is flowing.

These data illustrate that both the direction and magnitude of warpage can be manipulated through strategic placement of high and low sheared laminates via melt rotation. Theory would suggest that the highly sheared, warmer, material would shrink longer than the less sheared, cooler material ultimately causing differential shrinkage which is the primary cause of warpage of a plastic part (figure 3). In agreement with theory, the amorphous resin, HIPS, exhibits warpage in the direction of high shear when injecting at a high velocity (figure 8). The second amorphous resin, PC, also warps similarly, yet the overall shift in warpage is minimal (figure 8). Considering the relatively small warpage values obtained for PC, small deviations in sample measurements lead to inconclusive data. These deviations can be a result of uncontrollable process variations that may alter the warpage or the measurement techniques and equipment. In general, the standard deviation of the measurements in PC samples molded with the same side-to-side mold temperatures is significant enough to inhibit the ability to correctly diagnose shear's influence on directional warpage.

In contrary, the results show that the direction is of warpage is not always as theorized. All semi-crystalline resins molded, HDPE, PBT, and PP, exhibit warpage in the opposite direction of high shear (figure 8). This confirms the unusual findings in "Controlling Warpage through Melt Rotation Technology" where the semi-crystalline materials warped opposite of the high sheared material [1].

The injection velocity's influence on shear-induced warpage is not consistent with all materials. Theory suggests that a higher velocity would produce a higher shear rate creating a more drastic temperature and orientation increase in the highly sheared laminates. Accordingly, PBT, HIPS, and PP exhibit higher shear-induced warpages at the high injection velocity (figure 8). Changing injection velocities had nearly no effect in the PC

samples. In contrary to theory, the HDPE samples exhibit the greatest shear-induced warpage at the lower injection velocity (figure 8). This phenomenon is currently not fully understood. One theory is that the lower injection velocity may develop greater shear stresses, yet this is not consistent with the PBT, HIPS, and PP.

When comparing the effects of shear (figure 8) and the effects of side-to-side mold temperature variation (figure 9) on warpage, the most dominant factor can be determined for each resin. Differences in process set-up provide differences in the molded sample, which create an unknown variable that may impact the warpage. To eliminate the unknown variable, the results should be compared within the same velocities because each velocity entails a unique process set-up. Side-to-side mold temperature variation dominates warpage in the PBT, HIPS, PP, and PC at both injection velocities. Interestingly, the HDPE's warpage is dominated by shear at both velocities. At the low injection velocity, the shear induced warpage is 17.142 mm (figure 8) and the side-to-side mold temperature variation's affect on warpage is 2.475 mm (figure 9). This corresponds to shear being approximately 6.9 times more dominant than mold temperature to influence warpage at the low velocity. The same trend is noted at the high injection velocity with diminished effects.

One factor working against the shear effects on warpage is the actual distribution of the highly sheared material (figure 4). The actual distribution shows that the highly sheared laminates actually wrap around the lower sheared laminates with a large degree of highly sheared material isolated to the edges of the cavity. The effect of this "wrap around" is still unknown. To determine shear's affect on warpage, the best results would be obtained from the shear distribution presented in figure 3, yet this distribution is currently unattainable with melt rotation technology.

Summary and Conclusion

This study found that part warpage could be influenced through the strategic positioning of high and low sheared melt laminates within a simple geometric cavity. Although, both the magnitude and the direction of shear-induced warpage varies with different resins. Melt rotation technology provides the means to arrange these laminates prior to entrance in the part-forming cavity.

All of the semi-crystalline materials exhibited a trend of warping away from the highly sheared material. The amorphous HIPS exhibited an opposite trend by warping toward the highly sheared material as originally theorized. In addition, varying side-to-side mold temperatures had a more significant effect on warpage with four of the five materials tested. These four materials were PP, PBT, HIPS, and PC. Only the warpage of the HDPE was affected more

by the position of the high and low sheared material than varying mold temperatures.

According to theory, a faster injection velocity while processing PBT, HIPS, and PP produced greater shear-induced warpage. HDPE, in contrary, possesses an opposite tendency, greater shear-induced warpage at a slower injection velocity.

This research illustrates that while troubleshooting warpage in PP, PBT, HIPS, and PC variation in mold temperature will have the greatest affect on the molded part. In contrast, the position of high and low sheared material will have the greatest affect on warpage in HDPE, especially at a low injection velocity. This warpage response data grants the molder an additional method of countering warpage that was not previously being utilized in industry.

References

- 1) J.P. Beaumont, M. Myers, J. Huegel & C. Welsh. *Controlling Warpage Through Melt Rotation Technology*, ANTEC 06
- 2) J.P. Beaumont, R. Nagle, R. Sherman. *Successful Injection Molding*, Hanser Gardner Publications Cincinnati, Ohio, pp. 30-36, 38-41, 176-188 (2002)
- 3) J.P. Beaumont. *Runner and Gating Design Handbook*, Hanser Gardner Publications Cincinnati, Ohio, pp. 22-32, 94-100, 114-120 (2004)

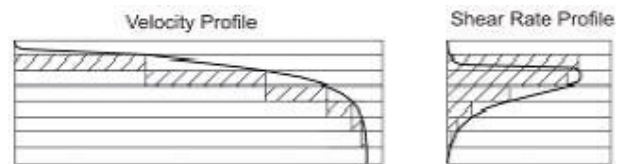


Figure 1: Velocity Profile & Shear Rate Profile [1].

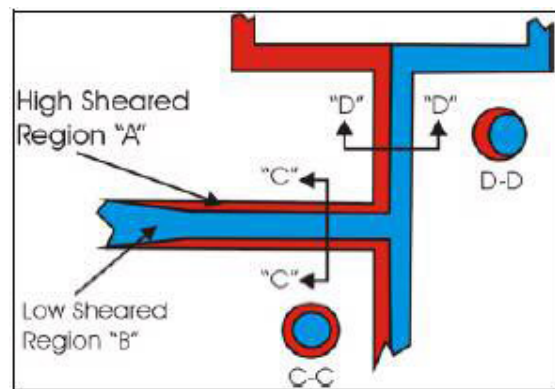


Figure 2: Shear Variations from Primary to Tertiary Runner [1].

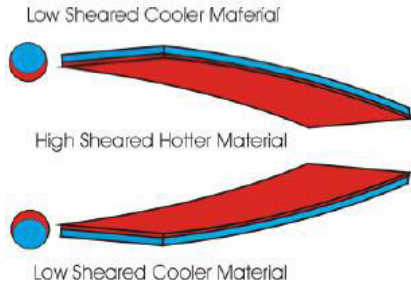


Figure 3: Expected Warpage from Strategic Placement of High and Low Sheared Laminates [1].

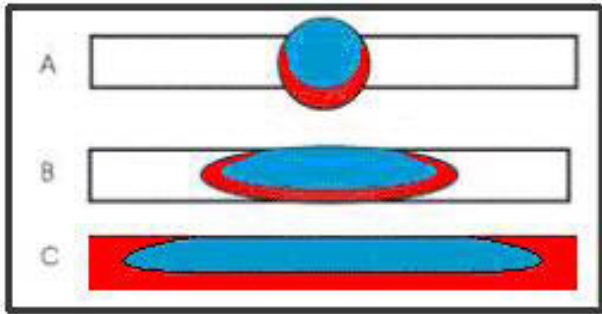


Figure 4: Position of High and Low Sheared Laminates in Mold Cavity with Melt Rotation [1].

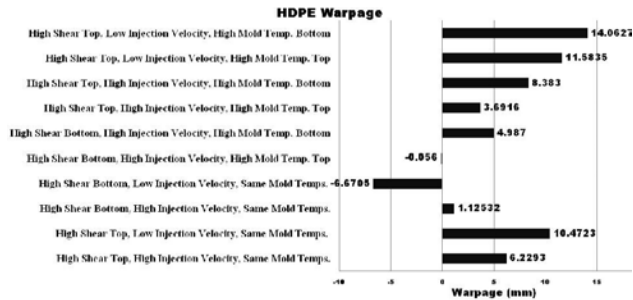


Figure 5: Warpage of HDPE samples molded under various process parameters.

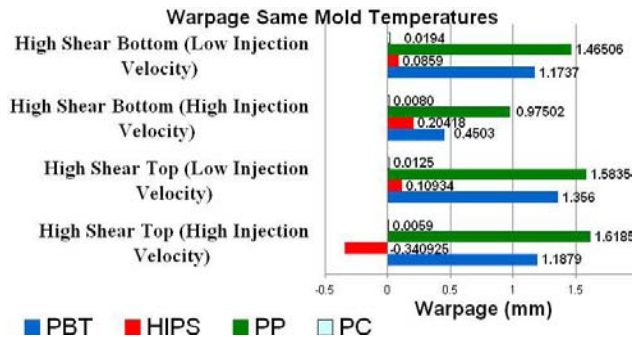


Figure 6: Warpage of PBT, HIPS, PP, and PC samples molded with the same side-to-side mold temperatures.

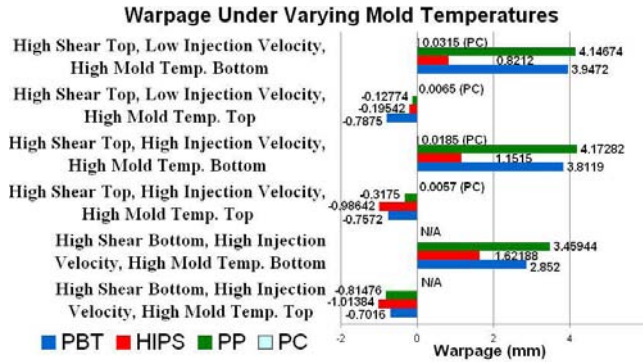


Figure 7: Warpage of PBT, HIPS, PP, and PC samples molded with variations in side-to-side mold temperature.

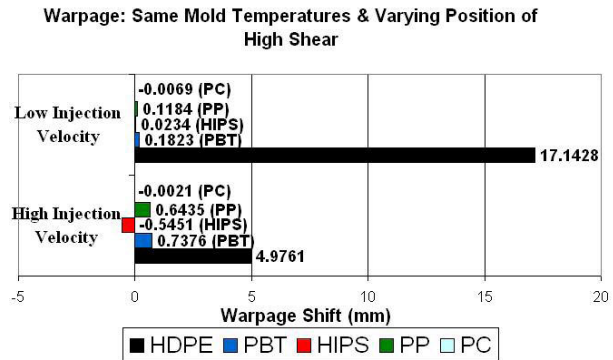


Figure 8: Resin warpage when varying position of high shear material under different velocities with the same mold side-to-side mold temperatures.

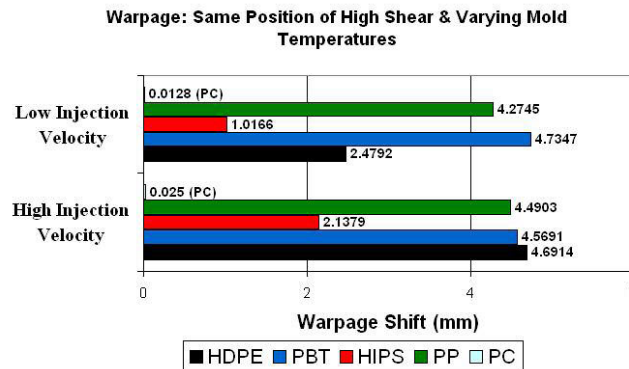


Figure 9: Resin warpage due to side-to-side changes in mold temperatures.

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Eastman Kodak
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jeffrey.gillmor@kodak.com

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Richard_C_Bopp@natureworksllc.com

Tricia McKnight
Society of Plastics Engineers
203-740-5430
mrusso@4spe.org

Ashish Sukhadia
Chevron Phillips Chemical Co.
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sukhaam@cpchem.com

Shriram Bagrodia (Sr. Senate)
Cereplast Inc.
310-676-5000
sbagrodia@cereplast.com

Pierre Moulinie
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pierremoulinie@bayermaterialscience.com

John Torkelson
Northwestern University
847-491-7449
j-torkelson@northwestern.edu

Frank Cangelosi
Unimin Corporation
203-966-8880
fcangelosi@unimin.com

Gregory McKenna
Texas Tech University
806-742-4136
greg.mckenna@ttu.edu

John Trent, Newsletter
S.C. Johnson & Sons
262-260-4943
jstrent@scj.com

Richard Clark (Sr. Senate)
Johnsmanville Company
303-978-3949

Joshua Otaigbe
University of Southern Mississippi
601-266-5596
joshua.otaigbe@usm.edu

(Josh) Shing-Chung Wong
University of Akron
330-972-8275
swong@uakron.edu

Kevin Kit
University of Tennessee
865-974-7055
kkit@utk.edu

Rajen Patel
The Dow Chemical Company
979-238-2254
rmpatel@dow.com

Dave Zumbrennen
Clemson University
864-656-5625
zdavid@ces.clemson.edu

Raj Krishnaswamy
Metabolix, Inc.
978-513-1832
krishnaswamy@metabolix.com

Hoang Pham (Sr. Senate)
Dow Chemical Company
979-238-5920
Hoang.Pham@dow.com

Brian Landes
The Dow Chemical Company
989-638-7059
BGLandes@dow.com

Murali Rajagopalan
Acushnet
508-979-3405
murali_rajagopalan@acushnetgolf.com

To submit an article for publication in
this newsletter, contact John Trent, Editor:
jstrent@scj.com

Michael Read (Sr. Senate)
Dow Chemical Company
989-636-9555
readm@dow.com

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Richard C. Bopp

Senior Materials Scientist at NatureWorks LLC

Richard (Dick) C. Bopp is a senior materials scientist at NatureWorks LLC in Minneapolis, Minnesota where he has worked on process and product development of Ingeo™ polylactide biopolymers for the past 12 years. Particular areas of technical interest have been PLA crystal nucleation, thermoforming, injection stretch blow molding and nanocomposite technology.

Prior to this position Dick worked at the General Electric Co. for 21 years, starting at the GE Corporate Research and Development Center and continuing at the GE Plastics PPO Technology Department in Selkirk, NY. At GEP Dick led a variety of development programs including microwaveable NORYL™ food packaging, GECET™ foam and UV stabilization. In 1992 he was the recipient of GE's Don Jaquiss Award for his development of a flame retarded Noryl resin for a McDonald's roof made from post-consumer recycled computer housings. In 1993 he was named Noryl Recycle Business Leader.

Dick earned his bachelor's degree in chemistry from the State University of New York at Albany and his M.S. and Ph.D. degrees in polymer chemistry from Rensselaer Polytechnic Institute in Troy, NY.

Active in the Society of Plastics Engineers since 1975, he is currently president of the Upper Midwest Section and past president of the Hudson Mohawk Section. He has served

on the EPSDIV board in various capacities since 2000 and is a member of the board with the Plastics Environmental Division.

He has authored or co-authored numerous technical papers and holds over 20 U.S. patents.

John S. Trent

Research Associate at S.C. Johnson & Son, Inc.

John is a Ph.D. materials scientist with special interest in structure/property relationships of polymeric systems. With 30+ years of research experience his research has focused on product development, exploring factors that affect processing/fabrication of cast polyolefin films, and characterization of thermoplastics & elastomeric polymers (i.e., PC, PBT, PPO, ABS, PC/ABS, PC/PBT, PVC, PPO/Nylons, CPET, polyolefins, styrenics and rubbers).

John coordinates staff assignments and multiple research projects from various businesses within SCJ. Additional responsibilities include the coordination of certified test for NSF and Underwriters Laboratories; conducting failure analysis of polymeric delivery systems and the development of accelerated aging chemical compatibility test methods for long-term product performance predictability.

John presently serves as Board Member & Newsletter

Continued on next page

Editor for SPE’s Engineering Properties & Structure Division and Board Member of CLiPS Program at Case Western Reserve University. He received his Ph.D. from Rutgers University in Mechanics and Materials Science, a MS from Case Western Reserve University in Macromolecular Science and a BS from Penn State University in Polymer Science. John has co-authored 11 technical journal publications and is also co-inventor of 7 granted US patent publications.

☐ Shing-Chung Wong
University of Akron

Shing-Chung (Josh) Wong, Associate Professor of Mechanical Engineering at the University of Akron, received his Ph.D. degree from the University of Sydney, Australia in 1999. Dr. Wong has been serving as a member in the Board of Director of SPE Engineering Properties and Structures Division (EPSDIV) since 2006. His current term expires in 2009. He has contributed regularly to SPE ANTEC since 1994.

He established an SPE student chapter at North Dakota State University in 2003. In 2006 he served as the local organizing committee chair for the EPSDIV TopCon entitled “Recent Advances in Organic and Polymer Display Technologies” held at the University of Akron. Wong also served as the Co-Chair of Technical Program for EPSDIV in ANTEC 04 and ANTEC 09, together with Hung-Jue Sue and Kevin Kit, respectively.

He was the US National Science Foundation CAREER Award recipient. He has been a summer faculty fellow and a senior faculty fellow at the Air Force Research Lab at the Wright Patterson Air Force Base in Dayton and the US Naval Research Lab in Washington D.C. under the ASEE programs in 2006 and 2008, respectively. Prior to this he was awarded the Australian Postdoctoral Fellowship from the Australian Research Council. Wong’s research interests are centered around cost-effective fabrication and structure-property relationships of polymers, polymer composites and nanocomposites. He has published over 50 journal papers and book chapters in the field of polymer science and engineering, and directly graduated 3 PhDs and 6 M.S. students. His publications have been cited independently over 400 times by researchers worldwide.

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He has authored or co-authored numerous technical papers and holds over 20 U.S. patents.

Frank A. Cangelosi

Global Marketing Manager at Unimin Corporation

Frank is a Ph.D. polymer scientist with over twenty five years of experience in the chemicals, plastics, and coatings industries. He is currently a Global Marketing Manager at Unimin Corporation, where he is responsible for mineral fillers and extenders used in a variety of polymer-based systems. Prior to this, he was Director of Marketing and Technical Service for the Polymer Additives Division of Cytec Industries. Frank also worked at Union Carbide Corporation in a variety of product development, R&D management, and technology licensing positions.

Along with other professional affiliations, Frank has been a leader in the Society of Plastics Engineers since 1981. He is a member and past chairman of the board of directors of EPSDIV, and just recently completed his term as chairman of the board of directors of the Polymer Modifiers and Additives Division.

Ballot for Councilor; continued on page 14

□ **Brian Landes**

Technical Leader at Dow Chemical Company

Brian is currently a Technical Leader in the Surface/Microscopy/X-ray Group, Core R&D at the Dow Chemical Company.

His scientific interests include effects of processing on polymer morphology and structure, development of in-situ, time resolved, and high throughput characterization

technology, and the development of image visualization, reduction, and analysis software.

He earned his Ph.D. in Polymer Science from the Pennsylvania State University. He is active in K-12 science education programs, and is active within the academic, industrial, and national laboratory communities.

He has been a member of SPE for 28 years and is a past chair of EPSDIV.



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