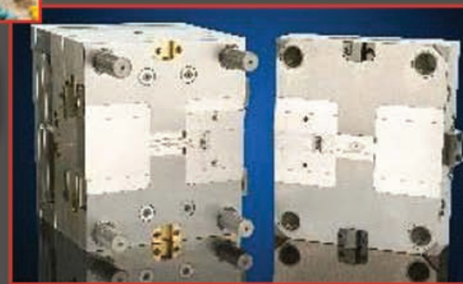
Summer 2017 | No. 104



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

It is now July and the Injection Molding Division is busy at work getting ready for the first IMTECH conference that will be held at the Chicago Marriott – Oak Brook in Oak Brook, IL. The conference is scheduled for Aug 1-3 and will feature a mixture of technical presentations, facility tours, and a strong set of keynote speakers. This is one of the biggest ventures that the Injection Molding Division has taken on in a long time and has the potential to be a fantastic event. The lineup of technical presentations is quite good and is geared more towards the individual who works in Manufacturing. The topics are more practical in nature and should be the premier event for a molder to send their Process Engineers, Manufacturing Managers, Maintenance/

Chair's Message Continued

Facility Managers, Design Engineers, and a multitude of others that are focused/tasked with producing high quality parts from design through manufacturing. This event will also be GREAT place to network with other individuals in the industry. Each day will have a networking reception follow the day's events. I encourage anyone who is interested in learning more about the conference to visit our website (www.injectionmolding.org).

Also key to our success as a division and what allows us to be able to provide high quality content is the support of our sponsors. Without them, we wouldn't be able to put on our annual Networking Reception at ANTEC, produce our newsletter, or have the confidence to start a new conference that focuses specifically on the topic of Injection Molding. I would like to recognize and say thank you to our sponsors for the confidence and general support that they continue to provide. I am looking forward to seeing the division continue to provide added value to our membership, through increased levels of content and support, but to also continue to pursue the mission of the division and the Society as a whole.

Best regards to all,
Ray McKee
2016-2017 IMD Chair
Sonoco
Raymond.Mckee@sonoco.com

Industry Events Calendar

Click the show links for more information on these events!

AUGUST 2017

AUGUST 1-3
IMTECH
Oak Brook, IL

AUGUST 10
ATI Industrial Automation Technology Fair 2017
Orion Township, MII

AUGUST 14
Plastics 3D
Indianapolis, IN

AUGUST 24: 2017 The Future is Plastics: A Celebration of SPE's 75th Anniversary & Plastics News Rising Stars
The Gem Theatre
Detroit, MI

SEPTEMBER 2017

SEPTEMBER 11 - 14
Thermoforminc Conference
Orlando, FL

SEPTEMBER 112 - 14
WESTEC 2017
Los Angeles, CA

SEPTEMBER 14-15
Midwest Design - 2 Part Show
St. Charles, MO

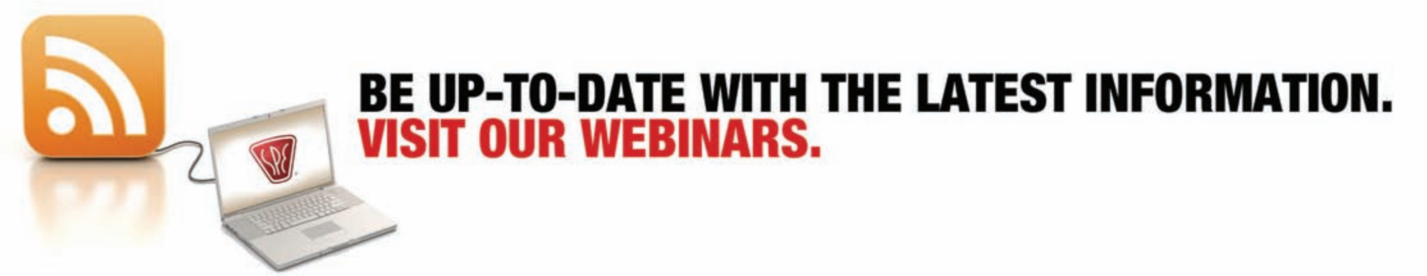
SEPTEMBER 17
Color and Appearance Conference: (CAD RETEC®)
Milwaukee, WI

OCTOBER 2017

OCTOBER 2-4
Blow Molding Conference
Oak Brook, IL

OCTOBER 4 - 5
I SPE Plastics e-Volution Conference
Fira, Barcelona, Spain

Webinars



Tools for Excellence | Mold Design Tools to Help YOU Excel in Today's Competitive Tooling Market

Primary Topics: 1. Analyzing parts for pitfalls 2. Geometry modifications made easier 3. Splitting parts…quickly 4. Why surfacing is a must 5. How to add parts in quantity 6. Special functions for molds 7. The ECO Process

Identifying Optimal Design Parameters for Injection-molded Parts

Injection molding is a very complex procedure that combines part and mold designs, materials, and process conditions. Each factor has a great impact on the final part quality. Getting the right combination of all factors requires trial-and-error, which consumes a lot of time and money. Moldex3D Expert is a powerful tool that can help evaluate and optimize process design using statistical Design of Experiments. Determining the optimum conditions for any given part / mold design will help achieve better part quality before even going to the mold.

The Design of Experiment (DOE) for Injection Molding

This Webinar will focus on solving injection molding issues using a systematic approach, called Design of Experiments, or DOE, that has been successful in other fields. With plastic processing becoming progressively more scientific, a common practice...

Injection Molding — From Art to Innovative Engineering

Who Should Attend:

- Process Engineers
- Tooling Engineers
- Design & Release Engineers
- Simulation Tech Specialists
- Program Managers
- Engineering Managers

Conference Highlights:

- 36 Technical Presentations
- Keynote Speakers
- Plant Tours
- Networking Receptions
- Industry Advancing Exhibits

Join us this summer for the Injection Molding Division's first annual three-day conference held August 1-3, 2017 at the Chicago Marriott Oak Brook, IL (near Chicago).

This full three-day conference includes 36 technical sessions, industry exhibits, plant tours at Chicago area plants and networking receptions. Don't miss this exciting event to get the latest industry trends, meet vendors with their products and services and network with fellow industry professionals. Students attending receive special reduced rate!

Sessions include:

- Injection Molding Part Design & Simulation
- Advances in Materials for Injection Molding
- Innovations in Tool Design
- Material Additives at the Press
- Innovations in Process Technologies
- Precision Molding-Machinery & Process Control
- And More!

Meet the Keynote Speakers

AUGUST 1ST:
Plastics

An overview of PLASTICS, discussing the association's re-brand and mission, share updates on the plastics industry's economics and discuss the new technology to be unveiled at its upcoming triennial trade show, NPE 2018

William (Bill) Carteaux
President and CEO, PLASTICS

Prior to becoming PLASTICS president and CEO in February 2005, Bill Carteaux spent more than 20 years in the manufacturing sector. He came to PLASTICS from Demag Plastics Group, where he was president and chief executive officer. Carteaux previously served as the company's executive vice president. Prior to joining Demag, he spent eight years with Autojectors, a manufacturer of vertical injection molding machines, as its president.

AWARDS & ACHIEVEMENTS

- Carteaux has an MBA from Indiana Wesleyan University and a BS from Purdue, where he has received several awards since graduating
- In 2015, Carteaux was the youngest person to ever be inducted into the Plastics Industry Hall of Fame

GROUPS & ASSOCIATIONS

- Carteaux also serves on the Board of Directors of four additional organizations:
- The Plastics Academy, the National Plastics Center and Museum, The Future of Plastics Foundation and SPE's Foundation.
- He currently serves as chair for the Council of Manufacturing Associations at NAM and sits on the Board of Directors

He is the immediate past director general of CIPAD, the Council of International Plastics Association Directors

AUGUST 2nd:
The Need for Higher Level Education & Training in Injection Molding

With the growing success and optimism within the US injection molding industry, recruiting, retention and training of skilled professionals is possibly the biggest challenge the industry is currently facing. Over 95% of engineers entering the industry have no foundational knowledge of plastics, let alone injection molding. The result is their actions are often limited to an over reliance on legacy practices, rules of thumb and 30-year-old techniques. In-house, contract and on-the-job training is the norm to orient employees as to the practices of the day. Plastics Hall of Fame inductee, John Beaumont, discusses the strengths and weakness of these current practices and what can be done to further advance the industries decision makers and engineers. This talk will include discussions on training vs. education, development of critical thought and innovation, and the role of the American Injection Molding (AIM) Institute which he founded in 2014.

John Beaumont

President and CEO, American Injection Molding Institute and Beaumont Technologies

John Beaumont is President and CEO of the American Injection Molding Institute and Beaumont Technologies. His earlier industrial credits include positions as Technical Manager for Moldflow's US operations and Engineering Manager for Ciba Vision Corp.

AWARDS & ACHIEVEMENTS

• John has authored several books on Injection Molding
• In 2015 John was inducted into the Plastics Hall of Fame
• John is also a Professor Emeritus at Penn State University where he helped develop and chaired the Plastics Engineering Technology Program at Penn State Erie

GROUPS & ASSOCIATIONS

• John was the founder and director of the Plastics CAE Center at Penn State
• He is a member of the Plastics Pioneers
• And an SPE Fellow

AUGUST 3rd:
Next Generation Plastics in Consumer Products

Today's highly competitive market forces global companies to focus on premium and value-added products. An environment encouraging continuous discovery in design, engineering, and R&D vision is critical. This talk highlights research & innovation used to develop emerging technologies in partnership with scientists, universities, and tech companies.

David Kusuma

Vice President, Research and Product Innovation, at Tupperware Brands Corporation

His focus is to leapfrog conventional boundaries of innovation by developing new technologies and materials to create game-changing product solutions. Prior to Tupperware David worked at GE Plastics as Global Manager, Design and Vehicle Engineering, and before that worked at Bayer Material Science.

AWARDS & ACHIEVEMENTS

• David has university degrees in Design, Business, and Engineering
• David also has a Ph.D. in Polymer Engineering, focusing on materials related to food science

GROUPS & ASSOCIATIONS

• David is a Fellow of the Industrial Designers Society of America (IDSA)
• And a Fellow of the Society of Plastics Engineers (SPE)

How Highlights:

JULY 31ST

TUTORIAL SESSION: A First Look at the Rheology of Injection Molding

PRESENTER: John Beaumont

Until recently the only way one could evaluate how a plastic will flow in a mold is through injection molding simulation. Depending on your needs, this can be excessively costly and time consuming. In addition simulation is an indirect method requiring calculations and modeling of non-injection molding based polymer data. This workshop looks at Thermaflo™ which is the first method that directly measures the injection molding rheology of polymers. The method not only can map a given polymers behaviors as influenced by process and flow geometry, but the accompanying software provides for the easy contrast of multiple similar or different polymers. The new method and software also shows promise as a means of identifying optimum molding processes, simplifying product design and advancing the development of polymers targeted for injection molding.

Facility Plant Tours:

On August 1 -2, visit area plants for tours of their facility and live demonstrations. See the daily operations of the latest technology in injection molding. Tours include:

Sodick Inc.
Sodick's 3D Printing platform, the OPM, is designed for molds, enabling high quality conformal cooling for many molding applications.

What to Expect on the Tour?
- 3D cooling for molding applications has helped customers achieve 30% – 50% reductions in total cycle time for plastic molding.
- Learn techniques and best practices for implementing this technology
- Learn about the latest advancements in technology to improve mold productivity

Highlights:
- Observe a live demonstration of the Sodick OPM250L 3D Printer as well as Sodick's proprietary software.
- Also on display will be Sodick's high-precision EDM and High Speed Mills, ideal for mold making.

Plustech Inc.
Sodick developed the proven No Check Ring "V-Line" Two-Stage Plunger System; providing an innovative approach to delivering exact dosages and pressures to mold through the use of a highly engineered injection plunger controlled by linear motor technology.

What to Expect on the Tour?
- Learn about the latest technology of Sodick Injection Molding machinery.

Highlights:

- Observe a live demonstration of the Sodick OPM250L 3D Printer as well as Sodick's proprietary software.
- Also on display will be Sodick's high-precision EDM and High Speed Mills, ideal for mold making.

WITTMANN Battenfeld, Inc.

WITTMANN is one of the leading manufacturers of auxiliary equipment needed for plastics processing. Wittmann Battenfeld is creating solutions for industry standards that are still developing. This is an exclusive opportunity for you to learn what they have created and how they are staying one step ahead of the game with their solutions for the plastics industry.

What to Expect on the Tour?

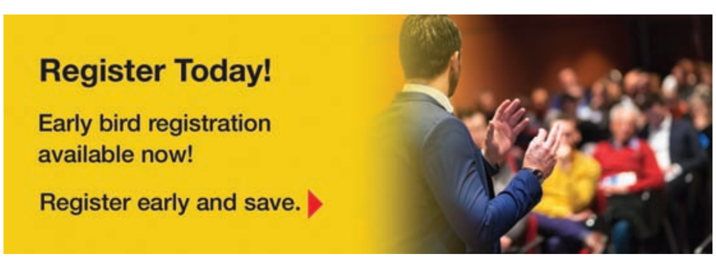
We'll start with lunch and an overview of Wittmann Battenfeld and its' Midwest facility.

Next, you'll have the opportunity to see live demonstrations of today's cutting edge technology including the:

- Wittmann 4.0
- EcoPower 180 molding machine with new UNILOG B8 molding machine control
- The NEW Pro Series Robots now produced in USA, will be on display in a W832Pro
- New G70 Aton Plus Dryer
- New G Max Series Granulator
- FlowCon Plus

Networking Reception:

IMTECH 2017 will be featuring two networking receptions on Tuesday, August 1 and Wednesday, August 2. at 5:00 PM. Spend an evening with good food and company. Enjoy a relaxing night meeting other professionals in the industry.



August 1-3, 2017 • Chicago Marriott Oak Brook • Chicago, IL

August 1-3, 2017 • Chicago Marriott Oak Brook • Chicago, Illinois

IMTECH Exhibit Hall Hours: Tuesday - August 1st, 8:00 am — 5:00 pm | Wednesday - August 2nd, 8:00 am — 5:00 pm
Thursday - August 3rd, 8:00 am — 5:00 pm

Monday- July 31st, 2017 | Tutorial Session

2:00 PM - 4:00 PM	**A First Look at the Rheology of Injection Molding** *John Beaumont President and CEO,* *American Injection Molding Institute and Beaumont Technologies*	Elmhurst Room

Tuesday - August 1st, 2017

Registration: 7:00 AM - 4:30 PM • Exhibit Hall: 8:00 AM - 5:00 PM

8:00 AM — **Day 1 Opening Remarks** | David Okonski & Peter Grelle

8:30 AM — **Keynote Speaker** | Bill Carteaux

	Injection Molding Part Design & Simulation	Innovations in Process Technolgies
Session Chairpersons	Eric Foltz & Pete Grelle Session Tu1	Tom Turng & Adam Kramschuster Session Tu2
9:00 AM	Warpage Prediction, Optimization, and Compensation for Injection Molding *Ethan Chiu, Core Tech Systems Ltd., Inc.*	Industry 4.0 in Your Molding Environment, a Practical Approach *Trevor Pruden, Arburg, Inc.*
9:30 AM	Addressing Stresses and Their Effects on Molded Part Durability *Mark Yaeger, Covestro*	Plastics 4.0- How to Turn Injection Molding Machine Data into Profit *Dr. Stefan Kruppa, KraussMaffei Technologies GmbH*
10:00 AM	The Role of Material Data in the Simulation of Injection Molded Parts *Herbert Lobo, Datapoint Systems*	Innovations in Decoupled Molding III *Doug Espinoza, RJG, Inc.*
10:30 AM	Let's Talk About Right-Weighting, Not Light-Weighting *Eric Foltz, The Madison Group*	Automatically Adaptable Hot Runner System *Marcel Fenner, Priamus*
11:00 AM	Breaking the Rules with Plastic Injection Molding *Roy Spatz, Bemis*	Utmost Repeatability through Constant Change *Joachim Kragl, Engel*
11:30 AM	Advances in Weldline Strength Prediction and As-Manufactured Structural Simulation in Plastic *Matt Jaworski, Autodesk*	Inmolt: Integrated Primering *William Asmann, Nolax, Inc.*
12:00 - 12:30 PM	LUNCH BREAK	
1:00 PM THROUGH 4:30 PM	Visit Our Exhibitors PLANT TOURS 1:00 - 4:30 PM	
5:00 PM	NETWORKING RECEPTION	

August 1-3, 2017 • Chicago Marriott Oak Brook • Chicago, IL

August 1-3, 2017 • Chicago Marriott Oak Brook • Chicago, Illinois

IMTECH Exhibit Hall Hours: Tuesday - August 1st, 8:00 am — 5:00 pm | Wednesday - August 2nd, 8:00 am — 5:00 pm
Thursday - August 3rd, 8:00 am — 5:00 pm

Wednesday - August 2nd, 2017
Registration: 7:00 AM - 4:30 PM • Exhibit Hall: 8:00 AM - 5:00 PM

8:00 AM	**Day 2 Opening Remarks** | David Okonski & Peter Grelle	
8:30 AM	**Keynote Speaker** | John Beaumont	
	Innovations in Tool Design	**Material Additives at the Press**
Session Chairpersons	**Brad Johnson & Susan Montgomery** **Session We1**	**Jeremy Dworshak & Chad Ulven** **Session We2**
9:00 AM	Product Design for Silicone Molding *Rick Finnie, M.R. Mold & Engineering, Corp.*	Using Titanate & Zirconate Additives at the Press *Salvatore J. Monte, Kenrich Petrochemicals, Inc.*
9:30 AM	Conformal Cooling on the Advance *Reiner Westhoff, Contura MTC GmbH*	Not Your Father's Additives *Wylie Royce, Royce Colors*
10:00 AM	TruCool 3D Conformal Cooling *David Baucus, DME Corp.*	Enhancing Polyolefin Performance & Cycle Time Reduction *Nate Renwald, Brandt Technologies*
10:30 AM	EDGELINE: Molds & Valve Gate Systems for Side Injection *Donald Hickel, Manner America*	Information Needed for Accurate Color *Blake Johnson, Lanier Color Company*
11:00 AM	Utilizing Gating & Runner Design Strategies to Reduce Warp Problems *Kevin Rottinghaus, Beaumont Technologies, Inc.*	Materials For Use in Injection Molding to Reduce Cycle Time and Improve Thermal Management *Phil Brunner, Interfacial Consultants*
11:30 AM	Multi-Material Molding with E-Multi (Auxiliary Injection Unit with Standalone Controller) *Rafael Izaguirre, Moldmasters/Milacron*	Performance Enhancement of Injection Molded Components Using Additive Masterbatch *Joe Raborn, Clariant*
12:00 - 12:30 PM	**LUNCH BREAK**	
1:00 PM THROUGH 4:30 PM	**Visit Our Exhibitors**	
	PLANT TOURS 1:00 - 4:30 PM	
	Injection Molding Special Session	
	1:30 PM: Using Simulation Results for Plastic Injection Molded Part Design *Steve Faes, Currier Plastics*	
	2:00 PM: Expected Benefits of Tungsten Carbide Core Pins *Frank Rymas/Jim Barrett/Gabriel Geyene, Crafts Technology/ Cavaform International/ Sigmasoft*	
	2:30 PM: Standardized Processing *Jon Ratzlaff, Chevron Phillips Chemical Company, LLC*	
	3:00 PM: Precision Injection Molding of Thermopastic Repeating Frames or Battery Applications *David Okonski, General Motors Corp.*	
	3:30 PM: Part Design & Material Selection – Critical Factors in Making Well Designed High Quality Medical Device Components & Parts *Len Czuba, Czuba Enterprises*	
5:00 PM	**NETWORKING RECEPTION**	

IMTECH 2017 August 1-3, 2017 • Chicago Marriott Oak Brook • Chicago, IL

August 1-3, 2017 • Chicago Marriott Oak Brook • Chicago, Illinois

IMTECH Exhibit Hall Hours: Tuesday - August 1st, 8:00 am — 5:00 pm | Wednesday - August 2nd, 8:00 am — 5:00 pm
Thursday - August 3rd, 8:00 am — 5:00 pm

Thursday - August 3rd, 2017

Registration: 7:00 AM - 4:30 PM • Exhibit Hall: 8:00 AM - 5:00 PM

8:00 AM	**Day 3 Opening Remarks** | David Okonski & Peter Grelle	
8:30 AM	**Keynote Speaker** | David Kusuma	
	Advances in Materials for Injection Molding	**Precision Molding Machinery & Process Control**
Session Chairpersons	Srikanth Pilla & Joseph Lawrence Session Th1	Sriraj Patel & Lynzie Nebel Session Th2
9:00 AM	How To Choose ABS Substrate for Best Plating Results in Automotive and Appliances Applications *Tom Chu, ELIX Polymers*	"A New Approach to Multi-Material and Cube Molding *Jim Overbeeke, Athena Automation*
9:30 AM	Design for Your Future Using Advanced Thermoplastics *Fei (Sky) Li, PolyOne Corporation*	Equipment Approach of Challenging Micro Molding Applications *Kohei Shinohara, Sodick*
10:00 AM	New Biomaterial Utilizing Cellulose Fiberswith PA/PP Blends(PPC) for Use in Micro Molding *Robert Joyce, FibreTuff Medical Biopolymers, LLC*	Features and Application Case Study: All-Round Inspection System for Molded Parts *Tomoko Uchida, Visco-Tech*
10:30 AM	A Molding Process Optimization Study of Electrically Conductive Stainless Steel Fiber (SSF) Compounds *Ned Bryant, RTP Company*	Advantages of Injection Compression Molding and Coining *Trevor Pruden, Arburg, Inc.*
11:00 AM	Advancements in Materials for Injection Molding-Unlocking an Additional Level of Lightweighting in Automobiles *Srikanth Pilla, Clemson University*	What Saving Energy Really Mean to Your Plastics Business: The Easiest Way to Increase your NET Margins 30% and DRIVE new Sales Opportunities *Robert Knaster, PlasticMetal USA*
11:30 AM	Reinforced Plastics: A Process Based Perspective on Applications *Gregory P. Dillon,* *Pennsylvania State University, Erie, Pa*	What You Didn't Think Was Possible with Automatic Water Flow Control *John Haddad, Whittman Battenfeld, Inc.*
12:00 - 12:30 PM	**LUNCH BREAK**	
1:00 PM THROUGH 4:30 PM	**Visit Our Exhibitors**	
	SPE Injection Molding Division Board of Directors Meeting 1:00 - 4:30 PM	
5:00 PM	**END OF CONFERENCE**	

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DAVID KUSUMA



AUGUST 1-3, 2017 CHICAGO MARRIOTT OAK BROOK, IL

Texturing Issues

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: Jeff Hatley from Extron Electronics asks:

I was wondering if you could comment on an appearance question. I have a set of parts that are intended to match, which are provided by different vendors. We have identified there are texture differences between these parts and we are working with the vendors to correct this. But other than the texture details themselves there is a notable gloss difference as you can see in this photograph. The larger part on the right is the desired appearance, MT-11000 specified but in actuality a bit finer. I was asked if the mold finish prior to texture may have been a factor here for gloss. Any experience on this as such? The material is PC/ABS. Thanks much.

Authors Note: Jeff attended one of my seminars and works for a company producing high end audio products where esthetes are extremely important. The pictures referenced cannot be shared as the product has not been released for sale as of this date.

A: I do see the texturing differences on the parts as well as the gloss levels, not sure which stands out the most. Obviously, correcting the texture pattern and texture depth is a necessary first step. The texturing issue could be one of two problems: 1. Different steels were used in the construction of the cavities; 2. The exposure time to the acid wasn't the same for both textures.

As for the gloss level, yes it does make a difference on the mold finish prior to texturing. On all automotive and consumer appliance molds I build I always specified a SPI B-2 mold finish prior to texturing. I was told that surface finish didn't have that much influence for texture appearance. I do know that where ever surface finish you start with, it should be the same for all molds where parts are used adjacent to each other. The parts produced off multiple molds with my mold finish always matched.

Of course textures will react differently as to type and hardness of the steel. Additionally, a difference in texture depth will change the appearance drastically. The best way to check texture depth is with "silly putty" impressions and measuring the height on the old shadow graph. I made sure that the steel type, source and hardness was the same and that all tools were textured at the

Ask the Experts: Bob Dealey Continued

same time at the same texture. On a coffee maker programs we had 14 side cover molds (two per item) and 8 top cover molds, and parts off all of the molds could be interchanged without concern for appearance differences.

About once or twice a year I had a maintenance procedure where we pulled the molds and then went over the texture with a walnut shell blast (think sand blast but definitely not with a harsh abrasive media) for molds over about 50 R/c, and a thermoplastic media blast for molds under 50 R/c. This would even out the surfaces and provide a consistent gloss level for the parts.

In order not to have old molded parts matched with the new, where a difference would be noticeable, we balanced inventories and separated the runs. When we were forced into doing some major clean up on a mold in a texture series (as for example a stain on the textured surface) we would clean up all the molds at that time.

Gloss levels will closely replicate the mold surface. However, other factors enter into the equation: i.e. use of regrind, flow infringement due to gate placement, venting, packing time and pressure and mold and melt temperatures. It is important to mold mating parts from the same batch of material. I once had an incident where one molder was mixing a small percentage of crystal polystyrene regrind with ABS. While the parts had a nice gloss to them they didn't match the other parts.

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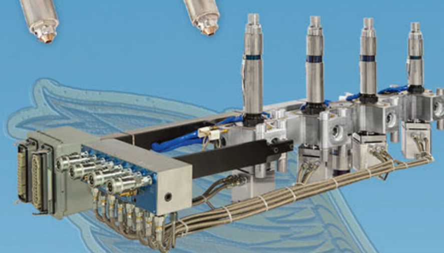

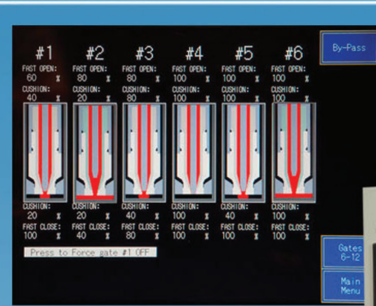

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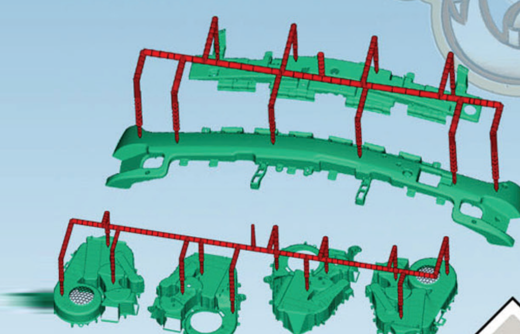
The Hot runners that feed the industry



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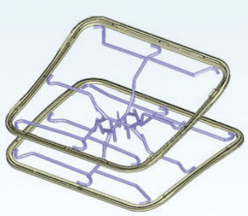

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By Kenji Okubo, Taisei-kogyo Co,. Ltd
Shigeo Tanaka, Taisei-kogyo Co,. Ltd
Hiroyuki Hamada, Kyoto Institute of Technology

Co-Injection Molding in Metal Injection Molding

Metal Injection Molding (MIM) is a process to manufacture metal parts, combining powder metallurgy with plastic injection molding. With MIM process, it is possible to produce highly functional composite metal structures by insert molding, co-injection or double injection molding. In this study, co-injection molding was applied to manufacture composite component of dissimilar metals. The effect of injection speed on flow behavior of dissimilar metal powder was experimentally investigated.

Background

Metal injection molding is a molding technique combining powder metallurgy and plastic injection molding. With MIM process, three-dimensional complex components can be produced in large quantity [1, 2]. Coinjection molding is an advanced application of MIM, and enables composite component of dissimilar metals. For example, by injecting stainless steel 630 for the outside of the component, and 316L for the inside, components with hard surface and ductile core are produced [3-5].

There are, however, many parameters that are difficult to control for co-injection, such as material properties, injection conditions, and injection timing. This study aims to establish manufacturing technique of MIM co-injection molding. For this purpose, two types of dissimilar metals were co-injected from the opposite direction, using a mold of dumbbell-shape specimen. The effect of molding condition on both flow behavior of dissimilar materials and tensile property was experimentally investigated experimentally.

Opposite Co-Injection Molding

Bonding method of dissimilar metal materials by molding technology In order to manufacture composite components, compression-assisted molding [6], insert molding, and coinjection molding are usually applied. Among them, insert molding and core–revolving molding are frequently applied. The molding type adapted in this study is coinjection molding technique, in which dissimilar materials are injected into the mold simultaneously. Initially, the bonded area of composites made by insert injection and co-injection molding was investigated.

Co-Injection Molding in Metal Injection Molding

Figure 1 and **Figure 2** show the microstructure of bonding area of 316L/316L composite and tensile property respectively. As observed in **Figure 1**, interface line is clearly visible at the bonding area made by insert molding, while there is no interface line in the composite made by co-injection molding. **Figure 2** shows that the tensile strength of co-injection molded specimen is almost equivalent to the solid 316L MIM specimen. On the other hand, the strength of the insert-injection molded specimen is as low as 40% of the solid, reflecting the influence of the interface at the bonding area.

(a) Insert molding (b) Co-injection molding

Figure 1: Bonding of dissimilar material

Secondly, dissimilar stainless steel 316L and 630 were co-injection molded. As shown in **Figure 3**, stainless steel 630 penetrated into 316L and bonded.

In this study, sandwich metal structure was attempted by increasing the penetration of 630 into 316L. The process was, thus, named "opposite co-injection molding".

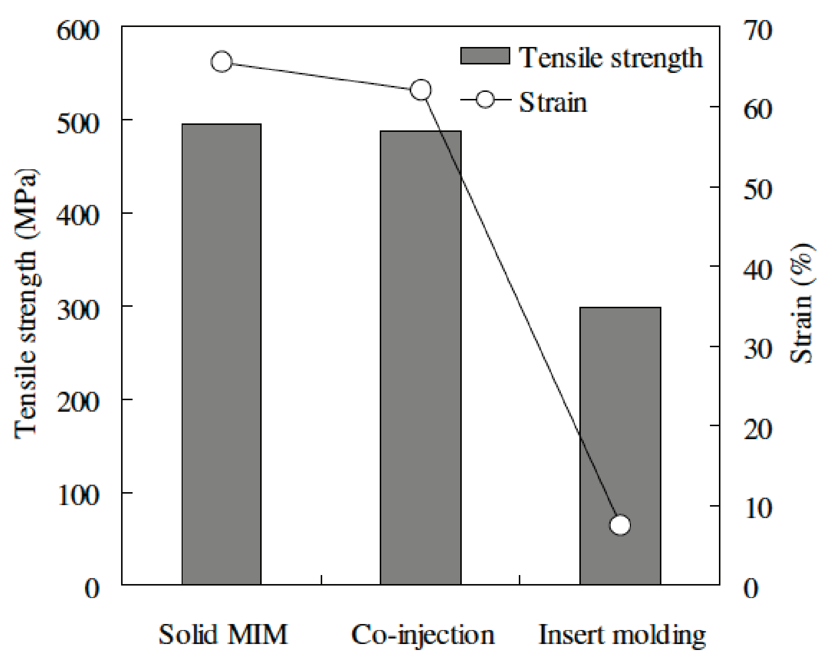


Figure 2: Comparison of tensile property

Fabrication of sandwich structure by opposite coinjection molding

In this study, the opposite co-injection molding used in one in which two dissimilar materials are forced to conflict in a mold with simultaneous injection.

Material A was first injected and filled in the cavity of the mold, then material B was injected from the opposite direction, in order that the material B penetrates into the material A and forms sandwich configuration. When it is successful, production of composite component of dissimilar materials such as stainless steel with hard surface and ductile core can be produced. Since the physical property of the

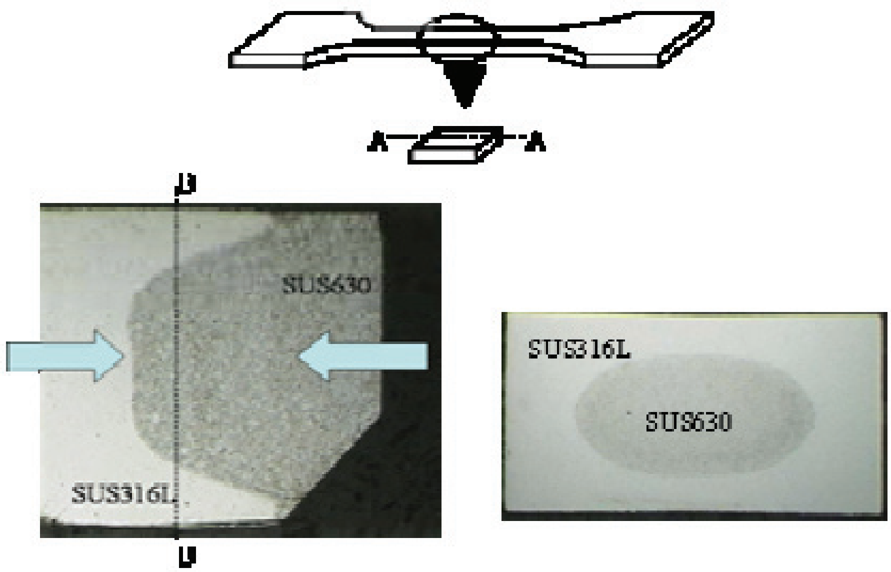


Figure 3: Composite of stainless steel 316L and 630

composite as well as the configuration may vary depending on the conditions of injection molding, they were investigated for different injection conditions.

Experimental Method

Device and Molding Condition

In this study, a co-injection molding machine with two injection units was used (Manufactured by NISSEI Plastics, DCE-60, 2E). For each unit, molding conditions were controlled separately. Not only simultaneous injection but also sequential injection with certain delay time was available. In this study, the sequential injection molding was selected.

The dumbbell shape specimen used in the study. Two gates were placed at both ends of the specimen, in order to inject dissimilar materials independently.

Molding conditions were selected by varying mainly the injection speed and categorized into A and B as shown in **Table1**. Material temperature and mold temperature were fixed at 180°C and 50°C respectively.

Table 1: Molding Condition

	Injection Speed of SkinMaterial (mm/s)	Injection Speed of Core Material (mm/s)	Injection Delay Time of Core Material (sec)
A	50	20 40 60 80 100 200	0.5
B	250	250	0.1

Material and Sintering Condition

In this study, two types of stainless steel powder were used. The one is highly corrosion resistant austenite stainless steel powder (SUS310HMO, Average grain diameter 9µm, Manufactured by Atmix), and the other is precipitation hardening stainless steel powder (SUS630, Average grain diameter 9µm, Manufactured by Atmix). Each powder was mixed with polyacetal binder and granulated. The volumetric fraction of powder was 67vol%. For the sandwich structure, corrosion resistant stainless steel 310 was selected the surface (skin) material, and high strength stainless steel 630 was selected as inner (core) material.

Debinding and sintering were performed in a vacuum furnace (VHL 20/20/20-MS, Shimadzu Co., Ltd). Binder polymer was removed in nitrogen atmosphere at 600° C holding for 2 hours. Then the specimens were sintered in argon atmosphere at 1300deg.C holding for 2 hours.

Evaluation Methods

In order to investigate flow behavior of the core material penetrating into the skin material, dumbbell specimens were sliced in the longitudinal direction with half thickness, and the cross-section was observed by using CCD camera after etched.

In order to calculate the filling ratio of the core material, the cross-section of central part of dumbbell specimen was analyzed with image processor.

In order to investigate the mechanical properties of the sandwich structure, sintered specimens were subjected to tensile test by using the universal testing machine (Auto-graph®, AG-10TD Shimadzu Co., Ltd, Tension speed: 1mm/min).

Results and Discussions

The results of the molding condition A are discussed first. **Figure 4** shows the photograph of longitudinal cross-section of sintered specimens, and the analyzed image of the core material. Concerning to flow behavior of the core material, it is recognized that the figure came closer to becoming a whole dumbbell specimen as the injection speed of the core material increased.

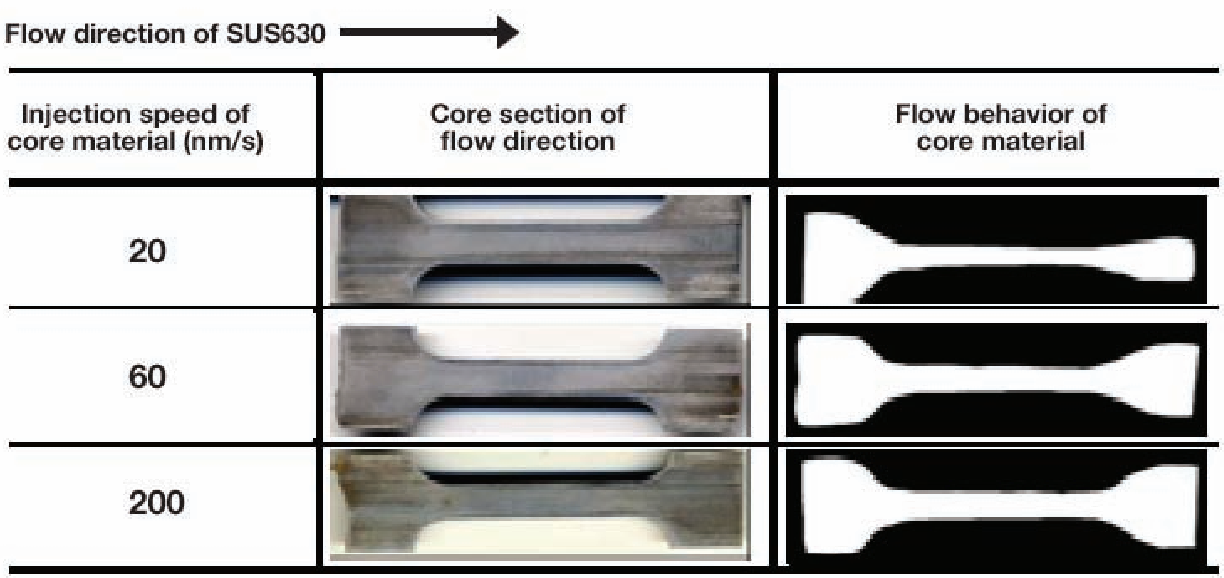
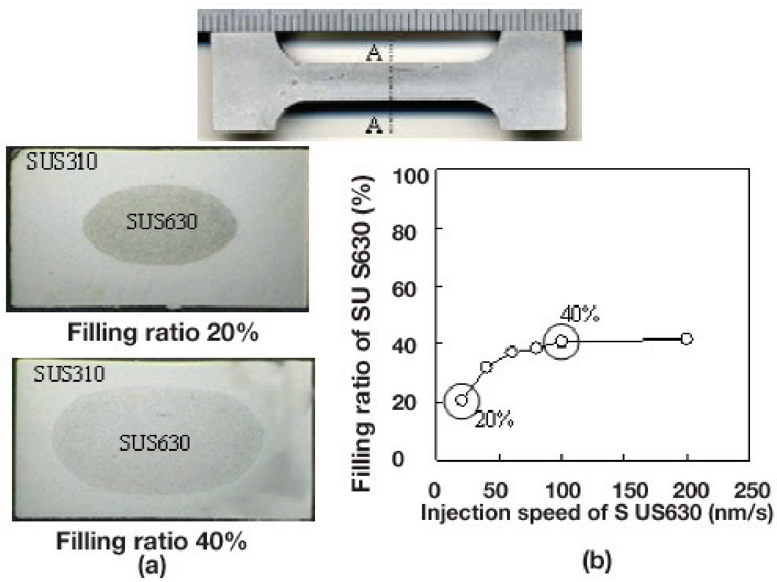


Figure 4: Effect of injection speed of core(SUS630) on flow behavior

Co-Injection Molding in Metal Injection Molding

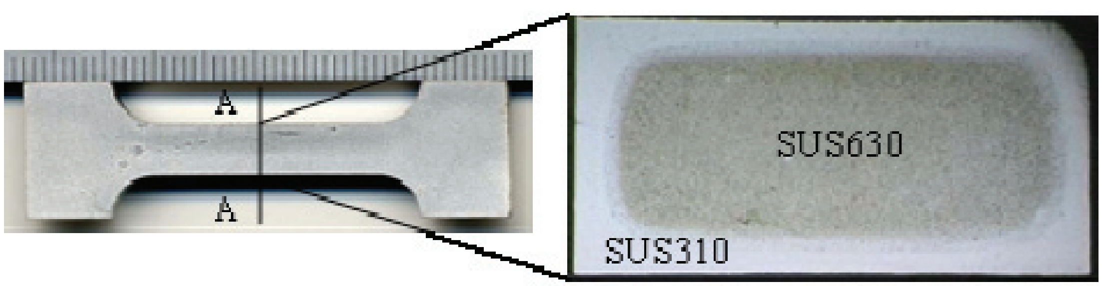
Depending on the injection speed, the core material presented different flow behavior. When the injection speed was 200mm/s, the width of the core material showed more uniform distribution along the flow direction than at speed 20 mm/s. This suggests the possibility of uniform sandwich structure for complex three dimensional shape by injecting the core material at high speed.

Figure 5 (a) shows photographs of transverse crosssection of the specimens with the core injection speed of 20mm/s and 200mm/s. **Figure 5 (b)** shows the relation between the filling ratio and the injection speed of core material. Filling ratio is defined as the portion of the core material over the total area. The filling ratio of core material increased as the injection speed of core material increased. The filling ratio, however, saturated with the injection speed above 100mm/s. For the next step, in order to increase the filling ratio, the molding condition B was applied. Then, the filling ratio reached up to 68% as shown in **Figure 6**.



(a) Cross-section A-A (b) Filling ratio vs. injection speed of 630

Figure 5: Effect of injection speed of core(SUS630) on filling ratio



(a) Photograph of sintered compact (b) Cross-section A-A

Figure 6: Cross-section of the specimen with 68% filling ratio

Concerning mechanical property, **Figure 7** shows stress-strain curve of the sintered dumbbell specimensm obtained by tensile test. The S-S curve of sandwich structures is intermediate to that of 630 with high strength and low elongation, and 310 with high elongation. The SS curve exhibited unique profile with extinguished ultimate tensile stress and rupture stress.

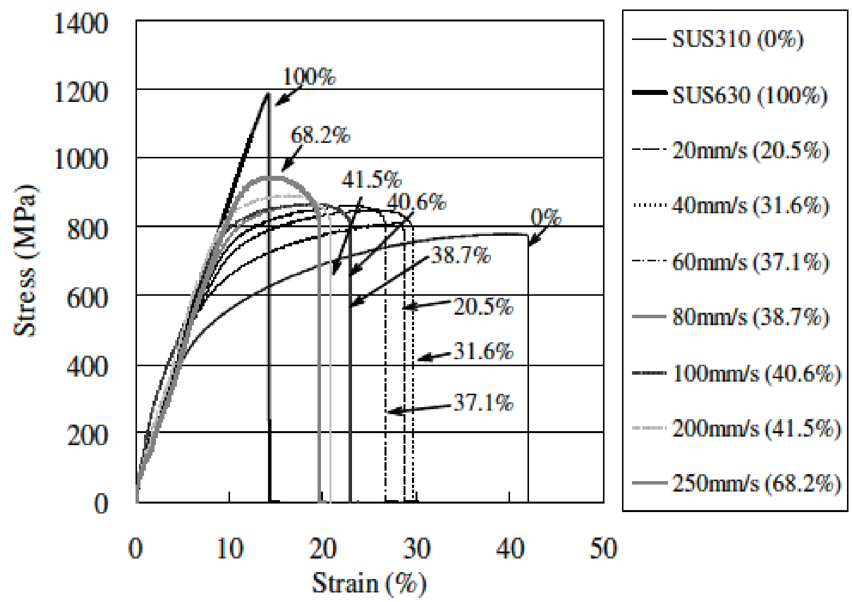


Figure 7: Stress -Strain curve of sintered compact

Conclusions

In this study, the opposite co-injection molding was introduced as a manufacturing method of highly functional composite materials, and applied for injection molding of sandwich composites. The configuration of the sandwich structure was investigated concerning the conditions of injection molding.

The opposite co-injection molding is applicable to manufacture of composite metal structure consisting of two or more types of dissimilar materials. Since high bonding strength is available with the process, a wide range of application is expected. By controlling the conditions of injection molding, especially the injection speed, the configuration of the sandwich structure was also optimized. It is confirmed that the process technique is also applicable to complex threedimensional structure, to combine dissimilar materials, and to manufacture highly functional composite components.

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Key Words

Metal injection molding, Opposite co-injection molding, Sandwich structure.

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Backflow Compensation for Thermoplastic Injection Molding

Minimization of fail parts save companies time and money. Therefore, the injection molding process has to be optimized regarding part quality, cycle time and fault frequency. Machine and process capability are a measurable property of a process to the specification and compare the output of an in-control process to the specification limits. Through process control on different levels of machine control, a high part- and process-quality is achieved. It involves both machine operation and the behavior of plastic. To accomplish these goals and to improve existing machine technology, an alternative injection concept is developed and examined to improve the process and machine capability using a reciprocating screw without moving, locking elements at the screw tip (**Figure 1**).

The proposed concept is based on the integration of a stage of continuous plasticization in the discontinuous injection molding process. It comprises backflow compensated (BFC) injection during the injection and packing stage by generating a suitable melt flow for the compensation of backflow of polymer melt into the screw flights. A conventional non-return valve is no longer needed to accomplish a complete cavity filling under high pressure. Depending on process and melt state, the "soft" or "open" system improves process capability with lower component wear. Also, the shot volume is kept constant to an even greater extent across a plurality of injection molding cycles. It is possible to dispense on passive locking geometries with their shortcomings as unsteady closing behaviour, the adverse tendency to wear and disadvantages in dosing.

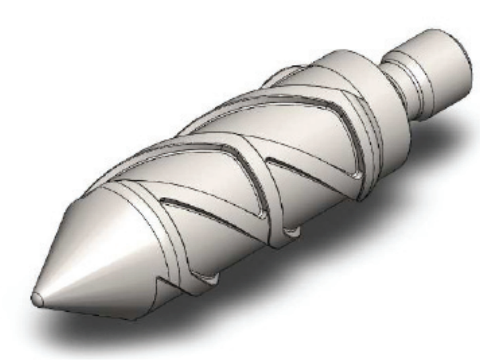


Figure 1:
CAD-Model of a "BFC screw tip".

Introduction

The conventional process control for the injection molding process is based on the discontinuous mode of operation, which is given systemically by the distinction between dosage and cavity filling [1]. In the cavity-filling phase, the screw is moved axially and held at the same time radially into position. The non-return valve (**Figure 2-I**) serves as a kind of valve and prevents leakage of melt back in the screw flights. The blocking elements block mechanically the backflow channel. Thus, it can be realized extremely high injection pressure of up 2500+ bar and long holding times. Passive backflow valve systems, however, are vulnerable to changes in the process, depending on the raw material used and the process settings been set [2], [3], [4]. A sporadic incorrect closing of the blocking ring of the non-return valve often results in an incomplete filling of the part and in fluctuations in the part properties. Active locking systems (**Figure 2-II**) does also exist but often cannot prevail due to a lack of robustness. Also they have disadvantages like a significantly higher complexity. By excluding the moving parts of a non-return valve a uniform movement of these (no longer existing) components can be turned off entirely. However, an alternative is required to prevent the backflow of the plastic melt in the screw flights.

Figure 2: I) Conventional non-return valve design with 3-wing screw tip and blocking ring to prevent backflow during filling stage. II) Auto-shut-off valve (ASOV) with spring-actuated shut-off mechanism. It operates independent of screw travel with instantaneous closing and is independent of resin viscosity

Background

Figure 3 shows how the closing behavior of a nonreturn valve can be indicated by monitoring the pressure in barrel and nozzle of an injection molding machine. The curves for successive injection molding cycles, recorded at an electro-mechanically driven injection molding machine for injection and holding phase are plotted. While the screw position s decreases at the beginning of injection stage, melt (p), barrel (pbrl1) and cavity pressure (pC1) as well as the melt temperature TIR increase.

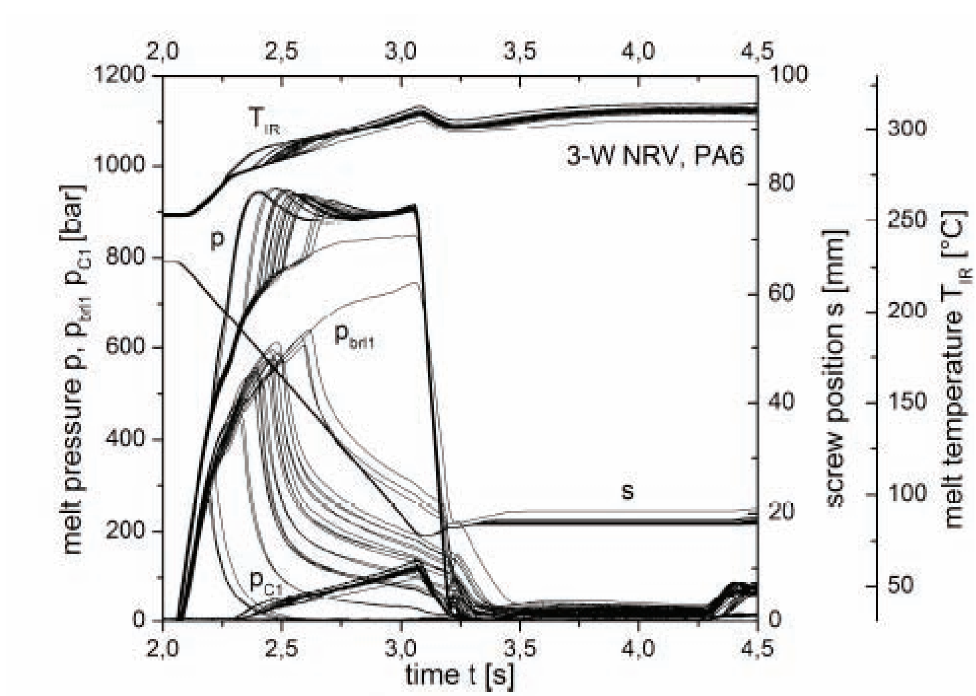


Figure 3: Curves for successive injection molding cycles using a three-wing non-return valve. The filling is conducted without holding pressure to examine the valve. The curves show an unstable process by a nonreproducible movement caused by the blocking-ring of the non-return valve.

While the screw is reproducible moved forward, the melt pressure p and the cavity pressure pC1 drop, once the nonreturn valve is not closed and melt flows back. A pressure sensor pbrl1 (Kistler 4021B) positioned in the meteringzone of the plasticizing unit measures the pressure directly behind the non-return valve (refer to Figure 4). Is the valve properly sealed, the pressure in the metering zone drops during the injection movement. If there is a persistent high pressure level, polymer melt continuous to flow back into the screw flights.

A different melt viscosity usually results in a changed flow behavior of the melt and thus often in a deviation in closing the non-return valve (different closing times), which in turn brings a change in the volume of melt filled into the cavity [6], [7], [8]. Furthermore, non-return valves and the directly interacting components such as screw and barrel are most prone to wear. It is usually caused by the use of high pressure during dosing and filling stage. Often the plastic is filled with talc, glass fibers and other non-melting materials that cause abrasive wear of the screw, barrel and non-return valve. Adhesive wear is caused by metal to metal contact under the high stress of the components [9].

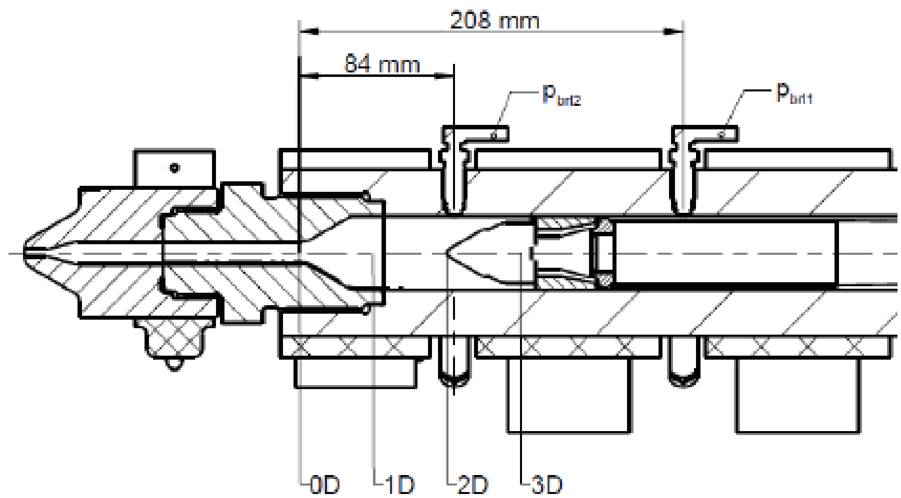


Figure 4: The plasticizing cylinder provides two holes for melt pressure sensors. The sensors are located between the heating elements at the screw positions 2D (D = screw diameter) and 5D pbrl1 and pbrl2. Thus, the pressure can be measured before and behind the screw tip.

Process Control

Previous approaches for process control define for the injection stage an axial movement for the screw while keeping it radially in position. A non-mechanical blocking system (BFC) provides now in the entire stage of the injection and holding stage as well as the remaining cycle time simultaneously to the axial forward movement a rotational movement of the screw. This has as a result that melt is conveyed in the screw flights by the flanks of the screw. With this transport of plastic melt, it is possible to prevent a backflow (and leakage) of material in the screw flights. In addition, thus additional material is dosed outside the regular metering phase. Depending on the variation and adaptation of the rotational speed, the filling ofMthe cavity during injection and holding phase can be influenced – it results in a further degree of freedom in the process settings made by the setup technician.

The screw rotation generates a drag flow, which superimposes or compensates the pressure flow (see **Figure 5**). The general output factor may also be amplified by increasing the flow rate, if the screw is rotated during the cavity filling process [10]. In addition, the effects of a possibly unsteady closing non-return valve are eliminated, which increases process stability. By varying the rotational speed of the screw a further degree of freedom is created, which makes it possible to leave the given limits in injection and holding pressure phase. State of the art is to use a transition from control of injection velocity to pressure control (v/p transition). The new method makes it now possible to leave this boundaries and to control the injection movement on the rotational speed of the screw and if necessary to affect the volumetric flow rate through the rotation of the screw further, which for example allows a smoother transition from the injection to the holding phase.

To avoid an initial backflow during acceleration of the screw, the rotational speed is coupled to injection velocity vinj and melt pressure p by a constant factor. During acceleration, the pressure builds up slowly, so that initially the rotational speed is controlled via the factor fv depending on injection velocity. If the pressure-dependent value exceeds the velocity-dependent one, the speed is from this point on pressure controlled. Already low rotational speeds can generate a sufficient drag flow and can compensate the pressure flow. For an exemplary pressure of 400 bar, following speeds result according to the set factor:

0.1 = 40 min^{-1}; 0.15 = 60 min^{-1}; 0.15 = 80 min^{-1}; 0.2 = 80 min^{-1}; 0.25 = 100 min^{-1}; 0.3 = 120 min^{-1}. The set plasticizing speed nplst during plasticizing stage is 100 min-^{1}. Accordingly, the torques in plasticizing and injection phase result. For velocity-dependent rotational speed a factor of 0.1 is set for the conducted experiments.

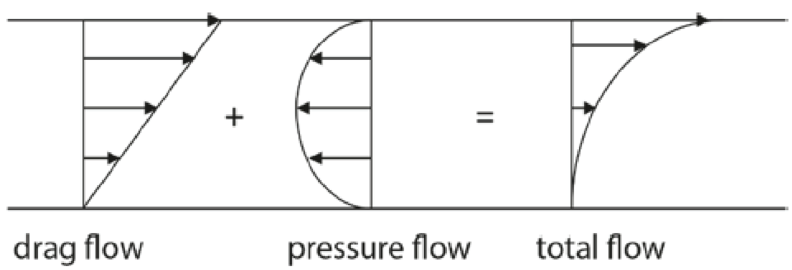


Figure 5: Drag- and pressure flow [11]

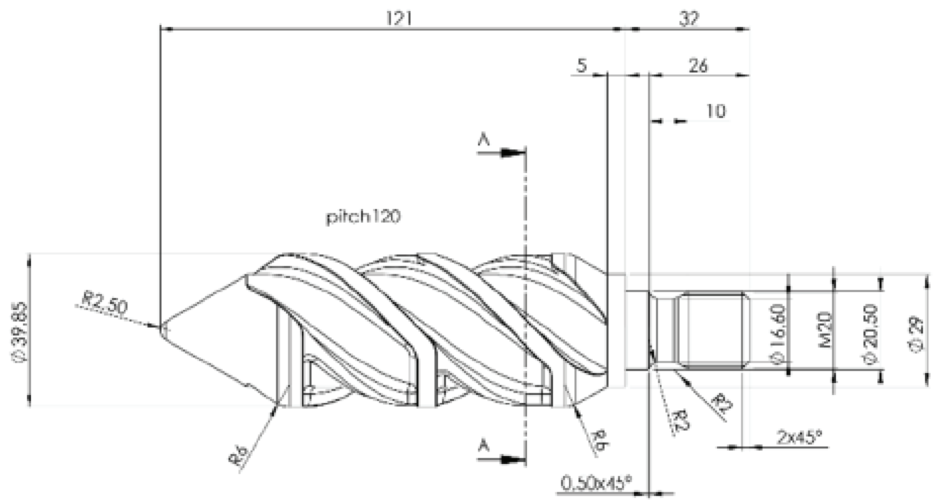
Screw Geometry

The absence of mechanical blocking elements such as blocking rings or spheres in the flow channel allows the melt to flow back unobstructed into the screw flights. Therefore, a screw geometry has been designed that produces a large flow-resistance to obstruct backflow. Concurrently it allows an acceptable plasticizing capacity during dosing stage. By using a spiral shearing device with cut-out helix grooves the melt backflow is strongly reduced for a non-rotating screw. Concurrently the geometry supports conveying the melt during a rotational movement of the screw by a forwardly directed drag flow. The result is a passive-locking system, optionally with an increased melt output factor. The backflow compensation during injection and holding phase is accomplished by an effective conveying melt flow (see **Figure 5**).

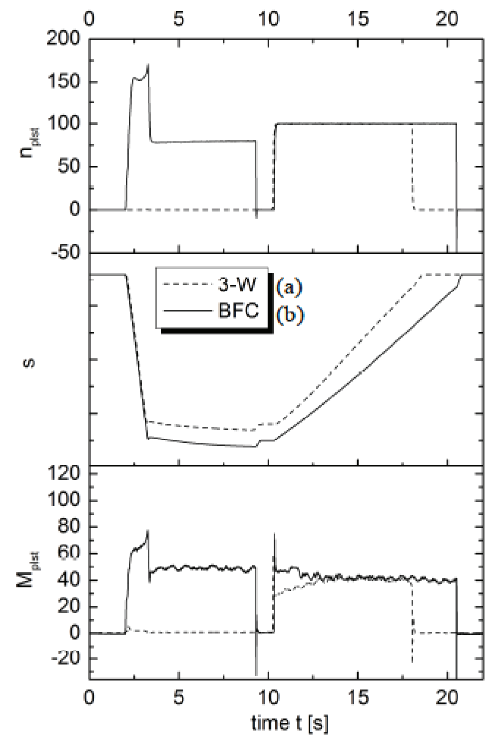
In addition to the barrier properties of the screw tip, the plasticizing properties are crucial. The demands on the melt quality and homogenization are different for the specific application, but improve through additional spiral shearing parts and a higher screw length. It is therefore desirable to have a screw, which can process

Backflow Compensation for Thermoplastic Injection Molding

Figure 6:



The design of the screw tip is based on a double spiral shear device. The melt is sheared over two shear webs (web width = 5 mm; shear gap width = 0.5 mm). The screw clearance is 0.15 mm, so that on the barrel wall only little leakage arises.



Curves for an injection molding cycle with 3-W-NRV and BFC-NRV. The rotational screw speed in the injection and holding pressure phase depends on the injection speed vinj and the melt pressure p.

many plastics at a high throughput level with good melt homogeneity. Unlike in the metering phase, the melt transport across the barrier webs is not preferred in the injection and holding pressure phase. This is achieved through a low pitch (3D), a narrow shearing gap (0.5 mm) and a low radial screw clearance (0.075 mm).

Experimental Validation

The main feature of a BFC-mode of operation for injection molding – in comparison to the standard process control with a three-wing non-return valve (3-W-NRV) – is the active rotation of the screw by rotating the plasticizing drive in the injection and holding pressure phase. Therefore, an independent moving drive usually used at all-electric or hybrid injection molding machines is a necessity. For validation an all-electric machine (Krauss-Maffei 100-380 AX) was equipped with the screw tip (**Figure 6**) and a modified software of the machine control, which provides a direct real-time interface to a personal computer running a MATLAB Simulink program. Two polymers were processed: PA6 Durethan B30S (LANXESS) and PP 970 BF (Borealis group).

Introducing the process control in general, **Figure 6** indicates the curves for an injection process using a nonreturn valve (a) and the passive locking geometry (BFC) [b]. Plotted are the rotational speed and torque curves for the plasticizing drive: nplst, Mplst and the screw position s. Of particular importance is the ap-

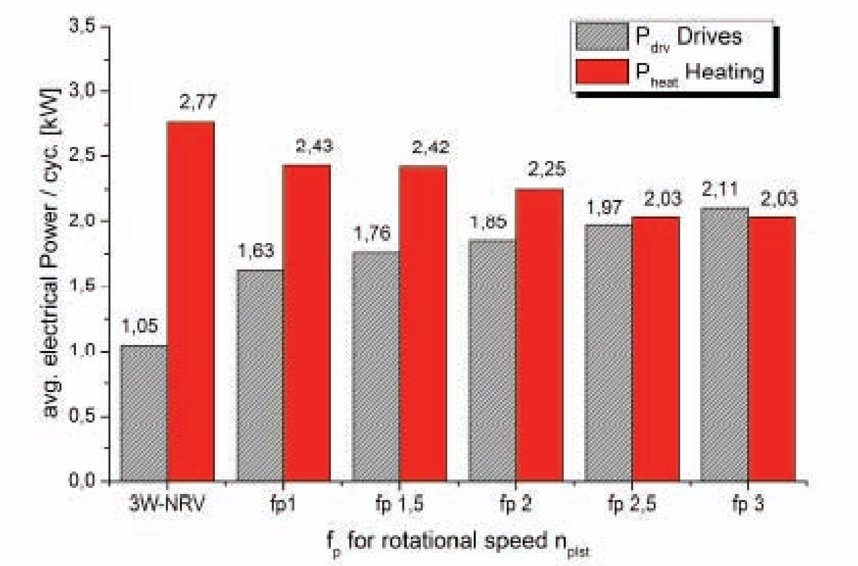


Figure 7: Average electrical power for drives Pdrv and barrel heaters Pheat in kW for different resultant screw speeds. Through additional dissipation in the injection phase less heat output is needed to keep the temperature level, so that the duty cycle value of the barrel heating decreases.

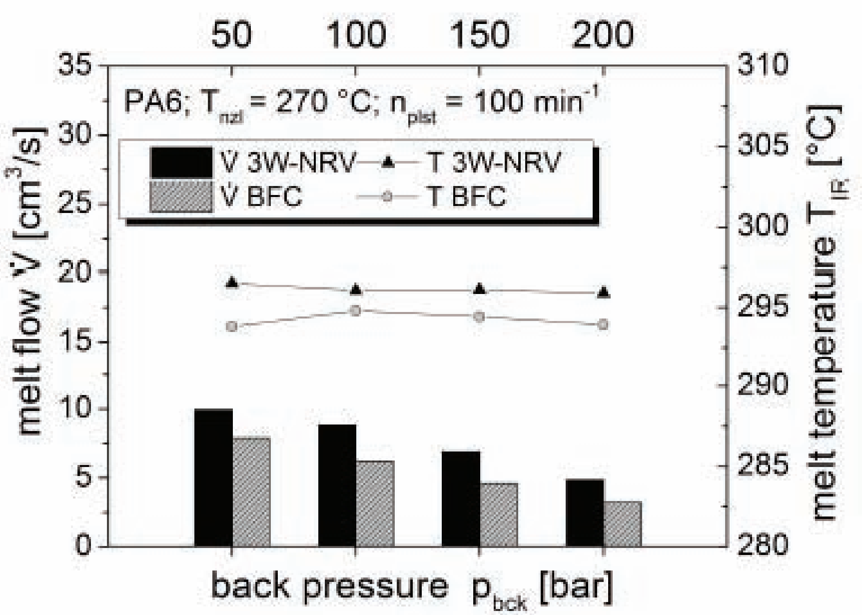


Figure 8: Shown is the volumetric flow during the plasticizing phase and the melting temperature in the injection phase for different back pressures. By the blocking effect of the BFC-geometry the flow rate is reduced. However, the melt temperature increase is not significantly.

plied torque. In (a) the valve seals during injection stage mechanically by pressing together the surfaces of the blocking ring and the inner wall of the barrel. The plasticizing drive usually requires a very low torque to keep the screw against the angular momentum of the melt in rotational position. In [b] the screw is actively rotated, thus creating an additional melt flow, which results in a torque of up to 60 Nm. An additional amount of energy is dissipated into the plastic melt. In **Figure 7** the average electric power consumption for drives Pdrv and heaters Pheat in kW are shown. The different factors fp result in different rotational screw speeds. Through additional dissipation in the injection phase by torque, less power from the heating devices is required. Thus, the power demand for barrel heating is decreased. The average electrical power consumption (drives + heating) for a complete cycle is 3.82 kW for the 3-W-NRV and for the BFC process (fp = 2) 4.1 kW (+ 7%). The average electrical power consumption for the heater Pheat 2.77 kW (72%) is decreased to 2.25 kW (54%).

Figure 8 shows the results on comparing different back pressure settings for both control methods, conventional and the BFC approach. The difference of the volumetric plasticizing melt flow plst is approximately 7%. This is explained by the restriction effect of the shear part on the screw tip and the higher torque intake related to it. To make an assertion about the pressure difference of the modified screw tip, the pressure transducer in the barrel, pbrl1 is used. The pressure difference pbrl1 minus p increases depending on the rotational speed. The average pressure difference for the used setting (75 bar; 100 min-1) is about 46 bar.

Backflow Compensation for Thermoplastic Injection Molding

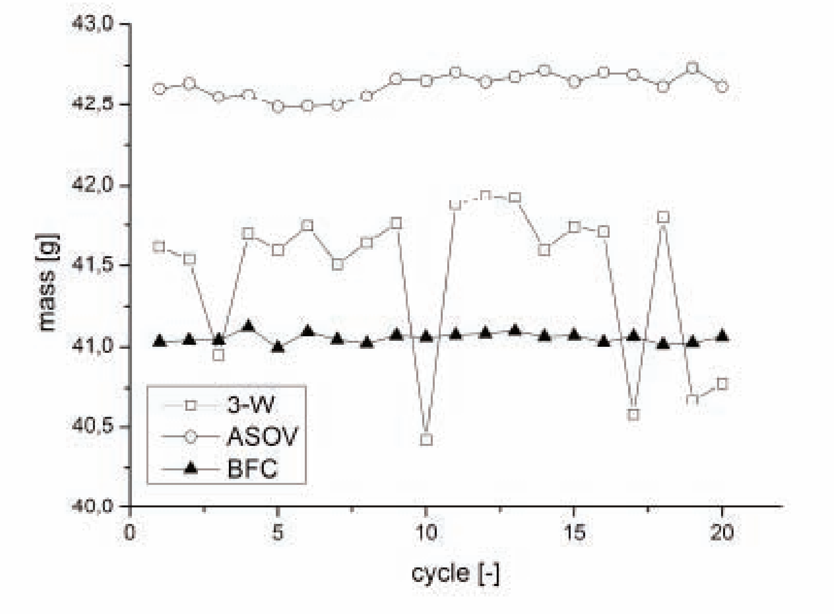


Figure 9: Shot weight for consecutive cycles for process control with standard 3-W-NRV, auto-shut-offvalve and BFC-process control. The molded parts are partially filled without holding pressure. Plastic material used: Polypropylene.

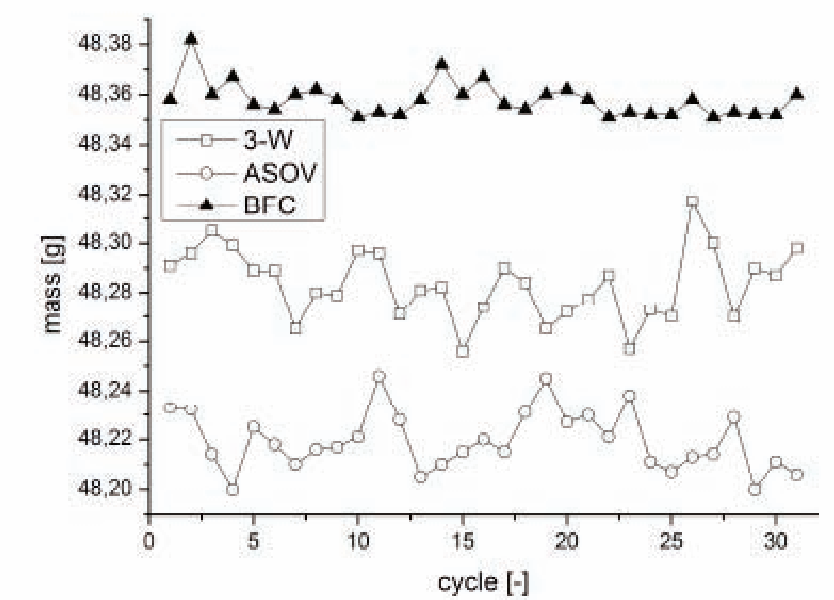


Figure 10: Shot weight for consecutive cycles for process control with standard 3-W-NRV, ASOV and BFC-process control. Holding pressure of 300 bar was applied for 6 seconds. Plastic material used: Polypropylene.

Furthermore, the molded part weights of 20 consecutively executed injection molding cycles (see **Figure 9**) are shown (no holding pressure) with 3-W-NRV, for an autoshut-of-valve (ASOV) and BFC (geometry and process control). The used plastic material in this experiment is Polypropylene (though experiments with PA6 show similar results). The different masses result from the different non-return valve geometries, which have been used, all settings were kept constant. It is shown that an injection molding process using the BFC-geometry has the lowest deviation regarding the shot weight. Also the ASOVsystem shows a good constancy. Since holding pressure is not applied at all, an unsteady closing behavior cannot be compensated. Therefore, the conventional three-wing nonreturn valve shows the biggest deviations regarding shot weight constancy.

For a more general statement, the shot weight constancy is examined in a series of experiments applying a holding pressure (**Figure 10**). It is clear now that an irregular closing behavior of the non-return-valve can be compensated by cavitiy filling during the holding pressure phase. The standard deviation of this series of measurements is for the BFC-process 0.01 g. This results for an average part weight of 48.35 g in a specific coefficient of variation VarK spec. of 0.014%. This represents an excellent value with respect to conventional injection molding processes. Both for partial filling as well as for filling with holding pressure the values for BFC process control have the lowest standard deviations, these are, however, in range of fluctuations regarding processes in this category.

Conclusions

The use of a spiral shear part at the screw tip results in a better homogenization of the melt. The disadvantage here is that due to the intense flow conditions, pressure is consumed and the melt temperature rises [12]. It thus makes sense to turn the screw only as fast as necessary [13], or even to accept a backflow during injection. To influence and especially for keeping the differential melt flow during the injection and/or pressure phase constant, it is useful to couple the rotating speed to the injection speed of the screw and/or to the melt pressure. It is shown that a process control based on an active, backflow compensated mold filling stage is equivalent, respectively superior to conventional process control methods using non-return valves, with regards to shot weight stability and reproducibility.

The output factor can be improved by increasing the rotational screw speed. Such process control, optimally using a suitable screw head, is particularly appropriate when a good mixing of the melt is required or a blocking geometry cannot be used for technical process reasons. It could be shown that due to the good reproducibility of the shot volume, the method is not limited to single materials or applications. It was also demonstrated that it is possible to maintain even at long holding times and with regards to the thermal processing limits of the material high holding pressure levels. It was shown that not necessarily a nonreturn valve must consist of mechanical, blocking components to enable high holding pressures with long holding times. Accordingly, it makes sense to optimize the geometry of the screw and the screw head, in order to compensate the backflow.

Acknowledgements

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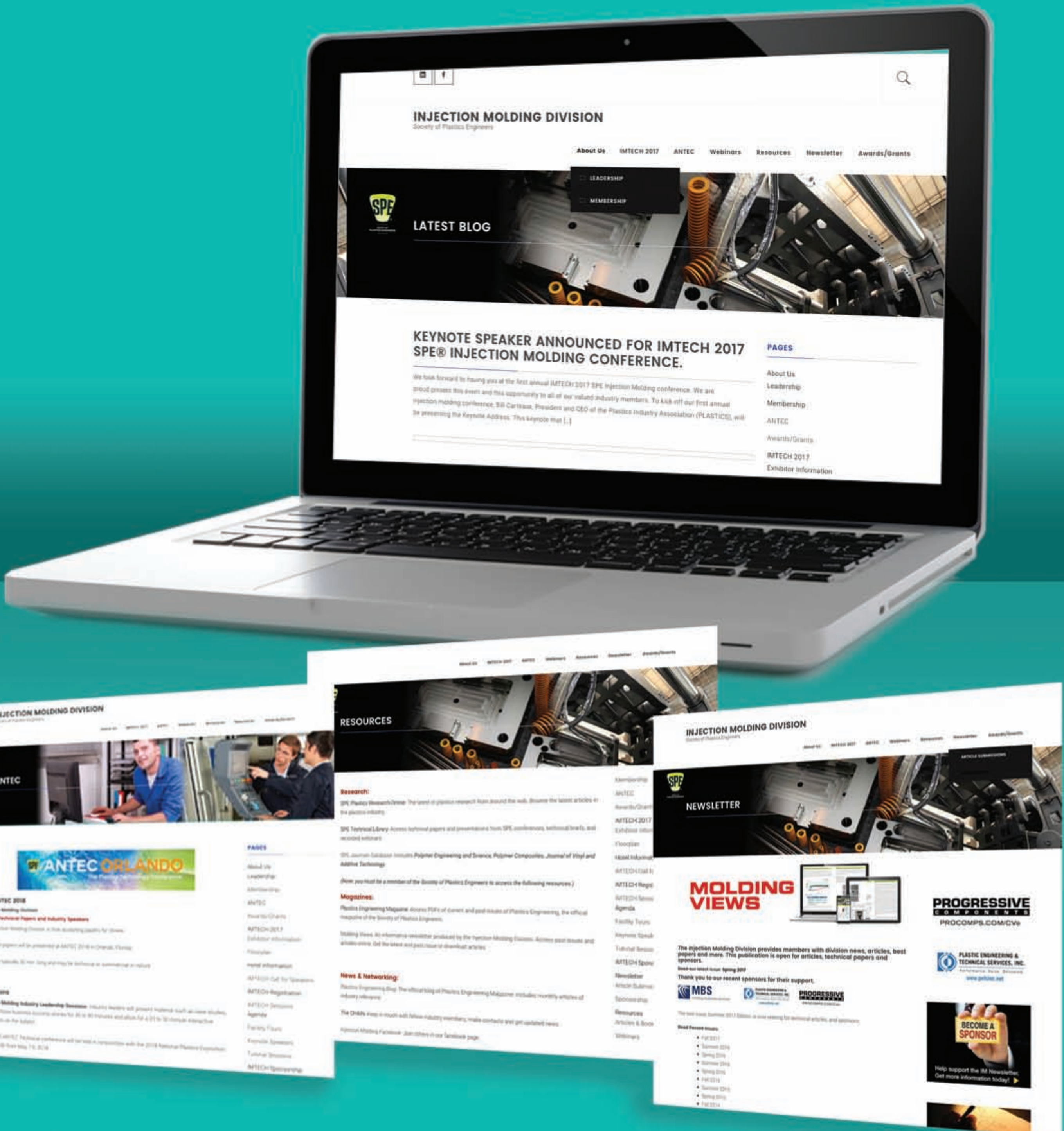

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Case Study

By Moldex3D

Utilizing CAE Tools to Overcome the Challenges of Multi-Cavity Co-injection Molding

Multi-cavity co-injection molding is one of the most commonly used processes to manufacture automotive components and structural reinforcement products, and it has been widely applied in many industries. The benefits of multi-cavity co-injection molding include the ability to reduce material waste and cost, and further enhance the productivity of co-injection molding parts.

However, the same general guidelines for developing a single-cavity co-injection mold cannot be fully applied in the development of a multi-cavity co-injection mold. The key to a successful multi-cavity co-injection mold is proper core/skin distribution. The co-injection molding is already a complex process itself. By combining multi-cavity molding process, which often results in flow imbalance, it would be very difficult to achieve the desired distribution of materials.

Moldex3D, a computer-aided engineering tool, is often used to predict potential molding issues and analyze the intricate mechanism of multi-cavity co-injection molding system. The following case study illustrates how Moldex3D is used to evaluate the effects of injection flow rate and cavity design for designing a better multi-cavity co-injection mold.

The runner geometries and the cavity used in this multi-cavity co-injection simulation experiment are shown in **Figure 1**. The material of the core and skin is POLYREX®PG-22. In the molding process, a certain percentage of skin is injected first, and then the core material is injected to finish the filling process. The skin to core ratio is 72:28.

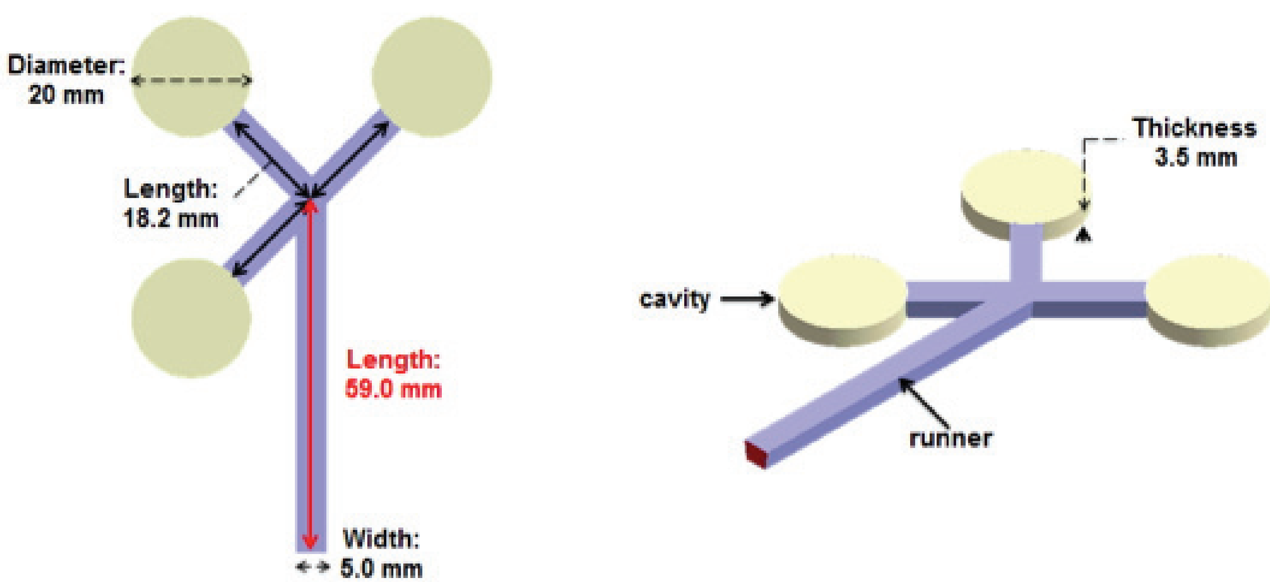

Figure 1: he cavity and the runner geometries used in the multi-cavity co-injection molding experiment

Case Study

The comparison of the simulation and experimental results of the core layer melt front is shown in **Figure 2** according to the study. As shown, at a low injection flow rate (10.2 cm3/S), Branch 1 has the longest core penetration distance, while at a higher injection flow rate (51 cm3/s), Branch 2 is the longest. Both simulation and experimental results show similar higher injection flow rate (51 cm3/s), Branch 2 is the longest. Both simulation and experimental results show similar trends.

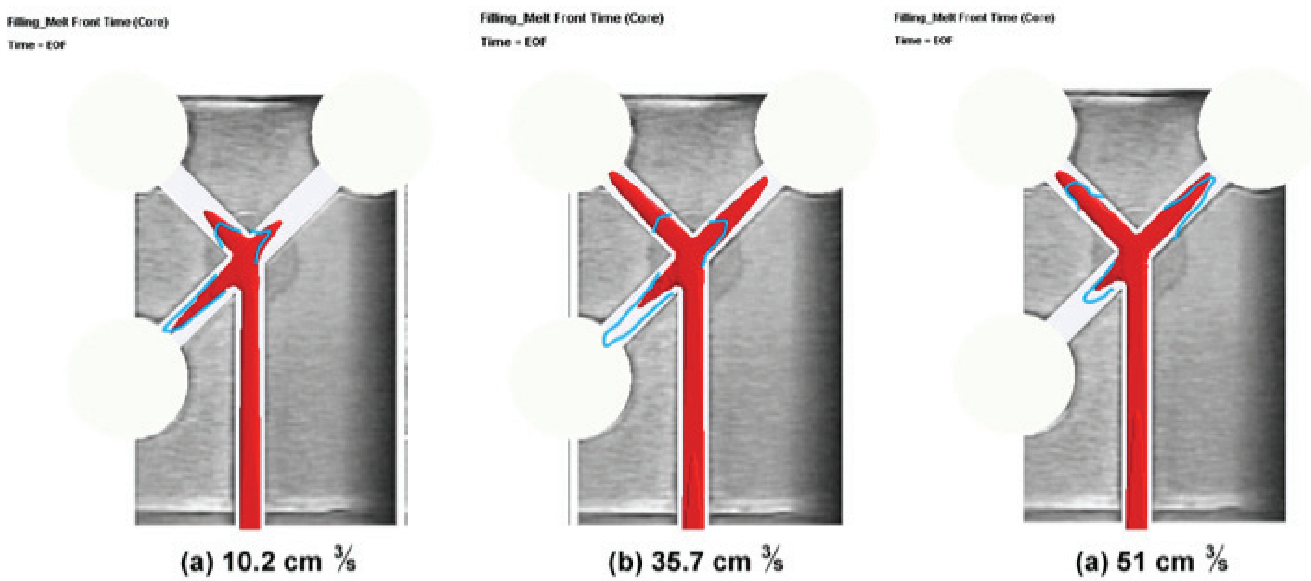

Figure 2: The blue lines show the melt front result measured in the experiments, and the colored red area is the melt front simulation result.

The following experiment was designed to further investigate the effects of different injection flow rates on the low-viscosity core material penetration. As shown in the analysis results, when the injection flow rate is at 10 cm3/S, the core material in Branch 1 reaches the cavity first. When the injection flow rate increases to 16 cm3/S, the core material in Branch 2 reaches the cavity first. Moreover, as the injection flow rate further increases, the proportion of the core material in Branch 1 decreases. The reason is that more core materials flow into the second and third cavities due to the high shear stress.

However, the core material penetration simulation results cannot guarantee ideal skin/core distribution can be achieved in the final molded part. **Figure 4** shows unbalanced skin/core distribution in each cavity, regardless of high or low flow rate, since the first cavity has been filled at the earlier stage.

Case Study

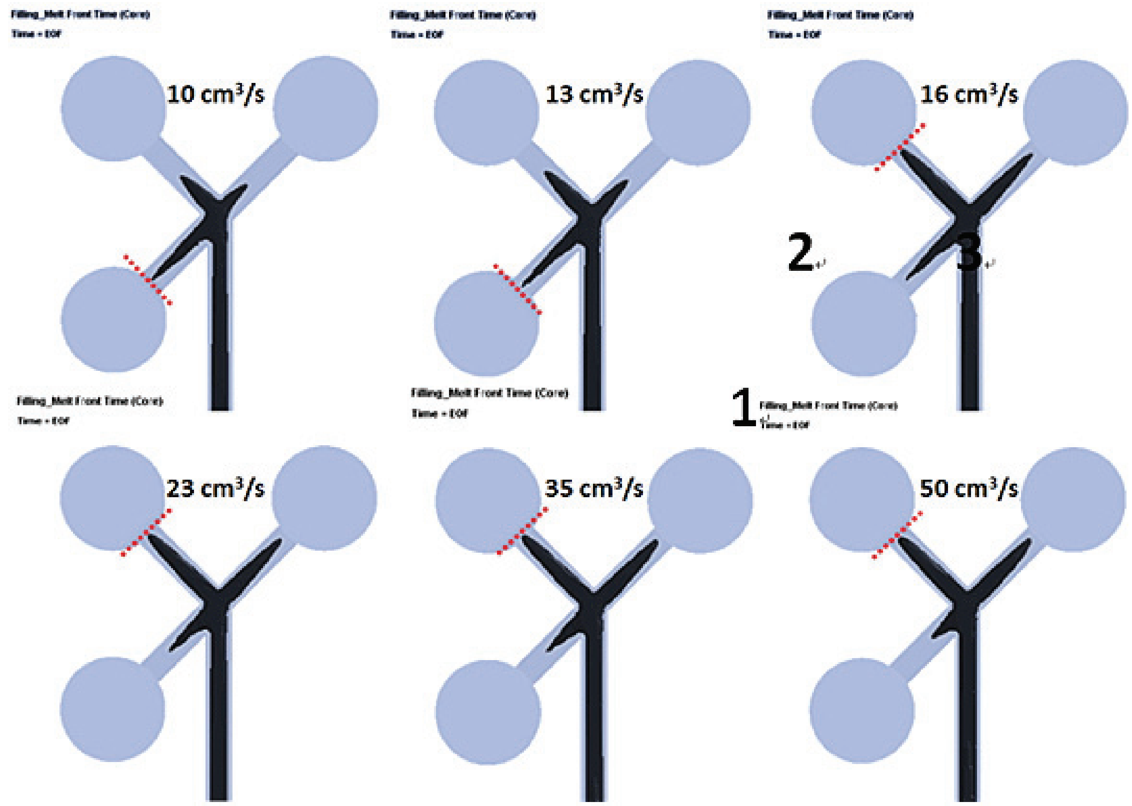

Figure 3: Simulation results of different injection flow rates.

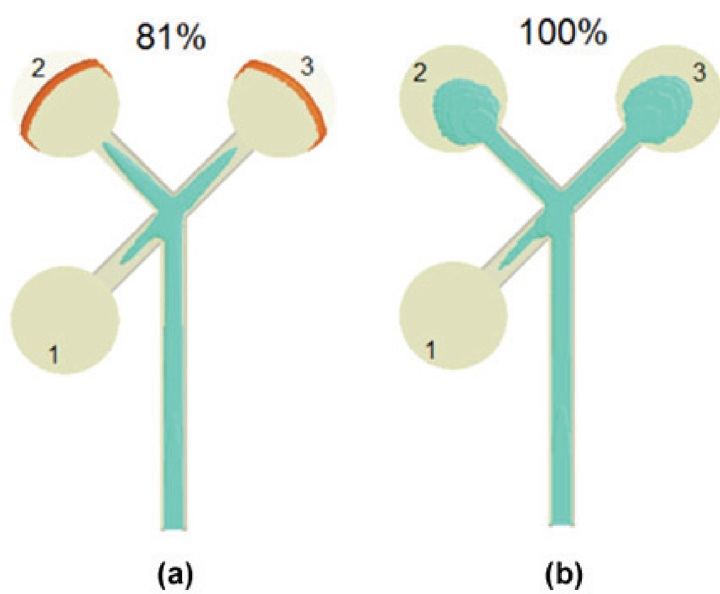

Figure 4: The melt front simulation results of core material: (a) 81% filling; (b) 100% filling.

Thus, in order to efficiently manage the skin/core distribution of the final molded part, it is necessary to take the effects of mold design into consideration. As shown in **Figure 5**, if we modify the angles of the runners to a more symmetrical design, we can obtain a more uniform skin/core distribution (Model 2). If the runner design cannot be modified, we can modify the cavity design. Adding an overflow region or adding a connector between each cavity can both improve flow imbalance (as shown in **Figure 3**).

Case Study

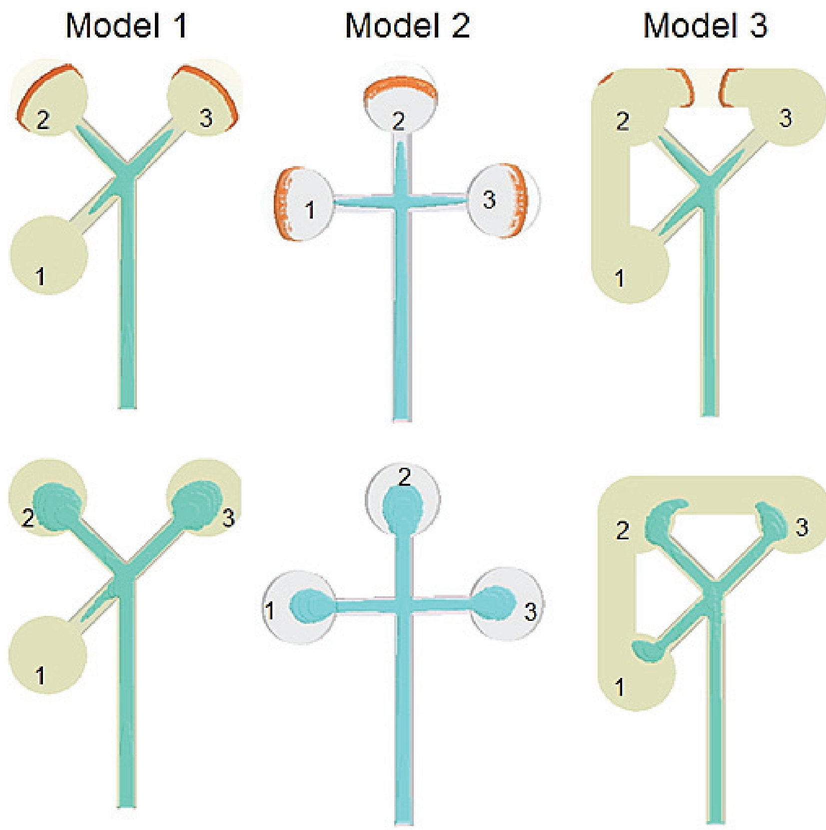

Figure 5: The influence of different mold design.

In summary, the dynamic behavior of core material penetration in multi-cavity co-injection molding is a complicated issue, involving many factors such as flow rate, material properties and mold design. Influenced by the interactions between these factors, it is difficult to achieve a uniform distribution by simply changing the process condition parameters. Therefore, utilizing Moldex3D as a CAE tool has become a much more efficient way to quickly identify and fix potential issues prior to manufacturing and it can also benefit the development of multi-cavity co-injection molding technology.

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IMD Board of Directors Meeting

May 7th, 2017

Hilton Anaheim located in Anaheim, California

Submitted by David Okonski

Welcome & Opening Remarks – Raymond McKee, Division Chair

Chair Raymond (Ray) McKee called the meeting to order at 8:00 AM and welcomed all attendees to the ANTEC 2017 IMD Board of Directors (Business) Meeting. Secretary David Okonski called roll at 8:05 AM.

Roll Call – David Okonski, Secretary

Present in person were:

Vikram Bhargava, Brad Johnson, Pete Grelle (Technical Director), Adam Kramschuster, David Kusuma, Ray McKee (Division Chair), Kishor Mehta, Lynzie Nebel, David Okonski (Secretary), Srikanth Pilla (ANTEC 2017 TPC), Rick Puglielli (ANTEC 2018 TPC), Tom Turng, Chad Ulven, Jim Wenskus (Treasurer), Alex Beaumont (Invited Guest).

Present via teleconference were:

Erik Foltz and Joseph Lawrence.

The participation of the official IMD Board Members constituted a quorum.

Absent were:

Jack Dispenza, Jeremy Dworshak (Executive Committee VP) (excused for Council Meeting), Nick Fountas, Susan Montgomery (Councilor) (excused for Council Meeting), Sriraj Patel, and Hoa Pham.

Notes:

1) Invited guest Alex Beaumont introduced himself to the IMD Board of Directors. Alex is a Penn State PLET graduate and is the Technical Sales Manager responsible for market development at Beaumont Technologies, Inc located in Erie Pennsylvania.
2) Chair Ray McKee appointed Alex Beaumont to a one (1) year term on the IMD Board of Directors. Welcome Alex !!!!

Approval of the February 3rd, 2017 Meeting Minutes

The meeting minutes from the IMD Board Meeting of February 3rd, 2017 were presented.

Motion: Pete Grelle made a motion to approve and distribute the February 3rd, 2017 meeting minutes as written. Adam Kramschuster seconded, and the motion passed at 8:10 AM (PT).

IMD Board of Directors Meeting Continued

Financial Report – Jim Wenskus, Treasurer

Treasurer Jim Wenskus was pleased to inform the Board that the latest quarterly rebate from SPE Headquarters was $5,300 USD. For the current 2016/2017 fiscal year, total revenue presently exceeds total expenses by $16,623.15 USD leaving a remaining positive balance of $57,564.76 USD; but, the final expenses for this board meeting and the ANTEC 2017 IMD Networking Reception were unknown at this time and not fully reconciled on the balance sheet. The 2017/2018 working balance sheet line items were reviewed for a final time and some of the budget line items were adjusted based on historical data so as to arrive at a proposed 2017/2018 budget.

Motion: Adam Kramschuster made a motion to approve the proposed 2017/2018 budget. Pete Grelle s econded, and the motion passed at 8:30 AM (PT).

As of this meeting, the Division appears to be in good financial standing.

Carry Over Action Item: At an upcoming meeting, the IMD Board needs to further discuss, establish, and implement a reimbursement policy (including the necessity of a trip report) for conference expenses incurred by IMD Board members who attend a conference and spend time marketing the Division for the purpose of generating awareness and membership.

ANTEC 2017 TPC Update – Srikanth Pilla, TPC

Srikanth Pilla informed the Board that the ANTEC 2017 session matrix is now complete and all sessions have moderators. The Wednesday tutorial session needs to be updated on the SPE App.

Action Item: David Okonski is to monitor the attendance and assess the effectiveness of the Wednesday tutorial session for the purpose of providing feedback to the Technical Director and incoming TPC as to how the IMD can improve our tutorial session.

Regarding the ANTEC 2017 IMD Networking Reception, $18,000 USD in sponsorship monies was raised; a big THANK YOU goes out to all our sponsors: SIGMASOFT, Moldex3D, Master Precision Mold Technologies, Detroit Section, Tupperware Brands Corporation, United Protective Technologies, and Steinwall. Rick Puglielli (Reception Chair) finalized the evening's menu and provided an initial cost estimate of $16,000 USD.

Technical Director Report – Pete Grelle, Technical Director

Technical Director Pete Grelle provided the Board updates on ANTEC, the webinar series, and future TOPCONs. Regarding ANTEC 2017, forty-seven (47) papers were submitted – 64% of these papers came from academia, 14% came from industry, and the remaining 22% were joint academia/industry submissions. From a geographic perspective, 36% of the submissions came from Asia, 34% from Europe, 20% from North America, 6% from Australia, and the remaining 4% from South America. The quality of the papers is better than what was seen in recent years; the IMD ANTEC Paper Quality (APQ) Index is at about 68% which is the highest value since 2001. Pete also informed the Board that he has revised the IMD ANTEC paper review

IMD Board of Directors Meeting Continued

form so as to supplement the eTouches process endorsed/provided by SPE Headquarters; this change will allow the IMD to provide better feedback to the author as how the author can improve future offerings.

Regarding the webinar series, webinars have finally been scheduled through SPE Headquarters: 1) Jon Ratzlaff from Chevron Phillips Chemical will present "Standardized Processing" at 11 AM (EST) on May 24th, 2) Vikram Bhargava will present "Plastic Material Selection – It's A Jungle Out There !" at 11 AM (EST) on May 31st, and 3) Vikram Bhargava will present "Design Errors Masquerading as Processing Failures" at 11 AM (EST) on June 7th. Scheduling these webinars proved to be very difficult working through SPE Headquarters, and so, Pete is recommending that all future webinars be sponsored events that the IMD provides on our own without relying on SPE Headquarters.

Regarding TOPCONs, the IMD worked with the SPE Detroit Section and the SPE Automotive Division to provide content for the AutoEPCON Conference that occurred on May 2nd, 2017. The IMD had its own injection molding session that consisted of nine (9) presentations which were all well received by attendees. Pete also informed the Board that the IMD will once again participate as a sponsor of the Penn State Erie TOPCON – "Innovations & Emerging Plastics Technologies Conference" – to be held in Erie Pennsylvania on June 22nd & 23rd, 2017. The IMD will sponsor the lanyards for this event. Regarding IMTECH 2017, twenty-two (22) presentations have already been submitted for review so we are well on our way to the thirty-six required. Pete would like to hold biweekly update meetings with session moderators from now until the August 1st event.

Communications Committee Rprt – Rick Puglielli, Chair & Adam Kramschuster, Co-Chair

Communications Chair Rick Puglielli was pleased to inform the Board that the IMD received the Communications Excellence Award for 2017.

Newsletter (Rick Puglielli): Rick Puglielli informed the Board that newsletter editor Heidi Jensen needs our Summer Newsletter content submitted by June 10th. The upcoming newsletter will feature IMTECH 2017.

Website (Adam Kramschuster): In the past, Adam Kramschuster expressed concern over our current limitations in creating web content and suggested that it may be time to hire an outside vendor to takeover and manage the IMD website; Adam is pleased to inform the Board that our own Heidi Jensen has taken over the responsibility for updating and maintaining the IMD website. Thanks Heidi – You're the BEST !!!!

Membership Report – Erik Foltz, Chair

Erik Foltz informed the Board that current membership stands at 2,224; we have 26 new members and had 38 members who let their membership lapse. New members joined for continuing education and networking opportunities. Members let their membership lapse because they left the industry, their company stopped paying the dues, didn't appreciate the Plastics Engineering periodical, too few networking opportunities or they didn't realize their membership had lapsed. Demographically speaking, the top five states having the

IMD Board of Directors Meeting Continued

highest concentration of IMD members are: 1) Michigan with 150, 2) & 3) Pennsylvania & Ohio each with 128, 4) California with 111, and 5) Minnesota with 107. The USA still has the most IMD members at 1,434 followed by India with 477, Australia with 75 and Canada with 73.

Erik provided some "membership" suggestions: 1) send a follow-up email to new members showing how to set-up a SPE account, 2) send out a monthly announcement of SPE events with a post on social media, and 3) have IMD Board Members act as ambassadors in different regions around the globe to reach out to new members as well as members who have let their membership lapse.

Nominations Committee Report – Hoa Pham, Chair

Hoa Pham was unable to attend this board meeting but was able to provide an update regarding the 2017 ballot. Chair Ray McKee presented Hoa's material.

Summary of the 2017 Ballot Results:

Board of Directors Officers 2017 – 2018 (term ends at ANTEC 2018),

1) Chair: Raymond McKee
2) Chair-Elect: Srikanth Pilla
3) Past Chair: David Okonski
4) Treasurer: Jim Wenskus
5) Technical Director: Pete Grelle
6) Secretary: David Okonski

Re-elected Directors (term ends at ANTEC 2020),

1) Brad Johnson
2) Hoa Pham
3) Jack Dispenza
4) Joseph Lawrence
5) Lynzie Nebel
6) Sriraj Patel
7) Vikram Bhargava

Councilor 2017 – 2020: Susan Montgomery

Hoa's presentation finished by re-confirming the following information for the ANTEC Technical Program Chair (TPC):

1) ANTEC 2018 TPC is Rick Puglielli,
2) ANTEC 2019 TPC is David Kusuma,
3) ANTEC 2020 TPC is David Okonski,

IMD Board of Directors Meeting Continued

Hoa issued a "Call for Volunteers for TPC Chair" for ANTEC 2021 and beyond; please let Hoa know of your interest.

HSM & Fellows Update & Awards Committee Report – Tom Turng & Kishor Mehta, Chairs

HSM & Fellows Update (Tom Turng): Tom Turng issued a "Call for Applicants" for Fellow and Honored Service Member. Applications for Fellow are due by October 7th, 2017, and applications for Honored Service Member are due by October 16th, 2017.

Engineer of the Year Award (Kishor Mehta): Kishor reminded the Board that David Okonski was selected as the IMD "Engineer of the Year", and the award is to be presented at the ANTEC 2017 IMD Networking Reception.

Education Committee Report – Srikanth Pilla, Chair

No education report/update was provided.

Councilor Report – Susan Montgomery, Councilor

Susan Montgomery was attending the Councilor's Meeting; no update was provided.

Pinnacle Award Application – Discussion of 2017 Goals & Work Plan – Ray McKee

Chair Ray McKee was pleased to inform the Board that the IMD received the Pinnacle Gold Award for 2017.

Old Business – Ray McKee, Division Chair

With regards to IMD Outreach, discussion focused on how best the IMD could support the SPE Foundation.

Carry-Over Action Item: David Okonski is to contact Eve Vitale, SPE Foundation Director, and solicit her opinion as to how best the IMD can support the SPE Foundation.

Carry Over Action Item: In the 2017/2018 calendar year, the Board needs to amend our bylaws to include a Sponsorship Committee.

New Business & Round Table – Ray McKee, Division Chair

Two new items were discussed:

1) Adam Kramschuster solicited interest from the Board regarding a tour of the M. R. Mold & Engineering Corporation which specializes in Liquid Silicone Rubber (LSR) molding. Enough interest was obtained for Adam to arrange and confirm a tour.
2) Much discussion ensued regarding the IMD teaming-up with the Medical Plastics, Mold Technologies, and

IMD Board of Directors Meeting Continued

Product Design & Development Divisions to do joint sessions at future ANTECs and IMTECHs. All agreed that this was a great idea and worth pursuing; Pete Grelle and Rick Puglielli agreed to explore potential opportunities for ANTEC 2018.

Adjournment – Ray McKee, Division Chair

Motion: Ray McKee made a motion to adjourn the meeting. David Okonski seconded, and the motion passed. The meeting was adjourned at 11:55 AM (PT).

The next meeting will be held during IMTECH 2017 on August 3rd, 2017 at the Chicago Marriott Oak Brook.
Chicago Marriott Oak Brook, 1401 West 22nd Street, Oak Brook, Illinois 60523
Meeting Room: TBD. Tentative Start Time: 1 PM (EST)

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IMD New Members

The Injection Molding Division welcomes 90 new members...

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Sean Coffey, Rennicks
Jerome Smith, Automation Plastics Corporation
Basher Al bBasher, Repall
Janice Bennett, Match Point Strategies LLC.
Amanda Hurd, Polymers Center of Excellence
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Ashutosh Giri, Polyplus Concentrates Pvt. Ltd.
Chaitanya Mundhe, Institute of Chemical Technology, Mumbai
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Gagan Khanna, G. Khanna & Co.
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Thirumal Mariappan, Ingersoll Rand
Samer Mansour, TE Connectivity
Theodoros Hondros, UMass-Lowell
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Message from the Publisher

IM SPE TECH 2017 INJECTION MOLDING

Injection Molding —From Art to Innovative Engineering

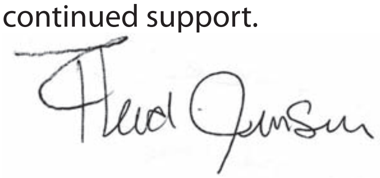
Hello members!

The Injection Molding Division has been very busy this season gearing up for the up in coming IMTECH 2017. Please join us August 1 for the three day conference including informative technical sessions, exhibits, tours and networking party! Get all the details at www.injectionmolding.com. Registration now open! Exhibit space and sponsorships are still available.

Also with the relaunch of the IM website, be sure to visit updated news, articles and more! The website will be featuring daily news so anyone who would like to send in company or industry news that you would like to share please send to PublisherIMDNewsletter@gmail.com.

Our next newsletter will be the Fall edition. Anyone who would like to participage with articles or sponsors please let us know! The IM Newsletter is always seeking information and support by readers to share with fellow members.

Thank you to all the authors and sponsors for their continued support.



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