SPE INJECTION MOLDING

MOLDING VIEWS

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

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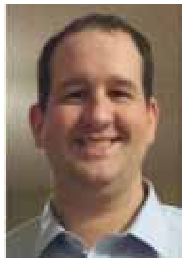

Chair's Message

Spring is upon us in most of the country and with that ANTEC is coming around the corner. This year ANTEC is co-located with NPE. The co-location of these two events means good things for those of us in manufacturing in that we can attend both technical sessions, that will lead to future technology developments, but it also means that we have an opportunity to see the latest and greatest in commercial technology. ANTEC is spread out over 4 days this year in a departure from the normal 3-day conference. This should provide each of us with plenty of networking opportunities. The IMD holds an annual Networking Reception at ANTEC. This year, we will be holding the reception at 6:00pm in room W308 of the Orange County Convention Center. This event is typically well attended and is sure to be a good time. I encourage all of you that are going to be at ANTEC to take the opportunity to attend.

Looking forward into the year, we are in the planning stages of IMTECH 2018 in Cleveland, OH. Please mark your calendars for this event. We held the first IMTECH last year and have received great feedback on the format and quality of the information. The IMTECH is really geared to be more practical and relatable to the manufacturers in industry. The IMD is excited to bring such a program to the membership and industry.

I am looking forward to seeing everyone at ANTEC and wish you all safe travels. See you soon.

Ray McKee
IMD Chair
2016-2018

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In This Issue:

This Month's Features:

Industry Events Calendar

Click the show links for more information on these events!

APRIL 2018

APRIL18 - 19
Additives & Colors Conference Middle East
The Westin Bahrain City Centre, Manama, Bahrain

APRIL 10 - 18
Fire Retardants in Plastics
Pittsburgh Marriott City Center, Pittsburgh, PA

APRIL 18 - 19
Design 2 Part Show
Meadowlands Exposition Center, Secaucus, NJ

APRIL 30 - MAY 1
Auto Epcon
Detroit Marriott Troy, Troy, MI

MAY 2018

MAY 1
AUTO EPCON 2018
Troy, MI

MAY 7 - 10
ANTEC® Orlando
Orlando, FL

MAY 9
Additive Manufacturing Workshop
Orlando, FL

JUNE 2018

JUNE 3 - 6
Rotational Molding Conference 2018
Cleveland, OH

JUNE 13 - 14
Amerimold 2018
Novi, MI

JUNE 19 - 20
Polymer Foam
Pittsburgh Marriott City Center, Pittsburgh, PA

SEPTEMBER 2018

SEPTEMBER 10 - 15
IMTS 2018
McCormick Place, Chicago, IL

Webinars

Faster Time to Market and Customer Satisfaction with 3D Printed Injection Molds

Learn how customers such as Berker are cutting production time and costs by switching to injection molds that are 3D printed rather than traditionally manufactured. Decrease lead time on production parts and bring in new customers by skipping the outsourcing process and mold creation using more time-consuming methods. **View now>**

Is It Time to Replace Your Injection Molding Robots?

Do you have older robots that you think are doing the job just fine? Are you questioning whether adding a robot is really worthwhile? Injection molding robots today are much faster and smarter than the ones produced 5 to 10 years ago. Is your robot thinking for itself to help improve cycle time? Can your robot be faster? A difference of only a tenth of a second mold open time can result in big savings! We will take a closer look at the technology offered today and how it can benefit your production. **View Now>**

Everything You Need To Know About Power Quality... In JUST 15 Minutes

In this webinar you will learn:

- The symptoms of poor power quality utilization in typical plastics plants and the economic impact caused by misunderstand and avoidance
- Why these symptoms are related to poor power conditions and what is really happening to your components
- How to easy diagnose and install power quality monitoring equipment
- What are the typical symptoms of poor power quality inside the plant electrical grid
- How poor power quality is destroying motors, drives and controllers
- How to become your own power quality expert and save money in your facility

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SPE SOCIETY OF PLASTICS ENGINEERS

ANTEC® ORLANDO

The Plastics Technology Conference

@ NPE2018

Join Us
May 7 - 10
Orange County Convention Center

Today's Ideas at ANTEC are Tomorrow's Innovations in Plastics

ANTEC®, produced by the SPE (Society of Plastics Engineers), is the largest, most respected and well known technical conference in the plastics industry. It's where classroom theory connects with real world solutions.

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PLASTICS for Life™ Global Parts Competition

We all know that plastics help improve the quality of life, and in many cases help extend and protect life. Whether it's for medical, packaging, toys, cars, planes, agriculture, education, industrial, electronics, or building & construction applications, join us in celebrating all that polymeric materials do to make life better on this planet by submitting part nominations for the 5th annual SPE® PLASTICS for Life™ Global Parts Competition. Parts must already have won a category or a competition in an SPE conference or mini-conference in the past year. Maximum 5 nominations per SPE division, section, or special interest group.

SPE THE PLASTICS RACE®

The Plastics Race is an app-driven scavenger hunt designed to entertain any attendee – from students to veteran industry professionals Throughout the course of the race, you will search for questions set to challenge your plastics knowledge.

Using a supplied map, each team plots their own course from one sponsor location to the next, answering questions which can only be accessed by visiting the sponsors' booth! This code will automatically populate a randomly generated question which will test the team's knowledge in the fields of polymer science, polymer chemistry, plastics engineering & more. At the conclusion, the team with the most correct answers will be awarded a fantastic prize.

For complete show information visit: injectionmolding.org

SOCIETY OF PLASTICS ENGINEERS

ANTEC® ORLANDO
The Plastics Technology Conference

May 7-10, 2018
Orange County Convention Center

PANEL DISCUSSION

“Part Process” Development andValidation for Multiple Machines

Organized by “Medical Plastics” and “Injection Molding” Divisions
Date and time: ANTEC Orlando, Tuesday, May 8, 2018, 10:00 – 11:30 am EST

A Medical Device OEM Consortium challenged the traditional plastic part validation process to facilitate moving a mold between machines – from Validation into Production. Much has been written and said regarding the “what and how-to” as it relates to process development and moving a mold between machines for the medical device industry. The Consortium member panel executed it - the economics of adopting this approach could potentially not only save tens to hundreds of thousands of dollars for each move, but the speed-to-market advantages and operations flexibility would be simply invaluable. **Read the full article here**.

Meet the Panel Speakers

Matt Therrien
Business Development Manager – Medical, RJG Inc.

Matt Therrien is the Northeast Regional Manager for RJG, Inc. with 28 years of experience focusing on promoting Customer success. Strategies include a strong consultative approach, with an emphasis on driving results and developing innovative solutions to a broad range of customer concerns, as well as client education. He has completed the RJG Master Molder Certification Program. He is a BSME graduate of the University of Massachusetts, Amherst and his experience is drawn from technical and commercial management positions at the global companies Nypro, Husky Injection Molding Systems, MoldMasters, Inc., and UPG/MedPlast – where he has implemented successful business models across all market segments, the last 15 years focused on medical device/assembly manufacturing. He can be reached at matt.therrien@rjginc.com

Paul Robinson
Lead Regulatory Advisor, QSCS

I am an accomplished Quality Executive with over twenty-five years of domestic and international experience. My career has been built on a solid foundation in quality, engineering, and manufacturing through progressive positions focuses on Quality Systems, Design Assurance, and Operational Excellence with companies such as Covidien, Boston Scientific, and BARD. I am a recognized QA RA leader, having maintained over twenty manufacturing plants worldwide that produced various products including plastics, electronics, pharmaceuticals, biologics, and woven/non-woven materials. As an Operational Excellence head, I conceived and launched an organization-wide effort that realized over $260MM in three years.

Ed Valley
Sr. Engineering Manager – Tooling, Nypro, a Jabil Company

Senior Plastics Professional with 20+ years of experience in several areas including Operations, Engineering, and Program Management. Proven Technical Leader of Tooling, Process, and Project Engineering teams within the Healthcare, Consumer, and Automotive industries. Skilled in Scientific Injection Molding, Design for Manufacturing (DFM), Tool Design, Project Management, New Product Introduction (NPI), LSS Principles, and Validation of Automation and Plastic Injection Molds. Obtained Certifications in Program Management, Design of Experiments (DOE), Master Molder I, and Master Molder II.

Rod Brown
Senior Injection Molding Steward, Eli Lilly & Company

Rodney A. Brown (Eli Lilly) provides expertise in Plastic Injection Molding, mentoring numerous individuals and development of engineering best practices. Before joining Lilly, he worked as a Project Manager for automotive components at Guide Corporation. He joined Lilly as a Consultant Engineer in 2006 bringing over 20 years of injection molding experience. He has been a key technical contributor to numerous delivery system projects critical to Lilly's future. The outcome of some of the projects has brought significant return to Lilly's injection-device-enabled business. Rod is also a recognized expert in plastic injection design and has worked with Lilly partners to ensure robust long-term supply of device components. His work not only improved existing products, but helped shape the next generation of Lilly devices.

Greg Lusardi
Worldwide Leader Molding, Becton Dickinson

I have spent nearly thirty years in various roles in the injection molding industry with the past twenty plus years at BD. I currently hold the position of Worldwide Molding Leader responsible for best practice implementation and Operational Excellence in over 50 manufacturing sites globally. Throughout my career I have held roles that include a focus in processing, tooling, hot runner technology, R&D, validation, new product development and vendor and operations management. I have worked in various industries to include medical device, consumer goods, electronics, industrial and automotive. I have completed the RJG Master Molder I and II certification courses.

Brad Smith
Principal Plastics Engineer, Johnson & Johnson Supplier Excellence

I am a Principal Plastics Engineer currently working for Johnson & Johnson in the Supplier Excellence organization. I support all three J&J Sectors – Pharm, Consumer and Medical Devices. I am Black Belt Certified by J&J. My role is to enable our external Plastics Suppliers to be more efficient, more cost effective and improve the quality level in the manufacturing of J&J products. I am a graduate of the University of Lowell, BS and MSin Plastics Engineering. I have been working in the Plastics industry for 3 decades. My career has included working in the Aerospace, Automotive, Consumer and Medical fields – all advancing plastics.

Scott Scully
Director, Corporate Molding/Tooling
Terumo Cardiovascular

Scott is a plastics veteran of 39 years, working the last 17 years at Terumo Cardiovascular Systems. A Master Molder II, Six Sigma Green Belt, with World Class Manufacturing and Project Management certifications. He was an apprentice, journeyman, mold designer, business owner, Medical Molding Engineering Chief, Business Unit Manager, and now a Corporate Director with Terumo. A solid foundation in Project Management, Tooling, Processing, Six Sigma, and Lean Manufacturing through progressive positions, proper training and being a constant seeker of new information. Focuses on using new technologies to improve quality, throughput, and cost. Project management at a dozen sites at any given time both domestically and internationally. Conceived and launched project initiatives that have saved the company over 2.5 million per annum. Created a validation/troubleshooting team to assist suppliers in educating and developing validation procedures that are compliant and cost-effective.

Maureen Reitman
Corporate Vice President, Exponent
Moderator

Dr. Maureen Reitman is a Principal Engineer and the Director of Polymer Science and Materials Chemistry at Exponent, a leading scientific and engineering consulting firm. She works across the supply chain to help bring new products to market, support continuous improvement, address risk, understand service life and facilitate innovation in many industries. Dr. Reitman has served SPE through her involvement in Medical Plastics Division, Failure Analysis and Prevention SIG and the New Technology Forum.

Optimized Adhesion Tips for TPE Materials & Substrate Pillars

Whenever I get a trouble shooting call about TPE parts it usually is a result of poor adhesion. My experience with TPE materials is in automotive weather seals however this tech brief will help optimize adhesion with all TPE related parts. More often than not, the parts I am asked to help with have splits within them. This is a result of poor adhesion between the material (TPE) and the substrate (usually made with TPV or a polyolefin material). In order to optimize adhesion between the substrate and TPE material I have created a list of important steps to help.

- **Design of the substrate (often referred to as an EPDM pillar).**
  - Incorporate a step in the substrate profile to create an abrupt transition between the TPE and substrate.
  - Use a proper shut off design.
  - Using mechanical interlocks in the component design will help immensely.
  - Avoid "feathering" or gradual thinning in the design for over molding TPE.
  - Keep the TPE flow-length/part thickness ratio below 150:1. Take care to have appropriate TPE thickness as too thin can lead to delamination. Delamination can result in poor adhesion.
  - Incorporate a suitable texture on the mold for long flow paths.
  - Optimize venting wherever possible especially at the end of polymer flow.
  - Optimize gating on the tool. Most tools will incorporate a sub-gate. It is imperative to use a gate size that will supply adequate polymer to the part.
- **Important substrate features.**
  - It is best if the EPDM pillars are extruded then fresh cut to length. They should then immediately be placed in the mold to bond with the addition of the TPE material. If the pillars are made in advance they need to be stored in an environmentally controlled area (as least moisture as possible). When these pillars are used it is important to fresh cut them.

From the Experts: Optimized Adhesion Tips for TPE Materials & Substrate Pillars

- Once again it is imperative to use fresh cut EPDM pillars.
- Make sure that the pillars are clean; i.e. no oils, dirt or dust. Wiping the pillars with a rag that is dosed in alcohol works the best.
- Preheat the pillars only if needed. Most mold shops have "curing ovens" or material drying ovens that can be used for this. Set the temperature on low (usually ~100°F).

- **Use compatible hard & soft materials; i.e. materials with both thermoplastic and elastomeric properties. In other words, ensure that the chosen TPE is compatible with the substrate material. This will result in better bonding**.
- **Insure that the type of color concentrate carrier used is comparable with both the plastic and the TPE.**
- **Drying conditions of TPE materials.**
    - A dehumidifying desiccant drying system is preferred when drying any plastic material.
    - Dry the material accordingly to the manufactures recommendations.
    - This also includes TPO materials. While they are non-hygroscopic they may have surface moisture upon them.
    - Most TPE materials will dry for 2 – 4 hours at 140°F – 175°F. It is highly recommended to examine the material moisture within a moisture analyzer. Materials should be dried to 0.05% or less before molding.
    - Keeping the material in a drying hopper that is placed upon the molding machine is best.
    - Properly dried materials will process better, produce parts with good adhesion and good aesthetics. Do not over dry material as they may be difficult to process and may discolor.

- **Preferred molding machines and process parameters for TPE materials.**
    - For best results, molding machines should be selected so the shot weight is approximately 50% of the machine barrels capacity. This minimizes residence time and prevents excessive thermal degradation.
    - If a machine has a capacity of more or less than 50% of the barrel capacity, profile temperatures accordingly to shot size vs machine barrel size. This is necessary to promote a homogeneous melt.
    - Use additional rear zone heat for short residence time (a reverse heat profile).
    - Use less rear zone heat for long residence time (a forward heat profile).
    - A good molding procedure employs barrel heats at the low setting and working your way up as needed.
    - Higher barrel or melt temperatures will usually create a better bond. Take care to prevent thermal degradation of the material.
    - Machine process conditions can be adjusted to compensate for non-ideal conditions.

From the Experts: Optimized Adhesion Tips for TPE Materials & Substrate Pillars

- **Additional processing conditions for TPE materials.**
    - Follow the processing or molding guide conditions from the material manufacture.
    - It is best to start any processing of materials using a decoupled molding process. This means, filling the part to 98% with 1st stage pressure than adding 2nd stage or pack pressure to complete the part. Weigh the parts to insure that they are filled and packed out.
    - Control melt temperature by injection speed, first stage pressure then barrel temperatures.
    - Again, using higher melt temperatures will result in better adhesion. Take care to prevent thermal degradation.
    - It is best to use a mold temperature controller to maintain heat on the mold. Most TPE materials will adhere best at a mold temperature of 120°F - 160°F.
    - The more polymer on the substrate surface, the better the adhesion. This is referred to as a resin rich surface.
    - Use a pyrometer to check both melt and mold temperatures.
- **Correct curing stage of parts.**
    - Once the part is molded it is best to cure the parts on a rack. The rack must be formed to distribute the weight of the part evenly. Uneven weight distribution can cause parts to "creep" thus causing splits between the polymer and substrate.
    - Once the parts are cured, they should be stored by laying them flat in a shipping container. Placing a piece of cardboard in-between each part will help maintain their post-molded form.

The information given in this tech brief should help with good adhesion of TPE materials and the substrate. The information covers conditions that will help with an over-molding and insert molding operation. Insert molding is most common where a pre-molded insert (such as a substrate of pillar) is placed in the mold. The TPE material is then shot directly over it. The advantage of this procedure is that a conventional single shot mold machine can be use. Tooling costs associated with insert molding are lower than with multi-shot procedures.

In summary, you will note that an optimized design, mold machine, drying and processing conditions will help with good adhesion. Also taking care to cure and store the parts correctly will help. This all helps eliminate splits within the pillar and TPE material.

Dallas Cada is a highly trained plastics engineer with over 20 years of sales support experience. Owner of a plastic consulting business (DDC Consulting), his experience includes technical service, application development, market engineering, injection molding, design, tooling, material suggestions and problem solving for plastic manufacturing companies. For more information with troubleshooting plastic problems or helping with new plastic applications, contact Dallas Cada by e-mail at dallascada@charter.net. Contact Dallas by phone (507) 458-5785 or (507) 452-1584.

By Ivor Tseng, Tseng H-C, Chang R-Y, Hsu C-H

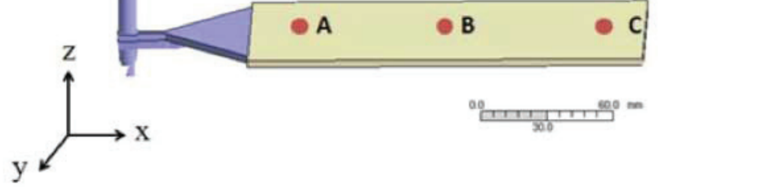
New Numerical Investigation of the Reinforcement Efficiency of Long Carbon Fiber Composites

Numerical predictions of fiber orientation and mechanical properties for injection-molded long-carbon-fiber thermoplastic composites.

Long carbon fiber reinforced thermoplastics (LCFRT) have become familiar lightweight automotive materials since they satisfy safety and durability requirements, and the mechanical performance characteristics of carbon fibers are superior to those of glass or natural fibers. In practice, a typical laminate structure, shell-core, is observed in the injection molded FRT parts. Long fibers' anisotropic orientation strongly influences the enhanced mechanical properties of an FRT product. However, predicting anisotropic orientation is a challenge in dealing with longer fibers and higher fiber concentrations. So far, only a few attempts have been made to probe the changes of fiber orientation for various fiber composites from a simulation point of view.

Two polymer matrices, polypropylene (PP) and polyamide 6,6 (PA66), are considered in the present study. The materials of interest are long carbon fiber (LCF) reinforced thermoplastic composite, including 50wt% LCF/PP and 50wt% LCF/PA66. The end-gated plaque of mold filling is illustrated in **Figure 1**. The plaque dimensions were 178mm x 178mm x 3.175mm. Different from the past method, the Moldex3D's model

Figure 1:
Illustration of injection molded geometry for the PNNL plaque with three measured regions.



iARD-RPR has only three parameters to accurately predict fiber orientation in injection molding simulation. **Figure 2** shows the fiber orientation distribution through the thickness at the center of the PNNL (Pacific Northwest National Laboratory) plaque (Region B, the middle of the plaque) for 50wt%LCF/PP and 50%LCF/PA66. Overall, the iARD-RPR predictive results matched the experimental data very well.

A micromechanical material modeling software, Digimat-MF (MSC Software & e-Xstream engineering), based on the Mori-Tanaka Mean Field homogenization scheme, was used to compute the mechanical performance of the fiber-reinforced thermoplastic composites. Based on the predicted fiber orientation data, we applied Digimat-MF to obtain the flow modulus E1. Consequently, the modulus distribution through the normalized thickness is presented in Fig. 3. We further made a comparison of modulus E1 to find: 50wt% LCF/PA66 > 50wt% LCF/PP. The thickness-averaged modulus E1 value are listed in **Table 1**, and compared with the experimental data. Roughly, the predicted E1 value is satisfied. Under adding the same fiber concentration of 50wt% LCFs, the reinforcing performance for the PA66 composite is more effective than the PP composite, as shown in **Figure 4**.

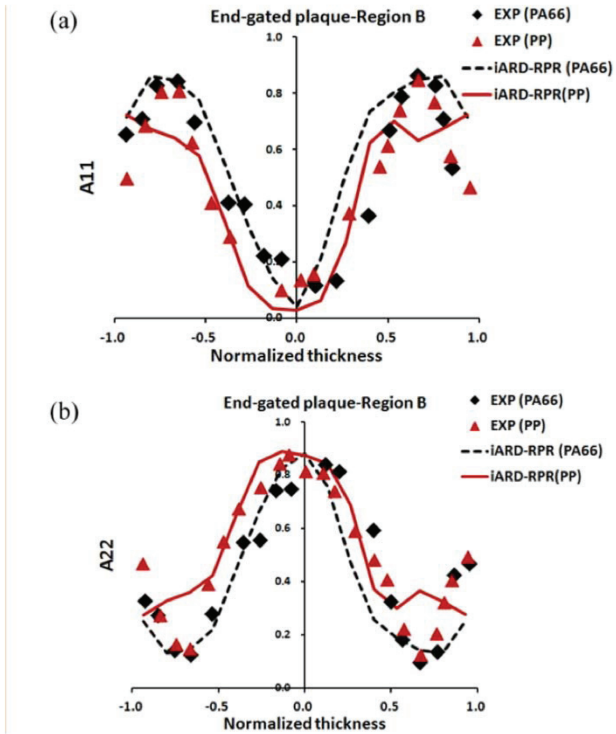


Figure 2:
A comparison of the 50wt% LCF/PA66 and 50wt% LCF/PP composites with the PNNL experimental data and the iARD-RPR curves for orientation components, (a) A11 and (b) A22, through the normalized thickness at Region Bmeasured in the end-gated plaque.

Table 1: The thickness-averaged orientation tensor components (A11 and A22) and tensile moduli (E1) at Region B of the end-gated plaque for different materials with the experimental bulk value of tensile modulus (Eexp).

Materials	A_{11}	A_{22}	E_1 (GPa)	E_{exp}[a] (GPa)
50wt% LCF/PP	0.4421	0.5328	**28.8**	**22.1**
50wt% LCF/PA66	0.5969	0.3840	**46.9**	**40.0**

Courtesy of PlastiComp Technical Data Sheet.

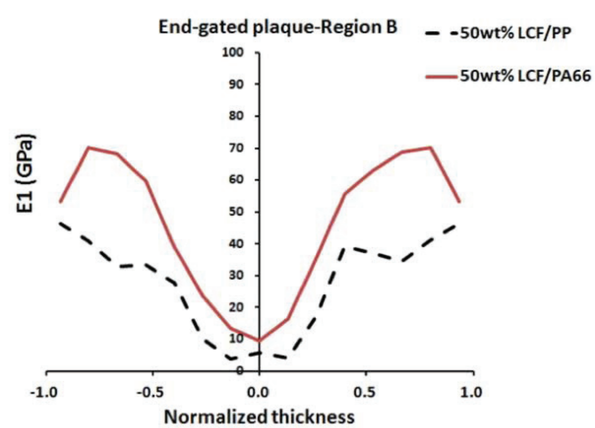
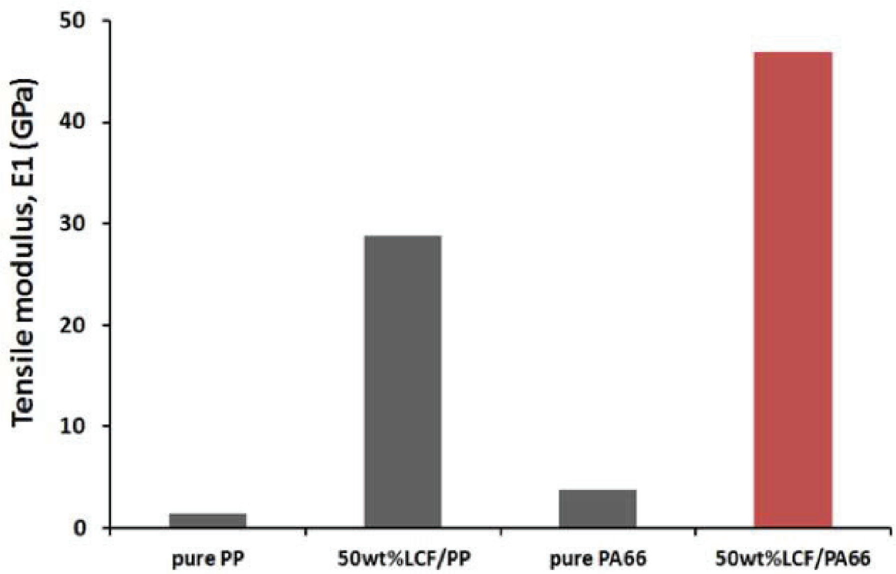


Figure 3: The predicted tensile moduli E1 distribution through the normalized thickness at Region B measured in the end-gated plaque for various fiber composites, 50wt% LCF/PP and 50wt% LCF/PA66.

Figure 4:
Bar chart of the predictive tensile modulus against various fiber composites with experimental data of pure PP and pure PA66.



In summary, an accurate prediction of fiber orientation is now available in the integrative simulation of Moldex3D and Digimat-MF computation for real automotive LCFRT products, and the structural strength can be further assured. Since the complex geometry of designing high-quality parts involves various changes in the direction of the flow, the inclusion of ribs and the changes in the thickness and holes, discovering how to determine the optimal parameters of the fiber orientation model is a critical goal for ongoing and future research.

Dr. Huan-Chang (Ivor) Tseng

Program Manager at the R&D Division of CoreTech System (Moldex3D)

Ivor Tseng has a doctoral degree of National Chiao Tung University, Taiwan. He majors in polymer rheology, polymer composite materials processing and molecular simulation. His brand new theoretical model, "Method and Computer Readable Media for Determining Orientation of Fibers in a Fluid", has received United States Patent. His paper entitled "An Objective Tensor to Predict Anisotropic Fiber Orientation in Concentrated Suspensions" has also been published by Journal of Rheology®, one of the most important leading publications in Rheological Fundamentals of Polymer Processing.

Best Paper

By Jake W. Nelson, James J. LaValle, Brian D. Kautzman, and Jeremy K. Dworshak, Steinwall, Minneapolis, MN

Eric M. Johnson, Ph.D. John Deere Moline Tech Center, Moline, IL

Chad A. Ulven, Ph.D., North Dakota State University & c2renew Inc., Fargo, ND

Injection Molding With an Additive Manufacturing Tool

This study attempts to determine the viability of additively manufactured injection molding tools by assessing the quantity and quality of molded parts. Plastic tools were made by using PolyJet™ and Fused Deposition Modeling™ both by Stratasys out of Digital ABS, FullCure 720, and Ultem 1010 materials. The test tools were then compared to the standard P20 metal tool by molding acetal, polycarbonate, and polypropylene in each tool type. The molded parts were analyzed for processing effects on part shrink, physical, and mechanical properties. Testing concluded that parts molded with additive manufacturing tools performed comparably to parts made on a P20 tool. The quantity of molded parts made from acetal and polycarbonate were consistent with the literature at 10-100 parts. Conversely, molding with polypropylene suggested that processing with additive manufactured tools could exceed 250 parts.

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Traditionally, production tools are constructed from metals such as steel or aluminum. This comes with a high cost and time commitment for the manufacturing of the tool [1]. Additive manufacturing (AM), also known as 3D printing, can create plastic tools that potentially alleviate this burden for both prototyping and short production runs by emulating the quality of parts produced in metal tools.

Numerous resins can be used to create both the tool and the molded plastic part [3]. With the utilization of AM tools, numerous designs can be created at low cost to test a variety of materials. Prior research suggests tools can be used to create between 10-100 parts for either analysis or distribution for short runs [2-4].

AM tools can add a wide range of versatility to the design and production process. However, the use of these tools does have some drawbacks. AM tools retain a greater amount of heat in comparison to their metal counterparts. To compensate the cycle time, tool temperature and injection pressure needs to be modified to allow the part to solidify and eject properly [5, 6]. These process changes also help to improve tool longevity [7].

The process changes to account for the difference in mold materials affect the final production quality of the molded parts. Research shows that changes in the processing parameters will alter the residual stresses found within the molded parts [8]. These residual stresses can alter the physical and mechanical properties of the parts through dimensional shifts and a change in the crystallization of certain resins [8, 9].

This study will examine the relationship of various AM tools compared to a P20 tool. Each tool type will be used to process a variety of resins to investigate the physical and mechanical implications on the molded parts. The resulting tool life will also be evaluated. Data will then be analyzed to determine what cost benefits exist.

Materials and Experimental Design

Tools were made from: FullCure 720, Digital ABS, Ultem 1010, and P20 as a control. Digital ABS and FullCure 720 tools were printed on an Objet Connex 260, while the Ultem 1010 tool was printed on a Fortus 400MC. Each AM tool had an average print time of 2.5 hours and were machined for approximately 4 hours for fit and function. **Table 1** reflects the overall approximate time commitment and cost to procure each tool.

Material Type	Total Cost	Print/Machining Time
FullCure 720	$ 500	6 Hours
Digital ABS	$ 550	6 Hours
Ultem 1010	$ 800	9 Hours
P20	$ 2,000	4 Weeks

Table 1: Approximate Tool Cost and Lead Time

FullCure 720 is an epoxy based photopolymer made with just a single material. It was chosen since it has a high dimensional stability and a smooth finish [10]. FullCure 720 can be printed on Stratasys Objet 30 Pro series printers which is lower cost than the professional series PolyJet machines.

Digital ABS is a photopolymer produced by Stratasys that combines RGD515 and RGD535 in the Objet production level machines. The materials can withstand high temperature while retaining a high level of toughness. It was chosen for this study since it is the most commonly used material for an AM tool [11].

Ultem 1010 was chosen to determine if fused deposition modeling (FDM) could produce usable injection molding tools. This material is noted to have the highest heat and chemical resistance, as well as, the highest tensile strength offered by Stratasys for their FDM process [12].

Material	Objective
Acetal (POM)	Identify how the tool impacts the physical and mechanical properties of the molded part
Polycarbonate (PC)	Inspect tool durability under high melt temperatures
Polypropylene (PP)	Commonly used resin

Table 2: Resins Used for Molded Parts

Parts were made from various resins in each tool type to test a variety of objectives for each resin (**see Table 2**).

Each tool was run on a Toshiba 55 ton electric press. Processing was performed until the tool broke or part failure was observed due to flash, short shots, or excess pulling. Each run had a maximum threshold of 250 cycles. Unlike the P20 tool, all AM tools were run in manual mode so that Stoner Zero Stick E342 mold release could be applied between cycles.

Molding parameters were altered for the AM tools based on prior literature. Tool temperatures were lowered to reduce tool degradation. Injection time and rate, as well as hold time, were modified to increase cycle time and lower strain on the tool. Additional mold open time was allotted to the cycle for the AM tools to cool (**see Table 3**). During this time compressed air was blown across the surface of the tools to assist in the cooling of the tool between shots.

		Acetal (POM)		Polycarbonate (PC)		Polypropylene (PP)	
Parameter	**Units**	**P20**	**3D Printed**	**P20**	**3D Printed**	**P20**	**3D Printed**
Inject. Pressure	MPa	82.7	82.7	68.9	68.9	34.5	34.5
Inject. Time	s	8	10	8	10	5	8
Inject. Rate	cm/s	1.78	1.27	2.03	1.52	1.78	1.27
Hold Time	s	15	50	25	100	25	60
Open Time	s	15	60	7	30	7	20
Barrel Temp	°C	176.7	176.7	287.8	287.8	179.4	179.4
Tool Temp	°C	68.3	46.1	68.3	46.1	37.8	26.7

Table 3: Processing Parameters for AM Tools Compared to Production Parameters for P20 Tool

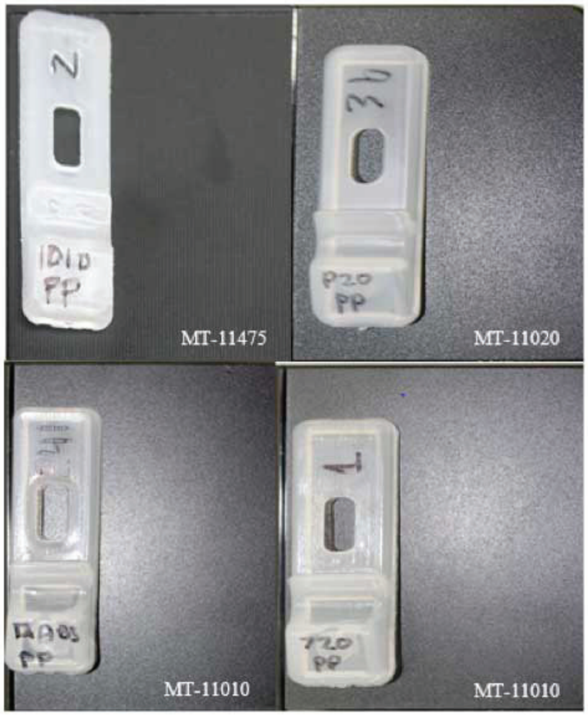

Figure 1: PP Molded Part Texture Comparison

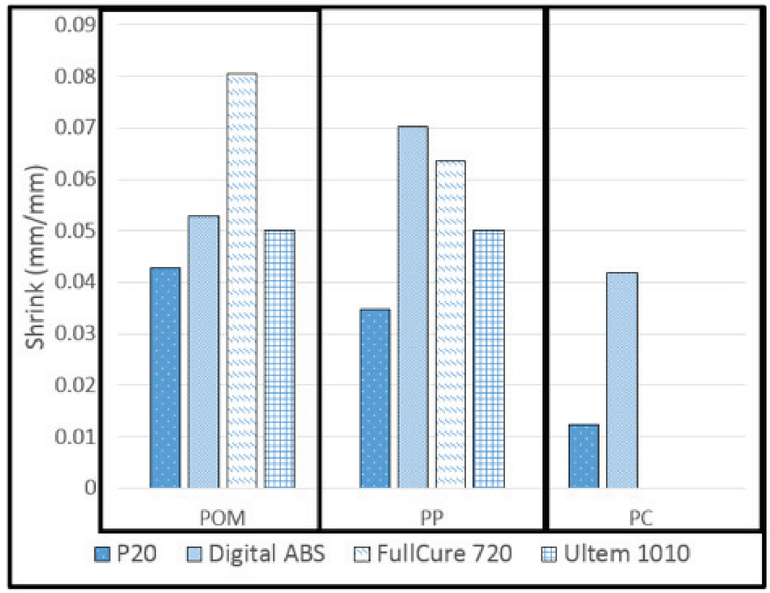

Figure 2: Measured Shrink Experienced

Results

After testing, parts were visually compared to Mold-Tech (MT) texture plaques in order to approximate surface finish [13]. Comparisons were made from the PP molded parts to the MT plaques (**see Figure 1**). These comparisons give an approximation of what surface finish can be expected when molding parts in these AM tools.

Processed parts were dimensionally analyzed to determine the degree of shrink experienced within each tool (**see Figure 2**). FullCure 720 and Ultem 1010 tools were trialed with PC resin, however, no acceptable parts were produced.

Differential Scanning Calorimetry (DSC) testing was performed to determine the degree of crystallinity developed within each part following guidelines established by ASTM D3418. The DSC results reflect parts selected from the end of each processing run, as they experience the greatest resonance time (**see Figure 3**). Upon completion of this study, Digital ABS tools were laser scanned. Each scan was compared to the CAD model of the tool to identify areas of degradation (**see Figure 6**).

Based on ASTM D790, a modified 3 point bend test was developed and performed. From each processing run three to five parts were tested at 2

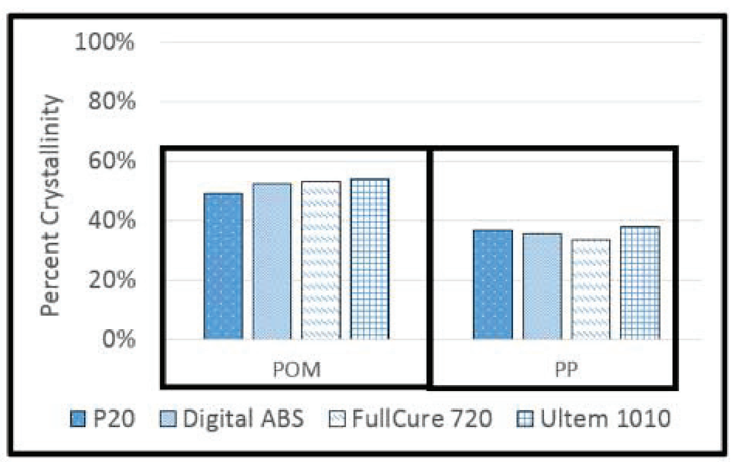

Figure 3: Percent Crystallinity determined by DSC

mm/min. Testing ran until parts crossed a 20% strain threshold (**see Figure 4**).

The 3-point bend data was analyzed and trended to determine stiffness, maximum load, extension at maximum load, and maximum strain (**see Figure 5**).

Discussion

The first objective of the study was to compare the cost of the AM tools to conventional process. Table 1 clearly shows the significant reduction in lead time of procuring tooling from weeks to days. This lead time reduction shows that AM tools allow time for nearly 4 iterations before the conventional tool is produced. This allows more effective designs because the parts have more opportunities for iteration.

The cost of the AM tools is approximately 25% (Digital ABS and FullCure 720) to 40% (Ultem 1010) of the traditional tool. The example presented in this paper is on the conservative side of the cost comparison as the complexity and size of the part has a lower cost than typical injection molds.

The next area the study set out to look at tool longevity. The laser scan data shows, as expected, tool degradation was proportional to the severity of the processing parameters. The PP shows the lowest amount of dimensional deviation and the PC shows the highest. The lower barrel temperature of 179.4°C and injection pressure of 34.5 MPa needed to mold PP kept

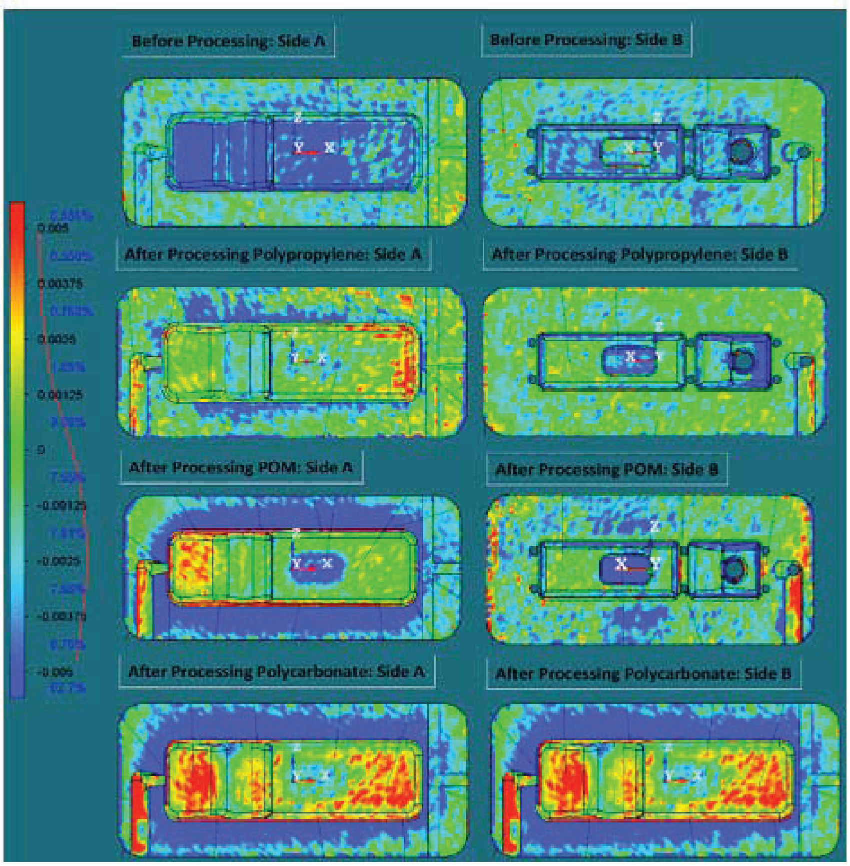

Figure 6: 3D Scans of Digital ABS Tools Before and After Processing

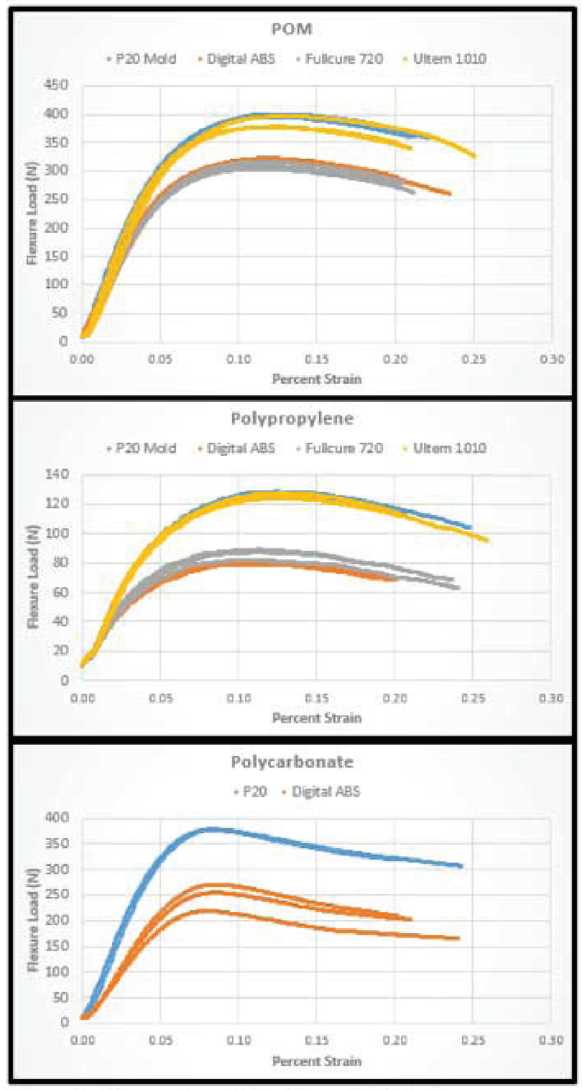

Figure 4: Comparison of the Plotted % Strain versus Flexure Load

each AM tool from suffering undue degradation. Conversely, under the severe conditions required to mold PC, barrel temperature of 287.8°C and injection pressure of 68.9 MPa, both the FullCure 720 and the Ultem 1010 failed in under 10 cycles. The durability of the AM tools were significantly higher for the PP with the expected life of the mold to be greater than 250 molded parts.

These results show that AM tools made from the materials used in this experiment are best suited for resins that use lower barrel temperatures and lower molding pressures.

Finally, the parts molded using AM tooling need to perform as well as parts molded with conventional tooling. The DSC results show that all the parts have approximately the same percentage of crystallinity although there is a slight increase in the parts molded with the Ultem 1010. The authors expected to see a large difference in the crystallinity due to the increased time the parts were held at a higher temperature in the mold.

When looking at the mechanical property results, it is interesting to see that the Ultem 1010 parts had nearly the same peak load and stiffness in bending as the P20 parts for PP and POM. In the PP and POM materials the Digital ABS or FullCure 720 were nearly the same in both peak load and stiffness. Although the crystallinity is slightly higher in the Ultem 1010 parts, the authors did not expect to see as much difference in the mechanical properties as the testing showed. These results could be due to the location of the test sample. There may be differences in cooling rates and thus changes in crystallinity within the samples.

In the PC materials the Digital ABS tool showed wide variability. This was not seen in the PP or POM materials. This variability could be due to a lack of necessary cooling time as PC has the most extreme processing parameters of the three resins.

Overall, all of the resins and tool materials that produced parts had sufficient mechanical properties to work for this prototype application. More work

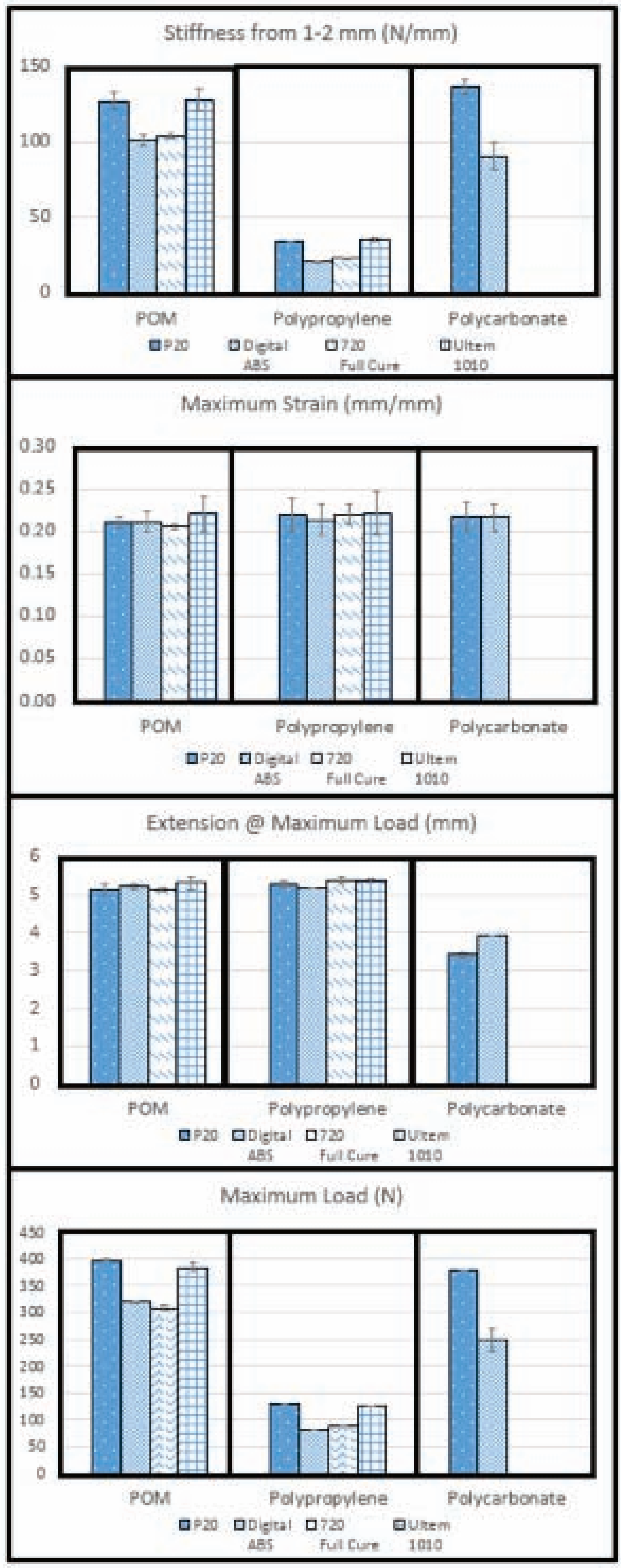

Figure 5: 3-Point Bend Test Results, trended mean

could be done to understand the source of the variations noted in the previous discussion.

Data for shrink for all tested parts was considered to be within acceptable margins. However, results indicated that the Ultem 1010 tools created molded parts that were consistently the closest to parts molded with the P20 control tool for both POM and PP. This could be due to the differences in heat transfer rates of the AM tools.

The surface texture of the AM tools did not match that of the P20 tool. While we compared the appearance of the surface finish to standard texture plaques, they are not an exact match. This is due to the manufacturing process of the AM tool being built layer by layer. Additional polishing of the cavity and core surfaces could improve the surface appearance if desired.

Conclusion

Advancements in AM technology have allowed for the development of injection molding tools. These tools can create parts with comparable properties to those made on a P20 tool, yet at a dramatically lower cost and lead time.

This study investigates only three AM tools out of a much larger pool of available material types. The correct tool type can vary per application. Future investigations would be needed to explore the benefits of other materials for AM tools.

Future Studies

Prospective research that could expand upon this study includes examining the thermal conductivity of the tools, experimenting with complex conformal cooling, and attempting to utilize alternative auxiliary cooling techniques. Each of these studies will be directed to further replicate the properties of the P20 tool while improving the production life of the tool.

Acknowledgements

The authors of this paper would like to thank John Deere and c2renew for their assistance in tool making and mechanical testing. Additionally, the authors wish to thank Steinwall, Inc. for sponsoring this research.

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By Laura Weaver
Technical Associate, Eastman Chemical Company

Injection Molding of Eastman TRĒVA™ Engineering Bioplastic

As public interest in sustainable materials (bio-preferred) grows, processors seek information on plastics which can offer benefits seen in established petroleum derived plastics. In the field of injection molding, understanding a material's processing and mechanical properties are equally important to those specifying and producing parts for fit and finish testing. The basic needs to be satisfied are whether the plastic has flow properties to fill a myriad of geometries using existing equipment and if the finished parts meet the functional requirements of the application in use. The introduction and interest in bio-preferred cellulose acetate propionate (TRĒVA™) stems from its inherently improved impact properties over polylactic acid (PLA), and its clarity, flow properties, modulus, and heat distortion properties versus traditional petroleum based polymers

Introduction

Public interest in sustainable chemistry is on the rise with 62% of chemical companies reporting customer interest in sustainable applications in 2014 – a 5% rise since 20091. The Bioplastic Feedstock Alliance reports that in the past 15 years progress in life science technology and in agricultural production systems has made it increasingly possible to envision a future where renewable carbon from plants replaces fossil carbon in production of chemicals and materials needed by society2.

The introduction of TRĒVA™ (**Figure 1**), a USDA Certified Biobased Product, as a next generation cellulose based polymer, is sourced from sustainably managed forests, not from food sources. For every pound of

Figure 1: Bio-based TRĒVA™

TRĒVA™ produced, approximately 40-50 percent by weight is renewable content3. The product durability allows for engineering resin performance from a bio-plastic. As is the case with most new product launches, two commercial grades (GC6011 and GC6021 (improved impact performance)) are available with more grades being developed.

Processing

TRĒVA™ is a bio-based polymer and should be dried for a minimum of two hours at 75-80°C. Once dried, it can be processed on most general purpose screws with length/diameter (L/D) ratio of between 18:1 and 22:1 with a compression ratio greater than 2.5:1. Residence time in the barrel and hot runner system should be kept to less than five minutes to avoid a shift in color. TRĒVA™ is a high flow material capable of filling thin parts with long flow lengths.

The injection molding machine size and/or screw size depends on part size, however melt residence time should be less than 3-5 minutes because excessive residence time at high process temperatures could lead to yellowing.

TRĒVA™ can be processed on a wide variety of molds and gate designs, including:

- Hot runner molds with thermal or valve gates
- Cold runner molds with edge, web, or fan gates
- Three-plate molds with tunnel or restricted/pinpoint gates

Gate size/thickness range may be 0.7-1.5 mm depending on thickness and size of the molded part and the required part aesthetics. A summary of processing information is shown in **Table 1**.

Table 1: Summary of TRĒVA™ Injection Molding Guidelines

TRĒVA™ processing summary	
Parameter	**GC6011, GC6021**
Drying time, hr	2-4
Drying temperature, °F (°C)	165-185 (75-85)
Barrel set temperature, °F (°C)	440-460 (225-240)
Target melt temperature, °F (°C)	460-480 (240-250)
Mold temperature, °F (°C)	150-190 (65-88)
Injection speed, in./s (cm/s)	1-2 (3-5)
Injection pressure, psi (Mpa)	1000-1500 (7-10)
Pack /hold/cooling time, s	2-4/4-6/5-10
Screw recovery speed, rpm	100
Screw back pressure, psi (Mpa)	100-150 (0.7-1.0)
Residence time in melt, min	3-5

Flow Properties

Processors are keen to understand the flow properties of TRĒVA™ in comparison to common petroleum based engineering thermoplastics and the good news is that this property is a key advantage. When TRĒVA™ was compared to other plastics in a mold designed to run polypropylene, TRĒVA™ was found to flow and fill the part the same as the polypropylene whereas the other common engineering plastics had difficulty as shown in **Figure 2**.

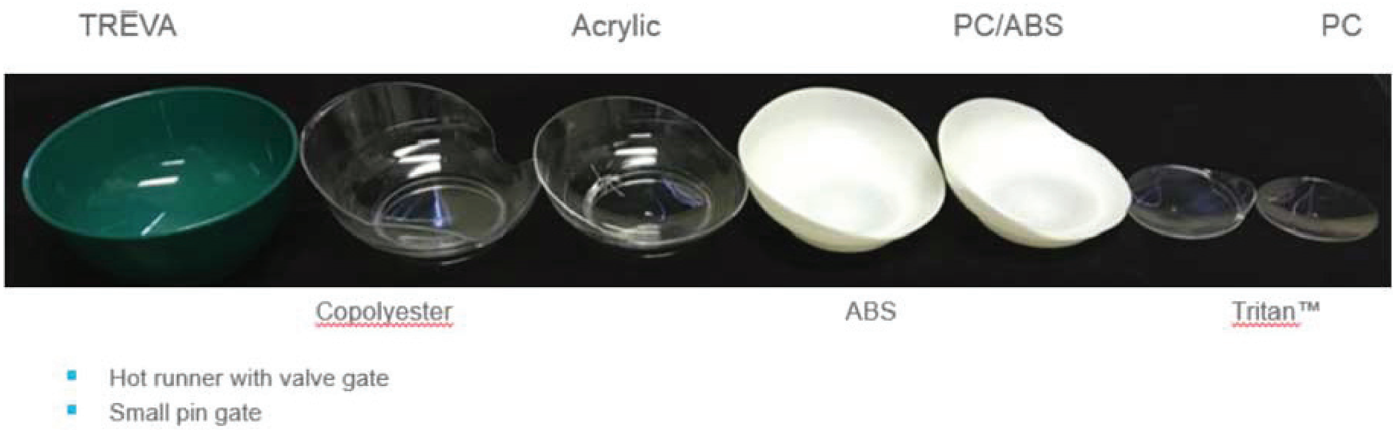

Figure 2: TRĒVA™ Flow Properties in a Bowl Mold Designed for Polypropylene.

Another way of looking at flow properties between plastics is via spiral flow where the material is processed at its recommended process conditions. Using a spiral mold having dimensions of 12.7 mm wide by 0.76 mm thick, TRĒVA™ GC6021 was compared to Polycarbonate (PC), Polymethyl methacrylate (PMMA), Acrylonitrile Butadiene Styrene (ABS), Styrene Acrylonitrile, Polycarbonate-Acrylonitrile Butadiene Styrene (PC-ABS). It should be noted that TRĒVA™ GC6011 has nearly identical spiral flow properties to the TRĒVA™ GC6021 grade shown which translates to improved flow in longer and thinner cross-sections. The melt temperatures used for each material are noted in **Figure 3**. The mold temperatures were set based on the literature which is typically set at a temperature 40°C lower than the glass transition temperature.

Mechanical Properties and Other Potential Benefits of TRĒVA™

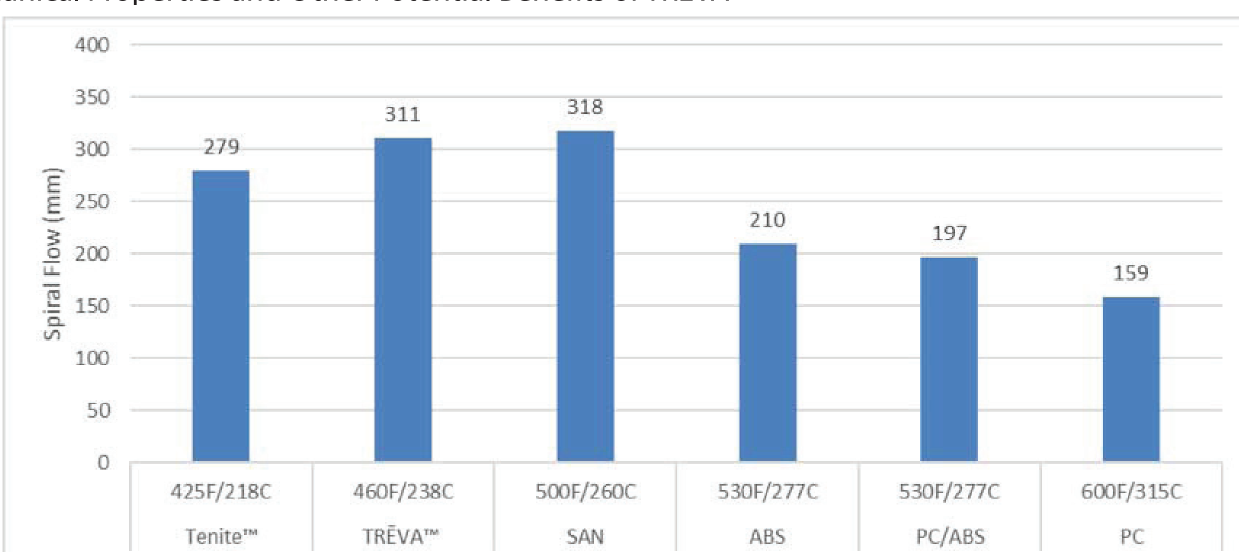

Figure 3: TREVA™ Spiral Flow Comparison to Common Engineering Thermoplastics

History has shown that plasticized cellulose acetate was patented for injection molding in 1939 by Arthur Eichengrün which validates the long history of this bio-based plastic4. A well-established consumer tool handle which has been on the market for several decades is still being made from a clear, durable plasticized cellulose acetate. An easy way of understanding the differences between commercially available Tenite™ plasticized cellulose esters (CE), which are used in a variety of molded applications, and TRĒVA™ is to look at the Dynamic Mechanical Analysis comparison shown in **Figure 4**. TRĒVA™ GC6011 shows improved modulus at higher temperatures over Tenite™ which allows it to be considered in applications as a viable alternative to other engineering plastics.

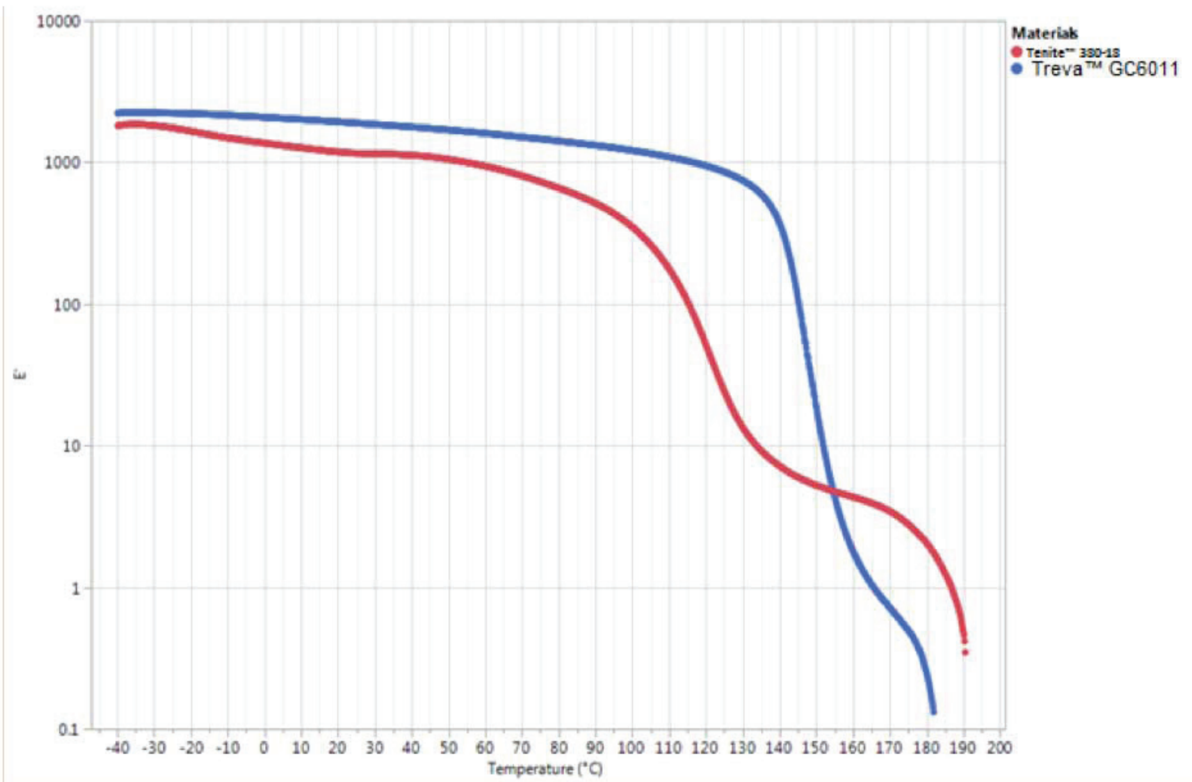

Figure 4: Dynamic Mechanical Analysis Comparison of Plasticized CE versus TRĒVA™

Common engineering properties such as density, strength, heat performance, and water absorption are shown in **Table 2**. While impact toughness is another critical property it is difficult to report because there is no standard impact test to effectively compare these materials, however ball drop impact comparison is shown in **Figure 5**. In general, it is fair to say that TRĒVA™ shows impact performance between PC and PMMA regardless of the impact test.

Chemical Resistance

Chemical resistance needs are dictated by the application and product literature5 shows an extensive list of chemicals that the cellulose esters have been tested against. Injection molded flexural modulus bars (3.2 mm thick) were placed on 1.5% constant strain jigs and fixed in position. Using a saturated cotton cloth, the chemical was wiped across the surface and the before and after

Table 2.: General Mechanical Property Comparison with Common Engineering Polymers

	ASTM Method	PC	PC-ABS	PMMA	TRĒVA™ 6011	TRĒVA™ 6021
Specific Gravity, g/cc	D792	1.20	1.13	1.19	1.23	1.22
Flexural Modulus, GPa	D790	2.3	2.3	3.4	2.2	2.0
Tensile Strength, MPa	D638	65	50	65	51	48
Heat Distortion Temperature, 1.8 MPa, °C	D648	125	112	95	102	100
Heat Distortion Temperature, 0. 45 MPa, °C	D648	137	126	NA	116	114
Water Absorption, % @ 23 °C	D570	0.3	0.7	0.3	2.3	2.2

24-hour exposure was recorded as shown in **Figure 6**. The chemical tested - medium-chain triglycerides (MCT oil) -— is found at higher concentrations in coconut oil and Danish butter, and results in relatively aggressive chemical attack.

Volatile Organic Emissions

Several industries (automotive, building and construction) are seeking plastics with reduced volatile missions in response to consumer demand for healthier materials. When tested to the automotive standard (VDA 278) both TRĒVA™ and Eastman Tritan™ copolyester (a bisphenol-A (BPA) –free co-

	1 Kg Steel Ball Drop Impact			
2 mm thickness	23 Deg. C		(-)30 Deg. C	
	1 Joule	5 Joule	1 Joule	5 Joule
PC	Pass	Pass	Pass	Pass
PMMA	Fail	Fail	Fail	Fail
Cyclo olefin Copolymer	Fail	Fail	Fail	Fail
Tenite™ - 12% plasticizer	Pass	Pass	Pass	Pass
TRĒVA™ GC6011	Pass	Pass	Pass	Pass

Figure 5.: Ball Drop Impact

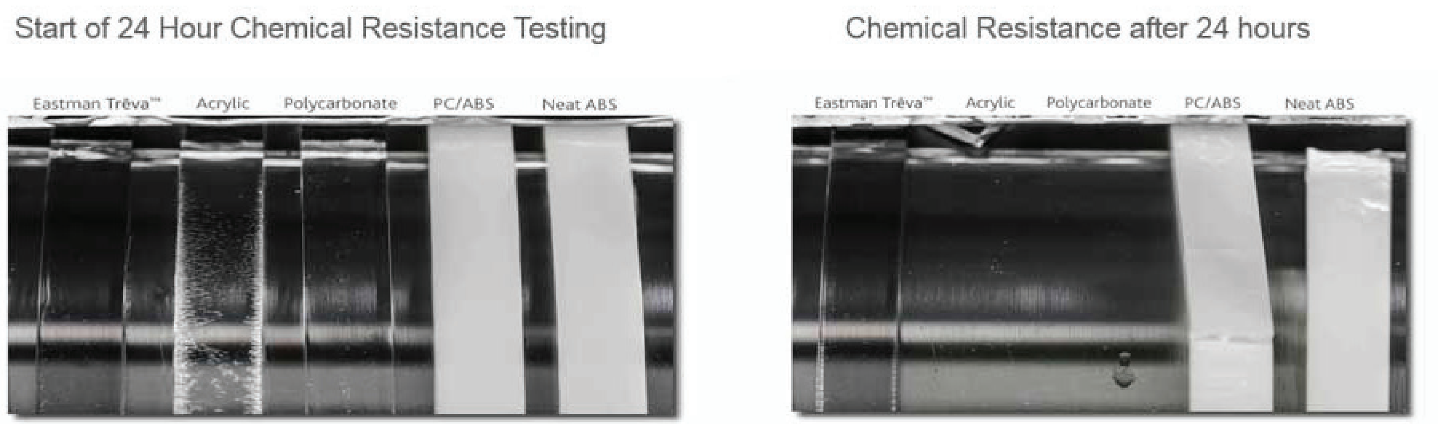

Figure 6. Chemical Resistance Comparison in Medium Chain Triglyceride

polyester) offer benefits as shown in **Figure 7** which sa isfy these demands and corroborate what 3D printers are inding as well. The BPA-free Tritan™ has Greenguard Certification while TRĒVA™ is in the process of testing for this certification.

Birefringence

Unless molders are tied to the electronics industry, birefringence is not a commonly sought performance need. Cellulose esters offer tunable birefringence properties which is the primary reason for their commercial use in polarizing films in the consumer electronics industry6. With the rapid growth of human machine interfacing (HMI) surfaces inside the vehicle interior, this is a high-demand property that the automotive industry is searching for because plastics with birefringence create a visual distortion which is a "safety related concern". When compared to the historically

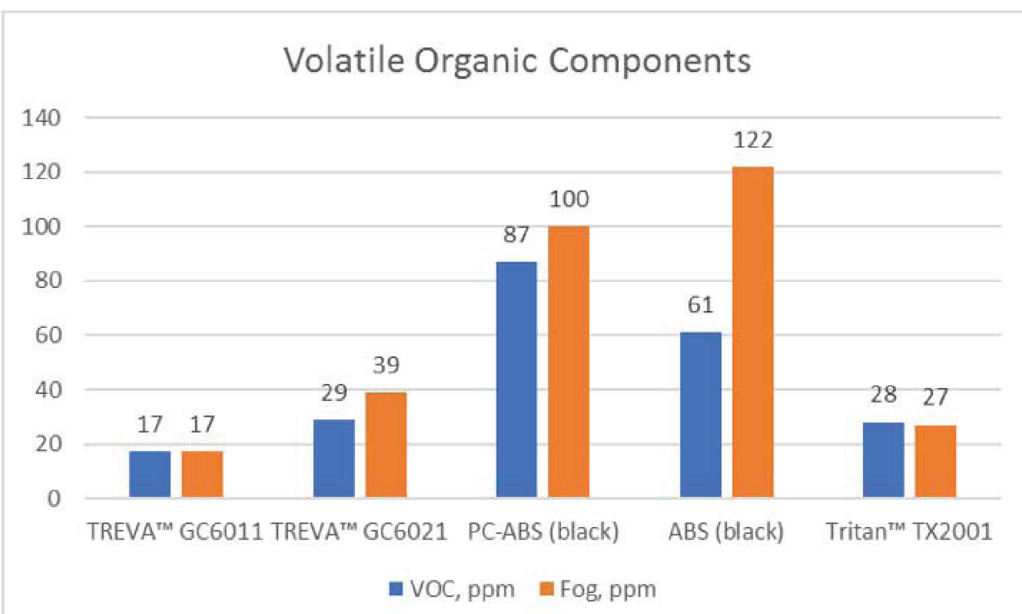

Figure 7: Volatile Organic Components Comparison (Test Method: VDA 278)

used clear plastics, PC and PMMA, TRĒVA™ shows improved birefringence over PC and improved impact resistance over PMMA as shown in **Figure 8**.

Sound Damping

Considerations of noise, vibration and harshness (NVH) are of significance to design engineers in the automotive industry7. Vehicle interiors must be designed in such a way that wind, road, engine, and HVAC noise do not interfere with the consumer's ability to interface with speech recognition software8. While other methods currently exist to manage NVH, changing the composition of a plastic decorative or functional part is rarely explored during design. Durable plastics, such as TRĒVA™ cellulosic and Tritan™ copolyester, have demonstrated superior bulk damping properties compared to other engineering thermoplastics and glass in previous studies9. For this reason, these materials could be of interest to automotive engineers.

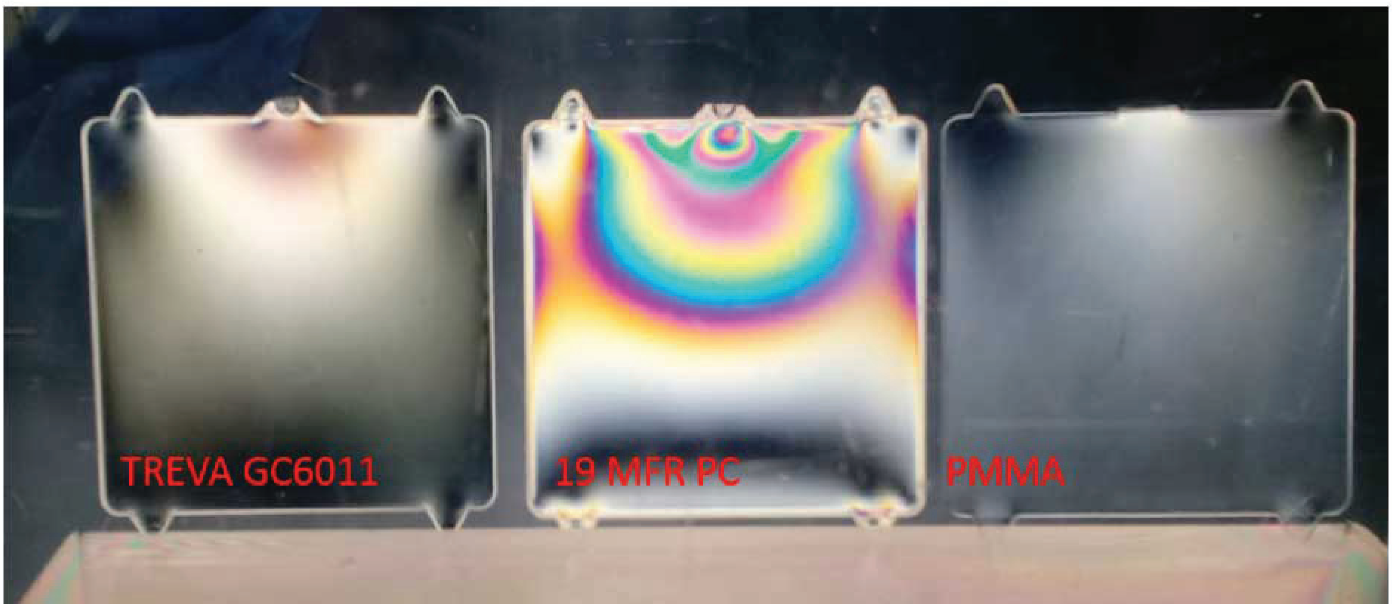

Figure 8: Birefringence Comparison - 2mm thick

Conclusions

Interest in bio-preferred polymers is on the rise and material specifiers are looking for performance characteristics which offer benefits beyond sustainability. The 2017 introduction of TRĒVA™ cellulosic polymers for injection molding applications has created an interest in the market based on its improved properties over other widely known bio-based plastics. The early adopters however are not molders of PLA but rather users of common petroleum based engineering thermoplastics. TRĒVA™ is one of the first bio-based polymers that delivers performance close to petroleum based alternatives, at an economical price. The interest stems from a whole host of performance attributes which are not commonly found on material technical data sheets such as:

- Chemical resistance to certain chemicals
- Flow properties in molding
- Reduced volatile organic components
- Low birefringence
- Sound damping
- USDA Certified Biobased Product

Other aging and durability type performance are presently being evaluated and will be reported in future articles.

Acknowledgements

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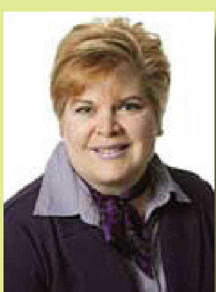

About the Author

Laura Weaver has been in the Plastics Industry for 32 years with employment at Upjohn Polymers Division, Dow Chemical, DuPont Dow Elastomers, LLC and Eastman Chemical Company. Her application development career has spanned several product areas: Polyurethane microcellular foams, elastomers and reinforced urethane composites; Polyolefin elastomers for extrusion, calendaring, thermoforming and injection molding; and most recently copolyesters and cellulose esters for injection molding, thermoforming, and rotational molding. She is the inventor or c o-inventor of 25 patents and author of over 30 publications. She has been an active member of SPE for many years.

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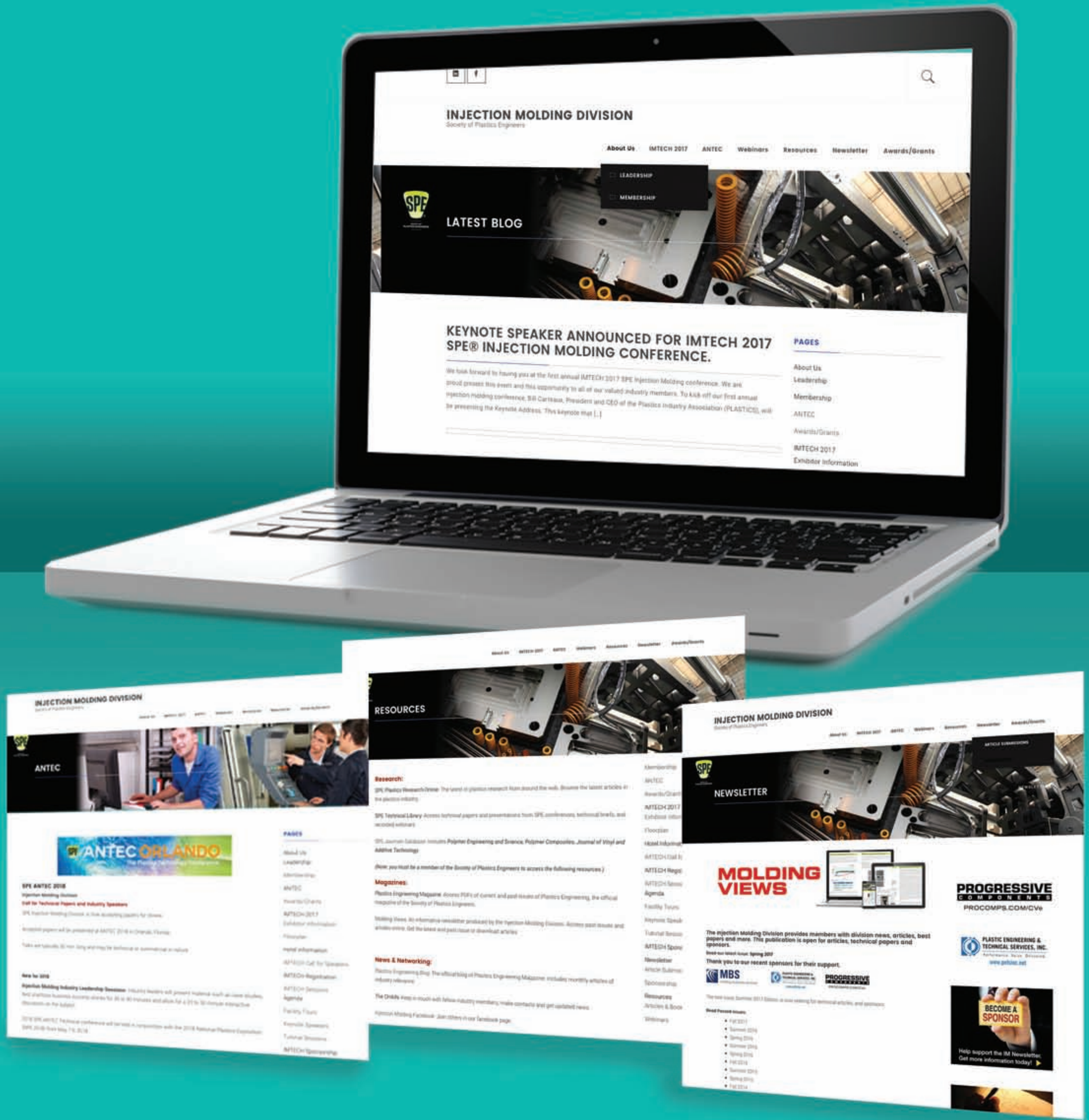

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IMD Board of Directors Meeting

November 16th, 2017

Submitted by David Okonski

Welcome & Opening Remarks – Raymond McKee, Injection Molding Division (IMD) Chair

Division Chair Raymond (Ray) McKee called the meeting to order at 9:00 AM (Eastern Time, ET) and welcomed all attendees to the Fall IMD Board of Directors Meeting. Secretary David Okonski called roll at 9:05 AM (ET)..

Roll Call – David Okonski, Secretary

Present via WebEx & MML/Teleconference:

Alex Beaumont, Erik Foltz, Pete Grelle (Technical Director), Adam Kramschuster, David Kusuma, Joseph Lawrence, Ray McKee (Division Chair), Kishor Mehta, Susan Montgomery (Councilor), Lynzie Nebel, David Okonski (Secretary), Hoa Pham, Rick Puglielli (ANTEC 2018 TPC), Chad Ulven, and Jim Wenskus (Treasurer).

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

Absent were:

Vikram Bhargava, Jack Dispenza, Jeremy Dworshak (Executive Committee VP), Nick Fountas, Brad Johnson, Sriraj Patel, Srikanth Pilla, and Tom Turng.

Approval of the August 3rd, 2017 IMTECH Meeting Minutes

The meeting minutes from the IMD IMTECH Board Meeting of August 3rd, 2017 were presented. The minutes were discussed, and it was determined that some changes were required.

Motion: Erik Foltz made a motion to approve and distribute the August 3rd, 2017 meeting minutes pending the required changes. Adam Kramschuster seconded, and the motion passed at 9:14 AM (ET).

Note: The August 3rd, 2017 Meeting Minutes were corrected by the secretary and distributed to the IMD Board of Directors and the IMD Newsletter Publisher on November 16th, 2017.

ANTEC 2018 Technical Program Chair (TPC) Update – Rick Puglielli, ANTEC 2018 TPC

ANTEC 2018 TPC Rick Puglielli confirmed the members of the ANTEC 2018 Paper Review Committee; the committee shall consist of: 1) Current TPC Rick Puglielli, 2) Past TPC Srikanth Pilla, 3) Future TPC David Kusuma, and 4) Technical Director Pete Grelle. The ANTEC paper review will take place at Tupperware Brands World Headquarters in Orlando, Florida one (1) day prior to the Winter Board Meeting which will also be held at Tupperware Brands World Headquarters on January 19th, 2018. Rick is contemplating the structure and timing of possible joint ANTEC sessions with the Medical Plastics Division, the Mold Technologies Division, and the Part Design & Development Division. Rick is scheduled for TPC training on November 17th, 2017 at 2 PM. ANTEC papers are due December 15th, 2017.

IMD Board of Directors Meeting Continued

Regarding the ANTEC 2018 IMD Networking Reception, Reception Chair David Kusuma is working with Phyllis Hortie (Senior Director, Trade Show Services for the Plastics Industry Association) to finalize the event details with respect to menu and floor plan/setup. What is currently known is that the reception will be held within NPE2018 space on the third floor of the West Hall of the Orange County Convention Center. (The Hyatt was just too costly.) To date, we have two (2) Gold Sponsors – Master Precision Mold Technologies and Moldex3D – that have contributed $10,000 USD to fund the event.

Technical Director Report – Pete Grelle, Technical Director

Technical Director Pete Grelle provided the Board with updates on: 1) the webinar series, 2) the Penn State Innovations & Emerging Technologies Conference, 3) AutoEPCON, and 4) the IMTECH conference series. Regarding the webinar series, nothing has been scheduled at this time; Pete Grelle is looking for a sponsor so that the webinars can be offered to SPE members at no cost. The Penn State Innovations & Emerging echnologies Conference was a huge success having over 190 attendees, and the conference did not lose money. Board Member and Conference Chair Brad Johnson was pleased with the conference results and informed the Board that this conference will not be held in 2018 which is a NPE year. Regarding AutoEPCON, the IMD offered a full day session at AutoEPCON 2017; this particular session was well received by conference ttendees. With the amount of sponsorship the IMD brought to AutoEPCON 2017, the IMD earned approximately $10,000 USD in profit and was invited back to participate in 2018. Pete Grelle called for help organizing the AutoEPCON 2018 IMD technical session. At this time Pete Grelle called on David Okonski, IMTECH 2017 Chair, to provide an update on the IMTECH conference series.

Regarding the IMTECH conference series, IMTECH 2017 was held in Oak Brooke, Illinois on August 1st through the 3rd and was the first of many injection molding innovations conferences that event organizers David Okonski and Pete Grelle hope to hold. IMTECH 2017 had 200 attendees and generated about $60,000 USD in revenue from registrations and sponsorship fees. The conference format of concurrent technical sessions in the morning and plant tours in the afternoon was well received by attendees. Unfortunately, the cost of the conference exceeded revenues by about $40,000 USD – the major contributors to the cost overrun were: 1) audio visual services, 2) the failure to meet hotel room commitments, and 3) unanticipated service fees. The loss was equally split between the IMD and conference partner SPE Headquarters. Cost containment measures will be implemented for 2018 and beyond. The desire is to hold the next conference in the vicinity of Cleveland / Akron, Ohio. Conference Chair David Okonski is in discussions with both the Cleveland and Akron Sections to identify a partner for IMTECH 2018. IMTECH 2018 dates are November 6th through the 8th.

Financial Report – Jim Wenskus, Treasurer

Treasurer Jim Wenskus was pleased to inform the Board that the IMD is in reasonably good financial shape despite the major loss associated with the IMTECH 2017 Conference; the IMTECH loss was substantial (exact number - $23,294.14 USD) but Chair Ray McKee believes the negative impact will only be short-term. t the end of the 2016/2017 fiscal year, the IMD had an account balance of $52,959.52 USD; the present account balance is $32,741.38 USD.

IMD Board of Directors Meeting Continued

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.

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

Newsletter (Rick Puglielli): IMD Newsletter Editor Heidi Jensen routinely makes a request of the IMD/SPE membership to submit articles for publication. Even though the newsletter contains a disclaimer indicating that the published work does not necessarily represent the thoughts and opinions of the IMD Board of Directors (i.e.; - the Board of Directors is not endorsing the author's work), Communications Chair Rick Puglielli posed the need for the Board of Directors to establish a review process for newsletter articles. After some discussion, the Board agreed.

Action Item: IMD Board of Directors will establish a review process for all articles submitted for publication in the IMD newsletter.

Website (Adam Kramschuster): Communications Co-Chair Adam Kramschuster informed the Board that the IMD website is much improved since Heidi Jensen took over the responsibility for updating and maintaining the IMD website. The Board agreed. Thank You Heidi – You're the BEST !!!!

Membership Report – Erik Foltz, Membership Chair

Membership Chair Erik Foltz informed the Board that current membership stands at 2,209. It appears that "drops" and "adds" are at steady state – i.e.; every quarter the Division experiences (on average) about 200 members dropping-off our roster and about 200 new members being added to our roster. Erik believes that the IMD might be experiencing an upward trend in membership due to the IMTECH 2017 Conference. Demographically speaking, the Division is still top heavy with members that are 40+ years of age. Membership and strategies to improve membership numbers were discussed by the Board; moving forward, the IMD will strengthen our relationship with the Next Generation Advisory Board (NGAB).

Nominations Committee Report – Hoa Pham, Nominations Chair

Nominations Chair Hoa Pham called for volunteers to fill the ANTEC Technical Program Chair (TPC) positions for 2021 through 2024. The current list of TPCs is as follows:

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

Ray Mckee volunteered to be TPC for 2023.

Hoa also asked for nominations to fill the Division's Executive Officer positions.

IMD Board of Directors Meeting Continued

Current Board of Directors Executive Officers for 2017 / 2018 (term ends at ANTEC 2018) are:

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

Action Item: Current Executive Officers need to inform Hoa of their intentions to stay in office or not by January 19th, 2018.

HSM & Fellows Update – HSM & Fellows Chair Tom Turng

HSM & Fellows Chair Tom Turng is still in need of applicants for both Fellow and Honored Service Member (HSM).

Action Item: Division Chair Ray McKee needs to follow-up with Tom Turng on the status of the Mark Yeager Fellows Nomination.

Councilor Report – Susan Montgomery, Councilor

Councilor Susan Montgomery submitted the meeting minutes from the August 24th and 25th, 2017 SPE Councilor Meeting to the IMD Board of Directors for review; Lynzie Nebel represented the IMD at this particular meeting.

Susan summarized the important takeaways from the August Councilor Meetings as follows:

1) Pat Farrey assumed the role of SPE CEO on June 20th, 2017.
2) Greg Dolan resigned from the Executive Board.
3) Full Membership trending down; eMembership up – are eMembers of any value?
4) The Pinnacle Award Task Force will roll-out the new award format at ANTEC 2018.
5) The ANTEC Task Force is to submit recommendations by the end of 2017 to the Executive Board on how best to improve ANTEC and get more attendance at TOPCONs.
6) Councilor Len Czuba complimented the IMD on how well the IMTECH Conference went.
7) Lynzie Nebel joined the SPE Foundation Board of Directors.

Pinnacle Award Application – Srikanth Pilla, Incoming Division Chair (Chair-Elect)

Chair-Elect Srikanth Pilla is responsible for the submission of the Pinnacle Award Application for the IMD. Also (and just as important), Communications Chair Rick Puglielli is responsible for the submission of the application for the SPE Communications Excellence Award.

Action Item: Current Division Chair Ray McKee needs to send Srikanth Pilla the Pinnacle Award information.

IMD Board of Directors Meeting Continued

Old Business – Ray McKee, Division Chair

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

No new business items were discussed. No round table items were discussed.

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 11:27 AM (ET).

The next meeting will be held in Orlando, Florida at the Tupperware Brands World Headquarters on January 19th, 2018. The meeting will start with a Continental Breakfast at 8:30 AM (ET).

Tupper Brands World Headquarters
14901 South Orange Blossom Trail
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IMD Leadership

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Secretary
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Reception Chair and
TPC ANTEC 2017
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Message from the Publisher

Hello members!

Spring is finally here and for some of us battling the cold and snow it couldn't come any sooner! I'd like to start by thanking all our appointed board members for all the hard work and time that they spend throughout the year. They all put in much time and effort to provide all the shows and conferences out for our members. Thank you all for your continued efforts.

Now it is time to gear up for ANTEC. If you haven't already mark your calendar for May 7 in sunny Orlando FL. To get all the details on the technical program, forms, events and registration visit injectionmolding.org for all the details.

The next newsletter will be the Summer edition. Please help with your support with articles, technical papers, company news and sponsors. We are always seeking industry professionals to provide other members with industry knowledge.

Newsletter: Papers, technical articles, and sponsor (Topics can include: Maintence, education, industry business strategies, molding tips etc.)

Website: Company news/press releases and sponsors

I hope you enjoyed this latest issue. Be sure to visit us online for more news, and event updates!.

Have a wonderful holiday and see you next year!

Heidi Jensen
PublisherIMDNewsletter@gmail.com

Keep informed on recent event information, industry news and more.

Keep the connection! Join us on:

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