Spring 2011 | No. 84

MOLDING VIEWS

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

Chair's Message

What is Sustainability?

At our last SPE Injection Molding Division board meeting we had a discussion about sustainability and the involvement of the FDA in branding sustainable products. The question that arose was "what is sustainability". After a search on the web, I learned that there are several accepted meanings. One of the statements that made me chuckle was "dictionaries provide more than ten meanings for sustain." No wonder everyone has their own definition. The one definition that seems to fit our industry is derived from the Brundtland Commission of the United Nations: "sustainable development is the development that meets the needs for the present without compromising the ability of the future generations to meet their own needs."

"Green" seems to be the accepted slang term for being sustainable. I attended a trade show in the fall as an exhibitor and we were asked if we were a "green" supplier. Who would really say "no" to this? One contribution to being a green supplier is to promote the use of electronic media vs. paper based media not only for advertising but also for product information. It would be great to hear stories from the "field" on how your company is implementing a

Continued on page 2.

In This Issue:

This Month's Features:

Events | Announcements

Industry Events Calendar

March 2011

March 2-6
AMBA Annual Convention
Las Vegas, NV
www.amba.org

March 7-9
Molding 2011
San Diego, CA
http://events.cleantechies.com/molding-2011

March 15-16
MASSPLASTICS 2011
Fitchburg, MA
www.massplastics.com

March 16-17
SPE European Additives & Colors Conference
Bonn, Germany
www.4spe.org/conferences/european-additives-and-colors-conference

May 2011

May 1-5
SPE ANTEC 2011
Boston, MA
www.4spe.org/conferences/antec-2011

May 24-27
AUSPLAS 2011
Melbourne, Australia
www.ausplas.com

June 2011

June 21-23
Plast-Ex
Toronto, Canada
http://www.canontradeshows.com/expo/plastex11

September 2011

September 25-27
CAD RETEC
Lombard, IL
www.4spe.org/conferences/cadretec-2011

September 27-29
INTERPLAS
Birmingham, UK
http://www.micromanu.com

April 2012

April 1-5
NPE 2012 & ANTEC 2012
Orlando, FL
http://www.npe.org/Exhibit

Injection Molding Division - Engineer of the Year Award

CONGRATULATIONS TO DR. LIH-SHENG (TOM) TURNG,

who was named 2011 Injection Molding Division's "Engineer of the Year" by the Awards Committee following their meeting in Orlando on Feb. 4, 2011. Tom has been a member of the Society of Plastics Engineers since 1990 and a member of the Injection Molding Division Board since 2000.

The Engineer of the Year Award was established in 1981-1982. Selection of an individual is based upon contributions to the Division. Length of service, committee-work and holding an office in the Division are some of the valid criteria for selection along with the quality of service to the Division.

Chair's Message Continued

sustainability/green program. You can send your comments to our newsletter editor: Heidi Jensen at publisherimdnewsletter@gmail.com.

I want to thank our former newsletter editor Chris Lacey for her outstanding work over the years to make our division newsletter what it is today and at the same time introduce our new editor Heidi Jensen. We look forward to working with Heidi and the new ***Molding Views*** publication team.

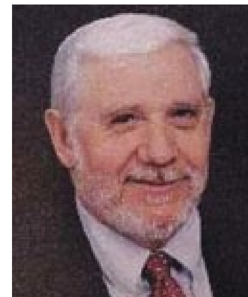
Lee Filbert
IQMS

Ask the Experts: Bob Dealy

Injection Molding Questions

Brian Sealy from Christ Church New Zealand asks;

Q: "Where can I buy an injection molding machine with stainless steel components to mold a corrosive and erosive formulated and filled material for a component that will be utilized in residential construction in earthquake zones?"



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

A: I think that most injection molding machine manufacturers will build a machine with special materials to meet your requirements. I checked with Wayne Vander Zanden of Norstech Plastics (608-497-04340) to confirm my answer. Wayne states that Absolute Haitian and Battenfeld would build a conventional machine with your specified components for an up-charge.

While no specifics on the polymer and fillers could be provided due to pending patents' I would expect that the plastic would be a PVC based resin coupled with heavily filled long glass fiber reinforcement. If my assumption is correct, I can understand the stainless steel for the corrosion, but not sure that stainless is the best choice for the erosive conditions. Perhaps a reader can relate experiences that will help Brian make the best choice.

A question was asked at the Milwaukee Sec-

Ask the Experts: Bob Dealy Continued

tion Society of Plastics Engineers Milwaukee Section meeting in January: "What are the advantages to the Mold Builder for using aluminium in an injection mold?"

I don't believe the mold builder benefits from building a mold out of aluminium. I believe the benefits all go to the injection molder. The molder benefits from a reduction in cooling time and the overall reduction of the molding cycle. Both the molder and end user benefit from a part that has less stress and warpage and more consistent dimensional consistency. The end user reaps the benefits of lower cost of the molded part and typically a lower initial mold build cost.

The debate continues if the cost to build an aluminium injection mold is lower than the same mold built of steel. Generally speaking, when the amount of conventional machining for cutting the cavity and core is high, then the advantage goes to the aluminium mold. However, the mold builder really does not benefit from this. If the mold takes 100 hours less to machine from aluminium, the mold maker charges 100 hours less. So in theory, the mold maker would make more money building a steel mold and the reason for my answer.

Bob Dealy *Dealy's Mold Engineering*

HOW TO STAND OUT IN THE YARD.

THE TOUGHEST LABELS ON EARTH.

When your durable products leave the showroom floor and are put to the test, consider the impact on your company if the decorative and warning labels chip, fade or peel off during the lifetime of the product. Take this lawn mower, for example. Such deterioration or failure of decorative labels could negatively affect your brand image and, even worse, inefficient warning labels could lead to potential litigation. Fortunately, there's a simple solution for your durable plastic products and parts—the In-Mold Labeling System from Industramark™. This solution provides photo-quality graphics that are permanent and stand up to the harshest environments while providing the flexibility to mark previously unreachable parts of your product. And did we mention that it's environmentally safe?

Learn more about our In-Mold Labeling System at industramark.com

WARNING & BRANDING LABELS
Industramark's In-Mold Labeling System ensures permanence, durability and flexibility.

PERMANENT DURABLE FLEXIBLE

industramark™
a Standard Register business unit

Ask the Experts: Terry L. Schwenk

Hot Runner Questions

The purpose of this column is to provide valid information concerning hot runner technology.

We invite you to submit questions or comments to our hot runner expert, Terry L. Schwenk, owner of Process & Design Technologies LLC.

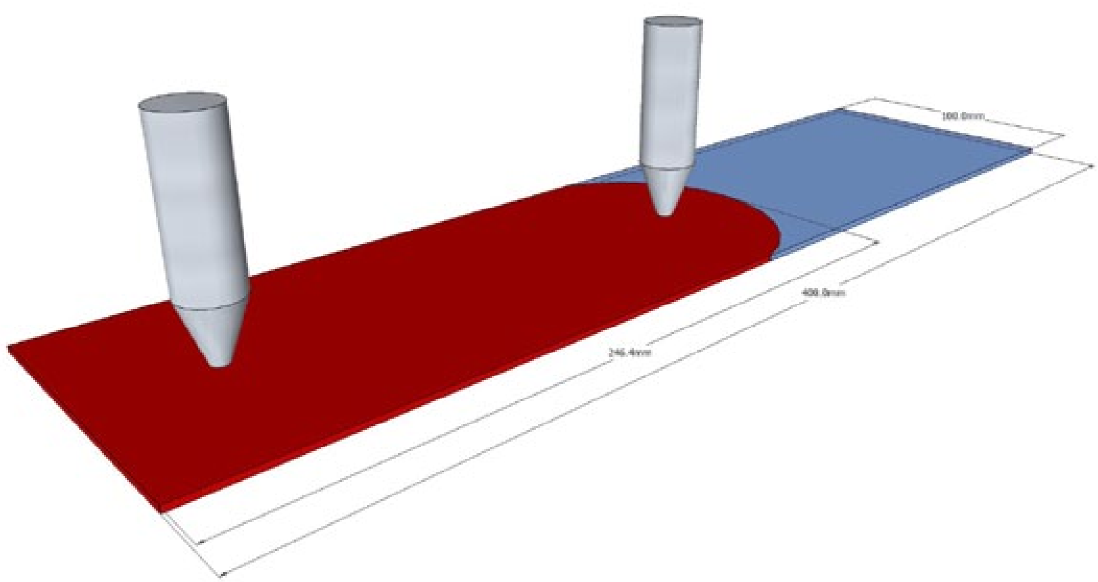
Terry has over 35 years of processing and hot runner experience.

Terry can be reached by emailing: tschwenk@processdesigntech.com.

Q: When sequencing valve gates for one large part, how can you ensure that each gate is actually all the way closed? I want to close some gates during fill and, then, open them to pack after the part is full.

A: This is a highly specialized hot runner application. The process has been around for as long as there have been valve gated hot runner systems. The applications I personally have been involved with were automotive bumpers and other large parts. Other applications would be family molds with different parts and sizes for each cavity.

The difficulty with trying to sequence multiple valve gates is the majority of hot runner systems with valve gate actuators, are an open loop system having no electrical or mechanical feedback on the position of the valve pin. Furthermore having no cavity sensors providing feedback on the position of the melt front creates



Ask the Experts: Terry L. Schwenk Continued

processing difficulties. An open loop system requires a considerable time in the development stage to establish the timing of the valve pins to open and close at proper times. The opening and closing operation can be achieved by using timers or trigger switches located on the molding machine injection screw. Predicting or estimating the timing of the valve pins sequence can be done with simple volume calculations. If you know the gate positions and can correlate the part volume with those gate position to the molding machine that will be used for the application, you can obtain the injection screw and barrel size. With the barrel size and shot volume, you can then calculate screw position with part fill volume. This will get you very close to knowing the timing of the valve gates. Let's say you will be molding a long bar and you don't want any warpage. The ideal gate position would be located at one end of the bar, but the part is so large one gate won't fill the part. So you add a second gate, however if you open both gates at the same time you will get a knit line in the center of the part. By having two gates and locating the first gate near the end of the part and the second gate just pass the center of the part, you will be able to sequence the valve pins. Opening the first pin will partially fill the part. As the melt front moves just pass the second gate, open the second valve pin and continue to fill the rest of the part. You will end up with a full packed out part with no knit line and the part will remain flat with minimal warpage. Knowing when to open the second pin is key. By using volume calculations of the part and relating it to the machine barrel volume, you can fairly precisely estimate the time or position of the injection screw to open the second valve pin.

My personal preference of valve sequencing is to open valve pins upon filling and you can delay or stagger the opening of the valve pins. You can also restrict the opening amount of the valve pin by placing restrictor plates behind the actuators to reduce the amount of opening travel of the valve pin. This can help control the flow out of each of the valve gates separate from timing. Once the part is full and packed out, close all the pins at the same time. The reason for this process is keeping the plastic material flowing. If you try to close a valve pin during the filling process, it becomes difficult due to the cavity pressure and injection pressure that are working against you. Also if

Ask the Experts: Terry L. Schwenk Continued

you successfully achieve closing of the pin during the filling process, the plastic material immediately begins to solidify at that gate, and opening the valve pin to further pack out the part is extremely difficult. It's much easier to pack out the plastic material when it's in a molten condition.

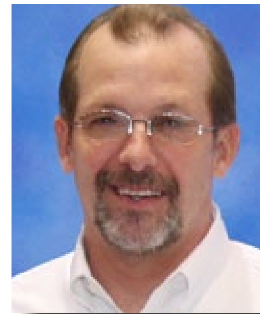
Opposed to the open loop system is the closed loop system, which provides the best solution for sequencing valve gates. Closed loop systems will have position sensors for the valve actuators and cavity sensors for monitoring melt position, and of course a controller to monitor the sensors and provide the control for operating the valve gates, taking out all the guess work and tedious calculations needed for an open loop system. There is a number of hot runner suppliers that provide closed loop systems.

Typically cost drives whether you use a closed loop or open loop system. One of the most advanced close loop systems comes from Synventive with its Dynamic Feed System, which uses pressure transducers to control the filling of each valve gate. Mold-Masters and Incoe have closed loop hot runner systems. Priamus, as well as other companies, manufactures a control system.

Terry L. Schwenk
Owner of Process & Design Technologies LLC

Ask the Experts: Steve Johnson

Mold Maintenance Questions



This new column is designed to provide useful and relevant information about injection mold maintenance for custom and captive molders alike.

Please submit any questions or comments to maintenance expert Steve Johnson, Operations Manager for ToolingDocs LLC, and owner of MoldTrax.

Steve has worked in this industry for more than 32 years. E-mail Steve at steve.johnson@toolingdocs.com or call (419) 281-0790.

Q: What is the number one problem mold repair shops face when trying to improve their maintenance efficiency?

A: Many times over the years this question has been raised. Having discussed this face to face with hundreds of attendees from 50+ companies at our training facility (and with hundreds more via email and phone conversations) the answer is clear. The number one problem is that most companies don't know what their number one problem is. They also don't know what the number two, three or four issues are or how to prioritize them for improvement.

They are not in that mode or stage of continuous improvement development. "We are just too busy fixing things to make time to improve" is a comment heard more often than not. So they patch, and run, patch and run…

But those that tire of the needless expense in mold repair time, tooling costs, missed shipments, quality issues and the stress will eventually put their mold repair process into focus. When that happens the amount of holes seen that need to be plugged can numb someone into doing, well, nothing.

With so many issues to grasp, how do you get your arms around it? How do you start to improve? Like anything else in this world that needs to be better understood, the areas that have a controlling effect upon the desired results must first be categorized.

To improve mold repair efficiency, the barriers a shop faces when attempting to achieve a continuous improvement culture must be addressed. For the mold maintenance trade in particular it comes down to these five factors:

Keeping mold repair technicians' skills up to date through targeted training initiatives is a key aspect of creating a systematized mold maintenance program.

Ask the Experts: Steve Johnson Continued

Leadership

- Is someone driving the improvement initiative forward?
- Is the initiative more than just the "flavor of the week"? In other words, does it have legs?
- Is there ongoing accountability for specific, measurable KPI's (Key Performance Indicators)?

Documentation

- Is your record keeping system capable of collecting specific and accurate data to measure?
- Does it utilize standardized terms for defects, tooling, corrective actions, etc.?
- Is the format easy to use and does it provide value for administrators and tradesmen alike?

A properly designed mold repair shop will help create an efficient, cost-effective and safe work area for technicians.

Maintenance Strategy

- What exactly is your maintenance strategy? (i.e., Reactive, PM, RCM, TPM, PmD, etc…)
- Within this strategy, what is being measured and targeted concerning shop and mold performance?
- Can you track tooling usage, and justify and keep an adequate amount on hand for repairs?

Shop Skills

- Are your technicians simply tooling replacers or are they skilled in troubleshooting defects?
- Are the corrective actions implemented skillfully and are they effective?
- Are technicians being trained in bench techniques and are they exposed to new repair technologies?

Shop Design

- Is the shop designed to repair your tools in a safe and efficient manner?
- Are benches and work spaces clean and organized with tools conveniently located?
- Are waste stream producing machines located away from molds and components?

Although listed in a general order of criticality to any maintenance improvement initiative, let there be no doubt that within any of these five categories lies a potential show stopper. It takes a thorough understanding of the interaction of these five categories to be able to move away from a long accepted, reactive, firefighting culture into a cost effective, continuous improvement maintenance strategy.

Now all you need to know is where to start. Stay tuned for future articles in *Molding Views* that will provide a more in-depth discussion of each of these five factors. Shops seeking to improve their mold maintenance efficiencies will begin to recognize and remedy the issues standing in the way of implementing a continuous improvement culture and, as a result, a more systematized mold maintenance program.

Steve Johnson *ToolingDocs LLC, and owner of MoldTrax.*

By Peter Egger and
Alexander Stock ,
ENGEL Austria GmbH

New Horizons for Lightweight Construction

Fully automated, efficient production of plastic fiber-reinforced composite components. The new Audi A8 front end weighs much less than its predecessors. This is made possible by the use of innovative fiber-reinforced composites, or so called organic sheets. New process technologies are being developed so that this new dimension in lightweight construction no longer belongs exclusively to the high price sector.

Lighter, faster, higher, further! Not since the advent of electric and hybrid cars has there been such a demand for economically produced lightweight parts. Lightweight construction and injection molding have long been key concepts for meeting the increasing demands of the transport and mobility sectors.

Lightweight construction is not only a question of the material. It depends far more on the interaction between the material, part design and manufacturing process. The thinner the walls, the lighter the component. Reinforcing materials are used to achieve a high degree of stiffness, impact strength, low shrinkage and good abrasion resistance for components with thin wall cross-sections. Until now, mainly long and short fibers were used for the reinforcement of thermoplastics where mechanical properties improve with increasing fiber content and length. Thermoplastics reinforced with short fibers exhibit anisotropic material behavior, according to the orientation of the fibers, which among other things depends on the filling of the cavity. Long-fiber reinforced thermoplastics achieve better mechanical properties and are therefore used for hybrid structures. However, the final properties of the component are also determined by the orientation of the fibers.

A first highly automated production cell for the cost-effective processing of thermoplastic fiber composite semi-finished products was showcased at ENGEL Austria's booth at the K 2010.

Photo courtesy of ENGEL Austria.

Long-Fiber Reinforced Thermoplastics as a Metal Substitute

Seemingly endless fibers, with a length equal to the dimensions of the component, can be distributed in such a way that they only fulfill the required reinforcing function in the direction they are embedded into the part. This enables the fiber content, and therefore the density of the component, to be reduced. The properties of a component can be improved while maintaining the same fiber content. Due to their low viscosity, long fibers are usually bound in a thermosetting plastic matrix, which incurs some disadvantages. The applications for long fibers are limited by long cycle times, lack of processing flexibility, limited shelf-life of previously cross-linked semi-finished products and inadequate existing automation technologies. To date continuous-fiber reinforced materials are mainly used in the aircraft and aerospace field and other high-tech sectors.

Plastic/metal hybrid structures are often used for components subject to particularly high mechanical stress. These hybrids are superior to sheet metal components in terms of the potential weight reduction and energy absorption capacity[3], and are ideally suited for use as crash elements which also form the support structure. However, even these components are not the be-all and end-all of car manufacturing. In the event of temperature fluctuations, the very different coefficient of thermal expansion of the metal and polymeric materials leads to stresses at the joints. In the worst case, components may fail. Hybrid structures made completely of thermoplastic do not suffer from these disadvantages. Long-fiber reinforced plastic components are potential substitutes for metal parts – an important driver for developing new material combinations and injection molding technologies which overcome the disadvantages of processing thermoset fiber composites.

The injection molding of semi-finished long-fiber thermoplastic components, the so-called organic sheet, promises the lightest components, shortest cycle times, highest efficiency and broadest range of applications. The sheets have an almost unlimited shelf-life, are formable, and at lower density they exhibit a rigidity and strength comparable to conventional fiber composites. Particular mention must be made of their good impact properties, which make them suitable for use in automotive applications. The name organic sheet stems from the organic matrix – mostly polyamide (PA), polypropylene (PP), polypropylene sulfide (PPS) or thermoplastic polyurethane (TPU) – and its use as a substitute for sheet metal.

Outstanding Impact Performance With Good Formability

The sheets of semi-finished material are manufactured on double belt presses. The fiber type, layer structure and number, and the thickness of the organic sheet can be varied according to the type of application. Common types of fiber used are glass, carbon or aramid fibers. Unidirectional (UD) structures and combinations of multiple UD layers can be achieved. As a result, all commonly known fiber composite laminating technologies can be used, and any combination of such technologies is possible.

The variety of material combinations with effective laminate con-

Feature: New Horizons for Lightweight Construction Continued

struction has predetermined the use of organic sheet for lightweight applications. If specifically designed thermoplastic laminates are used to create a hybrid structure, the weldability results in a firmly bonded hybrid part. This, for example, is utilized in creating a hybrid structure between an organic sheet and a short-fiber injection molded component. Organic sheets have high strength and outstanding impact behavior, with good formability, while injection molded structures such as ribbing bring high stiffness and component stability, with low mass.

Available organic sheets can be cut into any shape of blanks. For forming, the sheet is heated using infrared radiation, convection heating or contact heating.

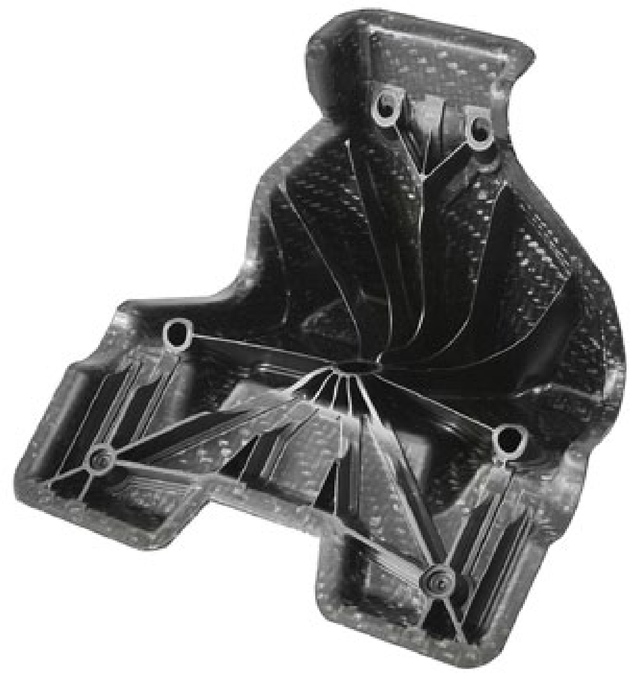


Figure 1: The steering column bracket consists of a high-strength forming component, organic sheet and injected ribbing.
Photo courtesy of ENGEL Austria..

Heating above melt temperature causes significant expansion of the composite thickness, which is called lofting. When lofting, the composite material tries to return to its initial shape prior to pressing. In this state, the individual fabric layers can easily be shifted against each other, making draping simpler. In total, processing of organic sheet consists of draping, forming and compressing the de-consolidated layers. These processes have a decisive influence on the mechanical properties of the component, as even small changes in the fiber angle have significant effects on elasticity, shear modulus and strength. Empirical trials to simulate drape were performed at the Institute of Polymer Technology (LKT) Erlangen-Nuremburg. The results produced can be used for blank optimization.

Six Process Steps in One

The overview of the individual processing steps for organic sheet establishes the direction for the design of a manufacturing cell for the production of hybrid structural components from thermoplastic fiber composites with an injection molded ribbed structure for additional support. The process chain primarily consists of heating, forming and back injection molding.

Until now, a fully automated process chain for cost-effective production of large volumes with high productivity and reproducible quality was unavailable. The first solution was presented by the injection molding machine builder and automation specialist ENGEL at the K-Fair in October 2010. On this occasion, the fully automated production of a steering column bracket was demonstrated using a mold from Siebenwurst (**Fig. 1 above and 2 page 15**). LKT and Neue Materialien Fuerth contributed their organic sheet processing experience to the project.

The steering column bracket consists of a flat, high-strength, shaping component, the organic sheet (four layers of twill weave bound in a PA6 matrix from Bond Laminates) and injection molded ribbing (PA6 GF30 from Lanxess, optimized for low flow resistance). The basis for the development of the manufacturing cell is

Feature: New Horizons for Lightweight Construction Continued

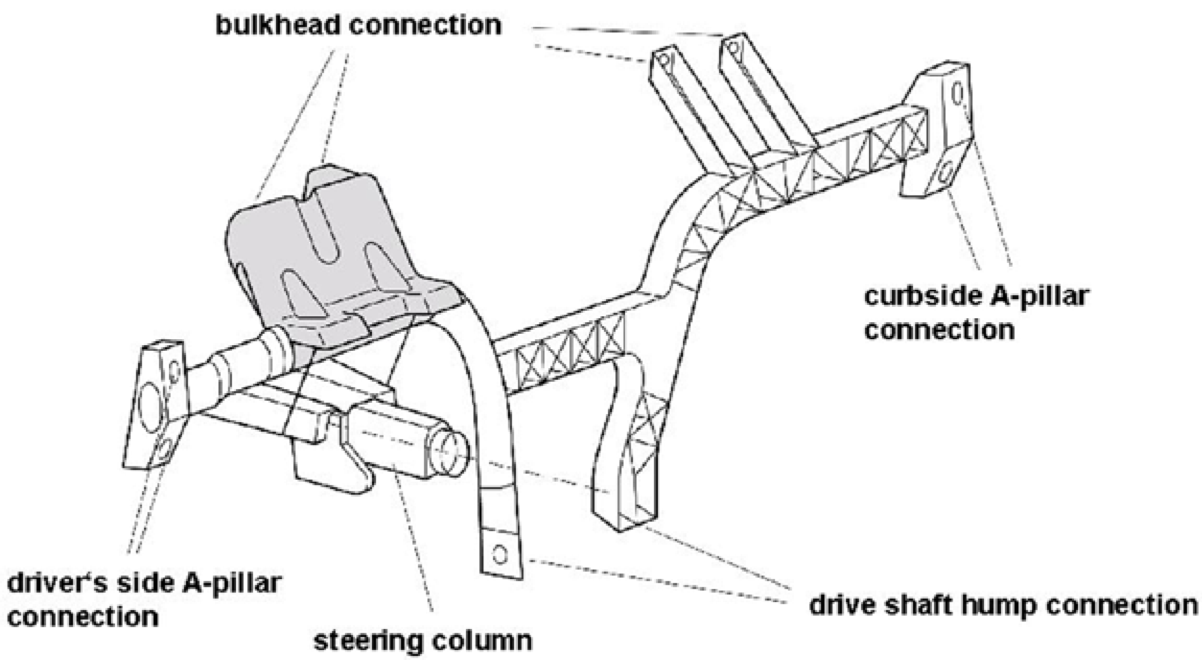


Figure 2: Installation of the steering column bracket. *Photo courtesy of LKT.*

so-called in-mold forming (IMF), a process chain developed by LKT for processing semi-finished thermoplastic fiber composite products into components with reinforcing structures[2].

The manufacturing cell exhibited at the K-2010 integrates six process steps:

- **Hand-over:** The organic sheets are stored stacked in a magazine, and passed by a linear robot to an articulating robot.

- **Heating:** The articulating robot brings the sheet to an infrared heating station, where the thermoplastic matrix is heated. The heat is applied within the cycle time of the injection molding machine in order to not lengthen the cycle. The total heating time is under 25 seconds.

- **Pre-forming:** The high degree of component forming makes pre-forming necessary. The articulating robot swivels the heated, soft organic sheet between the open injection molding machine mold halves, and rotates it into a vertical position. A gripper system, which is part of the injection mold half, holds the organic sheet by its upper edge, while two additional lateral grippers, mounted in the middle, draw the sheet toward the injection side of the mold. This causes the sheet to be pre-formed two dimensions.

- **Forming:** The active forming process is completed by the closing of the mold. Based on the IMF method, the semi-finished product is not pre-formed in a separate press but directly in the mold itself.

- **Back Injection:** After forming is complete, the rib structure is injected. The point of injection is on the opposite side to the ribbing, meaning it is injected through the organic sheet.

- **Trimming:** The complex component form requires a geometry of the organic sheet blank which pro-

Feature: New Horizons for Lightweight Construction Continued

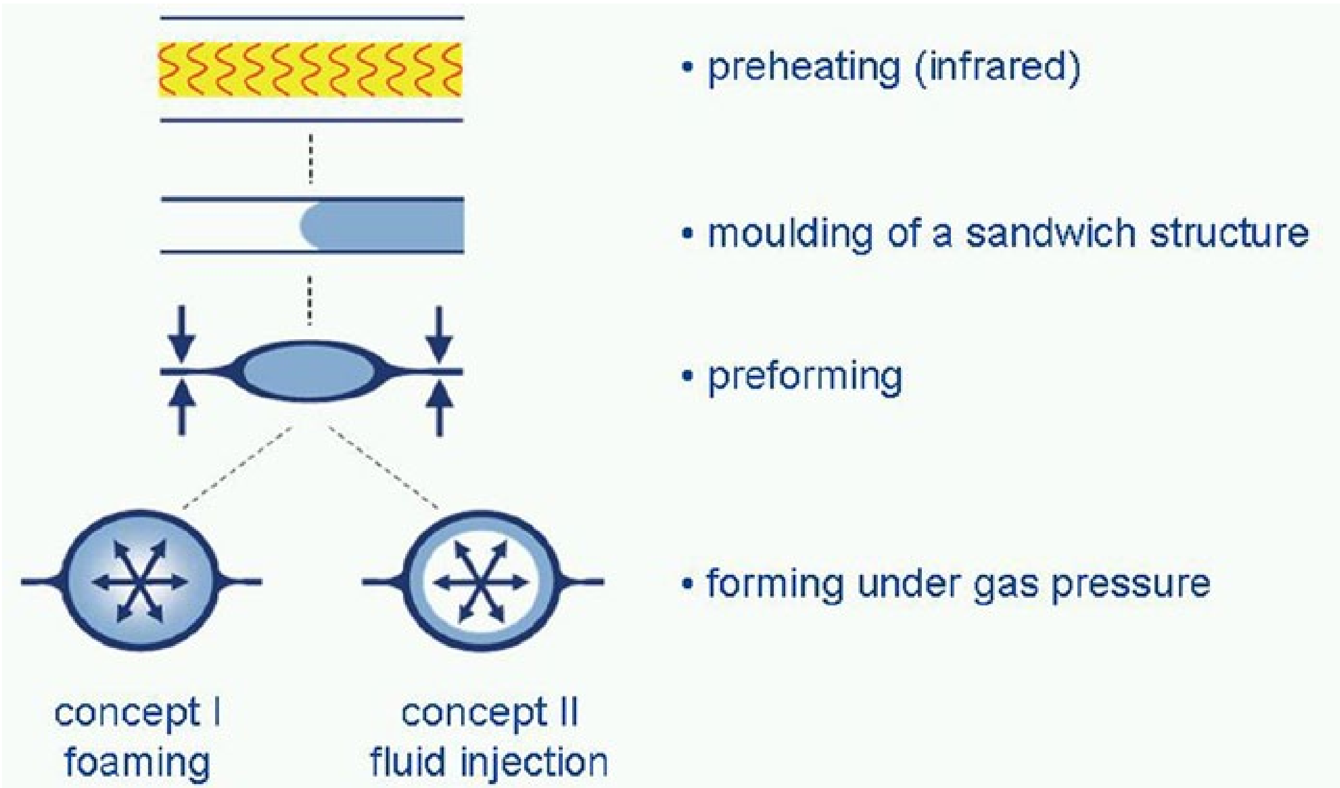


Figure 3: FIT hybrid process sequence. *Photo courtesy of LK.*

trudes beyond the edges of the mold and the component contour after forming is complete. This edge is separated from the component by a laser unit from the equipment builder Hans von der Heyde, which is integrated in the manufacturing cell.

Hybrid, fully thermoplastic, load-bearing structural parts were manufactured at the K-Fair by a fully automated process with a high level of productivity. The cycle time was under 60 seconds. ENGEL calls this technology "organomelt".

Outlook: Process Combinations Open up New Potential

In comparison to metal/plastic hybrids, a weight saving of up to 50% is achieved for the front end of the Audi A8 by using organic sheet reinforced hybrid components[3]. As this example shows, the use of organic sheet is nothing new. The goal of the current research and development is to make process technologies available for the economic processing of large batches. Higher productivity, made possible by the increasing degree of automation, has enabled a higher use of reinforced composite plastics and thermoplastic components in the automotive sector in applications such as underbodies, seat shells, rear seat panels, crash elements, door panels and trunk lids. The application possibilities for thermoplastic semi-finished products are diverse and varied.

The aligned long-fiber reinforcement of organic sheets, combined with the properties and advantages of thermoplastic material combinations and new process technologies, offer new possibilities in the construction of hybrid structures and their use in lightweight construction. With the injection molding machine as the core of the fully automated process chain, it is conceivable that various proven injection molding processing technologies can be combined. One promising approach is the FIT hybrid, a combination of process technologies that have already been distinguished by receipt of earning the "Network of Automotive Excellence" award during the Würzburg Automobile Summit 2010. Sandwich structures comprising of a thermoplastic laminate face and an injected plastic core, will be shaped by using compression stroke and gas injection technology, to form functionally integrative lightweight structures **(Fig. 3, page 16).** Neue Materialen Fürth displayed an array of parts (among them are some highly complex components) first at K 2010.

Future challenges for lightweight materials are accompanied by demanding requirements for automation and process technology. The considerable efforts by various companies and research institutions in this field are already bearing fruit. The use of fiber reinforced composite and thermoplastic hybrid structures is no longer restricted to the fields of aerospace and motor sport. Thanks to the rapid development of processing technologies, an increasing number of car models, including the small and medium classes, are being equipped with parts made of fiber reinforced composites. The reduction in component weight results in improved driving quality and lower fuel consumption, or can increase safety and comfort in other areas.

Authors

Dipl.-Ing. **Peter Egger**, Manager of Application Technology Dept., large machines, ENGEL Austria GmbH, St. Valentin, Austria. peter.egger@engel.at

Dipl.Ing. **Alexander Stock**, Technology Manager, Lightweight & Fiber Composite Technologies, ENGEL Austria GmbH, St. Valentin/Austria. alexander.stock@engel.atw

Literature

[1] *Benkel, A.*: Kunststoff-Metall-Verbundtechnik auf der Überholspur, http://www.innovations-report.de/html/berichte/maschinenbau/kunststoff_metall_verbundtechnik_Ueberholspur_124034.html, dated 23.11.2010

[2] *Müller,T.*: Plastverarbeiter 11/07, p. 30 et seq., Hüthig, Heidelberg, 2007

[3] *Risch, H.*: Nutzung von Metall-Kunststoff-Hybrid-Anbauteilen in der Karosseriestruktur des neuen Audi A8, Kunststoffe im Automobilbau, VDI Wissensforum GmbH, Düsseldorf 2010

By Ryan Katen, Micro Mold
and Rob Cooney, Plastikos

10 Basic Tips for Improving Manufacturability

We all have experience with parts that looked good on paper but didn't turn out well in production. There are some basic considerations that must go into designing a part beyond just aesthetics and function. Experienced engineers understand the importance of optimizing a part for manufacturability. So while many of you are probably already familiar with these pointers, this article will offer 10 basic tips to help you ensure your part is designed for maximum production efficiency.

1 **Maintain consistent wall thickness.** Consistent thickness makes your part much less likely to contain imperfections. Inconsistent thickness often creates sink marks; slight dips in the surface of a part; warp, distortion to the part caused by temperature variations during cooling; or voids, internal imperfections.

2 **Gate thick to thin.** Generally, a part should be gated thick to thin so that the last area to pack out is at the gate end of the part. That way, the gate end freezes off last and ensures adequate packing throughout the part.

3 **Avoid fragile features.** Mold ejection isn't always the gentlest of processes. As such, always consider the durability of the part to ensure that it is strong enough to handle the abuse of production. Avoid delicate, fragile features that have a tendency to break during the ejection process.

4 **Use the best material.** Certain materials do a better job than others filling out wall thicknesses, so make sure to choose the best material for your application. Many materials have more uniform shrinkage than others, which can influence the quality of the final part. More uniform shrinkage lowers the likelihood of warp. Often, it's a good idea to consult with an expert who has knowledge of the properties of various materials for advice on which ones are best suited for a given application.

5 **Make sure your part can be molded and your mold can be built.** Occasionally, it's possible to design a part that can't be molded. Beyond this concern, consider the mold itself and whether your steel can be fabricated according to the mold design. Steel often behaves differently during fabrication than you'd assume during design.

Feature: 10 Basic Tips for Improving Manufacturability Continued

6 **Know your steel.** It's important to make sure that the steel walls of your mold have adequate support in relation to the injection pressure. If the walls are too thin, a cavity can deflect under the pressure, causing flash or defects. Be sure walls in high-pressure areas are supported to prevent this problem.

7 **Line it all up.** Alignment is another key to a well-designed tool. When molds close, all components must align properly. Any misalignment will lead to premature wear.

8 **Anticipate wear.** Over time, all molds wear out and need sections replaced. On the front end, evaluate which parts of the mold will wear out most quickly due to abrasion of the materials. By identifying these sections, you can build replacement inserts. That way, the sections can be quickly replaced when necessary, significantly reducing downtime or interruption of production.

9 **Employ scientific molding.** Expert molders use what is known as Scientific Molding to evaluate the molding process and make any necessary adjustments. This provides a consistent, repeatable production of the part. Use this process to determine both the optimal molding conditions and the molding window—the best speed at which plastic should be injected.

10 **Install cavity pressure sensors.** Install these devices opposite the gate end of the mold and close to the last section to fill. Set a threshold on the sensor, generally a low limit for short shot and a high limit for flash. If the pin and the cavity sensor on the mold don't register the required pressure, the press will automatically divert the part with a chute or conveyor, letting you know your part is bad before the mold even opens.

To receive more information on this topic or consult with mold making or molding specialists, please call Plastikos at (814) 868-1656 or e-mail sales@plastikoserie.com.

Based in Erie, Pa., Plastikos and Micro Mold were founded to solve the most difficult problems that plagued customers and make the impossible, possible. Plastikos is a custom injection molder and its sister company, Micro Mold, focuses on medical mold building for small, tight-tolerance components. To learn more, visit Plastikos Inc. and Micro Mold online at http://www.plastikoserie.com.

Ryan Katen *is General Manager at Micro Mold, and he has more than 5 years of experience in the plastics industry.* **Rob Cooney** *is Vice President of Manufacturing at Plastikos, and he has more than 13 years of experience in the plastics industry.*

By Andre Eichhorn
AST Technology GmbH

Part Development Included Throughout Tooling and Production

In the high stakes game of product development, OEM's know that market share can swing quickly. As a result, product release timelines are continually compressed, making it very important to release a product to market as soon as possible to avoid falling behind a competitor with a similar product.

However, a product's release date and profitability can be threatened by problems and inconsistencies stemming from tooling and molding issues. In order to remove the risk that these problems might occur, a different approach has been developed that involves better connectivity throughout the design, tooling, and molding aspects.

"The Perfect Part"

Many factors will influence a plastic part's design as a part of an overall assembled product. Initially, the marketing and industrial design will determine the overall visual appearance and function of the end product. Further on, electrical and mechanical design will directly impact each individual part design, with input also coming from material suppliers, as well as processing and tooling personnel. But in the end all eyes will be focused on the production cost.

It will justify the feasibility of the release of the end product and generate the expectations as to the profits it will contribute.

It therefore becomes necessary to have a manufacturing system in place that comprises the following comprehensive steps for creating "the perfect product" and helps keep production costs in check:

- Combine Design for Manufacture (DFM) with "kit style tooling";
- Add in Process Optimization; and
- Prevent product development and production release from occurring in various "silos".

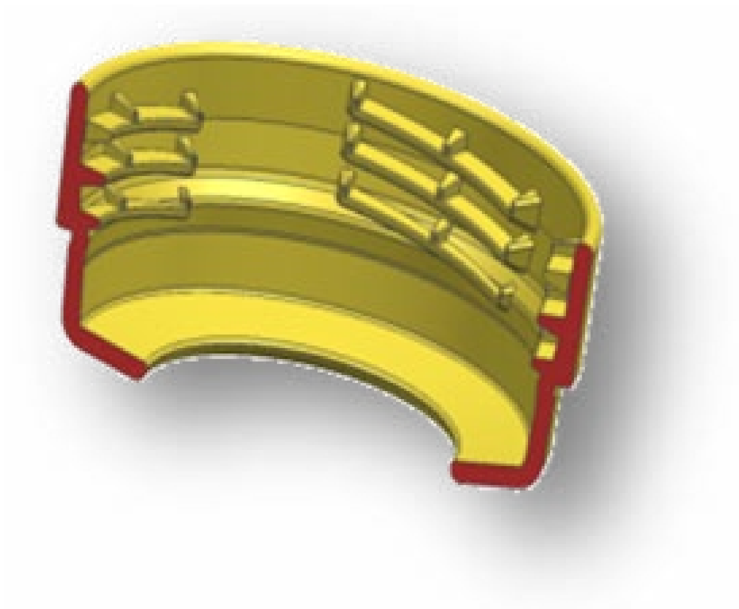
Optimized injection molding consists of three main areas:

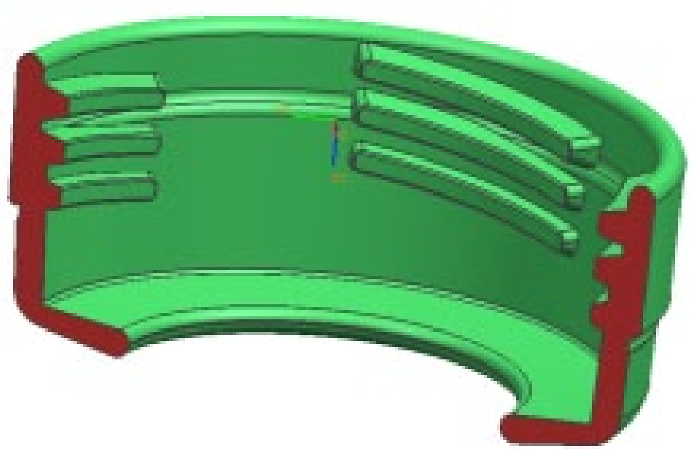
- Design For Manufacturing (DFM) – To get the best possible part design for production.
- Pre-engineered Tooling – To have reliable and cost competitive production tools available
- Injection Molding Processing – To develop the best possible injection molding process for consistent quality during production

Let's overview each area to gain a better understanding of the role it plays and the effect it has on the overall manufacturing process and outcome.

DFM

Design for Manufacturing analyzes the molded component design with regard to filling behavior. It also aids with material selections and will address the overall manufacturability of the component configuration. Using a structured approach with a structured documentation trail, the design is developed for the customer and all involved in the process, while all molded component related technical data is stored in one, revision-controlled place. Using this systematic approach makes it possible to make precise predictions on tooling, processing, cycle times and the production environment.





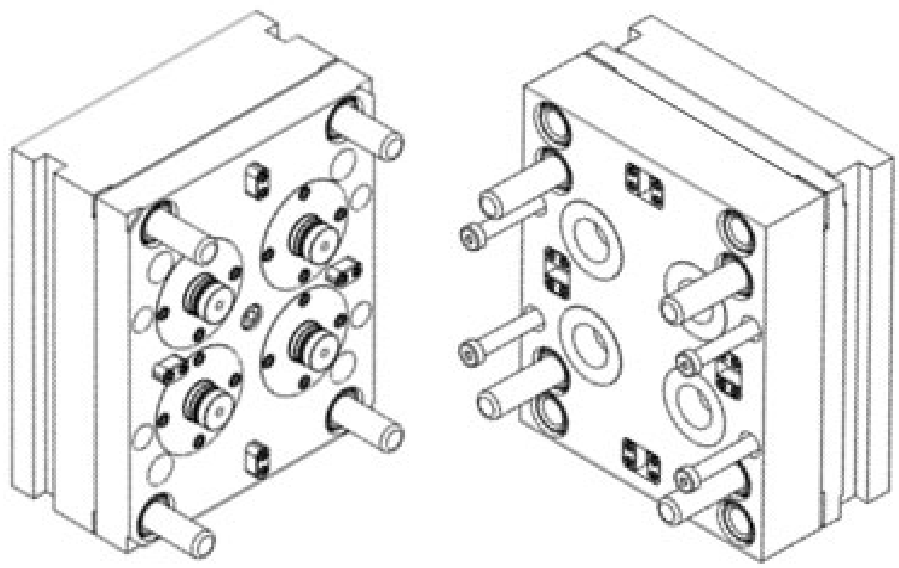
This baby collar cap shown in green was able to be optimized for efficient tooling and molding (yellow, redesigned version), resulting in 12% material savings and 42% lower cycle time. The Flow analysis performed during DFM also showed that the part quality was improved significantly.

Feature: Part Development Included Throughout Tooling and Production

Pre-Engineered Tooling

A customer-owned tool standard or requirement specification will shorten lead times and facilitate better cost control. To eliminate surprises and downtime, consistent mold inserts and components can be used for tool production, easing tool maintenance and tool repair. A certain level of reuse of mold components such as mold bases and hotrunners can be possible and, when combined with specific tool design rules, one can ensure that one gets the same tool and molded part quality from different suppliers.

In addition, the mechanical design and supporting DFM work are much more straightforward because everyone involved in the project understands and knows the capability of the tool standard and demolding features to be used.



"Kit style tooling" such as this four cavity standard cap producing mold, makes prototyping more efficient and predictable.

Injection Molding Processing

A stable injection molding process results in a safe and cost efficient production outcome.

Many injection molding processes are set as a result of an individual's expertise and knowledge of the machine, mold or material. Too often tooling or part design issues dictate how a mold will be run. The process becomes reactive rather than proactive.

The consistency of the injection molding process has a direct effect on quality, productivity and profitability. A structured and repeatable approach is needed to ensure that the best possible injection molding process can be achieved.

Continued involvement with DFM personnel during this manufacturing phase assures not only consistency for the program at hand, but also a continuous learning cycle for the entire team to hone the evolution of the most efficient practices together.

Feature: Part Development Included Throughout Tooling and Production

Methodical, proactive formulation of the molding process results in the maximum consistency and predictability needed for large scale product manufacturing.

A Continuous DFM Mindset

DFM support can be seen as a link between not only part design, but tooling and molding as well. Using a structured DFM approach and predefined DFM templates makes it possible to provide the tooling and production department with critical, upfront information prior to the tool builds.

Product development often becomes a race that does not include the initial engineers throughout the process. But, rather than viewing it as a luxury, embedding the DFM mindset throughout a project ensures that the prizes that were envisioned will be achieved.

Author:

Andre Eichhorn is the General Manager of AST Technology GmbH in Herford, Germany. He can be reached at contact@ast-tech.de.

AST Technology is part of the Progressive Group of Companies.

IMD Best Paper Finalist 2010

By Peter U. Jung, Yongrak Moon, and C.B. Park
Microcellular Plastics Manufacturing Laboratory
Mechanical and Industrial Engineering Department
University of Toronto
Toronto, Ontario, M5S 3G8, Canada

Comparison Study of N_2 and CO_2 as Physical Blowing Agents for Injection Foam Molded Wood-Fiber Plastic Composite

Due to rising environmental concerns, the plastic industry has been seeking bio-plastics that can replace current plastics. Efforts are continuously being made to reduce weight and cost without a major compromise to required properties. Foaming can offer a plastic with significant weight reduction. There has been research to evaluate the effects of chemical blowing agents (CBAs) on wood-fiber plastic composites (WPC). Although physical blowing agents (PBAs) have a number of advantages, their effects on WPC have not been fully investigated. Therefore, this research utilizes N_2 and CO_2 to analyze their effects on the foaming and mechanical properties of injection foam molded WPCs. For the last few decades, a number of different types of plastic composites have been developed to achieve industrial requirements such as lighter weight, lower material cost, better manufacturability, higher strength, and so on. Traditional examples include glass-fiber and mineral fillers, and their applications are often found in automotive parts. Because of rising environmental concerns, however, these conventional composites are being phased out and replaced by natural fibers such as wood, cellulose, hemp, and so on. Among them, woodfiber is definitely the most widely used and its applications vary from construction to automotive. The wood-fiber polymer composites are able to provide lower material cost and improved mechanical properties in terms of stiffness and strength [1].

It is a well-known fact that foaming technology can provide a significant weight reduction, so that the weight and material cost of the final product can be reduced dramatically. In order to employ the foaming technology, one strategy is to utilize a blowing agent. There are two of types blowing agents, chemical and physical. The chemical blowing agent (CBA) produces gas by chemical decomposition of its carrier whereas the physical blowing agent (PBA) is directly injected as gas or super critical fluid.

There have been a number of studies that discussed injection foam molding of various combinations of woodfiber and different thermoplastic polymers. However, most of them utilized CBAs to obtain foam structures because they can be utilized without any additional equipment. Thus, the effects of different types of PBAs on injection foam molded wood-fiber polymer composite (WPC) need to be further investigated. In addition, there are no studies that exclusively address the interrelationship between the foam structure and mechanical properties, although many researchers have reported both mechanical and cellular properties. The primary objective of this study was to investigate the effects of N_2 and CO_2 as PBAs on the foaming behavior and mechanical properties of WPC. The possible relationships between the foam structure and mechanical properties were studied.

Background

Compared to regular wood-fiber polymer composites, foamed wood-fiber materials have a number of advantages such as better acceptance of nails and screws, better surface definition, and improved dimensional stability [1, 2]. In addition, the advantages of injection foam molding technology include reduced cycle time, lowered processing temperature due to lower viscosity of molten polymer, and clamp force reduction [1]. In general, the microcellular plastics can achieve higher impact strength, higher toughness, better thermal stability, and lower thermal conductivity than the neat plastics [3-8].

A blowing (or foaming) agent is required to accomplish the polymeric foam structure. It can be classified as chemical blowing agent (CBA) or a physical blowing agent (PBA), based on the nature of gas formation [9]. CBAs are the substances that can liberate gaseous components via reactions and/or thermally induced decomposition within a polymer matrix [9]. According to their enthalpy reaction types, they are divided into two categories: endothermic and exothermic. The endothermic reaction is when the reaction absorbs energy from its surroundings; the exothermic one is when the reaction releases energy to its surroundings [1, 9].

Although foaming with CBAs does not need additional equipment changes, it certainly requires some considerations to be made regarding the dispersion of CBA particles, residence time, processing window compatibility with base polymer, type and amount of decomposed gas, and so on [9]. On the other hand, PBAs liberate gases by their physical state. They are dissolved into the molten polymer to form a saturated polymer/gas system; then it foams once it is subjected to an elevated temperature or reduced pressure [1, 9]. Traditionally, the PBAs were volatile organic chemicals; however, inorganic gases, such as carbon dioxide and nitrogen have become more in demand due to the increase of environmental concerns.

When CBAs are utilized to produce WPC foams, the decomposition temperature of CBA should be higher than the melting temperature of base polymer and lower than the degradation temperature of wood-fiber. The overall processing temperature also needs to be maintained at the lowest possible temperature to minimize volatile generation from wood-fiber [10]. However, these issues can be eliminated if PBAs are employed because they can be dissolved into the molten polymer by providing pressure that is higher than their solubility pressure.

For the last several years, many researchers have actively studied the extrusion foaming process of woodfiber polymer composites using several types of CBAs and PBAs [10-15]. In the case of CBA, Rizvi et al. achieved the lowest foam density of 0.55 g/cm^3 with the largest cell size less than 100 µm [12]. When PBA, specifically N_2, was employed, Guo et al. obtained a significantly lowered final foam density of 0.36 g/cm^3 with a similar range of cell size at the same die temperature. The experimental results also revealed that the processing window of PBA is much larger than that of CBA [15].

A number of studies has investigated various aspects of injection foam molding of wood-fiber polymer composites with various types of CBAs [16-23]. Bledzki et al. investigated the effects of different types of CBAs on the cellular properties of wood-fiber reinforced PP composite. Based on experimental results, the exothermic CBA was able to produce better overall foam structures compared to both endothermic and endo/exothermic CBAs [19]. However, the different types of CBAs did not demonstrate a significant effect when specific tensile properties of foam samples were evaluated [20]. In addition, it was observed that the addition of a coupling agent played a critical role in improving the mechanical properties of the wood-fiber polymer composite. Thus, the inter-phase adhesion between wood-fiber and polymer matrix was the predominant factor in determining the resulting mechanical properties of the injection foam molded structure [20].

The previously mentioned studies focused on determining how different CBAs influence foam structures and their mechanical properties. In these studies, the cellular and mechanical properties were evaluated

IMD Best Paper Finalist Continued

separately although the cellular parameters were expected to have a dominant effect on the mechanical properties of the foam structure. Therefore, this research study focused on investigating the effects of different PBAs on the foaming behaviour and mechanical strengths, as well as possible inter-relationships between these two properties.

Experimental

Materials

The polypropylene (PP) used in this study was BE170 supplied by Borealis, which has an average melt flow index of 13 dg/min and a density of 0.902 g/cm3. Pine 12040 from American Wood was utilized as the woodfiber. The coupling agent used was Fusabond P MD353D from DuPont, with an average melt flow index of 22.4 dg/min. The physical blowing agents, N_2 and CO_2, were supplied by BOC Gas.

Preparation of Wood-Fiber Polypropylene Composite (WPC)

The coupling agent and PP were dry-blended together based on the weight ratio in **Table 1**. For the compounding process of PP and wood-fiber, a co-rotating twin-screw extrusion system was utilized (Micro27-GG/GL from Leistriz with 40:1 L/D ratio). The PP and coupling agent blend were fed into the extruder through the main feeder (Brabender Technologies); whereas the wood-fiber was fed using the side-feeder (Brabender Technologies). The feeding ratio was determined according to the **Table 1**.

Injection Foam Molding Process

An Arburg 270C injection molding machine, equipped with a MuCell® system, was employed in this research. The three different contents of two PBAs were injected for both 90% and 80% shot size samples as shown in **Table 2**. The other processing parameters were consistent throughout the experiments, which are described in **Table 3**. A simple plate design mold with the dimensions of 111.7 mm × 134.6 mm × 3.2 mm was used in this research.

Foam Characterization

In this study, local void fraction, cell density, and cell perimeter were measured to evaluate the foaming behavior of the sample. Each measurement was repeated at three different locations on the sample as illustrated in **Figure 1** to examine homogeneity of foam structure within the sample. The foam density is determined by the water displacement method (ASTM D792-00). The expansion ratio (Φ) is calculated on the basis of the ratio of the bulk density of WPC (ρo) and the measured density of the foam sample (ρf). The void fraction is determined by

Table 1
Material Composition of WPC

Material	PP	Wood-fiber	Coupling Agent
Weight %	65	30	5

Table 2: PBA Contents

PBA Type	Low	Medium	High
N_2 [wt%]	0.3	0.5	0.7
CO [wt%]	1.0	3.0	5.0

Table 3:
Processing Conditions of Injection Foam Molding

Processing Parameter	Set Value
Processing Temperature	175 °C
Injection Speed	100 ccm/s
Mold Temperature	35 °C
Gas Delivery Pressure	3000 psi

Equation (1):

$$Void\ Fraction = (1 - \frac{1}{\Phi}) \times 100\% \qquad (1)$$

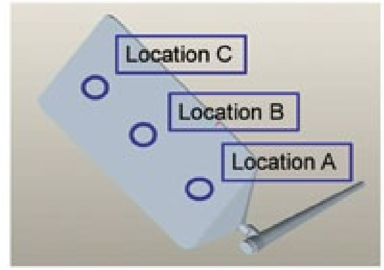


Figure 1: Measurement locations for cellular properties

The cell density was calculated using scanning electron microscopy (SEM) images. The samples were put into liquid nitrogen and fractured to reveal their cellular morphology. The samples were then coated using an argon sputter coater to enhance their conductivity. Finally, the morphology was observed using an SEM (JSM-6060, JEOL). The cell density is the number of cells per unit volume of unfoamed material, which was determined based on the following equation:

$$Cell\ Density = \left(\frac{nM^2}{A}\right)^{3/2} \times \Phi \qquad (2)$$

where n is the number of bubbles in the micrograph; A is the area of the micrograph; Φ is the expansion ratio; and M is the magnification factor of the micrograph. The cell perimeter was measured from the SEM picture using image processing software called Image-Pro Plus from Media Cybernetics.

Mechanical Properties

Since mechanical properties are often considered as the most important properties for the final products, three critical mechanical tests – tensile, flexural, and impact tests – were performed to evaluate the effects of using different PBAs. The tensile test was performed based on ASTM D638-03 and using the Type IV test specimens. The strain rate was 5 mm/min and the measured values were maximum tensile strength (or ultimate tensile strength) and tensile modulus. Instron 3367 was utilized for the test.

For flexural properties, the test was conducted based on ASTM D790-00 specifications; the dimensions of the test specimen were 127 by 12.7 by 3.2 mm. The length of the support span was 50 mm and the speed of the crosshead was 6.5 mm/min. The measured values were flexural modulus and flexural strength. The test was again performed using the Instron 3367 testing system.

To determine the impact properties, the notched IZOD pendulum impact testing was completed according to ASTM D256-00. The Type A test method was implemented and the impact resistance of the sample was measured. The testing system used was Model 892 from Tinius Olsen.

Results and Discussion

Foaming Behavior with Different PBAs

Foaming properties of the 90% shot size sample with N_2 are exhibited in **Figure 2, page 28**. In terms of cell density, the cell density at location C was significantly lower than the other two locations because this initial flow was exposed to a relatively lower pressure during mold filling, which encouraged severe cell coalescences. Therefore, the average cell perimeter at this location was certainly larger than those from the other two locations. These large coalescence cells also contributed to achieving lower local void fraction.

In **Figure 3**, **page 28** the foaming behavior of the 80% shot size sample with N_2 are described. In this case, uniform cell density was achieved throughout the sample, which meant cell nucleation occurred between the

IMD Best Paper Finalist Continued

injection nozzle and gate to maintain the in-mold pressure consistent at the three locations. As a result, the average cell perimeter, as well as the local void fraction, was more consistent than in the previous case. This uniformity was maintained not only with different locations but also with various contents of N_2.

Figure 4, page 29 shows the cellular properties of the 90% shot size sample, which was foamed with using CO_2. In the case of 1.0 wt% CO_2, the mold was not fully filled. Thus, initially nucleated cells were able to survive, which settled at location C. However, the cells at the later stage of the mold filling experienced low in-mold pressure due to this incomplete fill, which resulted in cell coalescences. This is why location A and B had considerably lower cell density values. When 3.0 and 5.0 wt% of CO_2 were injected, the properties followed the similar trend as those of the 90% shot size N_2 samples.

In case of the 80% shot size sample with CO_2, the foaming properties are shown in **Figure 5, page 29**. For 1.0 and 5.0 wt% CO_2 samples, the properties were varied significantly throughout different locations of sample. The nonuniformity of the 1.0 wt% CO_2 sample was caused by the identical mechanism as in the 1.0 wt% CO_2 case of the 90% shot size sample. For the 5.0 wt% CO_2 sample, few gas pockets were observed on the sample surface, which provided evidence of excessive gas content. With 3.0 wt% of CO_2, the 80% shot size sample exhibited uniform foaming behavior in terms of all three measured foam properties.

To evaluate the uniformity of each PBA, the individual distribution of cell density and cell perimeter with respect to three measurement locations has been studied. **Figure 6, page 30** illustrates the cell density distribu-

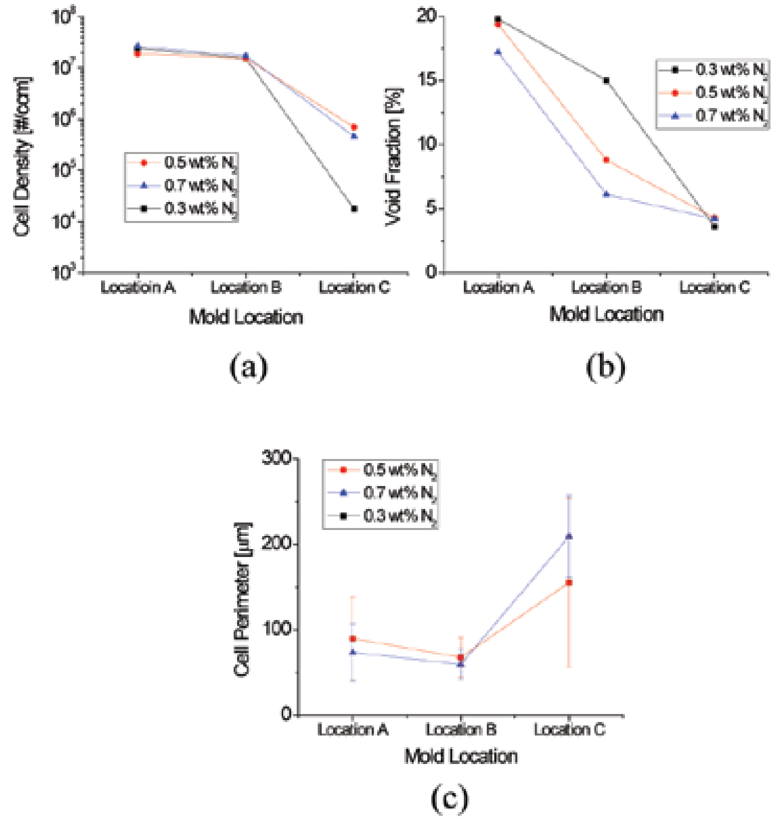


Figure 2: Cellular properties of 90% shot size samples with N_2 (a) cell density, (b) void fraction, and (c) cell perimeter.

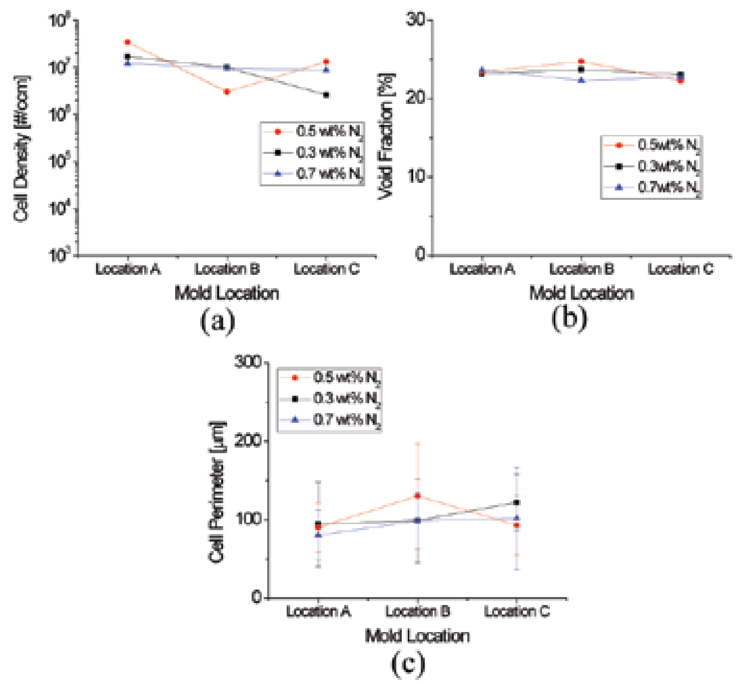


Figure 3: Cellular properties of 80% shot size samples with N2 (a) cell density, (b) void fraction, and (c) cell perimeter.

IMD Best Paper Finalist Continued

tion of N_2 and CO_2 samples. It is clear that N_2 was able to provide more uniformly distributed cell density than CO_2 regardless of their contents. Similar to the cell density distribution, the N_2 samples also exhibited superior consistency in terms of cell perimeter distribution according to **Figure 7, page 30**. In addition, the average cell sizes in the N_2 samples were significantly smaller than those in the CO_2 samples.

Mechanical Properties

Since N_2 was able to achieve much improved and uniform foam structures than CO_2 based on the foaming behavior analysis, N_2 samples were also expected to outperform CO_2 samples in terms of mechanical properties. However, the measured mechanical properties of the N_2 samples had enhanced properties for only the 90% shot size samples in tensile characteristics as shown in **Figure 8, page 30**. For 80% shot size samples, there was virtually no difference between N_2 and CO_2 samples in terms of both maximum tensile strength and modulus.

In case of flexural properties as shown in **Figure 9, page 30** 90% shot size samples did not have notable variance with respect to different types of PBAs for both flexural strength and modulus. For 80% shot size samples, however, CO_2 samples were able to obtain approximately 17% higher average strength and 20% higher average modulus.

When the impact strength was measured, the CO_2 samples demonstrated higher impact strength than the N_2 samples for 90% shot size as illustrated in **Figure 10, page 31**. In case of the 80%

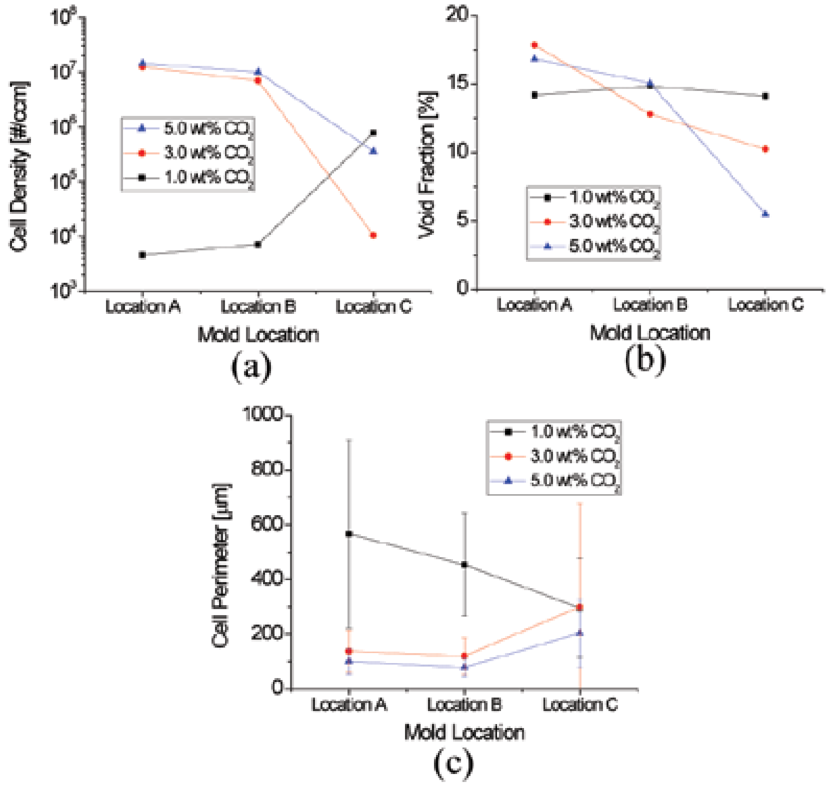


Figure 4: Cellular properties of 90% shot size samples with CO_2 (a) cell density, (b) void fraction, and (c) cell perimeter.

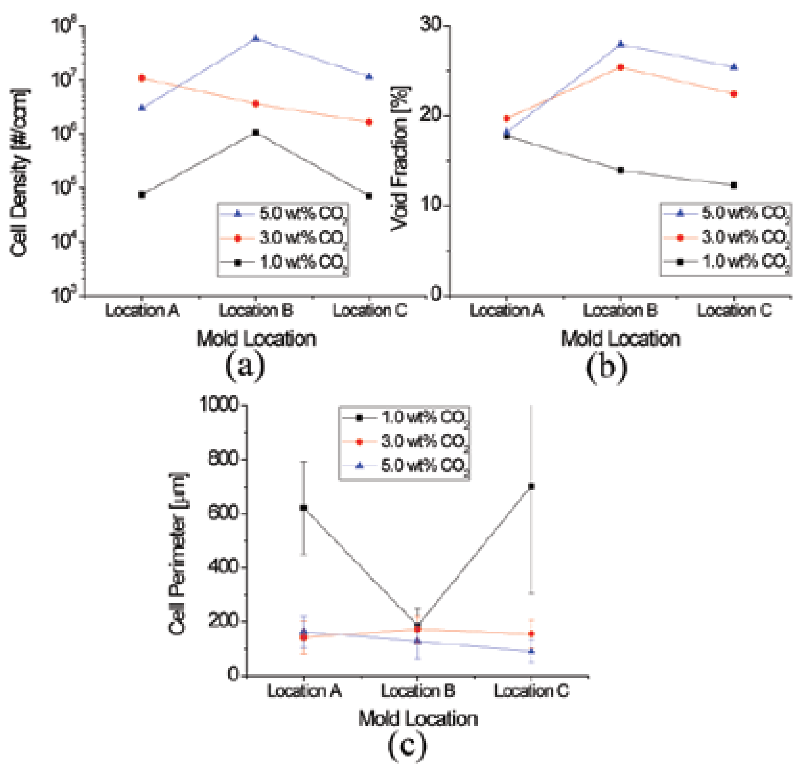


Figure 5: Cellular properties of 80% shot size samples with CO_2 (a) cell density, (b) void fraction, and (c) cell perimeter.

IMD Best Paper Finalist Continued

shot size samples, however, there was no significant difference between the strength values of N_2 and CO_2 samples.

According to the experimental results, it was realized that the utilization of different PBAs did not provide significant variances in the mechanical properties; whereas N_2 was able to provide much more enhanced cellular morphology than CO_2. Nonetheless, further study was carried out to investigate the relationship between the cellular properties and mechanical properties. Unexpectedly, the cell density and average cell perimeter values could not establish definite relationships with the mechanical properties. On the other hand, it was determined that the void fraction values had some linear relationships with the mechanical strength and modulus values, as shown in **Figure 11 page 31**. As the void fraction was decreased, in general, the strength and modulus values were decreased as well. The void fraction is a representation of how much void space exists within the structure. In other words, the higher the void fraction, the smaller the actual solid cross-section area where force could be applied on. Therefore, the mechanical strength and modulus values were reduced as the void fraction values were increased.

Conclusion

Although PBAs have several advantages over CBAs especially for WPC foaming applications, the effects of the utilization of PBAs have not been investigated extensively

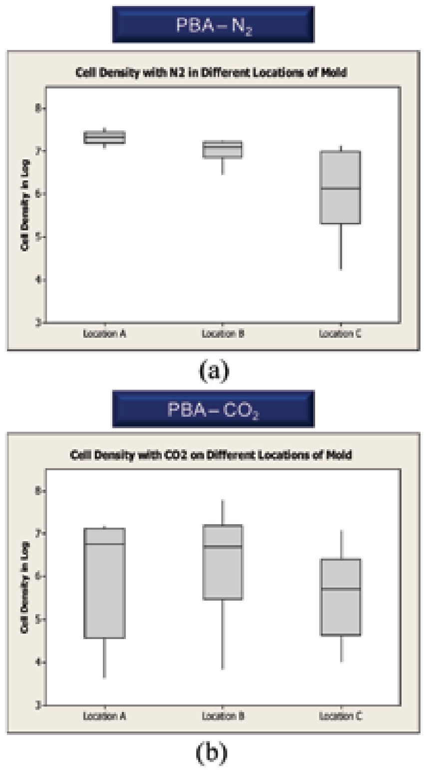


Figure 6: Cell density distribution for (a) N_2 and (b) CO_2

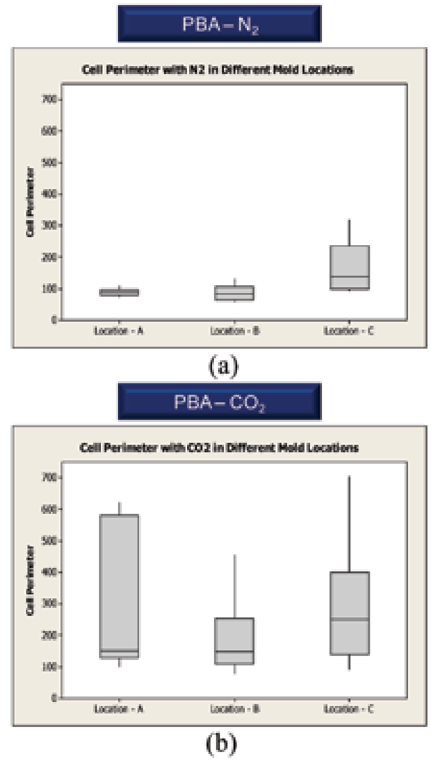


Figure 7: Cell perimeter distribution for (a) N_2 and (b).

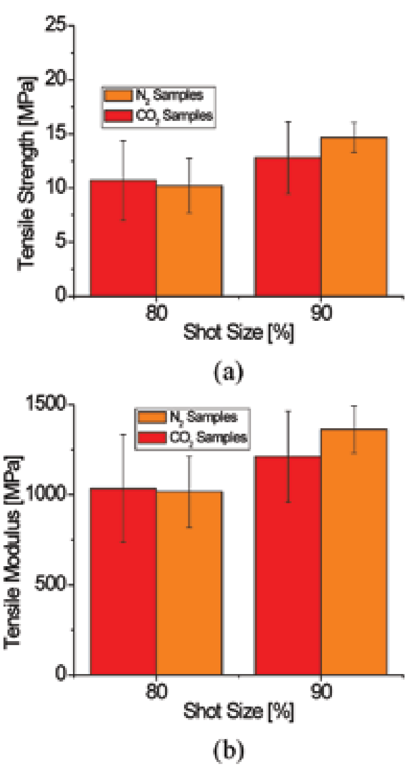


Figure 8: Tensile properties of injection foamed WPC samples (a) tensile strength and (b) tensile modulus.

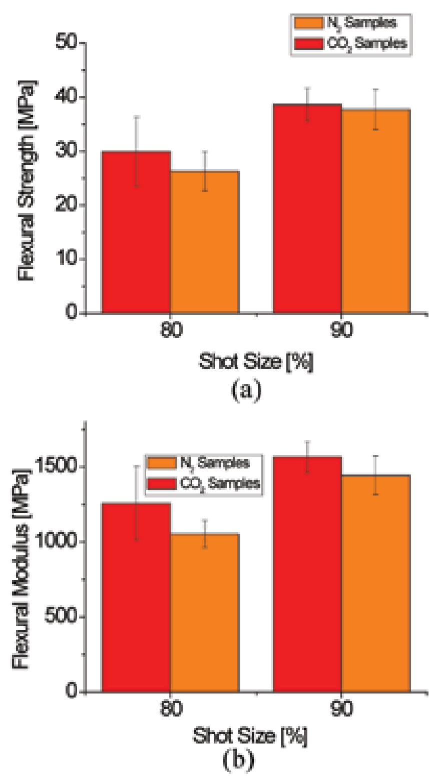


Figure 9: Flexural properties of injection foamed WPC samples (a) flexural strength and (b) flexural modulus.

IMD Best Paper Finalist Continued

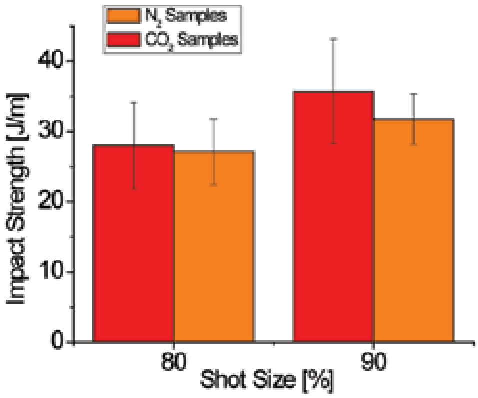


Figure 10: Impact strength of injection foamed WPC.

for injection foam molding process because it is technologically more challenging and requires a special gas injection system. Therefore, this research was conducted to investigate the effects of two different PBAs (CO_2 and N_2) in the injection foam molding process for WPC on its foaming behavior and mechanical properties. As a result, N_2 was able to produce a foam structure with significantly smaller cell sizes and higher cell density than that of CO_2. In terms of the mechanical characteristics, the effects of PBAs were not consistent. The cellular characteristics were analyzed with the mechanical properties in order to determine the inter-relationships between these two blowing agents. According to the results, although the average cell size and cell density values did not have distinguishable relationships with the measured strength and modulus values, the actual void fraction values were related to all measured mechanical properties in a consistent linear fashion. Further in-depth studies will be required to determine the dominant characteristics of foam structure for its mechanical properties.

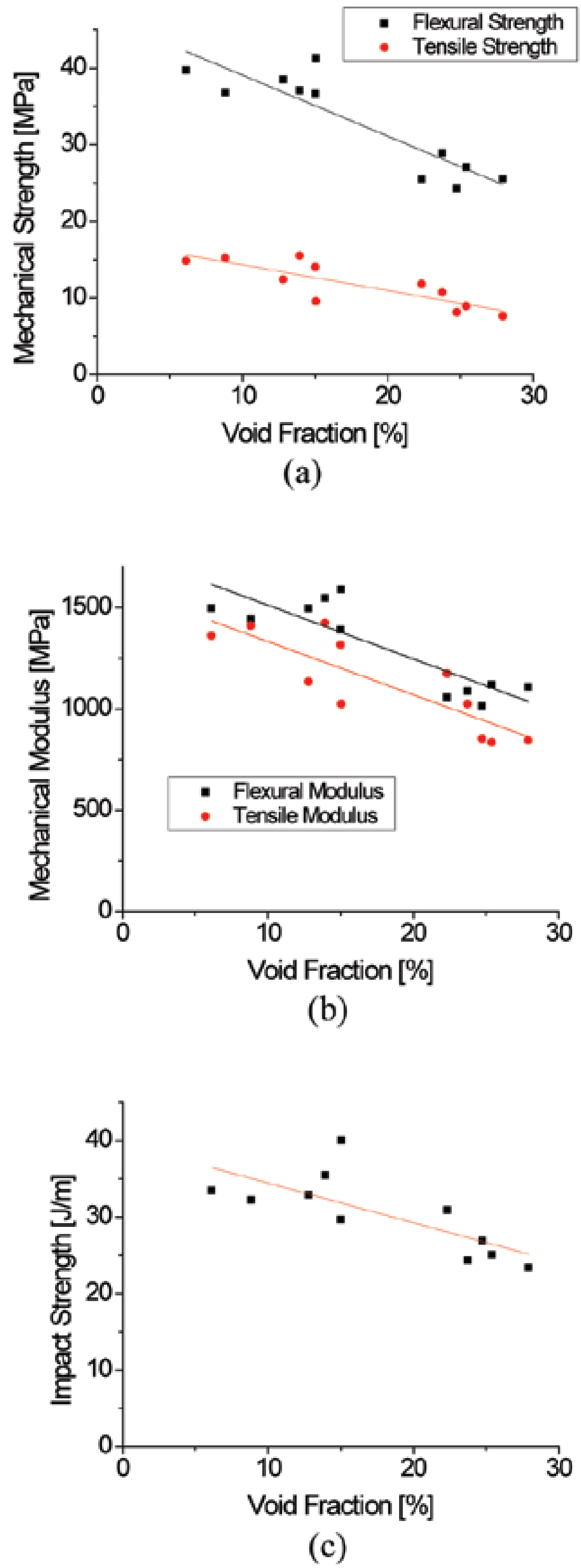


Figure 11: Actual void fraction values vs. (a) mechanical strength, (b) mechanical modulus, and (c) impact strength values.

IMD Best Paper Finalist Continued

Reference

1. O. Faruk, A.K. Bledzki, and L.M. Matuana, Macromol. Mater. Eng., 292, 113-127 (2007).
2. J.D. Yoon, T. Kuboki, P.U. Jung, J. Wang, and C.B. Park, Composite Interfaces, 16, 797-811 (2009).
3. S. Doroudiani, C.B. Park, and M.T. Kortschot, Polym. Eng. Sci., 38, 1205 (1998).
4. L.M. Mutuana, C.B. Park, and J.J. Balatinecz, Cell. Polym., 17, 1 (1998).
5. D.F. Baldwin and N.P. Suh, SPE ANTEC Technical Papers, 1503 (1992).
6. D.F. Baldwin, N.P. Suh, and M. Shimbo, Polym. Eng. Sci., 35, 1387 (1995).
7. D.F. Baldwin, N.P. Suh, and M. Shimbo, Polym. Mater. Sci. Eng., 37, 512 (1992)
8. N.P. Suh, Macromol. Symp., 201, 187 (2003)
9. S.T. Lee, C.B. Park, and N.S. Ramesh, Polymeric Foams: Science and Technology, CRC Press (2007).
10. C.B. Park, G.M. Rizvi, and H. Zhang, U.S. Patent No.6,936,200 B2 (2005).
11. G.M. Rizvi, L.M. Matuana, and C.B. Park, Polym. Eng. Sci., 40, 2124 (2000).
12. G.M. Rizvi, C.B. Park, G. Guo, and K.H. Wang, SPE ANTEC Technical Papers, 1041 (2003).
13. H. Zhang, G.M. Rizvi, and C.B. Park, Adv. Polym. Tech., 23, 263 (2004).
14. H. Zhang, G.M. Rizvi, W.S. Lin, G. Guo, and C.B. Park, SPE ANTEC Technical Papers, 47, 1746-1758 (2001).
15. G. Guo, Y.H. Lee, G.M. Rizvi, and C.B. Park, SPE ANTEC Technical Papers, Paper #102038 (2005).
16. A.K. Bledzki, O. Faruk, SPE ANTEC Technical Papers, 1897 (2002).
17. A.K. Bledzki, O. Faruk, and W. Zhang, Fifth International AVK-TV Conference for Reinforced Plastics and Thermoset Moulding Compounds, September 17-18, Baden-Baden, Germany (2002).
18. A.K. Bledzki and O. Faruk, Cell. Polym., 21, 417 (2002).
19. A.K. Bledzki and O. Faruk, Seventh International Conference on Woodfiber-Plastics Composites, May 19-20, Madison, Wisconsin, USA (2003).
20. A.K. Bledzki and O. Faruk, Workshop on Innovative Materials on the Base of Modified Wood Fiber and Polyolefins, February 14-16, Kassel, Germany (2002).
21. A.K. Bledzki and O. Faruk, SPE ANTEC Technical Papers, 2665 (2004).
22. A. K. Bledzki and O. Faruk, J. Cell. Plastics., 42, 63 (2006).
23. H. Winata, L.S. Turng, D.F. Caulfield, T. Kuster, R. Spindler, and R. Jacoson, SPE ANTEC Technical Papers, 701-705 (2003).

IMD Leadership

DIVISION OFFICERS

IMD Chair
Lee Filbert, IQMS
lfilbert@iqms.com

Chair-Elect
Jan Stevens, Tupperware
janstevens@tupperware.com

Past Chair, Alt. Treasurer
Dave Karpinski, NorTech
dkarpinski@nortech.org

Executive Committee Liason, Nominations Chair
Hoa Pham, Wash. Penn Plastics
hp0802@live.com

Secretary, Student Activities Chair
Walt Smith, Xaloy, Inc.
w.smith@us.xaloy.com

Technical Director
Peter Grelle
bevcard70@aol.com

Treasurer
Jim Wenskus
allerlei@alum.mit.edu

BOARD OF DIRECTORS

Awards Chair Communications Chair, Website Chair
Jim Peret
Vegawatt
JimPeret@cox.net

Councilor, Reception Chair
Jack Dispenza, Ideal Jacobs
jackdispenza@gmail.com

Education Chair
Pat Gorton, Energizer
pgorton@energizer.com

Engineer of the Year Award
Kishor Mehta, Plascon Assoc.
ksmehta@nauticom.net

Historian, Fellows & Honored Service Awards
Larry Schmidt
LR Schmidt Associates
schmidtlra@aol.com

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

TPC 2010
Jan Stevens, Tupperware
janstevens@tupperware.com

TPC 2011
Susan Montgomery, Priamus
s.montgomery@priamus.com

Board Member
Erik Foltz, The Madison Group
erik@madisongroup.com

Board Member
Brad Johnson, Penn State Erie
bgj1@psu.edu

Board Member
Raymond McKee, Rexam
raymond.mkee@rexam.com

Board Member
Lih-Sheng (Tom) Turng
Univ. of Wisconsin–Madison
turng@engr.wisc.edu

Board Member
Michael Uhrain, Demag
michael.uhrain@dpg.com

Emeritus Board Member
Don Allen
Phillips Sumika
okaafd@msn.com

Emeritus Board Member
Larry Cosma
Performance Polymers
LarryCosma@yahoo.com

Emeritus Board Member
Mal Murthy
Doss Plastics
dosscor@gmail.com

Emeritus Board Member
Jim Peret
Vegawatt
JimPeret@cox.net

IMD Board of Directors Meeting

February 4, 2011 – Orlando, FL

Chair:	**Lee Filbert**
Chair-Elect:	**Jan Stevens**
Councilor:	**Jack Dispenza**
Technical Director:	**Peter Grelle**
Treasurer:	**Jim Wenskus**
Secretary:	**Walter Smith/Hoa Pham**

Chair, Lee Filbert - Welcome

Quorum was established. Chair Filbert called the meeting to order at 8:55 AM, and welcomed all attendees.

Lee reported that Walter Smith resigned from the Board, and asked Hoa Pham to take the minutes for this meeting. He also reported that Dave Karpinski would not apply for re-election to The Board. Lee yielded time to Dave Karpinski.

Dave expressed his appreciation for the Board's support and friendship during his tenure.

Approval of May 5, 2010 Meeting Minutes

The meeting minutes of May 5, 2010 were presented.

Kishor Mehta moved that the May 5, 2010 meeting minutes be approved. Jack Dispenza seconded and the motion carried.

Treasurer, Jim Wenskus – Financial Report

Jim Wenskus reviewed the IMD finance from July 1, 2010 through December 31, 2010. With income and expenses kept within plan, the financial status was positive.

The budget for the 2011 – 2012 fiscal year was proposed. The impact of having a new editor/ publisher for the newsletter was discussed.

Councilor, Jack Dispenza – Council Meeting Report

Jack summarized the highlights of the Fall Council meeting on September 24 – 25, 2010:

- Completed SPE elections: J. Griffing – President; J. Ratzlaff – Sr. Vice-President; V. Boolani – Vice President; D. Cameron – Chair, COW
- Approved SPE 2011 budget.
- Stabilized membership; Working on Bylaws to redefine Council attendance.
- Rolling out new technology infrastructure to handle vast database, reduce cost, increase functionality and provide ease of use.
- Requested the Board to support SPE's Student Activities initiative. Details to be discussed under Student Activities Committee Report.

SPE Leadership Services Manager, Tricia McKnight – SPE Update

Tricia gave an overview of major milestones at SPE:

- SPE finances have shown significant improvement. Expected net positive in 2011.

IMD Board of Directors Meeting Continued

- Continuing efforts to grow membership and increase retention rate.
- Developing programs to address the changing demographics.
- Implementing change in business model for seminars.
- Changing the SPE on-line store.
- Gained success in socially oriented activities such as social media (Facebook, LinkedIn) and networking events.

Chair-Elect, Jan Stevens – Pinnacle Award

Jan reported that he submitted the IMD Pinnacle Award application for both the silver and gold levels. He discussed activities needed for next year's application.

Technical Director, Peter Grelle – Technical Report

Peter reviewed the trends in IMD ANTEC papers and the status on TOPCON.

IMD ANTEC Papers:

- 70 papers submitted for ANTEC 2011 (`30% down vs. 2005 also in Boston) – 53 papers accepted
- Papers from academia showed ~60% decrease, industry remained flat, and academia-industry joint papers increased 20%.
- Many more technical papers than commercial.
- Percentage of US papers has increased.

TOPCON Update:

- IM TOPCON at Penn State, Erie June 15 – 18, organized by Brad Johnson; focus on medical
- Minitec co-sponsored with the Upper Midwest/Medical Division – Discussed the timing, and the Board approved to organize the Minitec in 2012 to avoid conflicts with the IM TOPCON and Eurotec.

Education Committee Chair, Pat Gorton

Pat proposed to change the wording of the Bylaws section 6.1.6 to clarify the role of the Education Committee. After discussions, the Board agreed to clarify the role while maintaining flexibility.

Based on Pat's survey, he identified several themes where education could be beneficial to members:

- Sustainability – biodegradability, biopolymers, additives
- Emerging technologies – microcellular foaming, multishot
- Processing – biopolymers, thermal degradation, stability
- New and modified materials – biopolymers, fillers, modifiers

ANTEC 2011 Technical Program Chair, Susan Montgomery

Susan gave an update on the technical paper review and the preparations for ANTEC technical sessions.

Of the 70 papers reviewed, 10 were accepted without revisions, 43 with revisions and 17 rejected.

Identified top 3 papers, to be announced at ANTEC 2011 IMD Reception.

Invited keynote speakers for one technical session, and for the Reception

Nominations Committee Chair, Hoa Pham

Hoa presented the candidates for Board officers, and made the motion to approve the nominees: Chair-Elect: Susan Montgomery; Treasurer: Jim Wenskus; Secretary: Hoa Pham; Technical Director: Peter Grelle. Jack

IMD Board of Directors Meeting Continued

Dispenza seconded and the motion carried.

Hoa presented Brad Johnson as the candidate for Councilor (3-year term) and made a motion to recommend that the Board approves this nomination. Jack Dispenza seconded, and the motion carried. Brad's name will be included in the general ballot for membership voting.

Hoa presented nominees for the general election to a three-year term on the Board. She made a motion to recommend that the Board approves the nomination of Jack Dispenza and Michael Uhrain for the 2011 ballot.

Kishor Mehta seconded and the motion carried.

Fellows & HSM Committee Chair, Larry Schmidt

Larry reported that the Board had nominated Jack Dispenza for HSM, and the application was pending.

The SPE elected five new Fellows, of which two were nominated by the IMD – Professors David Kazmer and Furong Gao.

The deadline for 2012 Fellows & HSM is October 2011.

IMD Historian, Larry Schmidt

Larry reported that he would distribute hard copies of the history document at the next meeting (ANTEC 2011).

Membership Committee Chair, Nick Fountas

Nick reviewed membership trends:

- As of the end of December 2010, the IMD primary membership decreased slightly by 1%
- Composition of the Board: academia (14%), consulting (33%), equipment (24%), molder/OEM molder (19%), and resins/materials (10%).

Communications Committee Chair, Adam Kramschuster

Adam reported that he applied for the IMD Communications Excellence Award. He also highlighted some areas to improve overall communications:

- Increase interaction on Facebook and LinkedIn, and improve the IMD website.
- Strengthen the newsletter, which has been a successful tool for the Division, and pursue more effective marketing of this product.

Adam gave an update on the newsletter:

- New editor/publisher Heidi Jensen
- Sponsorships were ready for the Spring 2011 issue.
- Deadlines for content and sponsorships: Summer issue – June 1; Fall/Winter issue – October 3

The Board discussed briefly about getting sponsorships on the website. Lee suggested to focus first on getting the content on the website, then look at sponsorships.

European SPE Liaison, Jan Stevens

No new update

IMD Board of Directors Meeting Continued

Awards Committee Chair, Jim Peret

The Board discussed and agreed on the number of plaques for ANTEC 2011.

Student Activities Committee Chair, Jack Dispenza for Walter Smith

Jack reported on the SPE Student Activities initiative which consolidated all areas of activities supporting student members attending ANTEC (travel, luncheons, plant tours, etc). There were four categories of sponsorships: Platinum, Gold, Silver, and Bronze. The Board discussed the support of this initiative.

Jack made the motion for the Board to disburse $1000 for the Silver level contribution to the SPE Student Activities Committee. Tom Turng seconded and the motion carried.

Jack accepted to be Chair of the IMD Student Activities Committee to replace Walt who resigned from the Board.

Old Business, All

None

New Business, All

Jim Wenskus requested a new Assistant Treasurer to replace Dave Karpinski who elected to not apply for re-election to the Board.

Kishor Mehta reported that Tom Turng was selected as 2011 Engineer-of-the-Year. The Board congratulated Tom.

Lee Filbert encouraged the Board to identify 2 - 4 new Board members. Tom Turng suggested a candidate with European connection, and would invite this person to the next meeting.

Jim Wenskus followed up with the mystery composition of a plastic cup found at ANTEC 2010 meeting in Orlando. The major component was Polystyrene.

Next meeting: Sunday May 1, 2011 in Boston (ANTEC 2011)

Adjournment

At 2:40 PM, Hoa Pham moved to adjourn. Motion was seconded and carried.

IMD New Members

The IMD Welcomes 244 New Members From Around the World

Stan Agee
Mohammad Hossein Ahmadi
Neaz Ahmed
Jeremy E.J. Alexander
John Alger III
Mustafa Alioski
Gay Lee Alvis
Mandar Amrute
D. Anandamurali
B. Bharati Annamalai
Steve Armbruster
Teresa Arthur
S. Arunprasath
Haile Atsbha
Cyril Baidak
Liu Baosheng
Tyler M. Baran
Donald A. Berrill
Bikram Beura
A. Narasimha Bharathi
Nilesh Bhasvar
Kapell Kumar Birla
M. R. Biswal
Brian Black
Stephanie Blaha
Scott Blaine
Scott Brewer
Carl Brown
William Browne
Timothy P. Bryan
Deepak C.
Todd Callister
Kevin Casey
Eddy Chan
Dane Chang
Amador E. Charad
Sreenivas C.J.
Michelle R. Courneya
Vishal Das
Joni A. Davis
Mario Del Real
Joshua Derush
Dilip Dhobale
Joseph G. Dick
Yannis Dimakopoulos
Dawn Duncan
Michael F. Durina
Brad Faulkner
Mark W. Field
Paul L Finelt
Michael Formella
Robin Foster
Jason M. Fryer
Atul Gakhar
Richard J. Gallagher
Wayne Gerhardt
Henk Gerritsen
Anup Kumar Ghosh
Michael Gilchrist
Kyle Glavan
Nicholas H. Gniadek
Leslie Goff
P.R.S. Gopalan
Jim Greenhaw
Randy Guertin
Vilas Gupte
Nataraj H.
Michael T. Hammond
John Hanrahan
Terry M. Harris
Adam R. Hays
Joseph Hebert
Simon Ho
Kai Holl
Michael G. Holloway
Andrew Horsman
William Howard
Ben Hughes
Randy K. Hughes
Leon Hui
Zenji Inaba
Huseyin Irak
Patrick O. Jackson
Sunil Jacob
Nijith P. Jayan
Ted Johnson
Chacko Joseph
Ronald J. Juedes
Nagarajan Kamalakkannan
Vishnu Kamat
Costantinos Karicas
Dhaval J. Karkhanis
Mukund R. Kathare
Edward J. Kazor
Troy Keenan
John Keirstead
Ken Kelley
Donnie Kerksieck
Manish Khanna
William S. Kish
Yogendra S. Kolte
Jose Kong
Andrew Korzen
Andrew Kountz
C.R. Krishnamurthy
Sudhir Kulkarni
Anand Kumar
J. Shankar Kumar
Pradeep Kumar
Aaron J. Lapinski
Thomas Levasseur
Mike Lewis
Scott Linn
Jason D. Lipke
Jan Livingston
Gary W. Lockard
Greg Lusardi
Ed Lutz
Anthony Lytsikas
RAJA M
Phil Magnusson
V Manikandan
Antonio Marcucci
Ravindra Marudkar
Adesh Mathur
Andrew W. May
David L. Mayer
Christopher Mays
Joe McCaleb
Kenneth R. McCord
Patrick J. McDonough
Robert J. McHenry
Tom Mendel
M.D. Forhad Mina
Mary Ann Mings
Richard W. Moller
Ricardo Montes
Roy E. Moore
Bala Murali
Pierre Muri
G. Peter Murphy
Luke M. Murphy
G.S.V.L. Narayana Murthy
K. Nagaraj
B. Nagasayee
K. Narayanan
David Naughton
Griff Neighbors
Phu T. Nguyen
Mark C. Paddock
M. Padmanabh
Rajesh Panchal
K.V. Parthiban
Justin T. Patz
Thomas Paveglio
Vasant Pednekar
Gerald L. Peffley
Ricardo Pena
Christopher Thor Peplow
Anders S. Persson
R. Prabhu
Pat Primmer
Rohan Primrose
Geoff Puckett
Sandeep Puri
Hansraj R.
Srivathsan R.
N.K. Ramaswamy
P. Ramesh
Laird S. Raybuck
Mathew D. Raymond
Christopher Reeves
Ladis Reisinger
Sara L. Reynoso
Paul Robinson
Timothy Rourke
William R. Rousseau
Kaysie Rytlewski
Alfredo Saenz Fallas
M.S. Saravanan
Frances Scharnhorst
John A. Schmidt
Georg Schwalme
Arul P. Selvam
Acharya K. Sen
Ugur Sen
Nick Seto
Harit S. Shah
Nainesh Shah
Pulkit V. Shah
Rakesh Shah
Siva Shankaran N

IMD New Members Continued

Manish Sharma
Vinod Sharma
Mikko Silvennoinen
Joe Simmons
John M. Sims
Ankita Singh
Ram Veer Singh
Matt C. Smallwood
Justin Sowa
Jim Spatharos
Paul S. Sremcich
Girish Srinivasan
R. Srinivasan
Veeraraghavan Srinivasan
Wipoo Sriseubsai
Samantha Stone
Mark J. Summer
Andrew W. Svenningsen
Mariano Szellner
Subramaniam T.
Tadayoshi Takahara
Jonathan M. Tan
Stephen C. Taylor
Harshit A. Tejani
Aster Teo
Rajesh Theravalappil
Ryan Thomas
Deepak Thuse
Sergio Tkachuk
David Tonkiss
Apolonio Vargas Torres
Gregory E. Tremblay
Scott Tripple
John Tsamopoulos
Hakan Tunca
Victor Vazquez-Cruz
M.S. Venkataramani
C.R. Venkateswaran
Tom H. Vranken
Sachin Wagh
Sunil Waghralkar
Paul N. Walker
Barry J. Watson
Christian Wenk
Brian P. Wissner
Nathan G. Wright
Zhongbin Xu
G. Yuvaraj
A. Zainulabedin
Nan Zhang
Guoqiang Zheng
Ying-Guo Zhou

The IMD Also Welcomes Companies From 29 Countries

Argentina
Australia
Bangladesh
Belgium
Brazil
Canada
Chile
Colombia
Costa Rica
Czech Republic
Finland
Germany
Greece
Guatemala
Hong Kong
India
Iran
Ireland
Japan
Mexico
Netherlands
New Zealand
Peoples Republic of China
Saudi Arabia
Singapore
Sweden
Thailand
Turkey
U.S.A.

Representing More Than 157 Organizations, Including:

20 Microns Ltd.
3M Purification
ACOS Ltd.
ADC
Advanced Graphic Systems
Ajay Industrial Corporation Ltd.
Alimentos Ideal, S.a.
American Casting & Manufacturing
Applied Plastic Technology
Aqua Poly Equipment / Arhtech LLC
Arburg USA Inc.
Arcelik A S
Arizona Instrument
Arkema
Arkema Peroxides
India Pvt. Ltd.
Asheville Minerals & Chemicals Inc.
Associated Soapstone Dist. Co. Pvt. Ltd.
Autodesk
Autodesk Melbourne
Aziz Sezginis
Bangladesh U. of Engineering and Technology
BASF India Ltd.
Bayer MaterialScience Pvt. Ltd.
BD Medical
Becton Dickinson
BIC Violex SA
Birla Institute of Technology
Blow Line Plast
Brakes India Ltd.
Bright Autoplast Pvt. Ltd.
Callaway Golf
Carplast India
CIPET
Clariant Chemicals (India) Ltd.
Coperion Ideal Pvt. Ltd.
CSU
Datacolor
Diversified Plastics Inc.
DMSRDE
Donaldson Coordination Center
Dow Chemical
DSM Engineering Plastics
DuPont SA De CV
Erka
Evonik Degussa India Pvt. Ltd.
Fanuc India Pvt. Ltd.
Ferriot
First Engineering Plastics (India) Pvt. Ltd.
Flexituff International Limited
Ford India Pvt. Ltd.
Formulated Polymers Ltd.
Frontier Business Systems Pvt. Ltd.

IMD New Members Continued

G.V.S. Envicon Technologies Pvt. Ltd.

Gallagher Corporation

Glenair Inc.

Global Manufacturing Solutions

GLS Polymers Pvt. Ltd.

Gujarat Fluorochemicals Ltd.

Harita-NTI Ltd.

Hewlett Packard

Honeywell International India Pvt. Ltd.

Honeywell Technology Solutions Lab Pvt. Ltd.

Hydro S&S Industries Ltd.

Hyundai Motor India Ltd.

IKEA of Sweden AB

Indelpro Sa De Cv

Indian Institute of Technology Delhi

Infiltrator Systems Inc

ITW

ITW - Body & Interior Business

J.P. Polymers Pvt. Ltd.

J.R.D. Corporation

JDSU

Jiangsu U. of Science and Technology

Kautex Corp.

King Mongkut's Institute of Technology Ladkrabang

Koch-Alger and Assocs.

Kohler

Konkan Speciality Polyproducts Pvt. Ltd.

Kraiburg TPE Pvt. Ltd.

KraussMaffei Technologies India Pvt. Ltd.

L & T Plastics Machinery Ltd.

Lanxess Corp.

Leon Plastics Inc.

Liteonmobile

Lubrizol Corp.

Lucas-TVS Limited

M. Holland Company

Mahindra & Mahindra Ltd.

Manex Consulting

Mar-Bal Inc.

MD Plastics Inc.

Michada Resources

Microsoft

Milabtech LLC

Milliken Asia Pte. Ltd.

Molex Singapore Pte. Ltd.

Motherson Automotive Technologies & Engineering

Moulding Specialists

MRC Polymers

National Petrochemical Industrial Co. (NATPET)

Noetic Technologies Inc.

NOVA Chemicals

Oldcastle Precast

Onward Technologies Ltd.

Otario Tire Stewardship

Pandrol USA

Parker Hannifin Corporation

Paya Baspar Aria

PCS Company

Penn State U. - Behrend

Performance Plastics

Performance Plastics Ltd.

PF Associates,LLC

Philmac Pty. Ltd.

Pieresearch

Plasticos Tecnicos S.A.

PlasticPartSource

Poly Products Co. Pty Ltd.

Polymers International Australia Pty. Ltd.

Poly-Vac

PPC Moulding Services

Prabhu Polycolor Pvt. Ltd.

Pryde S.R.L.

Robert J. McHenry Inc.

Ropella

SABIC Innovative Plastics

Sakarya U.

Schoeller Arca Systems

Sercel Inc.

Shure Inc.

SKZ / Süddeutsches Kunststoff Zentrum

Sonoco Molded Plastics

Southco Inc.

Southwest Jiaotong U.

Suncast Corp.

Suttle Costa Rica

Technology Ranch

Thermoplastics Co.

Tomas Bata U.

Tupperware Brands Corp.

Tupperware Hellas S.A.

Turck Inc.

Tyco Electronics

U. Patras, Dept. of Chemical Engineering

Universidad Autonoma Del Estado De Hidalgo

University College Dublin

Vishal Plastic Industries

Vision Technical Molding LLC

Wacker Chemical Corp.

Washington Penn Plastic Co.

WDI

Welch Allyn

Welltec Machinery Ltd.

Wittmann Battenfeld

Zhejiang U.

Zhengzhou U.

Membership Application

Society of Plastics Engineers Membership Application

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

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

Applicant Information

Name:
first last mi

Company Name and Business Address (or College):
company/college:
job title:
address:
address:
city: state:
zip: country:

Phone/Fax Format: USA & Canada: (xxx) xxx-xxxx All Others: +xx(xx) x xxx xxxx

Work Phone: **Fax:**

Email: *used for society business only*

Home Address:
address:
city: state:
zip: country:

Home Phone:

(✓) **Preferred Mailing Address:** ❑ Home ❑ Business

Gender: ❑ Male ❑ Female

Birth Date: (mm/dd/yyyy)

Demographics

Job Function *(choose only one)*

- ❑ Consulting
- ❑ Design
- ❑ Education (Faculty)
- ❑ Engineer
- ❑ General Management
- ❑ Manufacturing
- ❑ Marketing/Sales
- ❑ Other
- ❑ Purchasing
- ❑ Quality Control
- ❑ R & D
- ❑ Retired
- ❑ Self-Employed
- ❑ Student
- ❑ Tech Support

Materials *(choose all that apply)*

- ❑ Composites
- ❑ Film
- ❑ General Interest
- ❑ Nylon
- ❑ PET
- ❑ Foam/Thermoplastics
- ❑ Polyolefins
- ❑ Polystyrene
- ❑ TPEs
- ❑ Thermoset
- ❑ Vinyls
- ❑ No Interest

Process *(choose all that apply)*

- ❑ Blow Molding
- ❑ Compression
- ❑ Compounding
- ❑ Engineering Properties
- ❑ Extrusion
- ❑ Fabrication
- ❑ Foam
- ❑ Injection Molding
- ❑ Mold Making
- ❑ Product Design
- ❑ Rotational Molding
- ❑ Thermoforming
- ❑ General Interest
- ❑ No Interest

The SPE Online Membership Directory is included with membership. Your information will automatically be included.

- ❑ Exclude my email from the Online Member Directory
- ❑ Exclude all my information from the Online Member Directory
- ❑ Exclude my address from 3rd party mailings

Payment Information

New Member 1 Year	New Member 2 Years *	Student Member
❑ US $144.00	❑ US $261.00	❑ US $31.00

My Primary Division is (choose from below)

Additional Divisions are available for a fee. Check below to select Additional Divisions.

- ❑ Additives & Color Europe (D45)
- ❑ Automotive (D31)
- ❑ Blow Molding (D30)
- ❑ Color & Appearance (D21)
- ❑ Composites (D39)
- ❑ Decorating & Assembly (D34)
- ❑ Electrical & Electronic (D24)
- ❑ Engineering Properties & Structure (D26)
- ❑ European Medical Polymers (D46)
- ❑ Extrusion (D22)
- ❑ Flexible Packaging (D44)
- ❑ Injection Molding (D23)
- ❑ Marketing & Management (D37)
- ❑ Medical Plastics (D36)
- ❑ Mold Making & Mold Design (D35)
- ❑ Plastics Environmental (D40)
- ❑ Polymer Analysis (D33)
- ❑ Polymer Modifiers & Additives (D38)
- ❑ Product Design & Development (D41)
- ❑ Rotational Molding (D42)
- ❑ Thermoforming (D25)
- ❑ Thermoforming, European (D43)
- ❑ Thermoplastic Materials & Foams (D29)
- ❑ Thermoset (D28)
- ❑ Vinyl Plastics (D27)

Students must supply graduation date: ______

Membership Amount ______

Primary Division FREE

Additional Division(s)
costs for each Additional Division

	1yr.	2 yrs.	
US	$10.00	$20.00	______

TOTAL ______

❑ CHECK ❑ VISA ❑ AMEX ❑ MASTERCARD

card number

expiration date (mm/yyyy)

PAYMENT MUST ACCOMPANY APPLICATION
No Purchase Orders Accepted

Checks must be drawn on US or Canadian banks in US or Canadian funds.

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

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

signature date

recommended by member (optional) Id #

WWW

Publisher Note | Sponsors

Message from the Publisher

New Editor/Publisher Is Heidi Jensen

Dear Readers,

You'll notice that some changes have been made to the look of ***Molding Views***. There is a lot of competition today for your reading time. So in addition to wanting this publication to be chock-full of useful information to help you in your jobs, I also want to make sure that it's the most attractive and easy to read as it can be. Let me know what you think.

With this Spring Edition, I'm delighted to welcome Steve Johnson of ToolingDocs as our newest **Ask The Expert** columnist. Steve has a wealth of information to share that will help you with your mold maintenance problems. Remember that you're invited to send questions related to their area of expertise to Steve (Mold Maintenance) steve.johnson@toolingdocs.com, Bob Dealey (Injection Molding) molddoctor@dealeyme.com, and Terry Schwenk (Hot Runners) tschwenk@processdesigntech.com.

If your company has a product or service that'll provide solutions for the injection molding community, please consider ***Molding Views*** Sponsorship Opportunities. With 5000+ current and past members worldwide, ***Molding Views*** can be a very valuable, very affordable touch-point with your target audience.

Finally, I want to express my deep appreciation to Chris Lacey for helping make as easy as possible the transition from her tenure as Editor/Publisher of ***Molding Views*** to mine.

Heidi Jensen

Try Out the New E-mail Links!
All our authors have e-mail links if you need to contact them for more information.

Become A Sponsor Today

The Injection Molding Division publication is issued three times a year to ***more than 5000 current and past members*** worldwide.

SPONSOR'S FEE SCHEDULE

1 page	$3,300/yr.
1/2 page	$1,900/yr.
1/3 page	$1,260/yr.
1/4 page	$960/yr.
1/10 page	$350/yr.

ISSUE DEADLINES

Summer Issue: *June 1, 2011*

AD SIZE	(W X H in inches)
1/10 page:	3 x 2 1/2
1/4 page std:	3-3/8 X 4-7/8
1/4 page horiz.:	4-3/4 X 3-1/4
1/3 page square:	4-3/4 X 4-3/4
1/3 page vertical:	2-1/4X 10
1/2 page horiz.:	7 X 4-7/8
1/2 page isl.:	4-3/4 X 7
Full page:	7 X 10

For information on sponsorships or article submissions please contact :
Heidi Jensen, 908-797-1968
SponsorIMDNewsletter@gmail.com