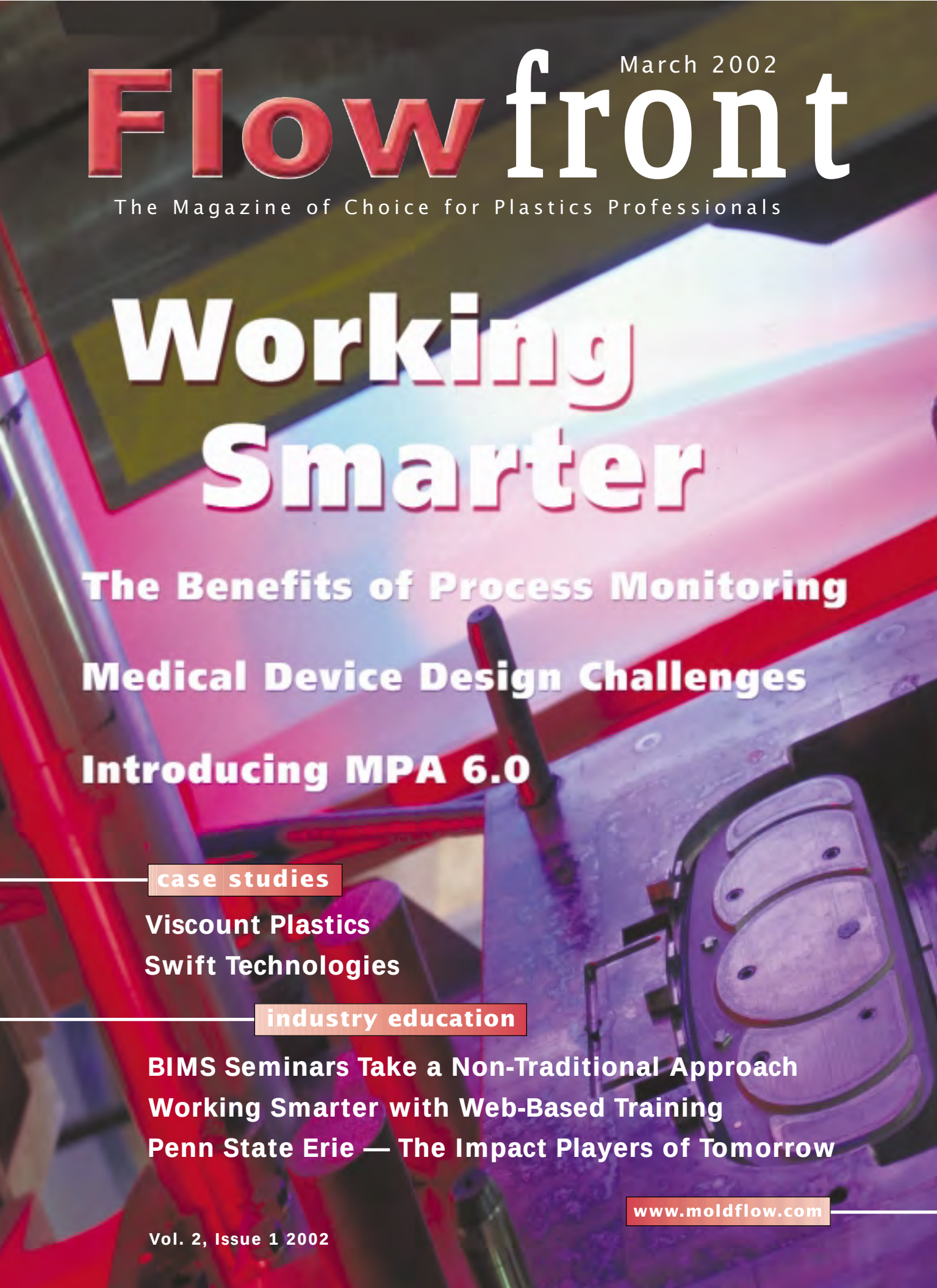
March 2002

Flowfront

The Magazine of Choice for Plastics Professionals



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Penn State Erie — The Impact Players of Tomorrow

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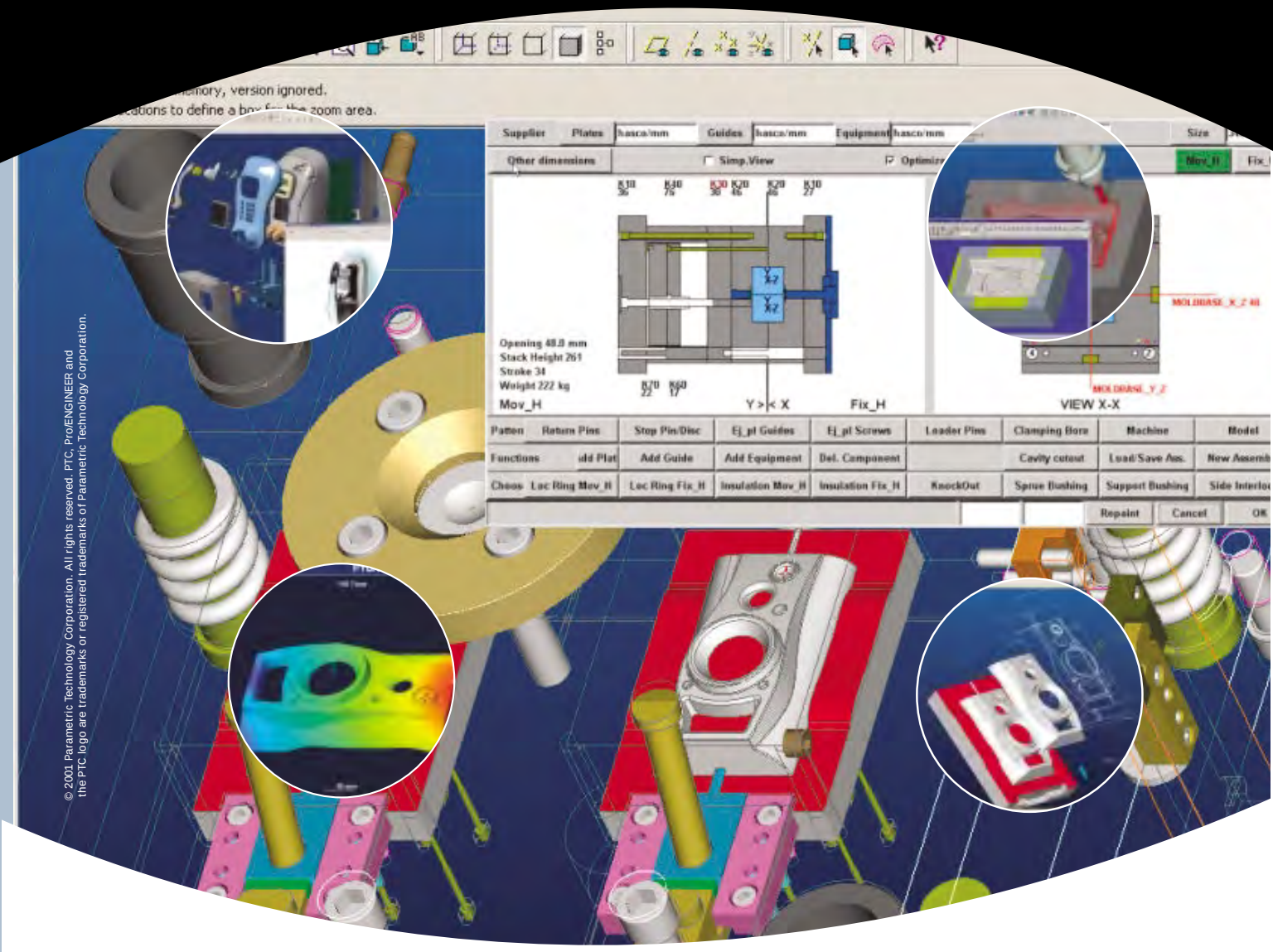
Art to Part at Breakneck Speed



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Finally! Refreshing news

Recently, I attended the Daratech Summit 2002 conference in New York City. It was well attended by technology leaders who now tout product lifecycle management (PLM) products and strategies. Whether you buy into this latest buzzword or not, I came away feeling much more confident about the state of our industry and the state of our economy. The reason? Presentations, in particular, by Bernard Charlès of Dassault Systemes, Carol Bartz of Autodesk, and Tony Affuso of EDS. They gave positive, uplifting commentaries about industry growth, profits, and new technologies that are helping to spur their businesses, and, more importantly, provide customers with innovative solutions to develop new products at record-breaking speed while reducing manufacturing costs and expensive prototypes. This is extraordinary good news for everyone served by these companies, their suppliers, and partners.

While the worldwide technology marketplace has experienced a rough road over the last 18 months, these three industry leaders envision a brighter future for everyone as we move forward into 2002 and beyond. In addition, Mark Goldstein, president and CEO of HKS, developer of worldclass ABAQUS CAE software and a Moldflow partner, announced his resolve at Daratech Summit 2002 to "take the wraps off" the company's quiet history. He provided statistics that showed stellar growth since the company's 1978 inception, as well as its recent news to partner with LMS and Dassault Systemes. More collaboration among vendors can only make the user workplace a friendlier, easier-to-innovate environment.

Even though Moldflow was not part of the Daratech Summit 2002 event, its latest news is just as encouraging. Company president and CEO Marc Dulude recently reported that the company's financial results for the second quarter of fiscal 2002 were encouraging. He said, "We entered this quarter with good visibility into our business and were able to close a high percentage of our sales opportunities. We were particularly pleased with the order flow for our Manufacturing Solutions products, which comprised 17% of our software product revenues this quarter. These products, which yield significant and rapid returns, present a compelling value proposition to injection molders who are seeking strategic advantages to remain competitive during this time of economic uncertainty."

In addition, this week financial guru Alan Greenspan announced that the global economy is beginning to turn around. I must believe that these technological and financial events and others to come will help our industry start to climb back to market profitability, calmer, more confident investors, and a bullish Wall Street. And, while it may be a little too early to toast to a new economy, I am confident that we can all rest easier, anticipate a brighter future, and confidently begin to consider reinvesting in profitable companies. We salute development and management teams everywhere that are committed to generating new products that exceed customer expectations as the economy moves back to a more stable, energetic state.

Certainly, Moldflow is taking the lead among leading software providers. This issue reveals how the company is offering innovative training and certification classes to help users become more productive and marketable. We describe the company's newest technologies, as well as detail customer testimonials as more competitive enterprises as a result of implementing the company's software. In addition, we believe in education - teaching university students the merits of using state of the art plastic simulation software as it relates to real-world applications before they enter the workplace. Case in point: we think you'll be impressed reading how Penn State University is using Moldflow technology in the classroom as an integral teaching tool. Students there are enthusiastic users who are realizing that the software will help them secure promising jobs that build upon lessons learned in the classroom.

Again, please send us your Moldflow software tips and techniques, questions, comments, and offers to act as customer testimonials. Send them to me at laura_carrabine@moldflow.com. I look forward to meeting with you at the 2002 International Moldflow User Group Conference as this issue unfolds.

Best Regards,

Laura Carrabine

Laura Carrabine
Editor

Focus on

Introducing Moldflow Plastics Advisers 6.0

By Murali Anna-Reddy, Moldflow Corporation

Introduction

Since its launch in 1997, the Moldflow Plastics Advisers™ product line has revolutionized the way that designers check their plastic part designs for manufacturability. The upcoming release of Moldflow Plastics Advisers 6.0 (MPA™ 6.0) provides users with significant new features and enhancements for collaborating with other users, providing product usage feedback in order to partner more closely with Moldflow, and increasing productivity. As part of Moldflow's commitment to provide ongoing value to the existing MPA customer base, most of the new features in MPA 6.0 are a direct result of customer enhancement requests.

This article describes in detail new MPA 6.0 features and enhancements, including:

- ❒ Moldflow Community Center — a suite of Web-centric tools that foster interaction with other MPA users and Moldflow Corporation.
- ❒ Automated Product Usage Feedback — an automatic method for submitting valuable product usage information to Moldflow to aid in creating better products.
- ❒ Gate Optimization Analysis — used to determine optimized gate dimensions.
- ❒ Automated gate design advice.
- ❒ Modeling tools and results visualization enhancements — including expanded automatic runner generation and geometry mirror capabilities, as well as a powerful results comparison feature.
- ❒ Enhanced CAD interfaces — MPA 6.0 supports Moldflow Design Link 3.0, which allows the direct import of native Pro/ENGINEER® part files, as well as Parasolid, STEP and IGES file formats.

Moldflow Community Center

The driving philosophy behind the new Moldflow Community Center is that a "whole product" implemented by the user is more than just a box of software. Just as important are elements such as service and support, market and industry education, product education, strategic partners, and a sense of community in which people work together to solve a common problem. Guided by this philosophy, the Moldflow Community Center has been developed to host a set of Web-centric tools that foster interaction and collaboration among MPA users and with Moldflow Corporation. Active maintenance users can access the Moldflow Community Center directly from within MPA 6.0 using embedded Web browser technology. The following tools are available at the Moldflow Community Center:

Discussion Group

Communicate with other MPA users, exchange ideas and tips, discuss issues, ask questions, and obtain answers. The discussion group facilitates a mechanism for users to gather collective knowledge and solve common problems.

Report Product Issues

MPA 6.0 streamlines the process of issue reporting by allowing users to report issues directly from within the product. A Moldflow customer support engineer will review the issue, take appropriate action, and update the customer on the problem-solving status.

Suggest Product Enhancements

MPA 6.0 users can have a say in future Moldflow software development by submitting enhancement requests to help us drive future product development.

Frequently Asked Questions (FAQ's), Known Bugs List, Hints & Tips

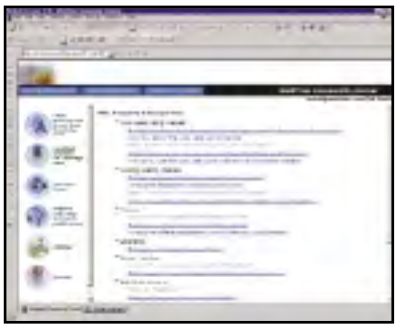
Stay up-to-date by reviewing FAQ's and the Known Bugs List. Also, become more productive by reading hints and tips posted by Moldflow support engineers and fellow users.

Direct Access to Knowledge Zone

Moldflow's Knowledge Zone is a vast information warehouse containing a wealth of knowledge on an array of topics from plastics product conceptual design to manufacturing. Tap into the Knowledge Zone content by linking to its Web site or perform a search to navigate directly to the topic of interest.

Product Revision Download

This feature allows users to access the most recent patch releases, ensuring they are using the latest technology.



Access Training Resources

View all training resources available for your Moldflow products and sign up for upcoming training sessions. Training elevates users to become more productive and maximizes their return on investment in Moldflow software.

File Exchange Area

This is a common file storage/download area for useful files such as common runner layouts, standard runner sizes, etc.

News Flash

The news flash relays important and time-sensitive information about MPA, the Moldflow Community Center, and any relevant current events.

It is increasingly more important to stay well connected with our customers to ensure that we are developing technology that adds value to our customers' processes.

Automated Product Performance and Usage Logging

Moldflow has kept abreast of customer expectations through a variety of methods including user surveys and user group meetings to ensure that we are developing technology that adds value to our customers' processes. We realize that one of the keys to meeting our customers' expectations and developing better products lies in the continuous monitoring and analysis of product performance and product usage.

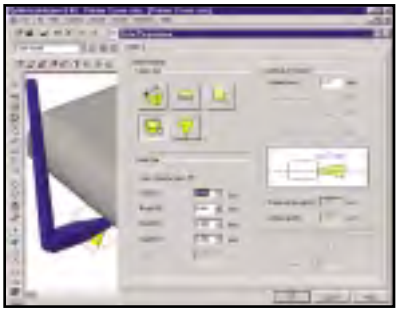
With that in mind, MPA 6.0 is configured to log product performance and product usage information and automatically send that information to Moldflow Corporation periodically. Information collected in these logs will allow us to investigate product usage patterns and identify areas for product improvements. Ultimately, this process will provide an opportunity for MPA users to more actively partner with Moldflow and help us create better products to meet their needs.

The product usage information will be automatically logged and uploaded to Moldflow Corporation through a secure FTP connection. It is important to note that no proprietary information is gathered in this process, nor will the data be shared with anyone outside of Moldflow Corporation.

Gate Design Optimization Tools

Troubleshooting and optimizing the gate design remain key challenges for many mold makers today. To help alleviate this problem, two powerful tools are introduced in MPA 6.0. The first of these tools is the ability to run an automatic gate sizing analysis, which estimates the best gate dimensions and automatically updates the model with the calculated dimensions. Automating the process of optimizing gate dimensions means mold designers have one less aspect to worry about in their mold design.

The second optimization tool is the automated gate design advice, which removes the guesswork involved in troubleshooting gate-related problems. Users are provided with gate-specific advice, allowing them to drill down at each gate and obtain specific advice on troubleshooting and solving gate design problems.



Moldflow Mold Adviser Modeling Enhancements

From a geometry model standpoint, a major focus of MPA 6.0 is to introduce several enhancements in Moldflow Mold Adviser that can drastically reduce the time spent in modeling, resulting in significant productivity gains.

In increasing the number of gate types supported, two new gate cross sections — half-round and trapezoidal — have been added to the database of available gate types. The half-round gate can be used to model gates that are part of an ejector pin or an insert. The trapezoidal gate allows for easier modeling of typical edge, fan, and tab gates.

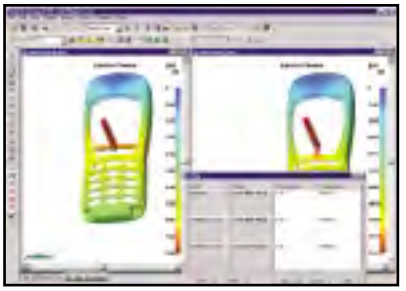
Within MPA 6.0, it is possible to perform an analysis with only the gate(s) attached to a part cavity model. This is extremely useful when several gate design analysis iterations are planned and analyzing a complete multi-cavity layout with the feed system attached would be time consuming. Once an optimized gate design is determined, the sprue and the runners can be added easily to complete the feed system.

With MPA 6.0, users can automatically create runners in three-plate molds, which eliminates the tedious task of manually creating runners for standard three-plate mold layouts. Another useful modeling enhancement is the facility to create a mirror copy of a part cavity model. With this feature, MPA users no longer need to depend on their CAD system for importing mirrored components, and therefore, separate CAD models for analysis purposes. The ability to easily edit runner system lengths makes it easy for users to decrease modeling time and reuse previously created runner system layouts. Finally, it is also possible for Moldflow Mold Adviser users to create a library of standard geometric sizes for use when modeling sprues, runners, and gates.

Results Comparison Tools

MPA 6.0 includes a powerful results comparison utility for simultaneously comparing analysis results from two or

Focus on



more models. Users simply open two (or more) models with results, then synchronize the window displays and the results plot scales. Users can then simultaneously investigate the models and results. This feature helps users to better interpret results and quickly identify optimized combinations of part geometry, material selection, gate locations, and processing conditions.

Enhanced CAD Interfaces and CAD Integrations

Moldflow Design Link 3.0 (MDL 3.0) is completely integrated with MPA 6.0. Moldflow Design Link 3.0 provides a geometry data translation interface between Moldflow Plastics Advisers and leading CAD systems using standard file formats such as IGES, STEP, and Parasolid, as well as allowing direct import of native Pro/ENGINEER® part files.

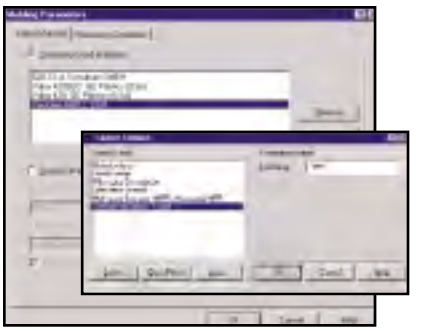
The MPA CAD-integrated versions have been updated to support the latest product releases from the world's leading CAD companies, including SolidWorks 2001Plus, Solid Edge 11.0, SolidDesigner 2001, and Mechanical Desktop 6.0. Also, new in MPA 6.0 is an integration with Autodesk Inventor 5.0.

Other Key Enhancements

The material database has been redesigned with an emphasis on ease of use. Commonly used materials are saved to a separate list to expedite material selection. Search criteria can be customized to search by virtually every material property in the database. Lastly, viscosity, PVT, and other relevant material data can be quickly and easily plotted.

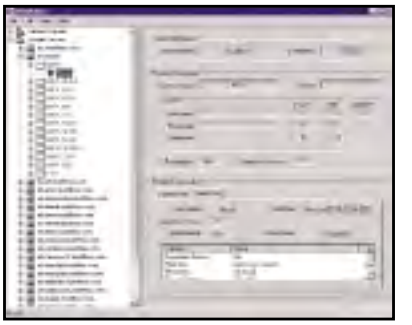
Enhancements to the Report Wizard focus on increasing the efficiency of the report creation process and the effectiveness of the reports created. Users can now create reports that include results from several analyses. In addition, reports can be customized in many different ways, including turning on/off features, selecting view bookmarks, adjusting image sizes, choosing font size, and arranging the order of results.

MPA users who wish to perform more in-depth analyses can export their data using the Moldflow Plastics Insight 3.0 (MPI 3.0) study file format. All pertinent model, material, and analysis information will be exported from MPA, eliminating the need for redundant actions in the MPI 3.0 environment.



Analyses can be set up using logical sequences to eliminate the need for manually launching individual analyses. For example, a Plastic Flow + Sink Mark + Cooling Quality Analysis sequence would launch the three analyses sequentially without any additional user intervention.

MPA 6.0 also includes a new, compressed common file format for both Moldflow Part Adviser and Moldflow Mold Adviser, reducing disk space storage requirements.



New License Manager

The Sentinel License Manager, from Rainbow Technologies, replaces Elan as the License Manager for MPA 6.0. New license keys are required to use MPA 6.0 and can be obtained by completing the product registration. A new Commuter License feature is available in Sentinel, which allows users to check out a license from a license server for up to 30 days, and use the license remotely, such as on a laptop computer. This feature is available only on PC systems and does require a floating license.

Update on Supported Hardware

PC users can now choose either Intel or AMD processors, as support of the AMD Athlon processor has been added. Also new is support of Microsoft's Windows XP operating system.

The complete list of officially supported hardware platforms and operating systems includes Microsoft Windows 2000, Windows ME, Windows XP and Windows NT, Sun Solaris 2.8, HP-UX 11.0, SGI Irix 6.5, and IBM AIX 4.3.5.

Conclusion

MPA 6.0 contains significant new features and enhancements for increasing productivity, collaborating with other users, and providing product usage feedback in order to partner more closely with Moldflow. ■

For the latest information on Moldflow Plastics Advisers and all of Moldflow's product and services, visit our Web site www.moldflow.com.

Early Analysis Reduces Lead Times for Sydney Olympics Athletes' Beds

By Laura Carrabine, Editor

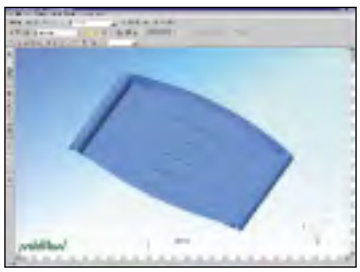
Background

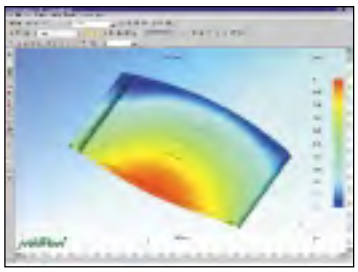
Dunlop Bedding, a division of Pacific Dunlop and the largest Australian manufacturer of beds, was the provider of 24,000 beds that made their debut at the Sydney 2000 Olympic Games athletes' village. These "bunkable" beds were designed for use as single beds or stacked to form bunks, with the option of extending the length of the beds by 300mm for use by the taller athletes. In addition to meeting the functional and structural requirements, Dunlop Bedding was also looking for a fresh, modern shape and color. Dunlop Bedding decided to manufacture the bed frames in powder-coated steel and the bedhead panels in translucent plastic with a choice of several bright colors.

Viscount Plastics is a member of the Pacifica Group and the largest injection molding company in Australia. Viscount Plastics (Victoria) was chosen by Dunlop Bedding to project manage the design and manufacture of tooling and to produce 48,000 bedhead panels for these beds. Viscount recommended polypropylene homopolymer as the material for the bedhead panels, as it met the requirements for safety, aesthetics, low weight, low maintenance, ease of assembly, and cost effectiveness.

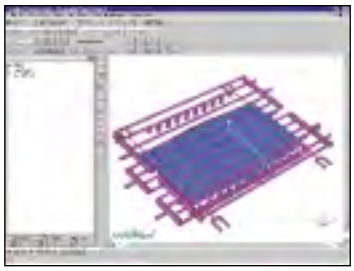
The Project

As the translucent bedhead panel is a highly visual part, a critical requirement was that there could be no visible defects or warpage. "We have utilized the analysis expertise of Moldflow's consultants for a number of years now, with filling, cooling, and warpage analyses being important tools in the part and mold design phases. We decided that the ability to verify and optimize tool and product designs early in this project should help us to reduce lead time to manufacture, avoid start up problems, and reduce reject rates," said Mr. Vadim Gershon, Product Development Manager, Viscount Plastics. In this project, Moldflow's consultants were employed at the product design stage in order to optimize the part and tool design and to verify cycle time and processing conditions. "We wanted to ensure that we could reduce lead times of the first acceptable samples, so that Dunlop Bedding would have enough time to tune the other components to fit the bedhead (if necessary), and supply beds in time for the Olympic Games," said Mr. Gershon.

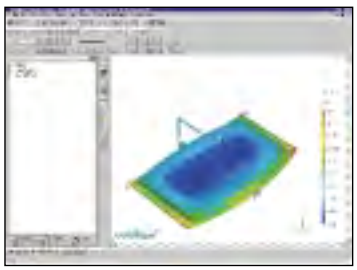




Moldflow Part Adviser software was used to verify the gate design and location suggested by Viscount and to assess the fill pattern. "The Part Adviser analysis confirmed that the area of the part at the end of the longest flow path would fill for the proposed cavity layout and wall thickness with the choice of polymer and gate location," said Mr. Derek Hain, Senior Consultant, Moldflow. The original design of the bedhead called for a three-piece assembly. Viscount's engineering team suggested the use of sliding cores driven by hydraulic cylinders, which would allow a one-piece bedhead panel to be manufactured. Several iterative analyses were undertaken, and it was found that the panels could be produced as a single part instead of three separate components.



Further analyses using Moldflow's MPI/Flow, MPI/Cool and MPI/Warp were undertaken to verify cycle times and to ensure the design specifications for dimensional tolerance, aesthetics, and negligible warpage were met.



"MPI/Cool was used to verify and optimize cooling line layouts and confirm that the processing conditions suggested by Viscount Plastics could be used," Mr. Hain said.

The results from MPI/Warp indicated that there would be very little warpage, as the fill pattern and the cooling lines had been optimized by then. "The predicted warpage was negligible and could be further reduced with fine tuning of the injection molding machine settings and tool temperatures during manufacture," Mr. Hain added.

The Outcome

The initial mold trials showed that the actual cycle time was very close to that predicted by Moldflow's software, and the parts produced had met design specifications. "Preliminary work conducted jointly by Viscount's engineering team and Moldflow, as well as excellent toolmaking by Centre Tooling, has allowed us to achieve a near-perfect part at the very first die trial. We have probably saved at least one tool rework and subsequent die trial, which could have cost us several thousand dollars and increased lead time by up to 20 percent," said Mr. Gershon. ■

Work Smarter with Moldflow Plastics Insight 3.0

By Matthew Jaworski, Moldflow Corporation

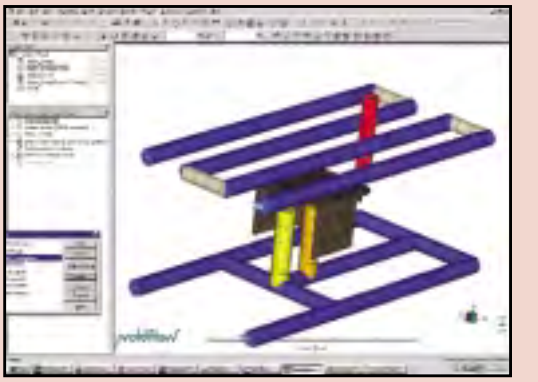
We want to help you work smarter and get up to speed faster with your Moldflow Plastics Insight (MPI) 3.0 software. Here are three tips that will help you streamline your modeling tasks and transition quickly from previous versions of the software.

Find a complete list of Hints & Tips as well as answers to Frequently Asked Questions and other valuable information on the Customer Resource Center (CRC) at www.moldflow.com.

Did you know?

The default colors of MPI 3.0 beam elements have specific meanings.

Red	->	**Hot Runner**
Green	->	**Cold Runner**
Blue	->	**Cooling Channel**
Yellow	->	**Baffle**
Orange	->	**Bubbler**
Beige	->	**Connector Hose**



tips continued on next page

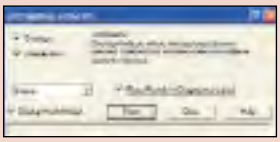
Fixing Overlapping Elements

Import a model into MPI/Synergy, then select **Mesh > Mesh Statistics**. Look under **Intersection Details** for information about Element Intersections and Fully Overlapping Elements. These are defects in the mesh that you will need to fix before running an analysis.

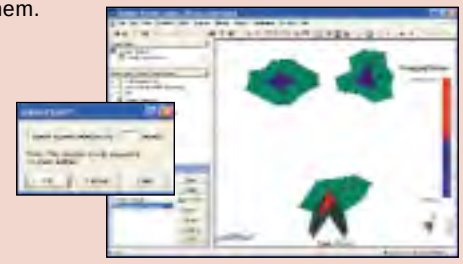
Select Mesh > Mesh Tools to access tools that will help you fix the defects. First, try the **Auto fix** tool, which automatically tries to fix overlaps and intersections. Don't worry about the result, because the tool reports **Aspect Ratio** before and after - this will change only if the fixed defect happens to be related to the minimum or maximum aspect ratio. Check **Mesh Statistics** again to see if **Auto fix** solved your element problems.

If **Auto fix** did not fix all the defects, go back to **Mesh Tools** and select **Global Merge**. This tool merges nodes within a specified tolerance. Be careful if you leave the **Preserve Fusion** checkbox option blank! When checked (turned on), this option prevents nodes from being merged if this would result in the removal of a side of a triangle.

Your next option is to display the overlapping elements and manually fix the mesh. To display these elements, select **Mesh > Overlapping Elements**. On the dialog that appears, you can select to display **Overlaps, Intersections** or both. Be sure to check the **Place Results in Diagnostic Layer** option.



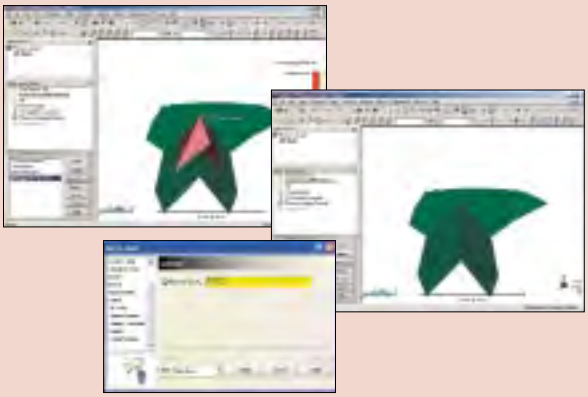
Deselect all layers, so that only the **Diagnostic Results** layer is visible. Clicking on the **Diagnostic Results** layer to highlight it, then select the **Expand** button. The **Expand** button grows the mesh around the highlighted layer by a user-defined level, in this case one. This feature is very useful to see what elements need to be fixed and the area around them.



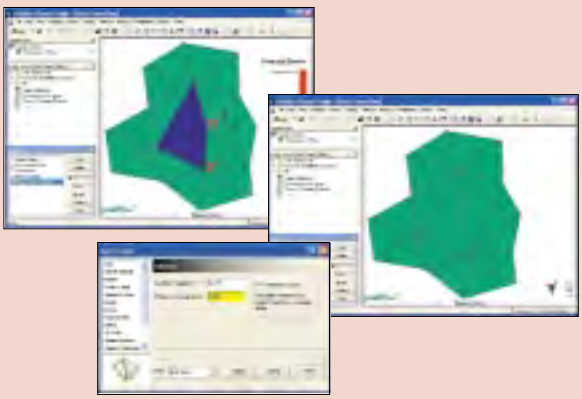
Next zoom in on one particular area and use the center icon  to center the view for ease of rotation.

There are many ways to fix overlaps and intersections. In this example, the problem element is protruding through other mesh elements at a corner. We can select and delete this element using **Mesh Tools > Delete** or simply by using the select icon  to select the element and clicking the **Delete** key on the keyboard.

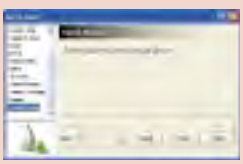
TIP: To speed up the mesh editing process, turn the mesh diagnostics window off before using any **Mesh Tools** or deleting elements. To do this, select **Mesh > Show Diagnostic** or click in the MPI/Synergy graphics window and click **Ctrl + D**. After the editing action is complete, you can turn the diagnostic window on again by repeating the process.



Another common way to fix overlaps is to merge nodes. This is also accomplished using the **Mesh Tools** menu. Simply select the node you want to merge to and then the node you want to be merged.



Use **Mesh Tools > Purge Nodes** to clean up any disconnected nodes that may have been created during the cleanup operations.

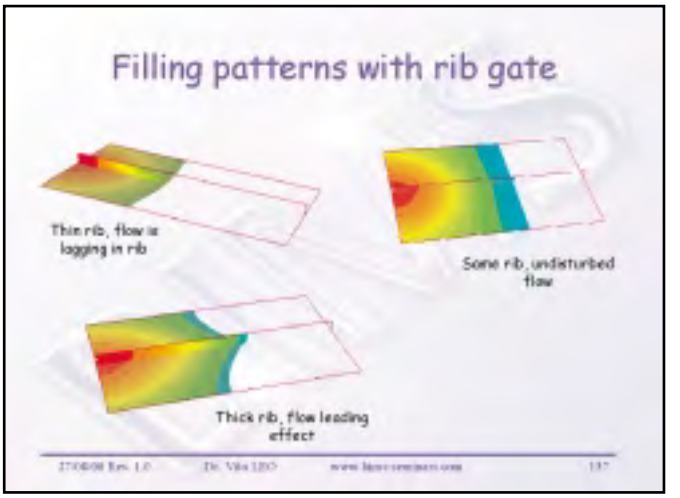


Finally, review the **Mesh Statistics** to make sure the mesh is defect free. ■

Dr. Vito Leo Successfully Launches BIMS-Seminars (Brussels Injection Molding Sessions)

By Laura Carrabine, Editor

In March 2000, Professor Vito Leo, Ph.D. (Brussels, Belgium), established the Brussels Injection Molding Sessions (BIMS-Seminars) business. BIMS-Seminars provides seminars based on Leo's 20+ years' experience in the injection molding and plastics industry and what he says is a real need for non-traditional training. His seminar called "Understanding Injection Molding of Thermoplastics — The Key to Optimum Plastics Part Design," provides an explanation of the mechanics and physics behind plastic injection molding processes. Leo is a physicist by training and has extensive experience in polymer processing. He is particularly active in the field of injection molding of thermoplastics and the use of thermoplastic finite-element numerical simulation.



"During my career at Solvay as a Principal Scientist at the Brussels-based company," says Leo, "I realized that there was a real need for a seminar that thoroughly explains some very complex phenomenon in fairly simple terms. People are extremely interested in attending this kind of seminar. It's not traditional injection molding training. It's not flow analysis training. It's not pure theory. I really try to fill a gap. People have real problems every day. How do they solve them? For many, it's been years since they graduated from their university. They may know a little bit about plastics, or they may know a lot. However, they don't have time to investigate rheology details and thermodynamics of polymers, crystallization and other complex issues."

"For me, there are clearly two very separate worlds when it comes to plastics professionals — those who make products but don't know physics fundamentals, and those who work in institutes or universities who are very interested in fundamental work or equations but don't know much about real life and real problems in injection molding. So, my material fits between these two entities," adds Leo.

As a result of this unique approach, Dr. Leo has attracted a diverse range of seminar attendees in the nearly two years he's been in business. The seminars generally attract engineers, designers, and shop floor operators. However, university students and professors attend them as well. "They all seem to take added value back to their workplaces after a seminar," says Leo.

Each two-day BIMS-Seminar includes the use of Moldflow Plastics Insight (MPI) software to show MPI/Flow, MPI/Cool, MPI/Shrink, and MPI/Warp. "I always envisioned Moldflow as part of the seminar because of its valued use over the years at Solvay," notes Leo. "The software is very useful to understand the process and the complex physics behind the analysis even though the accuracy of some predictions is not always perfect. It's an extremely useful tool to assess, for instance, the relative importance of various contributions in the warpage trend you predict with a given part."

Upon initiating his seminar business, Leo agreed not to use any Solvay resources or provide any proprietary Solvay information as part of any BIMS seminar. He relies on MPI software to build examples to illustrate the ideas discussed at the seminar. To make sure attendees get useful practical information, he asks known Moldflow consultants (NKT Research in Denmark and Promold in France) to conduct an evening session based on case stories at the end of the first training day.

The BIMS-Seminars offer a complete description of the physics behind injection molding. "I try to very clearly show the relationship between material structure and the problems users can encounter in injection molding. The seminar includes extensive descriptions of amorphous, crystalline, filled and unfilled materials. In addition, I try to show how different these four classes of materials can behave with respect to filling, packing, shrinkage and warpage. The very different behavior of glass-fiber-filled polymers compared to unfilled plastics is striking. Understanding the physics of these composite materials is the only way to design good parts and optimize the molding process," adds Leo.

He started his business with a private seminar at Nokia in Finland where 30 attended — 20 designers and some of their subcontractors such as molders. Leo noted, "There was a lot of positive response as a result of that session. Some attendees said it was the best seminar they ever attended in the field of injection molding."

BIMS completed six seminars in 2000 and seven in 2001. Many were held in Scandinavia because of the strong mobile-phone

industry interest and the training strategy as a whole in the northern European countries. A Danish institute agreed to organize BIMS-Seminars and booked five events in Denmark so far. BIMS-Seminars also organized two public seminars in Brussels and Paris, and the first Italian seminar is scheduled for Spring 2002. Overall, about 210 people have attended the seminars so far.

Leo uses Moldflow during his seminars, not because he is trying to sell the product, but because it's an extension of what he is trying to explain. "It's important to understand the assumptions on which any software package is based," says Leo. "A lot of the commentary during the seminar is about the physics behind the present state of the art in simulation and why, under certain circumstances, its capabilities may be limited. MPI is definitely helpful."

Leo says that he promotes extremely useful tools. He adds, "As soon as you can understand the trends, and trace the physics as to why you are experiencing a particular problem, then Moldflow will be extremely useful. However, you need to understand the fundamentals first."

He relates that when he trained the staffers at a large Finnish company, some of those in attendance claimed they didn't really want to understand the software. They just wanted the software to do the work for them. "That is exactly what I am fighting against," adds Leo. "The point I try to make is that you don't need to have a Ph.D. to understand the physics. But you might need someone who has a Ph.D. to explain it to you. That's what these seminars and I are all about."

As a result of the seminars at Nokia, Ericsson, and Bang & Olufsen, Leo says that designers have a much better understanding of the process. Flow analysts in these companies are using Moldflow much more effectively. He says, "Since the seminar at Ericsson, the company purchased a Moldflow license. I can't claim that's because of my seminar. However, I am pretty convinced that my contribution must have been important because they came away from the seminar feeling that even though the software isn't perfect, it will be very useful if you understand what you're doing."

Apparently, people from all over Europe are happy to find all this information within a single framework of one seminar presented in a consistent way. Leo says the enthusiasm for more seminars in more locations is growing despite a tight worldwide economy.

"As companies strive to work smarter in a challenging economic environment, they realize that doing better quality work up front is very important," adds Leo. "Taking a serious approach to conducting simulation relates to reducing costs. Error-riddled and expensive prototypes can be eliminated. I have first-hand experience with this phenomenon at Solvay using Moldflow."

"Recently, we experienced a slow-down in sales due to the general economic trend. However, during that same timeframe, we had a strong increase in Moldflow simulation requests. So even though sales are lagging, people are busy preparing for the future, trying to develop parts with better, more cost-effective designs at a faster rate. And with the right training, Moldflow is a perfect way to do just that."

While the seminars are a completely separate business from his work at Solvay, Leo says that the sessions work in favor of the plastics business as a whole. "I am just trying to increase the level of understanding of the process that I believe can only benefit the industry as a whole. Concurrent engineering will prevail when all the involved parties speak the same language and share a common knowledge base." ■

For more information about BIMS-Seminars, to view a complete list of customers to date, or to arrange a session, visit www.bims-seminars.com.

NEWS FLASH

The first edition of *Flowfront* was a big hit at the Office of Continuing Engineering Education at the University of Chicago at Urbana-Champaign. Professor Jonathan Dantzig of the Department of Mechanical and Industrial Engineering will be using *Flowfront* as part of his teaching materials. Notably, Professor Dantzig will use information in the first edition for teaching engineering students in his class called "Modeling in Materials Processing," Mechanical Engineering 351, which began in the fall semester of 2001 and continues through the spring semester of 2004.

At the school, engineering course lectures and course materials such as lecture notes, assigned readings, and handouts are made available to registered University of Chicago students over the Internet. The school will be making *Flowfront* available to students as a reference to the lead story "Introducing Moldflow Plastics Insight 3.0."

This unique approach to providing engineering students with valuable, real world information about state-of-the-art technology will help students gain insight to how innovative software products and methodologies are being used in product development today. This is a great example of how partnering industry with academia can enrich learning and strengthen undergraduate skills as preparation for real-world application of their knowledge and attaining excellent positions after graduation.

Working Smarter with Web-Based Training

By Stephen Thompson, Moldflow Corporation

A changing global economy has created new business cycles that are demanding rapid action and increasingly efficient operations, requiring new business fundamentals and changing the way companies function and conduct business. These new business fundamentals require that employees rapidly acquire new skill sets as the demand for trained professionals increases.

Even for the most experienced plastics professional, keeping current on the latest technology can be a challenge. To remain competitive and succeed, proper and ongoing training is essential. Yet in today's business climate, organizations face the difficult task of providing the necessary training amid the corporate calls for tighter budgets, hiring freezes, and doing more with fewer resources.

Given these parameters, Web-based training (WBT) has become an increasingly popular new trend over the past several years. In the simplest sense, WBT is the use of Internet technologies to deliver training online. Recipients can receive training on a 24/7 basis through browser access to the Internet, an extranet, or an intranet Web site, similar to common Web browsing activities.

This innovative delivery method provides high-speed access to training content at the user's convenience and at the user's locale, eliminating the need for travel and time away from work. These self-paced, Web-based courses are accessible anytime and anywhere through the Internet. By providing a cohesive, virtual training environment, companies can overcome production downtime, temporary loss of resources, and travel costs.

When properly implemented, WBT utilizes the immediacy, flexibility, and richness of the medium to deliver a learning environment that complements traditional classroom and "hard copy" delivery methods. Utilized as a foundation, WBT can even improve the overall effectiveness of instructor-led delivery instruction. Students can enroll in preliminary WBT courses, for instance, to prepare for an advanced, instructor-led class. In addition, WBT offers extremely powerful and compelling advantages for training employees in different locations. Global companies may have users working at differing levels of expertise, on a variety of products, in multiple areas of the world. WBT is ideally suited to address this type of worker training diversity.

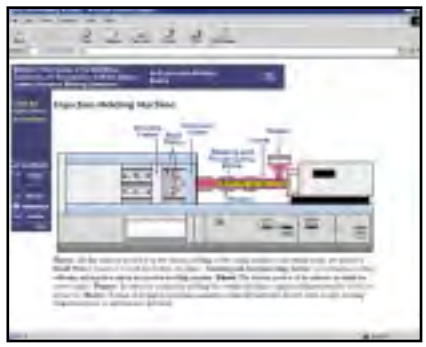
At the Moldflow Center for Professional Development, we realized that our global customer base is benefiting from WBT in several ways:

- ❑ Eliminating time away from the workplace.
- ❑ Accessing training at convenient times, locations, and individual paces.
- ❑ Bolstering student confidence in Internet-based training and increasing the likelihood of participating in additional WBT training sessions.

Moldflow's Web-based training courses are available through the Education Zone at www.plasticszone.com.

Here you will find both Moldflow courses and courses from our education partner, Nypro Institute. Courses cover the latest releases of Moldflow products, including Moldflow Plastics Insight (MPI) 3.0 and Moldflow Mold Adviser, as well as several general courses on injection molding, materials and mold design. These Web-based courses provide Moldflow customers with a wealth of plastics industry information.

Moldflow's Web-based training provides the ideal foundation for a blended training approach, complementing our traditional training courses with the power and immediacy of online technology. This results in learning programs that provide increased retention and greater effectiveness.



Oftentimes, a training course cannot be scheduled to meet everyone's individual or departmental needs. In a manufacturing setting, for instance, people who work in around-the-clock shifts often can only be removed from the line individually or in small groups. Web-based courses are an effective tool that can be used throughout a workday to train individuals without disrupting the production line. Unlike an instructor-led course, Web-based courses can be used at any time, in any place a computer is available.■

For more information about Moldflow's Web-based training courses and other education services, please visit the Education Zone at www.plasticszone.com.

Swift Technologies Applies Moldflow Plastics Advisers to Every Job

By Laura Carrabine, Editor

Swift Technologies Limited, a Cambridgeshire, England-based materials technology company, provides the manufacturing industry with unique solutions to traditional problems. The company's Swiftool Rapid Manufacturing System aids in quickly and economically producing plastic or polymer moldings. The technology is based on a smart polymeric tooling medium that facilitates the blending of materials and manufacture of mold tools on site. The process involves application of pressure and vacuum to the Swiftool composite via purpose designed vacuum presses.

Swift Technologies' equipment varies in size from presses as small as a household refrigerator to as large as a commercial truck. Paul Shepheard is the company's technical director. He says Swift Technologies' (Swiftech) reason for doing business is to provide tools as fast as possible.

"Traditionally, injection mold tools can take anywhere from one week to 16 weeks to manufacture," says Shepheard. "At Swiftech, we can fulfill orders in between one to 16 days. We are much faster. How? Our tooling system fast tracks the tool making process." Engineers and designers are also finding better ways of doing their jobs, such as initiating very sound proactive practices at the early stages of each job, including the use of Moldflow Part Adviser and Moldflow Mold Adviser software from Moldflow Corporation.

Swiftech operates two business models. One is designing and marketing systems that enable molders to make injection mold tools very quickly. The other side of the business is using its own equipment to make tools to generate customers' parts quickly. "Obviously," adds Shepheard, "we wouldn't be able to make the parts if we didn't have the tools. We are in a unique position in that we have all the equipment. When customers send us a 3D file, we are usually able to make those parts within a couple days by first making the tool and then making the parts."

However, in the first year of work, Shepheard and his colleagues found that their customers' designs were presenting them with production difficulties. "They didn't mean to," notes Shepheard. "Unknowingly, they sent us part files that couldn't be manufactured, and we didn't know it because we didn't design the parts. Back then, we went through our normal process. We'd make a tool and learn too late that the tool wouldn't satisfactorily make the part. That's when we investigated Moldflow software. We couldn't afford to stay on the same costly path we were going down at the time."

Now Shepheard's team uses Moldflow software on every single file that they receive. "Using Moldflow is an integral part of our procedures," says Shepheard. Swiftech operations can perform up to 20 Moldflow analyses per day. "Using Moldflow is part of our proactive strategy to make sure that the part can actually be made. We don't even charge for running the simulations."

When a file comes through that shows design flaws, Swiftech returns the file for customer redesign or for assistance from Shepheard and his team. Customers quickly learn that their designs are not manufacturable early in the design process versus later on when the tools have been machined and unable to produce parts. "It doesn't happen often," notes Shepheard, "but at least once or twice per week, we receive a file that we can't work with."

He says another reason for using Moldflow on every single job is for credibility. "Manufacturers have been making steel tools for years and years," says Shepheard. "There are no questions about integrity or quality, because people are used to tools being made out of steel. However, with a new process like ours, when we turned jobs around and told customers that we couldn't make their parts, the customer started to question our expertise. So, we invested in Moldflow to be able to show credible evidence that many issues are not our problems, but rather the customer's. Moldflow brings us confidence, credibility, and peace of mind."

Software benefits

Shepheard says that using Moldflow allows his team to locate design errors very quickly. "We didn't want to waste valuable time manufacturing something that couldn't generate parts," adds Shepheard. "The software automatically gives us the best injection point and gate location. That was an absolute godsend to us because now, for every single job, we know for sure that all gates are located in the optimized positions. Those two factors are the most important in our workflow."

"It works well for our customers, too. They know that we apply best practices to help them achieve their goal — obtaining parts. In the rare instances in which we fail, at least the failure arises before steel has been cut — before the cost of the mistake can cost customers five to ten times more than the actual job and take 10 times longer. Moldflow allows us to interact with the design much earlier, and if, there is a problem for whatever reason, now is the time to do something about it."

Shepheard says that Moldflow has changed the way Swiftech does business. If the software didn't exist, Swiftech would not exist or would be a significantly different organization. "The software has had that big of an effect on the way we do business," notes Shepheard.

Since investing in the software and hardware to run it, Shepheard says the company has recouped its ROI many times over. "We've made about 400 tools now as a result of using Moldflow over the last two years. We have made many more tools than could hope to be achieved by a conventional toolmaker of comparable size and Moldflow has played a major part in our success," adds Shepheard.

Swiftech operators can simultaneously run approximately 12 customer file simulations. Files are downloaded as STL, IGES, or native CAD formats. The process uses STL files in two ways — one for Moldflow simulations and one for making patterns for generating tools. Shepheard says, "When a customer sends a part file, we run the Moldflow analysis on it. If it's okay, we build the part using stereolithography equipment to make a pattern. We then fabricate the tool around the pattern."

When it came time for Swiftech to investigate plastic simulation software, Shepheard did some research on the Internet. "Moldflow has an excellent reputation in this arena," notes Shepheard. "We were overwhelmed by the level of confidence that we heard from colleagues who were using the technology. Soon after, we saw a demonstration of the products and became a customer." That was two years ago.

Learning curve

Shepheard says that to really become proficient using the software takes about four weeks. "For many other software packages, training and proficiency take upward of 12 to 16 weeks," adds Shepheard. "Moldflow Part Adviser and Moldflow Mold Adviser are so simple to understand. While the packages are sophisticated software, they are at the same time easy to learn and easy to use." Several Swiftech engineers attended training at Moldflow's UK-based offices.

"Since we do run so many Moldflow analyses per day, we have been able to build up a level of knowledge and understanding about the software. We like that it works with precision and reliability," adds Shepheard.

When Swiftech first installed the software, Shepheard and his team tested the product by "feeding it" a design that had given them problems in the past with regard to gate locations. "The Moldflow analysis showed that we shouldn't have gated the part the way we did. We were so pleased that the software investigated precisely what didn't work. That gave us good feelings about how it would treat files for us correctly in the future. That was a good initial test. We knew we had struggled in the past with troubled designs and experienced the headaches they cause internally. Moldflow has helped eliminate all those long, arduous hours for us." ■

For more information about Swift Technologies Limited, visit www.swiftech.co.uk. For more information about Moldflow Plastics Advisers (MPA) software, visit www.moldflow.com.

DO YOU HAVE A STORY TO TELL?

If so, we want to hear from you. To submit articles, case studies, or user reviews of any Moldflow technology, please contact Laura Carrabine at **laura_carrabine@moldflow.com** or call **+1 440 247 8653**.

Working Smarter in a Tight Economy

By John McEleney, President and CEO, SolidWorks

John McEleney, president and CEO of SolidWorks, offers some thoughts on how businesses should perceive the present economic situation and some tips on weathering the storm.

First of all, get a sense of perspective. The world is not ending. Workers and management should take a deep breath and realize that civilizations have been around for millennia. Think about it. We have endured centuries filled with upheaval and new discoveries. Be assured that there will be a tomorrow and business will be transacted. As soon as people rid themselves of fear, the black cloud will lift, and they will be in a much better state to be productive.

Second, focus on fundamentals. When times are good, companies try to accomplish as much as possible. However, when times are tough, people should focus on the fundamentals because they don't have the extra cycles, extra capital, or the extra personnel to achieve all that they would like to do. In addition, determine your company's raison d'être. Ask, "What do we do well?" and "What are customers willing to pay for?" Regard this time as an opportunity to refocus.

To do so, determine your competition's position in the market space and what you can do to gain a competitive advantage. This is the point where you need to tighten the belt one more notch and continue to make investments, even when times are tough. It's one sure way to gain the competitive advantage. Because when the economy begins to turn around, companies will find themselves in one of three scenarios: either having gained marketshare, maintained marketshare, or lost marketshare. I think most people in these markets hope to be able to maintain marketshare. That's the wrong mentality. Companies must regard this time as an opportunity to gain a competitive edge. Be aggressive, even now, to do whatever it takes to remain a winner. Take advantage of the opportunities that change creates.

Third, set priorities. In the book *The 7 Habits of Highly Effective People*, author Stephen R. Covey talks about urgent versus important. In times like today, I think prioritization is important. Determine what efforts are urgent and which ones are important. Then, structure your thought processes and work activities to address the important issues that are urgent.

Fourth, use this lull in the action to educate yourself and update your workplace. If your operation is using dated technology, study up on what's offered today and what best suits your needs. Invest and train your staff so that when the economy turns around, you will be in a much more competitive position to gain additional marketshare.

Case in point: Recently while on vacation, I met a longtime AutoCAD user. Ironically, his company recently purchased some SolidWorks seats. He told me that the younger users relished the new technology and migrated to it with gusto. However, the older users were using the traditional 2D CAD system and methodologies as a crutch. With business a little slow, we both agreed that this was a terrific opportunity for him to force the change-resistant users to improve their skill sets. Undoubtedly, this is the time to implement new technology and conduct training so that when events do turn around, companies will be in a competitive position and much stronger.

Technology providers today are focusing greater energy on forming collaborative partnerships, both for delivering the latest advancements efficiently to end users and promoting technology education. For example, Solidworks works closely with Moldflow to deliver integrated solutions for the injection molding plastics industry. Further, Web-based options abound, make it easier to acquire new technologies and the training necessary to use them to their fullest potential.

A few years down the road, when we look back, I bet the winners out of this recession are going to be companies that went the extra mile, made sound investments in people and technology, and updated their product development environments. Companies that take these bold initiatives will reap tremendous rewards.

Lastly, maintain a sense of optimism. The world is getting bigger every day and it will continue to need technology. Tomorrow someone will launch a new innovation, a new product, a new service, or new technology that will allow us all to be more efficient. There is always going to be that next level of innovation. Let me remind you that in the late 1800s, some folks wanted to close the US Patent Office because they thought that everything that could be invented had been. They were so wrong. ■

The Benefits of Process Monitoring in the Real World

By Peter Rucinski, Moldflow Corporation

You cannot manage what you cannot measure. These words ring true for all types of companies across all types of industries. Imagine a gas station that was not measuring and tracking the amount of gasoline it distributed, or an energy company that was not monitoring the amount of energy produced versus consumer requirements, or a soft drink producer that did not measure how long it takes to fill and package 500,000 bottles of its product. These companies would have no idea of when they were going to run out of gasoline, energy, or soft drink. Beyond that, they would not be able to manage and grow their respective companies because they were not measuring key performance indicators that are fundamental to their business operations. Although it is hard to believe, today there are multitudes of companies that do not measure key business performance indicators, and the price they pay is lost market opportunity, labor productivity losses, and costs associated with manufacturing inefficiencies and unscheduled production downtime.

Not so for one innovative US-based injection molder, Vision Plastics, who uses the Moldflow Shotscope® process monitoring and analysis system to measure and track key injection molding parameters, allowing employees to work smarter and more productively and give their company a strategic competitive advantage. The Moldflow Shotscope process monitoring and analysis system is a comprehensive product suite which collects critical data in real time injection molding machines on the factory floor, then records, analyzes, reports, and allows access to the information for use in critical decision making. This article discusses how Vision Plastics has implemented Moldflow's Shotscope system to monitor its injection molding process and the value derived from measuring what it has to manage in order to control and grow its business.

Eliminating Guesswork and Downtime with Shotscope

Vision Plastics, Inc. started out in 1988 in Tualatin, Oregon, USA with five molding presses and five employees. Today, the company is relocated in a modern facility in Wilsonville, OR that houses more than 38 machines and 150 employees. Vision Plastics is ISO

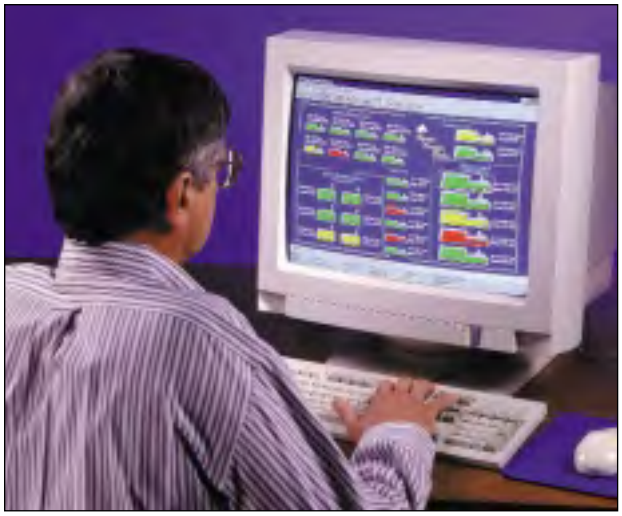
9002 certified and one of the most highly regarded custom injection molding companies in the Pacific Northwest.

Today, Vision Plastics utilizes the Shotscope process monitoring and analysis system from Moldflow to assure that the very best parts are being manufactured. This system, installed directly on each molding machine, is a real-time program designed to capture a picture of each injection shot through predetermined parameters. The data collected is available for review through a number of display screens. Shotscope provides shot profiles, statistical process control trend charts, shot-to-shot comparisons, and a number of other displays. Each molding press is equipped with an analyzer to capture the data and with a remote screen to display that data.

Each injection molding job has a set of predetermined parameters that are input into the Shotscope system. Should any of the parameters move outside the control limits, the machine alarms and highlights the discrepancy for immediate appropriate action by the mold technician.

Any changes to the established molding processes that might be necessary are well documented through a Cause and Effect system. This closed-loop system identifies the root cause of any discrepancies in the process and documents changes that are made to the injection molding machine settings to bring the operation back within the pre-set limits.

Mike Olson is Vision Plastics' Shotscope coordinator. It's his job to keep all 26 Shotscope-based plastic injection molding machines running at peak performance. "Shotscope generates profiles or overlays of what the machine is doing internally at all times," says Olson. "I save the overlays as references and as historical data. I can pull any overlay up at any time and lay it on top of another to see if there is any variation in the process. The overlays tell us if the machine is varying from shot to shot, showing inconsistency."



"We used Shotscope at my previous place of employment and the software was considered a valuable tool. I volunteered to get the system up and running at Vision and we have been using it ever since to its full potential," said Olson.

When Olson first joined Vision Plastics several years ago, the company was not actively using Shotscope. "We used it once or twice but that was only because one particular customer wanted cavity pressure and mold temperatures from every shot. Once we made the run, we downloaded the data to a diskette and sent it to them with the parts. At that time, that was the extent of Shotscope use here."

At that time, Olson approached the company owner to find out why. "We used Shotscope at my previous place of employment and the software was considered a valuable tool. I volunteered to get the system up and running at Vision and we have been using it ever since to its full potential." Shotscope monitors 26 machines, although the software can monitor up to 32 machines at once. Olson installed the Windows version of the software in August of 1997.

Shotscope Benefits

The software provides a graphical overview of the Vision Plastics shop floor. Different colored icons depicts each machine. Gray icons depict machines with no communication between the machine and Shotscope. If the machine is not running, then the icon is red. A yellow icon represents an operating machine that has exceeded one or more parameters. "Yellow signals me to investigate what is causing the machine to go beyond our set parameters," says Olson. A green icon indicates a machine that is running within all parameters.

"Anytime something goes wrong, I can quickly single out which machine needs attention," adds Olson. "Usually a quick adjustment or two is all that is needed and we are back in business. Shotscope saves a tremendous amount of time. Traditionally, it would take several technicians and a lot of time on the shop floor trying to figure out the problem and how to remedy the situation. Shotscope eliminates all that guesswork and down time."

Recently, Moldflow engineers from the company's Oregon and Australia-based offices visited Olson. I gave them a tour of the facility and showed them how I use Shotscope. I made some suggestions as to what I would like to see added to the next version of the software such as pop up windows that give the user information about what the machine is doing. They seemed very pleased with the recommendations that we provided," says Olson.

During the visit with Moldflow, a Vision Plastics technician made an adjustment to one of the molding machines without confiding with Olson or Shotscope. The adjustment caused a yellow icon to appear on Olson's monitor, indicating the highlighted machine's

process had been changed. Overlays were created to show before and after process profiles. Upon comparison, it was clear that the new process would cause an unstable process from shot to shot — an out-of-control condition and questionable parts. The information proved that the technician did not use Shotscope in his decision making. The process was subsequently re-adjusted and the machine was brought back into a controlled condition.

Three overlays originate from a linear transducer that measures the positioning and velocity of the screw. A pressure transducer provides pressure overlays. These profiles can be downloaded just seconds after the machine completes a shot and Shotscope analyzes the data. "After a few shots, I know pretty much what is going on with each machine's process. Whereas, out on the floor, it would take me 20-30 minutes to gather the same data," Olson says.

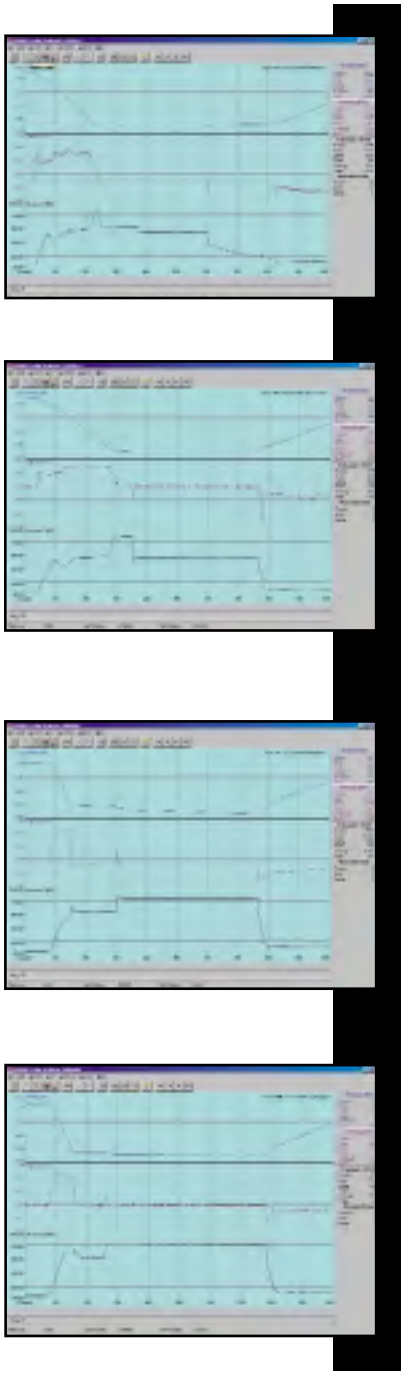
It can be busy at times. However, Olson says that once he and the technicians start the machine and a stable process is established, his work is nearly complete for the whole run of each particular machine. He adds, "If a heater band goes out, Shotscope will alert me now before we start producing rejects. I can keep my limits so tight that if the size of a part changes as minutely as 1/1,000 of an inch, I will know about it. Or, if I lose temperature, Shotscope highlights it and we can address the issue then, not when the machine stops making parts, or when it starts making burned parts, or when one of the zones overheats. Shotscope keeps a close eye on all those areas that could become potential problems."

"In this competitive market, Shotscope is invaluable. It helps Vision Plastics remain a viable contender in the industry as a leading producer of high quality parts," Olson explains.

Conclusion

You cannot manage what you cannot measure. These words ring especially true for injection molder Vision Plastics, who relies on Moldflow's Shotscope system to measure and track key business performance indicators so that they can control and grow their business profitably and with a significant competitive advantage. ■

To learn more about Moldflow's Shotscope product, visit www.moldflow.com. To learn more about Vision Plastics, visit www.visionplastics.com



Shotscope profile analysis revealed that the press was fighting to hit the transfer position, resulting in inconsistent fill time and hold time from shot to shot.

After the shot size was decreased, a stable process was achieved.

Shotscope results showed that the press was not holding a steady cushion length. Upon investigation, it was discovered that the machine's check rings needed to be replaced.

After check ring replacement, Shotscope verified that the machine performed as expected.

THERE ARE BETTER WAYS TO COLLECT DATA FROM YOUR INJECTION MOLDING MACHINE!

Do you know what job your machine is currently running? Is it running that job at its peak efficiency? What are the optimal settings on this machine for this specific job? This is information you need to know when producing your parts, but you don't have to carry that burden on your back!

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CRIMS, the Benchmark Standard for Shrinkage Prediction

A. Roland Thomas, Moldflow Corporation

"As far as the laws of mathematics refer to reality, they are not certain, and as far as they are certain, they do not refer to reality." Albert Einstein (1879-1955)

On the surface, this may appear a strange way to begin a discussion about a predictive capability that relies heavily on mathematics for its success. However the perspective it brings captures the essence of modeling such a complex physical behavior. In cases, such as the modeling of shrinkage, the general theory accurately captures the basic behavior and trends. However, the results are more useful if they can be made far more specific.

CRIMS (Corrected Residual In-Mold Stress) is a hybrid modeling technique that augments the mathematical theory used to predict shrinkage in injection molded parts. It works by comparing this general model to real molded samples and creating a function to minimize the difference. This function and its coefficients then become part of the predictive model when used for real applications.

The benefits of using CRIMS are too compelling to ignore. Moldflow analyzed nearly 20,000 moldings, each with varied process conditions, thickness, or material. The purpose was to compare the accuracy of predictions based on mathematical theory alone and those based on CRIMS. Greater than 85 percent of the predictions based on CRIMS were within 20 percent of the experimental result, whereas for the prediction based on mathematical theory alone, less than 15 percent of achieved this result.

Shrinkage background

As a brief introduction, Moldflow's approach to modeling shrinkage starts from the basic drivers for the phenomena. A model based on mathematical theory is used to simulate those drivers, which in turn is compared to the result of experimental observation and corrected to ensure that the model predicts what really occurs.

Volumetric Shrinkage

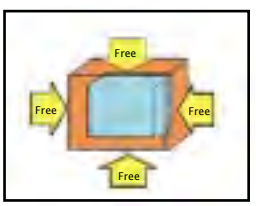

Figure 1

Mold Restraint

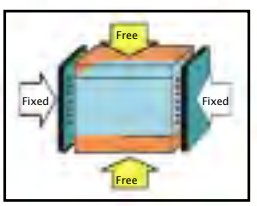

Figure 2

When shrinkage occurs in an unconstrained and undeformed material, the material attempts to shrink equally in all directions (isotropically) as shown in Figure 1. The shrinkage itself is caused by the change in state of the material from a molten, high pressure/high temperature state, as exists inside a mold, to a solid, low pressure/low temperature state, as exists at atmospheric conditions. For semi-crystalline materials, this change in state includes the crystallization process.

Inside the mold, the mold and its features resist this shrinkage, which in realistic moldings constrains all shrinkage to the dimensions of the mold with the exception of shrinkage across the thickness, where the material is free to move (Figure 2). Therefore, if the change of state requires that a certain volumetric change occur yet that change is resisted, a stress is built up in the material, which in turn begins to be relieved while the part cools in the mold.

When the part is ejected from the mold, the constraint is removed and the remaining stresses cause a change of shape in the part that we know as shrinkage. Subsequent cooling will also cause thermal contraction and more shrinkage.

There are other issues such as variations in crystallinity and the stresses due to the orientation of molecules and fibers that I will not address here. For further information, please see the references at the end of this article.

The steps to solve this are:

1. Calculate the residual stress while the material is in the mold using the calculated pressure-temperature history.
2. Using the residual stress, calculate the initial shrinkage at ejection.
3. Calculate additional shrinkage while the part cools to room temperature.

This is a general model called the residual stress model. The steps are straightforward to describe. However, this is an example of where the direct implementation of the mathematical model will result in a model that predicts the trends but does not describe reality with sufficient precision.

CRIMS

In order to calculate residual stress, a viscoelastic model with suitable material data over the range of conditions encountered in injection molding is required. In view of the temperature range in injection molding, such a model must be valid in the melt state, during the phase change, and in the solid state. At this time no suitable theoretical models are available. In order to make progress in simulation, some simplification is required. This simplification introduces errors that can make predictions from the simplified theoretical model too inaccurate for use.

The solution to this problem is the CRIMS model. This is a hybrid model that utilizes measured shrinkage data to improve the prediction of shrinkage and warpage from theoretical models such

as previously described. By comparing theoretical model predictions to experimentally measured shrinkages on molded samples, the CRIMS technique creates a function to minimize the error. The coefficients of this function are the "CRIMS coefficients" and are stored in the Moldflow Material Database. When users perform perform shrinkage and warpage predictions on their parts, these coefficients are used to correct the calculated residual streseses and so minimize the error introduced by using a simplified model.

The CRIMS method may be used for filled and unfilled materials and also performs well for polymer blends. It allows us to overcome the inaccuracy inherent in simplified models while retaining the ability of these models to follow trends. It also enables predictions using conditions outside the range of measurement of the samples used to obtain the coefficients.

The instrumented experimental mold is shown in Figure 3. Shrinkage values are measured both along and across the direction of flow under a variety of thicknesses and molding conditions. Figure 4 shows the measured results obtained for an unfilled polypropylene. The anisotropy in shrinkage between the flow and cross-flow directions is evident. Figures 5 and 6 each show experimental results, the mathematical theory result, and the CRIMS result for shrinkage in the flow and cross-flow directions, respectively. The improvement in the prediction is dramatic.

Moldflow supplies its mathematical model in both a CRIMS form and in a form that does not use measured values. The latter is useful for showing trends, for example, how a change in processing conditions would affect shrinkage, and allows predictions using the over 7000 grades of thermoplastics in the Moldflow Material Database.

For more information we recommend the articles and books listed on the following page.

For information on the Moldflow Material Database, CRIMS shrinkage modeling, or comprehensive material testing services, contact Moldflow Plastics Labs at mpl@moldflow.com.

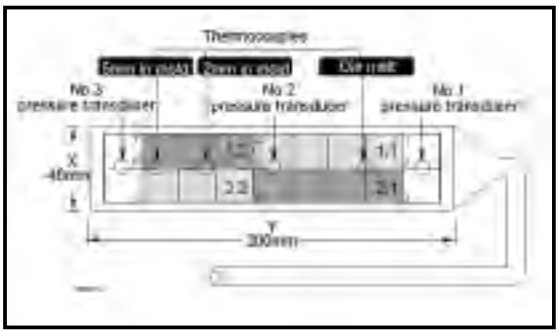

Figure 3. Diagram of Molded Shrinkage Sample

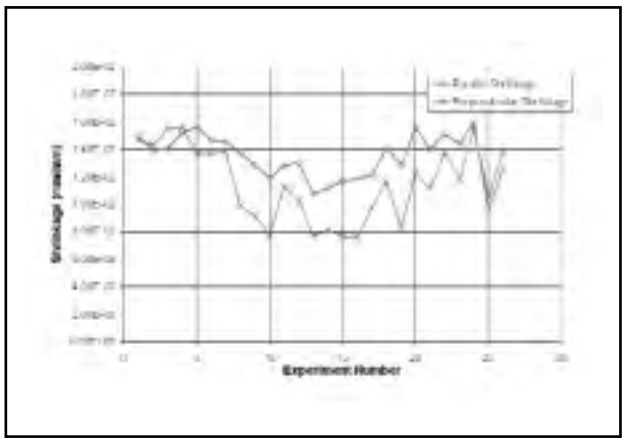

Figure 4. Measured Parallel and Perpendicular Shrinkage

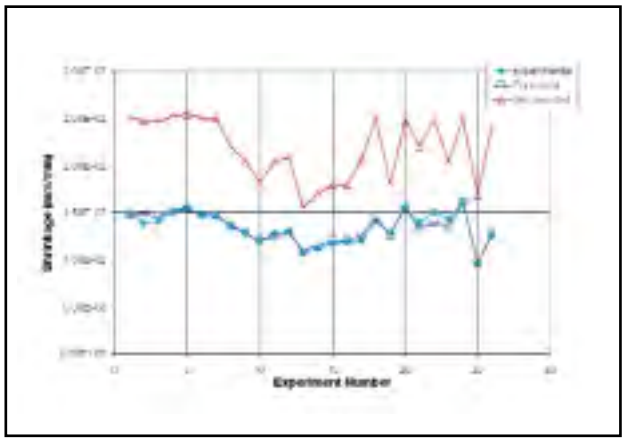

Figure 5. Measured and Calculated Shrinkages in the Flow Direction

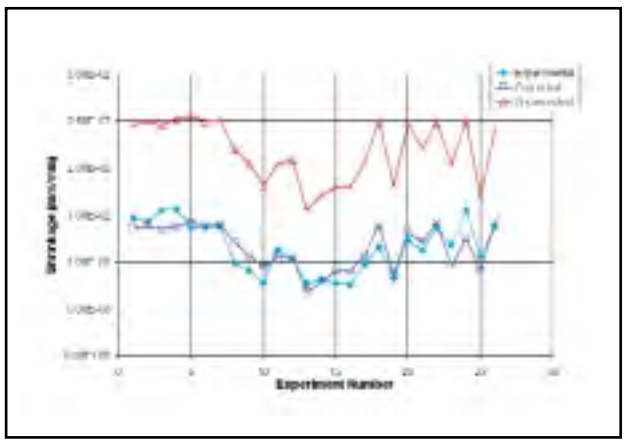

Figure 6. Measured and Calculated Shrinkages in the Cross-Flow Direction

continued from Page 22

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Penn State Erie: Teaching the Plastic Industry's "Impact Players" of Tomorrow

By Laura Carrabine, Editor

Emphasis on CAE

Students who opt for the Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (TAC/ABET)-accredited plastics engineering technology (PLET) program at Penn State Erie, The Behrend College, get education and training that make them "Impact Players" in the plastics industry, says John P. Beaumont, their professor, department chair, and a former technical manager at Moldflow. With the program's unique integration of computer-aided engineering (CAE) programs into courses from the sophomore year forward, Penn State Erie's PLET graduates are exceptionally well prepared to compete in the plastics industry.

"I came to Penn State Erie with a mandate to develop the newest technology in the plastics industry and teach our PLET students how to use it," said Beaumont. "CAE is a continually evolving technology, and since the program's inception we've made it part of our students' daily classroom experience."

"CAE is an accelerated learning tool, sort of like an X-ray that gives you insight into how a plastics mold should be made to produce successful plastic parts," said Beaumont. "A mold can cost a quarter-million dollars or more, so anything that ensures it's properly made saves time and money. We want Penn State Erie's PLET graduates to be able to use CAE for just those reasons."

However, according to Beaumont, just as an X-ray needs a doctor to interpret results, CAE needs someone skilled to interpret analysis results. Therefore, Beaumont and his colleagues require all students to complete industry-like projects using mold filling, cooling, shrinkage, and warpage analyses in both mold and product design courses.

PLET majors begin their computer foundation in the freshman year with solids modeling using Pro/ENGINEER®. In their sophomore year they begin to use mold filling simulation in the plastics processing courses to better understand what occurs during molding. In the first semester of their junior year, students begin a progression of design courses that deeply involve them in CAE technologies. During the junior year, they work with Moldflow's mold filling, cooling, shrinkage, and warpage programs as part of mold and plastic part design classes. In addition to the details of modeling, studies at this level emphasize interpretation and practical application of CAE technologies. Further courses focus on structural analysis using ANSYS® software and thin-shell modeling and meshing using Pro/ENGINEER software for plastics applications. During their senior year, students continue to learn and apply CAE technologies in both required and elective courses. Throughout this process, the faculty requires students to link their knowledge of plastic materials, processing, mold design, and part design; CAE technologies provide an efficient tool to connect all four of these areas.

Penn State Erie's PLET program has grown to include four engineering computer labs with more than 100 networked computers running the latest releases of CAE software. Over the years, instructors have evaluated a variety of CAE programs, but they have always featured Moldflow software, because of its quality and US-based support structure. As a result, Moldflow employs a significant number of Penn State Erie graduates because of their solid understanding of the applications.

Students utilizing Moldflow software in the engineering computer lab as part of their course work at Penn State Erie.

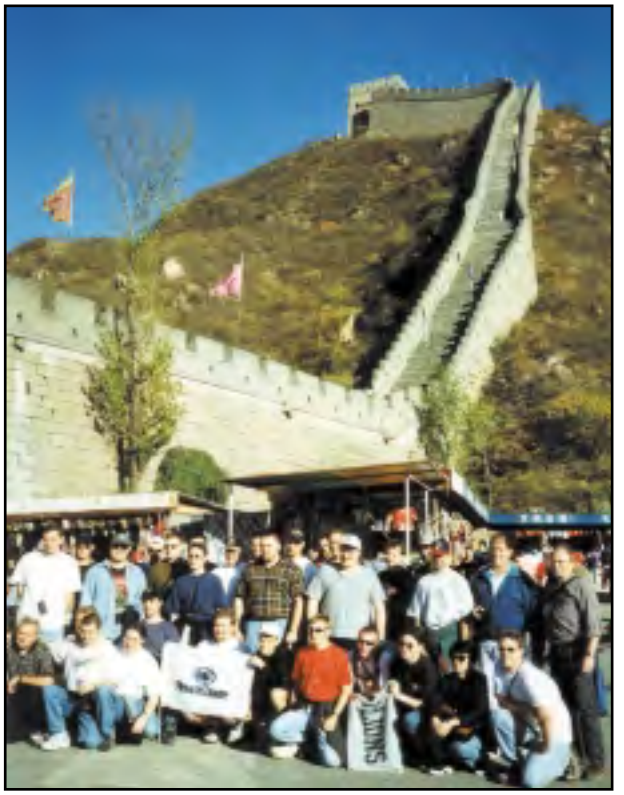
Overhead shot of plastics processing lab in the R.J. Fasenmyer Building at Penn State Erie.

In addition to the four PLET computer labs, the R.J. Fasenmyer Building in the engineering complex houses a plastics processing laboratory outfitted by industry with the most up-to-date equipment. The lab, a 180-foot-long, two-story, high-bay structure with a five-ton overhead bridge crane, is equipped with conventional hydraulic, fully electric, and hybrid processing machines. Adjacent to the processing laboratory are three labs for water treatment, plastics quality control, and rapid prototyping.

Student Opportunities

Since the beginning of the PLET program, Beaumont and other faculty have taken their students to the Society of Plastics Engineers Annual Technical Conference (ANTEC) each Spring. In 1989, Penn State Erie presented three of the 11 student papers at ANTEC; in 1996, they presented 20 of 28 papers. In 2001, faculty escorted 59 students to ANTEC, where 27 papers were presented and six won Best Paper Award in their student divisions.

"The ANTEC opportunities provide unique experiences for the students," said Beaumont. "They learn to organize their thoughts and go before a professional audience to defend their work. Once they do it, they've taken a major step toward proficiency and maturity. The experience helps build confidence and public speaking skills."



PLET majors traveled to China in 1997 to attend the Chinaplas show in Shanghai.

One aspect of the PLET program that helps to make Penn State Erie's students "Impact Players" is the opportunity for international travel. Each year, faculty and upper-class PLET majors attend an international plastics show outside the US. "New technologies are showcased every year at international trade shows," Beaumont said. "In addition to giving our students international competency — how to travel, eat, and live outside the American culture — we want them to see what's the latest and greatest. We live in an international economy, and there is no doubt we will continue to exchange technologies and products around the globe."

Applied Research Centers Make Industry Connection

One beneficial result of Penn State Erie's PLET program has been the several outreach centers that resulted from the industry orientation of the program. The first, the Plastics Technology Center (PTC), originated in 1989 when Beaumont and his colleagues responded as consultants to the industry's request for help. The PTC also provided a mechanism to get students involved with real industry problems, and this remains a primary objective of faculty outreach activities. In a very short time, the demand outgrew faculty time to respond, so they first hired a staff assistant, then hired their graduates as engineers. One of the first to join the PTC was Jon Meckley, a former student who, after working for several years with the PTC and as a consultant, returned to the PLET program as a faculty member. Today a number of former students currently work for the PTC.

Six years ago, Jon began to experiment with CAE applications in blow molding, the plastics technology used for molding hollow parts. Out of his work grew the Blow Molding Consortium, which serves the growing sector of the industry that uses this technology. The college, with the support of industry and grants from the National Science Foundation, the PTC, and the Ben Franklin Partnership, was able to acquire three blow-molding machines, several molds, and blow molding simulation software. Today, several regional plastics companies are members of the consortium and receive support in the areas of training, product and process development, equipment selection, and process optimization.

History

The concept of Penn State Erie's plastics program originated in the early 1980s, when a group of local plastics manufacturing CEOs, including Hoop Roche from Erie Plastics, Joe Prischak from Plastek, and Bill Witkowski from Port Erie Plastics, asked the School of Engineering and Engineering Technology at Penn State Erie to consider developing a plastics engineering technology program that would improve and advance the skill base of their employees. The college agreed, and by 1989 had a core group of three faculty, Robert Farrell, Paul Koch, and Beaumont, to get the program under way. Before coming to Erie, Farrell, a mechanical engineer, was vice-president of engineering at Reed Machine, and Koch, a chemical engineer, was program manager for Avery International, Fasson Division. Beaumont was employed as the technical manager for Moldflow in Kalamazoo, Michigan.

Today, the PLET program enrolls more than 250 students. New faculty-educators who average more than 10 years of industry experience-add practical knowledge to their teaching and industry outreach. Together, the great faculty and the engineering staff of the PTC give the PLET program a total of more than 50 years' experience in the application of CAE technologies. By hiring new faculty with expertise in materials and processing, and by nurturing its strong ties with the plastics industry, Penn State Erie has built one of the strongest CAE educational centers in the world. ■

For more information about Penn State Erie's PLET program, contact Loretta Brandon in the Office of University Affairs (tel: +1 814 898 6063, email: lzb6@psu.edu) or visit http://engr.bd.psu.edu/degrees/plet.html.

Medical Device Design Challenges

By Len Czuba, President, Czuba Enterprises, Inc.

Medical device developers are rapidly realizing the benefits and challenges of using CAD and manufacturing tools, rapid prototyping services, mold design and support services, and new Web-based product development resources. Speed-to-market was the mantra in the 1990s and with the growth of — or rather the "shrinking of" — computerization, more features can be built into next-generation products.

High Tech but Easy-to-use

I believe that in spite of all the hype about speed and power and the ability to do things better than ever before, we must consider other factors. The bottom line is the ability to create a product that can and will be used in a way that avoids setup problems and mistakes in usage in the field, and offers intuitive simplicity. Medical devices provide life-saving therapies if used properly. They are used in several settings; emergency rooms, during critical surgery, and in the delivery of medication. Any mistakes in setup, use, or function of the device can put the life of the patient at risk. Fail-safe systems are not really fail-safe, as has been repeatedly shown in reports of user-caused errors.

Medical device designers are faced with tough challenges, especially since regulatory agencies worldwide are mandating fail-safe products. It is the responsibility of the product designer and engineer to create the product in a way that will meet the needs of the user as efficiently as possible while not compromising the wealth of features that can be built into the product.

An Infusion Pump

Consider, for example, a new infusion pump for IV drug delivery. The design engineer must understand issues such as:

❑ What solutions or drugs will the pump be used for?
❑ Will it be used for high volume or slow infusion of low volumes?
❑ Are the drugs to be infused controlled substances that need to be stored securely?
❑ Who will use this pump - a trained health care professional such as a nurse or physician, or will it by used at home by the patient or their family?
❑ Where will the pump be used - in the emergency room, ambulance, intensive care unit, on the hospital floor bedside or at home, or will it be for the active ambulatory patient?
❑ Will this product be used in developing countries?
❑ What language or symbology will be used?
❑ If the unit is in a harsh environment what are the chances damage will be incurred?
❑ How will maintenance be performed and I.V. tubing and sets be changed?

A Clean Sheet of Paper

The designer starts with a clean sheet of paper and initiates designs that meet the physical and functional requirements of the product. Considerations include the shape, colors, controls, and interfaces that give the product its unique characteristic that will appeal to the user and enhance their ability to do their job. Ease-of-use and reliability separate the mundane products from the great ones. The so-called plug-and-play product will more quickly be accepted by the user than one that requires extensive in-service training to be able to use it.

The Layout, Wall Thickness, and Materials

Once the initial design layout is complete, the mechanisms, boards, cabling, and controls can be laid out more formally and built into the design. CAD systems allow rapid assessment of space utilization and areas of interference. Proper material selection can offer thinner wall sections, longer runs, and greater resistance to breakage with better impact resistance. By using appealing, colored thermoplastic elastomers (TPEs) in the housing, a product can be given drop impact protection and an enhanced appearance. Color displays that have high resolution and readability from wide angles and distance add to the tendency of the product to be used correctly. The science of human factor interaction with the user interface must be considered as new regulations mandate systems that are designed to prevent mistakes.

The manufacture of the product with a good idea of annual volume requirements must also be considered early in the design of the product. This factor will dictate what type of tooling will be built and used to make the parts. If new software is developed and used, it must be carefully and extensively tested and validated. Meanwhile, during all this development, the regulatory requirements must be met. Design controls requirements need the attention of the design team throughout the development program, not just when the product is ready to be marketed. A properly run development program will support a filing to the FDA, for example, and the filing will be tremendously easier.

Inside or Outsource

Product development programs of any size can be maintained and managed internally or by outsourcing some components of the project. Depending on the talent and resources on staff within an organization, the decision can be made to use the internal skill set or to rely on external experts. For many companies, the use of outside resources makes good business sense-allowing the company to do what it does well while outsourcing parts of the project to outside pros. This collaborative effort results in obtaining a better product, in less time, and for less cost.

It is the ultimate responsibility of the design engineer to develop the products that customers need, as well as adhere to the requirements set for that product. Don't overlook the need for in-process product reviews. Evaluate and test the prototypes. Engage typical users with the product in the early stages of the program. The feedback from the non-informed, eventual user can be sometimes more insightful than a whole roomful of engineers and designers. Consider the product from cradle to grave. Throughout the process, consider product lifecycle, as well as disposability, waste disposal (are batteries a disposable part of the product?) and whether the device is recyclable.

Finally, it can be a challenge to develop a new medical device given the current engineering and regulatory environment. But, if executed properly, the process can be profitable, gratifying, and an enjoyable occupation! ■

Moldflow Extends the Capabilities of MPI/Gas in Moldflow Plastics Insight 3.0

By Dean Piepiora, Moldflow Corporation

For certain types of part geometry, the gas-assisted injection molding process is a common alternative to conventional injection molding. However, the level of processing complexity is increased versus conventional injection molding due to the injection of the gas within the polymer melt. Understanding and predicting the behavior and flow of the gas within the polymer melt is critical to achieving success in designing both parts and molds for the gas-assist process. Through years of research and industry alliances, Moldflow has developed an understanding of not only the gas-assisted injection molding process, but also how to accurately predict the flow behavior of both the polymer melt and the injected gas. Furthermore, in Moldflow Plastics Insight™ 3.0 (MPI™ 3.0), the capabilities of MPI/Gas have been significantly extended (MPI/Gas is the MPI module for simulating the gas-assist process). MPI/Gas now interfaces with both MPI/Warp and MPI/Fiber to predict both the shrinkage and warpage of gas-assisted injection molded parts, as well as to predict the effects of fibers during the filling of the part and the effect of the fibers on post-molding shrinkage and part warpage. MPI/Gas recently introduced capabilities that benefit those who need to optimize part and mold designs, as well as the gas-assisted injection molding process itself.

The gas-assisted injection molding process has found a niche among certain types of applications such as television cabinets, automotive interior door handles, appliance parts, toys, and many others. It is common knowledge that by using the gas-assist process, it is possible to produce parts that are rigid, devoid of sink marks, and have a lower tendency to warp. The gas-assist process also has been proven to reduce material consumption, machine clamp tonnage and cycle time. The gas-assist process is frequently used to produce complex parts that consist of a combination of thick and thin sections.

Because the gas-assist process involves the dynamic interaction of two rheologically dissimilar materials flowing within typically complex mold cavities, the optimization of the part design, mold design, and process conditions is, at best, extremely difficult. Furthermore, even years of experience with conventional injection molding are not sufficient to deal with the gas-assist process, especially in designing the gas-channel network and optimizing the processing window.

MPI/Gas is a powerful software tool that provides the know-how to better understand the complexities of the gas-assisted injection molding process. The knowledge gained from using MPI/Gas typically equates to improved part and mold design and the reduction or elimination of problems during the production of gas-assist parts. The software assists part and mold designers in:

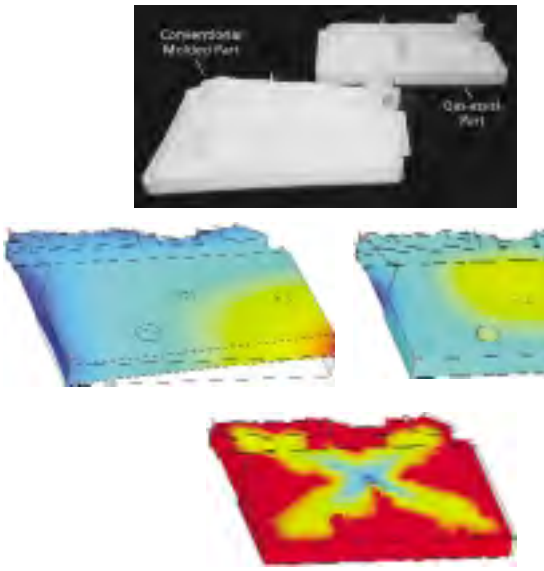
- ❑ Evaluating material selection for gas-assisted injection molding part design.
- ❑ Optimizing the plastic part design to obtain the desired gas penetration.
- ❑ Evaluating mold design options and their impact on gas penetration.
- ❑ Determining the appropriate processing conditions for producing acceptable quality parts, including the volume of plastic to inject and the timing of the gas injection.

New MPI/Gas Analysis Capabilities

New with the release of MPI 3.0, the MPI/Gas analysis module supports the simulation of shrinkage and warpage of a gas-assist part through an interface to MPI/Warp. As a result, it is possible to estimate the residual stresses in the gas-assist part and consider the effects on part warpage. All things being equal, a gas-assist molded part typically will be more structurally rigid versus the same part made by the conventional injection molding process. Part designers can now validate this in the early stages of part design, where the cost of change is minimal and the impact of that change is greatest.

Below is an example of an actual part produced by conventional injection molding, which was found to have an unacceptable amount of post-molding warpage. The same part was molded using the gas-assist process in an attempt to reduce warpage to within acceptable tolerances. The design was slightly modified to add flow leaders, which served as the gas channels and which were the primary source of gas coring.

The images that follow indicate the out-of-plane displacement using conventional injection molding and gas-assisted injection molding. It can be seen that the image on the left, produced by conventional injection molding, has significant warpage, while the image on the right, the gas-assist part, is relatively flat. The



bottom image displays the predicted penetration of the gas channels, seen as an X across the surface of the part.

In MPI 3.0, MPI/Gas users can also benefit from a new interface to MPI/Fiber, which allows for the accurate simulation of the gas-assist molding process with fiber-filled plastics. Fibers such as glass and carbon are often added to plastics to improve the structural performance of the final molded parts. These parts are often larger in nature and lend themselves to the gas-assisted injection molding process to reduce wall thickness, part weight, warpage, and cycle time. The complexities of injecting fiber-filled plastics with gas can now be simulated in MPI 3.0 to help ensure that the molded parts will be of acceptable quality.

In addition, MPI/Gas flow results can be used as an input to an MPI/Cool analysis, allowing users to study the impact of a cooling-line layout on gas penetration and cycle time. The cooling-line layout can be modified to improve the overall cooling of the part, as well as to promote gas penetration.

Conclusion

Because of the inherent complexities of the gas-assisted injection molding process, it is necessary for companies to understand the behavior and flow of the gas within the polymer melt in order to optimize part design, mold design, and the gas-assisted injection molding process itself. The MPI/Gas module of the Moldflow Plastics Insight product line provides the tools required to accurately predict the behavior of both the gas and polymer within the gas-assist process so that users can optimize their part and mold designs with confidence. Furthermore, in MPI 3.0, the capabilities of MF/Gas have been significantly extended. MPI/Gas now interfaces with MPI/Warp to predict both the shrinkage and warpage of gas-assisted injection molded parts, and with MPI/Fiber to predict the effects of fibers on the filling of the part and the effect of the fiber orientation on post-molding shrinkage and part warpage. ■

For more information about Moldflow Plastics Insight products, visit www.moldflow.com or contact your local Moldflow representative

Managing Innovative Product Development in Tough Economic Times

By Marc Halpern, Research Director, Gartner Group

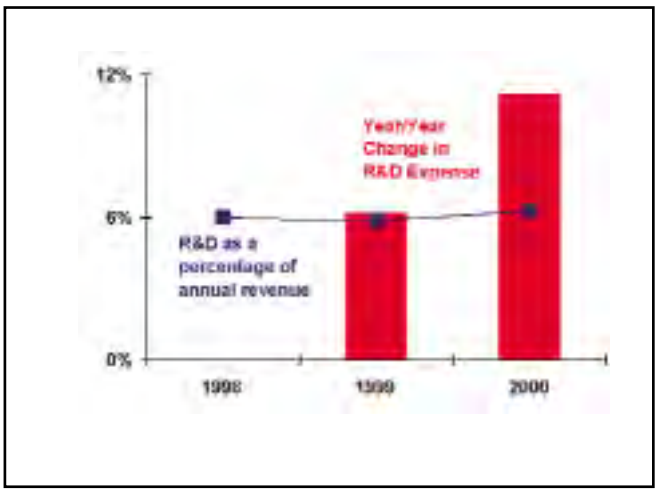
Marc Halpern is an analyst for the Gartner Group in New York.

In the current era of consumer-driven markets, companies must improve their ability to innovate. Yet, an analysis of R&D spending data from 48 Fortune 500 companies shown on the figure below, suggests that the research and development capacity of corporations is declining.[1] Therefore, manufacturers are challenged with improving the efficiency of R&D without negatively impacting their ability to innovate.

The bars on the figure suggest that the cost of R&D has been rapidly accelerating from 1998 through 2000. Yet, research and development investment remains constant at an average of six percent of total revenues for these 48 manufacturers. Since these corporations will probably maintain the six percent level of R&D spending while the cost of R&D will continue to increase, the net R&D capacity of manufacturers will decline with increased pressure on revenues in these difficult economic times.

Businesses can increase their R&D capacity through adoption of broad-based business imperatives that eliminate waste and simultaneously take steps to improve R&D performance. Elimination of waste can add financial and human resources that can be applied to high priority R&D initiatives. R&D capacity improves when businesses apply the increased resources to an R&D organization that can perform better. Broad-based business imperatives that cut waste include customer retention, elimination of unnecessary IT expense, and Product Portfolio Management.

Gartner estimates that it can cost up to 40 times more to attract a new customer than to keep a current one. So retaining just five percent more customers can translate into savings of 25 percent to 55 percent in profitability. Also, companies that prioritize customer-service processes, people, and technology will be better positioned for the economic rebound with more loyal customers.



When appropriate, companies should seek opportunities to make IT operations more efficient. Opportunities include reducing the diversity of desktop operating systems and office applications, reducing the number of levels of IT services to the minimum needed, eliminating unnecessary physical moves by personnel, seeking ways to reduce support costs for geographically disperse users, and eliminating unnecessary rollouts of software updates. Gartner research indicates that large enterprises with 10,000 users or more can save in excess of $300 per user per year, or $3 million.

Product Portfolio Management (PPM) can improve time to completion of R&D efforts by 40 percent according to early adopters by establishing objective and systematic methods to prioritize new product and program initiatives. PPM incorporates financial tracking, human resources management, technical risk assessment, and market opportunity to reach consensus on how to work smarter and which tools to invest in to attain that goal. Most companies do not have this discipline. Consequently, they rarely understand how R&D dollars and time are being spent. Successful companies focus their efforts on the programs that matter without compromising on the quality of R&D conducted.

Further, Product Portfolio Management should be supported with project and program management applications that assist in the management of development efforts involving multiple nested projects. Adopters of project management tools with design collaboration functionality report 20 percent to 30 percent improvement in the time and cost to complete individual projects. Program management software helps realize the time and cost savings by enabling managers to detect and resolve resource bottlenecks.

Companies must invest to achieve Product Portfolio Management benefits. Adopters report costs ranging from $250,000 to $1 million over two to 12 months to deploy a Product Portfolio Management environment, depending on the scope of the implementation. Adopters must also have the support of senior management to establish and enforce the new business processes and to dedicate a team to execute the deployment. ■

[1] Raw data published by Technology Review.

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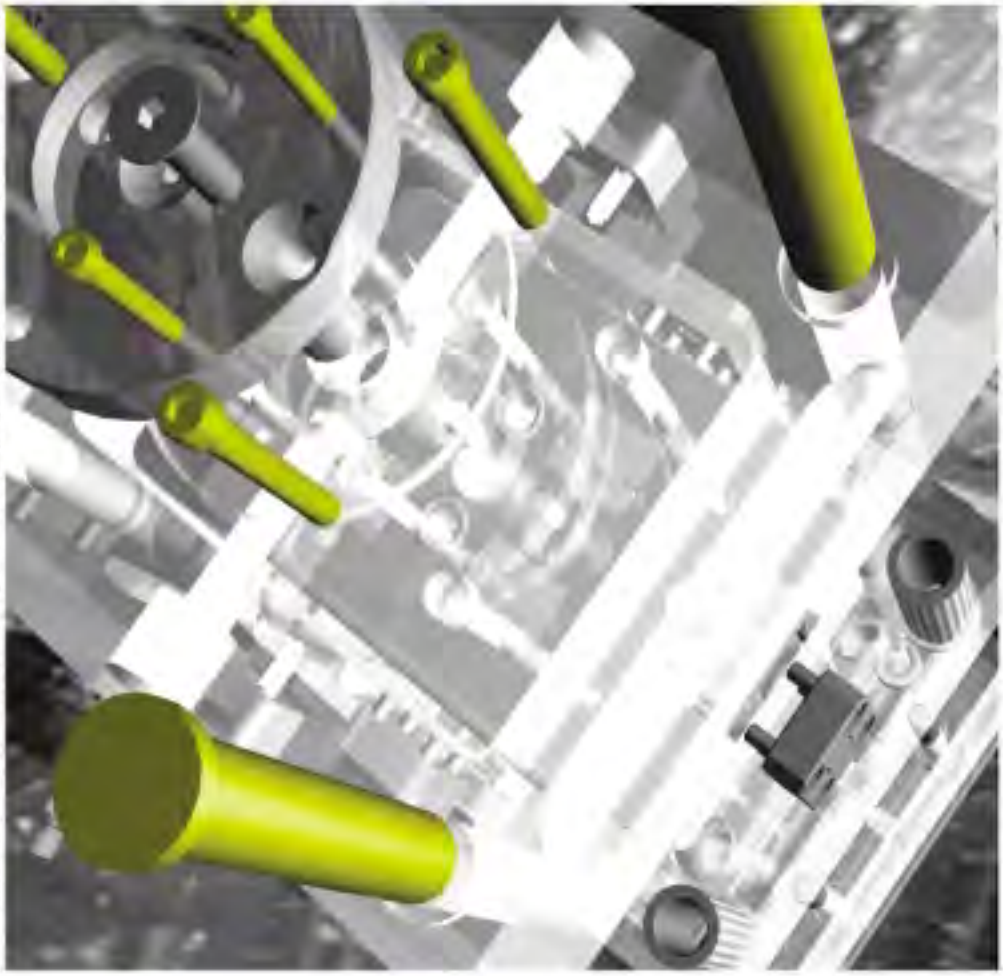

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