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Flowfront

The Magazine of Choice for Plastics Professionals

Strategic Choices in Design and Manufacturing Yield Competitive Advantages

special features

A Mesh by Any Other Name — Is It Still the Same?

How Choice of Mesh Type Affects Analysis Outcomes

Injection Molding Automation:

From Concept to Flawless Volume Production in One Go

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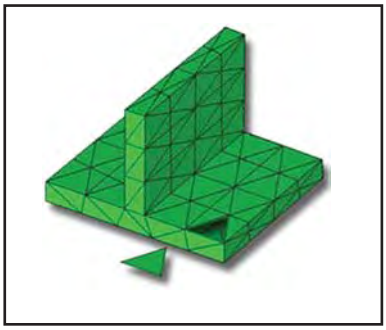

A Mesh by Any Other Name — Is It Still the Same?

Flowfront

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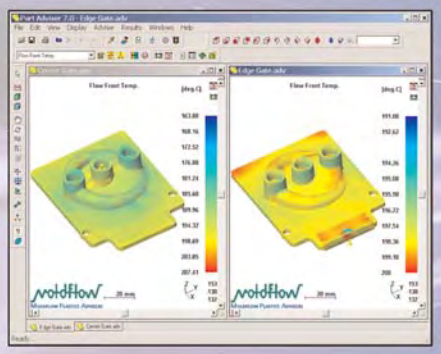
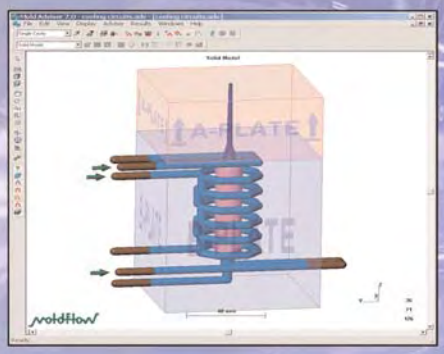
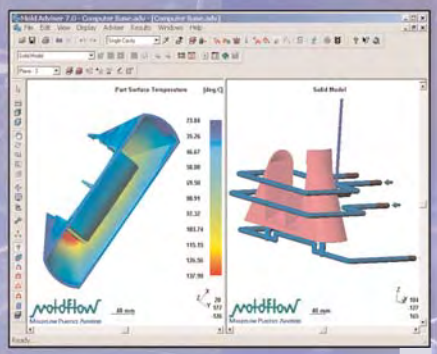
solutions that fit your needs







Moldflow Plastics Advisers

part design ~ mold design ~ part performance evaluation ~ cooling circuit optimization

Moldflow Plastics Advisers® (MPA®) solutions bring the benefits of injection molding simulation directly to the desktops of part and mold designers, allowing them to:

- ❑ Test every part and mold concept
- ❑ Work directly from 3D solid CAD models — no need to manually create a finite-element mesh
- ❑ Quickly optimize part and mold designs based on intuitive result displays and detailed design advice
- ❑ Communicate results effectively with a Web-based, automatic report generator

Moldflow Part Adviser provides an entry-level solution developed specifically to help users assess the manufacturability and quality of plastic part designs for injection molding applications early in the design process.

Moldflow Mold Adviser provides a mid-range solution developed to deliver the optimal balance of functionality to address critical mold design parameters before the mold construction begins, to allow mold designers to create and optimize gate and runner systems for single cavity, multi-cavity and family molds.

new Optional add-on modules extend Moldflow Mold Adviser capabilities further:

- ❑ **Moldflow Performance Adviser** allows designers to predict and minimize undesirable part shrinkage and includes an intuitive warpage indicator.
- ❑ **Moldflow Cooling Circuit Adviser** helps users optimize mold designs to achieve uniform cooling and minimum cycle times.

Moldflow Plastics Advisers 7.0 ... It's the solution you've been waiting for.

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Market Momentum: Companies Using Software and Business Savvy to Gain Leads

Teeth whitening, low-carbohydrate diets, cosmetic surgery — there are so many popular options today for consumers to change physical appearances in order to brighten smiles, lose weight and look good, all in attempts to feel more confident, obtain jobs, look younger and gain recognition. It's a craze, with providers offering quick fixes on the Internet, TV, radio, print media and consumer goods. This zeal for change and renewal is apparent in the manufacturing sector as well.

Today, companies are reinventing themselves utilizing smart, dynamic management and innovative strategies to keep them viable in a fiercely competitive global marketplace and, most importantly, investment in technologies that keep them more efficient. Call it organizational facelifts — companies are taking steps to redefine and enhance sales, marketing and profits. For instance, after a nearly three-year downturn, consumers and businesses are once again buying software, computers, networking devices and associated services. According to *USA Today,* IBM reported that earnings this past quarter tripled on an eight percent increase in revenue versus one year ago. "This year begins the next growth cycle for technology," says John Joyce, IBM's CFO.

Moldflow customer Dean Sparks of DRS, Inc. says his company has been so busy lately that he is doing all he can to keep up. Since 1982, DRS, Inc. (Holland, OH) has provided vital product development assistance to manufacturers in primarily the automotive, healthcare and consumer goods industries. Since its inception, the company has grown from building hand-constructed parts and tooling to fully automated manufacturing.

Sparks says that keeping software and hardware up-to-date are key elements to remaining competitive. His 30-employee operation spends approximately $150,000 annually for IT support. "Leveraging the cost of the new systems against the performance gain by faster computers allows us to manufacture our products faster year by year," says Sparks. "Not only can our computer-aided manufacturing (CAM) equipment be cutting faster on new work, it also speeds up the painful process of fixing mistakes. We added seven new high speed CNC machines in the past year, and both cutting time and surface finish have dramatically improved. In addition, we added a new Makino electrical discharge machining (EDM) unit that can burn mold components in less than 10 percent of the time required by conventional EDMs."

In addition, DRS outsources servers for specific tasks instead of forcing one server to carry the burden of many tasks. The organization also invested in new Windows 2003 Enterprise Server software to be able to cluster its servers. "This allows several computers to act as one," notes Sparks. "We have three mail servers acting as one server. We have three SQL servers acting as one to maintain our database information available at all times. Our shop data servers are clustered as well to feed the CNC machines with programs 24 hours each day. We can't afford to have a single PC go down that would result in disabling 20 CNC machines."

St. Louis-based Coin Acceptors, Inc. (Coinco) is a world leader in the design and manufacture of coin mechanisms, bill acceptors and control systems for vending machines for the global food and beverage vending industry. Max Molenaar, Coinco senior engineer, says that while production slowed in the last couple of years, a new vice president of engineering realized the importance of investing in new hardware to support the latest version of Unigraphics, the company's main design software. Molenaar says, "The company knew that the investment would pay off in the long run and we are definitely more productive as a result of the implementing the new hardware."

"Capitalism and the American dream reward those who take risks," says Joe Moglia, CEO of Ameritrade. "Executives should not feel too limited. Successful leaders assess risk and reward all the time. The most successful evaluate the risk, define tolerances and decide whether they can accept the consequences on the downside."

Many companies such as DRS and Coinco have achieved success by thinking outside the box — pushing the envelope and taking risks. For example, VDO North America purchased Moldflow Plastics Advisers® software to do upfront analyses of wall thickness and Moldflow Plastics Insight® software to gather vital design information in terms of flow, cooling and warpage, including thermoset and Fusion analysis capabilities. VDO's manufacturing engineer Dana Bryan says, "As a direct result of using Moldflow software, we have avoided a lot of design-related issues and problems. Performing simulation is definitely worth it in terms of improving product design and saving time and money."

Advanced Elastomers Systems (AES) is saving its customers time and costs associated with building expensive prototypes. Shaival Mehta, AES senior process and design engineer, says, "Moldflow software helps our customers to optimize part and mold design without guesswork and can eliminate the cost and time to produce a prototype tool."

Avenue Mould, the UK and Ireland's leading mold maker, is committed to using state-of-the-art products and techniques to develop its molds. "As a result of investing in Moldflow technology," says Felim McNeela, the company's managing director, "we have retained top manufacturers and our return business is at a rate of 98 percent. Our work demands precision and quality and using Moldflow assures us and our customers of both."

These examples and many others from Moldflow's archives detail how savvy manufacturers around the world are taking risks, investing in leading edge technology and upgrading operations to remain successful and profitable. These "facelifts" are reaping significant rewards and return on investment.

Laura Carrabine

Laura Carrabine, Editor

Focus on

Injection Molding Automation:

From Concept to Flawless Volume Production in One Go

By Serge Jonnaert, Moldflow Corporation

There is no need to belabor the challenges facing today's injection molding industry. In the last couple of years, injection molders have made sizable capital investments to improve quality and efficiency in an effort to counter competitive pressures as well as rising material and labor costs. Investments such as new injection molding machines, advanced automation and inspection devices, to automated assembly machinery and sophisticated materials handling equipment have enabled molding plants to significantly increase output with a lower operating cost basis. As a result, they now enjoy the highest historical productivity rates.

However, in spite of all these advances, the injection molding industry faces its biggest challenge yet. To further optimize efficiency, there is a need for an integrated approach that guarantees a flawless execution from the conceptual stage of part design, to its high volume production, to its ultimate delivery to the customer. Unfortunately, the injection molding manufacturing process is a patchwork of disparate systems with which it is difficult to intelligently exchange data, making the planning, setup and ramp-up of new production lines time consuming and plagued by inefficient trial-and-error and fine tuning methods.

From Design to Manufacturing Optimization

Moldflow needs no introduction in the world of part and mold design optimization. It virtually invented the space, and Moldflow's design analysis products have become the world's most widely used CAE solutions in the injection molding industry.

The CAE space has gradually evolved from basic problem solving tools in the 1980s to modeling and simulation for problem avoidance in the 1990s. The new frontier for CAE is a more comprehensive approach that also includes manufacturing optimization, an area where Moldflow remains on the forefront.

Moldflow Plastics Advisers® (MPA®) products are easy-to-use, 3D solids-based plastics flow simulation tools that allow part designers and mold makers to predict the manufacturability and quality of their designs during preliminary product development stages. MPA users benefit by avoiding potential downstream problems that can lead to production delays and cost overruns.

Moldflow Plastics Insight® (MPI®) products are a complete suite of advanced plastics process simulation tools for predicting and eliminating potential manufacturing problems and optimizing part design, mold design, material choice and processing conditions. MPI products simulate the broadest range of manufacturing processes and support all design geometry types associated with plastics molding processes.

Set Up, Optimize and Monitor

Once the part and mold designs are optimized and the effects of the molding processes have been taken into account, the logical next step is to deliver optimal processing parameters to the primary equipment and other process controls in the manufacturing cell.

Automating the setup process enables production to start more quickly and shortens the time required to determine and achieve the ideal process parameters such as cycle time, temperature and pressure settings. Used intelligently, design analysis simulation results can provide appropriate initial conditions from which to begin the manufacturing process setup and downstream optimization and control tasks. The more complex the part, the material or the mold, the narrower the processing window and the higher the need for continuous monitoring and optimization during production.

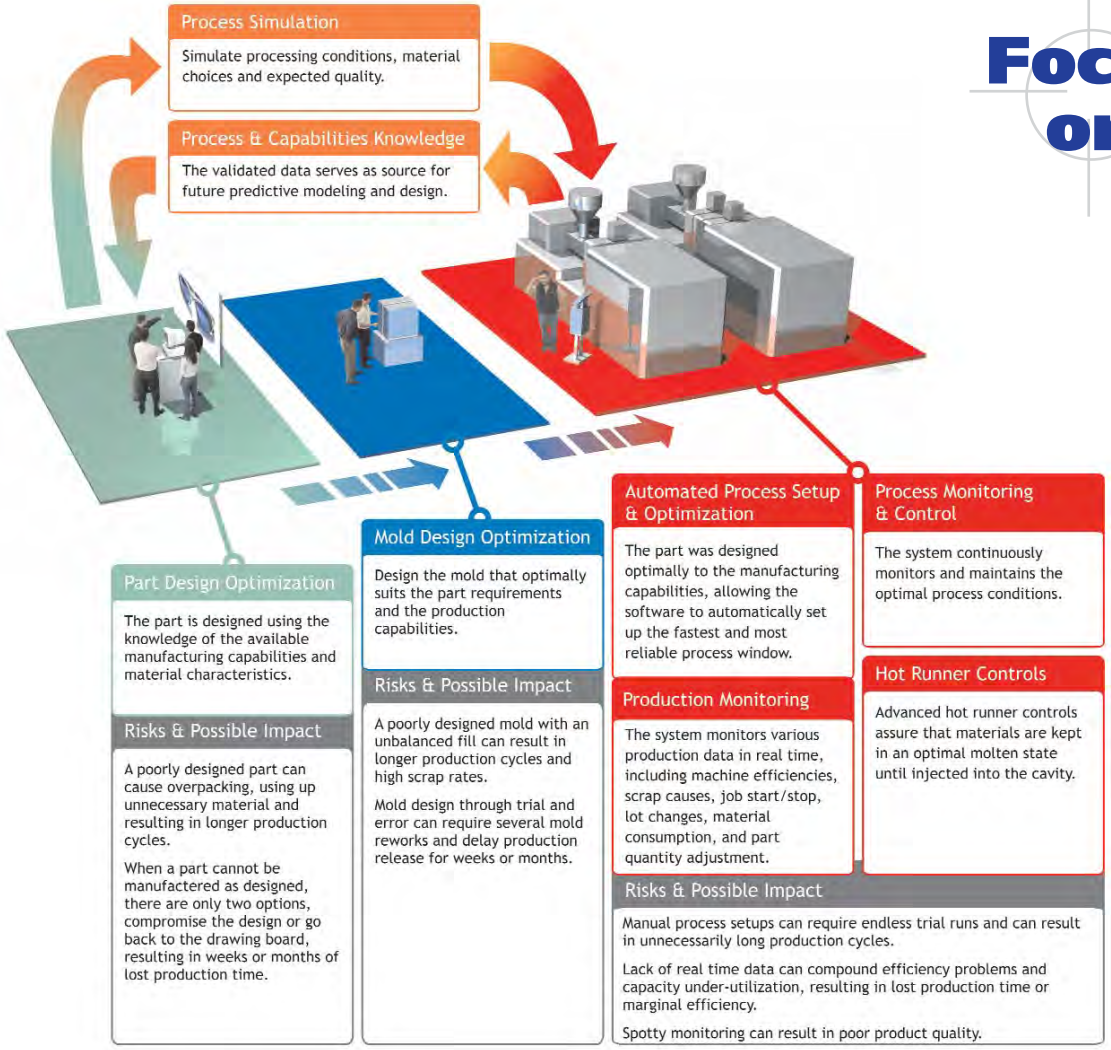
In a networked environment, monitoring and optimization can now be handled automatically from a single operator console in a central location, limiting operator interventions in the production cell to major equipment failures.

Optimal Temperature and Flow

Production capacity and yield are ultimately determined by the speed, reliability and quality by which the melt flows from the machine into the mold. This is where advanced hot runner controls come in, as they assure that materials are kept in an optimal molten state until injected into the part cavity. This final control element guarantees higher yields, reduced cycle times and better part quality. Moldflow now also offers the world's most advanced hot runner control technology.

How Are We Doing Today?

Bringing production equipment into a networked environment does more than just extend the control and monitoring functionality. It provides access to real-time data that can be used for production monitoring, work order management, job scheduling, statistical quality control, production scheduling, preventive maintenance, production reporting and part traceability. The instant access to the metrics that define an operation's performance give it the agility to quickly and confidently respond to changing market conditions and competitive pressures. Can you schedule



additional jobs to maximize your capacity? How aggressively can you price your services? Can you provide detailed production quality data and assure part traceability to your customers? Moldflow Manufacturing Solutions™ products provide you those capabilities.

The Knowledge Loop

To accomplish all of the above, a system needs to be totally integrated and balanced. It has to be a "knowledge loop" that starts with the in-depth profiles of production capabilities and material characteristics that are used to optimally design a part and mold and determine a practical processing window. From there, the information is used to control and monitor the optimal settings of the process equipment and the auxiliaries in the manufacturing cell. The knowledge loop is closed with the validated data serving as the source for future predictive modeling and design.

Implementing this knowledge loop requires a technology partner who understands the complex data interfaces needed to communicate with older as well as today's state-of-the-art equipment. Turning proprietary signals from a multitude of sources into a wealth of meaningful and usable information is invaluable.

The knowledge loop needs to be extendable to upstream and downstream processes. This can go from the basic handoff or exchange of intelligent data between process entities, to a superset of centralized control and monitoring functions that start with the supply management of raw materials, through automated assembly and packaging. The ultimate goal is to create a single continuum that is proactive in that it intelligently determines the optimal process steps to produce a product, and also reactive enough to predictably adapt to erroneous behavior, expand the body of process knowledge and document product genealogy and quality.

Solutions for the Entire Design-through-Manufacturing Process

To maximize capacity utilization and production efficiency without compromising quality, manufacturers need integrated manufacturing solutions that facilitate continuous process improvements and ultimately make them more competitive.

Moldflow's "best-in-class" products allow manufacturers to optimize operations, drive down costs and increase profitability with end-to-end solutions that optimize the entire design-through-manufacturing process. ■

For more information about Moldflow Manufacturing Solutions, visit www.moldflow.com or contact your local Moldflow representative.

Focus on

Extending Process Control to Hot Runners

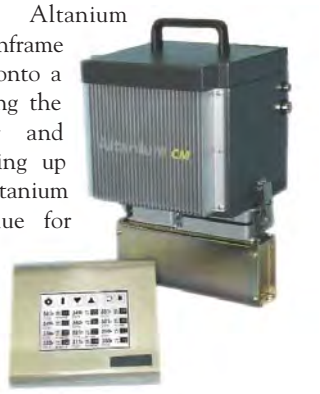
By Serge Jonnaert, Moldflow Corporation

On January 26, 2004, Moldflow announced the acquisition of American MSI Corporation of Moorpark, CA. Founded in 1984, American MSI Corporation pioneered real-time industrial temperature control systems using the PC or personal computer as a platform. In the 20 years since its inception, the company had earned critical acclaim for meeting the unique, and sometimes very complex, requirements of over 3,000 of the world's leading manufacturers.

The acquisition of American MSI represents a key step in Moldflow's longer term strategy to provide solutions that optimize the entire plastics injection molding process from the early product design stages, through mold design, material selection and process optimization. The hot runner control technology developed by American MSI is the last function to assure that the material is kept in an optimal molten state until it is injected into the cavity of the mold. Moldflow will now be able to provide an end-to-end solution that optimizes flow and temperature control, resulting in higher yields, reduced cycle times and better part quality.

Altanium is the industry's first and only modular, small footprint hot runner control solution that can support from one to 384 zones. Its unique, modular control units can be used freestanding, mounted on the mold or mounted alongside, behind or even inside the injection molding machine.

Moldflow's new, affordable Altanium C-Series features a control mainframe that can be mounted directly onto a mold's junction box, eliminating the need for expensive power and thermocouple cables and freeing up valuable floor space. The Altanium CM provides unequaled value for integrated, multi-zone temperature control.



Altanium features advanced technology for autoslaving, boost control, standby management, mold diagnostics and data collection. It offers the highest degree of temperature control accuracy for existing and future low-mass nozzles with user selectable phase-angle or zero-cross power control per zone, state-of-the-art "Hall Effect" current transducers and enhanced control software.

Altanium can be used with a variety of Moldflow interchangeable, global operator interfaces, including the monochrome touch screen Neo™ (for up to 12 zones), the mid-range color Delta2 (up to 48 zones), or the soon to be released, high-end color Matrix™ (up to 384 zones), featuring numerous temperature control, monitoring, alarm and diagnostics functions. ■

For more information on Altanium hot runner controls, call Moldflow Corporation at 805-523-9593 or go to www.moldflow.com.

Why Hot Runner Controls?

Hot runner systems continue to gain popularity because they provide immediate, tangible benefits such as reduced cycle times and superior part quality due to tighter control of temperature and pressure, with no material waste from the sprue and runner system, resulting in less scrap. More and more industry segments use nothing but hot runner systems as they increasingly use complex, large and high cavitation molds.

The packaging industry leads hot runner usage with cap and closure producers beginning to standardize on large, 100-plus-cavity molds. More and more thin-walled packaging products are being produced using the hot runner process, but in particular it is in the PET industry where the hot runner process has become the most predominant method of production. So called "barrier PET bottles" are created from monolayer or multi-layer preforms, using a co-injection molding process that assures high-barrier performance (basically keeping carbon dioxide loss to a minimum). These barrier PET preforms are produced with a narrow process window that requires a hot runner system.

Medical device production has always been a primary market for hot runner controls with its complex, high cavitation requirements, especially for the production of small, ultra-low-tolerance parts.

The automotive industry continues to mold larger, more complex parts to reduce assembly cost and time — for example, bumpers, dashboards, hoods, even entire body panels. Other areas where hot runner systems are applied include the co-injection of different materials and/or colors, such as multi-colored automotive lenses and interior parts.

The increased use of temperature-sensitive engineering plastics, hard-to-mold polymers and co-injected materials demands the ultimate in temperature control to assure dimensional consistency, which is where Moldflow hot runner controls add value. It is imperative for the best part price ratio that the core of a mold, the hot runner, be properly controlled.

Choose Training Options to Match Your Learning Style

By Stephen Thompson, Moldflow Corporation

It is well accepted that within any group of students there exists a variety of preferred learning styles. For example, you have probably noticed that when you try to learn something new that you may prefer to learn by listening to someone talk to you about the topic. Or you may prefer to read about a topic to learn it while others need to see a demonstration or get hands-on experience. Learning styles group common ways in which people learn and everyone has a mix of styles. Simply put, a learning style is a preference for the method by which you learn and remember.

As developers of an extensive range of training materials, Moldflow is aware of these multiple preferred learning styles and has designed materials to account for this. This approach is one that some trainers and instructional designers have only recently started to implement. By recognizing and understanding your own learning style, you can select training delivery techniques better suited to you while attending classes. This improves the speed and quality of your learning experience.

Which Style Is Right for You?

❑ **Visual.** If you like the visual style, you prefer using images, books, colors and maps to organize information and communicate with others. You can easily visualize objects, plans and outcomes. You also have a good spatial sense, which gives you a good sense of direction. To aid visual learners, Moldflow offers both classroom and Web-based courses.

❑ **Aural**. If you prefer the aural or auditory style, you like to work with sound and music. You typically learn best when instruction is delivered by an instructor, audio or in a traditional classroom lecture setting. The Moldflow Lunchtime Luminaries seminars are very popular with aural learners.

❑ **Verbal.** The verbal style combines both the written and spoken word. If you are comfortable with this style, you find it easy to express yourself, both in writing and speaking. You love reading and writing. You learn best in classroom settings or working in groups. The Simulation Fundamentals five-day course is structured with a combination of lecture and group lab work so the verbal learners feel comfortable.

❑ **Physical.** With the physical style, you use your body and sense of touch to learn about your surroundings. You like to think through issues, concepts and problems while you exercise. You learn best in a hands-on environment using models and exercises.

❑ **Logical.** The logical style is best for those who use the brain for logical and mathematical reasoning. You can recognize patterns easily, as well as connections between seemingly meaningless content. This also helps you to classify and group information to help you learn, understand and recall it.

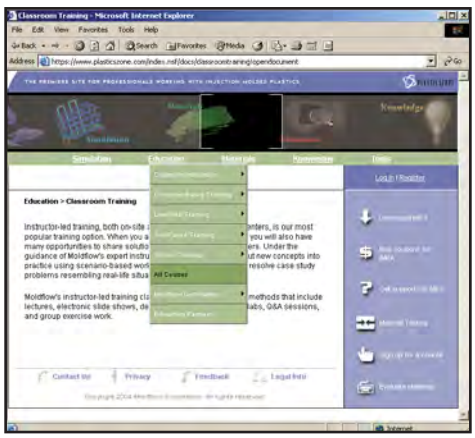
❑ **Social.** If you have a strong social style, you communicate well with people verbally and non-verbally. You listen well and understand others' viewpoints. You typically prefer learning in groups or classes, or you like to spend one-on-one time with an instructor. All of Moldflow's Advanced Simulation (MPI/Flow, MPI/Cool, MPI/Warp) courses are designed with the social learner in mind. We encourage group activities and sharing of issues and solutions.

❑ **Solitary.** If you have a solitary style, you are more private, introspective and independent. You can concentrate well, focusing your thoughts and feelings on your current topic of study. You do best with self study or non-group training. For these learners, we offer self-paced courses which allow students to work at their own pace.

Your learning styles have more influence than you may realize. Your preferred styles guide the way you learn and change the way you internally represent experiences, the way you recall information and even the words you choose. Now that you have identified your learning style, it will be easier to choose an effective method of instruction for future training courses. With the availability of Web-based, computer-based, video and instructor-led training, you will find a Moldflow training option that best suits your learning style. ■

For more information about all of Moldflow's training options, visit www.moldflow.com or www.plasticszone.com.

Moldflow Training Options Fit Your Style



Whether you choose traditional classroom instruction, computer-based training, live Web training, self-paced study or online training, you'll find a Moldflow training option that best fits your learning style, educational needs and budget requirements.

To review all of Moldflow's training options, go to www.plasticszone.com and click on the Education menu.

Working with the New Moldflow Performance Adviser

By Murali Annareddy, Moldflow Corporation

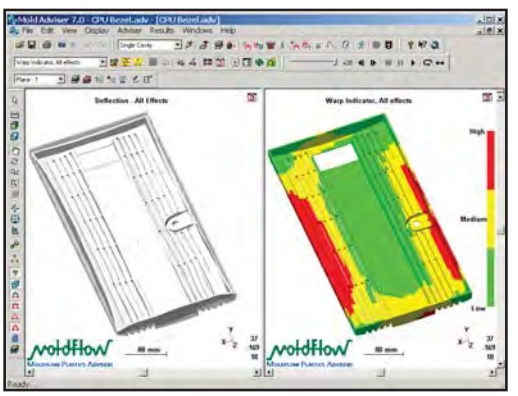
With the release of Moldflow Plastics Advisers® (MPA®) 7.0, two optional, add-on modules to Moldflow Mold Adviser are available. These add-on modules allow users to simulate more phases of the injection molding process and evaluate molded part performance and cooling circuit design. The result is faster mold commissioning, minimal mold rework, a more robust manufacturing process and faster time to market.

The focus of this article is on the new Moldflow Performance Adviser module. The Moldflow Performance Adviser module extends the capabilities of Moldflow Mold Adviser to simulate the packing phase of the injection molding process to predict and minimize undesirable part shrinkage, as well as provide a warpage indicator tool that indicates if a part is likely to warp or deform beyond acceptable levels. Here, we provide guidelines for determining the reference plane which is used in generating the warpage indicator plots.

Warpage Indicator Plots

The warpage indicator plot is a three-color display based on the analogy of a traffic light. It is produced by comparing the part deflections perpendicular to a user-defined reference plane with a nominal maximum deflection (NMD) value. This NMD value is also user-specified. The definition of the colors is as follows:

- The green (low) color represents the regions where the deflections are less than 80 percent of the specified NMD value. The warpage in these areas is low.
- The yellow (medium) color represents regions where the deflections are between 80 percent and 120 percent of the specified NMD value. The warpage in these areas is significant enough to warrant consideration of corrective measures.
- The Red (high) color represents regions where the deflections exceed 120 percent of the specified NMD value. The warpage in these areas is substantial and corrective measure should be taken.



Four warpage indicator plots are generated for a given reference plane and NMD value. Understanding that warpage comes from three sources — non-uniform shrinkage, non-uniform cooling and material/fiber orientation — it is critical to know the cause of the warpage in the part design in order to take appropriate corrective measures. Therefore, the analysis calculates the individual components of the warpage. This information is then translated into four warpage indicator plots, one of each of the three individual sources of warpage as well as one of the overall warpage.

Evaluating Part Warpage

The first step in evaluating part warpage is to review the deflected shape of the part. There are a number of different aspects that you should consider when assessing the deflected shape of the part, including:

- Is the deflection across the entire width of the part or limited to a few specific regions?
- If a few specific regions are affected, which regions are they?
- If the part is required to mate with another part, will the deformations of the part prevent or hinder this mating?

Tip: A useful tool to leverage when viewing the deformed shape is the option to magnify the deflection by a scale factor. This option can be accessed from the animation toolbar. Using the animation toolbar, you can magnify the deflection by up to a factor of 20.

Once you have a fairly good idea of how the part warps, the next task is to evaluate whether the deflection is within tolerance or not. This is where the warpage indicator plots are useful.

As indicated earlier, there are two inputs to creating the warpage indicator plots. The first is the selection of a reference plane and the second is the specification of a nominal maximum deflection (NMD) value.

Warpage Reference Plane

The reference plane is defined by selecting three locations on the part. The reference plane is used to calculate the part deflections perpendicular to the reference plane (in other words, out-of-plane deflection). These deflections are then compared to the specified NMD value to produce the three-color warpage indicator plots.

Careful consideration should be given to the selection of the reference plane. Preferably, the reference plane should be

located across a flat section of the part, where you can easily visualize the deflections, and where the implications of the deflections can be most clearly interpreted. Possible locations may include:

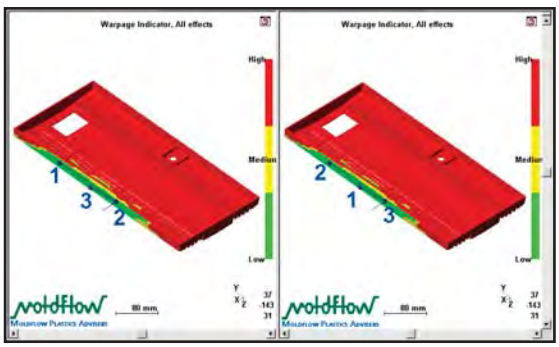
❑ The area of a part that is required to lie flat on a surface, or

❑ The joining plane to a mating component.

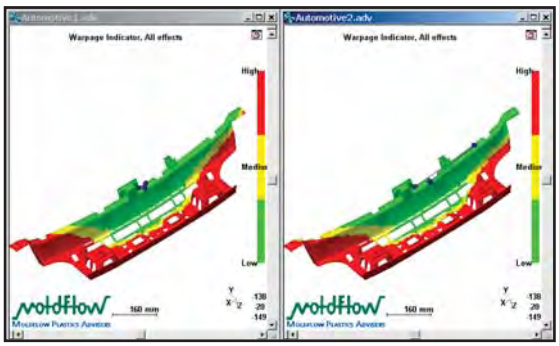
The three locations should be selected over a large area to define an easily visualized reference plane relative to which the deflections are to be measured.

Other important aspects to note about the reference plane are:

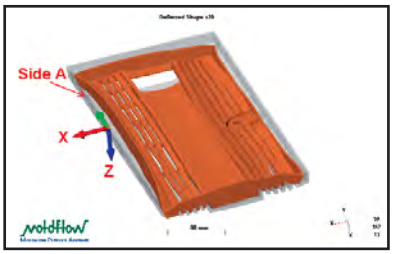
❑ The order in which the points are selected is not important and does not influence the resultant warpage indicator plots. The example below shows two warpage indicator plots of the same geometry. The only difference in the two plots is the order (marked as 1-2-3) in which the reference plane points were selected. The two plots clearly illustrate that the resultant warpage indicator plots are not influenced by the order of the selection of the points.



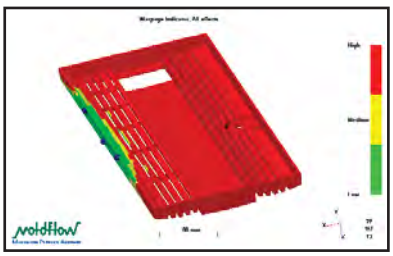
❑ If the surface on which the points are being selected is curved (non-planar), we recommend selecting the points closer to each other. The example shown below highlights this aspect. The plot on the left has the three reference plane points closer to each other while that on the right has the points spread apart. The resultant warpage indicator plots are different.



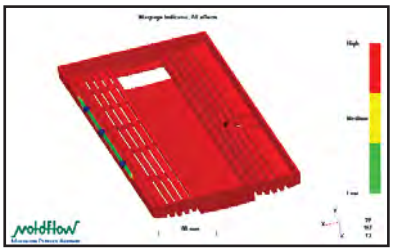
❑ Depending on the shape of the warped part, several reference planes may be required to evaluate whether the different sections of your model are within tolerance. In the example model shown here, the first image shows the part deflection (scaled to 20 times for illustration). If we focus on side A, its deflection is primarily in the X and Z directions. To evaluate whether each of these deflections are within tolerance would require the creation of two separate reference planes.



The second image shows a reference plane created by picking three points along side A; the resultant warpage indicator plot can be used to evaluate warpage in the X direction.



The third image shows a parting plane created by picking three points on the edge of side A; here, the resultant warpage indicator plot can help in evaluating warpage in the Z direction.



Upon reviewing a warpage indicator plot, if the warpage exceeds the acceptable level (the user-specified NMD value), the next task is to ascertain the primary source of the warpage, whether it is from non-uniform shrinkage, non-uniform cooling or material/fiber orientation. This can be done by reviewing the three additional warpage indicator plots or by using the Results Adviser to query specific locations on the part. The on-line help provides comprehensive advice on how to resolve warpage due to each of the three sources. ■

For more information about Moldflow Plastics Advisers products, go to www.moldflow.com.

A Mesh by Any Other Name — Is It Still the Same?

How Choice of Mesh Type Affects Analysis Outcomes

By Matthew Jaworski, Moldflow Corporation

Computer-aided engineering (CAE) simulation of injection molding is a mathematical representation of a physical manufacturing process. As such, there are assumptions and limitations inherent in the software that users must understand in order to obtain the most accurate results. One crucial area is that of mesh type. There are several meshing options available in Moldflow's Design Analysis solutions — Moldflow Plastics Advisers® and Moldflow Plastics Insight® products. In particular, there are four basic types of mesh used to represent the different geometry components for injection molding simulation. These four mesh types are:

- ❑ Beam (1D) mesh elements
- ❑ Midplane (2.5D) mesh elements
- ❑ Dual Domain™ mesh elements (also referred to as modified 2.5D and MPI/Fusion meshes)
- ❑ True three-dimensional (3D) elements.

Not every mesh type is available in every Moldflow product or even appropriate for use in every analysis. Let's take a detailed look at these four mesh types to gain a better understanding of each.

Four Basic Mesh Types

Beam Mesh

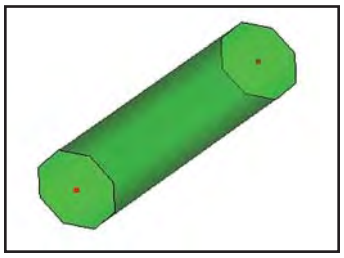


Figure 1. Beam (1D) mesh schematic.

Beam elements are simple, one-dimensional lines that connect two nodes and have an assigned, cross-sectional area shape. They are used in Moldflow Plastics Advisers (MPA®) and Moldflow Plastics Insight (MPI®) software, usually to represent melt-delivery systems (cold and hot runners) and cooling lines. Further, in MPI software, beam elements have the additional functionality to represent part geometry that is "beam-like" in nature, such as a boss. In beam elements, flow is assumed to be symmetrical about the axis. The length of a beam element should be two to three times its diameter. Also, a gate should have at least three elements defining its length.

Midplane Mesh

A midplane (or shell) mesh represents a three-dimensional part with a two-dimensional planar surface at the center of the thickness. A thickness property is assigned to this planar surface, hence the terminology "2.5D." Midplane elements are used in MPI software.

Using a midplane mesh works best when the part being modeled is a traditional, thin-walled injection molding application. To reduce computation time in the simulation, this mesh type relies on the assumption that the flow length of a section is much greater than the wall thickness; this is known as the Hele-Shaw approximation. Care should be taken when working with midplane mesh models of parts that are not considered thin-walled, otherwise significant error may be introduced. As a minimum, the average of the length and width of any local region should be greater than four times the local thickness (see Figure 3). This guideline is sometimes referred to as the "4 to 1" rule.

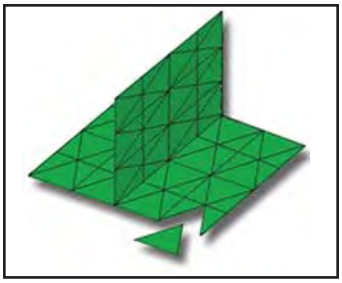


Figure 2. Midplane mesh schematic.

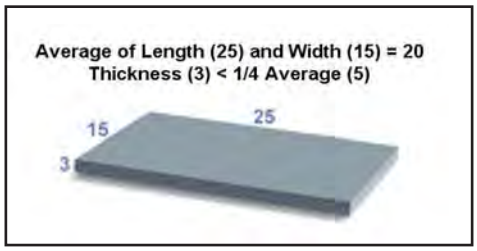


Figure 3. Minimum thickness guideline for thin-wall analysis assumption in midplane mesh models.

A more conservative rule is that the width should not be less than ten times the thickness of a particular section. The more a midplane mesh model deviates from these guidelines, the greater is the potential for error in analysis calculations. This is a particular problem for square-shaped, "beam-like" geometry such as connecting ribs, housing vents or grills.

Dual Domain Mesh

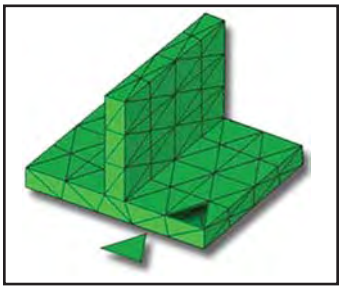


Figure 4. Dual Domain mesh schematic.

Dual Domain mesh is a Moldflow patented technology that represents a three-dimensional part with a boundary or skin mesh on the outside surfaces of the part obtained from a common CAD translation model such as STL or IGES format. A Dual Domain mesh is very similar to a midplane mesh, but this boundary shell mesh

has aligned and matched mesh on both corresponding outside surfaces (Figure 5). Dual Domain mesh is utilized in both MPA and MPI/Fusion analyses.

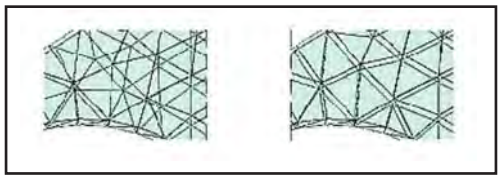


Figure 5. Unmatched mesh (left) compared to matched mesh (right) in a Dual Domain mesh model.

The distance between the mesh surfaces defines the part thickness. Mesh density plays a key role in determining the thickness of varying geometry such as drafted ribs or living hinges. Best results are obtained by maintaining at least three rows of elements across a dramatic change in thickness so the thickness effects are not averaged out. In the MPI environment, the initial thickness is automatically determined when meshing the model. The same thickness ratio limitations that apply for midplane mesh models also apply to Dual Domain mesh models — that is, the Dual Domain mesh is most appropriate for thin-wall parts. Although MPI modeling tools allow users to change element thickness manually, the initial element match interpretation influences analysis results, so it is important to have overall high mesh matching ratios (greater than 80 percent at minimum).

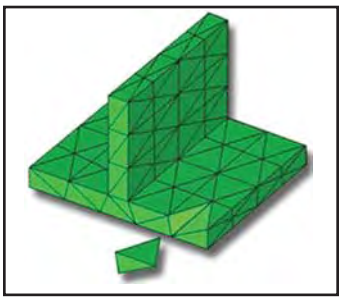


Figure 6. 3D mesh schematic.

3D Tetrahedral Mesh

A 3D mesh is available only in MPI software and consists of four-node, tetrahedral elements meshed through the part volume, which gives a true three-dimensional representation of the part. 3D mesh works well with "thick and chunky" parts such as electrical connectors or thick structural components that violate the thin-wall thickness limitations described previously. This is because MPI/3D analyses use the full 3D Navier-Stokes equations, rather than the Hele-Shaw approximations that apply specifically to thin-wall parts.

Total Solution Time

It is important to consider the total solution time when choosing a mesh type for analysis. Total solution time includes model preparation (mesh clean-up) as well as analysis run time. These components are highly dependent on model complexity, element count and user-selected analysis options. As such, it is difficult to predict, but in general, using a Dual Domain mesh offers the best compromise between model preparation time and analysis run time for most applications.

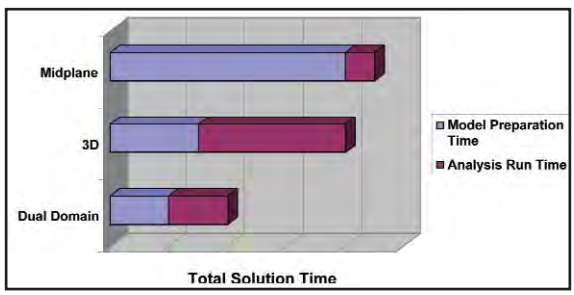


Figure 7. Total solution time includes both model preparation and analysis run time.

Research: How Does Mesh Type Affect Analysis Results?

With so many mesh types to choose from, you may ask, "Am I using the best mesh type for my particular part geometry? And, how do I know when to use one mesh type over the other? Or, how severe are the consequences if I choose the wrong one?"

Since many Moldflow customers have been asking these very questions of the Moldflow technical support group, I wanted to conduct a study to research these issues. While working as Moldflow's US technical support manager, I have also been pursuing a Masters of Science degree in Plastics Engineering at the University of Massachusetts/Lowell. One of the requirements for this degree is to successfully write and defend a thesis topic. I chose to use this opportunity to research the different mesh types and how they can affect analysis results; it is intended that Moldflow customers can take advantage of this research as a guide to selecting and using the correct mesh type to achieve the most accurate filling analysis results on their particular part geometry.

Experimental Study

This study compared actual moldings of an injection-molded plastic comb with the flow patterns resulting from simulations on models using beam, midplane, Dual Domain and 3D mesh types. Short shots of a polypropylene material were taken strategically at different shot volumes and a comparison was made between reality and simulation to demonstrate how the assumptions related to the different mesh types can affect the accuracy of filling analysis results for this particular part geometry. Filling pattern was chosen for comparison because if this analysis result were not accurate, then the rest of the analysis results, such as predicted pressure values, also would be suspect.

The comb mold is a two-plate, four-cavity mold with an unbalanced cold runner system. The layout of the comb mold is shown in Figure 8. It should be noted that because of variations in the tool and the scope of this study, the experimental results focus on the filling pattern of a single comb cavity, as indicated in the figure.

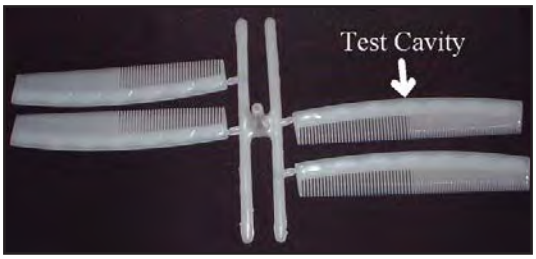


Figure 8. Comb mold layout.

Meshed models used to simulate the comb geometry are shown in Figure 9. All simulation work was conducted using MPI 4.1.

The Dual Domain mesh model in this study (Figure 9(d)) had to be manually altered because the thickness in the rim area was not interpreted correctly. It is extremely important to double-check

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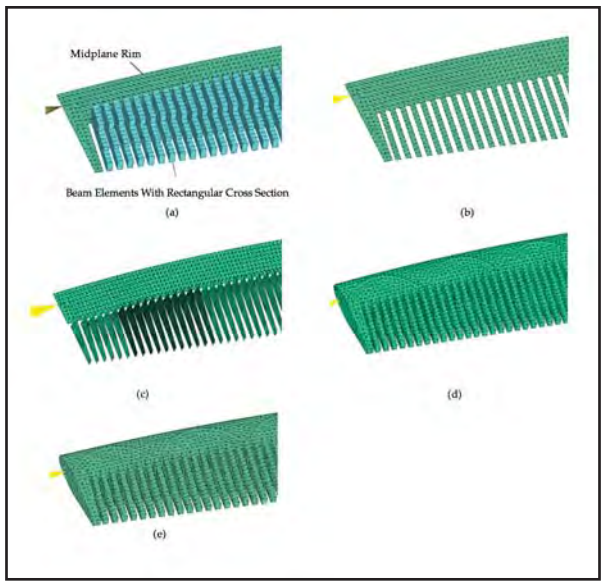

Figure 9. Close-up views of comb models used in simulations: (a) beam elements for teeth and midplane elements for rim, (b) midplane mesh with horizontal teeth representation, (c) midplane mesh with vertical teeth representation, (d) Dual Domain mesh, and (e) 3D tetrahedral mesh.

Dual Domain thickness interpretation compared with the original CAD model to ensure an accurate model geometry representation.

Results and Discussion

Experimental and numerical results are compared in Figure 10 for beam, midplane, Dual Domain and 3D mesh types at a fill time of one second. It can be seen from the simulation trends that the predicted filling pattern of the midplane mesh with horizontal teeth representation (Figure 10(c)) is not very accurate in the teeth sections for this particular part, while the beam elements (Figure 10(b)), midplane mesh with vertical teeth representation (Figure 10(d)), Dual Domain mesh (Figure 10(e)) and 3D mesh (Figure 10(f)) simulate the filling pattern more accurately. The inaccuracy or success of filling pattern prediction can be attributed to the assumptions made for each mesh type.

For the midplane horizontal mesh model (result shown in Figure 10(c)), the teeth of the comb are interpreted as a collapsed surface from top to bottom as described schematically in Figure 11(a). The side edges of each tooth are ignored as sources of heat transfer and flow resistance. The negative impact this assumption has on the analysis results is visually apparent in Figure 10(c). The simulation predicts an easier flow through the teeth of the comb as there is virtually no hesitation in the teeth.

A better result is achieved when the teeth are meshed in the vertical or side-to-side direction, as indicated schematically in Figure 11(b). The results of this method are seen in Figures 10(d) and 10(e), the midplane mesh with vertical teeth representation and the Dual Domain mesh, respectively. The simulation error is significantly minimized but does still exist.

For this part, the best results are obtained by modeling the teeth as beam elements (result in Figure 10(b)) as shown schematically in Figure 11(c), or by meshing the model with 3D elements (result in Figure 10(f)).

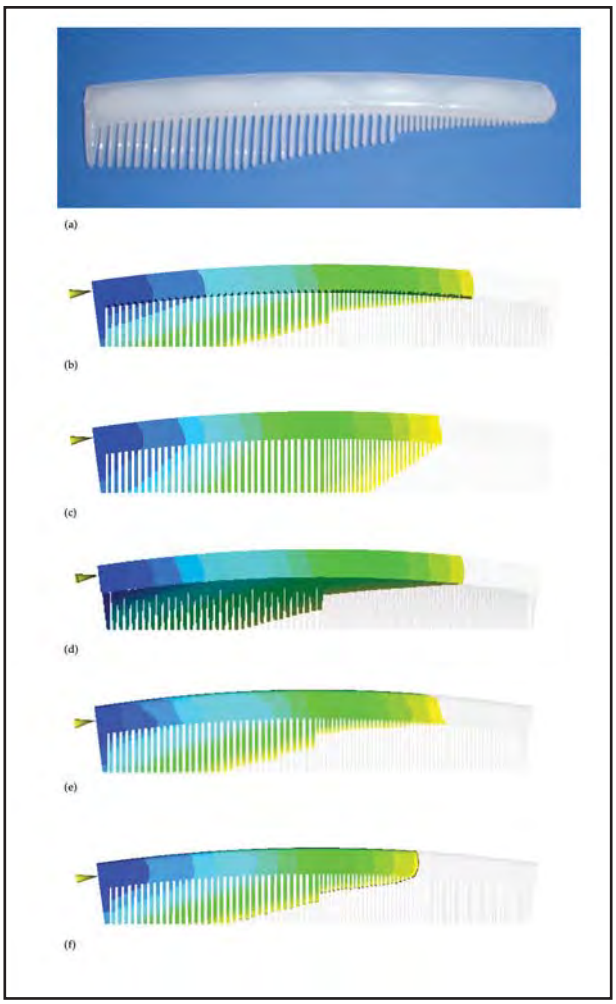

Figure 10. Comb short shots (1.0 sec fill time) obtained by experiment and various mesh simulation results: (a) experiment, (b) beam mesh result, (c) midplane mesh result with horizontal teeth representation, (d) midplane mesh result with vertical teeth representation, (e) Dual Domain mesh result, and (f) 3D mesh.

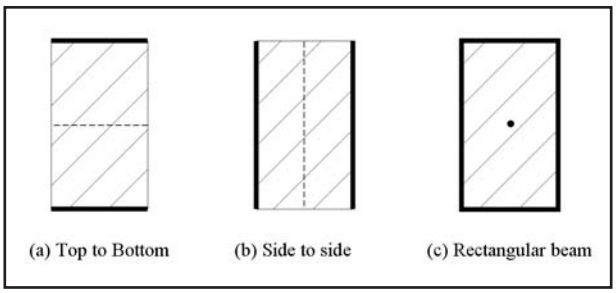

Figure 11. Thickness interpretation comparison for comb teeth. Dark lines represent where heat transfer is considered; dashed lines represent collapsed midplane surface.

Conclusions and Future Considerations

Because the great majority of injection molded parts are thin-walled, using a midplane or Dual Domain mesh model in most cases provides accurate simulation results because the thickness assumptions that are inherent in the CAE analysis reflect the typical part geometry.

However, as demonstrated in this study, there are some "thick and chunky" part geometries where these assumptions do not result in optimal solution accuracy. In these cases, using a combination of mesh types such as midplane and beam elements or using 3D elements should improve the accuracy of results.

It is important to consider the total solution time when choosing a mesh type for analysis... Moldflow products offer a wide range of software solutions to our customers, so they can obtain accurate results in the shortest period of time.

This study also demonstrated that the orientation of the midplane mesh can have a significant effect on the accuracy of the simulation. To minimize simulation error, it is suggested to consider how the part is going to fill and choose the most significant midplane orientation direction when creating the analysis mesh.

If a given part geometry has several features that require different mesh types, the user will have to make an educated decision on which mesh type to use based on the analysis options required and the mesh types available. This will mean selecting a mesh type that will most accurately describe the majority of the part geometry. For example, if a part is mostly "thick and chunky" in nature and violates the thickness guidelines in many areas, then a 3D mesh should be used.

As seen with the results of the combined midplane and beam mesh model of the comb mold, some mesh types can be combined and used successfully in a flow analysis, but use this technique with care. Mixed mesh types in a single model may not be supported in other advanced analyses such as cooling or warpage simulations, so user discretion is advised. Consult the training documentation, on-line help or your local technical support office for specific details on the limitations of combining mesh types for Moldflow analyses.

Utilizing a 3D mesh for all simulations is just not feasible today from an analysis time/benefit perspective. Moldflow products offer a wide range of software solutions to our customers so they can obtain accurate results in the shortest period of time. However, a fundamental understanding of the assumptions and limitations that govern each is necessary to achieve the most accurate possible analysis results. ■

For more information about Moldflow Plastics Advisers and Moldflow Plastics Insight solutions or any Moldflow Design Analysis or Manufacturing Solutions products, visit www.moldflow.com.

Reducing Time to Market

By James R. Knirsch, President and CEO, RSP Tooling

One of the most pressing requirements for any manufacturer of plastic parts is the need to reduce tooling delivery time. Part production has made many improvements over the years but one thing has stayed substantially the same — the amount of time it takes from concept to going into production. The major cause for this continuing bottleneck is the tooling lead-time. There is a new indirect spray form process now being commercialized to manufacture production quality tooling that will overcome this problem. It is Rapid Solidification Process (RSP™) Tooling. This process allows the manufacturer to build production tooling in the time it usually takes to make a prototype tool. And what is sacrificed to get this improved delivery? Nothing. In fact, there is strong evidence to believe this new tooling will increase tool life compared to conventional tooling made from the same alloy.

History

The Rapid Solidification Process (RSP) was developed at the Idaho National Engineering and Environmental Laboratory (INEEL) under grants from the U.S. Department of Energy. The initial patent for the process was written in 1990 and had as its basis the invention or discovery that a liquid could be broken down into small droplets by use of the shearing effect of a flowing gas.

Work on the process resulted in another patent in 1995 which introduced the use of pressurized injection of liquid into a Ventura tube, thereby improving the operational flexibility of the device while producing a more uniform droplet size distribution in the spray. An additional benefit was the ability to control and increase the cooling rate of the droplets, which results in microstructure and material property improvements in the deposited metal. This resulted in two things: a new patent in 1997, and the terminology of RSP Tooling. Additional patent applications have been submitted which refine the actual process to produce tooling.

RSP Tooling, LLC was formed in January 2002 to design, build, use and sell machines that manufacture tooling using this process. The company signed a license agreement with Bechtel BWXT Idaho, LLC (the company managing INEEL) for the exclusive worldwide use of the RSP patents for all tooling applications. The first production machine was designed and built by Belcan Corporation's Specialty Equipment Engineering Division (SEED) of Solon, Ohio. This machine (see Figure 1) is able to produce a 50-pound steel insert (7 inches x 7inches x 4 inches) every three hours. It is designed as a single batch unit so that a different metal can be used for each insert. The spray process is able to spray steel at a rate of about 500 pounds per hour. The machine is located at The Technology House also located in Solon, Ohio and is now producing tools for various industries including forging, die casting, stamping and plastics injection molding.

Figure 1. RSP Tooling beta machine.

The Process

The RSP Tooling technology makes high-quality production tooling from virtually any tooling metal, for any tooling process. The technique eliminates the need for CNC milling, sink EDM, benching, polishing, engraving and conventional heat treatment. The general concept involves converting a mold design described by a CAD file to a tooling master using a suitable additive rapid prototyping technology such as stereolithography, a subtractive method out of a soft material, or even hand-worked clay. A pattern transfer is made to a castable ceramic. This is followed by spray forming a thick deposit of tool steel (or other alloy) on the pattern to capture the desired shape, surface texture, detail and thickness. The resultant metal block is cooled to room temperature and separated from the pattern. Typically, the deposit's exterior walls are machined by wire EDM and any bolt holes and water lines are added as seen in Figure 2.

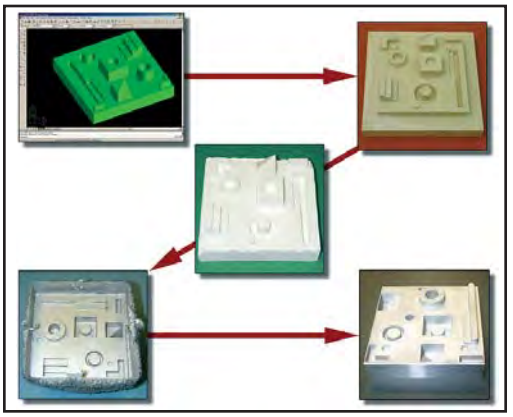

Figure 2. RSP process.

The high cooling rate of the deposit greatly impedes atomic diffusion, so segregation is very limited compared to cast metal. It also minimizes the erosive interaction of the metal and ceramic tool pattern, allowing the deposited metal to accurately capture surface details of the ceramic that would not be possible if the metal was cast onto the ceramic. The rapid solidification rate also results in non-equilibrium solidification, extended solid solubility and very limited segregation, as can be seen in Figure 3.

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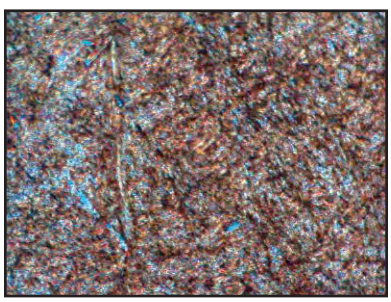


Figure 3. RSP H13 at 500x.

New Moldflow Certified Consulting Partner Program Aims to Change Perceptions, Enhance Customer Success

By Laura Carrabine, Editor

In today's competitive marketplace, increasingly more manufacturers are realizing the benefit of utilizing computer-aided engineering (CAE) in the early stages of new product development. They know that performing analyses prior to committing to expensive prototypes or steel helps to determine whether a part is manufacturable. Yet, many small and medium sized companies do not have on-site analysts or the software tools necessary to perform this type of work. In addition, many manufacturers do not need to perform analyses on a regular basis, so the incentive to invest in new CAE technology is not high. As a result, these companies omit analysis and rely on their limited experience, work-arounds or obsolete technologies. Yet for many others, the availability of and access to innovative, state-of-the-art technology and expertise can be vital for certain "make or break" projects.

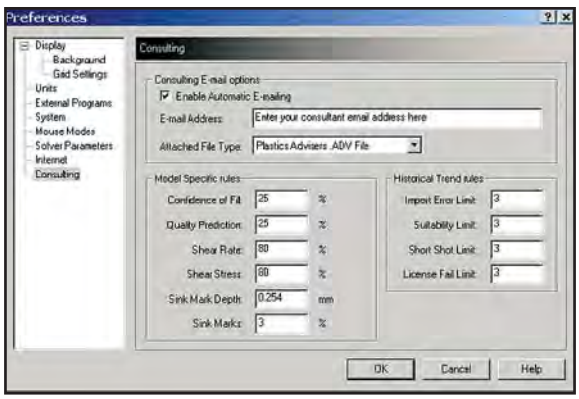
To address this growing need, Moldflow Corporation recently announced its Certified Consulting Partner Program, which provides an integral link between Moldflow software functionality and companies that can take advantage of the technology via certified, independent Moldflow consultants. John Twerdok, director of the Certified Consulting Partner Program, says, "While there are many excellent engineering consulting firms out there, companies may hesitate to use them due to perceptions of poor quality control and cost issues. As a result, outside consultants may have gotten a 'bum rap' in the past."

Moldflow's Certified Consulting Partner Program is focused on changing that perception by developing a network of certified consultants who qualify at Bronze, Silver and Gold level status based on the range of Moldflow software product expertise. Consultants who are selected for the program are trained by Moldflow-certified software instructors. "Our program removes barriers for these consultants so they can access the software technology and receive proper training to successfully apply Moldflow technology," Twerdok adds.

The program targets CAE consulting firms that offer services and support to the plastics injection molding industry. These companies can include those that are presently Moldflow Plastics Advisers® (MPA®) and Moldflow Plastics Insight® (MPI®) resellers.

Consultant organizations that join the Moldflow Certified Consulting Partner Program commit to attaining Silver level certification within the first year with the incentive to earn Gold level certification. They also agree to attend training for all licensed modules, provide materials for at least one case study for publication per year and serve as usage and quality monitors.

The latest release of Moldflow Plastics Advisers software, MPA 7.0, features a new Connect to Consultants tool. This capability allows all Moldflow Certified Consulting Partners to be designated as mentors by MPA customers. The service provides fast, easy notification of results for verification and guidance by the consultants. The Connect to Consultants tool is an innovative mechanism to help facilitate collaboration between the Moldflow Plastics Advisers user and a plastic simulation expert to ensure the successful application of MPA simulations. This interaction will help reduce the cost of MPA implementation within a design group, as well as allow the consultant to assist its clients with results interpretation, troubleshooting, alternative design recommendations and improve the overall software comprehension and use.



New in MPA 7.0 software, users can set up Connect to Consultant preferences. This allows the user to specify the e-mail address of an expert/consultant and define criteria that will trigger notification when an issue arises.

Mark Howards, owner of 3D Shapes, Inc. (Sharon, MA) and a Moldflow Certified Consulting Partner — Silver level, says, "I was very impressed with John Twerdok's understanding of the challenges that independent consultants face, as well as his vision for providing extended services and support for Moldflow customers. I have already attended the Simulation Fundamentals and Advanced Simulation training courses that cover all aspects of filling, packing, cooling and warpage for the MPI products. I also have gas-assist experience." Howards

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Groupe Plastivaloire Implements Moldflow Manufacturing Solutions Software at Multiple Sites

For the past seven years the group's primary site — PVL Langeais — has been optimizing its shop floor thanks to the improvements in information output from its production monitoring system

By Catherine Baghdiguian, Moldflow Corporation

Founded in 1963 and specializing in plastic injection molding of complex components, Plastivaloire has grown over the years through a combination of acquisitions and the construction of new sites. It now has a turnover in excess of 167 million euros and employs 1,700 people. Launched on the Paris stock market in 1991 (symbol: PVL), Plastivaloire now operates out of nine sites in France as well as sites in Poland and Romania. Langeais is the group's headquarters and its largest site, with 82 molding machines ranging in size from 25 to 2,700 tons and a workforce of 450 people.

Most of the group's customers come from three major sectors with a high demand for plastics: the automotive sector, with customers such as Valéo, Faurecia and Vistéon; the television and video sector, with customers such as Philips, Alcatel and Thomson; and household electrical goods and leisure goods, with customers such as Salomon and Seb. Each of these sectors represents about one-third of the group's business, and are all interested in quality, productivity and certification. In response, Plastivaloire has concentrated on developing its skills to obtain complete control of the commercial production processes, helping control costs, delivery dates and production quality variances. This strategy was facilitated by the purchase and implementation at Langeais and other sites of production monitoring software now available from Moldflow Corporation.

According to Mr. Audiger, Plastivaloire's head of Information Technology, "Prior to installing the new products, we realized that we absolutely needed to address product delivery issues by monitoring the shop floor and the workers in real time. For instance, when production was high and more than 40 machines were running, it was impossible to follow or track cycle times. Without a monitoring system we had to wait for the time-consuming manual output of production data at the end of each worker shift."

"With the range of machines we operate and such demanding customers, it was vital for us to find a production monitoring system that would allow us to control our costs, trace production and stay on tight production schedules. Moldflow's MMS/Production Monitoring software was just what we needed and is fully adapted to the plastics injection molding environment," adds Audiger.

The technology was installed easily at the Langeais site and within one month, shop floor technicians and others associated with production became proficient using the software. Today, manufacturing floor terminals attached to production machinery provide vital information to operators such as deadlines, materials, quantities, new orders, scrap rates, etc. Using the technology during production, operators can launch new orders and flag changes in status such as downtimes and reasons for scrapping. Terminals are utilized as raw materials centers and maintain data such as raw material batches, assigned production runs and job lists. "This approach to providing real-time information allows all staff to react if they notice a discrepancy, helps control downtimes and their causes, and thereby contributes to boosting production and overall efficiencies," notes Audiger.

Information obtained from the terminals is useful both on the shop floor, and also to company production analysts who can review the data derived from the system. Multiple reports can be generated, summarizing details by machine, operator, shift, day, week, month, etc. The analysis helps the company to monitor important factors such as scrap rates, cycle times, downtimes and other elements that can affect production efficiency.

"The production monitoring system enables us to improve our machine capacity utilization," Audiger adds. "We have increased machine production and reduced our scrap rates. We are optimizing the information which we receive in real time thanks to the Moldflow system. For each production run, for example, we see improvements in downtimes, recycling times, mold changes, production start and finish times and so on. We've been using the system for seven years now, so the rate of improvement is naturally leveling off, but the improvement is steady," concludes Mr. Audiger. ■

For more information about Groupe Plastivaloire, visit www.plastivaloire.com.

For more information about Moldflow Manufacturing Solutions products, 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**.

Easy Repair and Optimization of Surface Meshes Leads to Fast and Accurate MPA Analysis on STL Models!

By Koen Engelborghs, M.Sc., Ph.D., Development Manager, Materialise

RapidParts (UK), Materialise's rapid tooling site, has a unique approach to tool design and manufacture: they routinely use the STL format throughout the entire design and manufacturing process. One of the secrets behind RapidParts' short lead times is the emphasis they place on analysis. All parts are analyzed with Moldflow Plastics Advisers® (MPA®) software to anticipate manufacturing issues and product quality. With hundreds of projects each year, RapidParts relies on MPA as a valuable tool for ensuring efficient and cost-effective production. In order to maximize the advantages of using MPA, RapidParts looked for a way to guarantee fast and accurate analysis for any STL model.

Rachel Collier, a CAD and tool designer at RapidParts, explains: "Because RapidParts aims at keeping analysis lead-times short, while optimizing the analysis' added value, we studied ways to maximize the quality of analysis results. Our research revealed that the 'garbage in, garbage out' rule also applies here. So we investigated ways to improve the quality of the input data."

"Garbage In — Garbage Out"

RapidParts examined a random sampling of 100 recent tooling projects. Their researchers were able to establish three categories for distinguishing input data. In category 1 are STL models RapidParts receives that don't require adjustments in order to allow correct MPA analysis. Category 2 encompasses models whose flaws make them unusable for analysis. Most of these defects originate from incorrect or poor export of CAD files. Finally, RapidParts identified category 3, files that look fine at first sight, but either cannot (completely) run in MPA or return sub-optimal results.

"In terms of analyzing these problematic files, only two options are available: review the results with caution or stop the analysis. If the part is quite complex and analysis by MPA is required to ensure good tool design and molding, this restriction can be a big disadvantage. Failing to recognize inaccurate results can mean drawing the wrong conclusions regarding design and manufacturing. Imagine the additional time and costs involved," says Collier.

Optimizing MPA Input Data with Magics Software

Next, RapidParts looked for easy ways to transform problematic files (of categories 2 and 3) into files that return accurate analysis results. Because a defective mesh cannot be repaired in MPA, RapidParts uses its own Magics software before analyzing the file to fill holes and small gaps, remove noise and double surfaces, invert wrongly oriented triangles and repair untrimmed surfaces. In this way, category 2 files are easily made suitable for import in MPA. The study showed that 70 to 80 percent of these watertight models can be analyzed correctly and completely with MPA.

In 20 to 30 percent of the projects, however, the MPA software either indicates "potential mesh problems" or cannot process the parts completely. Nine percent of these files can't be processed at all. These are the STL files classified above as category 3. Closer inspection revealed low quality surface meshes; all files contained triangles with a quality aspect ratio below the one advised by MPA.

"With Magics Remesh module, which was released in September 2003, we could finally deal with such low quality surface meshes. We now systematically optimize every STL file with potential mesh problems, with a normalized quality parameter set at a minimal required value (advised by MPA). This results in a much better STL surface definition. After importing the optimized file into MPA, we can thoroughly perform each analysis without any problems. We now have a 100 percent success rate!"

Figure 1 shows the surface mesh of a part received at RapidParts. Rachel Collier was

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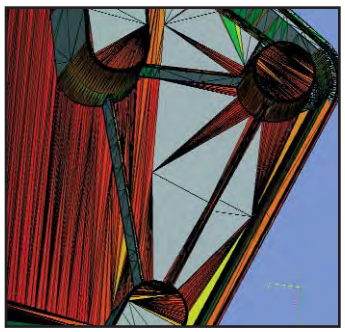

Figure 1. Surface mesh of the original file.

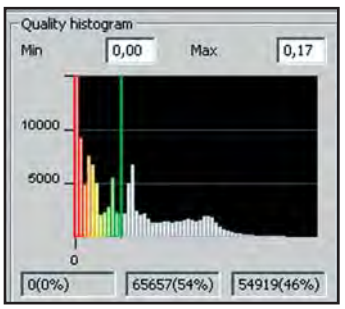

Figure 2. Quality histogram of the original file.

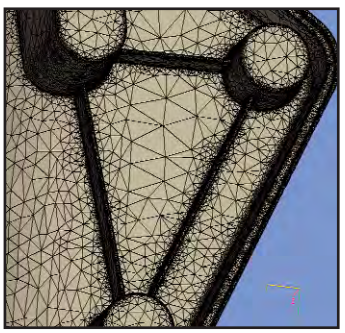

Figure 3. Surface mesh of the optimized file.

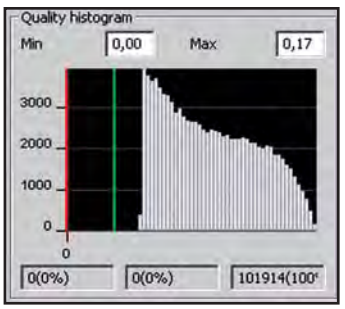

Figure 4. Quality histogram of the optimized file.

Achieving the Most Accurate Simulation Results Depends on the Highest Quality Input Data

How can you know your material properties data is accurate and reliable?

Go to the source.

Moldflow Plastics Labs constantly strive to provide the highest quality material data that yields the most accurate simulation results. Our commitment to continuous improvement has lead to numerous innovations in material testing and behavior modeling as simulation technology has evolved.

Standard testing packages include a rigorous array of molding trials and data verification in Moldflow software. Each material tested and modeled for shrinkage predictions undergoes molding trials under dozens of process settings. You can be sure that material properties data from Moldflow Plastics Labs represents the best data for Moldflow simulations.

Moldflow Plastics Labs. The right source — and we prove it.

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Polymer-based Nanocomposites: a Brief Overview

By Prof. Michele Laus, Università degli Studi del Piemonte Orientale, Alessandria, Italy

The use of organic and inorganic fillers is a common practice in the plastics industry to improve the mechanical properties of thermoplastic materials such as heat distortion temperature, hardness, toughness, stiffness and mold shrinkage or to decrease other properties such as gas permeability and often, material price. The filler effect on the composite properties strongly depends on its shape, size, aggregation state, surface characteristics and degree of dispersion. In general, the mechanical properties of a composite material with micron-sized fillers are inferior to the properties of a composite with nano-sized fillers. Physical properties such as surface smoothness and barrier properties cannot be achieved effectively using conventional, micron-sized fillers.

For these basic reasons, systematic work in polymer nanocomposites has exploded over the last few years.[1] This novel material technology, based on work at the molecular level to create large structures endowed with peculiar molecular organizations, is leading to nanoscale materials with properties different from the ones of their macroscale counterparts.

On the other hand, new problems in polymer processing arise because of the inherent characteristics of the nano-sized fillers. In general, the specific features of nanocomposite materials are due mainly to the very high interfacial area and very short distance of the reinforcing particles. The contact surface in such a dispersion between the filler elements and the matrix material grows dramatically with respect to conventional fillers, thus leading to the creation of wide interfacial regions which are of utmost importance in determining the material properties. In addition, the percolation threshold is expected to occur at very low concentration of the filler. However, the smaller the reinforcing composite elements, the larger their internal surface and hence their tendency to agglomerate rather than to disperse homogeneously in a matrix.

On the basis of aspect ratio, nanotubes, spherical nanoparticles and sheet-like particles are the most representative nanofiller geometries. Although nanocomposites based on carbon nanotubes, which so far display the highest values of elastic modulus (~1.7 TPa), or spherical nanoparticles[2], for example PTFE or calcium carbonate, display interesting mechanical, electrical and also optical properties[3] and are the subject of intense studies, the most promising class of nanocomposites includes those made from polymers and layered phylosilicate clay materials, such as montmorillonites.

The montmorillonites are often modified through an ion exchange process in which the interlayer cations are substituted by cationic surfactants such as alkylammonium ions. The intercalation of these small molecules between the layers reduces the forces that hold the stacks together and the resulting modified clays (or organoclays) are more compatible with the organic polymers. In fact, unlike talc and mica, the organoclays can be delaminated and dispersed into individual layers with a thickness in the order of one nanometer and very high aspect ratios (10-100).

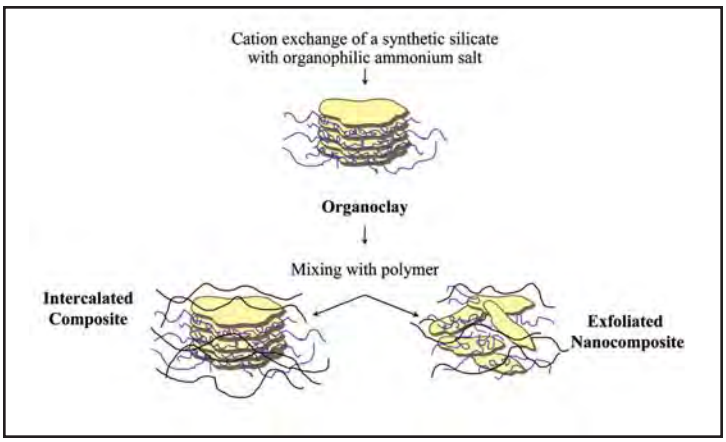

Figure 1. Schematic representation of nanocomposite structures.

Unseparated montmorillonites, after introduction into the polymer, are usually referred to as tactoids. Two types of structure, schematically represented in Figure 1, may be obtained, namely intercalated nanocomposites, where the polymer chains are sandwiched between silicate layers, and exfoliated nanocomposites, where the separated, individual silicate layers are more or less uniformly dispersed in the polymer matrix. As the original montmorillonite is made up of particles nominally 8-10 μm in size, there should be one million or more platelets in each particle.

Consequently, the key benefit of montmorillonites in nanocomposites, but the challenge in processing to make the nanocomposite, is to obtain a perfect dispersion of such a great number of individual platelets within the polymer matrix. The attainment of a good dispersion derives from two different aspects: the chemistry of the clay surface, including the compatibility of the surfactant with the polymer matrix and the processing conditions. Given that the surfactant chains are miscible with the polymer matrix, a complete layer separation depends on the establishment of very favorable polymer-surface interactions in order to overcome the penalty of polymer chain confinement. In addition, the help of shear forces during the preparation and the processing of nanocomposite material is often necessary.

In this respect, the extruder configuration[4] with appropriate screw design appears essential. In fact, shear intensity is required to start the dispersion process, by shearing the particles apart into tactoids or intercalants (Figure 2). Residence time in a low shearing or mildly shearing environment was demonstrated to be required to allow polymers to enter the clay galleries and peel the platelets apart. Considerable work must still be carried out to find the proper balance between the chemistry of the clay surface and processing conditions. In this context, it should be recognized that metastable morphologies can be frozen in by processing if the compatibility between the polymer and the organoclay is too low. Under this condition, substantial aging effects are expected, thus complicating the inherent properties and material dynamics.

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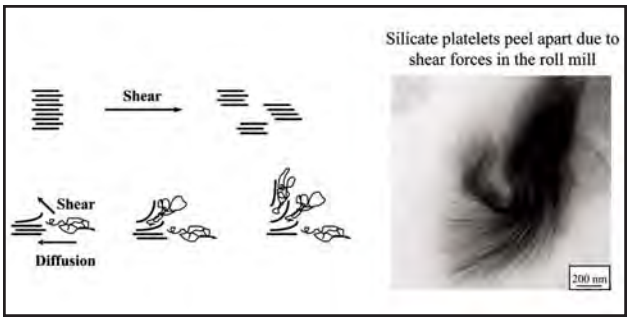

Figure 2. Shear intensity is required to start the dispersion process.

Nanocomposites exhibit enhanced mechanical properties at very low filler level, usually less than five percent by weight. Mechanical analysis via stress-strain testing showed a substantial increase in the Young's modulus, while values for strain at break and yield stress remain nearly at the same level of the pure matrix material. An increase in thermal stability, gas barrier properties and flame retardancy was demonstrated. In addition, provided that an excellent dispersion degree is obtained, these materials are often optically transparent. An enhanced fracture toughness is also claimed for these nanocomposites although it is hard to find any convincing evidence in the open literature.

Concerning possible field applications[5], these nanocomposite materials have to compete with traditional composites, reinforced by carbon, glass and aramids. Consequently, only in areas where enhanced mechanical properties and transparency are required have these quite complex and far from cheap materials a chance for application today. In addition, in areas in which the characteristic material dimensions are measured in microns, as in the case of glues, fibers, foams and coatings, a prospective use of nanocomposites could be envisioned. ■

Prof. Michele Laus will present his work with nanocomposite materials at the 2004 International Moldflow User Group Conference, May 17-19 in Frankfurt, Germany.

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Benefits

The benefits of the RSP Tooling process can be summarized as:
- ❑ Reduces tool lead time
- ❑ Reduces tool cost especially for replacement tooling
- ❑ Increases tool life

The entire operation from receipt of a CAD model to the delivery of a finished tool insert could theoretically be done in 64 hours. Normal delivery time should be approximately seven days. This time savings is compounded when multiple cavities are required, since each cavity would add only two hours (an eight-cavity die with mating halves could be completed in eight days). Another interesting advantage is that complexity is not relevant. The two-hour cycle time is the same for a flat plate or a detailed engraving as seen in Figure 4.

Figure 4. Details as small as 0.003 inch are captured.

There is also a reduction in costs. Since many standard operations are eliminated, costs are less. There is also the financial benefit of reduced tooling lead times and reduced tooling inventories. Significant reduction of energy usage results from the elimination of heat treating and machining. There is very little material waste, since excess material and even old and worn tools can be used as the initial melt material. It is also imperative to design the process, gates, vents and runners prior to making the cavity, since it can all be added to the mold for the same cost.

Improvements

Research continues at RSP Tooling with the goal of improving accuracy and cutting delivery time. Accuracy of the process is approximately +/- 0.002 inch. Dr. James Folkestatd of Colorado State University (CSU) is developing data on the shrink of the ceramic which is expected to improve accuracy by 50 percent. CSU and INEEL are also working on new, faster, more accurate ceramics which will reduce timing and cost and improve accuracy.

Dr. John Frater of Cleveland State University is working on new subtractive methods of making the initial pattern. Initial data indicates that both the time and cost of this pattern could be reduced by 50 percent. This work is being partially funded by the Forging Industry Association.

RSP Tooling is also working on clad tooling with the help of INEEL. This tooling is made by spraying a thin layer of steel and then following up with a copper addition to complete the tool. This has the benefit of both reducing the cost and time to finish an RSP tool and decreasing the cycle time by up to 40 per cent. ■

For more information about RSP Tooling, LLC, visit www.RSPtooling.com or contact James Knirsch (tel: +1 440 505 6033, email: knirsch@rsptooling.com).

Benefits of Real World Training in a University Environment

By Jay Shoemaker, Moldflow Corporation

Moldflow has been conducting regularly scheduled CAE software training classes at Western Michigan University (Kalamazoo, Michigan) for over 10 years. In 1998, Moldflow donated multiple seats of the Moldflow Plastics Insight® (MPI®) software products and additional resources to establish the Moldflow Center for Design Excellence with a dedicated training room at the university. This partnership has provided several benefits to Moldflow customers who attend Moldflow Plastics Insight® software training classes at Western Michigan University.

Research in Action

Western Michigan University has a well-established research program involving injection molding process optimization and injection mold tooling design. A dual role as Moldflow's education manager and an adjunct assistant professor at Western Michigan University allows me to participate actively in research activities that the university conducts.

In the last several years, Western Michigan University has conducted research involving the use of copper alloys in injection molding tooling. There have been two major projects. The first is to understand and quantify the efficiencies gained in using high thermal conductivity alloys compared to traditional steels for both cycle time and part warpage. The second major project is to understand the wear mechanisms of abrasive polymer flow in injection molds so wear of copper alloys can be minimized. These two primary research activities have lead to several secondary studies, several of which involve Moldflow.

Moldflow Plastics Insight software was used to optimize the design of the tooling for these studies, including the feed system wall-thickness selection and cooling line design. The production runs for these studies have provided excellent validation studies for not only MPI/Cool analysis, but also MPI/Flow and MPI/Warp analyses, as well.

Information derived from the studies has a direct impact on the training materials developed for the MPI modules. Several tooling studies have provided part samples and tooling components that help describe issues with cooling system design. Tools used in research have also been used in models used in the MPI/Flow classes as well, so the models used for MPI analyses can be compared to the actual molded part.

Research conducted in late 2003 and to be published in May 2004 looks at the relationship between mold material thermal conductivity, cooling line depth and cooling line pitch (distance between the cooling lines). Through this study, guidelines for properly laying out the tool's cooling lines were determined. In addition, this study identified the statistical and practical importance of mold material selection with regard to mold temperature uniformity and the difference between the part and coolant temperatures. This information will be integrated into Moldflow's Advanced Simulation — MPI/Cool training class.

Figure 1. East wing of Western Michigan University's College of Engineering and Applied Sciences.

State-of-the-Art Facilities

In September 2003, Western Michigan University dedicated a new, $99 million campus for the College of Engineering and Applied Sciences as part of a Business, Technology and Research Park. The main engineering complex is a $72.5 million facility totaling 343,000 square feet (31,800 square meters). This facility boasts a plastics processing laboratory of 8,000 square feet (740 square meters).

In addition, the Moldflow Center for Design Excellence was built and furnished into the new facility. AMD Corporation has donated eight computers for the new training center, which now has plenty of room and comfortable chairs at each workstation. The center features indirect lighting which can be dimmed for optimal control during presentations and work on the computer. Presentations are given using a 3M digital wall display.

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Figure 2. (a) The Moldflow Center for Design Excellence features computers donated by AMD Corporation. (b) Customers who attend Moldflow training also may visit the plastics processing laboratory for a look at a production facility in action.

Introducing Moldflow Manufacturing Solutions 2.0

By David Duarte, Moldflow Corporation

The release of MMS™ (Moldflow Manufacturing Solutions™) 1.0 in April 2003 was a major milestone for Moldflow Corporation as it represented the integration of Moldflow's MPX® and Shotscope® technologies to co-exist on a single platform. Since the release of MMS 1.0, there has been a series of point and revision releases which have included major enhancements to MPX in automated process setup, optimization and control, as well as expanded local language support, including French, German, Italian and Hungarian implementations.

Moldflow Manufacturing Solutions 2.0

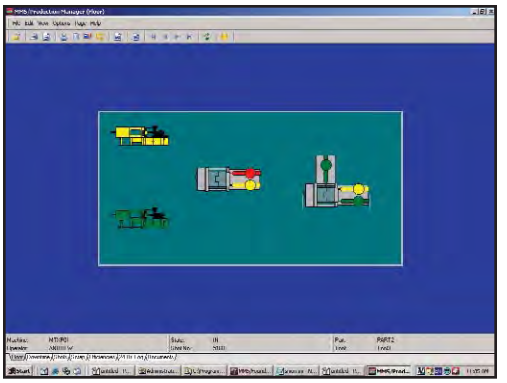
The newest version of Moldflow Manufacturing Solutions, MMS 2.0, features customer-driven enhancements to the Shotscope and MPX modules as well as improvements to the underlying data architecture, MMS Foundation, to support the most current versions of the Microsoft® Windows® operating system and the latest Borland databases.

Shotscope Enhancements

The following are some of the key new features and benefits available in the release of Shotscope:

Support for Multi-Barrel Injection Molding Machines

Many injection molding machines in use today have multiple injection units to enable the injection of different materials. One example of this would be molding rubber seals on various plastic automotive components. Another example is the production of rear taillight lenses for automobiles, requiring the use of multiple colors — for example, red, amber and clear — in a single component. Our customers have requested the ability to schedule, manage and monitor these multi-barrel machines, functionality which has been added to Shotscope.



MMS 2.0 now includes the capability to schedule, manage and monitor multi-brarrel injection molding machines.

In general, multi-barrel machines are used in two different ways within a plant. The first method is a sequential use of the barrels, where the first barrel injection cycle occurs and is followed by the second barrel injection cycle. This method is often used to inject two different materials into a mold. The second method is the parallel use of the barrels, where each barrel can be injected independently of the other(s). Shotscope now supports both of these multi-barrel configurations.

Moldflow's New Manufacturing Solutions Group

Showing its commitment to delivering best-in-class process-wide plastics solutions, Moldflow recently launched the Manufacturing Solutions Group. The newly formed business unit will focus its attention and energy on Collaborative Manufacturing Management (CMM) which provides the framework for organizing and controlling the key business processes of a manufacturing enterprise. The Group will develop and market solutions geared to install rapidly and deliver an immediate ROI by increasing the quality, speed and efficiency of the injection molding manufacturing process.

With ten locations in the Americas, six locations in Europe and five in Asia, the Manufacturing Solutions Group is uniquely positioned to support local as well as global organizations involved in the manufacturing of injection molded plastic products.

Ability to Manage Multiple Machine Operators

Many of our customers routinely assign multiple operators to one injection molding machine. Depending on the production requirements and production line speed, there is the need to provide additional labor for activities such as flash removal, quality inspections or packaging of the components. With the latest release of Shotscope, these customers will now have the ability to assign and manage the association of multiple operators for login and logout, as well as data entry for scrap, downtime and changes to mold cavitation and material lot control numbers. This improved functionality in Shotscope provides additional flexibility, allowing our customers to use Shotscope in a manner consistent with their current business practices.

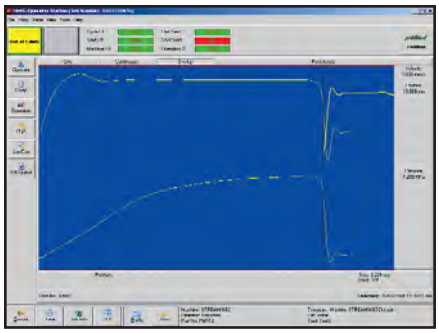
Enhancements for the Metal Die Cast Industry

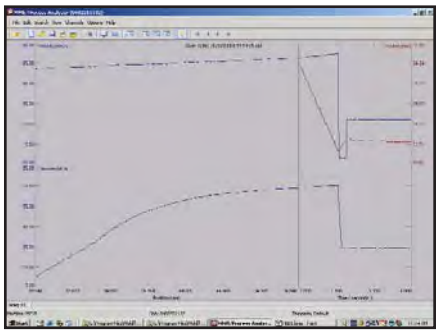
We have served the monitoring needs of the die cast market for many years with Shotscope. As the die cast process has its own unique set of criteria for process monitoring we have created Shotscope FX and given it the most popular enhancement request from this customer group, a new process display format. Shotscope FX for die casters is a hybrid display, showing the velocity and pressure as a function of position, with a switch over to a time-based display in mid-cycle.

This hybrid, position-based display is the industry accepted format and is essential to our continued participation and growth in this important market segment. This new display option available in Shotscope FX advances Moldflow's support of the die cast market.

Documentation of the Database Schema

Many of our customers desire custom applications written on top of our collaborative manufacturing management (CMM) applications to





The new position-based display capability enhances monitoring of metal die cast processes.

enable functionality unique to their manufacturing or business processes. Supplying documentation of the database schema will provide our customers with the database structure and dependencies, enabling the efficient development of custom applications, queries and reports. This open format is part of our continued commitment to provide maximum product value to our customer base. If preferred, our Custom Applications group can be consulted to assist with custom development requirements.

Enhanced Enterprise Resource Planning (ERP) Interface System

Linking real-time manufacturing operations data with enterprise-wide management systems helps to achieve real-time performance management (RPM), which is a management practice that measures performance in real-time where the measures are used to adjust production targets to exploit current market conditions and improve business agility. To enable seamless communication with the world's leading ERP systems, we have implemented a robust, user-friendly application programming interface (API) for both inbound and outbound communication as part of MMS Foundation.

Legacy Product Migration

For customers using older versions of MPX and Shotscope, we have developed a clear and concise facility to migrate the data from the older versions to the new ones in MMS Foundation. This new facility allows customers running Shotscope 2.6 and MPX 3.2 to easily upgrade to the latest versions of Shotscope and MPX without any loss of historical data or configuration and calibration settings.

Ease-of-Use Product Improvements

Enhancements to the operator station user interface in Shotscope improve data entry and ease-of-use. Information such as scrap entry, downtime entry, lot/cavitation, etc. can now be entered easily through a series of graphical, intuitive icons.

Injection Molding Machine Controller Interface Support

New in MMS Foundation is a bi-directional communication interface with Ferromatik Milacron's new XTREEM™ XP control, expected to be shipping worldwide on all Ferromatik Milacron molding machines by the end of 2004. The interface allows for direct integration of all Moldflow's CMM suite of products onto the Ferromatik Milacron controller hardware — eliminating the need for any external or additional hardware. In addition, bi-directional communication interfaces are supported for the following machine/control platforms:

Injection Molding Machine Manufacturer	Controller
Arburg	Dialogica
Arburg	Selogica
Battenfeld	Unilog 4000
Battenfeld	Unilog 9000
Battenfeld	B-4
Billion	DIXIT 2
BMB	ELSY 206
BMB	ELSY TRE
BMB	M7
BMB	MOOG
Demag	NC-4 Arcnet
Demag	NC-4 Euromap 63
Engel	CC80
Engel	CC90
Engel	CC100
Engel	EC88
Engel	EC100
Ferromatik Milacron	XTREEM XP
Ferromatik Milacron	IQT Protocol 2
Italtech	Alpha 5
Krauss Maffei	MC-3
Krauss Maffei	MC-4
Maico	TEK/S
MIR	DS-2
Netstal	DSP/2
Netstal	DSP/3
Stork	CDS 500
Stork	CDS 600
Van Dorn	Pathfinder 2500
Van Dorn	Pathfinder 3000
Van Dorn	Pathfinder 4500
Van Dorn	Pathfinder 5000
UBE	NEC PC

Supported Operating Systems and Recommended Hardware Requirements

Touchscreen PCs , Client Workstations and Non-touchscreen Data Collectors

	Windows 2000 Pro	Windows XP Pro
Processor	Intel Pentium II 233 MHz	Intel Pentium 850 MHZ
Ram	128 MB or higher	256 MB or higher
Hard Drive Capacity	10 GB minimum	10 GB Minimum
Available Disk Space	1.5 GB minimum	1.5 GB minimum

MMS 2.0 — continued on page 29

Making the Tool Fit the Process

Moldflow Custom Applications Development Services

By Robert Newman and Matthew Pooley, Moldflow Corporation

Every manufacturer has certain distinct management methods, processes and procedures that they have employed to leverage unique competitive advantages. Due to the specialized nature of these systems, it is usually not possible for any standard product to facilitate all such approaches.

Too often, the addition of new enterprise tools implies that clients need to change their procedures and operations standards to meet the functionality and limitations of the new tool. However, in many circumstances, a better solution would be to adapt the tool to meet the individual manufacturer's operational standards and needs.

Moldflow provides an effective solution through custom-developed tools that augment its collaborative manufacturing management (CMM) suite of products. As a result, Moldflow customers can utilize our technology to add greater value and achieve more seamless integration with their other enterprise management systems and operational processes.

The Moldflow Custom Applications Group provides development facilities to meet a wide range of custom requirements such as:

- ❑ Alarming systems, delivered through pagers, text messaging, etc.
- ❑ Customer-specific reports, summaries and data representation
- ❑ Additional data input for scrap entry, QA events, operator changes, etc.
- ❑ Additional user input methods and devices, such as swipe cards, barcodes, etc.
- ❑ Custom interfaces with ERP, MRP, QA and other tools
- ❑ Customized algorithms for part diversion, alarms or part tracking
- ❑ Collection and integration of data from external devices
- ❑ Integration of barcode reading or printing facilities

When bridging the gap between the Moldflow CMM suite of products and other processes, procedures and systems, the Moldflow Custom Applications Group utilizes its wide range of experience to automate interactions and boundaries. This reduces the workload involved in usage of the many plant systems and allows customers to obtain extended benefits to a standard approach.

The Moldflow Custom Applications Group is also available to investigate solutions to any unique requirements which customers have. The experience and broad-based knowledge of the Custom Applications Group allows it to consistently implement solutions which meet or exceed customer expectations.

When you need services to fully integrate your systems, thus supporting the end-to-end solutions required in manufacturing operations, you need Moldflow's custom application development services.

Customers are already talking about the benefits of custom applications development:

"Thanks to work by the Moldflow Custom Applications Group, I was able to automate a task which previously wasted valuable staff time. As a result, we were able to actualize a ROI on the customization in less than 12 months while also reducing potential sources of error in our process."

Sylvain Theroude
Production Manager
Qualipac America

"When integrating our industry leading SPC package with Moldflow's CMM suite of products at a customer site, we found that the Moldflow Custom Applications Group provided support beyond our expectations. It was a pleasure to work with Moldflow in order to meet the customization needs of our mutual customer."

Steve Wise
Director of Statistical Applications
InfinityQS International, Inc.

"The Moldflow Custom Applications Group has been great at gathering and understanding our requirements and delivering to deadlines. I would recommend their services to current and future manufacturers in my industry."

Gilbert Estrada
CIO
Technology Integration Services

Supported Products

- ❑ Moldflow Manufacturing Solutions 1.0 and above
- ❑ MMS/Production Monitoring 1.0 and above
- ❑ Moldflow Shotscope 2.4 and above

Note: Local language support provided with the assistance of local sales representatives.

Standard Requests

❑ **Customized ERP/MRP interfaces.** The necessity of ERP/MRP systems in manufacturing plants has been shown worldwide. However, each plant has different processes surrounding its ERP/MRP system, which require different interactions between this and supporting systems such as Moldflow's shopfloor products. The Moldflow Custom Applications Group can provide solutions when the standard integration facilities of the Moldflow products do not meet specific requirements of a customer's ERP/MRP configuration.

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High-Fidelity Product Creation through Digital-Physical Convergence

By Bruce Jenkins, Principal and Senior Analyst, Spar Point Research LLC, Danvers, MA

Low-fidelity information. After decades of IT investment, product development and manufacturing organizations still find themselves plagued by information that's not complete enough, detailed enough, or timely enough to support confident, low-risk decision making.

The culprit? Gaps within product-creation IT solutions, gaps between solutions and gaps in manufacturers' product creation processes. Where are these gaps, and what can program managers and discipline leaders do about them?

Low Fidelity in Design and Production

Design systems are low-fidelity? How can that be?

It's not that solids models aren't dimensionally precise — reality isn't. More accurately, reality is stochastic. Contemporary 3D modeling systems define nominal, idealized geometry, but in the real world geometry is variable. Why this matters for manufacturers is that as-designed is never as-produced — parts coming off the production line will always vary from the digital model.

Understanding that variance is critical for managing quality and yield. Needed are information technologies to help determine what variances can be expected, the probable frequency and range of variances, what's acceptable given product requirements, how variances can be constrained — and at what cost.

Low Fidelity in Simulation and Test

In addition to production issues, design systems are low-fidelity in the insight they offer into product function and performance. Beyond simple mass properties, solids modelers "know" little or nothing of how a part or product will behave in use; 2D CAD systems, of course, even less. Meanwhile, the software tools that do know about product performance — those for simulation and analysis — traditionally were connected to design systems poorly, if at all.

Nor have simulation technologies in themselves been very high-fidelity. Any given analysis tool simulates only a narrow slice of a product's behavior under tightly bounded conditions. Analysis tools for one discipline have not been easy to use in concert with those for other disciplines. Exercising a solver over a range of conditions to get a more complete picture of product performance under a variety of conditions, or to explore alternatives, has been prohibitively difficult.

Physical test automation likewise offers only limited snapshots of a product's performance. And the domains of digital simulation and physical test are not well integrated. Because of this, manufacturers have a hard time capitalizing on the physical test's potential to boost confidence in simulation results and that of analysis to make physical testing more efficient and informative.

Higher Fidelity through Digital-Physical Convergence

On the horizon are technologies and approaches that we believe promise a leap forward in fidelity of IT-based product creation. Their essence is integration between computer-generated digital models and sensor-based digital capture of physical conditions. By bringing together computer-based abstraction and sensor-based measurement, these new approaches promise to help manufacturers bridge gaps between the nominal, idealized world of computer-aided design, analysis and manufacture, and the stochastic, probabilistic conditions of real-world production and use.

Bridging the gaps between design, simulation and test will yield greater understanding and control of the variables that affect performance, quality and cost. Bridging the gap between design and production will make it easier to optimize designs for production, then monitor production conditions to control quality, maintain yield and maximize the value of production assets.

Boosting Fidelity by Converging Processes — Today

Already we see program managers driving aspects of this convergence in their organizations and processes. While not experts in any one discipline, these individuals are collecting input from specialists in design, manufacture and test, then making decisions aimed at balancing and synthesizing these discipline-level viewpoints and needs. If you have responsibility for product development, what you can do today is look for efficiencies you can achieve by bringing these work processes together, then seek solution providers and partners who get it and will work with you to make it happen.

Why now? For many, it's the next challenge. With solids-based design affordable and well understood, practitioners are looking for the next constraint to overcome. Also, the considerable computing power needed to link multiple disciplines and run more work processes in parallel is now available and affordable, or well on the way. Of course the overriding driver is the pressure to deliver more new product with more features at higher quality, without massive new investment.

The good news is that there are solution providers who get it. Across the industry we see dawning realization of the potential in tighter integration between modeling and simulation, simulation and test, design and production. Some leading providers of test-and-measurement environments are reaching out to connect

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their solutions to product design systems. Analysis tool developers are working to devise more sophisticated ways to give designers functional insight than early tries at this. Software for control systems simulation is evolving to foster early involvement of this function. Of course not all of this may be available from a company's current solution providers, at least right away — some may have to look further afield.

The old way was to develop product with incomplete information and not much automation. Consequently, product development processes were carried out more or less serially. The promise of emerging tools and approaches is to help program managers and discipline leaders correlate and integrate processes so that more work can go on in parallel. Product performance analysis can be confirmed by physical test and measurement. Product design can be informed by manufacturing and producibility experience. Besides accelerating product delivery, the payoff is that information and decisions move upstream in product development, where their impact is greater.

The business objective of this new focus on integration is to get disciplines and functional specialties involved in the product development cycle early enough to make a difference. This isn't easy in a world where product creation is carved up into separate departments for design, analysis, test, manufacturing engineering, quality, value — but some are doing it today. If you're a program manager, of course you have to protect the edge your company has painstakingly built up in a particular discipline. The challenge is to do so while bringing that knowledge closer to all the other competencies spread throughout your organization. When that happens, everyone wins. ■

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especially interested in identifying and eliminating sink marks, so the part was imported into MPA. "MPA predicted a short shot, something unexpected for this size part. Also, we could not visualize where the short shot occurred. This prevented further analysis phases, including the sink analysis, because you need a complete shot to do it. So I had to conclude the analysis of the original file had failed," Collier says. MPA advises maintaining an aspect ratio (the ratio of the height perpendicular to the longest side, to the length of that side) higher than 0.17. The quality histogram shows that the original file included a great many triangles with a height/base ratio below 0.17 (the green line).

Magics easily optimized the mesh. The histogram (Figure 4) shows that all triangles have moved to the right side of the 0.17 line, well above the recommended quality. Imported in MPA, the optimized model was correctly analyzed and the sink mark analysis could be run.

Quickly Analyze Every STL File with More Accurate and Complete Results

This is just one example from the 100 STL files in RapidParts' study. A comparison was made between the MPA analysis results and calculation times from the original and optimized files. Rachel Collier summarizes the results of the study: "By using different STL optimization tools, we obtain a wider range of results, since all files can be fixed and prepared for the MPA analyses. The results are more accurate and complete because the mesh meets MPA quality requirements. An average time-saving of 16 percent was realized because the STL surface definition is better and contains fewer triangles (an average reduction of the number of triangles of 23 percent), allowing faster calculations." ■

You can get more information about Magics at www.materialise.com or by attending Materialise's presentation at iMUG 2004, May 17-19, Frankfurt, Germany.

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More than Software Training

Customers who attend a typical training course at the Moldflow Center for Design Excellence also benefit from a visit to the new plastics processing laboratory. Often, Moldflow customers may not have had much exposure to an injection molding production facility in the course of their work. The plastics lab is set up like a production facility. The larger machines are hooked to a Motan resin drying and distribution system, there are several types of chillers and thermalators by the presses, and there are material handling components by the presses.

This direct experience can help customers relate the various analysis inputs to the actual equipment used on the production floor. Often the molds in the lab can be used to show the components of a tool or how a tool can be designed. The lab operations can also demonstrate what impact Moldflow simulations have on the part and mold design. In many cases, a research production run is in progress during the class. The production cell can be viewed so Moldflow customers can see the system integration.

The interactions that take place when customers participate in training courses at the Moldflow Center for Design Excellence facilitate learning much more than just how to use MPI software. Customers have the opportunity to learn more about the entire injection molding product life cycle. Viewing operations in the plastics processing laboratory often sparks questions about ongoing research activities at the university and at Moldflow. Many customers finish a training class having taken away not only information about Moldflow software, but also a better understanding about the entire injection molding process. ■

For more information about Western Michigan University and its College of Engineering and Applied Sciences, visit www.wmich.edu/engineer.

For more information about all of Moldflow's training options, visit www.moldflow.com or www.plasticszone.com.

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uses his consulting expertise to perform analyses using all of the MPI products including Midplane, Fusion and 3D modules. His organization also markets the Moldflow Plastics Advisers products.

Original Concepts Design, a consulting company in Mt. Laurel, NJ, is another member of the new program. Owner Greg Janice views this as an opportunity to better serve his customers and alleviate some of the fears commonly associated with consulting services. "After attending Moldflow's simulation training, I am a firm believer in the value of becoming a certified consultant. Moldflow's training was extremely intense and professional. Customers can be assured that anyone who attains certification has been rigorously tested on the use of their products."

Twerdok adds, "Another goal of this program is to facilitate collaboration among consultants. Our products solve a lot of problems and it is difficult to be an expert in all fields. The ultimate goal of our new consultant program is to make our users more successful. Whether it is helping to increase their knowledge of familiar applications, showing them how to get more out what they already have, or leading them into new areas, this network of certified consultants will fill those niches."

In 2004, Moldflow looks to expand the program internationally. ■

For more information about the Moldflow Certified Consulting Partner Program, contact your local Moldflow sales office or John Twerdok (tel: +1 412 367 6100, e-mail: john_twerdok@moldflow.com).

For more information about 3D Shapes, Inc., visit www.3DShapes.com.

For more information about Original Concepts Design, visit www.3Dproductdesign.com

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Database Server

	Windows 2000 Server
Processor	Single Processor Pentium III 1 GHz or higher
Ram	1 GB
Hard Drive Capacity	36 GB minimum
Available Disk Space	1.5 GB minimum
Database	Borland InterBase 7.1
Modem	56K

To summarize, the latest version of Shotscope contains significant new features and functionality including multi-barrel injection molding machine support, expanded machine operator tracking and a hybrid position based display in the FX version for the metal die casting industry. MMS Foundation has added database schema documentation and enhanced ERP interface capability.

Building upon its broad set of existing CMM applications, Moldflow will continue to set the standard for process setup and monitoring, manufacturing optimization, control and production monitoring software tools for the plastics injection molding and metal die casting industries. ■

For more information about Moldflow Manufacturing Solutions products, visit www.moldflow.com.

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❑ **Extended data tracking.** Many Moldflow customers find that they use additional internal tracking mechanisms which are not explicitly supported by our standard CMM product suite. In these situations, the Moldflow Custom Applications Group can provide facilities to integrate the collection and storage of additional data alongside the standard product.

❑ **Extended data entry functionality.** Barcodes, and lately, RFID devices, are pervasive in the world of manufacturing. They provide a method of tracking inventory and production which far surpasses that available previously. However, true standards in these areas have been hard to achieve, with only a few (KANBAN/CODE39) being accepted globally. The wide range of different standards means that the core Moldflow product set cannot accommodate all possible approaches. In situations where a data entry standard not supported by the core product is required, the Moldflow Custom Applications Group can investigate and potentially integrate such support.

❑ **Custom reports.** The necessity for compiled data and measures in the form and format most useful to the user is a critical factor in gaining value from MES tools. The Moldflow Custom Applications Group can develop tools to generate custom reports from Moldflow's own data and data from other sources, based on the client's specifications.

❑ **Custom alarms.** Ensuring that the correct personnel receive information in a timely manner is key to many processes which aid efficiency and quality. The Moldflow Custom Applications Group can provide automated methods for delivering information to personnel, reducing the potential error and delays inherent in manual systems. ■

To find out more about how the Moldflow Custom Applications Group can help you to achieve greater benefit from your manufacturing systems, contact your MMS sales representative or CAgroup@moldflow.com.

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