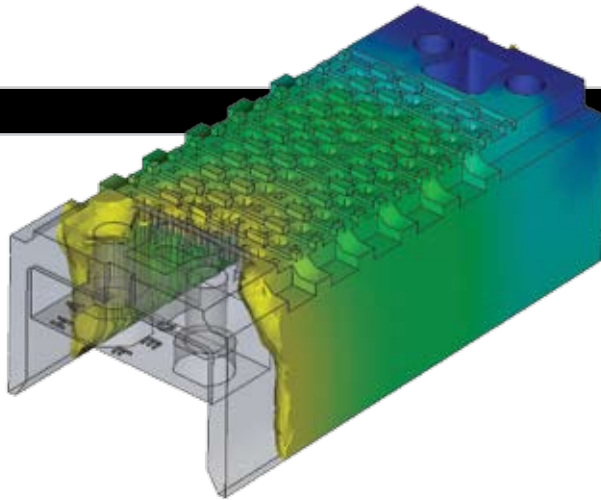


Moldflow Plastics Advisers™ 3D



White Paper



Abstract

The Moldflow Plastics Advisers™ (MPA™) product line comprises 2 commercially available products, the Moldflow Part Adviser™, the Moldflow Mold Adviser™ and until now, 2 add-on modules, Moldflow Performance Adviser™ and the Moldflow Cooling Circuit Adviser™. With MPA 8.0, we are now introducing a third add-on module, MPA/3D.

The Moldflow Part Adviser addresses the specific analysis needs of plastic part designers, while the Moldflow Mold Adviser provides additional capabilities that target the needs of mold designers.

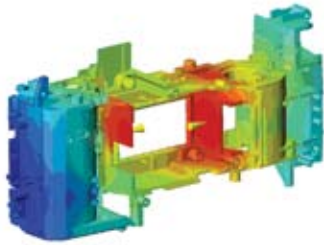
The Performance and Cooling Circuit Advisers extend the analysis capabilities through the packing phase and provide a warpage indicator and an evaluation of the mold cooling circuit design.

This white paper describes how the Moldflow Plastics Advisers have been extended by the new 3D module and how its capabilities benefit both part and mold designers.

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Introduction



From the initial product launch in 1997, the Moldflow Plastics Advisers™ (MPA™) have provided part and mold designers the tools to optimize their designs and check the impact of critical design decisions on the manufacturability and quality of the product.

Moldflow Plastics Advisers are integrated with the designer's CAD environment and work directly from a 3D solid model without the need of the user to create a mesh or midplane model.

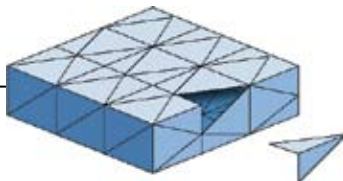
How a Mold Fills

Laminar flow through thin walled molding



As molten plastic enters a mold cavity, it rapidly freezes as it comes in contact with the cool mold surface, while the central core remains molten. As additional material is injected, it flows into this central core, displacing the material already there, which forms a new flow front. This new flow front then becomes a combination of forward flow and outward flow. The outward flow contacts the cool mold wall, freezes, and forms the outermost layer or skin of the part while the forward flow forms the new molten core. When more material enters the mold, it flows along a channel, lined with these frozen walls of plastic. This means that typically the forward flow of the molten plastic is very predictable and predominantly parallel to the mold surface. The flow can be considered to be laminar.

Dual Domain Mesh



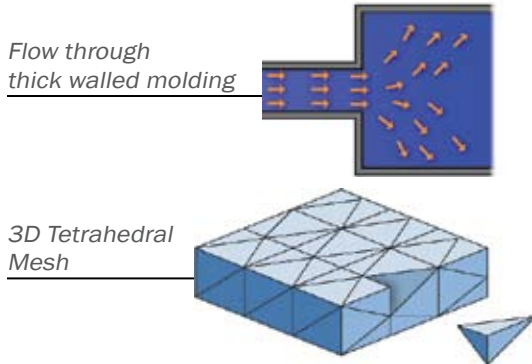
Moldflow's patented Dual Domain™ technology has been designed to simulate injection molding by analyzing a representation of a three-dimensional part with a boundary or skin mesh on the outside surfaces of the part. This is usually obtained from the translation of a CAD model file such as STL (Stereo-Lithography) or IGES format. It allows you to analyze complex CAD solid models of thin-walled parts directly, resulting in minimal model preparation time for the part or mold designer.

Not only is this highly accurate, it is also incredibly fast. The Dual Domain™ solution is optimized for fast, reliable analysis of thin-walled plastic parts, the vast majority of plastic parts designed in practice.

The remaining smaller fraction of parts is characterized by having thick, solid regions, which can compromise the integrity of MPA solution.

Part thickness has a great influence on how the plastic material flows and cools. These factors in turn influence pressure, temperature, clamp force, weld lines, orientation and the resultant part warpage. Therefore, accurate calculations across the entire model thickness is essential for reliable results.

The Problem



As the part thickness increases, that core channel of molten plastic becomes much wider and there are more options for the direction of flow. As a part becomes very thick, the direction of flow is no longer laminar, it is less predictable and it now becomes important to analyze what is happening in the core as well as the outer skin.

In these specialized situations, a true 3D simulation is required to establish exactly how the part will fill, where weld lines will form and air traps will occur. A 3 dimensional tetrahedral mesh is required as the foundation for analysis.

Using a proven solution technique based on a solid, tetrahedral finite-element volume mesh, MPA 3D allows you to perform true three-dimensional flow simulations on parts that tend to be very thick and solid in nature as well as those that have extreme changes from thin to thick.

The MPA 3D Solution

The addition of MPA/3D to Dual Domain, offers the following benefits:

1. Analyze more parts

- Allows accurate analysis of parts that are thick and solid or have excessive thickness variation
- Offers a solution for models previously evaluated as “Not Suitable” when using Dual Domain exclusively

2. No Guesswork

- MPA automatically recommends which technology (Dual Domain vs. 3D) will offer the best results for a given model

3. Fully Automatic 3D Meshing

- MPA automatically meshes the model, simplifying the process and saving time
- MPA/3D simulation is based on analysis of a 3D tetrahedral volume mesh created automatically from the solid model, drastically reducing the time and burden associated with preparing traditional finite element models for analysis

Analyze More Parts with the Optimal Technology Solution

The optimal solution is to take advantage of the speed of Dual Domain whenever possible, but then in those specialized cases when the geometry requires additional calculations for proper accuracy, conduct a 3D analysis. With MPA/3D added to MPA, users have the optimal technology solution.

No Guesswork Means Ease of Use

With 2 powerful options, it can be challenging to determine which technology is best for a particular part. What is needed is a system to evaluate the part design and assess suitability for analysis to identify the optimal solution.

Moldflow makes this easy with the “Advanced Geometry Adviser.” Before the introduction of MPA 3D, it would determine if a part design was suitable for analysis. If the part design was determined unsuitable for the Dual Domain™ solver technology, the part or mold designer was left with no direct access to accurate or reliable analysis. Now with MPA/3D, the “Advanced Geometry Adviser” within MPA will analyze the part geometry and recommend which solver, Dual Domain™ or 3D, is most suited to each unique geometry.

Together, these fully automated solution techniques, Dual Domain™ and 3D, provide a breadth of geometry support that is unmatched in the plastics industry today.



“From the first time I imported a model into MPA 8.0 and saw the geometry check and repair features, I was impressed and pleased, and the software’s capability to recommend the appropriate analysis technology removes the guesswork from evaluating the model for analysis. I realized the benefits of 3D technology firsthand on a project involving a highly complex part design that was not suitable for Dual Domain analysis. Instead of pursuing expensive and time-consuming part de-sign or mold tooling changes to address a potential manufacturing concern, I used the new 3D technology to help me identify an alternative plastic material as the most efficient solution.”

Gregory Janice ■ Original Concepts Design Inc.

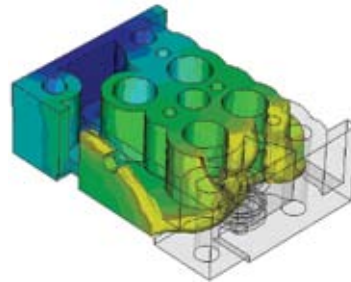
Fully Automatic 3D Meshing Means Ease of Use

An automated “Wizard” provides the MPA user with a step-by-step, simple to follow process to import the part geometry. The “Wizard” will automatically check and repair model defects, then check suitability for analysis using either the Dual Domain or 3D analysis technology. This Optimal Technology Solution eliminates the need for the user to make this decision and is based upon a rigorous geometric analysis of the model.

Having validated the integrity of the model, MPA automatically meshes it appropriately for 3D analysis and proceeds to analyze and simulate the plastics injection molding process.

A Complete Suite of Analysis Solutions

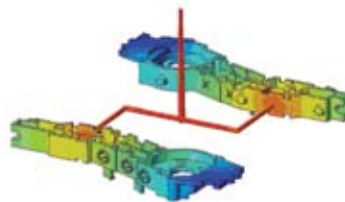
MPA 3D will answer basic manufacturing questions common to MPA and also provide detailed results of the part filling through the thickness.



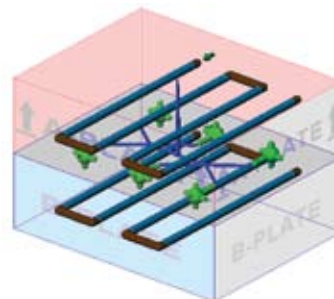
The optional add-on module, Performance Adviser will analyze the packing phase and provide an indication of part warpage.



Areas of high, non-uniform shrinkage, cooling variation and molecular orientation contribute to overall part warpage.



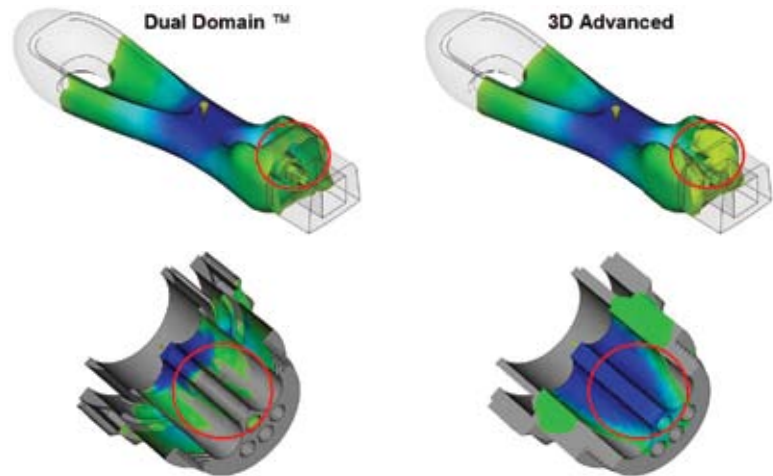
The optional add-on module, Mold Adviser provides tools to model the feed system (runners and gates) and extends the analysis capabilities to include both family and multi-cavity mold designs.



The optional add-on module, Cooling Circuit Adviser provides tools to model the cooling circuit and mold boundary and extends the analysis capabilities to evaluate the performance of the cooling circuits and their effect on part quality and performance.

The MPA 3D Advantage

MPA 3D will clarify the fill pattern by providing detail through the part thickness when compared to results from the Dual Domain Domain™ solver.



MPA 3D will remove any ambiguity seen in results from the Dual Domain Domain™ solver where thickness calculations were unreliable and the internal geometry comprises complex 3D intersections.

MPA 3D enables direct analysis of solid models, providing improved solution accuracy and a deep insight into true plastics behavior while addressing a class of problems (thick, solid parts) previously unsolvable using traditional automated solvers.

Conclusion

To summarize, with the addition of MPA 3D, MPA users can now benefit from:

- The Ability to analyze more parts
- No guesswork on which solver type to use
- Fully automatic 3D meshing

The features and enhancements presented in this document demonstrate how users of MPA can work smarter and more efficiently to reduce or eliminate time delays, improve part quality, and deliver projects on-time and within budget constraints.

There are many companies today across a broad range of industries for which the design and manufacture of plastic injection molded parts is on the critical path to achieving successful and profitable product launches. These companies require a tool such as Moldflow Plastics Advisers to become and remain competitive on a global scale.

Moldflow Plastics Advisers are a suite of plastics injection molding process simulation tools to predict and eliminate potential manufacturing problems and optimize part design, mold design, and the injection molding process.

For the latest information on Moldflow Plastics Advisers and all of Moldflow's products, visit our World Wide Web site at <http://www.moldflow.com>.