MOLD FLOW ANALYSIS 101: A PROCESS PRIMER & KEY BENEFITS FOR MANUFACTURERS

AN EBOOK BY NEW BERLIN PLASTICS

New Berlin Plastics

MOLD FLOW ANALYSIS 101

WHAT IS MOLD FLOW ANALYSIS?

Mold flow analysis is a process whereby the injection cycle is simulated, and the results are analyzed using specialized software. A vitally important step in any large-scale manufacturing process, mold flow analysis is most effective when it occurs prior to launching a tool build.

HOW IT WORKS

Mold flow analysis is a software-enabled process that provides a simulation by mimicking the conditions of the mold and resin when manufacturing a part prior to going into production.

The materials used in the plastic injection molding process can vary in rigidity and pliability, among other differentiating characteristics. Since these materials behave and respond differently, it is crucial to leverage mold flow analysis to predict any complications you might encounter.

This simulation is achieved through the mapping of various design properties, including:

- Fill Pattern
- Heating and Cooling
- Injection Pressure
- Air Traps
- Stress
- And more

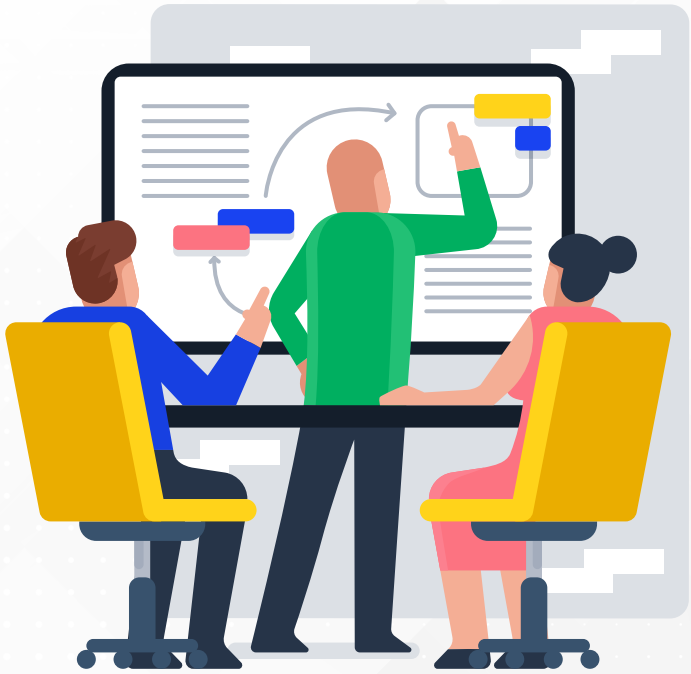
A well-defined mold flow analysis can offer manufacturers a host of benefits. A significant benefit is cost savings. The cost associated with mold flow analysis is notably less than the dollars needed to perform numerous trials on a injection molding machine. The simulation process allows for early identification of issues, such as warp, sink, and fill issues.

Ultimately, the most important and fundamental benefit of mold flow analysis is its ability to prevent issues, errors, and unnecessary costs before manufacturing.

Effective analysis is a collaborative effort. By including all essential manufacturing personnel in the analysis, companies can avoid a siloed approach in which a designer operates in a vacuum and information and knowledge are not shared or freely offered.

The various steps of the mold flow analysis process also offer specific benefits. Below are just a few benefits in each stage that manufacturers can expect.

- ***Filling Analysis:*** Benefits in the filling analysis include the ability to predict the fill pattern, injection pressure, temperatures, and sinking. A defined process around filling also allows for the best possible gating and ram-speed profile, among others factors. Air traps can also be avoided through this process.
- ***Cooling Analysis:*** The cooling analysis is critical in terms of locating hot spots, determining the time to freeze, and setting the necessary coolant flow rates. It also helps you determine the cooling flow rates and cycle time.
- ***Packing Analysis:*** In the packing analysis, both pressure and the packing profile are defined.
- ***Warp Analysis:*** This component of the process allows manufacturers to predict and anticipate warp – identifying the cause(s) in order to implement preventative measures.
- ***Gas-Assist Analysis:*** Through gas-assist analysis, important factors and considerations are evaluated and determined. These include penetration, permeation, channel layout, and required gas pressure.
- ***Co-Injection Analysis:*** The co-injection analysis is focused on factors related to skin/core, such as the overall ratio, distribution, and switch-over points.



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WHEN TO PERFORM A FILLING ANALYSIS

Filling simulations are utilized primarily for either fine-tuning a new mold design before cutting steel or troubleshooting issues with a current mold.

While analyses offer numerous benefits, as with any business function, it is essential to evaluate the process within the context of your company and manufacturing system to determine if the potential exists for an adequate return on investment.

Before deciding to perform a filling analysis, manufacturers should have a clear picture of their objectives.

"WHAT DO THEY WISH TO GAIN OR LEARN THROUGH THE ANALYSIS?"

This should be developed along with cost estimates so that the two can be examined to determine if the cost of the analysis is justified.

Analyses and data are great, but if they are not utilized, then the time and money invested in producing and analyzing reports are wasted. It is not uncommon for companies to create systems to evaluate processes and gather data, only to have reports sit on a shelf and collect dust. It is important to secure a commitment to the analysis effort within your organization, buy-in from key stakeholders, and agreement that reports will be reviewed, and their findings used to improve processes.

As part of the buy-in process, manufacturers must also ensure that their firms recognize that the results of the analysis may be less than favorable and could warrant adjustments for "the greater good." Additional cost and delays on the front-end, however, can often prevent delays in the final delivery of a product or part, along with significantly higher costs had production proceeded with a flawed design or process.

THE POINT PERSON FOR A FILLING ANALYSIS

A critical component of a filling analysis is who should conduct it. There are specific skills and attributes required of the person performing the analysis that will determine whether it is executed correctly, producing clear and actionable results.

The first requirement of this individual – often referred to as a simulation analyst – is having a thorough knowledge of the materials, as well as manufacturing, processing, and tooling. While software is a critical piece of the analysis, it cannot make up for an inexperienced operator. You can have the best program in the world, but if the person using it does not understand the technology, it will not be effective.

A simulation analyst must be able to serve as a translator. They will be in charge of conveying the simulation results and explaining what they mean to key personnel, such as the processor.
It is also imperative that the analyst has access to design information and can communicate with the design team and other key staff members.

With these specific requirements and skills in mind, manufacturers should consider partnering with a company that can provide seasoned professionals with extensive experience performing fill analyses for a variety of clients. New Berlin Plastics partners with original equipment manufacturers (OEMs) and tiered suppliers that require high-quality products, engineering services, and value-added activities from a single supplier. New Berlin Plastics' advanced technologies and processes, combined with an expert team, will help to ensure that your firm executes an effective and informative analysis to produce a product which meets high-quality standards and stays within budget – results of which you can be proud.

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MOLD FLOW ANALYSIS FOR SIMILAR PARTS

Efficient companies are continually looking for ways to avoid "reinventing the wheel." This is certainly true of a mold flow analysis. If another mold exists with key features that are similar to the mold undergoing analysis, the results can be applied to some degree to the similar mold. Correlations can be helpful, and any errors based on the differences in the molds can be corrected during further analysis and testing.

OVERCOMING COMMON CHALLENGES AND BARRIERS

Plastic injection molding is not without its challenges. The proactive processes and real-time adjustments performed through mold flow analysis and simulation address many of the common pitfalls manufacturers encounter with regard to injection molding.

Among such solutions is addressing "short-shots," or portions of the mold in which the material may not be adequately filling. This is an area in which simulation is vital for proactively adjusting the process or part to optimize performance.

Additionally, a simulation helps identify weld lines, or areas at which two flows join together and "weld" the material. Once located via the simulation, welds can be examined to determine their structural integrity and fitness.

Material performance is also a challenge that simulation takes into account. Not all resins and part designs are compatible, and simulation software provides readings and measurements related to the filling plastic's pressure. This information can help identify potential issues in production.

Information gleaned from simulations can aid designers in choosing gate locations and determining gate sizing. Factors such as flow distance and part aesthetics are important considerations when setting gate locations. The sizing of the gate is an especially crucial consideration, due to the potential for shearing and packing of the part. Each type of resin has a unique shear rate limit or the point at which chains of molecules are re-stretched beyond capacity, thereby weakening the material and causing aesthetic issues. For this reason, gates must be strategically positioned to allow the melted material to both fill and pack the mold.

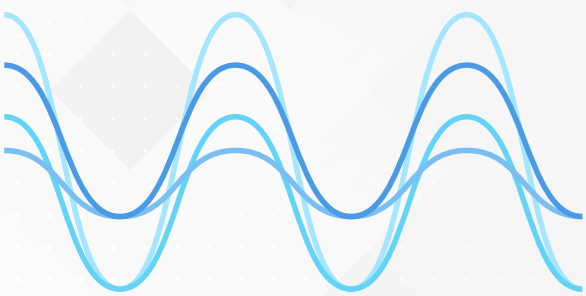
The simulation also allows the analyst and other key personnel to assess cooling lines in the mold design. Cooling lines impact whether a part warps, or in what way it warps. By simulating both the heating and cooling of a mold, the warp of the part can be induced. This process can help ensure that necessary adjustments are made to optimize part integrity. Heating and cooling simulations also aid manufacturers in estimating production times and temperatures and then adjusting as necessary.

A mold flow analysis allows production teams to identify any areas in which air is trapped as part of the mold filling process. Trapped air can be addressed by ensuring proper venting in the tool. Adequate venting is critical to ensuring both part quality and the proper flow of materials within a mold.

ADVANCEMENTS AND TRENDS

Advancements in technology have offered new opportunities in the manufacturing industry. One area in which this is increasingly evident is cloud computing. This single innovation is perhaps the most critical development in computer-aided engineering today. Cloud technology makes computing exponentially faster by connecting multiple computers and systems.

With regard to mold flow analysis, cloud-based solutions can immediately meet the demands of numerous users. As the number of manufacturers using cloud-enabled mold flow analysis solutions increases, so too will the amount of data generated. This data will, in turn, help providers refine their offerings, and it could also serve to provide shared knowledge and insights within user communities or other crowd-sourced repositories.



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KEY TAKEAWAYS

To recap, manufacturers looking to improve performance and minimize errors in their injection molding process through a mold flow analysis should remember the following key considerations:

1. Develop a Plan - Begin with a clear and well-defined list of objectives. This will help inform the cost-benefit analysis/determination of ROI.

2. Crunch the Numbers and Determine the ROI - Evaluate the process based upon your company's current situation and goals in order to determine if the potential exists for an adequate return on investment.

3. Consider the Timing - Simulations are most helpful when performed prior to production – when fine-tuning a new mold design prior to cutting the steel for the mold, or troubleshooting issues with a current mold.

4. Collaborate - Breaking down silos and fostering a culture of information and knowledge sharing is an important element of an effective analysis.

5. Commit - Ensure the team is committed to the analysis and all parties agree to review reports and findings for process improvement opportunities.

6. Hire the Right People for the Job - Hire a simulation analyst who possesses the specific skills and knowledge necessary to correctly execute simulations and produce reports that are clear and actionable.

7. Watch Technology Trends and Opportunities - As previously stated, technology has a significant impact on the manufacturing industry. Developments and new offerings have the potential of bolstering your scientific injection molding practices, streamlining processes, and improving overall workflows and quality. It is important to remain abreast of trends, not only with regard to cloud computing but in terms of other new technologies as well. Emerging technologies can represent added efficiencies and other potential benefits to manufacturers.

8. Keep an Open Mind - It is important to recognize that the results of an analysis can be less than favorable and could warrant adjustments. A small investment in process improvement at the onset can prevent considerable recovery costs or lost profit later in production.

A Mold flow analysis represents the intersection of technology, R&D, and risk mitigation. Manufacturers that choose to implement simulations into pre-production will reap the benefits in process optimization, cost savings, reduction of errors, and improved part quality.

IN YOUR CORNER

At New Berlin Plastics, we know what makes an excellent mold flow analysis. We offer custom solutions to help you improve your firm's processes while protecting your bottom line.
With a variety of services and capabilities, we can support you throughout your project's life cycle.

By employing advanced technologies and processes, we can ensure that your final product meets and beats your expectations.

New Berlin Plastics' knowledgeable team has years of experience performing filling analyses for a wide variety of complex, tight tolerance, parts for medium to large OEMs from diverse industries.

Contact us today to learn more about the New Berlin Plastics difference and to discuss a custom solution for your company.

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