COMPANY
MOTHERSON

LOCATION
Noida, Uttar Pradesh, India

SOFTWARE
Autodesk Moldflow

Motherson Utilizes Autodesk solutions for Conformal Cooling Channel Design Validation & Optimization

Established in 1975, Motherson stands as a prominent global auto component manufacturer, serving OEMs across 42 countries in five continents through a network of over 350 facilities and a workforce exceeding 180,000 employees. Renowned within the automotive sector, Motherson specializes in exterior rearview mirrors, wiring harnesses, and polymer modules, boasting a diverse portfolio of ancillary products and services. Embracing technology and innovation, the company fosters creativity, employee engagement, and performance excellence to deliver world-class solutions to its global clientele. With a steadfast commitment to innovation and customer satisfaction.

Motherson caters to a diverse range of industries beyond automotive, including technology, healthcare, aerospace, and logistics. As India's largest auto ancillary, Motherson ranks among the top 25 automotive suppliers worldwide, embodying a focused, dynamic, and progressive approach in delivering innovative and value-added solutions to its customers.

Challenges

The escalating competition in India's automotive sector necessitates increased productivity, cost reduction, and rapid design development cycles for vehicles and related products.

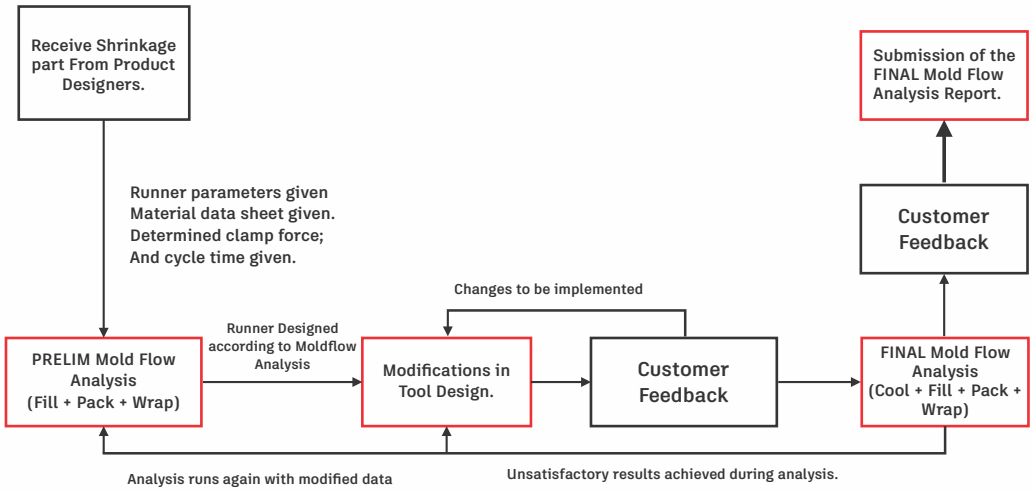
As a leader in the automotive industry, Motherson has made substantial investments in designing and developing solutions. Previously, analyzing and refining molds entailed lengthy trial-and-error processes with costly physical prototypes. However, tight schedules and budgets no longer permit this approach.

Motherson has crafted a process employing advance technologies to ensure informed decisions and achieve higher product quality from the outset. With years of experience using Autodesk Moldflow, Motherson engineers have devised a structured approach, as illustrated in Figure. This aids in resolving potential product issues early by conducting comprehensive filling, packing, cooling, and warpage analyses with realistic inputs and outputs throughout the development and manufacturing stages of every new product for their OEM customers. Furthermore, Autodesk Moldflow integration facilitates

"Autodesk Moldflow has become an indispensable part of our product development cycle. Our clients now expect Moldflow reports even before we commence the actual job. These reports serve as trust certificates, validating the quality work we deliver. I believe our market leadership is closely tied to our system, which consistently meets and exceeds client expectations."

Dhirendra Senapati
Head of Design Department, Motherson

Process: Mold Flow



accurate predictions for quoting, including cycle time, tonnage, and other crucial process parameters. This enhances the feasibility review process for the quoting team before generating quotes for customers.

Traditionally, the cooling process in plastic injection molding has been plagued by longer-than-optimal cooling times, leading to extended cycle times and reduced manufacturing volume. The use of conventionally drilled cooling lines in molding tools has posed numerous limitations.

Motherson has turned to Autodesk Moldflow to address these challenges effectively. Since adopting Moldflow, the engineering team has consistently explored advanced technologies in mold development, particularly focusing on enhancing cooling efficiency over conventional designs. Illustrated in the figure is a model featuring intricate geometry, varying slot sizes on the shaft, and thickness variations across the part.

Rather than relying on conventional methods, the company has opted for conformal cooling channels. These channels are meticulously designed using 3D CAD software and undergo Moldflow simulation before proceeding to 3D printing. This strategic approach ensures optimized cooling and improved manufacturing efficiency.

The part was fitted with three cooling channels on the top and three on the bottom, with inlets and outlets as depicted in the figure. These channels closely matched the product's geometry.

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"With Autodesk Moldflow, we can digitally explore and test different options. Relying solely on experience may not be sufficient to design the best channels for conformal cooling in complex parts. Modifying a virtual design is not only more cost-effective but also much faster than altering a physical mold."

Adarsh Daniel
Engineer,
Motherson

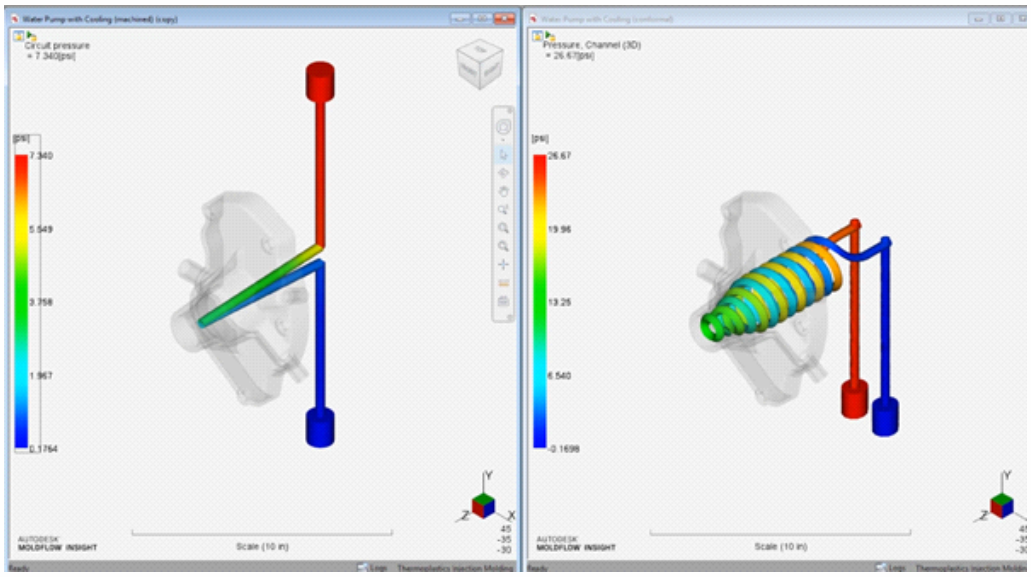

Fig.1
Image courtesy - Motherson

Upon analysing the Circuit Flow Rate results in the cooling analysis, it was noted that when coolant flowed through the junction and divided into three channels or pipes, the center pipe drew all the liquid while the two pipes on either side remained in efficient. This resulted in significant heat accumulation in the shaft sections where coolant was not reaching. As a consequence, the part did not cool uniformly, leading to inconsistent material shrinkage and the development of defects. Material that cooled too rapidly caused flow-front welding, while material that cooled too slowly began to shrink, compromising its shape of the part.

Solution

After several iterations using Autodesk Moldflow features for conformal cooling, Motherson Engineers made modifications to the junctions based on the results. These modifications were accurately predicted by Moldflow, aiding in the finalization of the conformal cooling design. Cooling lines and junctions were then created using the DMLS 3D printing method, enabling more intricate shapes and closer proximity to the part cavity than possible with milling or drilling. The innovative junction modifications led to improved uniform flow through all three channels, resulting in uniform cooling of the shaft with consistent temperature distribution compared to the previous design.

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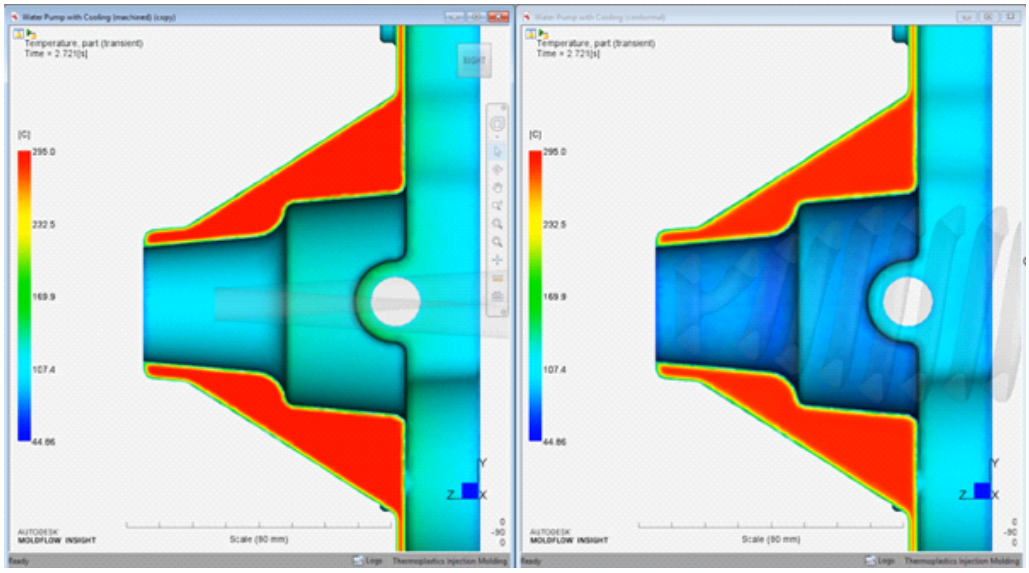

Fig.2
Image courtesy - Motherson

Moldflow proves to be a valuable tool for identifying the optimal conformal cooling channel. Results indicate that these channels can significantly enhance cooling time, reduce temperature differences, and minimize part deformation.

Results

Aexperimental findings further confirm that conformal cooling channels offer superior cooling efficiency compared to conventional methods enabling Motherson to make well-informed decisions. Utilizing information obtained from Moldflow simulation, Motherson optimizes cooling channels, thereby avoiding costly mold repairs and reworks. Moreover, these simulations provide confidence in the accuracy of future designs. Extensive cooling measures were implemented to address high deflection in the part, reducing it from 1.1 mm to 0.9 mm, successfully meeting the customer's specified upper limit of 1.0 mm.

"Moldflow empowers us to foresee potential manufacturing challenges prior to production commencement. While our Autodesk Moldflow simulations are typically highly accurate compared to experimental results, occasional variations may arise due to limited usage or user expertise. Looking forward, we anticipate Autodesk's integration of AI features into Moldflow, promising enhanced result analysis speed and accessibility for non-experts."

Dhirendra Senapati
Head of Design Department, Motherson

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