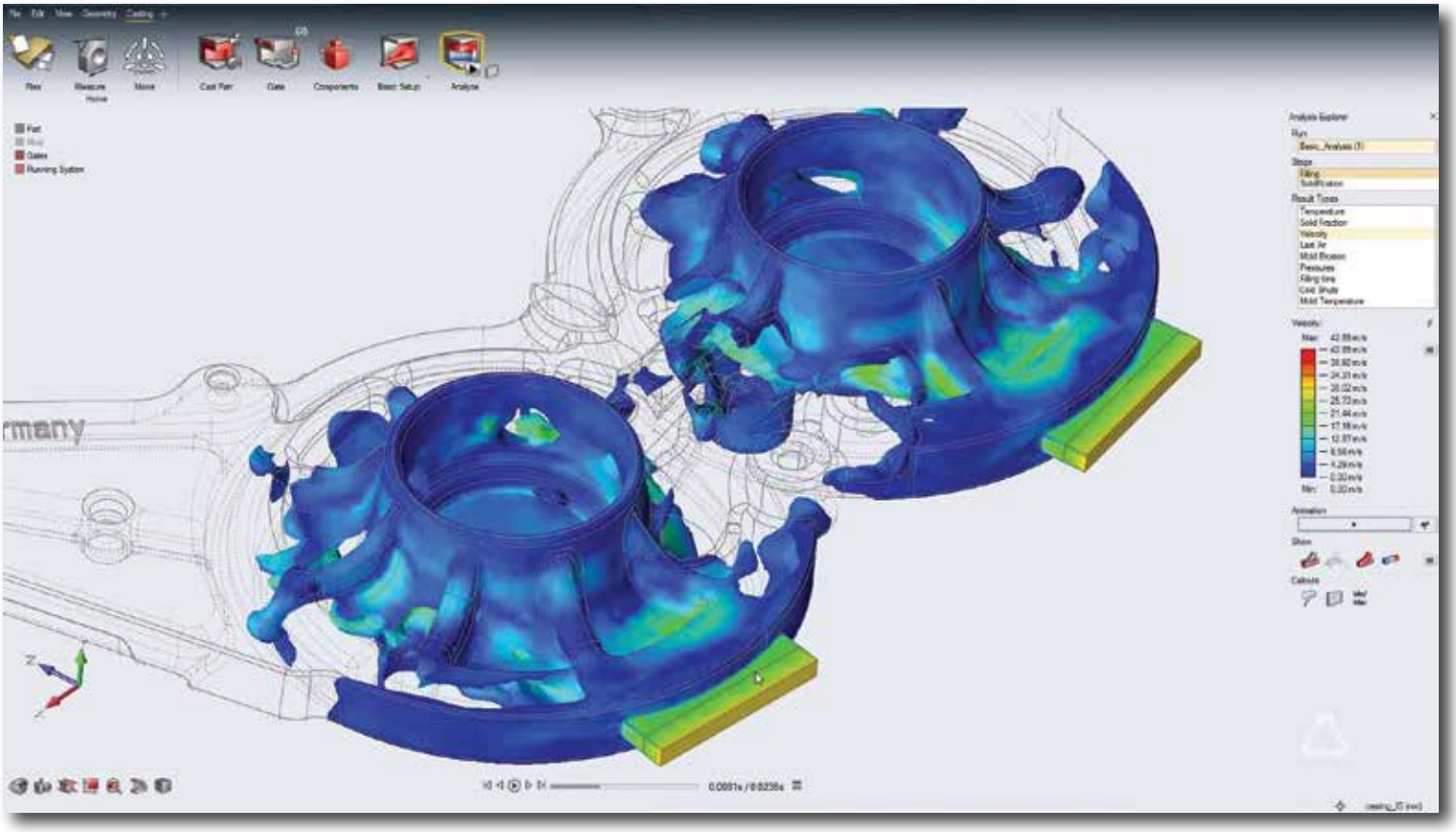

From die design to defect-free castings: Simulation casting software for more efficiency

Shiva Tool Tech, an automotive manufacturing industrial powerhouse, for long had been following a tedious and time consuming casting simulation process. While they realised the downside of this process, outsourcing was dawdling and a costly option. As an option for in-house investment, Shiva Tool Tech bought in the Altair Inspire Cast. This case study explores how Altair's streamlined simulation casting software helped Shiva Tool Tech address their major concerns of cost and time.

Shiva Tool Tech, for over 25 years, has been providing support to its customers for everything, right from manufacturing process design to the production stage. Manufacturing processes include milling, drilling, hardening, grinding, Computer Numerical Control (CNC) machining, Electrical Discharge Machining (EDM), inspection and polishing to get the final assembly of the casting die.

Process efficiency for defect-free die design

At Shiva Tool Tech, casting dies are designed & manufactured for automotive and non-automotive components, like brackets, crankcase, housing, cylinder heads, compressor housings, manifolds, alloy wheels, etc with a lead time of three weeks to eight weeks, depending on the complexity of the project.

The casting die designs are developed based on the years of experience for components received from their customers in the form of the Computer-Aided Design (CAD) and/or engineering drafts. Once the die for the casting is designed, it is manufactured and assembled at their facility. The die is then sent to the customer for carrying out the physical casting trial. The cast part manufactured from the new dies is sent back to Shiva Tool

Tech with an inspection report and defects identified. The die design is then modified to eliminate the defects. This entire process takes about three to four physical iterations to get a defect-free die design.

Realising the value of simulation software in optimising this design and manufacturing process to save time and money, Shiva Tool Tech began outsourcing casting simulation when needed. However, outsourcing the simulations was expensive and time consuming. In addition to paying for every iteration, the turnaround times for simulation from the service providers were long. This led them to explore options of bringing the expertise in-house by investing in simulation software. They chose Altair's casting simulation software, Inspire Cast, which met their requirements for ease of use, accuracy of results, speed of computational analysis and rich visualisation of results while remaining within budget considerations.

Inspire cast in the casting simulation process

The updated process at Shiva Tool Tech now involves Inspire Cast in two phases:

1. On receiving the CAD of the casting part, the model is taken to Inspire Cast for running simulations with a virtual gating system on the part. Once the gating location is fixed based on the desired simulation results, the shot model for the component is designed in CAD.
2. The shot model is then taken to Inspire Cast for carrying out the detailed casting simulation to understand the occurring defects. The methodology is modified to reduce or eliminate defects by changing the gate size, shape and with additions of risers and chillers.

Project details

For a recent project intended for the design and manufacture of casting dies for an automotive pump, the housing was to be cast with Aluminium AlSi7Mg by the tilt pouring process, with Steel HDS-H13 as the mould material. Engineers imported the pump housing model in the Inspire Cast to evaluate an appropriate gating location. Using the Inspire Cast tilt pouring template, the process parameters were fed-in to run the simulations.

From the solidification results obtained, bulk porosities were observed on the top and minor porosities were observed near the bottom. The bulk porosity on the top could be eliminated by using an appropriate runner for the gating system. Accordingly, the shot model was prepared in CAD, and it was then taken again to the Inspire Cast for carrying out a detailed simulation. The bulk porosity observed earlier shifted to the runner, but the porosity near the bolting location remained.

Based on filling results, the liquid fraction animation in the Inspire Cast showed the last regions to solidify. It was observed that the bottom bolting location had a slower solidification rate due to the intricate mould cavity geometry. This reflected the reasons for the porosity obtained after complete solidification of the part. It was decided that a second iteration should be carried out by adding chillers near the affected bottom bolting location to speed up solidification, keeping the same process parameters. An external chill was placed near the bolting location. The liquid fraction plot demonstrated that the solidification occurred evenly on the bolting location and the porosities were completely eliminated from the casting component during this phase. The design of the die was finalised and sent for manufacturing.

The complete die assembly after manufacturing was sent to the customer for carrying out the casting of the pump housing. The prototype of the component was sent back to Shiva Tool Tech for performing the inspection and the part was found to be defect-free.

Optimum future & time saving

Three iterations were carried on the Inspire Cast to finalise the methodology of the pump housing. It took two days altogether to finalise the methodology and took about 45 minutes per iteration to get the simulation results in the Inspire Cast. The time it saved was 80% over the traditional physical trails. "We are happy that we invested in Altair's Inspire Cast. We look forward to the new features and capabilities to be added to the Altair Inspire Cast in the future versions of the software," mentioned Shivaji Pawar, Managing Director, Shiva Tool Tech. □

Courtesy: Altair Engineering