

Simulation in support of the development of innovative processes in the casting industry

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Abstract

The paper illustrates the application of simulation for the development of innovative casting processes at BMW Light Metal Foundry in Landshut and other foundries.

1. High pressure die casting of complex structural parts

Complex structural parts are very demanding with regard to the HPDC process and the tooling concept. BMW performs a detailed analysis of the complete process incl. the filling of the shot chamber, modelling of the piston movement applying PQ² diagrams, solidification, cooling and the calculation of residual stresses.

2. Inserts in high pressure die casting

The casting simulation software **FLOW-3D** was used for the analysis of the influence of inserts on the filling pattern and the infiltration of the inserts.

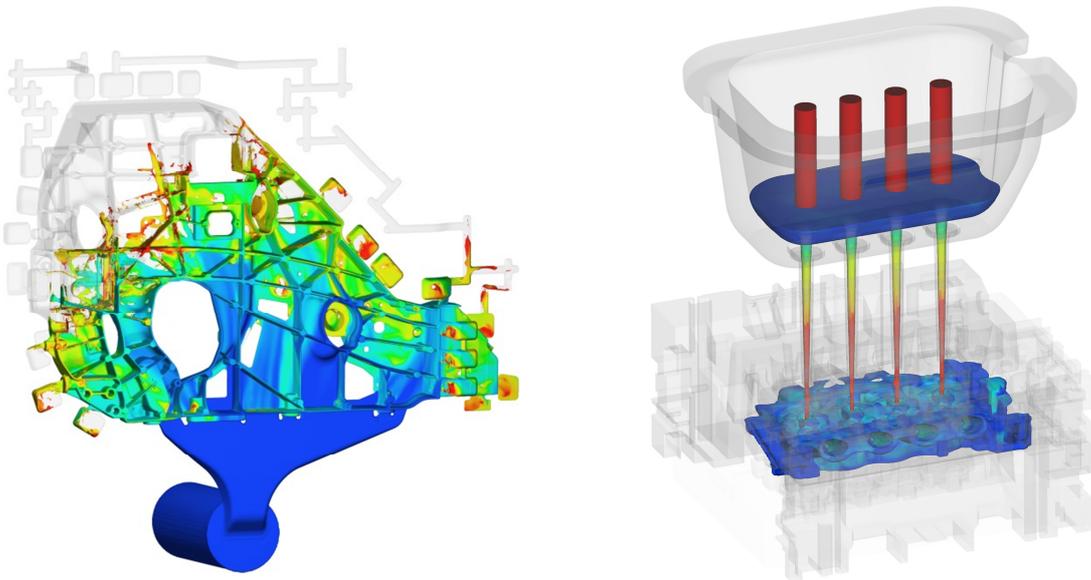


Figure 1: Filling pattern of a complex structural part (BMW i3) (left) – Gravity filling process using a innovate moving ingate system (right)

3. Innovative ingate systems for gravity casting

The newly developed Injector Casting process of BMW combines the advantages of traditional processes (top pouring, bottom casting) and avoids their disadvantages by applying a moving ingate system. It greatly reduces casting defects due to turbulence and oxide generation. Amongst others, advantages are that the risers are filled with hot melt at the end of the filling process and that the cooling of the bottom plate can be active during the entire filling process which is beneficial for the control of the properties of the structure. **FLOW-3D** was used for the optimization of the design and movement of the ingate system.

4. Core blowing and core drying for sand cores with inorganic binder systems

The Light Metal Foundry of BMW substituted conventional organic binder systems for sand core production by eco-friendly inorganic binders in 2010. The introduction of this innovative production method was facilitated by simulations of the shooting and drying process of the cores with **FLOW-3D**.

5. Application of salt cores in high pressure die casting

Hitherto it has not been possible to produce castings with cavities using the HPDC process because conventional sand cores do not withstand the high pressures and velocities characteristic for the process. Salt cores are a solution for this dilemma due to their superior stability. The fluid-structure-interaction option in **FLOW-3D** allows to simulate the interaction of melt and salt core, specifically the high forces on the cores during the filling process and the thermally induced residual stresses during the solidification.

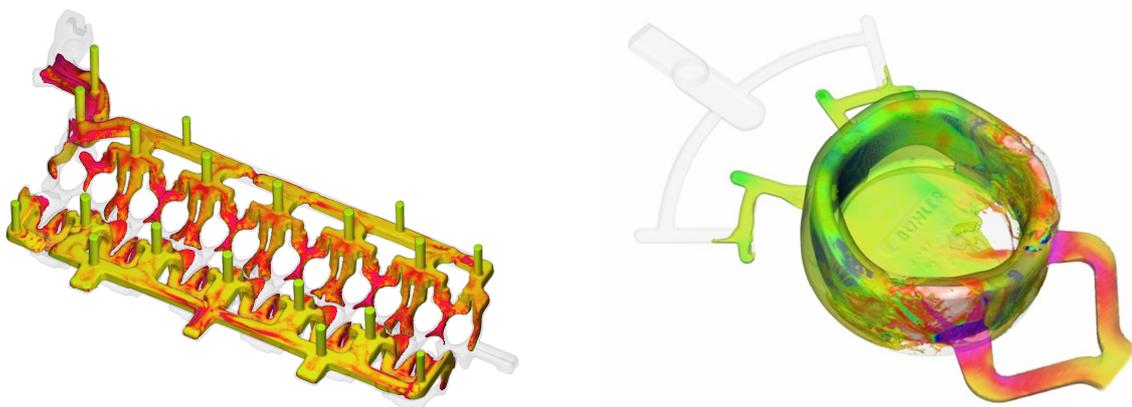


Figure 2: Simulation of a core blowing process (left) – Stresses inside a salt core (specimen, courtesy Bühler AG) during HPDC filling process (right)