MAGMA GmbH Press Release

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MAGMASOFT® 5.4 – Autonomous Engineering

Aachen, August 2018. With the latest software version MAGMASOFT® 5.4, MAGMA Giessereitechnologie GmbH, Aachen (Germany), the worldwide leading supplier of software for the optimization of casting processes, presents a comprehensive toolbox of new capabilities for the optimization of casting designs, tooling layouts and robust production processes.

By integrating the MAGMA APPROACH and the possibilities of Autonomous Engineering into the software, the user can now fully utilize virtual experiments to ensure sound decision-making and effective root cause analysis. By specifying quantitative objectives and the critical production variables in the software, the simultaneous optimization of casting designs, tooling layouts and robust process design throughout the entire development process can be easily achieved.

For this purpose, comprehensive enhancements have been integrated into the new release, which make Autonomous Engineering with the simulation software even more efficient.

New Solver for High Pressure Die Casting

A major advancement in the new version is the extensive support of the development for the component, the tooling and the process setup of high pressure die casting. With the innovative TAG-meshing (**T**rue **A**daptive **G**eometry), MAGMASOFT® 5.4 offers new possibilities for the flexible, local meshing of the geometry. A new algorithm for the filling process in high pressure die casting considers the special requirements of the process on the description of the free surface of the melt, the metal viscosity, and the prediction of air entrapment for improved result quality. The new solver can

simultaneously calculate different flow models (such as the flow through cooling lines during filling of the casting) while also supporting flexible boundary conditions (plunger movement, squeezing).

With these new features, MAGMASOFT® 5.4 enables the detailed investigation of the dosing process and the shot profile considering the shot chamber geometry **(Fig. 1)**. This enables the optimization of dosing parameters, dwell times, plunger velocities, and switching points.

The consideration of the available machine capacity (PQ^2 diagram), the venting conditions and the complete thermal balance in the die, which are all critical for casting quality, can be evaluated at the earliest stages of process and tooling design.

Simulation of the Spraying Process

Based on the level of detail required to achieve a given objective, MAGMASOFT® 5.4 offers various capabilities for optimizing the spraying process in both die casting tooling and process development: a classical approach with uniform heat extraction from the cavity in early-stage product optimization, an extended approach with user-defined static or movable spray areas, or even the realistic consideration of the spray head with individual circuits, nozzle positions, and programming of the head movement.

This enables an even more precise evaluation of the influence of spraying on the thermal balance in the tooling, the distortion of casting and die components, or local die lifetime **(Fig. 2)**.

The flow within cooling lines, spot cooling or conformal cooling near the die contour can be optimized for increased thermal efficiency, by taking into account the cooling medium with its inlet/ outlet conditions, temperatures, and flow rates **(Fig. 3)**.

MAGMASOFT® 5.4 now additionally offers an intuitive visualization for all casting processes of the thermal balance between the casting and the die for the quantitative evaluation of energy exchange over the complete process, in individual process phases, or for defined time intervals **(Fig. 4)**.

With the integration of all important process steps in die casting, the virtual process chain is represented realistically: from ejection, quenching and cooling of the casting, through trimming of gates and overflows, to

consideration of the residual stress redistribution caused by machining of the as-cast part.

Die casting tool design is supported by the calculation of contact pressures between casting and die, now including the prediction of the corresponding required ejector forces **(Fig. 5)**.

The simulation of heat treatment is also seamlessly integrated. Therefore, minimization of casting distortion through the optimization of production parameters, or by compensating for dimensional change when designing the die cavity, or through the design of heat treatment racks can be investigated during the development process **(Fig. 6)**.

New quality criteria like the local porefree zone thickness help to securely design die cast components by taking into account the casting properties.

Casting Optimization Beyond High Pressure Die Casting

In addition to the comprehensive toolbox for high pressure die casting, MAGMASOFT® 5.4 offers numerous other new capabilities for casting optimization and process validation.

Prediction of Binder Decomposition and Core Gases

Gases are generated during the casting process when the binder systems used in the cores and molding materials decompose.

Depending on the binder system and its degradation behavior on the core geometry and the layout of the core prints, these gases may lead to casting defects. With complex cores or core packages, it is not always easy to understand and control the impact that the amount of gas generated, the permeability of the core package, or of vent size and placement can have on defect formation.

MAGMASOFT® 5.4 virtually reproduces these processes in a comprehensive manner, thus enabling a systematic prediction of the risk for gas-related defects. By systematically analyzing gas formation, gas transport and venting conditions, the use of Autonomous Engineering ensures the prevention of casting defects due to binder gases **(Fig. 7)**.

Segregation and Porosity Under Risers

The steel casting module MAGMAsteel has always offered the ability to predict the impact of thermal convection on the development of segregation within the casting. Convective flow during the solidification of steel castings can significantly change the temperature fields and thus the feeding behavior within the casting, especially heavy sectioned steel castings. MAGMASOFT® 5.4 now offers the coupled calculation of both convective and feeding flows. This improves the quality of the segregation predictions and also the feeding behavior, especially with risers that have a narrow feeder neck **(Fig. 8)**.

Extended Aluminum Microstructure Prediction

The prediction of microstructure for aluminum alloys with MAGMAnonferrous has been significantly extended. The new features enable the prediction of the local solidification behavior and the resulting microstructure within a broad alloying range of Si, Cu, Mg, Zn, as well as numerous other elements. The visualization of local liquidus and solidus temperatures also provides new opportunities when displaying cooling curves.

Effective Software Operation

The new release simplifies the use of MAGMASOFT® in various areas: In the Geometry Perspective, you can now select and modify several geometries at once. This is especially useful for optimizing parametric geometries. Complex surfaces, like partitions, can be created by extruding curves. The new “Cutting Knife” capability is a powerful tool that enables the engineer to cut CAD or STL geometries. This is especially useful for separating gating and rigging systems from the actual part or for the segmentation of tool data in imported geometries. The geometry database has been extended significantly and now offers a large variety of parametric geometries for easy use within your projects for optimizing gating and risering or tool design **(Fig. 9)**.

In the Result Perspective, the visualization and handling of curve results has been greatly enhanced, enabling the engineer to quickly and easily display different curves as needed. The curves are always shown in the context of their process mode. The software enables an easy comparison of different projects and project versions, which also includes measured data. The

movement of virtual tracers or inclusions during mold filling is now visualized with the help of 3-D “bubbles” **(Fig. 11)**.

Multitasking Design Optimization

In MAGMASOFT® 5.4, the Parallel Design feature facilitates the parallel computation of several simulations (virtual trials) within a Design of Experiments or optimization, dependent on the number of available CPU cores. For example, with a 16-core license, up to 8 virtual trials can now be calculated in parallel, which can lead to a significantly faster time to solution.

Through the extension of the MAGMAlink module, any geometry and all results from MAGMASOFT® can now be used for forming simulations with Simufact (for further details see www.magmasoft.de/en).

The new release is now fully integrated with the MAGMA website. By saving your login credentials in MAGMASOFT®, the customer support area of the MAGMA website www.magmasoft.de/en is now directly available from within the software. The online help system now allows an integrated opening of videos and tutorials from the website. A direct upload of support requests to MAGMA’s support through the website is also possible.

Soon, the MAGMASOFT® 5.4 user interface will also be available in Chinese and Portuguese.

By systematically applying Autonomous Engineering, MAGMASOFT® 5.4 supports a fast product and process development, optimized process and tooling designs as well as a robust process layout with maximum reproducibility of quality.

About MAGMA

MAGMA offers comprehensive solutions to the metal casting industry, casting buyers and casting designers world-wide. MAGMA’s range of products and services includes the simulation software MAGMASOFT® for virtual designs of experiments and autonomous optimization of casting processes as well as comprehensive engineering services for casting design and process optimization. Today, MAGMA’s software is used by companies all over the world for cost-effective casting production, reducing quality costs

and establishing robust processes for all applications, particularly in the automotive and heavy industries.

With the MAGMAacademy, MAGMA provides extensive educational offerings including trainings, workshops and seminars both for MAGMASOFT® users and for users of casting process simulation results and virtual casting optimization.

MAGMA Giessereitechnologie GmbH was founded in 1988 and is headquartered in Aachen, Germany. A global presence and support are guaranteed by offices and subsidiaries in the USA, Singapore, Brazil, Korea, Turkey, India, China and the Czech Republic. Additionally, more than 30 qualified partners represent MAGMA around the world.

www.magmasoft.de/en

1,565 words, 10,618 characters including spaces

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Images

Images: MAGMA

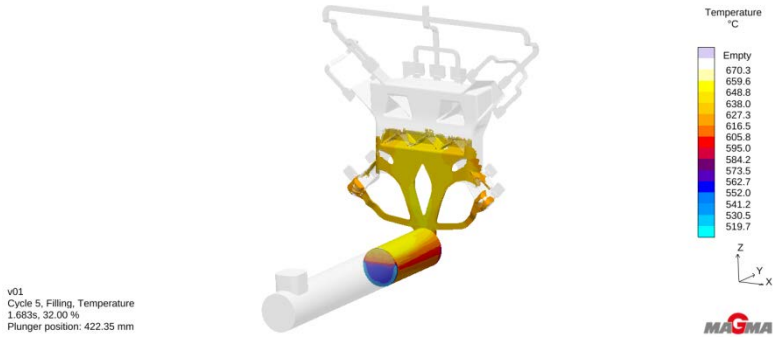

Fig. 1: Dosing and shot profile in the shot chamber

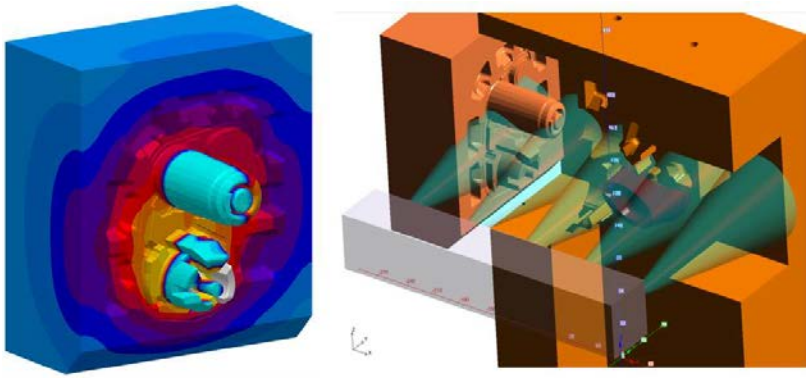

Fig. 2: Realistic description of the spray process

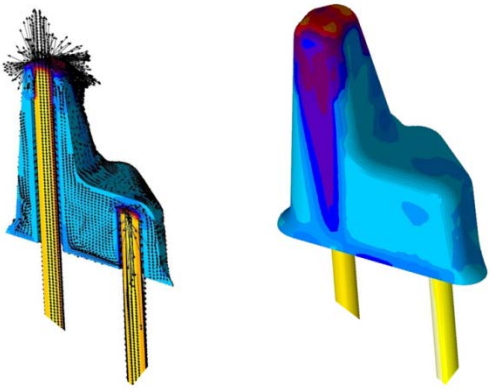

Fig. 3: Prediction of flow and heat transfer for cooling channels and contour cooling inserts

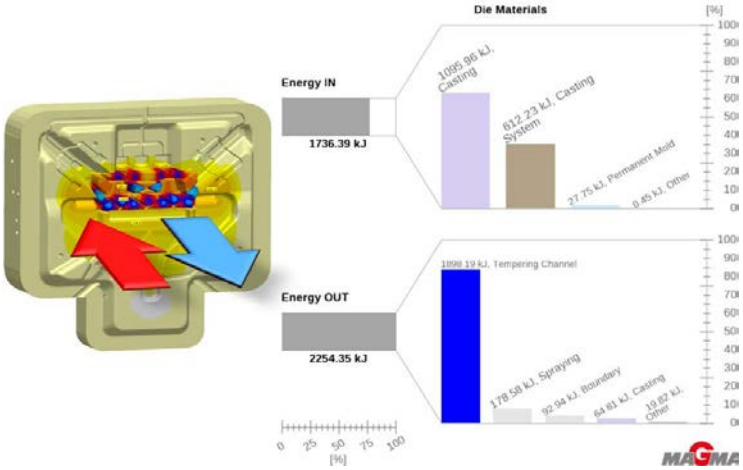

Fig. 4: Visualization of quantitative heat balance data for casting and mold

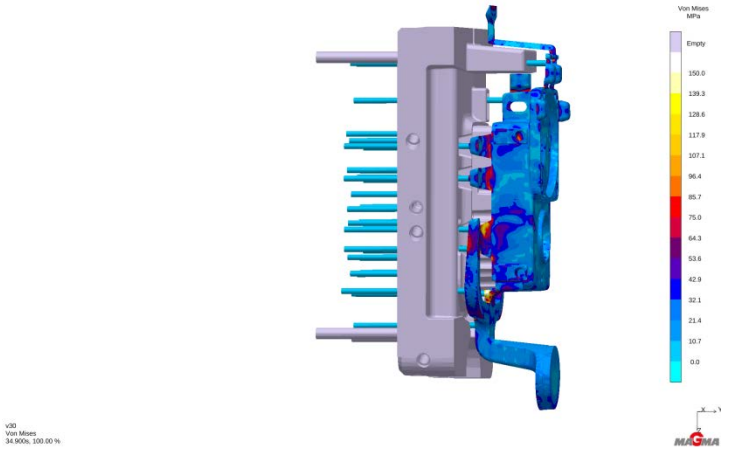

Fig. 5: Prediction of ejection forces and contact pressures in the casting

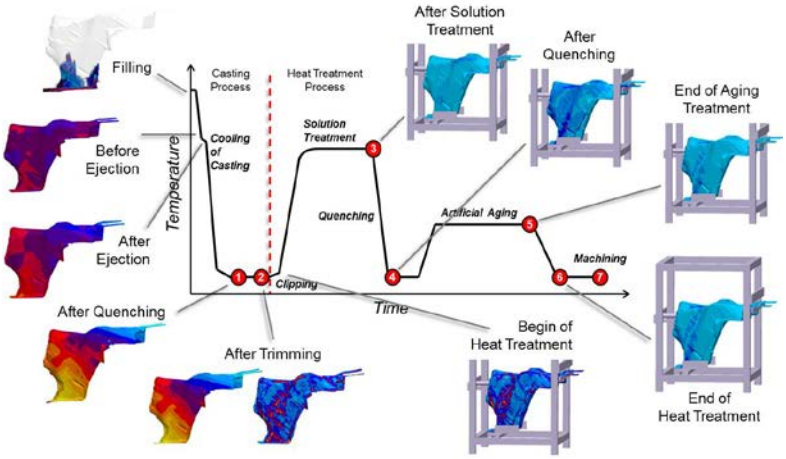

Fig. 6: Support of the complete process chain for distortion-optimized castings

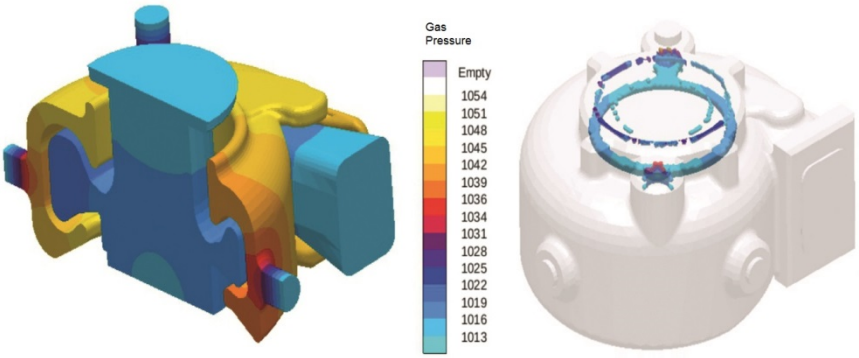

Fig. 7: MAGMASOFT® calculates the impact of gas generated during binder degradation (left) and predicts the risk of casting defects due to gases (right)

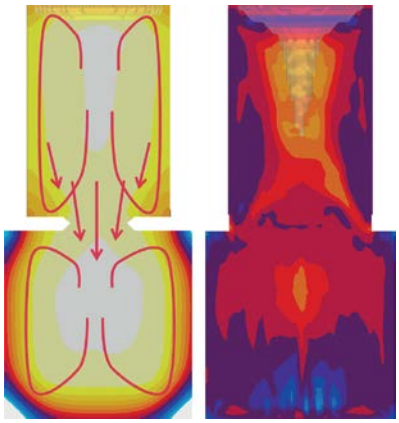

Fig. 8: Coupled calculation of convective and feeding flows (left) and their effect on segregation (right) in steel castings

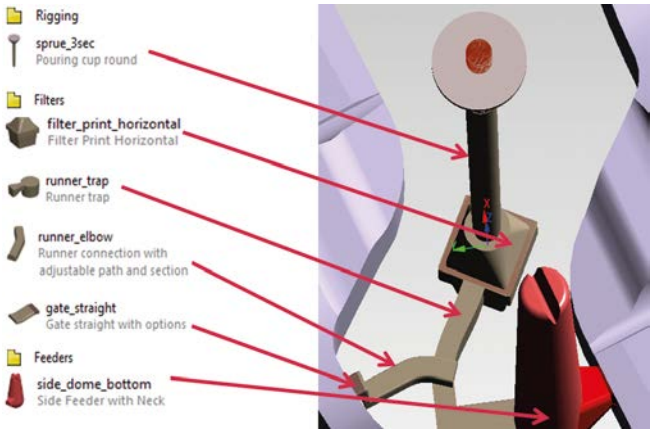

Fig. 9: Significant additions and extensions to the parametric geometry library

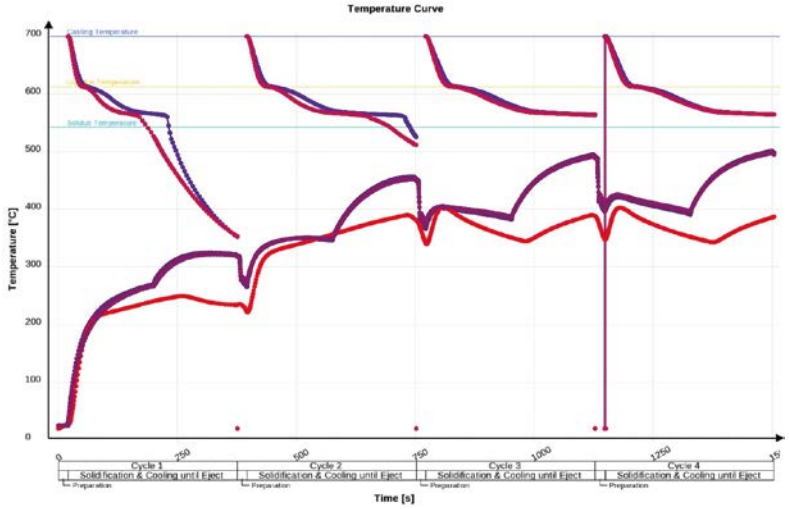

Fig. 10: Intuitive curve visualization for a given process

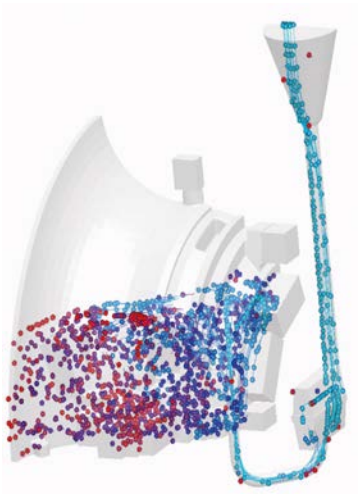

Fig. 11: Visualization of complex turbulent flows by three-dimensional tracer particles