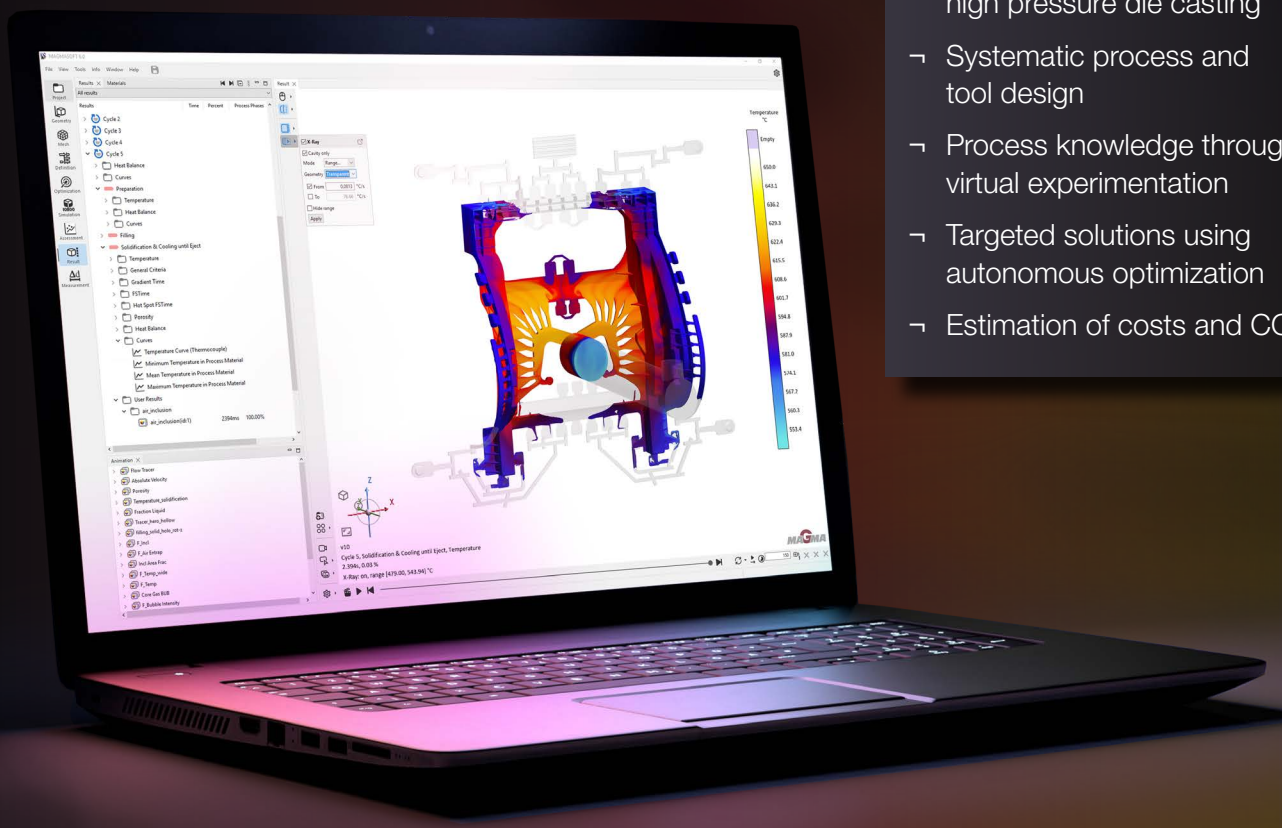
MAGMA HPDC 6.1

Autonomous Engineering

High Pressure Die Casting

- Robust cold and hot chamber high pressure die casting
- Systematic process and tool design
- Process knowledge through virtual experimentation
- Targeted solutions using autonomous optimization
- Estimation of costs and CO_2 emissions



Robust, Economical, Fast, **Optimized**

Optimize all aspects of die casting production and find the best solution for your requirements — with MAGMASOFT® autonomous engineering.

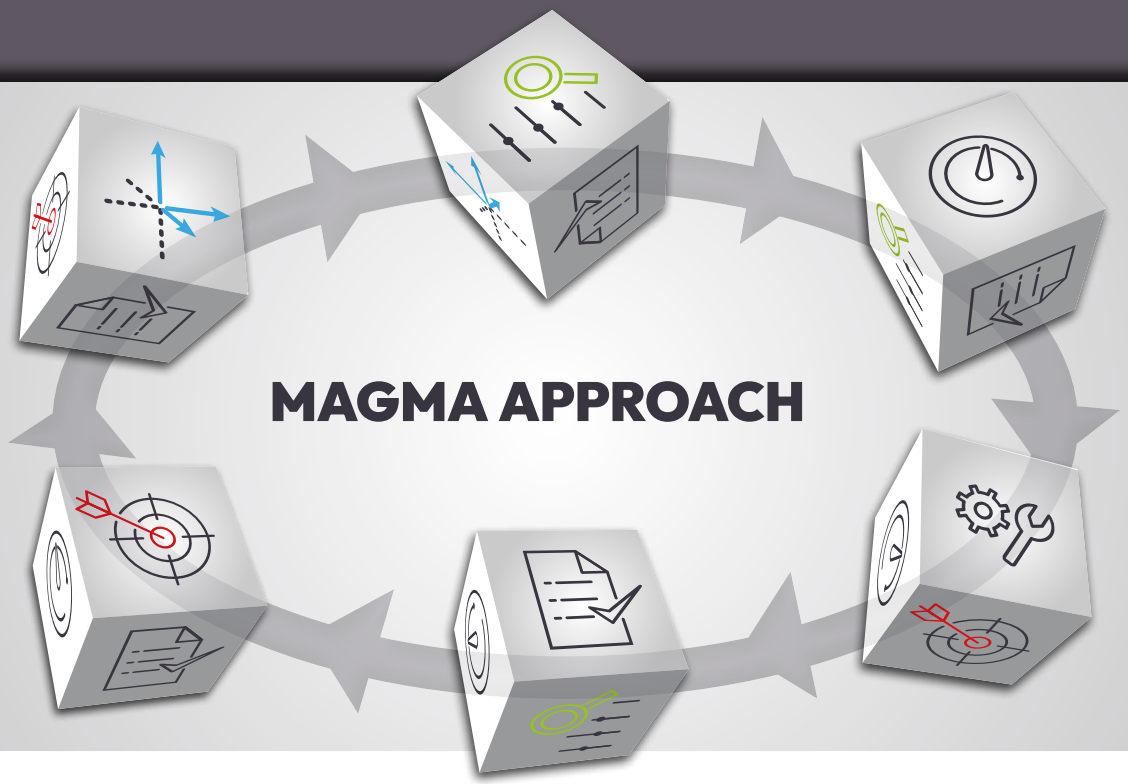
MAGMASOFT® is the comprehensive and powerful simulation software for all aspects around designing and improving die casting quality, tooling design and robust process conditions while ensuring optimal profitability. The focus is on your resources, time and costs.

With MAGMASOFT®, you use simulations in an automated virtual design of experiments or genetic optimization. The result is Autonomous Engineering – systematic and fully automated decision-making for tooling design and die casting production conditions.

With Autonomous Engineering, you can simultaneously pursue different quality and cost objectives. From securing part quality and process robustness at the concept stage, through final tooling design and the continuous improvement of profitability in series production.

MAGMASOFT® autonomous engineering:

- Supports you in the comprehensive prediction of all process steps in cold and hot chamber die casting applications.
- Offers you a virtual test environment for the reduction of casting defects.
- Allows faster decision-making, saving time for all parties involved.
- Empowers preventive quality management through detailed understanding of process variations.
- Improves communication and cooperation both within your organization and with customers.



Targeted And Systematic Success

The MAGMA APPROACH, which is fully integrated in MAGMASOFT®, is a systematic methodology for achieving your objectives using virtual experiments. In combination with MAGMASOFT® autonomous engineering, secured actions can be identified and implemented to achieve continuous improvements, without economic risks.

The MAGMA APPROACH supports you at every stage of the product development or improvement process, through a systematic methodology. The result is a robust casting process that is optimally designed for the desired objectives and that enables stable and cost-efficient production conditions taking into account alloy chemistry, melting practice and metallurgy.

Set Your **Objectives**, Define Your **Variables**, Specify Your **Criteria**

Die casting today demands maximum robustness and efficiency at an early stage of the process. With MAGMASOFT® autonomous engineering, simulations with different quality and cost targets can be carried out and evaluated automatically. The result is an optimally designed, robust process sequence to avoid casting defects, residual stresses and distortion.

Die Preparation

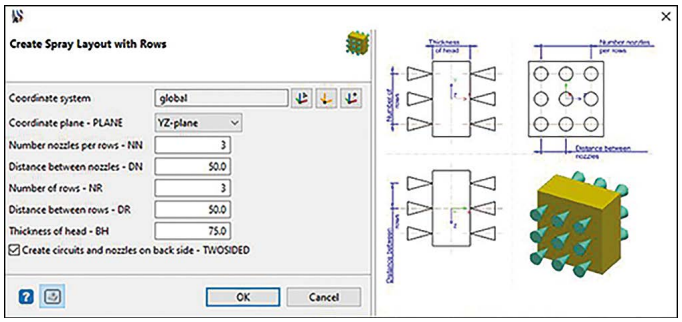
Analyze the influence of spraying on part quality, distortion of castings and tool components, or local tool lifetime at any point in the development process.

MAGMASOFT® supports efficient tool and process development by three spray process scenarios.

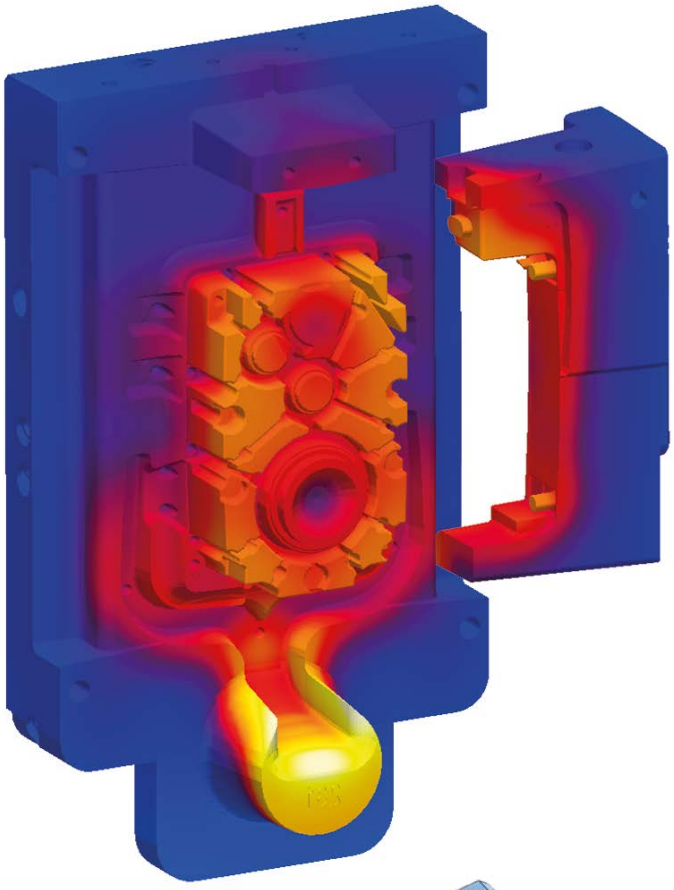
- In the early product optimization phase with a simplified heat extraction from the cavity
- During the concrete process and tool design stage with any static or movable spray surfaces
- Up to the realistic simulation of the spray head with circuits, nozzles and the spray program for the detailed evaluation of the wetting of individual tool surfaces

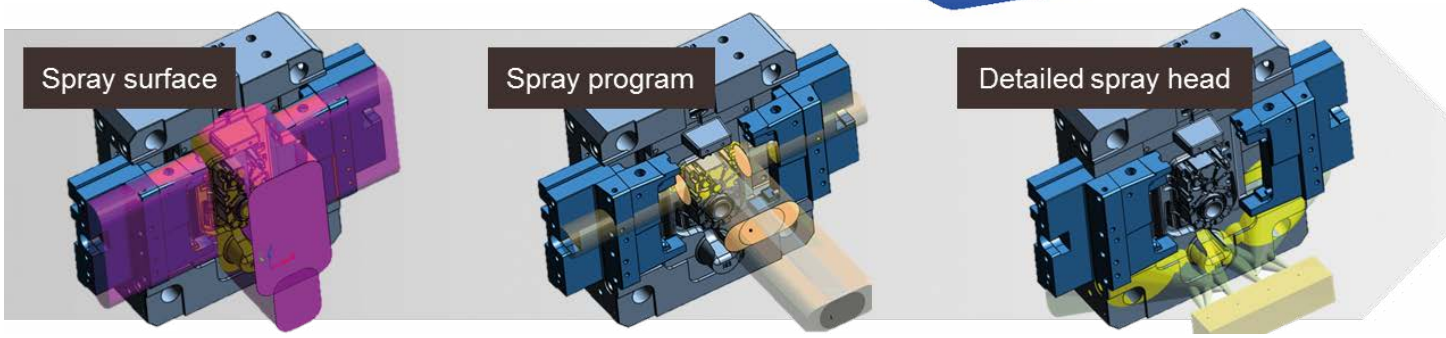
Assisted Modeling

Versatile assistants and convenient CAD functions support you in targeted and effective model preparation and enable a short time to answer with minimum effort.



MAGMASOFT® offers the creation of parametric geometries, the use of an extensive geometry database, or a simple segmentation of complex CAD model data using the 'cutting knife' function.





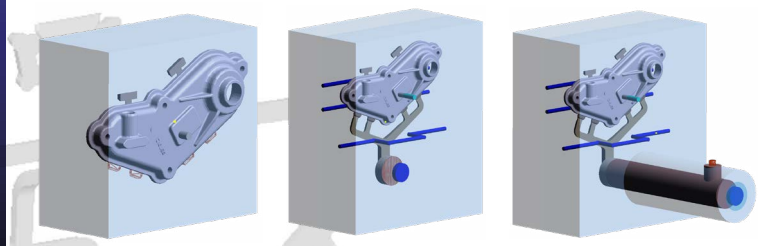
Simulation of the spraying process in different levels of detail adapted to the casting and tooling development phase

Rigging System Design

Intelligent assistants support you in calculating, preliminarily laying out, and optimizing machine parameters and shot curves for both cold chamber and hot chamber die casting.

Additionally, depending on the level of detail in your model, you can define the filling boundary conditions in three different ways:

- Early design stage: Use virtual gates to identify the optimal gate positions, without having to design the casting system in detail.
- Moderate level of detail: Simulate the casting system including biscuit and shot curve.
- Highest level of detail: complete representation of the shot chamber of the shot unit possible



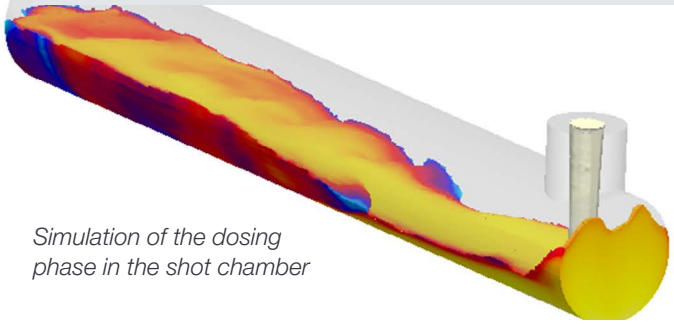
Levels of detail of the filling boundary conditions: design with virtual gates, casting system, biscuit, and complete representation incl. shot chamber

The simulation of the dosing process into the shot chamber and the representation of the shot profile with plunger movement are the starting point for die filling. Create the shot chamber by importing a CAD file or by using a parametric model in MAGMASOFT®.

Systematically analyze the system consisting of shot chamber geometry, dosing, dwell times, plunger velocities and switch-over points.

Evaluate and use optimization to solve problems such as:

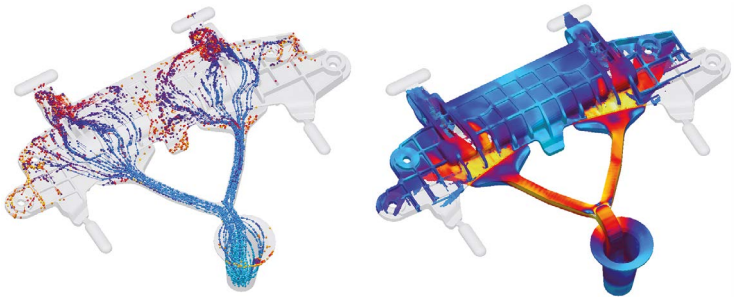
- What influence does the temperature loss of the liquid metal have on the risks of cold shuts and oxide formation?
- What happens to air entrapped in the shot chamber?
- How does the shot chamber distort?



Simulation of the dosing phase in the shot chamber

Analyze the filling process of the casting by considering the complete thermal balance in the die, the venting conditions, as well as the available machine capacity (PQ diagram).

Use MAGMASOFT® results such as flow vectors, flow velocities and tracer particles to design robust and economical gating systems.



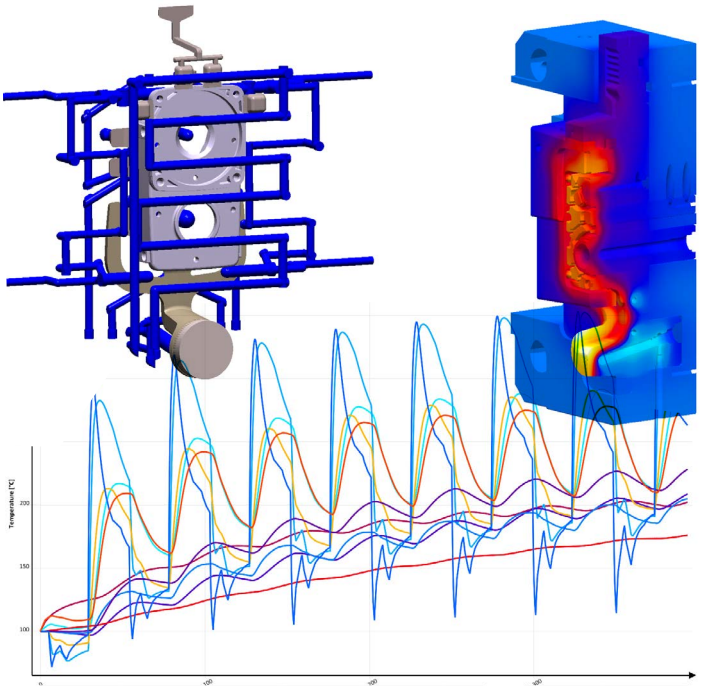
Visualization of die filling

Optimize the casting quality regarding the danger of cold shuts or air entrapment and porosity with the help of automated parameter studies, from the variation of the plunger velocity up to the level of the intensification for time and pressure-dependent feeding.

Vacuum or local feeding through squeezing can also be used as optimization parameters.

Depending on the development phase, use appropriate settings to illustrate the thermal boundary conditions in the die.

Use the comprehensive MAGMASOFT® geometry database to quickly define simplified cooling elements.

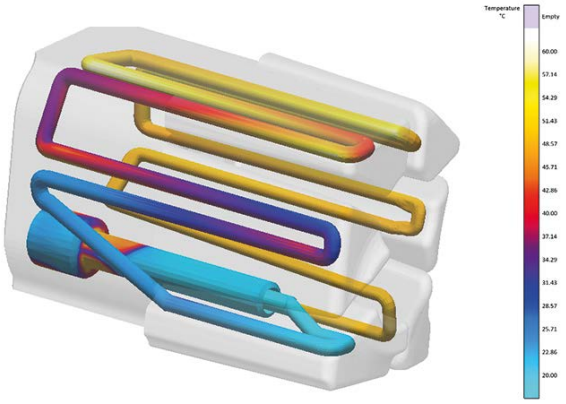


Realistic representation of the thermal balance in the die

Tool and Process Design

The local thermal conditions in the die influence the solidification path in the casting.

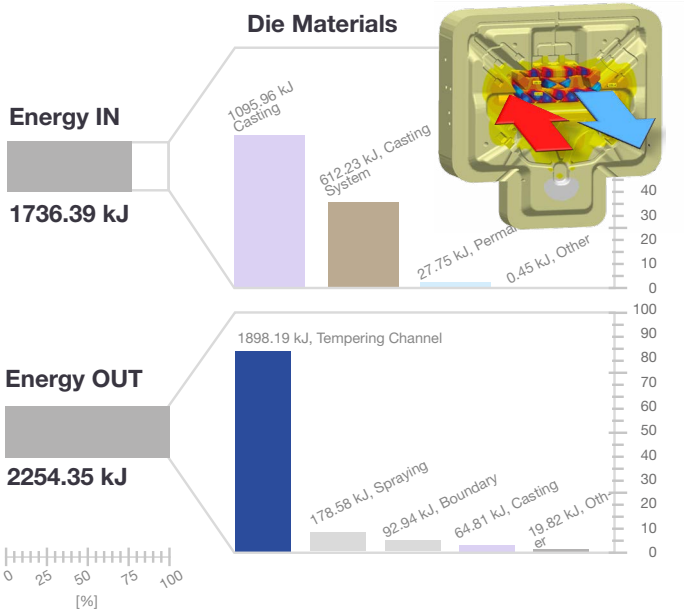
Analyze in detail the local cooling capacity of the die cooling elements for any geometry (water lines, spot and conformal cooling) taking into account the inlet and outlet, the cooling medium, the temperatures and the flow rates.



Flow through cooling channels and calculation of local heating or cooling performance

Use the automated variation of cooling element geometry, position and process settings of the die thermal control system to improve casting quality, reduce cycle times, optimize the energy balance of individual cooling elements or the overall system, and reduce die stresses.

The visualization of the energy exchange between materials and material groups (energy balance) over the complete process, individual process phases or defined periods of time allows you to optimize your die casting process in terms of energy efficiency and profitability.



Detailed visualization of the energy balance for each process step and die section

Evaluate quality criteria such as macroporosity and microporosity, thickness of the pore free zone or die soldering tendency taking into account the cyclic temperature profile.

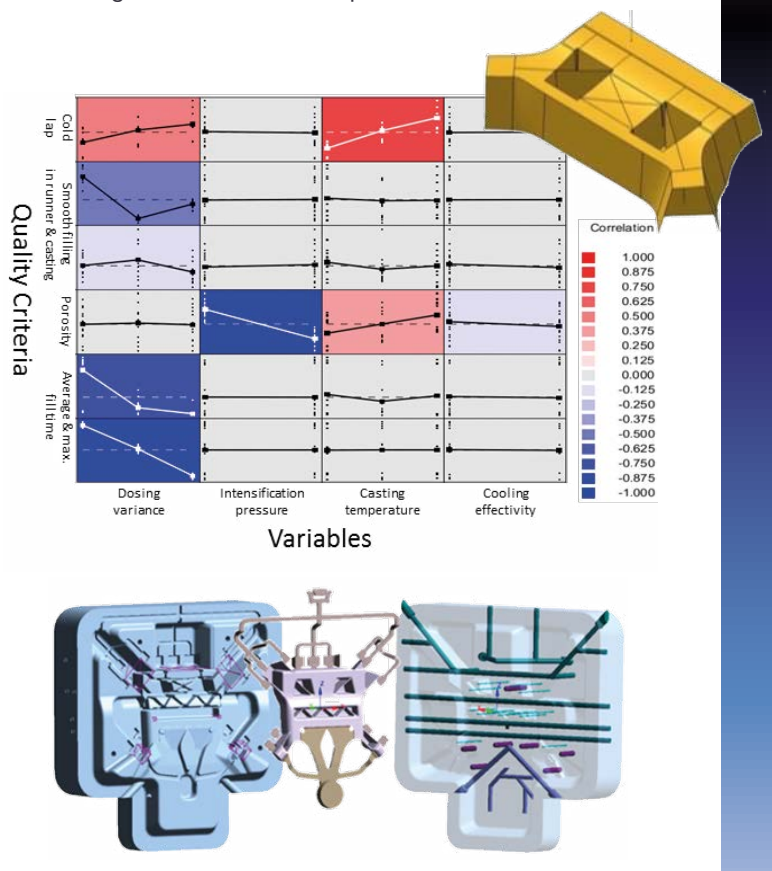
Prediction of critical die areas and their lifetime

Use the parametric variation of casting or tooling geometries integrated in MAGMASOFT®, for example, to minimize die wear caused by erosion or cavitation.

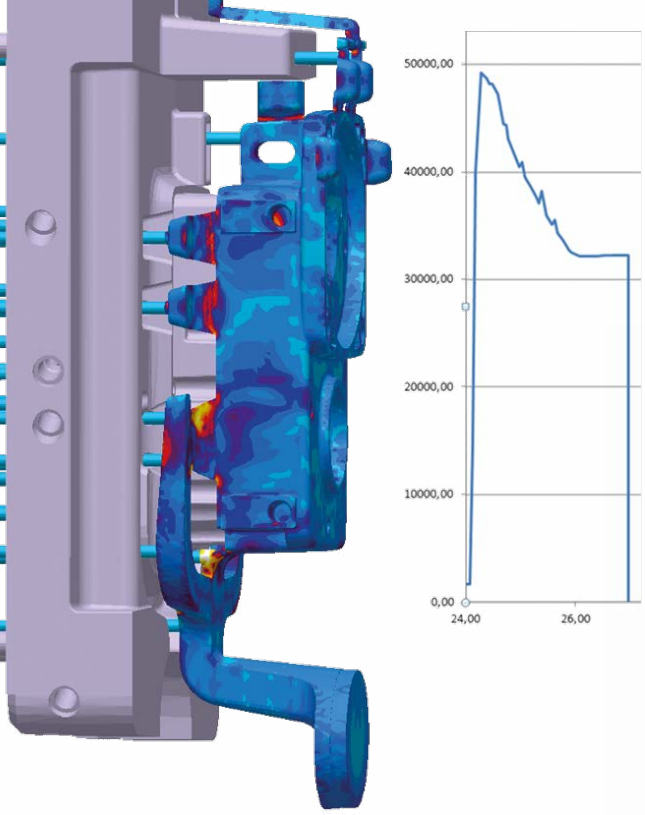
The Robust Process

An early-stage virtual analysis of the effects of process fluctuations on quality, function and service life of the product avoids time-consuming and cost-intensive testing on the machine.

MAGMASOFT® autonomous engineering shows you the critical process parameters that lead you from the initial design idea through to a robust start of production.



Main effect matrix visualizes relevant influencing variables on cast quality – virtually generated process knowledge at a glance, long before the first prototype is cast.



Von Mises stresses and resulting ejector force curve during casting ejection

Ejection

Calculate ejector forces throughout the ejection process based on local contact pressures between casting and die.

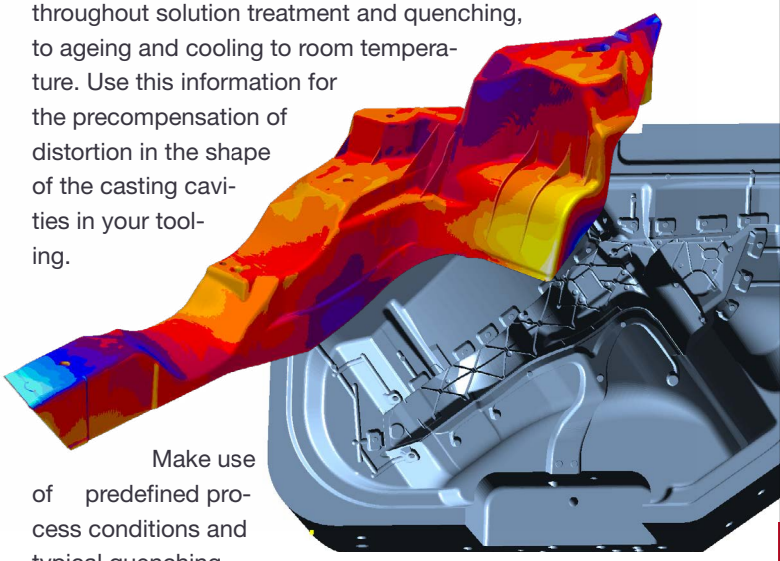
Analyze ejector forces as a function of the draft angle, start time and the duration of ejection.

Optimize the number and position of ejector pins or minimize casting deformation during ejection.

Improve the subsequent process sequence with respect to residual stresses and casting distortion.

Heat Treatment

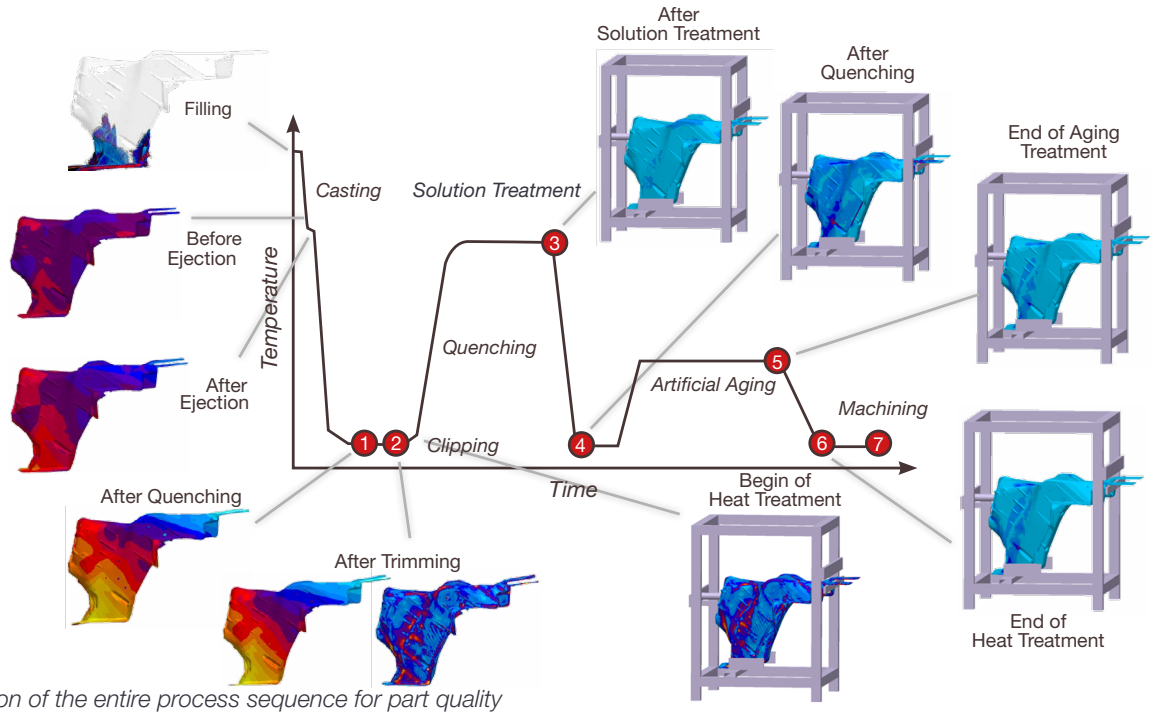
The simulation of the heat treatment process is seamlessly integrated into the virtual die casting process sequence. Evaluate local, thermally driven residual stresses as well as casting distortion. Consider all process steps from heating, throughout solution treatment and quenching, to ageing and cooling to room temperature. Use this information for the precompensation of distortion in the shape of the casting cavities in your tooling.



Make use of predefined process conditions and typical quenching media for optimizing the casting-specific heating sequence, the ideal solution treatment time and temperature, as well as the quenching behavior.

During solution treatment and ageing, both residual stress relaxation through creep and casting distortion due to the influence of gravity are considered.

Assess the extended process sequence after heat treatment, for example, by evaluating the deformation of the casting due to stress redistribution during machining. This allows you to construct robust heat treatment racks – long before real castings are available!



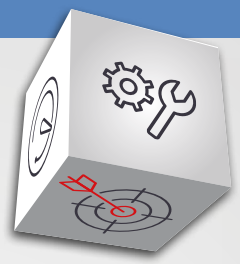
Consideration of the entire process sequence for part quality

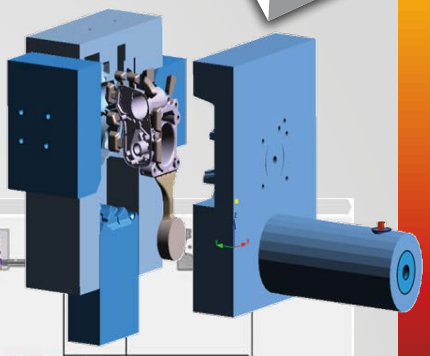
Work **Efficiently** and **Systematically**

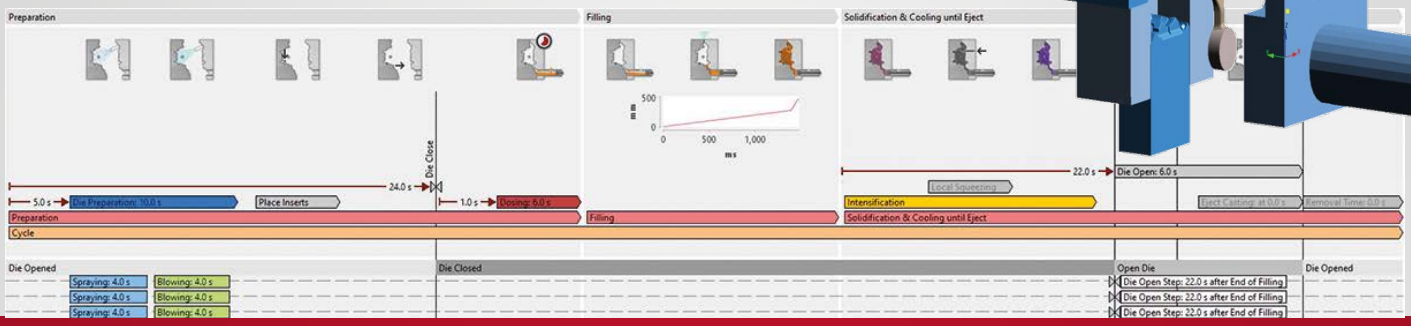
Your time is limited! To achieve your goals, it is crucial to systematically and efficiently utilize all the available possibilities in MAGMASOFT®'s comprehensive toolbox.

Intuitive Process Control

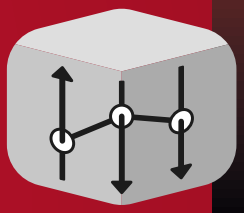
Take advantage of the control of all relevant process steps for optimization of the die casting cycle. Starting from spraying, placing of inserts and dosing times, through the opening sequence of the sliders, to handling times during ejection and quenching of the component.







MAGMA ECONOMICS Technology & Profitability

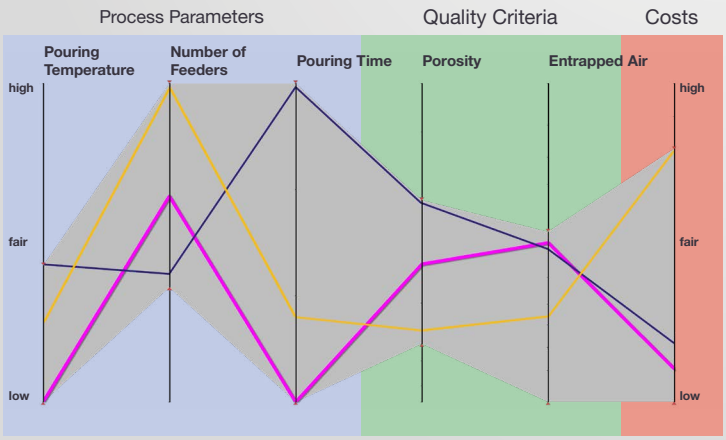


MAGMA ECONOMICS expands technical optimization with MAGMASOFT® to include economic decision-making criteria. This allows identifying savings potentials that are often overlooked in purely technical simulations.
The information provided by MAGMASOFT® thus creates additional opportunities as a management within the company.

Optimize Your Casting Quality, Cost & Carbon Footprint

MAGMA ECONOMICS calculates and compares costs, energy consumption and CO_2 emissions of different scenarios. The perspective draws on existing geometry, material and process data as well as simulation results.

Customizable templates for common materials and processes contain specific cost and emission factors, enabling a detailed analysis of resource consumption and production costs along the entire casting process – from tooling preparation to actual casting and possible machining steps.



Key Features

- **New perspective:** comprehensive quantitative analysis of costs, energy and resource consumption, and CO_2 emissions, coupled with quality criteria in MAGMASOFT®

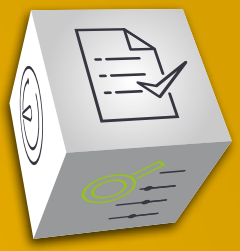
  Intuitive evaluation of quality, productivity, project costs, and sustainability as key tool for your competitiveness
- **Database:** evaluation based on existing geometries, materials, processes, and simulation results
- **Customizable templates:** templates for materials and processes with specific cost and emission factors
- **Scenario comparison:** individual variation of process parameters and comparison of different scenarios – thanks to intuitive control – without addition simulation time
- **Autonomous Engineering:** seamless integration with optimization and virtual design of experiments

With MAGMA ECONOMICS, the parallel coordinate diagram as established, interactive tool for analyzing process variations and quality criteria is complemented by corporate criteria such as costs, energy/resource consumption and sustainability.

Systematically and quickly find the best compromise between quality and costs (violet line) and the limits of your robust manufacturing process (process window, marked in gray).

Act & Check Your **Improvements**

Success is more than software and hardware. MAGMA's professional team is ready to comprehensively support you in realizing your goals. You can take advantage of the services of our MAGMAacademy, engineering and support teams when and how it suits you, and all from a single source.



Implementation

All MAGMASOFT® programs are more than just software. They offer a methodology for optimizing engineering, communication and profitability in your organization.

Even before starting with our software, we will take the time to discuss with you the most important factors to ensure an effective and secured use of our tools based on your situation: from the required computer hardware through the qualification and training of users, to jointly defining objectives regarding where you want to be in the next year.

Whether you are a new customer or a long-time user of our software: We have plans with you!

MAGMAsupport

MAGMAsupport stands for the competent, methodical and fast support of our customers worldwide regarding all questions in the application of and problem-solving with our products. With the MAGMA APPROACH, our qualified support staff will help you to make better use of our software every day.

MAGMAacademy

The MAGMAacademy systematically supports you in the implementation of both casting process and virtual optimization, from the initial rollout to the comprehensive application of Autonomous Engineering throughout the entire organization.

In our training courses, workshops and seminars, we convey interdisciplinary understanding across all processes and departments for the best possible use of MAGMASOFT® – conducted at our offices or through a customized solution on-site.

MAGMAengineering

As an independent and competent partner, MAGMAengineering supports a successful virtual product development, tooling design and optimization of your robust foundry processes within the framework of engineering projects.

An interdisciplinary and international team of experts, with numerous years of casting expertise, is available to work with you using MAGMASOFT® autonomous engineering to address your challenges.

More Information:

MAGMA Gießereitechnologie GmbH
Kackertstr. 16-18 | 52072 Aachen | Tel.: +49 241 88 90 1-0 | info@magmasoft.de | www.magmasoft.de