Advanced Heat Treatment for Steel

MAGMASOFT® 5.5
autonomous engineering

HIGHLIGHTS OF MAGMAsteel 5.5

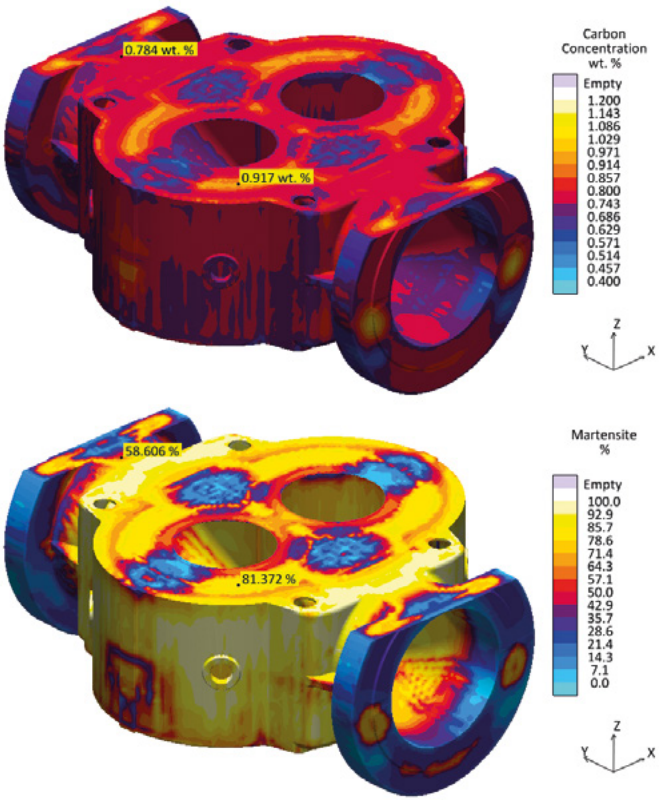
- Prediction of **microstructure** and material **properties** for **low and high-alloy steel grades**
- Consideration of **austenitic grain size**
- **Extension** of the **limits for alloying elements**
- Transfer of **segregation** results from the **casting process** into the **heat treatment simulation**
- New results for **microstructure** as well as for **mechanical properties**

MAIN BENEFITS

- **Saving energy** and **costs** during heat treatment
- **Reduction** of **tests** and **efforts** for **measurements**
- **Prediction** of local casting microstructure dependent on **heat treatment process times** and **conditions**
- **Assessment** of **local microstructures** and **mechanical properties** to fulfil specifications

For many castings a heat treatment following the casting process is required to obtain the desired microstructures and mechanical properties or to reduce existing residual stresses. MAGMAsteel enables the calculation and optimization of temperature distributions in the casting during each heat treatment step. The furnace characteristics, process times and used quenching conditions are considered.

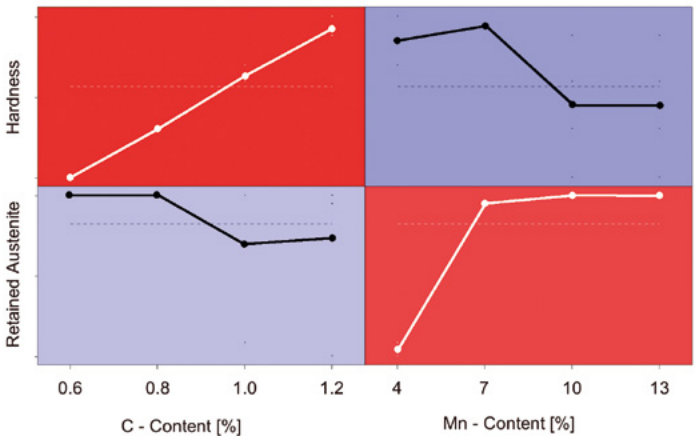
MAGMAsteel allows the prediction of microstructures and resulting mechanical properties during and after heat treatment.



Prediction of local microstructures taking carbon segregation into account

EXTENDED LIMITS FOR ALLOYING ELEMENTS

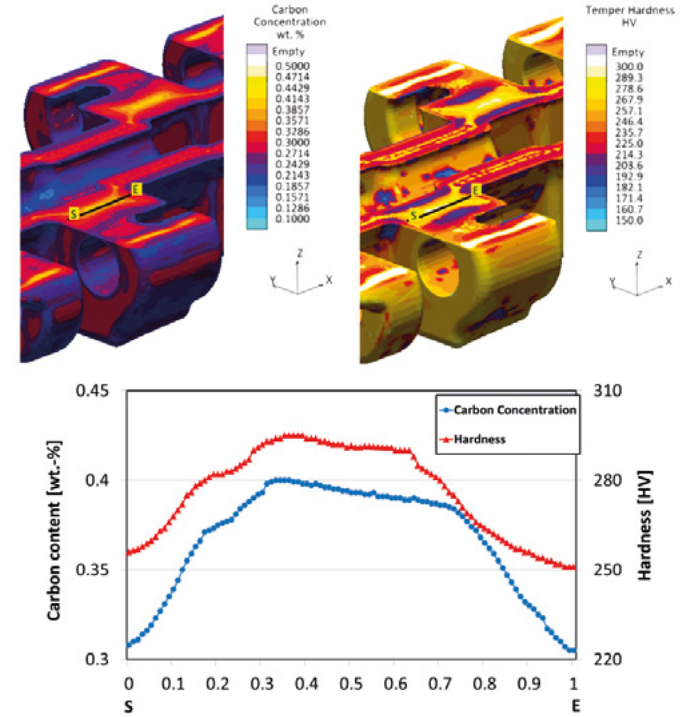
MAGMAsteel offers a widened range of chemical composition to predict the microstructure after heat treatment. This allows to investigate carbon, low and high alloy steel grades.



Effect of alloying elements (C and Mn) on microstructure and properties of high manganese steels

MACRO SEGREGATION AS AN INPUT FOR HEAT TREATMENT SIMULATION

Segregation of alloying elements occurs in all steel casting processes. The steel casting module MAGMAsteel predicts thermal convection and segregation within the casting. You now can transfer segregation results as input for a subsequent heat treatment simulation and evaluate the effect of concentration differences on the microstructure formation and resulting properties.

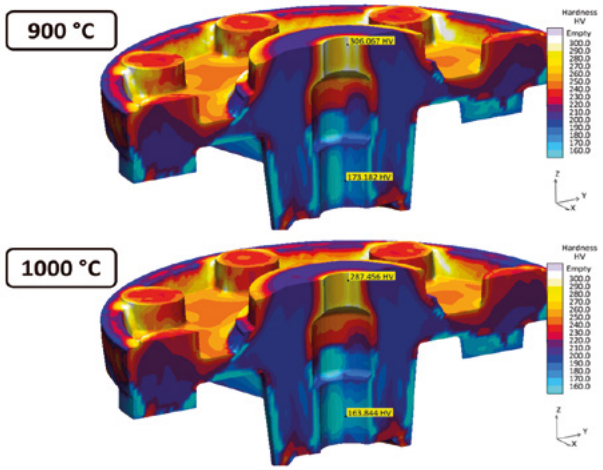


Influence of local carbon segregation on hardness

PREDICTING LOCAL AUSTENITIC GRAIN SIZE

The austenitization has a major influence on the microstructure. On the one hand desired homogeneity requires longer holding times in the austenite region. To avoid grain growth short holding times and small grain sizes are desired.

MAGMAsteel now predicts the local austenitic grain size as a function of the process condition and offers to find the best compromise for optimal mechanical properties.

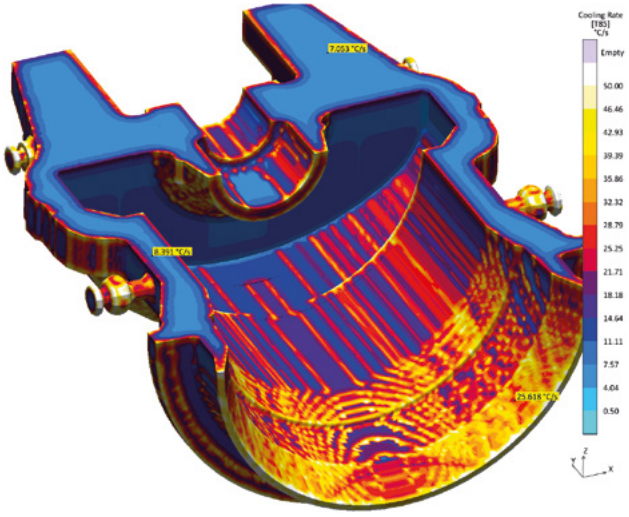


Hardness reduction due to grain growth for same austenitizing times, but different austenitizing temperatures

NEW RESULTS FOR MICROSTRUCTURES AND MECHANICAL PROPERTIES

MAGMAsteel offers the following new results:

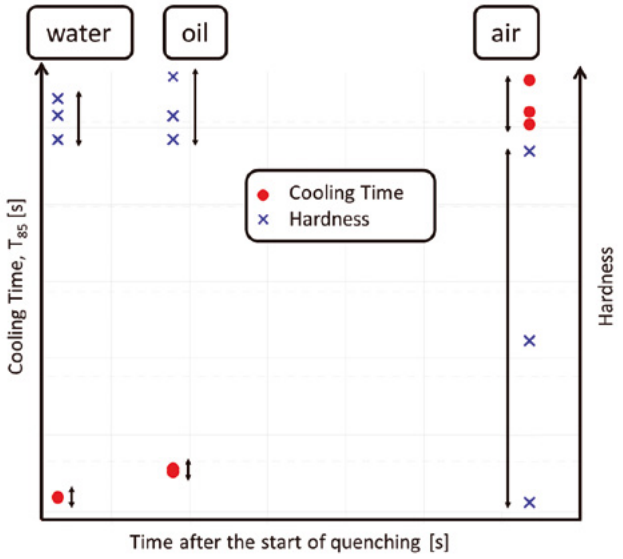
- Distribution of martensite, bainite, ferrite/pearlite and retained austenite
- Mechanical properties: hardness, yield strength, tensile strength and fracture elongation after quenching and tempering
- Required heating times to the target temperature during austenitization
- Cooling rates and cooling time distribution during quenching from 800 °C to 500 °C



Cooling rates in the casting during quenching between 800 °C and 500 °C

ROBUST AND OPTIMIZED HEAT TREATMENT PROCESSES

MAGMAsteel steel offers to systematically investigate process variations during heat treatment to establish a robust and cost effective process design for high quality cast steel products.



Effect of cooling time before quenching on hardness for different cooling media