Casting

Standard Use Cases

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Casting Smart Manufacturing

Unlock precision and efficiency in your casting processes with ESI's cutting-edge casting simulation software, ProCAST. Ensure right-first-time casting, meeting deadlines without the waste of resources on scrap parts or costly redesigns. ProCAST is a comprehensive solution covering a wide range of castable alloys and casting methods, including sand casting, die casting, investment casting, and their various process variants. Clients have trusted ProCAST for decades as their essential tool for addressing casting process fundamentals—filling, solidification, and porosity prediction.

ProCAST, equipped with advanced physics and Finite Element technology, goes beyond the basics. It predicts intricate phenomena, tracking residual stresses and anticipating subsequent deformations, leading to dimensional variations and extended die/tool life. It also computes microstructure, grain structure, and mechanical properties, crucial for enhancing component durability.

In **sand casting** foundries, ProCAST enabling optimization of gating systems, mitigating the risk of shrinkage porosity. The key to success in sand casting is effective gating system optimization, and ProCAST facilitates comprehensive modeling of any sand casting process, including high-pressure molding lines.

For **die casting**, ProCAST replicates shop floor conditions by simulating multiple production cycles and obtaining steady-state die temperatures. This allows a thorough study of filling, solidification, intensification pressure effects, cooling channel design, and optimization of process parameters.

Investment casting with ProCAST involves the automatic generation of a mesh representing the shell mold suitable for Investment casting & Shell Molding processes. It includes dedicated features catering to the specific needs of investment casting foundries, such as blending non-uniform shell thickness and creating multiple shell layers. Consideration of radiation with view factors, including shadowing effects critical for high-temperature alloys, is also a part of its capabilities.

Explore representative cases from the Automotive and Aerospace domains in our catalog, and for a comprehensive overview of typical results, visit ESI internet pages at

ProCAST | Casting Simulation Software (esi-group.com)

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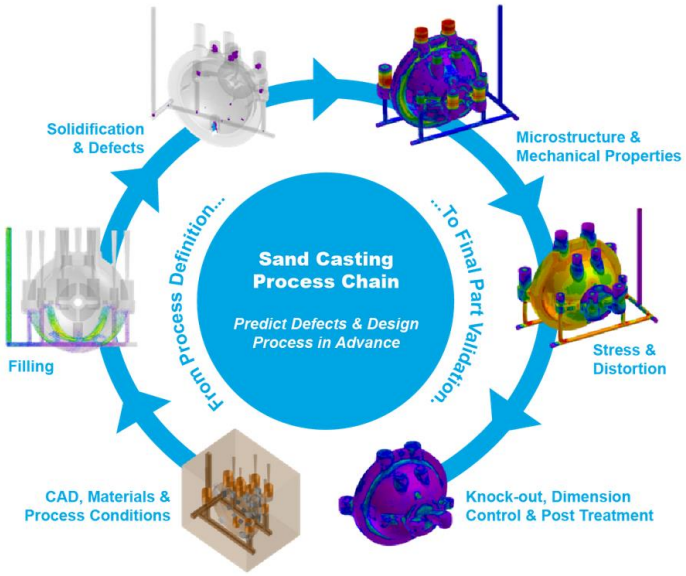
Sand Casting



Targeted Outcome

Optimize Quality & Costs, Ensure Castability, Improve Gating & Feeding System, Reduce Trials and Scrap

Input data:

- Geometry Information
  - Part, Gating, Mold, Cores, Chills
- Material Information
  - Casting Alloy, Mold Material, Core Material, Chill Material, Insulating Sleeve, Exothermic Sleeve, Hot Topping, Filter Type
- Process Information
  - Pouring and Mold Temperature, pouring Method, filling temperature and time, hot topping time, shakeout time.

Major results for the customer:

- Design the feeding, gating systems maximizing the yield.
- Asses new materials and investigate mechanical properties.
- Evaluate filling sequences, prevent mold erosion risks, enable inclusion tracking.
- Reduce scrap rates by avoiding defects, including porosity defects.
- Predict the effect of expansion on porosity for cast iron.
- Determine the right production process window.
- Track residual stresses, control dimensional tolerances.
- Assess critical areas to achieve specific mechanical characteristics.
- Use dedicated micro-models for grey iron, CGI, ductile iron, and Ni-resist alloy grades.
- Simulate expansion depending on the grade of cast iron, metal treatment, and cooling rates.
- Anticipate the effects of heat treatment

Project Description:

⁎Methodology used to simulate this process

- Kick-off meeting.
- Early research.
- Geometry modeling
- CAD Assembly
- 2D and 3D meshing
- Simulation setup - Process conditions / Simulation parameters.
- Material Creation
- Model Modification
- Report preparation

Pre-requisite to replicate the case:

ESI Software Configuration	ProCAST	
Hardware Configuration	☒ Workstation	☐ HPC
Training	☒ Standard	☐ Advanced
Automated workflow	☐ Yes	☒ No

Complexity level: ☐ Low, ☒ Medium, ☐ High

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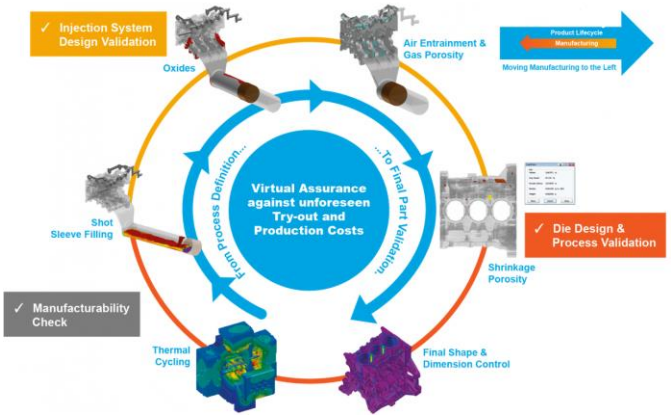
High Pressure / Low Pressure Die Casting



Targeted Outcome

Estimate castability risks early by facilitating 'Design For Manufacturing', and bridging the gap between OEMs and their suppliers.

Input data:

- Geometry Information
  - Part, Gating, Mold, Cores, Chills
- Material Information
  - Casting Alloy, Die Material, Secondary Die Materia, Spray/Lube Material.
- Process Information
  - Alloy and Die Temperature, shot profile, die cooling and heating conditions, thermal cycle, Spray cycle.

Major results for the customer:

- Evaluate numerous design alternatives at an early stage
- Assess critical areas to achieve specific mechanical characteristics
- Reduce process development time to produce a sound casting with optimal costs and lead-time
- Analyze air entrainment in the sleeve
- Optimize the slow shot via iterative process
- Determine the right switching point
- Find the right runner balancing, overflow & vent positioning
- Evaluate the effect of heat loss (misrun)
- Understand the effect of counter-pressure and vacuum on filling and gas porosity
- Account for the effect of max machine pressure on piston velocities (real-time piston control)
- Align die temperatures with reality
- Spot & measure shrinkage porosity accounting for the intensification phase & squeeze pins
- Virtual Dimensional control

Project Description:

⁎Methodology used to simulate this process

- Kick-off meeting.
- Early research.
- Geometry modeling
- CAD Assembly
- 2D and 3D meshing
- Simulation setup - Process conditions / Simulation parameters.
- Material Creation
- Model Modification
- Report preparation

Pre-requisite to replicate the case:

ESI Software Configuration	ProCAST	
Hardware Configuration	☒ Workstation	☐ HPC
Training	☒ Standard	☐ Advanced
Automated workflow	☐ Yes	☒ No

Complexity level: ☐ Low, ☒ Medium, ☐ High

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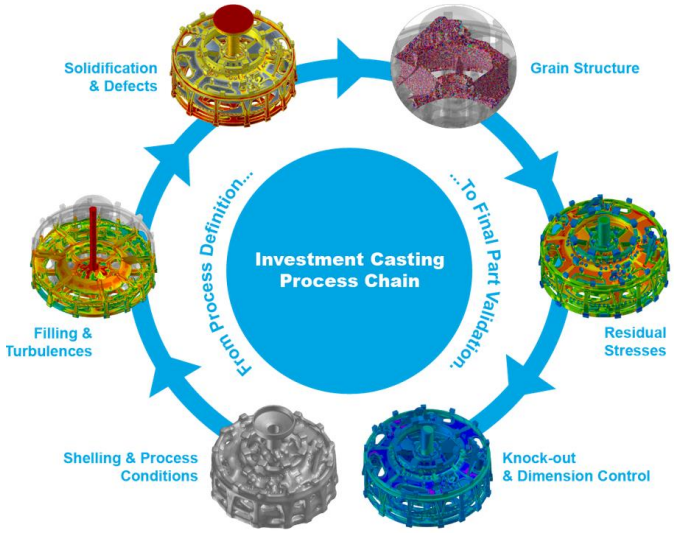
Investment Casting



Targeted Outcome

Estimate castability risks early by facilitating Design for Manufacturing and bridging the gap between OEMs and their suppliers.

Input data:

- Geometry Information
  - Part, Gating, Mold, Cores, Chills, Casting Chamber
- Material Information
  - Casting alloy, shell material and thickness, core, insulation, hot topping, heater, baffle.
- Process Information
  - Alloy and shell temperature, filling time, delay time of mold removal from furnace, hot topping time, vacuum

Major results for the customer:

- Evaluate numerous design alternatives at an early stage.
- Assess critical areas to achieve specific mechanical characteristics.
- Reduce process development time to produce a sound casting with optimal costs and lead time.
- Evaluate shell bridge.
- Filling defects: Turbulences, air entrapment, oxides, inclusions, cold shuts, misruns, surface defects, and core gases
- Solidification defects: hot spots, piping defects, macro-porosity, micro-porosity, gas porosity.
- Stresses: residual stresses, hot tears, cold cracks, distortion
- Metallurgy defects: grain structure defects including stray grain, freckles, and segregation.

Project Description:

∗Methodology used to simulate this process

- Kick-off meeting.
- Early research.
- Geometry modeling
- CAD Assembly
- 2D and 3D meshing
- Simulation setup - Process conditions / Simulation parameters.
- Material Creation
- Model Modification
- Report preparation

Pre-requisite to replicate the case:

ESI Software Configuration	ProCAST	
Hardware Configuration	☒ Workstation	☐ HPC
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Automated workflow	☐ Yes	☒ No

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