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Casting Simulation for Sand Casting of Housing by Cast Designer

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Abstract: ***In this research work present the design of experiment based approach which is adopted to obtain an optimal setting of moisture content, grain particle size and temperature of pouring metal related parameters of green sand casting in SUSHA FOUNDERS AND ENGINEERS at G.I.D.C PANDESARA, SURAT. The casting parameters identified for green sand casting process are moisture content, green strength, mould hardness, permeability, sand particle size, pouring temperature ramming pressure, cooling time. For defect analysis, the possible causes are grouped into design, material and process parameters. The effect of suspected cause parameters on casting quality is ascertained through simulation. Based on the results and their interpretation, the optimal values of the parameters are determined to eliminate the defects.***

Keywords: casting simulation, Gating system design, Solidification simulations, porosity, housing

1. Introduction

Simulation simulates the real casting phenomenon using a computer program. The simulation program is consisting of set of mathematical equation. Casting process simulation has become an invaluable tool in production of economical and high performance cast components. Its application by experienced and knowledgeable operators leads to reduced casting defects, casting yield improvement and reduce trial and error iteration in development of casting optimization. Increasingly casting simulation is being used as a collaborative tool between component designers and producers to reduce lead time, to develop casting friendly component designs and to produce better castings.

1.1 Types of casting simulation software's:

The most useful casting simulation programs available in India are AUTOCAST, MAGMA pro-CAST, solid-CAST and CAST DESIGNER. Some of these are available on hire monthly and annually.

- Finite element method (example-proCAST)
- Finite difference method (example-solidcast)
- Finite volume method (example-MAGMA)
- Vector element method (example-auto-cast)
- Vector element method (CAST DESIGNER)

2. Data Gathering

This is most important stage, correct and complete data will lead to accurate simulation and conclusion. The problem must be defined first and also define the need and type of simulation. There two types of aim of projects which are as

- Quality or yield improvement
- Rapid development of new casting design Inputs required for simulation:
  - CAD model of casting should be in 3D of cast part,
  - Cast metal properties as thermal conductivity, specific heat, shrinkage, viscosity, etc
- Method design data including details about mould parting, cores, feeders, gating system, cavity and feed aids.

1.3 Data input in Simulation tool Cast designer of Housing

Table 2.1: Data of Simulation

Parameters	Specification
Ambient temperature	26 ^{0}C
cast material	FG 400
Mould material	Green sand
Metal velocity	0.8 mm/sec
Pouring temperature	1330 ^{0}C

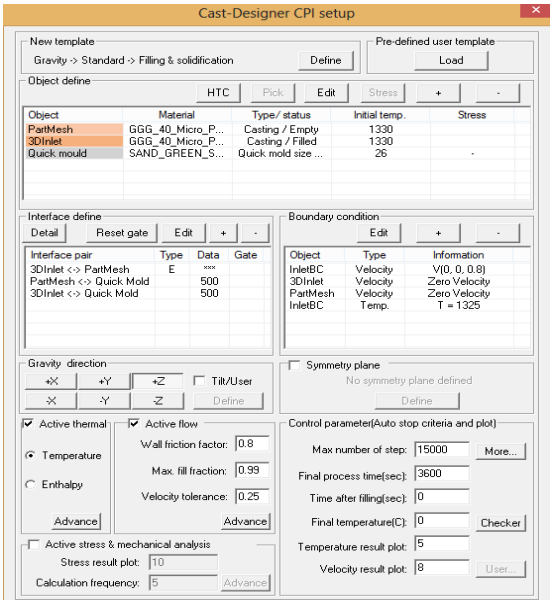

Figure 2.1: Data input in simulation tool

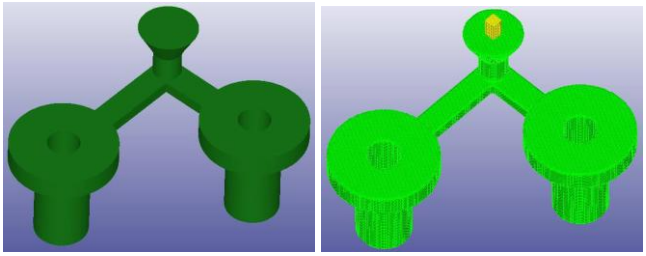

Figure 2.2: Model and part-mesh

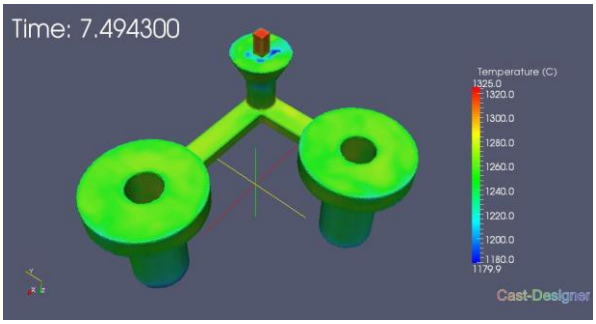

Figure 2.3 Filling time of metal in casting

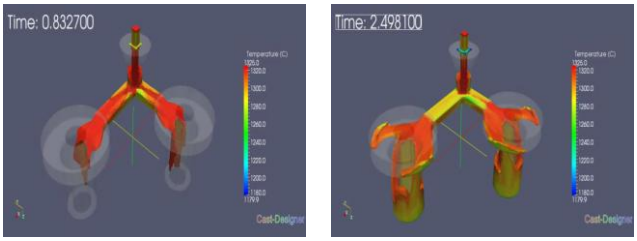

Figure 2.4: The different area filled at different time (sec).

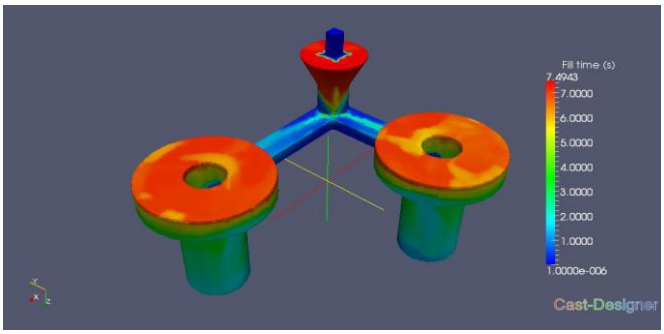

Figure 2.5: Temperature contours

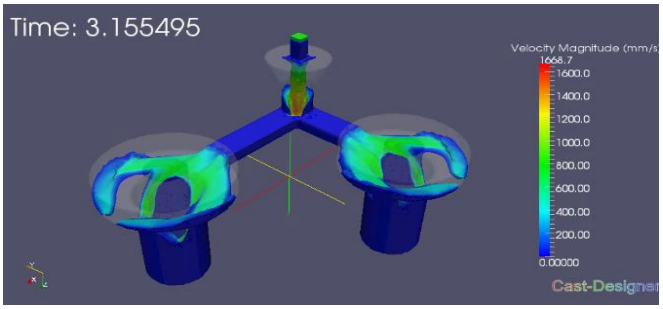

Figure 2.6: Velocity of metal at 3.1 sec

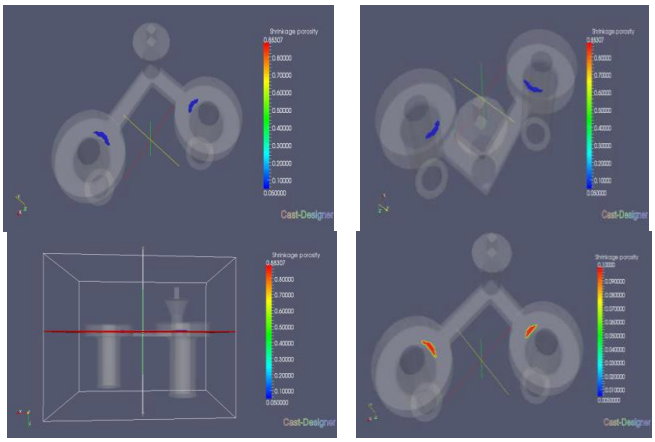

Figure 2.7: Shrinkage porosity is found at a few portions in the housing near ingate

Shrinkage porosity is caused by difficulties in supply of molten metal needed to compensate for sharp decrease of molten metal volume which occurs during solidification.

One of the reasons for this may be premature freezing of the sprue as evident from temperature. The shape of cast item and properties of FG400 are found to influence the extent of shrinkage porosity in the casting.

Out come from Simulation

- By using cast designer simulation tool,
- We can detect porosity near Ingate of gating system.
- Also we got filing time of castings is 7.4 sec.
- Also we can know temperature counter, velocity and pressure of metal in component.
- Also we know the solidification time of component.
- Also we know area where shrinkage porosity detected.
- Percentage(%) of yield 84.41

3. Simulation of modified gating system cast iron housing

3.1 Simulation of Present Study

The simulation was carried out to understand the mould filling process of Housing castings, to find the defects and study the solidification process. Using the optimal combination of process parameters, which are the Moisture content (A) A2, sand particle size (B) B2, pouring temperature(C) C2.

3.2 Data input in Simulation tool of housing

Parameters	Specification
Ambient temperature	26 ^{0}C
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Mould material	Green sand
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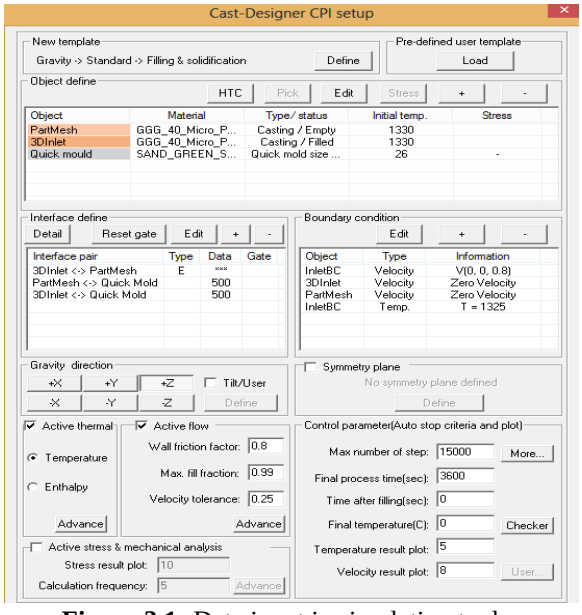


Figure 3.1: Data input in simulation tool

The first was modeled with housing alone without riser. The purpose of this initial run was to observe the solidification of casting, and accordingly determine which parts need feeding i.e. the location where defects. Its revealed that the solidification is directional from top of housing from temperature counters shown in fig.

In this trial of casting of FG 400 housing with foundry design gating system, the following observations were made:

1) 3D model and meshing part in Fig 3.2
2) Filling time of metal in casting cavity in Fig.3.3
3) Fig.3.4 shown the different area filled at different time (sec).
4) Temperature at differ area at solidification in Fig.3.5
5) Shrinkage porosity is found at a few portions in the housing, mainly near the ingates, This is shown in Fig.3.6

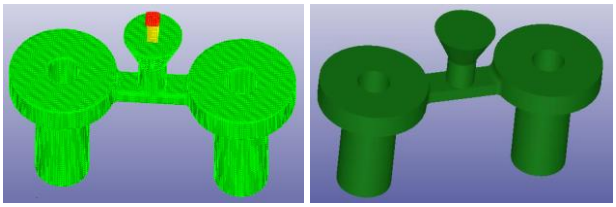


Figure 3.2: 3D model and part-mesh of modified design

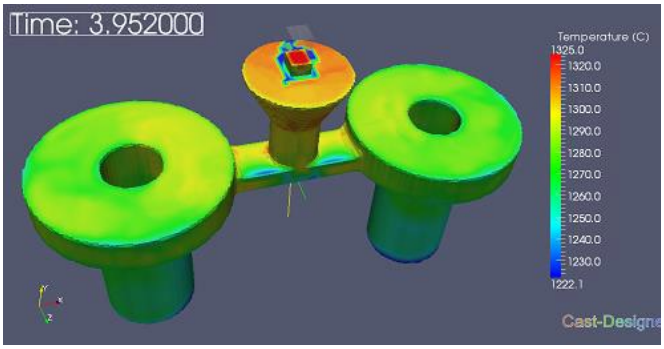


Figure 3.3: Filling time of metal in casting.

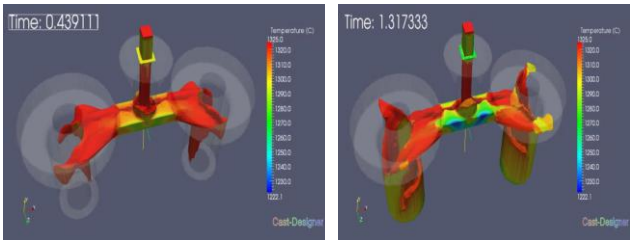


Figure 3.4: The different area filled at different time (sec)

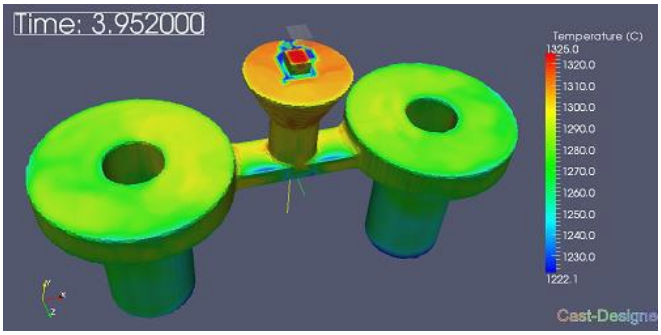
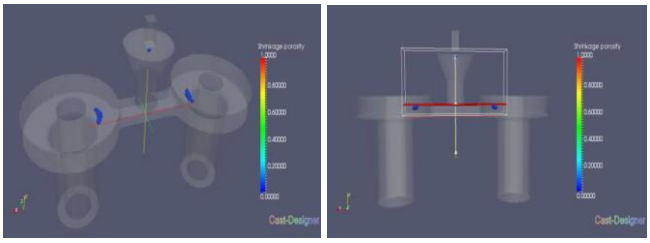


Figure 3.5: Temperature contours



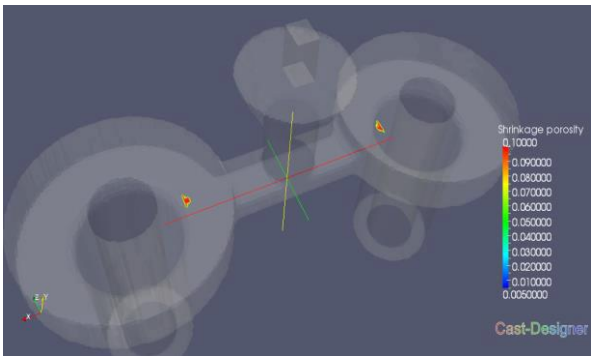


Figure 3.6: Shrinkage porosity is found at a few portions in the housing near ingate.

Shrinkage porosity is caused by difficulties in supply of molten metal needed to compensate for sharp decrease of molten metal volume which occurs during solidification.

One of the reasons for this may be premature freezing of the sprue as evident from temperature. The shape of cast item and properties of FG400 are found to influence the extent of shrinkage porosity in the casting.

Out Come from Simulation

- By using cast designer simulation tool,
- We can detect porosity near Ingate of gating system.
- Also we got filing time of castings is 3.9 sec.
- Also we can know temperature counter, velocity and pressure of metal in component.
- Also we know the solidification time of component.
- Also we know area where shrinkage porosity detected but it is very less compare the existing component have.
- Percentage (%) of yield is 92.85

4. Conclusion

In this present work a 3D component model was developed casting simulation software CAST DESIGNER to evaluate possible casting defects for sand casting of Housing in foundry.

Conclusions from this study are:

- By designed new gating system the fluid flow was smooth without ant entrapment inside the mould cavity. Simulation showed that the molten metal able to filled the mould cavity within desire time. So fluid heat distribution was good and no cold shut was observed.
- In first model with improper location of ingates to formation of shrinkage porosities were founded.

Second riser is located at center of two housing in order to achieve directional solidification.

The second model resulted in reducing the shrinkage porosities and defect associated with the cast is eliminated and sound cast is achieved.

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