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Experimental Analysis and Investigation of Hot Spot in Rear Cross Over FG260 Solid Disc [SS4404] Casting

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Abstract- : In Zanvar Group of Industries Private Ltd, Ashta. Sangli maharahtra Rear Cross Over FG260 Solid Disc [SS4404] Casting products rejection by many defects like hot spot shrinkage Porosity, Gas porosity etc. But among all these defect hot spot defect is responsible for 11 % rejection of casting of Rear Cross Over FG260 Solid Disc [SS4404]. So currently in the casting of brake drum disc, hot spot is occurring at top face. We have reduced this percentage of rejection of casting by reducing the Hot Spot defect. For reducing this hot spot defects there are many ways like changing gating design system, changing metallurgical parameters (by adding inoculants), by using different statistical tools, different software techniques etc. Out of which we have concentrated on the gating design system. This paper discuss how can we detect the hot spot in casting by using E-Foundry simulation technique which uses AUTO-CAST software for simulation purpose. E-Foundry is advanced technique by which we can detect the hot spot defects in castings. In past they were getting hot spot on the top surface of brake drum disc, but after performing some iteration by simulation technique we diminished that hot spot from surface.

Index Terms- Hot spot**,** Inoculants, E-Foundry, Gating system , AUTO-CAST, CATIA V5 R20.

1. INTRODUCTION

As per literature review many researchers reported that about 90% of the defects in castings are due to improper design of gating and risering system and only 10% due to manufacturing problems due handling and storage of molds, improper pouring temperature and time etc. Casting simulation process can able to overcome these problems by detecting location of Hot spot. It has observed that various type of simulation software has used in foundry, out of which AUTO-CAST based casting simulation software is used in our organization Ashta Liners Private Limited, Ashta[4].

To detect these defects we have gone through the casting simulation. Computer simulation provides a clear insight regarding the location and extent of internal defects, ensuring castings are right first time and every time. It however, requires a 3D CATIA model of the method layout (with mold cavities, cores, feeders, and gating channels), proper setting of boundary conditions for each virtual trial, and correct interpretation of results. AUTO-CAST software integrates and automates the above tasks, and provides an extremely easy-to-use graphical user interface suitable for even first-time computer users. The mold cavities, feeders and gating system are automatically optimized, driven by the criteria and constraints specified by user. This reduces the total time for methods design and simulation of a typical casting to less than one hour[4].

Computer simulation of casting process has emerged as a powerful tool for achieving quality assurance without time consuming trials. Software packages for simulating the solidification of molten metal in the mold enable predicting the location of shrinkage defects and optimizing the design of feeders to improve the yield; more advanced packages perform coupled simulation of mold filling and casting solidification. It has been reported that simulation studies can reduce casting defects, manufacturing costs and lead time by as much as 25%. Casting simulation can overcome the above problems. Virtual trials do not involve wastage of material, energy and labor, and do not hold up regular production[2]. However, most of the simulation programs available today are not easy-to-use, take as much time as real trials, and their accuracy is affected by material properties and boundary conditions specified by users. The biggest problem is this preparation of 3D model of the mold cavity with cores, feeders and gating for every iteration, which requires CATIA skills and takes considerable time for even simple parts[5]. This also prevents early manufacturability evaluation and Improvement by product designers, which can benefit several times more than tooling and process changes. The AUTO-CAST software firstly developed by Advanced Reasoning Technologies, Mumbai in collaboration with I.I.T. Bombay provides a single integrated easy environment for casting methods design, solid modeling, and simulation[3].

2. INPUTS AND PROCEDURE OF SIMULATION

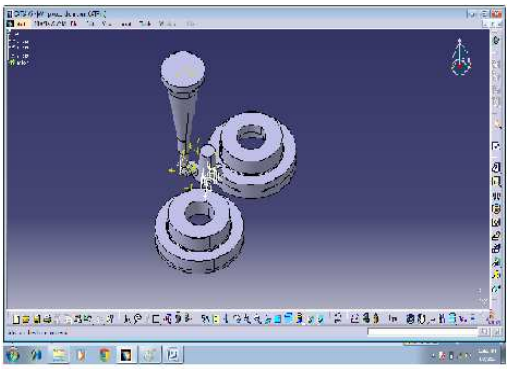
Following are the inputs required for this simulation purpose-

- CATIA model which is in the .STL format
- Metal of Casting (Ferrous Metal)
- Type of mould (Sand mould)
- Meshing required (Fine Meshing)
- Pouring temperature of 1200-1300.
- Tapered shape riser
- Tapered shape sprue

Following procedure has to be followed for simulation purpose-

- Solid model a cast part and save it as a .STL file.
- Browse and upload the casting model file on E-Foundry website.
- Wait till the simulation results are displayed.
- Identify hot spots. Decide feeder size and location.
- Model the part with feeder and save as a .STL file.
- Simulate again and check the location of hot spots.

3. GENERAL PROCEDURE FOR ANALYSING HOT SPOT



Fig(1) CATIA Model Of Brake Drum Solid Disc

The example of case study for the application of casting simulation presented here to optimize the casting feeding system design. The Fig (1) shows the 3D drawing of brake drum disc which is drawn in CATIA software along with actual component, feeder, runner, riser and gates. And this file is converted in .STL format as shown above.

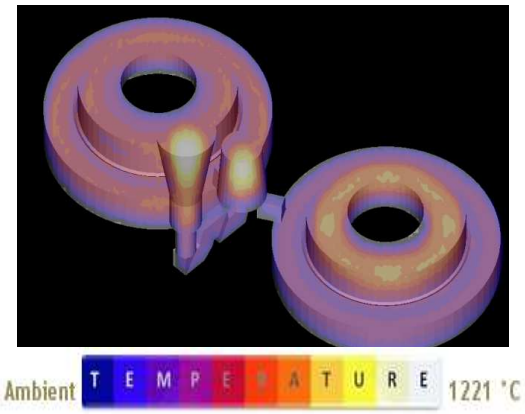


Fig (2) Simulation result of First iteration

Iteration No- 1: When we did the simulation of component shown in fig (2) we got the hot spot (the yellow colour shown on surface, in the riser and in the sprue) on the top surface of the brake drum disc. So when the length of sprue is having certain height then we got hot spot on surface of Brake Drum Disc.

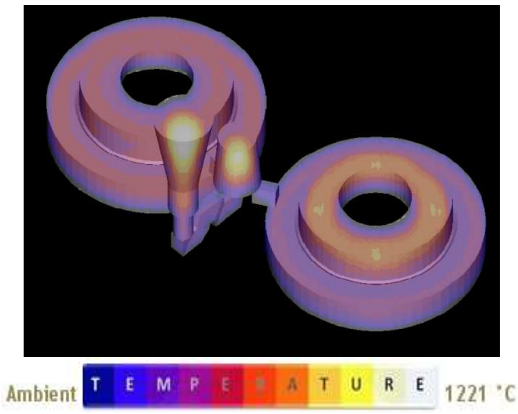


Fig (3) Simulation result of Second iteration

Iteration No- 2: We changed the height of sprue by certain mm. When we did the simulation then the results are as shown in fig (3). Still we are getting a hot spot in the one of the brake drum disc but the size of hot spot as well as number of hot spot gets reduced as compared to fig (2).

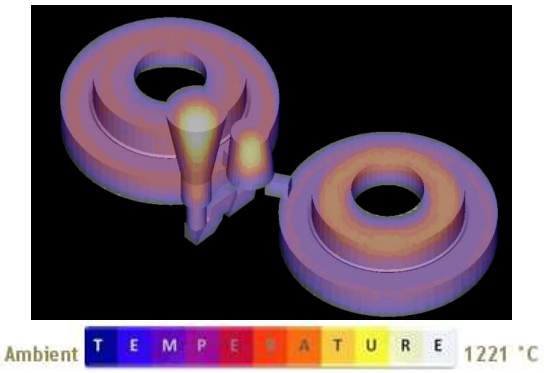


Fig (4) Simulation result of Third iteration

Iteration No- 3: For experimental purpose again we changed the height of sprue again by certain mm and did the simulation. We did the simulation and got the result as shown in fig (4). For this time, the hot spot get diminished from the surface. But still we are getting yellowish red colour on the surface. This shows that molten metal is not completely solidified for this length of sprue.

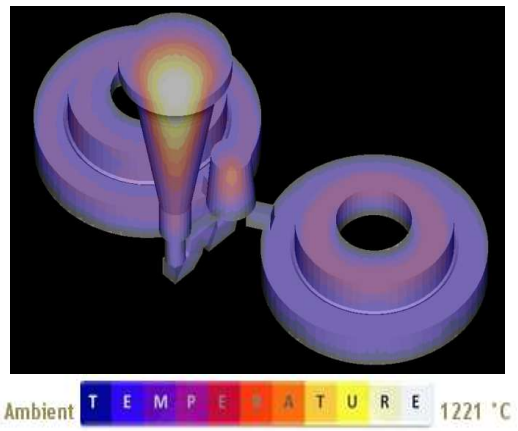


Fig (5) Simulation result of Fourth iteration

Iteration No- 4: Again we changed the height of sprue by certain mm still we are getting reddish colour on the surface of brake drum disc as shown in the fig (5). This shows that the molten metal is on the way of complete solidification.

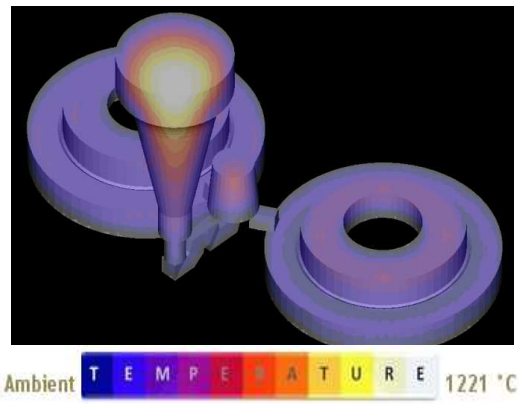


Fig (6) Simulation result of Fifth iteration

Iteration No- 5: Finally we changed the height of sprue directly by certain mm and got the result as shown in the figure (6). But this time result shows that the molten meal is completely solidified and we are getting the hot spot in the sprue that will not create any problem to the product.

Comparitive Study of Hot Spot for different sprue heights

Sprue Height (mm)	Hot Spot (%)
204	32.9
214	25.6
224	18.3
294	9.4
394	0.2

4. RESULTS AND DISCUSSION

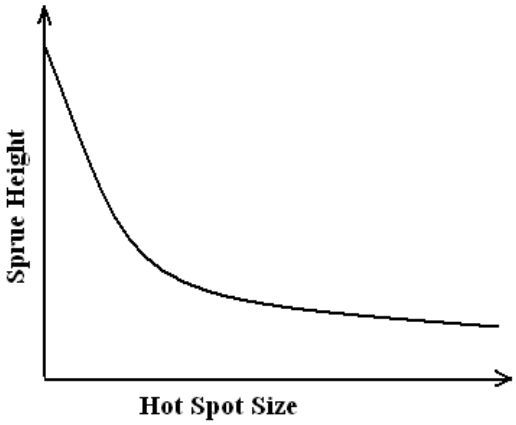


Fig (7) Graph of Sprue Height Vs Hot Spot Size

By performing this experiment we plot one graph which is Hot Spot Vs Sprue Height which is as shown above. When the height of sprue is 394mm, no hot spot is obtained. As we decrease the height of sprue till 204mm the size of hot spot is getting increased and at such a height of sprue, the size of hot spot remains constant[1].

What happens to the hot spot when we increases the height of sprue:

When the height of the sprue is less then the molten metal will fall with the less velocity that is called as flowability of molten metal, which creates the turbulence and it will not fill the mold cavity completely before freezing or solidification of casting, which generates the Hot spot in the casting, but when we increase the height of sprue then the velocity will increase and turbulence will not be generated which fills the mold cavity before freezing or solidification. And the Hot spot is get diminished.

5. CONCLUSION

From above research we are concluding that, in Zanvar Group of Industries, Ashta, 11% casting rejection due to Hot spot defect is reduced to 4% due to proper design of gating systemwith the help of modern software of AUTO-CAST by taking different iterations at different design criteria. This gating

system design suggests to the manufacturer to select proper pouring temperature, flow rate and methods and technique of pouring molten metal into the mold cavity. So that mold cavity fills completely without turbulence before freezing time or solidification time. So it improves productivity of product (Rear Cross Over Brake Drum Disc).

6. REFERENCES

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