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# CASTING SIMULATION TO IDENTIFY SHRINKAGE ZONES IN FLYWHEEL CASTINGS BY USING PROCAST.

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**ABSTRACT**

*A flywheel is a rotating mechanical device that is used to store rotational energy. Flywheel has a significant moment of inertia, and thus resist changes in rotational speed .The amount of energy stored in a flywheel is proportional to the square of its rotational speed. Rejection rate is one of the major issues in Indian foundry. Foundries try to reduce rejection by experimenting with process parameters or modifying method and tooling design which reduces the quality of castings and increase cost of production. Shrinkage, blowhole, porosity, etc. are the main casting defects which is responsible to increase casting rejection rate. In present theories, good flywheel casting purposes we have to simulate the parameter which is helpful for defect free flywheel casting. For good casting purpose, first of all we have to identify casting defect & location of flywheel casting. After the defect identification & visualization we can simulate the responsible parameter & get good casting of flywheel.*

***Keywords: flywheel, Shrinkage, casting simulation, PROCAST.***

## 1. INTRODUCTION

A flywheel is a mechanical device successfully designed to efficiently store rotational energy .Flywheel resist changes in rotational speed by their rotational speed. The way to change a flywheels stored energy is by increasing or decreasing its rotational speed by applying a torque aligned with its axis of symmetry. Flywheel is useful in smoothing the power output of an energy source. For example, flywheels are used in reciprocating engines because the active torque from the individual piston is intermittent. In energy storage systems, delivering energy at rates beyond the ability of an energy source.[1] This is achieved by collecting energy in flywheel overtime & then releasing it quickly, at rates that exceed the abilities of the energy source. Flywheels store energy very efficiently (high turn-around efficiency) & have the potential for very high specific power compared with batteries. Flywheels have very high output potential & relative long life. Flywheels are relatively unaffected by ambient temperature extremes. For simulation purpose 3D simulation degree, Autocast, FLOW-3D CAST, PROCAST, Finite solutions casting simulation software,MAGMA5,Etc software's available in market which is provide number of options to get easy solutions.

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Fig 1.1: Flywheel

## 2 DEFECTS: SHRINKAGE, POROSITY, BLOWHOLE, METALLURGICAL DEFECTS

A casting defect is an undesired irregularity in a metal casting process. Some defects can be tolerated while others can be repaired, otherwise they must be eliminated. They are broken down into five main categories: gas porosity, Shrinkage defects, mould material defects, pouring metal defects, and metallurgical defects.[2-3]

### 2.1 SHRINKAGE

Fig 2.1: Shrinkage

The most common causes of shrinkage are related to the casting sprue,which is the passage through which molten metal is poured into a mold.In some areas,such as the heavy sections of the mold, the metal takes longer to contract & solidify which reduces feed material availability & increses the likelihood of shrinkage,especially if the sprue is too small for the valume of flow.a properly sized sprue attached directly to the heavy section can

feel the cavty & provide the feed material necessary to counteract shrinkage as cooling occeres. In addition, using a rounded,rather than a flat oe sprue can further reduce the risk of forming defects.Using a narrow or tapperedsprue can results in the molten metal being sprayed rather than poured into the cavity when this happens,certains section of the workpiece begin to solidify before the entire mould is filled.[4-8] Molten flow into the cavity should be as uniform as possible, & a larger central sprue or a multile sprue arrangement can help achieve the even supply of material.

**3 Problem Identification & methodology**

Identify & visualize defects, eliminate defects with the help of PROCAST software. In present theories we have to identify the defects & visualization of the zone area of shrinkage defect of flywheel. What is the main reasons & parameter behind the opening shrinkage defect during casting we have to analyse.

Based upon the above mentioned literature PROCAST software is used for meshing and casting simulation on the flywheel. The present CAD model is getting from as per customer requirement. The model of flywheel is shown below in fig3.1

**3.1CAD:**

In this phase, design is provided by customer as per their requirement now we have to do modelling of flywheel.

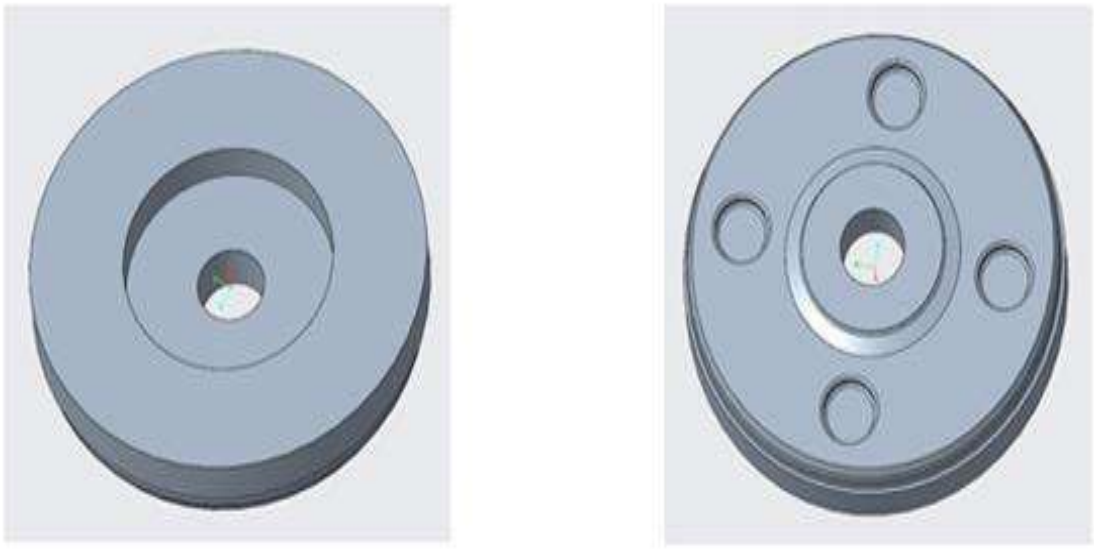

Fig 3.1: CAD Model of flywheel

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### 3.2 GATING SYSTEM

The assembly of channel which facilitates the molten metal to enter into the mould cavity is known as Gating system. Alternatively, the gating system refers to all passage ways through which molten metal passes to enter into the mould cavity. To fill up the mould cavity is needed some arrangement in between this arrangement runner, riser, sprue cup, filter, etc. must be present with their proper specification. Total gating system arrangement is shown in fig3.2 as below.

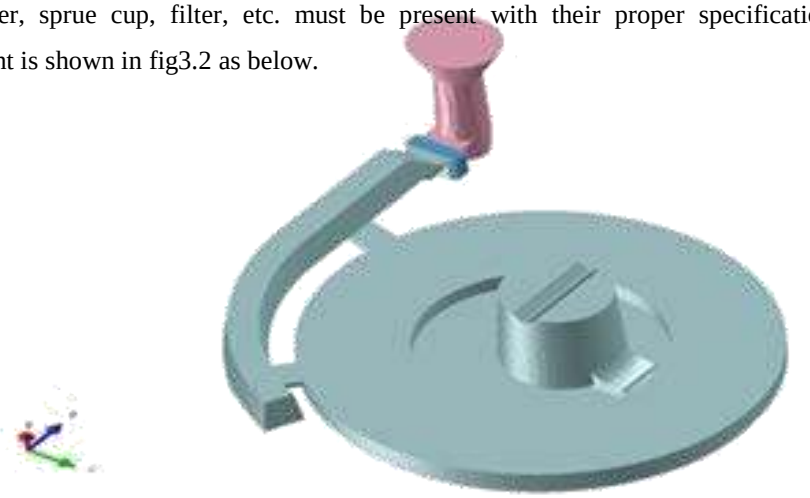

Fig 3.2: Gating system

### 3.3SAND RISER

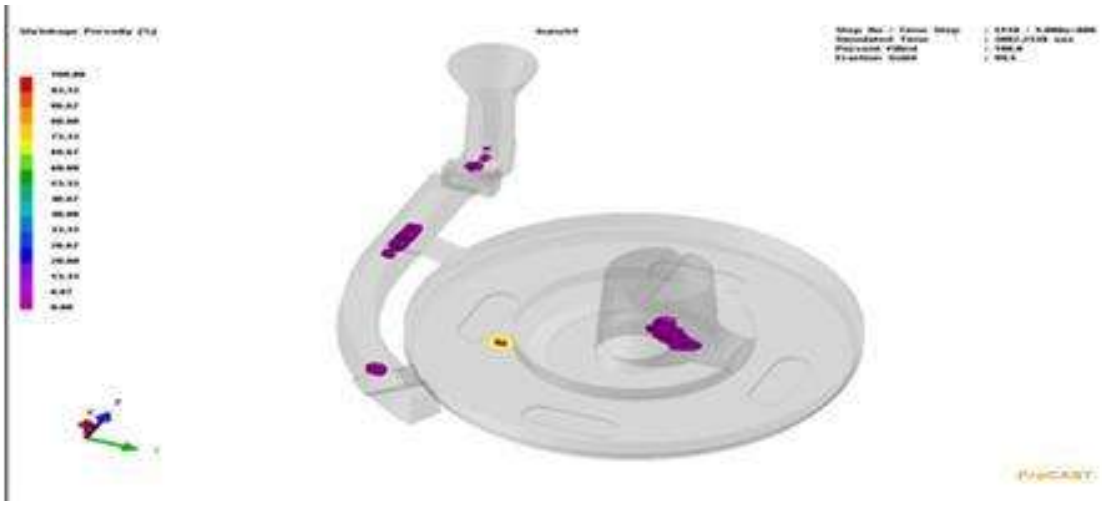

Fig3.3: Centre pouring with sand riser

In general, casting procedure prefer centre pouring with centre riser. When we did it that's time it concludes that sand riser is with centre pouring is failed.

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## 4 RESULTS & DISCUSSION

### 4.1 Shrinkage Identification using PROCAST

When simulation is done & checks the results then we conclude that Shrinkage is opened in flywheel casting & caught the zone on shrinkage area. By using PROCAST simulation is done by as per general procedure. As per casting simulation process it could be denoted that shrinkage is opened in flywheel casting.It shows in below fig4.1

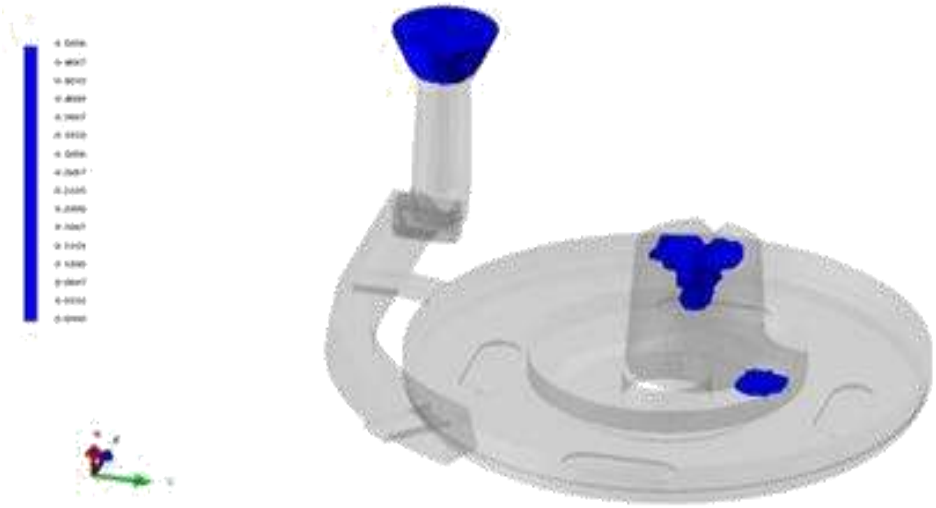

Fig 4.1: Shrinkage Identification

### 4.2 Actual Physical Trial:

As per simulation data & results when we got it then it concludes that, shrinkage zone by using PROCAST & actual physical trial is remain same. When we check out the casting of flywheel that's time never any kind of roughness present but when we decided for confirmation then we cut the flywheel model perpendicularly & take cross section of casting then actual shrinkage is visualise.Actual physical trial, shrinkage is open in flywheel casting which shows below fig4.3.

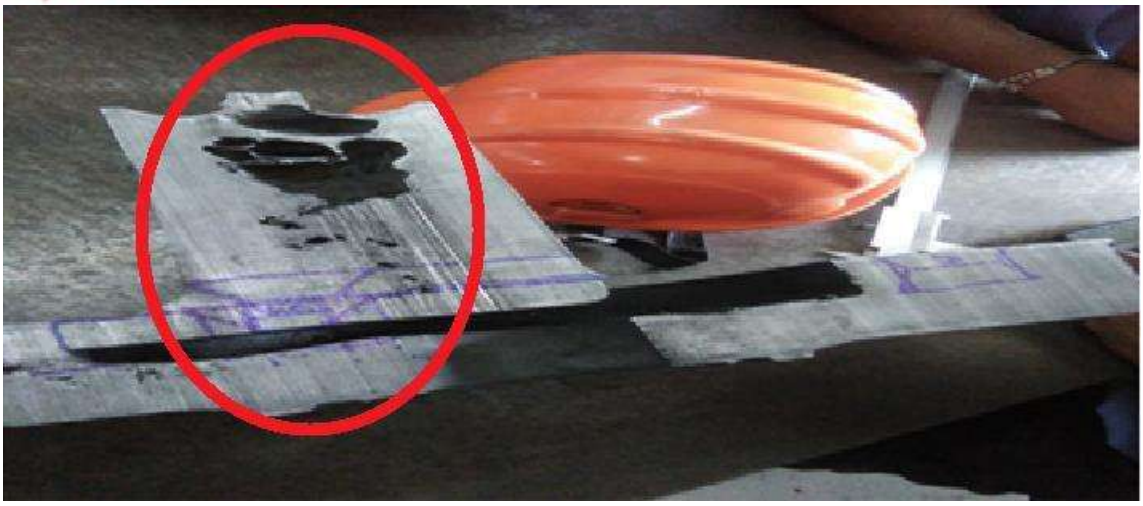

Fig 4.2: Actual Physical trial

### 4.3 HIGH MODULUS

As per above mentioned data, Shrinkage defect is open in flywheel casting. When we studied in details then it could be visualise that solidification time & temperature cooling rate between casting & sand riser is low due to this parameter shrinkage defect is open in flywheel casting. It would be shown in below fig 3.5

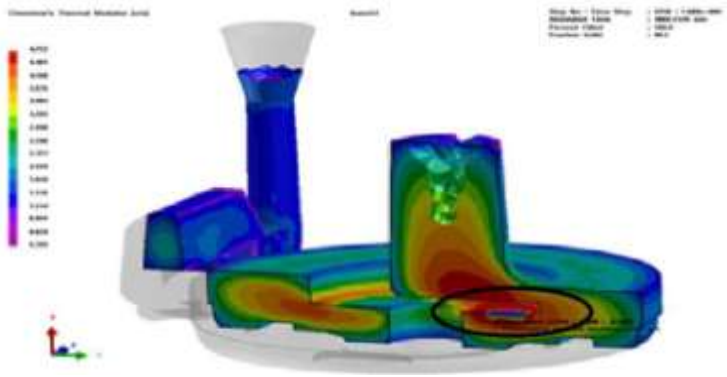

Fig 4.3: High modulus

## 5. CONCLUSION

Due to the high rejection rate the production in foundry and customer confidence is lost. We proposed to use simulation techniques to predetermine the defects and find appropriate solutions for reducing rejection rate of castings before its trial production in foundry.Various factors that must be considered for simulation purpose changes depending upon the working environment and hence alter results of simulation. Casting simulation software PROCAST enables us to forecast the defect identification & visualisation. By using simulation we can reduce manufacturing cost, reduce development time and reduce trial cost, manufacture & optimised simulation of flywheel casting.

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