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DESIGN OF GATING SYSTEM FOR FABRICATION OF BUTTERFLY VALVE BODY

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Abstract— The foundry industries in developing countries faces problems in poor quality and productivity due to involvement of number of process parameter. This study was titled "Design of Gating System for fabrication of Butterfly Valve body" done at AUTOCAST Ltd, a government of Kerala undertaken industry at Cherthala. Our study comprises design of gating system for the fabrication of a butterfly valve body casting. The function of a gating system is to permit the flow of molten metal to the mold cavity at the proper rate without excessive temperature loss, it should be free form turbulence, entrapped gases, slag. For a new casting the development of the gating system and feeding system take a lot of time, cost as well as man power for a manual trial. In most casting industries rectangular shaped gating system are used. The most efficient gating system is attained by comparing different types of gating systems. which should have minimum casting defects, and minimum overall cost .

Index Terms— Gating system, Design.

I.INTRODUCTION

Design of gating and riser system has important stage in attaining quality of products.

Principles of casting consists of introducing the molten metal into a cavity and making the mold of the desired shape and allowing it to solidify. The molten metal passes through the four stages which are, liquid, mushy, plastic and solid stages, till the solidification takes place

The major target of this study is to design a gating and riser system, for the requisite casting set up, which should have minimum casting defects at minimum cost. This attempt will reduce chances of failures during production.

An attempt is made to revolve an optimum design for the gating and riser system for the components to minimize the lead time.

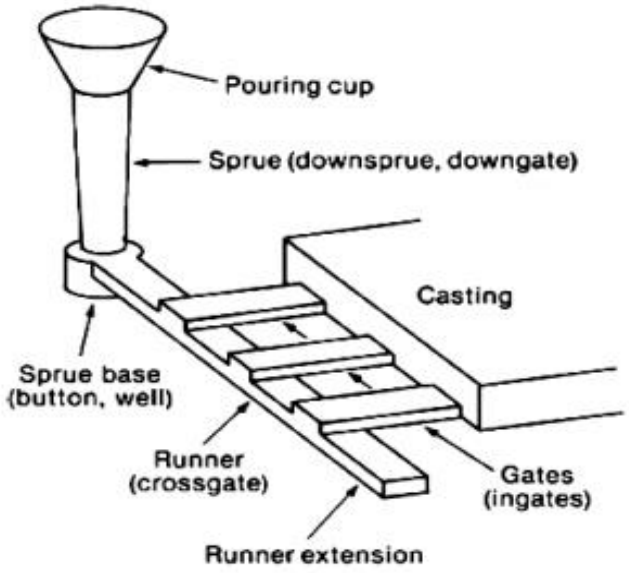
II. LITERATURE SURVEY

The aim was to design and develop a gating and riser system for the components of a butterfly valve and study and analyze various steps in casting development. Design of gating riser system assumes important role in attaining quality of product. An attempt is made to evolve and optimum design for the gating and riser system for components under study

Butterfly valve consist of two main components. They are valve body and valve disc. Valve body is a flanged cylindrical part forming the main passage of the following fluid and valve disc, a more complicated geometry, is a curved plate of which rotation is controlling the fluid flow through the butterfly valve.

III. DESIGN

GATING SYSTEM



The gating system consists of a pouring cup, which helps in pouring the molten metal. Through the sprue the molten metal reaches the sprue base, and to the runner. In the runner certain ingates are provided, through this ingate the molten metal enters the mold cavity uniformly.

a) DESIGN OF MOULDING BOX

Molding box is generally a fabricated or cast metallic surface which helps in holding the mold cavity for easy handling of molds.

Molding boxes (in dimensions) = 750sq
Volume of mold in cb.m = 0.48cb.m
Consumption of sand per mold in kg = 45 kg
Consumption of sand per core in kg = 40 kg

For the use of sand in casting there is an economical limit to the amount of sand that needs to be used for quantity of casting. The economical sand to metal to sand ratio is 1:16.

b) DESIGN OF GATE

Gates, also called the ingates, are the openings through which the molten metal enters the mold cavity. The shape and cross section of the ingate should be such that it can readily broke off after casting solidification and also allow the molten metal to enter quickly into the mold cavity.

Normally the thickness to width ratio of ingates can be taken as 1:4 and the total no of ingates used in the gating system is fixed by the experience in the work.
Ingate should be thin and wide with a thickness to width ratio of 1:4 .
If "t" is the thickness, width = 4t
Here we can calculate dimensions of ingates by taking the no of ingates as 10.
Choke area = total ingate area
= no of ingate x sectional area of each ingate
$52 = 10 \times 4t \times t$
Thickness of ingate, t = 1.14 cm
Take thickness, t = 12 mm
Width of ingate, $w = 4 \times 12$
= 48 mm

A minimum of 25 mm distance is to be maintained between the neighboring gates .The bottom runner and bottom gate is kept at 100 mm past the sprue or more. A neck should be provided at the entrance to the mold cavity for the ease of cutting gating system from required casting.

c) DESIGN OF RUNNER

It is generally located in the horizontal plane which connect the sprue to its ingate, thus letting the metal enter the mold cavity. The runners are normally made trapezoidal in cross section. The main purpose of runners are to trap the slag and dross which are lighter and thus trapped in the upper portion of the runners. For effective trapping of the slag runners should flow full.

Height of runner should be twice its width
Runner area = no of runner × sectional area of each runner
$138.66 = 2 \times (2a \times a)$
Width of runner = $\sqrt{\frac{138.66}{2\times2}}$
= 59 mm

d) DESIGN OF BUTTERFLY VALVE BODY

Density of SG Iron
= 7.5x10-6 kg/mm3
Approximate weight of casting
= 2140 kg
Actual weight of molten metal to be poured
$= \frac{2140}{0.7}$
=3057.14 kg
This value may be taken as 3100 kg
pouring time , $T = 0.97\times \sqrt{pouring\ weight}$
$= 0.97\times \sqrt{3100}$
= 54 sec
By considering human delay pouring time can be taken as 54 seconds
Gating ratio SG Iron casting = 4:8:3
Once the pouring time in seconds is calculated the next step would be to calculate the choke area which means lower cross section area in the gating system
According to RW White study choke area can be calculated as follows

e) DESIGN OF CHOKE

It is the part of the gating system which has the smallest cross sectional area. It perform the following functions

- To control the rate of metal flow to help the lower flow velocity in the runner.
- To hold back slag and foreign material and float these in the cope side of the runner.
- To minimize sand erosion in the runner.

Choke area = $\frac{\text{Pouring weight in Kg}}{1.1\times\text{Pouring time}}$

$$= \frac{3100}{1.1 \times 54}$$

=5200 mm2

And from the gating ratio sprue area

$$= \frac{Choke\ area}{0.75}$$

= 52/ 0.75

=6933 mm2

Min diameter of the sprue

$$= \sqrt{(\frac{4}{3.14} x Sprue\ area)}$$

$$= \sqrt{(\frac{4}{3.14} x 69.33\ )}$$

= 939 mm

There for diameter can be taken as 1000 mm

Runner area = sprue area x 2

= 69.33 x 2

= 138.66 mm2

CONCLUSION

Without affecting the quality of the product the yield assumed in the design is from 60% to 65%. The use of chills at the bottom flange side of valve body casting that reduces the chance for shrinkage by proving uniform cooling is recommended. The preheating of ladle before tilting the furnace may lead to extra energy expenditure due to non-standardized procedure. This will make casting design in the form of reducing the number of cores. This was quite feasible for the company to make the entire process more cost effective. Also the product with a minimum defect. The redesign of gating system of the butterfly valve body will definitely improve the economic feasibility and the quality of the product. The design strictly resist the backward flow of molten metal through the ingates.

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