PARAMETRIC OPTIMIZATION OF SAND CAST PARTS FOR HARDNESS AND SHRINKAGE

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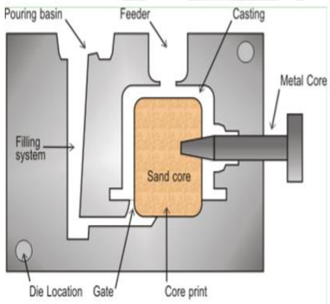
Abstract : Die-casting is a fast, versatile and cost-effective manufacturing process for producing complex-shape metal components by injecting liquid metal at a high pressure in a steel mold called a die. Die-castings are among the highest volume, mass-produced items manufactured by the metalworking industry, and they can be found in thousands of consumer, commercial and industrial products. The die-casting process typically uses a non-ferrous alloy, such as aluminum and zinc, which is melted in the furnace and then injected into the die; the die is installed on a die-casting machine.A die, or mold as it is sometimes called, is an essential requirement for manufacturing parts with the die-casting process. The die-casting die is said to be the back-bone of die-casting process, and greatly influences the cost, rate of production and quality of the parts produced. Designing a die for die-casting is a non-trivial and time consuming process that requires vast technical know-how and experience of a die designer. A die-designer has to go through a number of steps, all of which involve critical decision making, taking into account multiple factors, such as part material, production and delivery requirements, process requirements, die-design knowledge, and industry best practices. The non-triviality of the die-design activities further increases manifold in case of a multi-cavity die, which are commonly used in the industry.

IndexTerms – Shrinkage, porosity,

I. Introduction

Die casting is a manufacturing process for producing accurately dimensioned, sharply defined, smooth or textured-surface metal parts. die casting is a simple casting process which utilizes reusable metallic mould. It is mostly suited to casting light alloys but can also be used for steel and cast irons.



Die casting has the ability to produce the castings with thin walls, low weight, high integrity, close dimensional control, good surface finish, good strength and high rate of production than any other casting process.die castings are made from non-ferrous metals, specifically zinc, copper, aluminum, magnesium, lead, and tin based alloys, although ferrous metal die castings are possible. The effectiveness of the pouring system which in turn depends on accurate positioning and orientation of the gates, runners and risers.

ADVANTAGES

Good surface texture. Equipment costs are relatively low. No need for applied pressure, so mould designs tend to be quite simple. Scrap metal can be recycled.Quick set up times.To achieve a mass production with better reproduction.Castings ranging from few grams to 100 Kg of Aluminium alloy can be cast.

DISADVANTAGES

High percentage of scrap metal. High cost and time consuming for machining operation.High occurrence of porosity, but this can be minimized by slower pouring. Only good for simple 3D shapes.In the standard die casting process the final casting will have a small amount of porosity.

SHRINKAGE is occurs when molten metal solidifies because metals are less dense as a liquid than as a solid.Shrinkage is a reduction in the volume of a materialShrinkage is the reduction of the dimensions of a s.s. Part, compared with its mold dimensions.Shrinkage is a reduction in the volume of a material.

TWO TYPE OF CHAMBER MACHINE

Hot-chamber machines

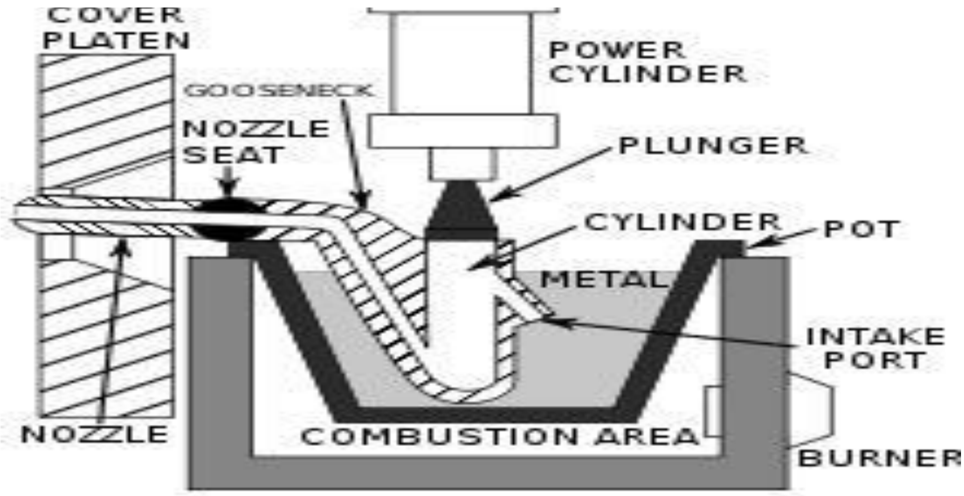


Figure 1 Hot-chamber machines

Hot-chamber machines, also known as gooseneck machines, rely upon a pool of molten metal to feed the die. At the beginning of the cycle the piston of the machine is retracted, which allows the molten metal to fill the "gooseneck". The pneumatic or hydraulic powered piston then forces this metal out of the gooseneck into the die.

The advantages of this system include fast cycle times (approximately 15 cycles a minute) and the convenience of melting the metal in the casting machine. The disadvantages of this system are that high-melting point metals cannot be utilized and aluminium cannot be used because it picks up some of the iron while in the molten pool. Due to this, hot-chamber machines are primarily used with zinc, tin, and lead based alloys.

Cold-chamber machines

These are used when the casting alloy cannot be used in hot-chamber machines; these include aluminium, zinc alloys with a large composition of aluminium, magnesium and copper. The process for these machines starts with melting the metal in a separate furnace. Then a precise amount of molten metal is transported to the cold-chamber machine where it is fed into an unheated shot chamber (or injection cylinder). This shot is then driven into the die by a hydraulic or mechanical piston. This biggest disadvantage of this system is the slower cycle time due to the need to transfer the molten metal from the furnace to the cold-chamber machine.

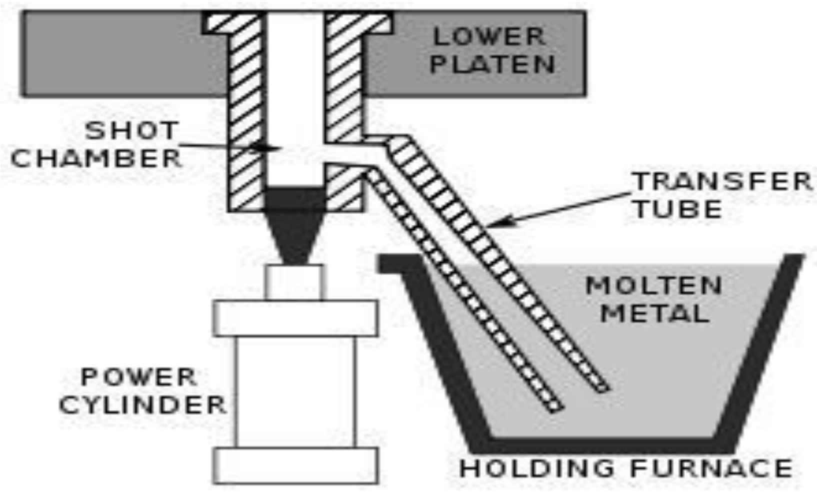


Figure 2 Cold-chamber machines

EXPERIMENTAL PROCEDURE

Major there are two parameters we are taking.

1) Runner Height
2) Runner Width

Sr. No.	Runner Height (mm)	Runner Width (mm)	Weight (kg)	Runner -Riser total weight
1[a]	85	34	3.6	1.1
2[b]	90	37	4.2	1.35
3[c]	80	31	3.1	0.8

Table 1

Show in table in there are three type of runner use in parts. First one is 85mm runner height and 34mm runner width.Second is 90mm runner height and 37mm runner weight.third one is 80mm runner height and 31mm runner weight.

➢ **Runner Height (90mm) and Runner Width (37mm) figure**

Figure 3 90mm runner height and 37mm runner weight

Show in figure is sand mold and above mold is 90mm runner than after pouring show in photos casting part in porosity and shrinkage are high. Finishing is not good for using in application.

- **Runner Height (85mm) and Runner Width (34mm) figure**

Figure 4 85mm runner height and 34mm runner weight

Show in figure is sand mold and above mold is 85mm runner than after pouring show in photos casting part in porosity and shrinkage are low. Finishing is good for using in application.

- **Runner Height (80mm) and Runner Width (31mm) figure**

Figure 5 80mm runner height and 31mm runner weight

Show in figure is sand mold and above mold is 80mm runner and 31mm weight than after pouring show in photos casting part in porosity and shrinkage are high. Finishing is poor for using in application.

CASTING PHOTOS

DIFFERENCE BETWEEN MATERIALS

S.S.410	S.S.430
Hardness = 35 to 40 Chromium = 9.410 % Carbon = 0.380 % Nickel = 0.360 % Manganese = 0.370 % Silicon = 0.650 % Sulphur = 0.023 % Phosphorus = 0.044 % Pouring temperature low	Hardness = 40 to 48 Crome = 12.550 % Carbon = 0.280 % Nickel = 0.410 % Mangeniz = 0.420 % Silicon = 0.380 % Sulphur = 0.006 % Phosphorus =0.020 % Pouring temperature high

Table 2

RESULT & DISCUTION

- The optimum set is Runner height 85 mm, runner width 34 mm. obtain the result of set as shown in table.Shrinkage and Porosity are low.S.S.430 material is perfect to use in application because this material hardness high and corrosion low.Cast iron material is breakable and no hardness.

Sr.No.	Runner Height (mm)	Runner Width (mm)
1[a]	85	34

Table 3

CONCLUSION

- Result obtained from validation experiments using optimum parameter combination gives excellent agreement with predicated results.The performance of the optimized model is better than the original model and also prove that parameter design concept is more powerful and efficient tool for minimize the shrinkage.

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