

Review on die casting

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Abstract - In this paper we covered all basic and advanced information about die casting process. In this paper covered advantage and disadvantage of die casting Process. In this article what are the defect occur in casting metal that also mentioned and how to reduce this type of defect that are mentioned. There are mainly two type of die casting one is hot chamber die casting and another is cold chamber die casting, for our requirements, by material properties and which properties we will required in our casting product we can choose one of hot or cold chamber die casting .

Key Words: Introduction of die casting, types , advantage, Disadvantage, defect, Solution.

1.INTRODUCTION

Casting is a manufacturing process in which a liquid material is generally poured into a mold, which contains a concave hole of the desire shape, and also allowed to solidify. The solidified part is also known as a casting, which is ejected or broken out of the cavity to complete the process.

Different Types of Casting Process :

1. Sand casting.
2. Investment casting.
3. Die casting.
4. Low pressure casting.
5. Centrifugal casting.
6. Gravity die casting.
7. Vacuum die casting.
8. Squeezing die casting
9. Lost foam casting
10. Continual casting

1.1 Die casting

Die casting is the casting process in which to produce exactly dimensions zone by forcing molten material under pressure into split material dies which resembles a common type of permanent mould. Molten material is fitted to mold hollow at an increase pressure. The applicable steel mold used in the die casting process is a die. Die casting is a largely productive system of casting parts with low accurately tolerances and high surfaced quality. The casting solidifies speedily permitting the die halves to be separated and the casting ejected. However,

several region may be cast at one time in what's known as multiple - cavity die

If the region is small. This process is particularly suitable for lead, magnesium, and zinc alloy. The advantages of die casting practice lie in the possibility of carrying casting of sufficient accurateness and in the installation for casting thinner section that can't be produced by any other casting system.

1.2 Advantages of die casting:

- 1) In this casting process very high rate of production is achieved.
- 2) Close dimensional tolerance of the order of +0.025,-0.025 mm is possible
- 3) Surface finish of 0.8 microns can be achieved.
- 4) Very thin section of order of 0.50 mm can be cast.
- 5) Fine details may be produced.
- 6) Longer die-life is obtained.
- 7) Less floor space is required.
- 8) Unit cost is minimum
- 9) Disadvantage of this process :
- 10) This casting process is not economical for small runs.
- 11) It is only economical for non ferrous alloys.
- 12) Heavy casting cannot be casted. In fact, the maximum size is limited by the size of the dies and the capacity of the die casting machine available
- 13) Cost of die and die casting equipment is high.
- 14) Die casting usually contain some porosity due to the entrapped.

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History

The first die casting machine are construct in 1838, which is manually operated machine. In this type of machine mainly used an alloy of tin. Die casting was limited to the printing industriousness for the first many decades until Herman. It manufactured die- cast zone and was a demand leader until 1998.

It was in 1925 when we first got the regard of what a ultramodern die casting machine can look like, which was developed by Louis. Morin and Joseph Soss in the USA. Since also, we've seen several improvements in this field with machines getting more important and effective in due course.

There are two type of die casting:

- 1.Hot chamber die casting
2. chamber die casting

1.Hot Chamber die casting:

In the hot chamber die casting machine is pressure chamber(cylinder) and the plunger are submerged in the molten material in the pot(gauntlet).

Hot chamber die casting can be used with zinc, magnesium, and other low melting alloy using either our common multi-slide or conventional tooling.

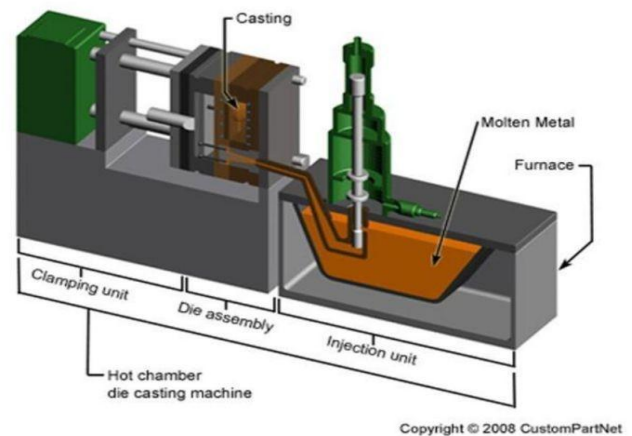
The Hot Chamber Die Casting Process :

The injection system of a hot chamber machine is immersed in a molten material bath of a material holding furnace. The furnace is attached to the machine by a material feeding system called the gooseneck. As the injection cylinder plunger rises, a port in the injection cylinder opens allowing the molten material to fill the cylinder. As the plunger moves over, it seals the harborage and forces material to fill the concavity through the gooseneck and nozzle to the dies cavity. After the material has solidified in the cavity of die, the plunger is withdrawn. The die is opens and the casting ejected.

Advantages of Hot Chamber Die- Casting :

There are also multiple reason to choosing hot chamber die- casting. Because the hot chamber machine has the melting pot inside it, the process is significantly very fast and more accessible than cold chamber die- casting. The normal of this are 900 cycles per hour. With hot chamber die- casting. This helps cut back on product cycle time and eventually makes for a cheaper manufacturing process.

The material in the hot chamber die- casting process don't dissolve or erode under pressure, performing in reduced porosity and longer die life. This also means that because the dies design process is so effective, less wasted material results from this process



Disadvantages of Hot Chamber Die- Casting :

There are some disadvantage or limitation of using hot chamber die- casting. First, it's only used successfully for casting low- melting material same as „ zinc, and magnesium and other metal alloys. Indeed so, you 'll need to conclude for cold chamber die- casting rather, If your product requires a material type that doesn't advanced to itself well to high temperatures.

Hot chamber die- casting requires a high- pressure range that is not suitable always for making every product. It also offers limited material fluidity due to discordancy in amalgamation malleability, limiting the final product and shape and/ or complexity.

Another dis-advantages of hot chamber die- casting is that it's only cost-effective if you have a high volume of products that need to be produced. Still, hot chamber die- casting may not be the most cost-effective option for your business, If you only need a limited number of products. Another disadvantage of hot chamber die- casting is that it's only cost-effective if you have a high volume of products that be produced. However, hot chamber die-

casting may not be the most cost-effective option for your industry, If you only required a limited number of products.

2. Cold chamber die casting:

In the cold chamber die casting machine hydraulically operated piston is force a molten material to flow in the cold cylinder (chamber). Cold chamber die casting is an idea for metal with high melting points and properties of corrosive

Process:

In cold chamber die casting process, the material is heated as long as it is not converted into liquid form in a furnace located outside the machine. The molten metal is flow to the casting machine and fed into the machine's chamber. The machine uses a piston or plunger, this piston is forces the liquid metal go inside of the cavity of the mold.

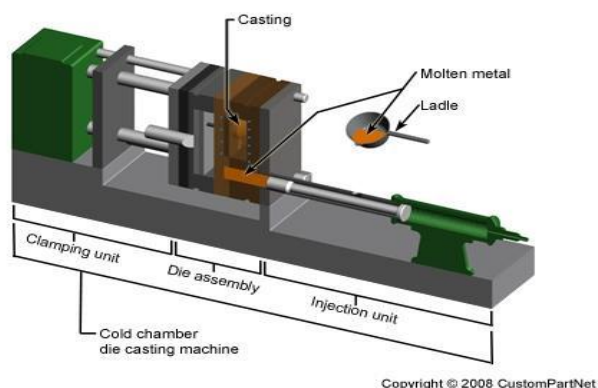
In this process pressure ranges usually from 2,000 and 20,000 psi.

In cold chamber die process there are separate heating process. The molten material is shift automatically or manually by the ladle to the shot sleeve. The piston is forced by air or hydraulic pressure to force the charge into the die.

This is a single-shot operation, therefore this process helps very less contact between the injector components and hot metal. As soon as the ladle is emptied, plunger moves to the left and force the metal into the cavity. When the molten metal is solidified, the core is withdrawn and the die are opened. Ejector are employed to remove the casting automatically from the die.

In this process, lower the melting point of alloys is possible.

The process of cold chamber die casting is good for metals with properties of corrosive or high melting points.



Advantages of Cold Chamber Die Casting

- 1) Long-lasting and robust components

Cold chamber die casting is used to create long-lasting parts and strong part. The components made up of this process are improve the visual appeal of the surrounding area and robust.

- 2) Cost-effective process

This process is save much money and highly effective, helping to create a various components compared to other manufacturing methods.

- 3) More strength

Cold chamber die casting helps to create more strength Full parts than those made out of plastic injection moldings having the exact dimensions.

- 4) Easy to assemble

This casting process is easy to assemble compare to other casting process.

- 5) Accurate in dimension

By this casting process we create machine parts with accurate dimension with having a hive level of tolerance. This component also having good heat resistant.

- 6) finished products

In this process of cold chamber die casting is helps to produce high level of finished surface.

Disadvantages of Cold Chamber Die-Casting :

In cold chamber die casting process wall thickness need thinner than 8mm. This process cannot run heat treatment. In this process die are expensive. It's request more space and more manual operation.

What are difference in Cold Chamber Die-Casting and Hot Chamber Die-Casting ?

How metal is molded is the main difference between hot chamber die casting and cold chamber die casting. There are some difference between hot chamber die casting and cold chamber die casting is given as follow:

Cold Chamber Die-Casting :

- Ideal for metals with a high melting point
- Heating chamber is outside of the machine

- For Aluminium, and metal having high melting point
- Production is more but not as fast as hot chamber die-casting

Hot Chamber Die-Casting :

- Ideal for metals with a low melting point
- Heating chamber is to be used
- For Zinc, and other alloys is low melting point
- Production is fast but not cost-efficient.

Defect in Die casting:

There are various types of defect in die casting process this defect occur by loose raw material control, production planning, manuals, and others.

There are various types of defect in Die casting this defect is mainly classified in two parts 1. Internal and 2.Superficial die casting defects.

1. Internal die casting defects :

i. Gas Porosity:

When the casting is done there are some bubbles are form in casting when after the cast is cooled. Most of solid material can not hold large number of dissolved gas, but the liquid material is hold. This bubbles is form by the gas in the solid material when the cast is cooled. It is occurred during solidification and some holes are occurs within the cast. There are many reasons behind this like involved gases in the metal alloy filling process, gases from mold releasing agents.

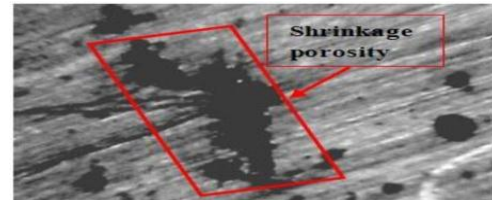


Solution: Check whether dies are clean and sure a metal alloy are dry and ingot. A sufficient sprue and runner length will help molten metal to flow stable and discharge the gases. Used high quality mold releasing agents and reasonable amount is to be used.

ii. Shrinkage Porosity :

In the die casting process this defect is form during the solidification and cooling process of casting. And the material is shrink upon cooling process. That's the reason high porosity is occurring without adequate precautions. It

become a defect when an uneven shrinkage makes the hole in the cast. Major reason for this defect is unreasonable design of cooling system, mold opening of too early, by external high pouring temperature.



Solution: Adjust the temperature of casting to reduce total volume deficits. Redesigned of gate or runner system to have riser that are enabled to flow molten metal continues. Improve casting structure overall. Increase heat dissipation for ribs, cooling coil and insert internal chills.

2. Die casting defects:

I. Cracks

There are some cracks are occurs on material when material is break due to inside stress and out of the material. The produce linear patterns and irregular pattern on surface of die casting. First crack are occurs when solidification and cooling operation.

It's defect is produced because of the cavity geometry material can not shrink in their natural state. Due to external force of the component second form of crack are occurs. Cracks is result of in molding alloys improper alloying elements are contained.

II. Cold shut

In that type of defect there are irregular linear lines are form on surface of cast. The lines are small and narrow with smooth edges which might extend with external force. There are some causes of cold shut low injection speed, low molten temperature, unreasonable design of gating system. To avoid this type of defect increase temperature of molten metal and mold. Change the shape and position of mold and increase the plunger speed.

III. Drags and Soldering

Drags defect is occurred parallel to die opening direction. Soldering form abnormal sticking of the die cavity and metal alloy. It is occur excess or missing materials on the small area of metal.

IV. Flow Marks

In this type of defect there are stripes are form and non-directional lines on the die casting parts surface that is different in colour from the casting base. The liquid

material entered the cavity of form a thin and incomplete layer that may be filled with molten metal. To reduce this type of defect increase die temperature and adjust speed of injection, cross section area, and other casting parameters.

V. Short filling

This defect in die casting occurs because of missing of some material on the surface area of the cast. It occurs due to low injection pressure, poor fluidity, low filling temperature, excessive use of lubricant. To reduce this type of defect first choose the right alloys of metal. It is help to increase filling temperature and also injection speed and pressure.

Some point to remember to avoiding defect in die casting

- Selection of right wall thickness
- Right filling time.
- Right metal flow pattern
- Right die temperature

CONCLUSION

In this article the basis as well as advanced concepts related to die casting process is explained therefore reader is must be known all basics of die casting and type of die casting and the working principle of die casting. In this paper the advantage of die casting and disadvantage of die casting also explain and what are defect occurs in die casting is also mentioned in this paper and how to minimize the casting defects there are some tips also given in that particular paper.

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