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A Review on "Squeeze Casting and Conventional Die-Casting"

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ABSTRACT*:* This paper present information's about the casting process which shows remarkable capacity to cater for the wide range of manufacturing applications mainly because of a ready adaptability in its basic scheme of operation. This paper focus mainly on the review of such process Squeeze casting process. The Die casting process is a conventional process which is most widely used for manufacturing of automobile components. This paper mostly focuses on Squeeze casting and Conventional Die-casting. The squeeze casting process involves applying direct Mechanical pressure on the melt contained in a metallic mold. However, the process is not being widely used in our country as an alternative economics process for making high integrity metal components.

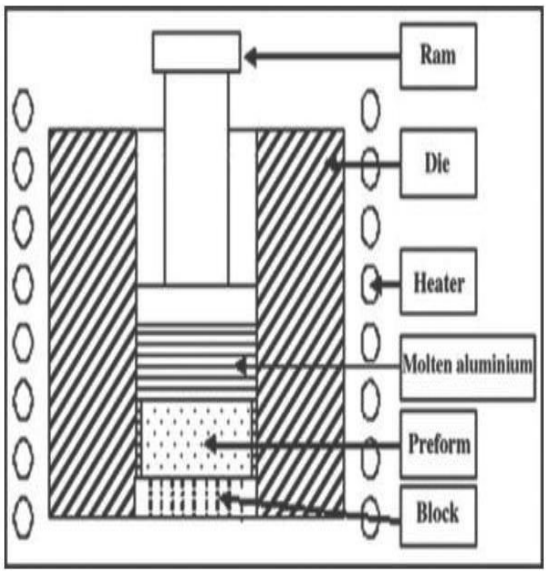
KEYWORDS*:* Squeeze casting, Die-casting, Direct Mechanical pressure, Mold.

I. INTRODUCTION

Squeeze casting is a single step process which is a combination of casting and forging process. The molten metal is poured in to the mold and solidifies under the pressure. Squeeze casting is the modification of traditional die casting both ferrous and nonferrous metals that can be processed by squeeze casting, although magnesium, copper and aluminum are the most commonly used.

The die containing the molten is preheated to 300-400-degree C is the first step of squeeze casting. The punch with a constant speed is driven with the ram in to the die cavity after the molten metal has been injected in to the die. The pressure of 20 to 30 Mpa is ideal. This pressure is maintained during the solidification for 5 to 10 min. After that RAM is removed and casting is ejected.

Squeeze casting process is shown in figure.



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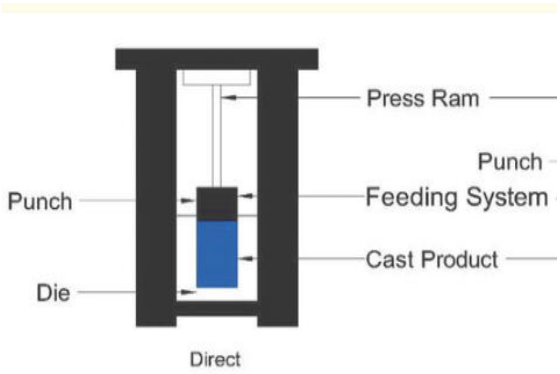
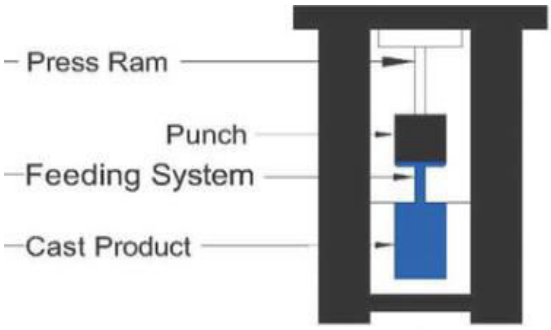
Squeeze casting is divided in to two types

Direct Squeeze casting and Indirect Squeeze casting,

Direct Squeeze: - casting is similar to forging process. in this method molten metal is poured in to the bottom half of the mold. The upper half is closed, causing the entire mold to fill with the molten metal, with pressure applied over the whole cavity the solidification process begins.



Indirect Squeeze casting: - It is similar to high pressure die casting. The molten metal is injected in to the indirect squeeze-casting machine from there it is injected in to the die casting chamber through a thicker gate and a lower velocity than the velocity used in pressure die casting.



There has been a continuing need and necessity to make automobiles lighter and more fuel efficient while also improving passenger comfort.

Reduced porosity in the metal matrix, improved mechanical capabilities, and increased wear resistance are among the improved qualities. Squeeze castings can also be heated-treated, which is not possible with traditional die castings. The high pressure used during solidification retains the molten metal in direct contact with the die surface, resulting in castings that are faithful to the die dimensions.

The process's main selling points are the possible cost savings compared to forging and the metallurgical advantages compared to alternative manufacturing techniques.

The sound cast structure is bound to give the material isotropic properties. With excellent dimensional accuracy and repeatability, the squeeze casting technique may produce complex shapes.

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Above are the reasons why Squeeze casting compare to traditional Die casting?

Process Parameters: -

Temperature of Molten Metal, the starting point is 35-55degree C above the melting point.

Die temperature -300-400-degree C.

Squeeze pressure: - 20-30 Mpa.

Pressure duration: - 20 to 120 seconds.

Casting Defects: -

Oxide inclusions

Porosity and voids

Extrusion Segregation

Centerline segregation

Blistering

Cold laps

Hot tearing

Sticking

Extrusion debonding

Die Casting: -

The die casting (dc) is a special casting process that consists of forcing molten metal into a die cavity under pressure and filling the die sections to form a finished casting.

cost-effective casting process for mass-producing small to medium-sized casting at a faster rate and less time.
Surface finish, fine details, complex shape and dimensional accurate casting products can be obtained from this casting process

Applications: - A variety of manufacturing industries currently rely on one or many types of die casting processes, including the auto, aerospace and power tools industries.

Types of Die Casting

Hot Chamber and Cold Chamber Die Casting

Hot Chamber Die Casting: -

The hot chamber process is sometimes known as the hot die or gooseneck casting process. In this process, the plunger and chamber of the injection mechanism are dipped in the molten metal bath of a metal furnace (Image below) and used for low melting point metals that don't chemically attack the dipped plunger assembly.

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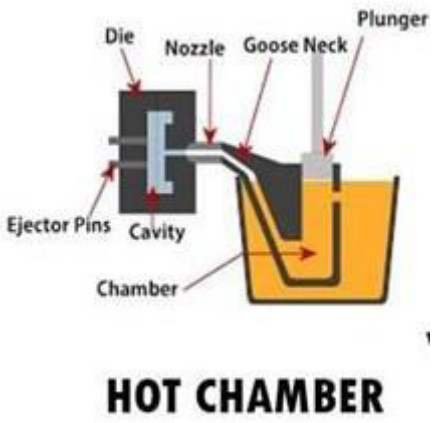
With the dies closed, the plunger withdraws and opens the chamber port to allow the molten metal to flow into the chamber. Then the plunger seals the port while pushing the molten metal into the die cavity through the gooseneck and the nozzle. After entering the die cavity, the molten metal is held under pressure until it solidifies inside the die. The hot chamber process yields a much higher production rate than the cold chamber process because of the high pressure.

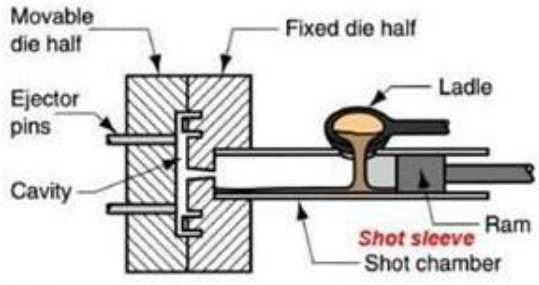


Cold Chamber: -

In the cold chamber process, molten metal is poured into the shot sleeve or chamber part of the injection cylinder before pushing into the mold. Because the sleeve is not heated, the procedure is known as the cold chamber process. Since the metal melting pot is separate, it doesn't have a corrosion problem.

The cold chamber process starts when molten material is transferred to the shot chamber from the furnace through the pouring hole. Then a hydraulic plunger seals the cold chamber port and forces the metal into the mold cavity at pressure. The pressure ranges between 30Mpa and 150 MPa.

This process is typically used for high-melting-point alloys of aluminum, magnesium, and copper, while other metals including ferrous metals can also be cast. Molten-metal temperatures begin at 600°C for aluminium and certain magnesium alloys and rise significantly for copper- and iron-based alloys.



Advantages of Die Casting

1. Suitable for Mass Production.
2. Produces high surface finish.
3. Intricate forms and complex shapes can be cast easily, with part sizes ranging from 25g to 25Kg.

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4. Because the molten metal rapidly cools at the die walls, the casting has fine-grained hard skin with excellent strength. As a result, as the wall thickness decreases, the strength-to-weight ratio of die-cast components increases
5. Excellent dimensional accuracy and good surface finish.

Die Casting Vs Squeeze Casting

An Overview High pressure die casting

High pressure die casting in which molten metal is injected in to a steel Mold or Die. It is an Ideal Die casting Method for dimensionally precise parts with as low post – processing requirements as possible.

An Overview Squeeze Casting

It is a method in which elements of forging and casting process combines. Direct pressure is also applied to the molten metal The process results in the formation of strong and near- net shape squeeze casting products.

Material Flow: - Both of these casting methods have different material flow patterns.

Porosity: -

High pressure die casting provides high porosity due to gas entraptment as well as rapid cooling. Contrarily, Squeeze casting usually produces denser parts, but with low porosity as compared to high pressure die casting.

Mechanical Properties

Squeeze casting offers improved mechanical properties including higher strength as well as ductility. This is due to reduced porosity combined with optimized rain structure.

Cycle Time

High pressure Die casting provides exceptionally faster Cycle time, making it the best in cycle time comparison with squeeze casting. It is Ideal for high volume production. Whereas, squeeze casting comes with longer cycle times due to applied pressure. However, it comes with superior material properties.

Tooling Life

High pressure die casting usually faces more wear and tear due to the application of advanced pressure injection. Whereas squeeze casting comes with longer tool life as their tools endure less stress.

Cost Implications

Initial Investments die casting often requires high cost for tooling and Machinery. On the other hand, squeeze casting is of low cost for tooling, but when it comes to operational costs it requires higher cost.

Quality and Surface Finish

The surface of die casting components have usually smoother surface finish. Contrarily Squeeze casting does not provide smoother surface and appearance.

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Advantages of Squeeze Casting

There is less shrinkage due to the high pressure and the tight sea that keeps molten metal from evaporating.

It's an economical process because most of the raw material that is used or scrapped can be reused.

Higher Density levels gives a longer life span to the components. During the cooling part of the process, the grains of the metal become stronger and denser.

There is low porosity or an absence of air bubbles in the cavity which creates a strong component and a good surface texture.

Ferrous and Nonferrous casting can be performed through squeeze die casting unlike many casting processes.

II. CONCLUSION

Because of the above benefits or advantages Squeeze casting is usually beneficial for Industrial, technology and Automobile Industries. Squeeze casting is particularly useful for Automobile components because of the combination of high density keeping is durable and long lasting and light weight, which is better for the overall cost of the automobile to the manufacturer and customer.

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