

# ADVANCEES IN CASTING



Presented by:

**M K PODDAR**

**M.Tech (Student)**

**Manufacturing engg.**

**NIT Warangal**

**<http://ajourneywithtime.weebly.com>**

# CONTENTS

- ❑ Introduction
- ❑ Conventional casting process
- ❑ Advances & recent development in casting process
- ❑ Conclusion
- ❑ References



# INTRODUCTION

- One of the oldest materials shaping methods.
- Casting means pouring molten metal into a mold with a cavity of the shape to be made, and allowing it to solidify. When solidified, the desired metal object is taken out from the mold either by breaking the mold or taking the mold apart. The solidified object is called the casting.
- Intricate parts can be given strength and rigidity frequently not obtainable by any other manufacturing process.



## ○ **Advantages:**

- Molten material can flow into very small sections so that intricate shapes can be made by this process.
- It is possible to cast practically any material that is ferrous or non-ferrous.
- As the metal can be placed exactly where it is required, large saving in weight can be achieved.
- The necessary tools required for casting molds are very simple and inexpensive.
- Size and weight of the product is not a limitation for the casting process.

## ○ **Limitations:**

Dimensional accuracy and surface finish of the castings

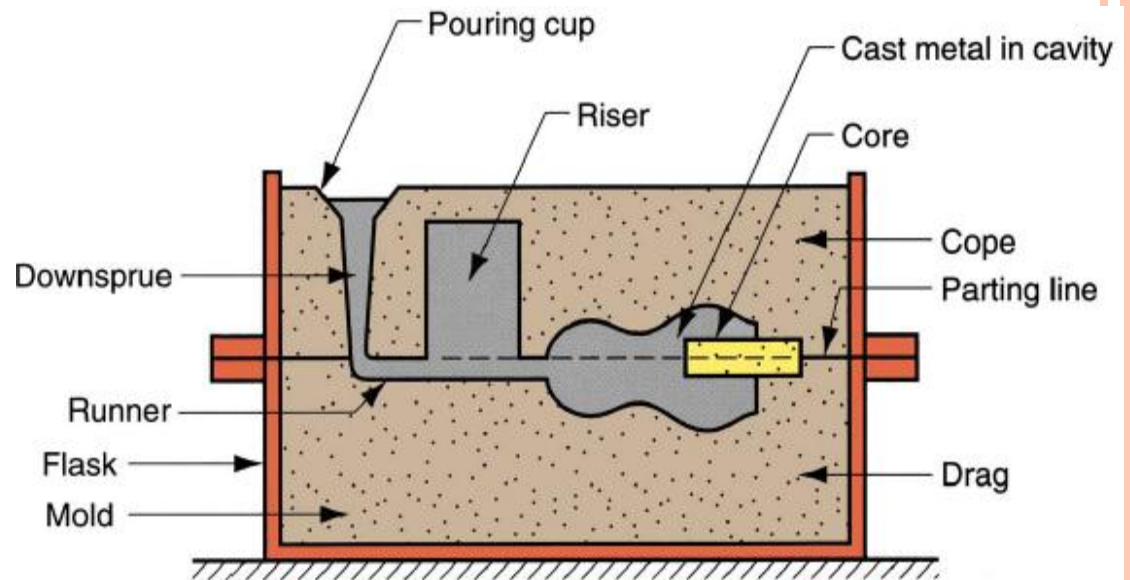


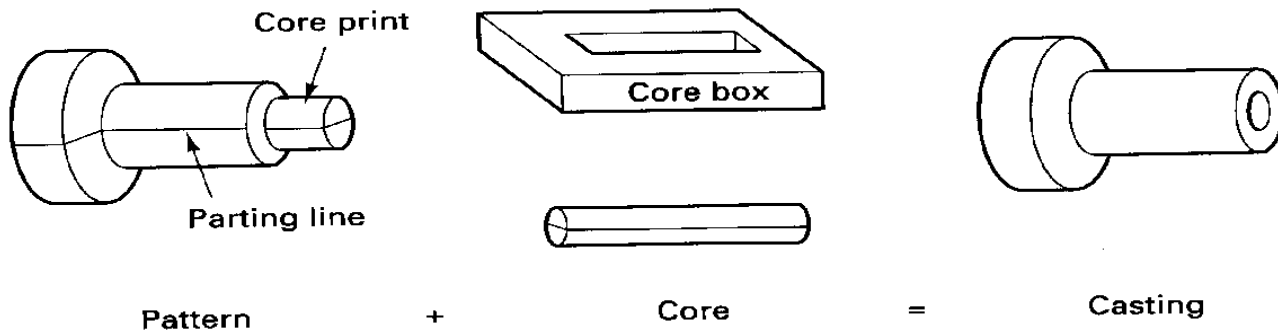
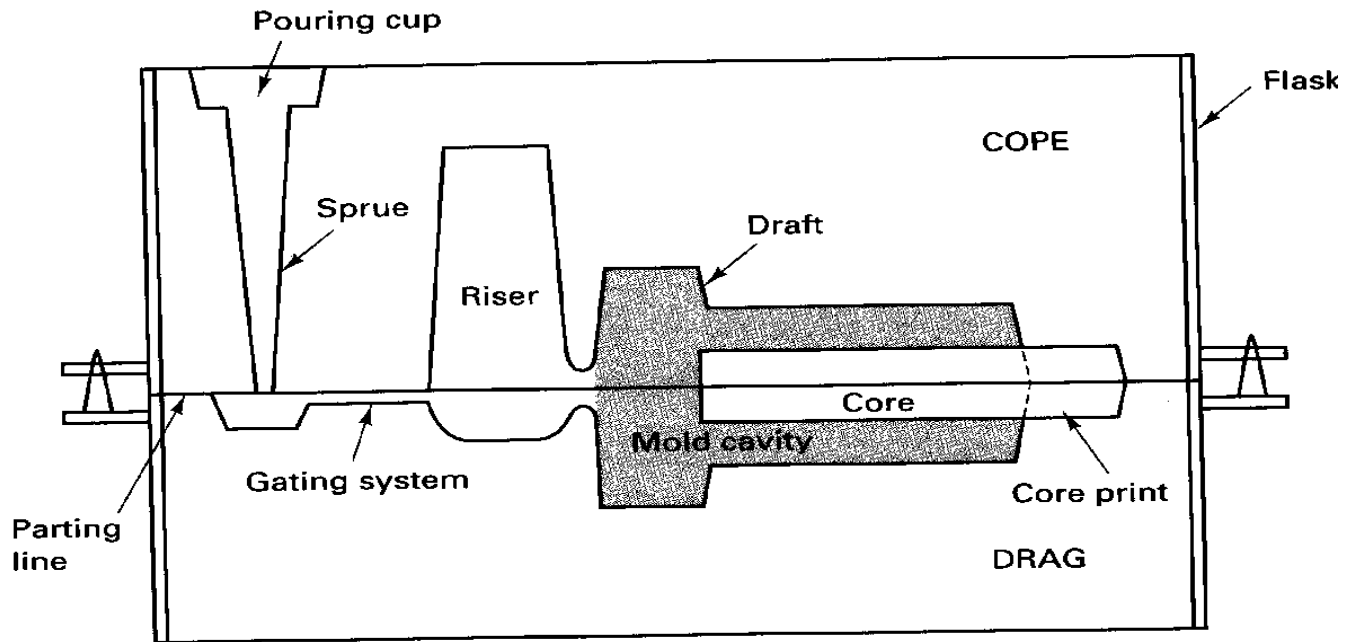
# CONVENTIONAL CASTING PROCESS

## ❖ SAND CASTING PROCESS

There are six basic steps in making sand castings:

1. Patternmaking
2. Core making
3. Molding
4. Melting and pouring
5. Cleaning





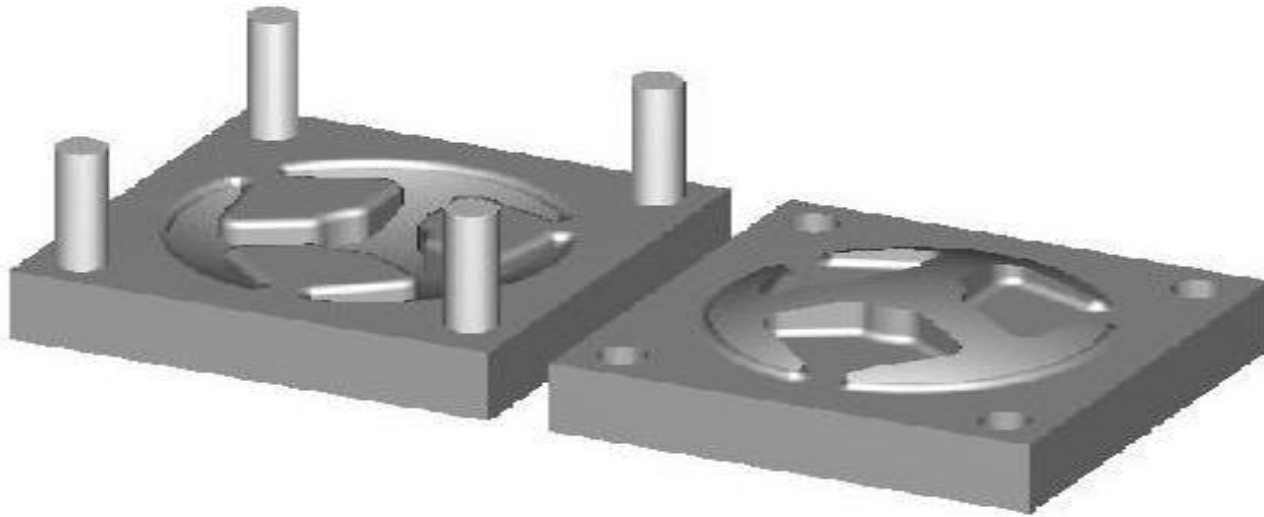
# CONVENTIONAL CONTD....

## ○ DIE CASTING

- The process in which we use a die to make the castings is called permanent mold casting
- The die consist of two part, one called the stationary die or cover die which is fixed with to the casting m/c & 2<sup>nd</sup> part called the ejector die is moved out for the extraction of the casting .
- Because of the high pressure involved in die casting, any narrow sections, complex shape and fine surface finished can be easily produced.
- Die casting m/c are of two type: hot chamber die casting & cold chamber die casting



# CONVENTIONAL CONTD....



Die Casting





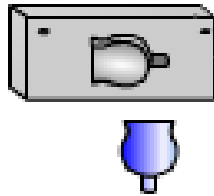
# CONVENTIONAL CASTING CONTD...

## ○ INVESTMENT CASTING

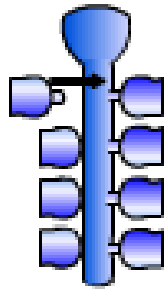
- In this process , the preparation of the pattern for every casting made.
- To do this , molten wax which is used as a pattern material is injected under pressure into a metallic die which has of the cavity of the casting to be made.
- Wax when allowed to solidify would produce the pattern.
- Products artefacts , jewellery, & surgical instrument, presently vanes & blades for gas turbines, wave guider for radar and triggers for fire arms.



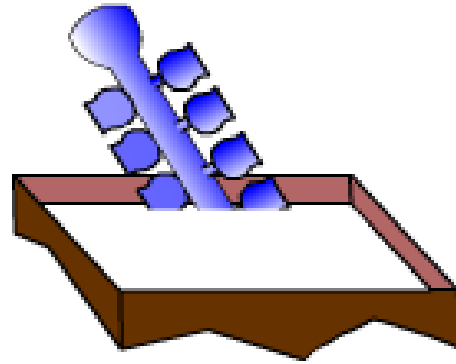
# INVESTMENT CASTING



*Wax Injection*



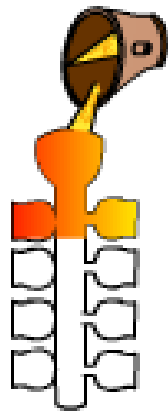
*Assembly*



*Shell Preparation*



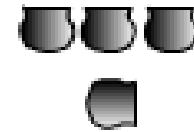
*Dewax*



*Pouring*



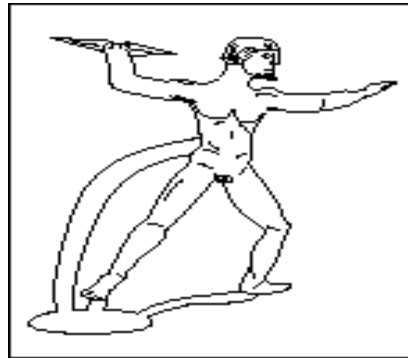
*Cut-off*



*Finished Castings*



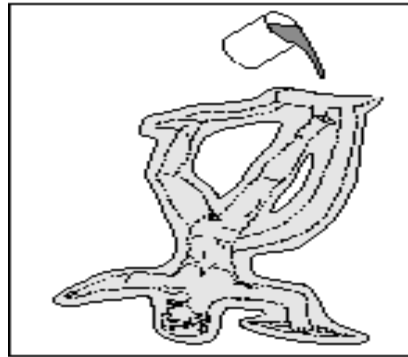
# INVESTMENT CASTING



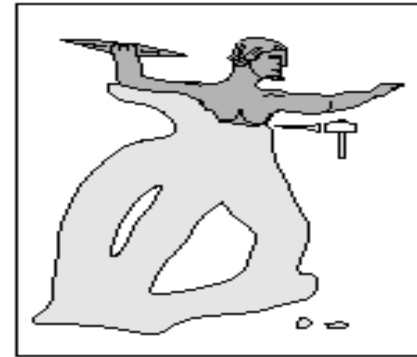
(a)



(b)



(c)



(d)



# CONVENTIONAL CASTING CONTD...

## ○ CENTRIFUGAL CASTING

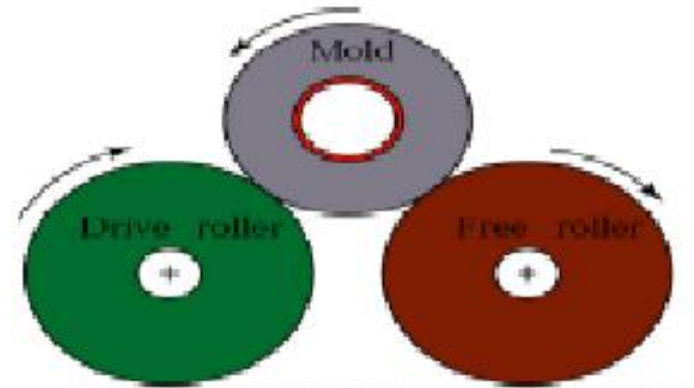
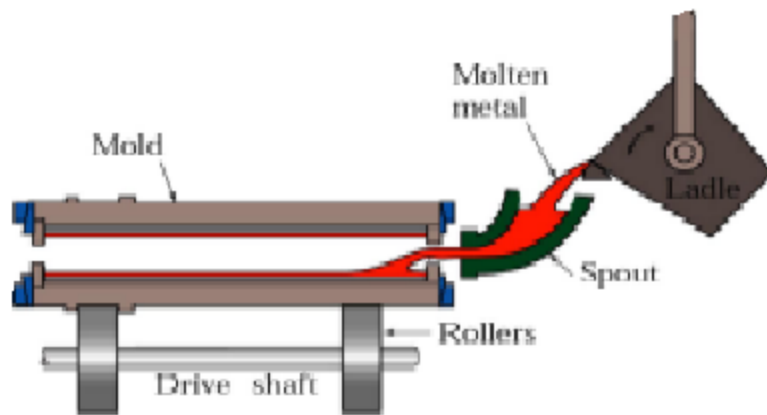
- the mold is rotated rapidly about its central axis as the metal is poured into it.
- Because of the centrifugal force, a continuous pressure will be acting on the metal as it solidifies. The slag, oxides and other inclusions being lighter, get separated from the metal and segregate towards the center.
- This process is normally used for the making of hollow pipes, tubes, hollow bushes, etc., which are axisymmetric with a concentric hole.
- The mold can be rotated about a vertical, horizontal or an inclined axis or about its horizontal and vertical axes simultaneously



# CONVENTIONAL CASTING CONTD...

## THREE TYPES OF CENTRIFUGAL CASTING

1. TRUE CENTRIFUGAL CASTING
2. SEMI CENTRIFUGAL CASTING
3. CENTRIFUGING

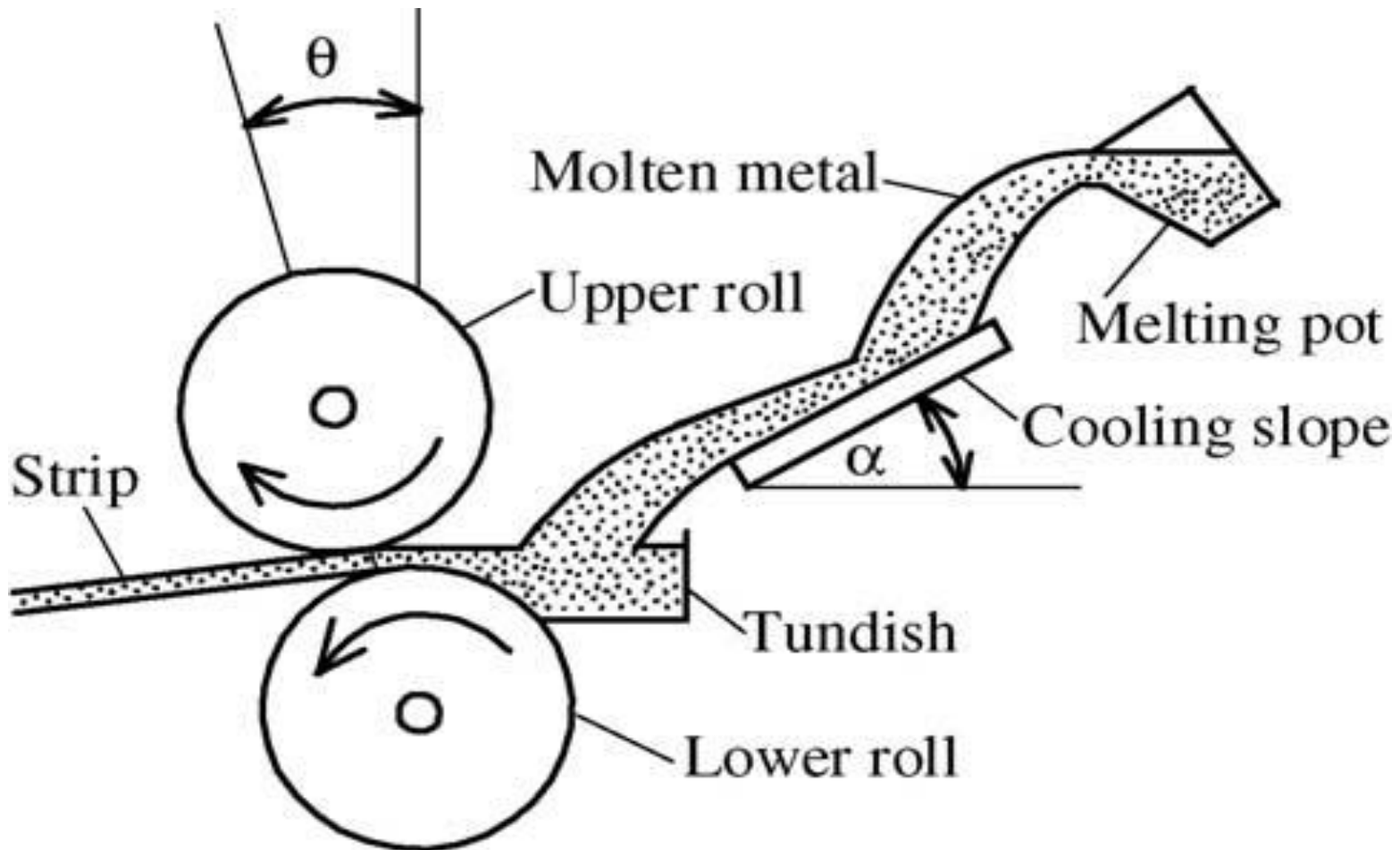


# ADVANCES IN CASTING

- **Semi-solid manufacturing process of magnesium alloys by twin- roll casting:**
  - Magnesium is 36% lighter per unit volume than aluminum and 78% lighter than iron. When alloyed, magnesium has the highest strength-to-weight ratio of all the structural metals
  - Utilization of magnesium alloys has mainly depended on casting technology and SSM
  - Unfortunately, the major barrier to greatly increased magnesium alloy use in cars is still primarily high manufacturing cost. So for solving this problem is to develop semi-solid roll strip casting technology to manufacture magnesium sheet alloys economically while maintaining high quality.



# ADVANCES IN CASTING CONTD...



## ADVANCES IN CASTING CONTD...

- the twin-roll strip caster for the horizontal casting direction.
- molten metal that feeds into the space between a pair of counter-rotating, internally cooled rolls.
- A cooling slope is used to obtain slurries with fine and spheroidal microstructures. the slurry that is rapidly cooled by the slope.
- The molten metal slurry in the tundish is dragged onto the surface of the lower roll.
- The molten metal solidifies very soon after leaving the casting tundish due to the contact with cooled rolls and is rolled between the upper and lower rolls. A solidified strip can thus be manufactured.
- Magnesium alloys AZ31B, AZ91D, AM50A and AM60B have been used for twin-roll strip casting





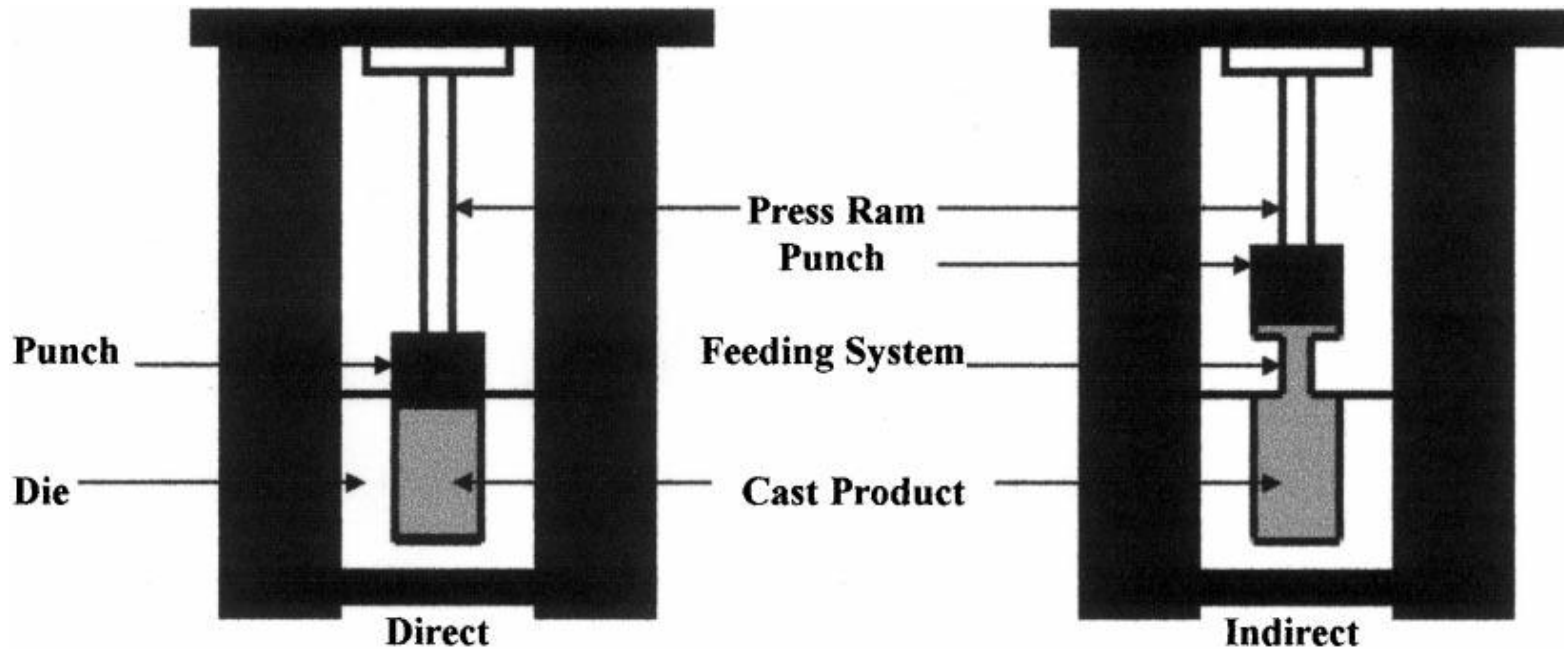
# ADVANCES IN CASTING CONTD...

## ○ Squeeze casting

- squeeze casting has greater potential to create less defective cast components.
- Squeeze casting (SC) is a fabrication technique where solidification is promoted under high pressure within a re-usable die.
- It is a metal-forming process, which combines permanent mould casting with die forging into a single operation where molten metal is solidified under applied hydrostatic pressure.
- In this process a die set is placed on a hydraulic press and preheated, and the exact amount of molten alloy is poured into the lower half of the open die set, the press closed so that the alloy fills the cavity and the pressure maintained until complete solidification occurs.



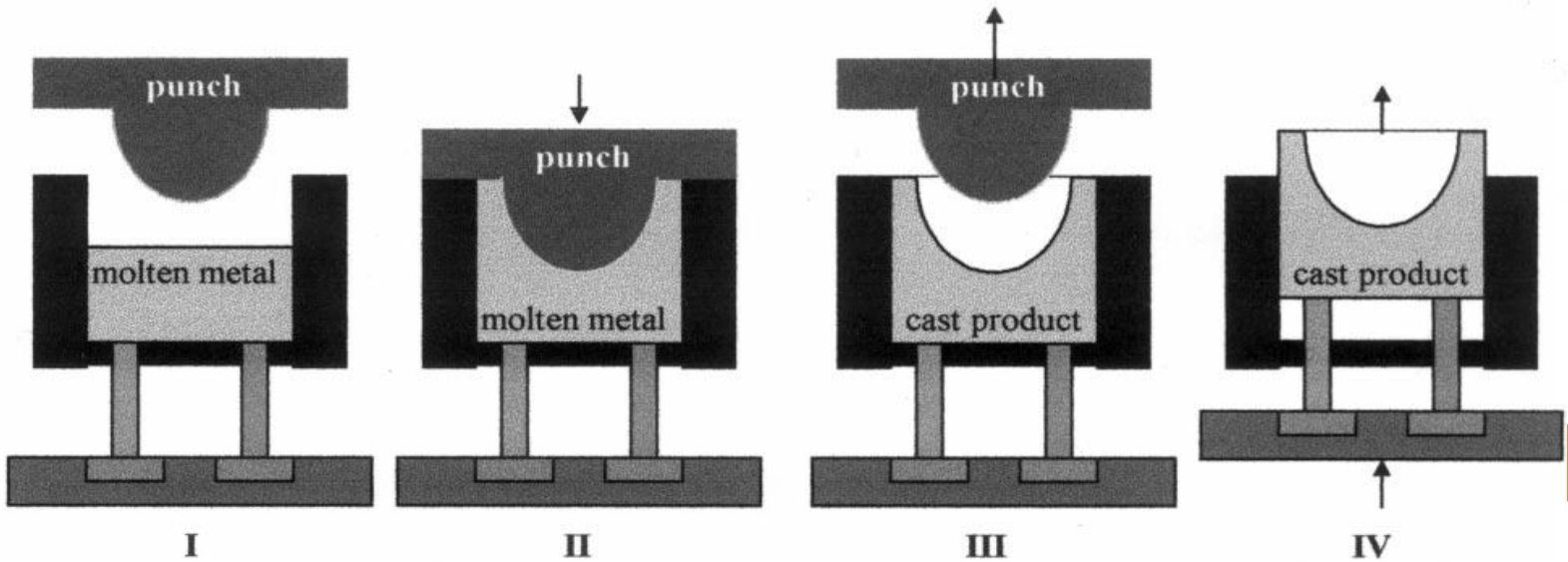
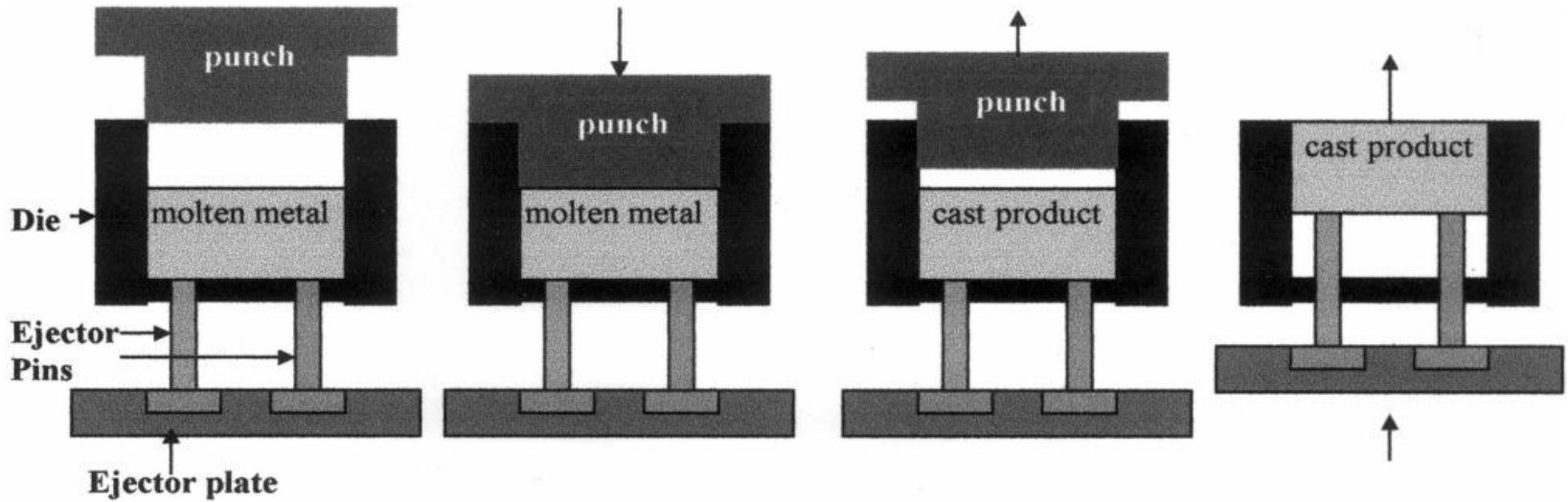
# ADVANCES IN CASTING CONTD...



the SC-fabricated engineering components are fine grained with excellent surface finish and have almost no porosity. The mechanical properties of these parts are significantly improved over those of conventional castings.



# ADVANCES IN CASTING CONTD...



# ADVANCES IN CASTING CONTD...

## ○ **Simulation of transport processes in squeeze casting:**

- The main advantage of the deployment of high pressure is that it enhances the heat transfer coefficients by several orders of magnitude.
- The applied pressure has another role in increasing the melting temperature of the alloy.
- Studies the solidification process in an automotive disk brake manufactured through squeeze casting route using MAGMASOFT package.
- the mechanical properties of the developed components are related with the temperature distribution.
- attempts to simulate in a systematic manner the heat transfer process during squeeze casting for a cylindrical geometry

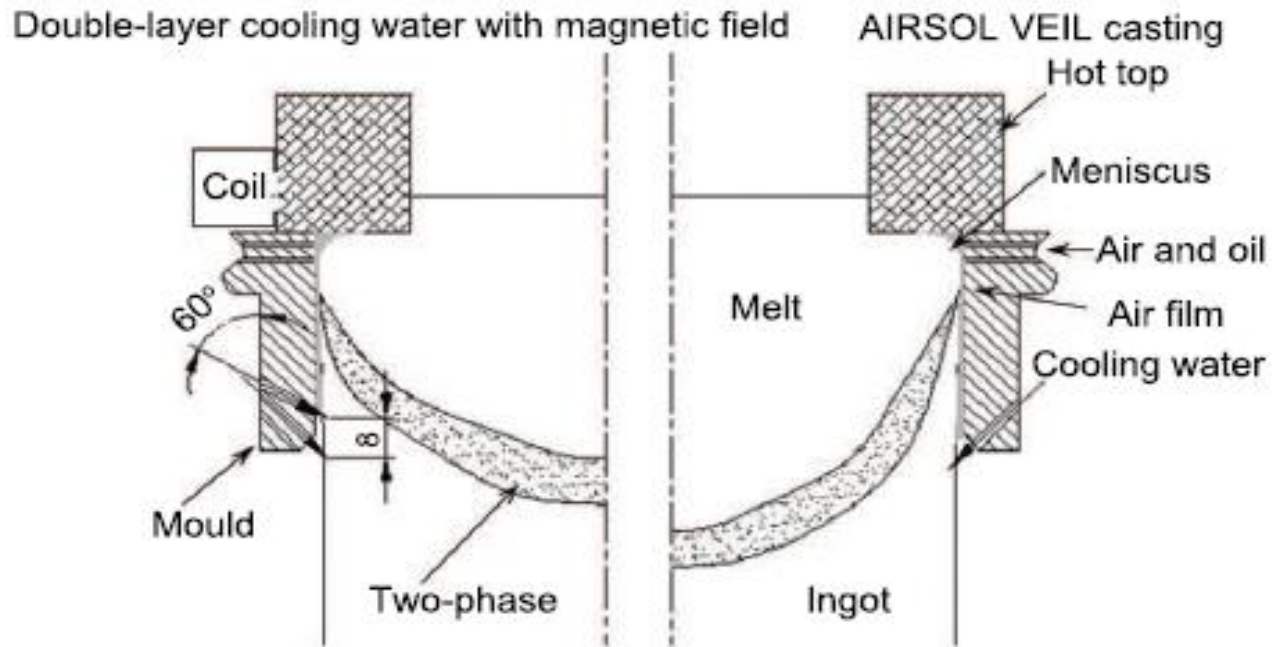


## ADVANCES IN CASTING CONTD...

- **Rapid air film continuous casting of aluminum alloy using static magnetic field:**
  - Casting with double-layer cooling water and static magnetic field.
  - double-layer cooling water can improve the surface quality and avoid of hot crack, which created conditions to increase the casting speed. The electromagnetic casting process can effectively improve the surface quality in high speed casting process, and static magnetic field has a great influence on solute distribution along the radius direction of ingot.

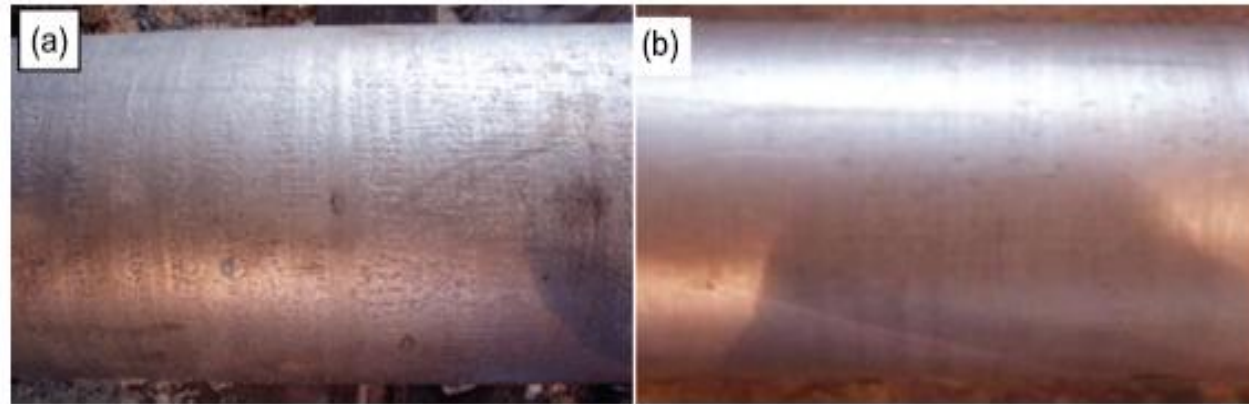


# ADVANCES IN CASTING CONTD...

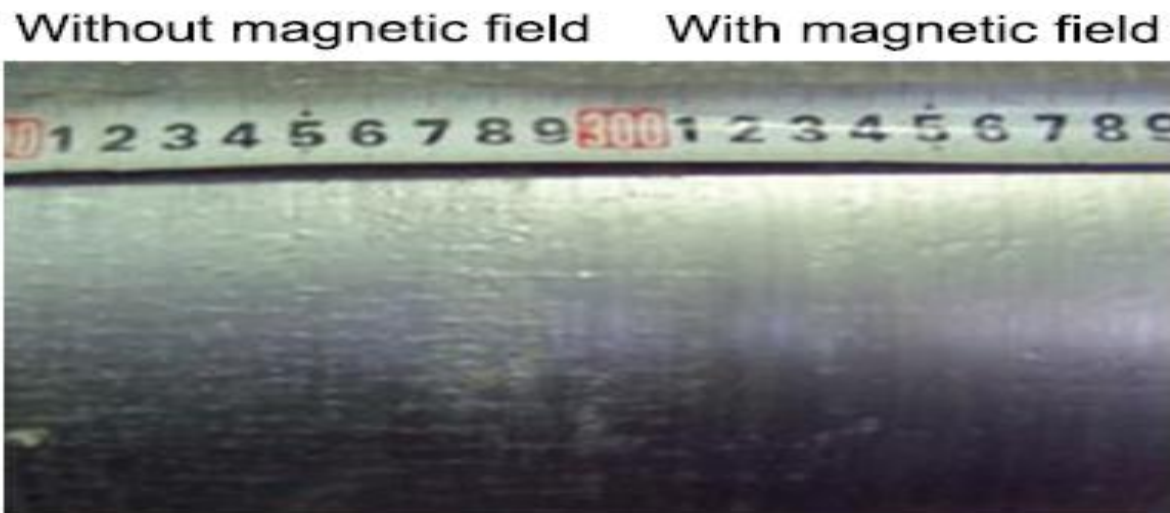


**Fig.1** Schematic diagram of air film semi-continuous casting with static magnetic field.





**Fig.3** Surface quality of the ingots with monolayer cooling water (a) and double cooling water (b).



**Fig.6** Diagram of surface quality of ingots at the speed of 170 mm/min.



# CONCLUSION

- The metal casting industry plays a key role in all the major sectors of our economy. There are castings in locomotives, cars trucks, aircraft, office buildings, factories, schools, and homes.
- Casting process is extensively used in manufacturing because of many advantages. so advancement in casting process has been required to produce product which is optimal & economical.





# REFERENCES

- **Journal of Materials Processing Technology 155–156 (2004) 1662–1667**  
**H. Watari , K. Davey, M.T. Rasgado, T. Haga, S. Izawa**  
**Semi-solid manufacturing process of magnesium alloys by twin- roll casting.**
- **NPTEL (NATIONAL PROGRAMM OF TECHNOLOGY ENHANCED LEARNING)**  
**A JOINT VENTURE OF IIT'S & IISc banglore**
- **Manufacturing technology**  
**by, P N RAO**
- **Journal of Materials Processing Technology 101 (2000)**  
**Squeeze casting: an overview**  
**M.R. Ghomashchi, A. Vikhrov**



**THANK U**

