Presentation on Casting

Submitted by:

Anamika Karmacharya

Aman Kumar Ray

Anjali Bista

Abhishek Yadav

Introduction to casting

- Casting is a crucial process in the production of various items, from art pieces to industrial components. It involves pouring liquid material into a mold to shape it into the desired form. The technique dates back to ancient civilizations and continues to play a vital role in modern manufacturing and artistry.

Importance of casting

Precision Manufacturing	Material Efficiency	Design Flexibility	Industry Diversification
• Casting allows for the production of complex shapes with high precision. This is crucial in industries such as aerospace and automotive.	• It enables the efficient use of materials, minimizing waste and reducing production costs, making it economically beneficial.	• Offers designers the freedom to create intricate and detailed components, enhancing product performance and innovation	• Contributes to the diversification of industrial products, serving various sectors like medical, energy, and consumer goods

Types of Casting Methods

Sand Casting	• Sand casting is one of the most popular and simplest types of casting, widely used for creating large metal components.
Investment Casting	• Also known as "lost-wax casting," this process is valued for its ability to produce components with high precision, complex detail, and smooth surface finishes.
Die Casting	• Die casting is a metal casting process that is characterized by forcing molten metal under high pressure into a mold cavity.
Plaster and mold casting	• Plaster mold casting is metalworking casting process similar to sand casting except the molding material is plaster Paris instead of sand.

Whole Process of Producing Casting

Pattern making

- Pattern is the principal tool during the casting process. The process of making a pattern is called pattern making.

Pattern Materials

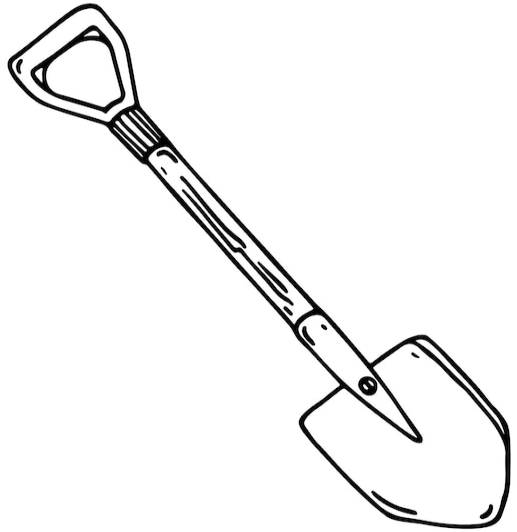
Wood	• Wood is the most common material for pattern making as it satisfies many of the requirements.
Metal	• Metal is used in large number of castings are desired from a pattern or when conditions are too severe for wooden pattern. Metal pattern do not change their shape when subjected to moist conditions.
Plastics	• Plastics are now finding their place as a modern pattern material because they do not absorb moisture ,are strong and dimensionally stable ,resistant to wear ,have a very smooth and glossy surface and are light in weight.
Rubbers	• Certain types of rubbers, such as silicon rubber are favored for forming a very intricate type of die for investment casting.
Waxes	• Wax patterns are excellent for investment casting process. The materials generally used are blends of several types of waxes and other additives which act as polymerizing agents stabilizers etc.

Foundry tools

- The common tools used in foundry work are:

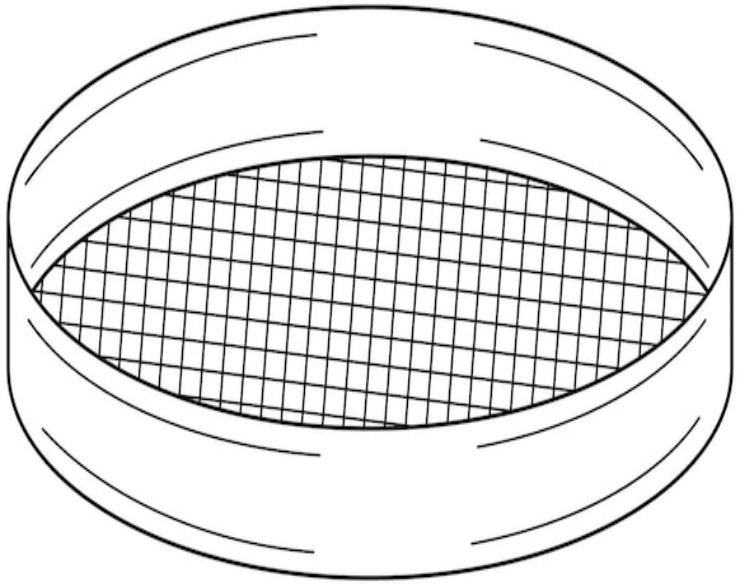
1. Shovel:

It consists of an iron pan fitted with a wooden handle. It is used in mixing and conditioning the foundry sand by hand and transferring it to the flask.



2. Hand riddle:

It consists of a wooden frame fitted with a screen of standard wire mesh at its bottom. It is used for hand riddling of sand to remove foreign material from it.

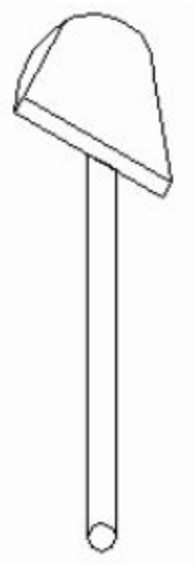


3. Rammers:

Rammers are used for striking the sand mass in the moulding box to pack it uniformly around the pattern. The common form of rammers used in hand ramming are the following:

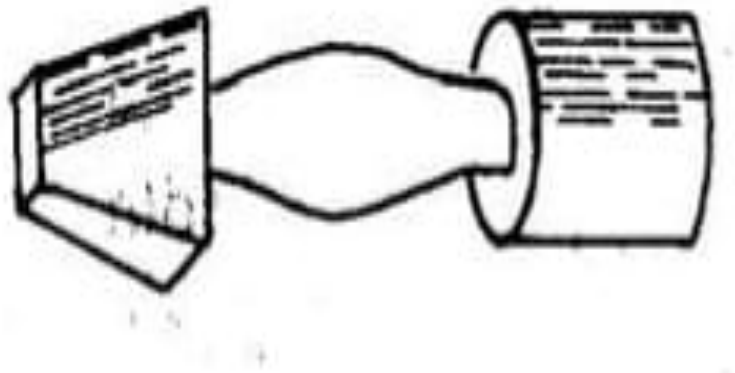
a. Peen rammer:

It has a wedge-shaped construction formed at the bottom of a metallic rod, as shown. It is a common hand tool and is quite useful in packing the sand in pockets and corners.



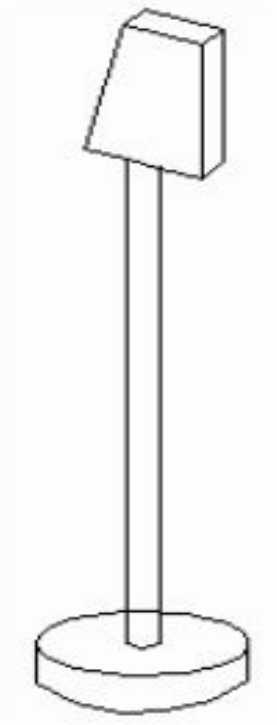
b. Hand rammer:

It is smaller than the former and generally made of wood or metal. On one end it carries a wedge type construction, called peen, and on the other a solid cylindrical shape, known as butt. It is mainly used in bench moulding.



c. Floor rammer:

It consists of a long steel bar carrying a peen at one end and a flat portion on the other. It is a large and heavier tool than the above two. Its specific use is in floor moulding for ramming the sand in very large moulds. Due to its large length the moulder can operate it in standing position.



4. Strike off bar

It is a flat bar made of wood or iron, to strike off the excess sand from the top of a box after ramming. It's one edge is made bevelled and the surface perfectly smooth and

plane.

A strike off bar

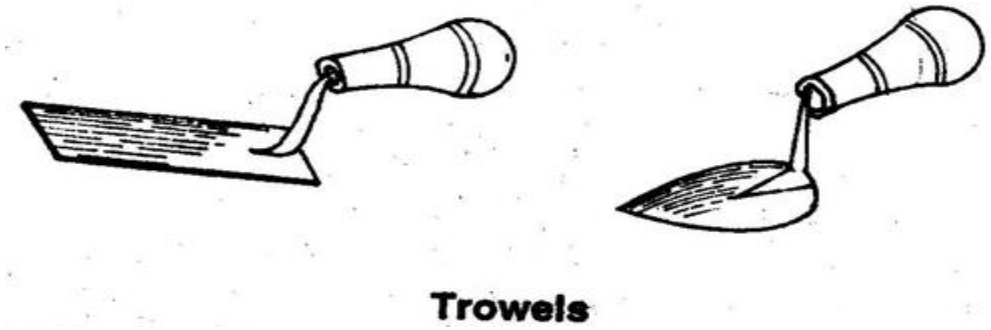
5. Vent wire:

It is a thin steel rod or wire carrying a pointed edge at one end and a wooden handle or a bent loop at the other. After ramming and striking off the excess sand it is used to make small holes, called vents, in the sand mould to allow the exit of gases and steam during casting.

Vent wire

6. Trowels:

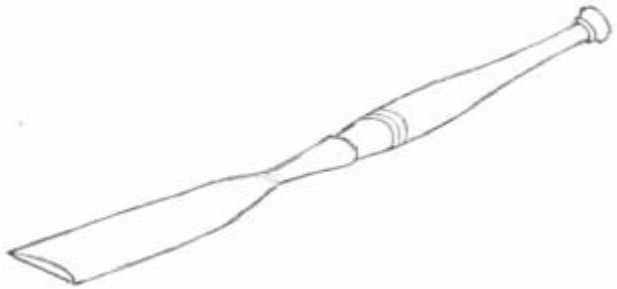
- Trowels are used for finishing flat surfaces and joints in a mould. They are made of iron and are provided with a rode wooden handle.



Trowels

7. Slicks:

They are used for repairing and finishing the mould surfaces and edges after the pattern has been withdrawn. The commonly used slicks are heart and leaf, square and heart spoon and bead and heart and spoon.



8. Lifters or Cleaners:

They are also finishing tools and are used for repairing and finishing the sand mould after withdrawal of pattern. They are also used for removing loose sand from mould cavity.

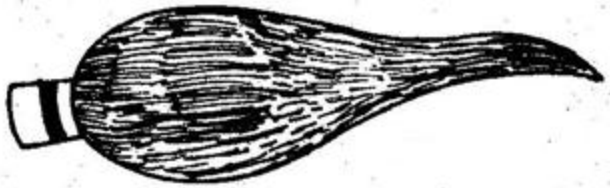
LIFTER

9. Mallet:

It is similar to wooden mallet as that used in carpentry work. In foundry work it is used for driving the draw spike into the pattern and then rapping it.

10. Swab:

It is a hemp fibre brush used for moistening the edges of sand mould, which are contact with the pattern surface, before withdrawing the pattern. It is also used for coating the liquid blacking on the mould faces in dry sand moulds.



Swab

11. Sprue pin:

It is a tapered rod of wood or iron, which is embedded in the sand and later withdrawn to produce a hole, called runner, through which the molten metal is poured into the mould.

12. Spue cutter:

It is also used for the same purpose as a sprue pin, but there is a marked difference between their uses in that the cutter is used to produce the hole after ramming the mould. It is in the form of a tapered hollow tube which is inserted in the sand to produce the hole.

Sprue cutter

13. Bellow :

A hand operated bellow is shown in fig. it is used to blow away the loose or unwanted sand from the surface and cavity of the mould.

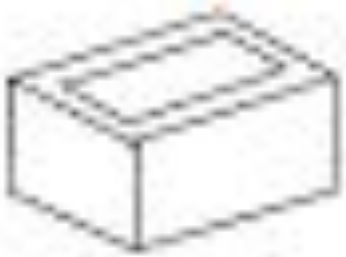
Core Making

Core making is the process which forms the interior part of the casting. The mould provides a space for the molten metal to go, while the core keeps the metal from filling the entire space. Cores can be used to extend mould projections to create extra mould sections, or to block out and create negative drafts.

Core making procedure

Procedure

- Sand preperation
  - Roller mills
- Core making



- Core Baking
  - Furnace Or ovens
- Core Finishing
  - Fins & bumps Removed by rubbing

- Core sand preparation:

The first consideration in making a core is to mix and prepare the sand properly. The mixture must be homogenous so that the core will be of uniform strength throughout.

- Core moulding/making :

Cores are then made manually or with machines. Normally a core box is required for the preparation of cores. Green sand cores are made by ramming the sand mixtures into boxes, the interiors of which have desired shapes and dimensions.

- Core baking:

After the cores are prepared and placed on metal plate or core carriers, they are baked to remove the moisture and to develop the strength of the binder in core ovens at temperature from 150° C to 400° C depending on the type of the binder used, the size of the cores, and the length of baking time.

- Core finishing:

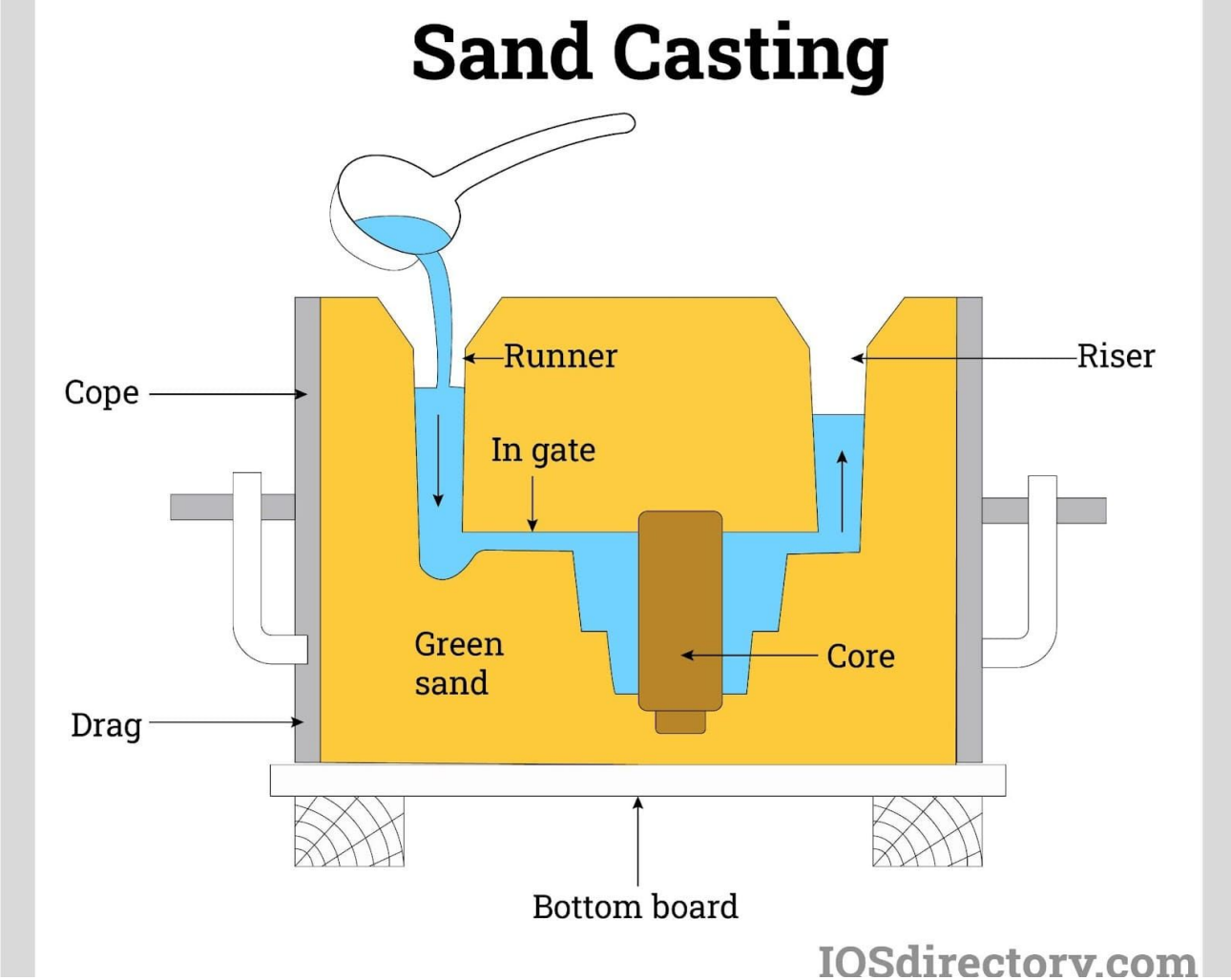
- After the baking operation, cores are smoothed. All rough places and unwanted fins are removed from filing. Some cores are made in two or more pieces which must assembled usually by pasting together with dextrin or other water soluble binders.

Types of Cores

- Horizontal core
- Vertical core
- Balanced core
- Hanging and cover core
- Wing core
- Ram up core

Sand Casting

Sand casting is a process where molten metal is poured into a sand mold to create various metal components. It is one of the oldest and most widely used metal-forming processes. The process involves creating a mold from a pattern, then compacting sand around the pattern to form a cavity for the molten metal.



Process in sand casting

1

- **Mold Preparation**
- In sand casting, a reusable pattern is used to create the mold, and then the liquid metal is poured into the mold cavity.

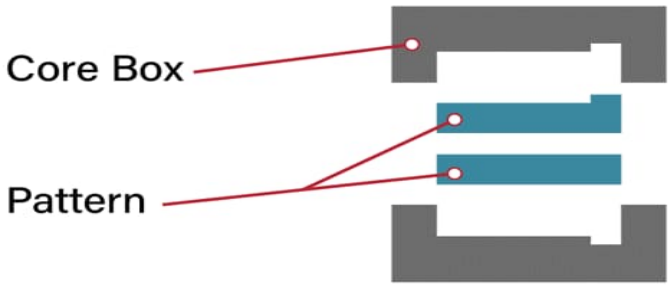
2

- **Cooling and Solidification**
- After the pouring process, the metal cools and solidifies in the shape of the mold cavity.

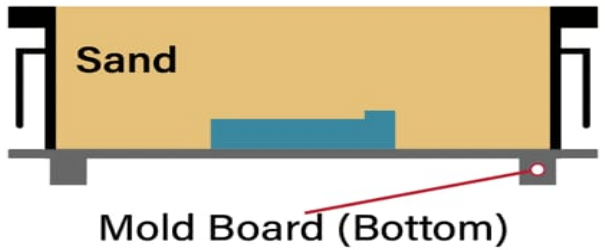
3

- **Removal and Cleaning**
- Once the metal has solidified, the casting is removed from the sand mold, cleaned, and finished as required.

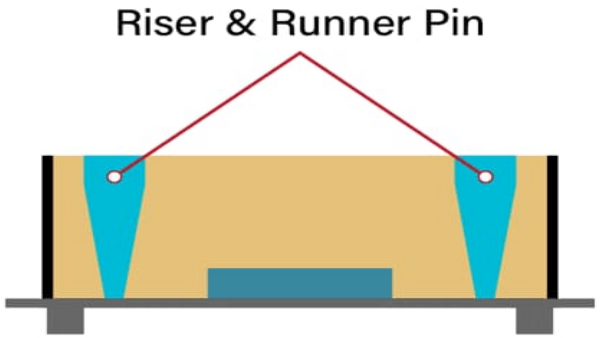
Sand Casting Process



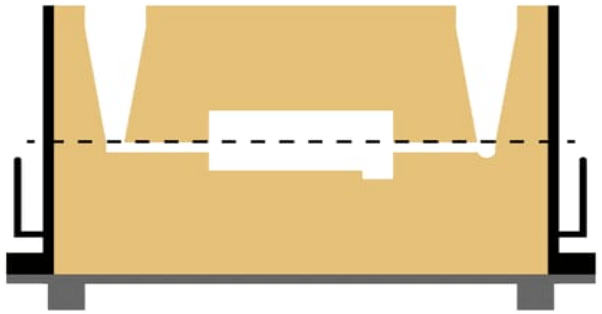
Pattern Creation



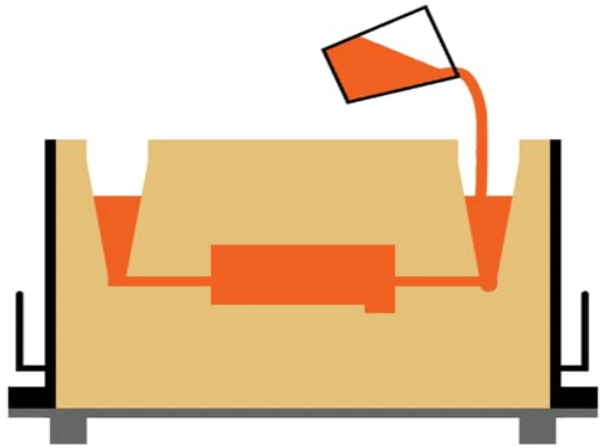
Mold Creation (Drag)



Mold Creation (Cope)



Mold Assembly



Pouring

Cooling/Shakeout

Importance of Sand Casting

Cost-Effective

- Sand casting is a cost-effective method for producing both small and large metal parts making it an economical option for manufacturers.

Flexibility in Material Choices

- Sand casting can accommodate a wide range of materials, including ferrous and non-ferrous alloys, providing flexibility in material selection for different applications.

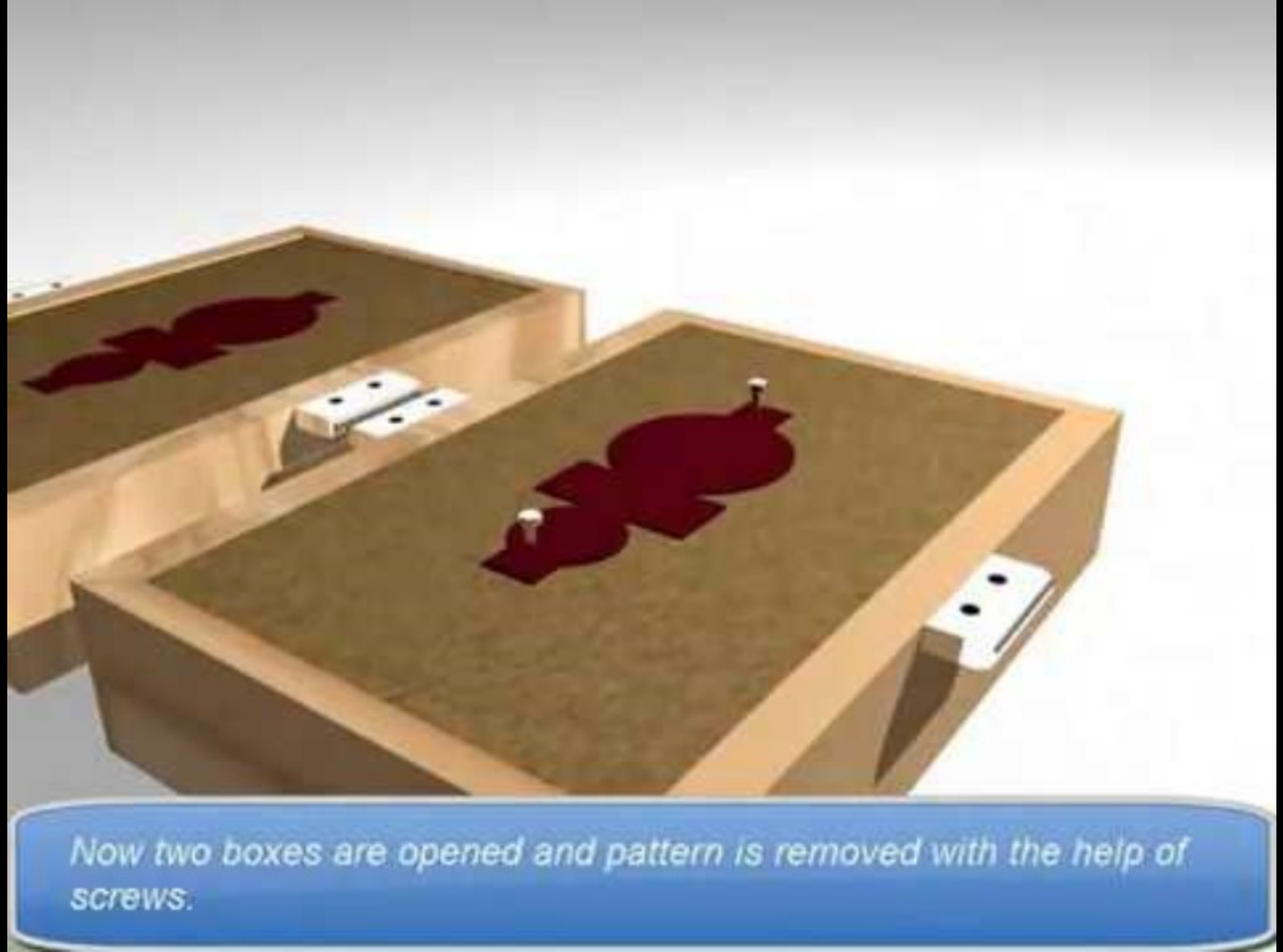
Advantages and disadvantages of sand casting

Advantages

- Low cost for tooling
- Can produce very large parts
- Complex part geometries are possible

Disadvantages

- Surface finish is not as smooth
- Not suitable for high precision parts
- More finishing and cleaning required


Now two boxes are opened and pattern is removed with the help of screws.

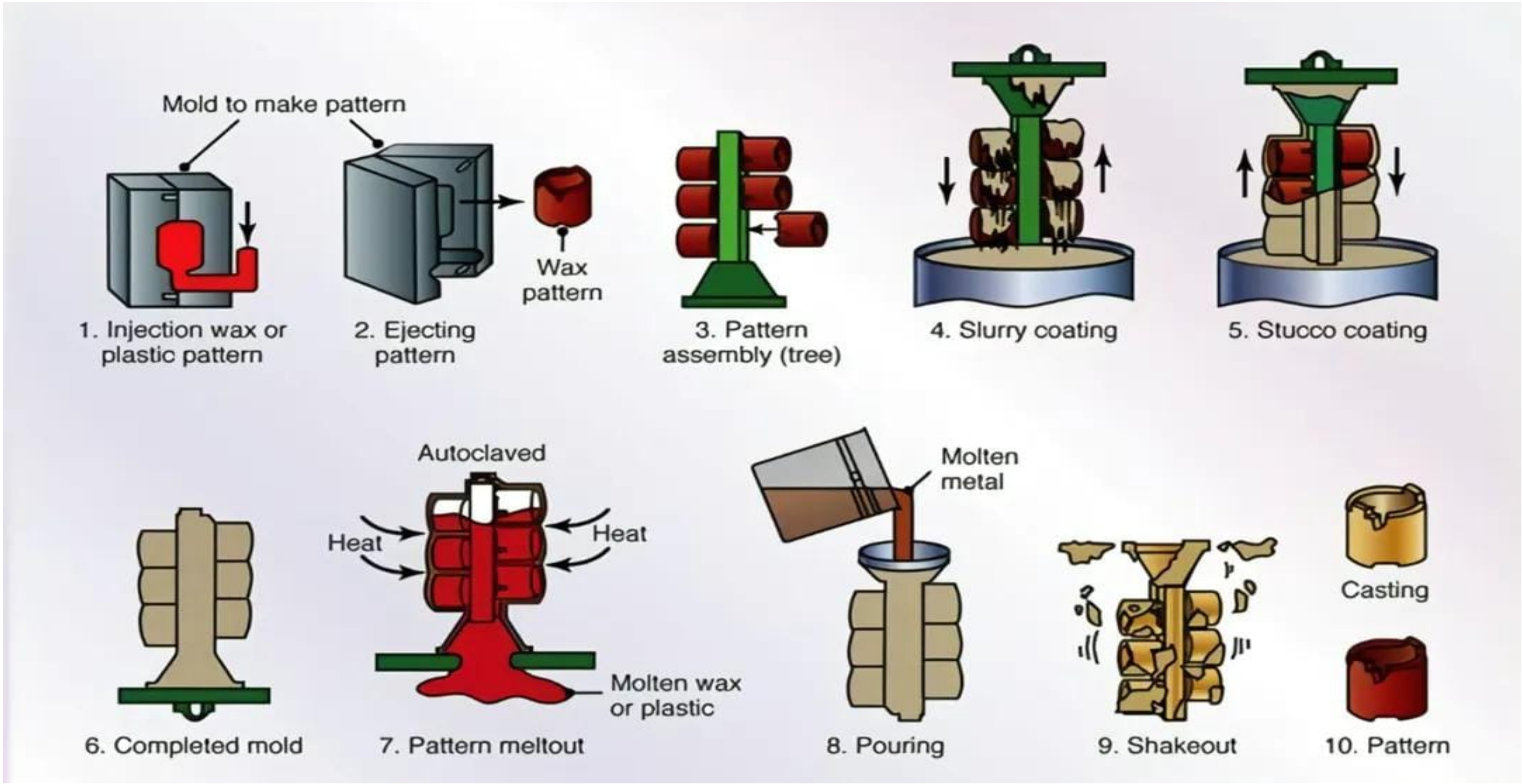
Investment Casting

Investment casting is a manufacturing process that produces precision and complex metal components. It involves creating a wax pattern, coating it in a ceramic shell, melting the wax to leave a hollow mold, and then pouring molten metal into the mold.

This process is ideal for intricate shapes and high precision parts, providing a smooth surface finish and minimizing the need for additional machining.

Preparation for investment casting

1. **Wax Pattern Creation**
   - A wax pattern, typically made using a metal die, is created and assembled to form the complete pattern intended for casting.
2. **Ceramic Shell Building**
   - The wax pattern is dipped in ceramic slurry, coated with sand, and then allowed to dry, forming a shell around the pattern.
3. **De-Waxing and Pouring**
   - The shells are placed in an oven and heated, causing the wax to melt and pour out, leaving behind a cavity ready for the molten metal.


Mold to make pattern
1. Injection wax or plastic pattern
2. Ejecting pattern
Wax pattern
3. Pattern assembly (tree)
4. Slurry coating
5. Stucco coating
6. Completed mold
Autoclaved
Heat
Heat
Molten wax or plastic
7. Pattern meltout
Molten metal
8. Pouring
9. Shakeout
Casting
10. Pattern

Importance of Investment Casting

Precision Engineering	Versatility	Reduced Waste	Diverse Materials
• It is crucial in industries where high precision and quality metal components are required.	• It can be used to produce parts with complex shapes and intricate details.	• It minimizes the amount of machining required and reduces material wastage.	• Allows for the production of parts in a wide range of metals and high-perform ance alloys.

Advantages and Disadvantages of Investment Casting

Advantages

- Highly intricate and complex shapes can be cast with great accuracy.
- Smooth surface finish, reducing the need for extensive machining.
- Allows for the use of a wide range of materials, including ferrous and non-ferrous metals.

Disadvantages

- Costlier than other casting processes due to the use of expendable patterns and refractory materials.
- More time-consuming, especially when producing large quantities.
- Requires skilled labor and careful handling to achieve consistent results.

Die casting

Die casting is a metal casting process that involves feeding molten nonferrous alloy into dies under high pressure and at high speed to rapidly create molded products.

Die Casting Process

Mold Preparation

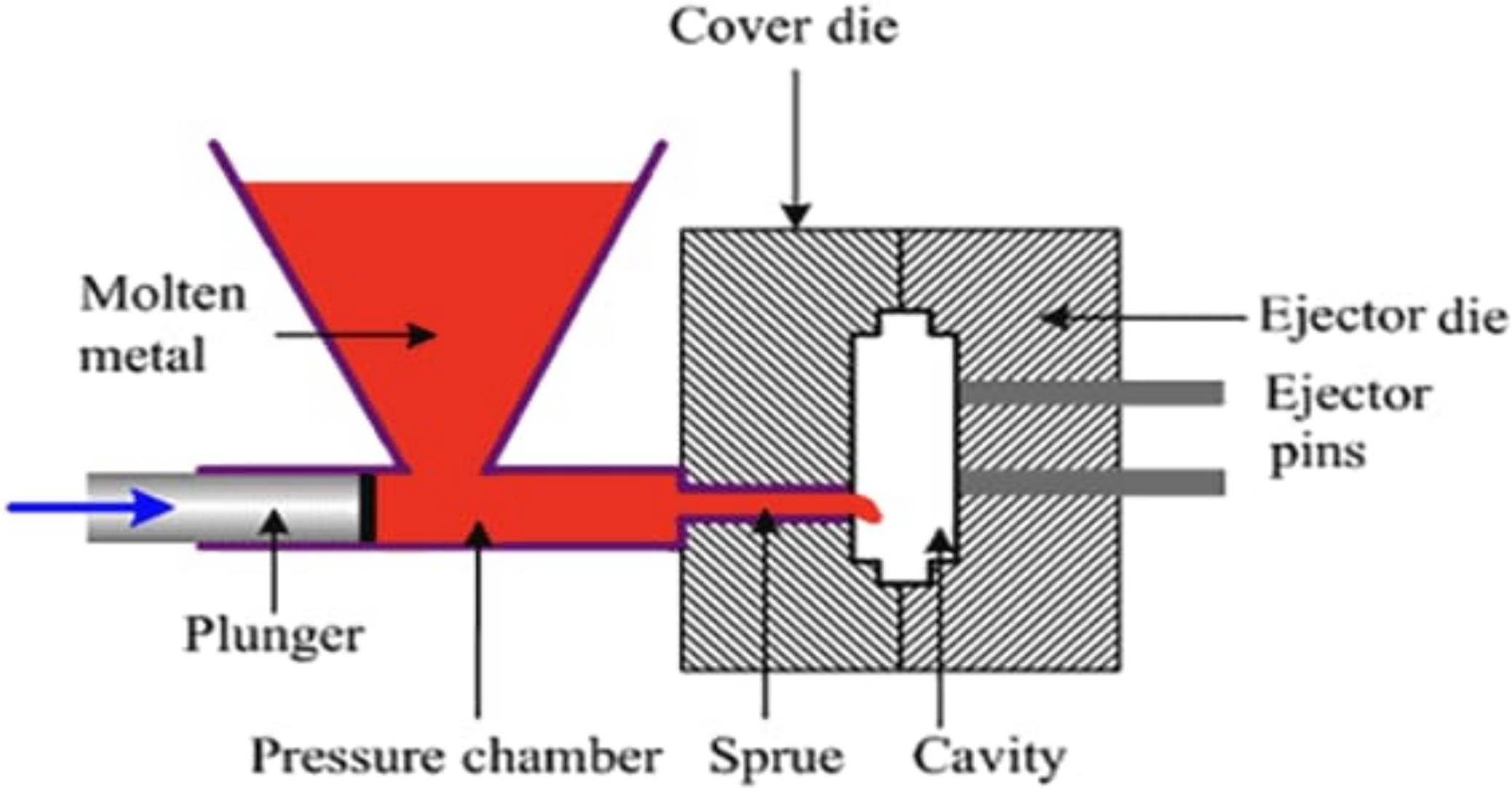
The die, or mold, is prepared by being closed and then injected with molten metal at high pressures.

- **Cooling and Ejection**

  Once the metal has solidified, the mold opens, and the part is ejected, ready for any necessary finishing processes

Die Casting Process Flow Chart

Die casting


Cover die
Molten metal
Ejector die
Ejector pins
Plunger
Pressure chamber
Sprue
Cavity

Advantages and limitations of Die casting

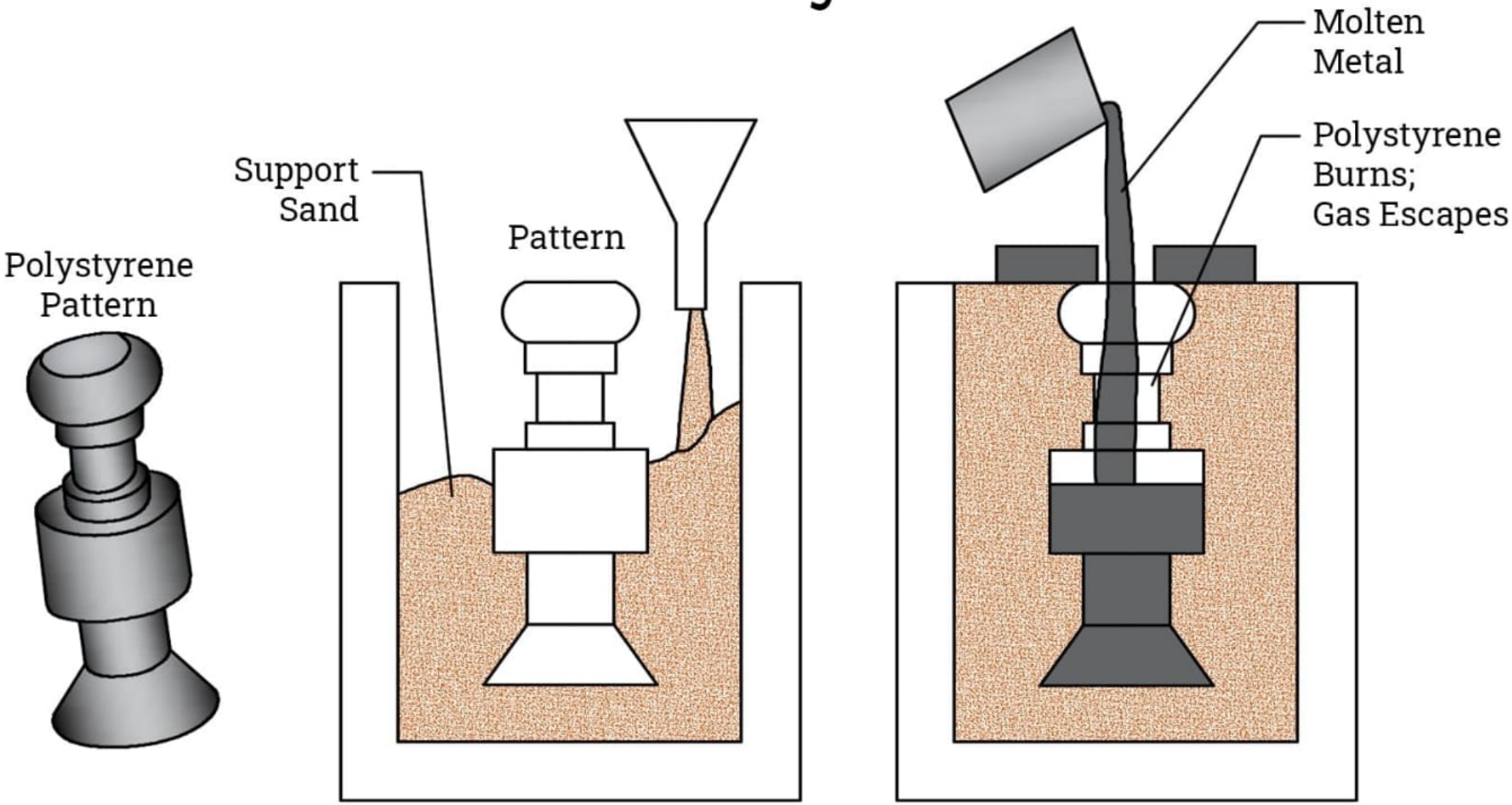
Advantages	Disadvantages
• Economical for large production quantities. • Good dimensional accuracy and surface finish. • Thin sections are possible.	• Generally limited to metals with low melting points. • Part geometry must allow removal from die cavity. • Porosity due to air and gasses entrained in the filling process.

PLASTER MOLD CASTING

Plaster Mold Casting

Plaster mold casting is a metalworking casting process similar to sand casting except the molding material is plaster of Paris instead of sand.

Plaster Casting Process



Advantages and Disadvantages of Plaster Mold Casting

Advantages

- Good dimensional accuracy and surface finish.
- Capability to make thin cross-sections in casting

Disadvantages

Moisture in plaster mold causes problems:

1. Mold must be baked to remove moisture.
2. Mold strength is lost when is over-baked, yet moisture content can cause defects in product.

Plaster molds cannot stand high temperatures, so limited to lower melting point alloy.

Advantages and disadvantages of casting

Advantages

- Wide range of metals can be used
- Complex shapes can be achieved
- Cost-effective for large production runs

Disadvantages

- High setup costs
- Surface finish may require additional machining
- Not suitable for small quantities

Conclusion and Summary

Sand Casting	Die Casting	Investment Casting	Plaster Mold Casting
			Cost effective for small batches of complex –shaped parts.
			Offers intricate detailing and smooth finish.

References

1.Wikipedia

2.Author Luza Shrestha.
Workshop technology

3. Google