SNS COLLEGE OF TECHNOLOGY
(An autonomous institution)

Department of Mechanical Engineering

Unit – I

Topic
Shell Mold Casting

Prepared by
P.Divyakumar,
Assistant Professor / Mechanical Engineering
SNS College of Technology, Coimbatore

Types of Casting

- Sand Casting Process
- Gravity Die Casting Process
- Pressure Die Casting Process
- Investment Casting
- Plaster Casting
- Centrifugal Casting
- Lost-Foam Casting
- Vacuum Casting
- Squeezing Casting
- Continuous Casting
- Shell Mould Casting

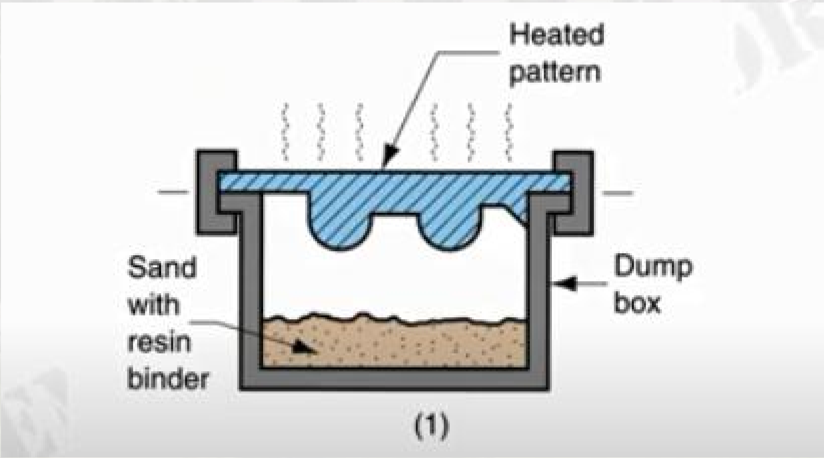
Shell Molding

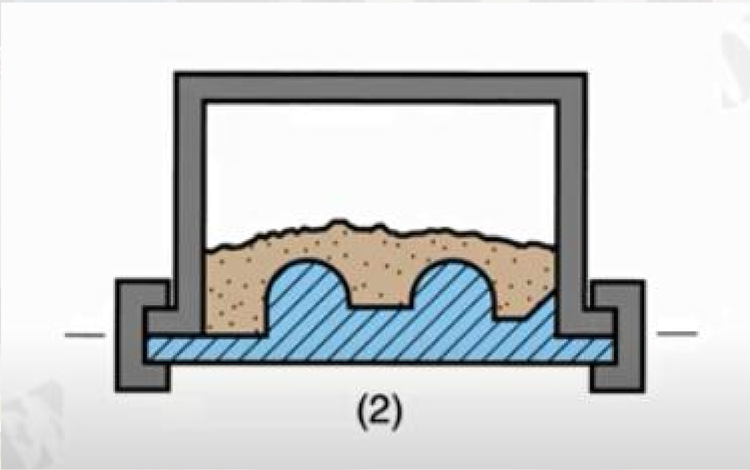
- Shell mould casting is a metal casting process similar to sand casting, in that molten metal is poured into an expendable sand-based mould.
- However, in shell mould casting, the mould is a thin-walled shell created by applying a **sand-resin mixture around a pattern.**
- The pattern, a metal piece in the shape of the desired part, is reused to form multiple shell moulds.
- A **reusable pattern** allows for higher production rates, while the disposable moulds enable complex geometries to be cast.
- Compared to sand casting, this process has **better dimensional accuracy, a higher productivity rate, and lower labour requirements.**
- It is often used for small to medium parts that require high precision.

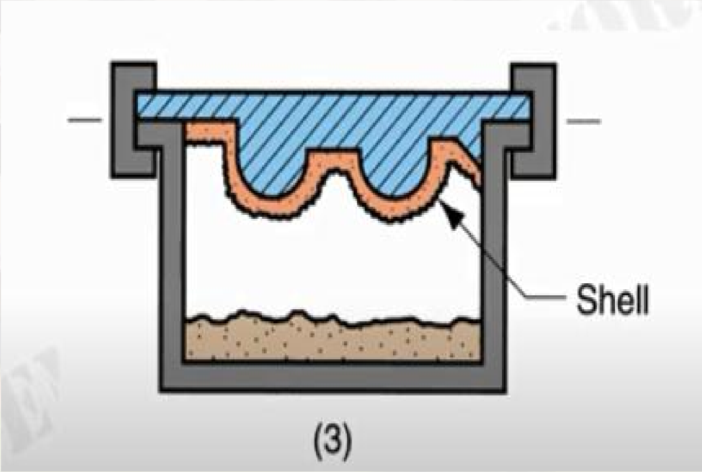
Shell Molding

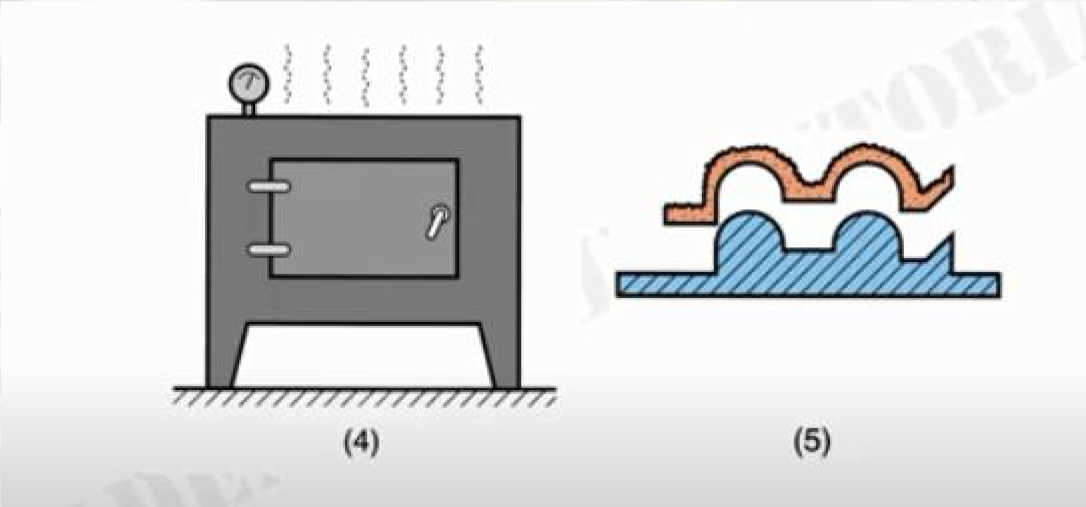
- Shell mould casting is used for both ferrous and non-ferrous metals.
- The most commonly used are **cast iron, carbon steel, alloy steel, stainless steel, aluminium alloys, and copper alloys.**
- Typical parts cast using this process are small-to-medium in size and require high accuracy, such as **gear housings, cylinder heads, connecting rods, and lever arms**.

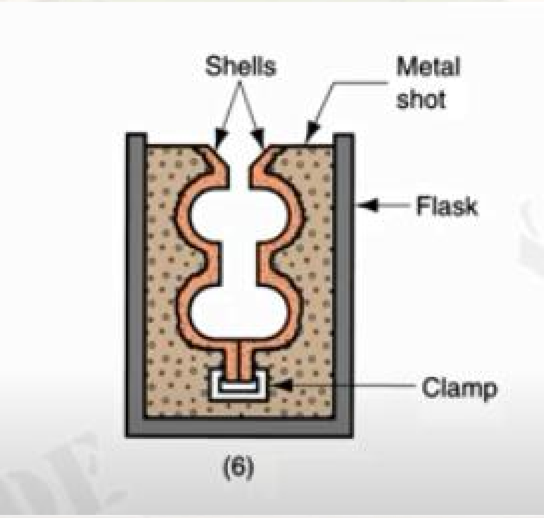
Shell Molding











Shell Molding

Shell Mould Casting Process

- A two-piece metal pattern is created in the shape of the desired part, typically from iron or steel.
- Other materials are sometimes used, such as aluminum for low volume production or graphite for casting reactive materials.

- **Mould creation:** Each pattern half is heated to 175-370 °C (350-700 °F) and coated with a lubricant to facilitate removal. The heated pattern is clamped to a dump box, which contains a mixture of fine **silica sand and a thermosetting phenolic resin binder**. The dump box is inverted, allowing this sand-resin mixture to coat the pattern. The heated pattern partially cures the mixture, which forms a shell around the pattern. Depending on the time and temperature of the pattern, the **thickness of the shell** is 10 to 20 mm. Each pattern half and surrounding shell is cured to completion in an oven giving it a tensile strength of 350 to 450 psi (2.4 to 3.1 MPa), and then the shell is ejected from the pattern.

Shell Molding

- **Mould assembly:** The two shell halves are joined together and securely clamped to form the complete shell mould. If any cores are required, they are inserted prior to closing the mould.

- The shell mould is then placed into a flask and supported by a backing material

- **Pouring:** The mould is securely clamped together while molten metal is poured from a ladle into the gating system to fill the mould cavity.

- **Cooling:** After the mould has been filled, the molten metal is allowed to cool and solidify into the shape of the final casting.

- **Casting removal:** After the molten metal has cooled, the mould can be broken and the casting removed. Trimming and cleaning processes are required to remove any excess metal from the feed system and any sand remaining from the mould.

Shell Molding

- **Applications:**
- **Aerospace Components:** Shell casting is used for **creating complex and high-precision** components in the aerospace industry, such as turbine blades.
- **Jewelry Making:** Fine jewelry is often made using a similar process, especially for intricate designs.
- **Automotive Parts:** Engine components and other critical parts are often produced using shell casting.

SNS COLLEGE OF TECHNOLOGY

(An autonomous institution)

Department of Mechanical Engineering

Unit – I

Topic
Investment Casting

Prepared by

P.Divyakumar,

Assistant Professor / Mechanical Engineering

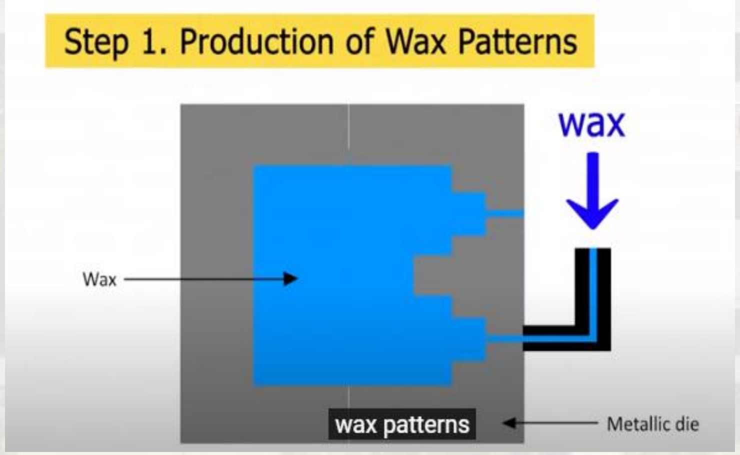
SNS College of Technology, Coimbatore

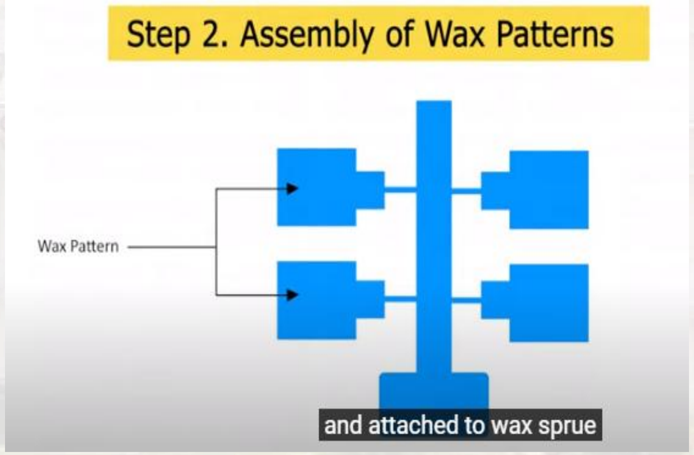
Investment Casting(Lost Wax Casting)

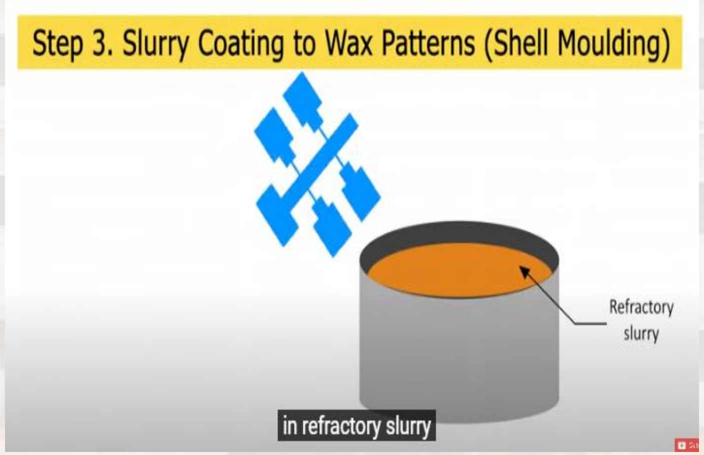
- Investment casting, also known as lost-wax casting, is a precision manufacturing process used to create intricate metal parts.

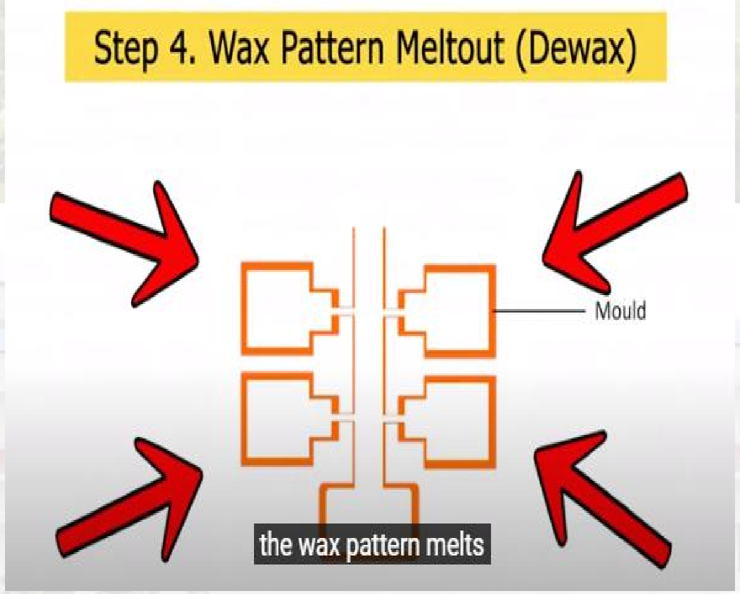
- It is one of the oldest known metal-forming techniques and is highly valued for its ability to produce complex shapes with excellent surface finish and tight tolerances.
- **Steps in Investment Casting**
  - Pattern Creation
  - Assembly
  - Shell Building (Ceramic Coating)
  - Wax Removal (Dewaxing)
  - Metal Pouring
  - Cooling
  - Cutting and Finishing

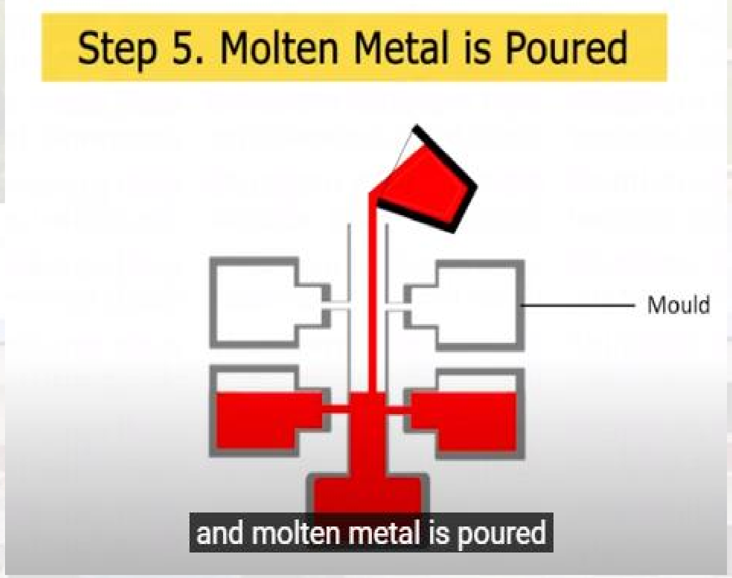
Investment Casting

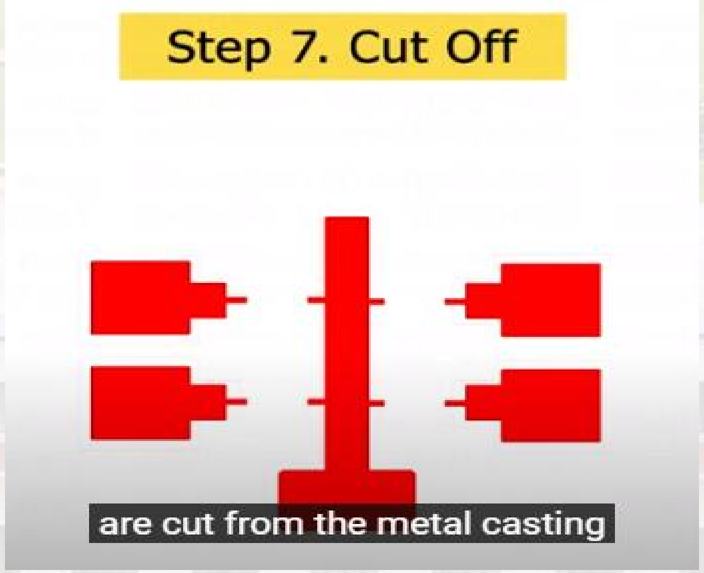












Investment Casting

Pattern Creation

- A wax or plastic model (pattern) of the part to be cast is created. This pattern is an exact replica of the final metal part.
- Multiple patterns may be attached to a central wax structure called a sprue, forming a "tree" that allows multiple parts to be cast simultaneously.

Assembly

- The wax patterns are attached to a gating system, which includes the sprue and other channels that allow molten metal to flow into the mold and gases to escape.

Shell Building (Ceramic Coating)

- The assembled wax patterns are repeatedly dipped into a ceramic slurry, then coated with fine sand or refractory material.
- This process is repeated several times, building up a thick ceramic shell around the wax patterns. Each layer is allowed to dry before the next is applied.

Investment Casting

Wax Removal (Dewaxing)

- Once the ceramic shell has reached the desired thickness, the entire assembly is heated, usually in an autoclave or furnace, to melt and remove the wax, leaving a hollow ceramic mold.
- The mold is then further fired to remove any residual wax and to strengthen the ceramic shell.

Metal Pouring

- The ceramic mold is preheated to a specific temperature to avoid thermal shock, and molten metal is poured into the mold.
- The metal fills the cavity, taking on the exact shape of the original wax pattern.

Investment Casting

Cooling

- After the metal has cooled and solidified, the ceramic shell is broken away, revealing the cast metal parts.

Cutting and Finishing

- The individual cast parts are cut off from the sprue and undergo various finishing processes, such as grinding, polishing, heat treatment, or machining, to achieve the desired specifications.

Investment Casting

Advantages of Investment Casting

Complex Shapes: Allows for the production **of intricate and complex shapes that** would be difficult or impossible to achieve with other casting methods.

Fine Detail and Smooth Surface: Produces parts with a high level of detail and a smooth surface finish, often reducing the need for additional machining.

Material Variety: Can be used with a wide range of metals and alloys, including **stainless steel, carbon steel, aluminum, bronze, and superalloys.**

High Dimensional Accuracy: Capable of producing parts with tight tolerances and consistent quality.

Investment Casting

Applications

Aerospace: Turbine blades, engine components, and structural parts.
Automotive: Engine parts, gear components, and transmission parts.
Medical Devices: Surgical instruments, implants, and prosthetics.
Industrial Machinery: Pumps, valves, and other precision components.
Jewelry: Used for producing detailed and intricate designs.

SNS COLLEGE OF TECHNOLOGY

(An autonomous institution)

Department of Mechanical Engineering

Unit – I

Topic

Centrifugal Casting

Prepared by

P.Divyakumar,

Assistant Professor / Mechanical Engineering

SNS College of Technology, Coimbatore

Centrifugal Casting

Centrifugal casting is a casting process used to produce **cylindrical parts** with a high level of accuracy, density, and strength.

It is particularly well-suited for making components such as pipes, cylinders, and rings.

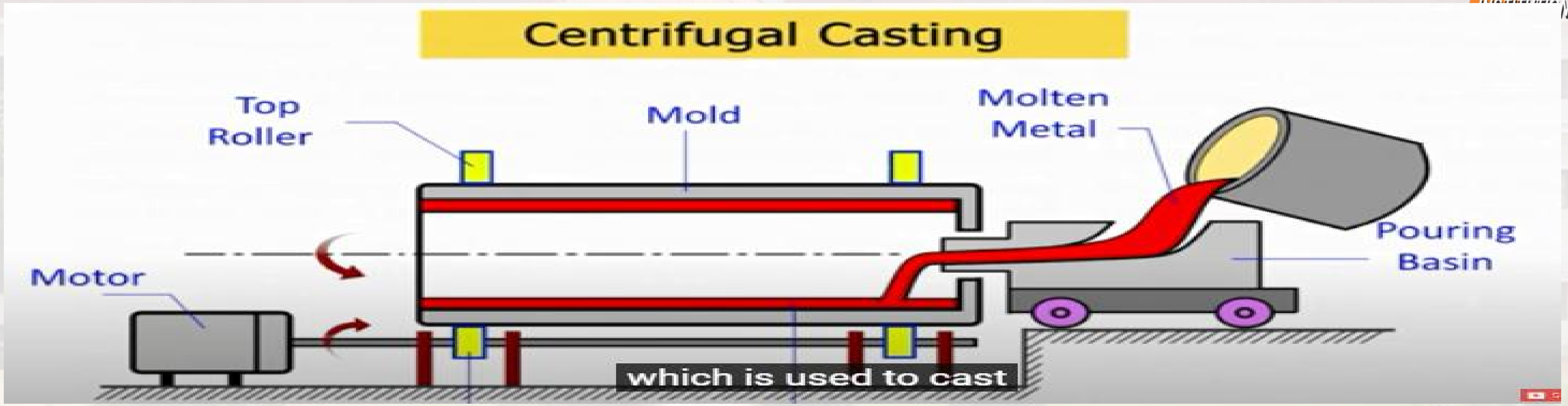
The process involves pouring molten metal into a spinning mold, using centrifugal force to distribute the metal and form the desired shape.

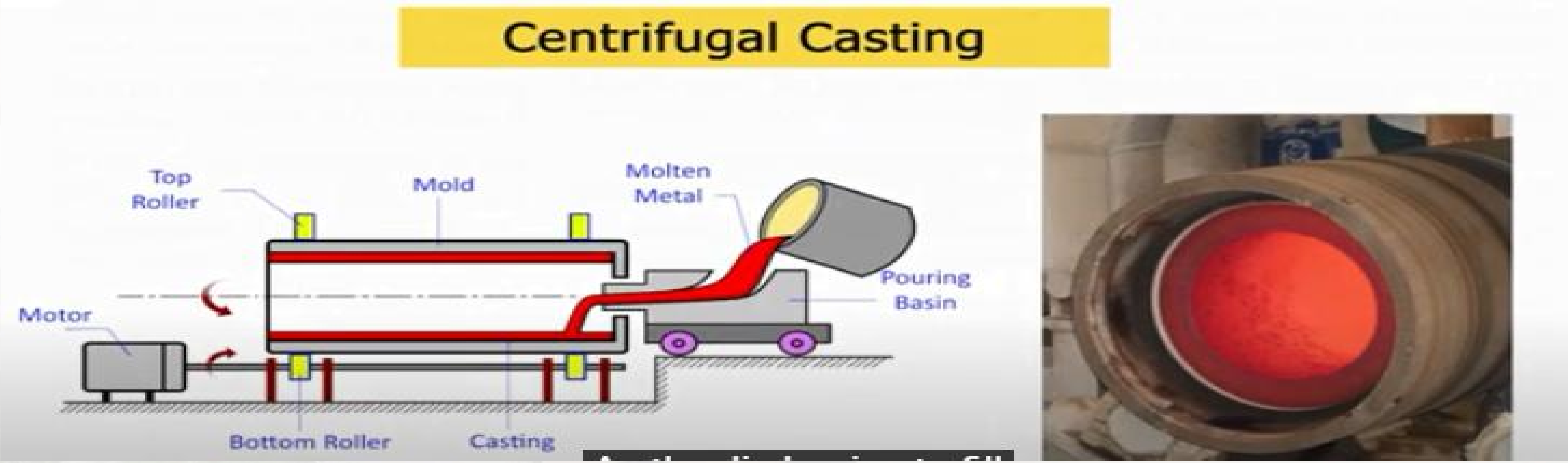
Centrifugal Casting

Steps in Centrifugal Casting

- Mold Preparation
- Molten Metal Pouring
- Metal Distribution
- Solidification
- Cooling and Extraction
- Finishing

Centrifugal Casting





Centrifugal Casting

Mold Preparation

A cylindrical mold, typically made of metal or graphite, is prepared and positioned horizontally or vertically. The mold can be coated with a refractory material to prevent the molten metal from sticking to it and to improve surface finish.

Molten Metal Pouring

The mold is rotated at high speed (centrifugally). Molten metal is poured into the spinning mold. The centrifugal force generated by the rotation causes the molten metal to be pushed outward against the mold walls.

Centrifugal Casting

Metal Distribution

The centrifugal force ensures that the metal is evenly distributed around the mold's circumference, forming a uniform, dense, and defect-free casting. Any impurities or less dense materials tend to be forced toward the center and can be easily removed later.

Solidification

As the molten metal cools, it solidifies against the mold walls, forming the desired shape. The **speed of rotation, mold temperature, and pouring temperature** are carefully controlled to ensure proper solidification and minimize defects.

Centrifugal Casting

Cooling and Extraction

Once the metal has fully solidified, the mold is stopped, and the casting is allowed to cool further. The casting is then removed from the mold.

Finishing

After the casting is removed, any excess material, such as the inner surface layer that may contain impurities, is machined off. Additional finishing processes, like polishing or heat treatment, may be applied to achieve the desired final properties.

Centrifugal Casting

Types of Centrifugal Casting

True Centrifugal Casting

Used for producing hollow, cylindrical parts like **pipes, tubes, and rings**. The mold rotates **horizontally,** and the centrifugal force creates a uniform wall thickness.

Semi-Centrifugal Casting

Used for producing solid parts that are symmetrical, such as **wheels and pulleys.** The mold **rotates vertically,** and the centrifugal force helps in achieving better material distribution and density.

Centrifuging

A variation of centrifugal casting where multiple molds are attached to a central sprue. The assembly is rotated, and the molten metal is distributed into the molds using centrifugal force. This method is typically used for casting smaller parts.

Centrifugal Casting

Advantages of Centrifugal Casting:

High Material Density: The centrifugal force ensures that the **metal is tightly packed,** resulting in castings with high density and low porosity.

Improved Mechanical Properties: The **uniform grain structure and density** result in castings with superior mechanical properties, such as strength and resistance to wear and corrosion.

Cost-Effective for Large Production Runs: Suitable for high-volume production, especially for components like pipes and tubes.

Reduced Material Waste: The process minimizes material waste since the metal is efficiently distributed and impurities are concentrated in areas that can be easily removed.

Centrifugal Casting

Applications:

Pipes and Tubes: Widely used for producing **metal pipes and tubes** in industries such as oil and gas, water treatment, and construction.

Rotating Machinery Components: Ideal for producing **rings, bushings, and other components used in turbines, engines, and pumps.**

Structural Parts: Used in the **automotive and aerospace industries** for producing parts that require high strength and precision.

High-Pressure Vessels: Suitable for creating components that need to withstand high pressure, such as **pressure vessels and gas cylinders.**

Centrifugal casting is particularly valued for producing parts that require high reliability and integrity, making it a popular choice in industries where quality and durability are critical.

Cupola Furnace