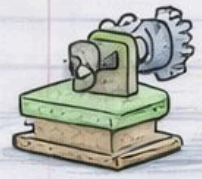


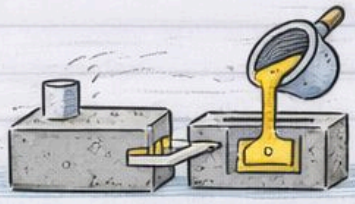
Manufacturing Practices

Module-3 Notes

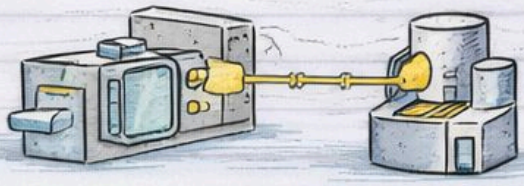
by pyqfort.com

Contents Covered:

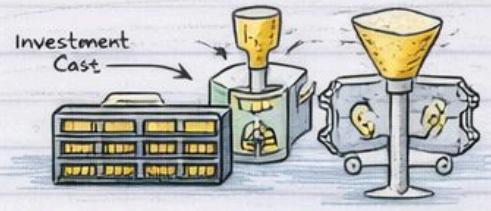
- Intro to Casting



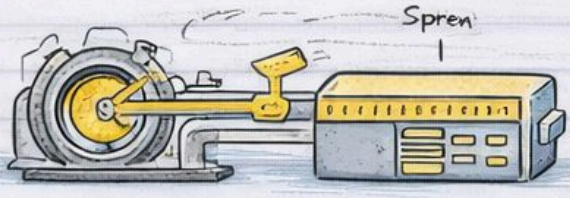
- Die Casting



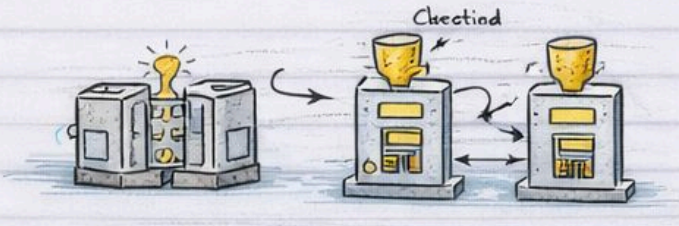
- Precision Casting



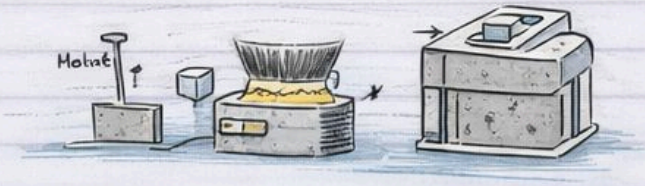
- Centirfrupal Casting



- Pressure Casting



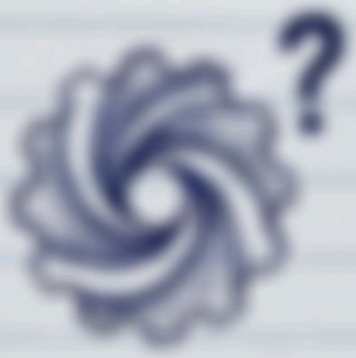
- Pressure Casting



2.1. INTRODUCTION TO CASTING

Casting methods are **universally used** for a **wide variety** of products. **Very small** to **extremely heavy** metal products can be made.

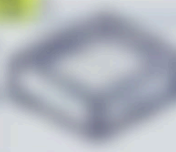
Casting is the **best option** when it is **difficult** or **economically impossible** to **produce an item by another process.**



DIFFICULT SHAPES

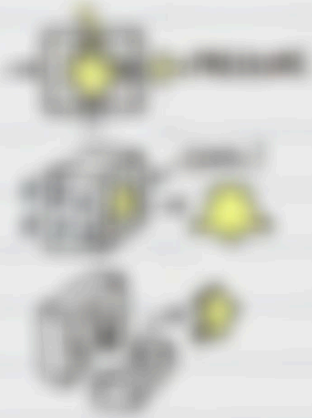
ECONOMICALLY IMPOSSIBLE

Various **casting processes**

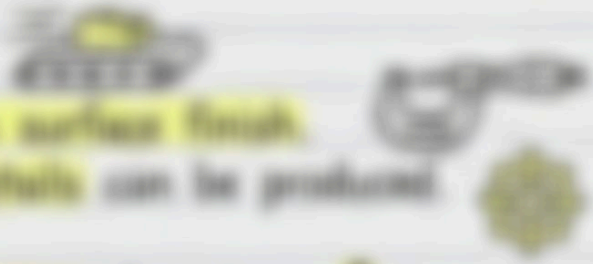
1. **Sand mould** casting ( of sand box).
2. Plaster mould casting
3. **Metallic mould** casting (Gravity, Slush, Pressure, **Die casting** -  of metal die with molten metal)
4. **Centrifugal casting** 
5. Precision casting
6. CO_2 - mould casting
7. Continuous casting

Die Casting Processes

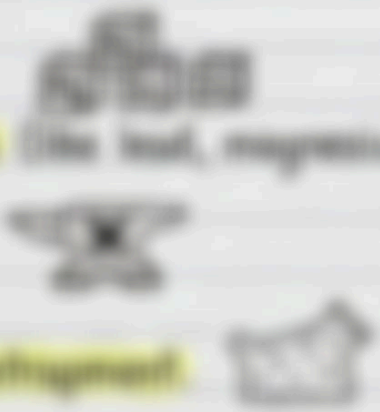
1. The Concept:
   - Process of rapid production of precise castings.
   - Molten metal under pressure is forced into split metal dies to fill the entire die and details.
   - The die is water cooled, so casting solidifies very quickly.
   - The two halves are separated and casting is ejected.



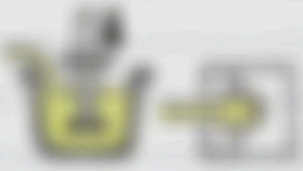
2. Advantages:
   - Very high rate of production.
   - Very precise dimensions & high surface finish.
   - Very thin castings with fine details can be produced.
   - Die has very long life.
   - Low floor space needed & low cost of casting. $

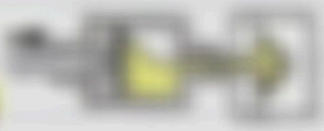


3. Limitations:
   - Not economical for low batch size.
   - More suitable for non-ferrous alloys (like lead, magnesium, tin, zinc).
   - Heavy castings cannot be produced.
   - High cost of equipment and die.
   - Castings have porosity due to air entrapment.



4. Die Casting Machines (Two Types):
   - Hot Chamber (Plunger Type):
     - Molten metal fills channel by gravity.
     - Plunger forces metal into the die.
     - Plunger (made of refractory material) operated manually/mechanically/hydraulically.
   - Cold Chamber (Horizontal Plunger):
     - Chamber operated pneumatically or hydraulically forces charge into die.
     - Suited to aluminium alloys & high melting temp non-ferrous ...Cont.

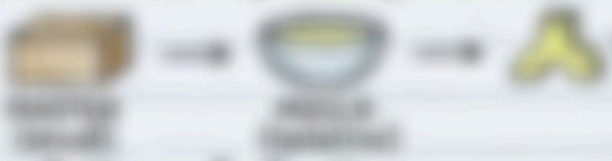




Precision Casting / Lost Wax Process / Investment Moulding

1. **The Concept & Goal**
   - Also known as *'lost wax process'* or *'investment moulding'*.
   - Produces *very precise castings that do not require subsequent machining*.

2. **The Process** (Two Stages):
   - *Stage 1*: Preparation of Master Pattern.
     - A *master pattern* (wood/metal) is used to form a *mould* (plastic/low-melting alloy).
     - *Liquid wax* is poured into this mould to produce the *wax pattern* (*'investment of the pattern'*).



   - *Stage 2*: Wax Pattern & Casting.
     - The *wax pattern* is used to make the *final casting mould*.
     - Crucially, the *wax pattern is not taken out*, *it is melted/lost during the process.*

3. **Advantages**:
   - *High surface finish, machining eliminated/reduced.*
   - *Very thin castings* can be produced.
   - *Complex shaped* castings possible.
   - *Sound and defect-free.*
   - *Suitable for mass production of small castings.*

4. **Limitations**:
   - *Not suitable for heavy* castings.
   - *Requires strict control* at all stages.
   - *Very expensive* process. $$$

5. **Applications**:
   - *Turbines, Motor cars, Sewing machines, Type writers, Calculating machines, Various instruments.*

Centrifugal Casting

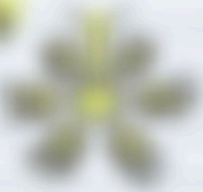
1. The Concept (Process):
   - Molten metal is poured into rotating moulds.
   - Metal is thrown towards the periphery due to centrifugal force under sufficient pressure.

   - Solidification progresses from the outer surface towards.
   - All areas of weakness/impurities are located at the inner wall.

2. Three Types:
   - 1. Fully Centrifugal Casting: Moulds of rotational symmetry (shell/sand) rotated with horizontal axis.
     - Used to produce hollow cylindrical castings (pipes, [illegible] bushings, gun barrels) without a central core.

   - 2. Semi-Centrifugal Casting: Moulds rotated about vertical axis. Metal fed at axis, flows through gates.
     - A dry sand core may be used for the central hole.
     - Used for large castings like gears, disk wheels.

   - 3. Centrifuge Casting: Multiple moulds located radially about a central sprue. Horizontal rotation.
     - Used for shell moulding of small intricate castings.



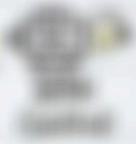
3. Advantages:
   - Castings are completely free from porosity defects.
   - Dense and sound castings.
   - No directional variation of properties.
   - Gates, feeders, and cores are eliminated (in some types).
   - Moulds are cheap and less complicated.
   - Light impurities thrown to outer surface (can be machined out).
   - Weakness at central wall can be machined out.

4. Applications:
   - Hollow cylindrical products (cast iron pipes for water/sewage).
   - Steel gun barrels.
   - Symmetrical castings such as gears, disk wheels, pulleys.

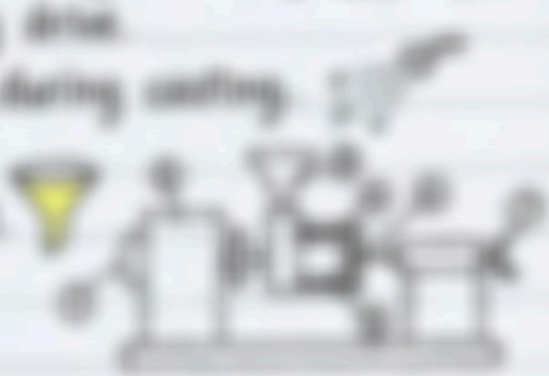
Centrifugal Casting Machines

1. Variable Speed Centrifugal Casting Machine:

- D.C. Motor (3.5 kW, 900–2250 rpm): Provides **variable speed drive**.



- Key Components:
  - **Head stock** & **Tail stock**: Support the rotating assembly.
  - **Clutch plate**: For engaging/disengaging drive.
  - **Cooling water spray**: Cools the mould during casting.
  - **Holding fixture**: Holds the mould.
  - **Feed hopper**: For feeding molten metal.

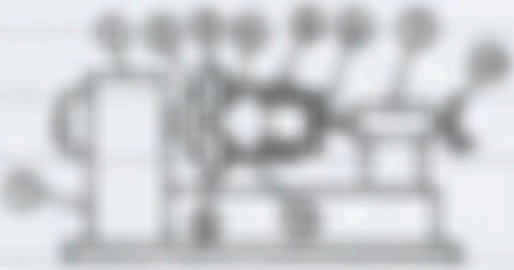


Sketch as per Fig 1.1

2. Centrifugal Casting Machine with Pneumatic Grips:

- Features **pneumatic grips** for holding the mould.

- Key Components:
  - Electric motor & **Variable speed device**: Provide controlled rotation.
  - Head stock with **pneumatic gripping mechanism**.
  - Chuck, Removable plate, Grip plate, Bush, Connecting rod: Form the **gripping assembly**.
  - **Pneumatic cylinder**: Operates the grips.



Sketch as per Fig 1.2

3. Benefits & Speed Selection:

- Ensures **high quality** of babbitting and **improved productivity**.
- Provides **stepless speed regulation** and **fast mounting** of bearing.
- Speed of bearing rotation (n) is selected by formula:

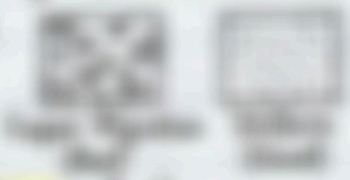
$$n = \frac{1210}{\sqrt{r}}$$

where r = bearing bore radius (cm).

Pressure Casting

1. Purpose & Goal:

- Used to ensure high quality of centrifugal casting of babbitt.
- Prevents copper migration which can occur due to improper rotation speed or cooling rate.

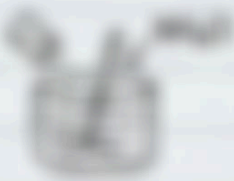


- Achieves a uniform and homogeneous distribution of the structural composition of babbitt lining.
- Crucial for certain applications requiring high reliability.

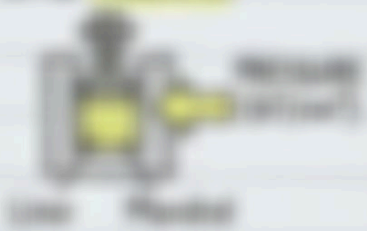
2. The Process (Step-by-Step):

- **Preparation:** Check lining surface of liner. Heat working plunger & grip fixture in a portable electric furnace. Place assembled liner in crucible & mandrel (ensuring machining allowance).

- **Pouring & Mixing:** Pour babbitt and deoxidizer by mixing with dry ammonium chloride using a propeller.



- **Injection:** Open stop valve.
- **Injection:** Open stop valve. Operate the press. The working plunger pushes molten metal through a pipeline and nozzle.
- **Pressure Application:** Metal is forced into the space between the liner and mandrel at a high pressure of 6 tonnes/cm².



- **Cooling & Removal:** Cool liner and grip fixture after a few seconds with compressed air and water spray. Remove liner for inspection.

3. Key Machine Components:

- **Working plunger & Press:** Apply pressure.
- **Electric crucible & Furnace:** Melt and hold the metal.
- **Pipeline & Nozzle:** Direct the flow.
- **Liner & Mandrel:** Form the casting cavity.

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