Subject: MM-141 12/05/24

Exp: 04

## Casting & solidification:

Casting begins with molding. Molds are of sand, ceramics, metals and plaster. There two types of molds:

1) Open mold:

In this molten metal is poured directly in the mold from it's open mouth.

2) Closed mold:

In this molten metal is poured through an opening (downsprue/runner) that connects to the shape of material. There is a riser that compensates for shrinkage.

After some time, the material cools down & is removed. Further processing maybe required.

## Casting types:

1) Expandable casting:

In this, the mold must be sacrificed in order to recover the material. Examples include sand casting.

2) Permanent casting:

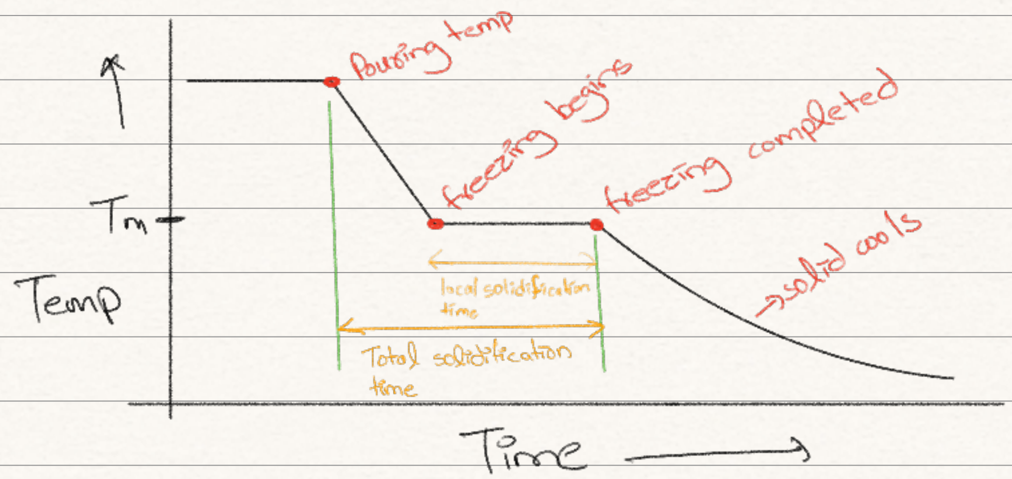
In this, the mold is divided in two sections that open to recover the material. The mold is made of metal, ceramic refactory material. Examples include die casting.

Subject: / /

## Sand casting:

- The mold consists of two parts: cope and drag. The cope is the upper portion of mold and the drag is the lower portion of the mold. These are contained in box called flask.
- The shape is created in the mold by pressing the shape made of wood, plastic into the sand.
- The pattern is made oversized to allow for shrinkage of metal.
- The internal pattern can be created by placing a core in the cavity.
- molten metal is poured through an opening (downsprue /runner) that connects to the shape of material. There is a riser that compensates for shrinkage of the metal as it cools down.

## Pure metals:




## Investment casting:

- Mould created with wax.
- Wax coated with ceramic.
- Wax melted to get mold.

Subject: / /

## Centrifugal casting:

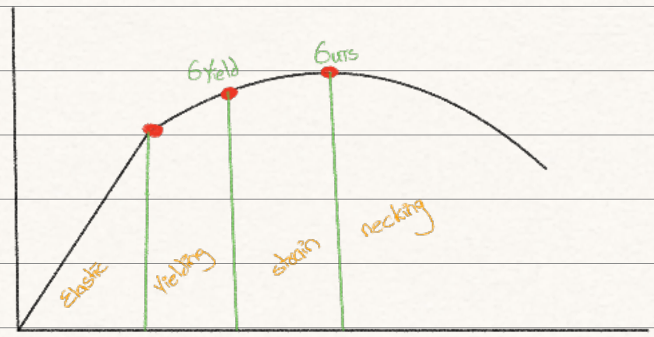
• Molten metal poured in rotating drum at high speeds to long pipes. The molten metal sticks to wall. The speed of rotation affects thickness of final material.

## Alloys:

Most alloys freeze over a temp range rather than a single temp.

## Exp: 07

## Tensile testing of Engineering materials




UTS: Max strength that can be beared by a mat

Yield: Elastic & plastic exist simultaneously.

• ↑Ductile ∝ Necking↑

↳ pure metals → alloys → ceramics

Strain Rate: 1mm/min

$$\text{Tensile strength } st = \frac{F_{max}}{A_0}$$

$$\%\varepsilon = \frac{l - l_0}{l_0} \times 100$$

$$\%A = \frac{A_0 - A}{A_0}$$

Subject: / /

Exp:08

# Hardness testing of engineering materials

## Hardness Test:

↳ Resistance to deformation

### 1) Brinell's test:

Indenter: Hardened steel/tungsten carbide ball
- Load applied
- Diametre of shape created measured. Hardness formulated
- Can't tell hardness of components.

### 2) Vicker's test:

Indenter: Diamond pyramid
- Load applied } less required
- Length of shape created measured. Hardness formulated
- Can tell hardness of components.

### 3) Rockwell's test:

Indenter: Diamond Cone/steel ball
- Load applied → Major (For material) & Minor. For breaking thin layers (10kg)
- Length of shape created measure
- Can tell hardness of components.

| Scale | load | Mark |
|---|---|---|
| A | 60 | Cone |
| B | 100 | sphere |
| C | 150 | Cone |

Subject: / /

4) Nano identation:

For measuring hardness of thin film.

# Exp:09
## Impact testing of Engineering materials

Toughness: Impact absorbtion ability of a material.

Critical temperature:

Temperature at which a material becomes brittle from ductile.

Toughness $\propto$ brittle.

If fracture & yield point are close then material is brittle otherwise ductile.

Reinforcement:

1) Whisker bridging
2) Fibre
3) Grain bridging

- If crack is along grain boundaries then material is ductile.
- If across, then brittle.

Two common types of testing:

- A notch is made to create stress concentrated region. To make sure that materials are tested along a standard.

Subject: / /

## 1) Charpy testing:

- Sample is horizontally placed.

For metals used in constructions

## 2) Izod testing:

- Sample is vertically placed.

For plastics & composites.

# Exp 10:

## Atomic force microscopy

Tells topography of a material.

## 1) Contact mode:

- The tip is in continous contact with material.
- The force is kept constant adjusting height.

## 2) Tapping mode:

- Tip is tapping on material.
- The amplitude is kept constant

## 3) Non-contact mode:

- Tip hovers over sample

Subject:

• The interaction of forces changes tip's oscillation frequency or amplitude.

4) Force modulation:

• Tip occilates at a certain frequency
• Changes in amplitude & phase of oscillation tells about stiffness & adhesion forces.

Exp 11:
X-ray diffraction