Casting

- **casting** is a process in which a liquid metal is poured in a mould cavity and allowed to solidify. Then part is removed which is called casting.
- Basing on type of mould classified into two types.
- 1. expendable or disposable casting
- 2. permanent or reusable casting

- Expendable moulds are made up of sand, plaster, ceramics, wax, shell moulds
- Permanent moulds are made up of metals(steel, cast iron, aluminium, brass), wood(pine, teak, mahogany)
- Thermo-setting plastics

Steps involved in casting

- 1.making a pattern of the parts with all details
- 2.making a mould by packing with sand around the pattern and then removing the pattern to leave a cavity
- Inserting cores if required
- Melting and pouring the molten metal into the mould. After solidification casting is removed
- Fettling, inspection and finishing.

Pattern making

- Pattern is the replica or full size model of casting to be made. It gives its shape to the mould cavity where the molten metal solidifies to the desired form and size.

- It should be simple in design for ease of manufacturing and enable to draw easily from the sand. Pattern should retain its dimensions during the service period.

Pattern allowances

- 1.shrinkage allowance: the pattern must be made oversize to compensate for contraction of solid metal on cooling. This addition to the of the pattern is known as shrinkage allowance.
- 2.finishing(machining) allowance: the excess in the dimentsions of the casting over the finished casting is called finishing allowance.

- 3. Draft allowance: The provision of taper on vertical faces of the pattern is called draft.
- 4. distortion allowance: It is applied to the castings of irregular shapes that are distorted in cooling because of metal shrinkage.
- 5. Rapping (shake) allowance: To draw the pattern from the mould cavity it is slightly rapped to make it free from the mould.

Types of pattern

- Solid pattern (single piece)
- Split pattern
- Match plate pattern
- Gated pattern
- Cope and drag pattern
- Loose piece pattern
- Segmental pattern
- Follow board pattern
- Shell pattern

- Special pattern
- i) sweep pattern
- Ii) skeleton pattern
- Colour coding:
- Surface to be left un machined - Black
- Surface to be machined – Red
- IS:1513
- Surface to be un machined – Blue(steel)
- Surface to be machined - Yellow

Moulding procedure

- The drag is placed upside down on moulding board. Pattern is kept inside the flask. Parting power is dusted on pattern surface. Next facing sand is riddled on the face to a depth of 25mm. The drag is filled with backing sand.
- The mould is vented. The drag is now turned over. The cope is now placed on drag. Sprue and riser pins are placed in position.

- Sand is filled in the cope and rammed. Excess sand is removed. Sprue and riser pins are withdrawn , cope is vented.
- The mould is closed by positioning the cope on drag and clamped.
- Allowed to solidification
- Remove the clamps , separate the cope and drag.
- Remove the Casting from the mould.

Moulding materials

- Silica sand 70-85%, clay 10-20%, water 3-6%, additives 1-6%
- Natural sand 5-20% clay
- Synthetic sand 3-5% clay, 3-4% water
- Special sand Zr,Al, Cr, Mg silicates.
- According to use:
- Green sand-clay-18-30% water-6-8%
- Dry sand-6-8% clay and additives
- Loam sand-clay 50% for large castings.

- Facing sand-20-25% coal dust.
- Backing sand – to support facing sand
- System sand- reconditioned sand
- Parting sand-very fine brick powder
- Core sand-silica mixed with linseed oil, resins and other binding material.
- Binders: clay, cereals, linseed oil, resins, pitch, cement and sodium silicates.
- Additives: coal dust, wood flour, silica flour, iron oxide powder.

Properties of moulding sand

- Porosity(permeability)-steam, gases
- Plasticity-good impression.
- Floability-
- Collapsibility-
- Adhesiveness-stick on the surface of moulding box
- Cohesiveness-stick to each other to hold sand grains
- Refractoriness-

- Sprue, A1/A = sq.root h/h1
- Runner,
- Gates, pressurised 1:0.75:0.5, 1:1:0.7
- unpressurised 1:2:2, 1:3:3,
- Pouring time
- Rate of flow.
- Risers
- Vents.

Special casting processes

- 1. shell moulding:
- Preparation of thin shell-5% thermo-setting resin is heated about 250 c about 30 sec.
- Coal dust and lubricants are added.
- Separating the shell from the pattern when thickness 5-10mm. Curing it for 2min at 315c.
- The shell is further hardened by final curing for few min. at 320c.

- 2. Investment casting:
- A) Wax is melted and injected at a pressure of 3.5 to 7 n/mm2. into a master die.
- Entire assembly is coated by dropping in a refractory slurry.
- Flask is heated at 100-150c.
- The mould is heated 650-1000c.
- Small castings only.

- B) Mercast process: mercury is injected into a master die and cooled to -40c by submerging in refrigerated acetone
- The frozen pattern is dipped in a ceramic slurry bath until a shell thickness 3mm.
- By heating mercury runs out. The shell is dried at 100c.
- Good surface finish.

3.CO2 moulding

- Fine silica sand is mixed with 3-5% sodium silicate. CO2 gas is allowed 10 -30sec. Chemical reaction takes place. Sodium carbonate and silica gel are formed.
- It gives harder sand mould.
- The collapsibility is improved by adding 1% of wood powder or coal dust.
- Cores are making in this method.

4. Permanent mould casting

- In this mould or die is made from metal.
- It is made in two halves for easy opening and closing.
- The mould is coated with refractory material.
- When die closed, molten metal poured into it and as soon as molten metal solidifies the die is opened and casting is removed.
- No. of components with uniform structure.

5.Die casting

- Die casting involves use of permanent metal moulds or dies.
- One part of die is fixed and the other part is moved away or removing the casting.
- Forcing by plunger of molten metal into die cavity under pressure and maintains the pressure until it solidifies.
- A ram is used for opening and closing the die halves.

6.Centrifugal casting

- This is the method of producing castings in a rotating mould.
- The molten metal is poured into mould while it is in rotation at a speed of 1500 rpm.
- Centrifugal force spreads the molten metal uniformly along the entire length of the mould and holds it there until solidification is complete.
- This results hollow castings such as pipes and tubes with uniform thickness.

7.Continuous casting

- In continuous casting the liquid metal is directly poured from the ladle into the tundish uniformly and continuously flow into the top of bottomless graphite or water cooled copper mould .
- A solid skin is quickly formed at the mould metal interface and is further solidified by intensive cooling with water spray as cooling moves down.
- As the casting produces from the bottom of the pinch rolls, it is cut to desired lengths.

- Advantages: very small to very large size.
- Intricate components with cavities with accuracy and good surface finish.
- Some metals which can only be cast.
- Mass production
- Resists creep
- Limitations: Not suitable for the metals having high melting point and low fluidity.
- Do not exhibit directional properties. Strength and toughness inferior to forging.

Casting defects

- 1.blow holes, porosity-voids or cavities by dissolved gases
- 2.Misrun and cold shuts- incomplete casting that has solidifies before completely filling the mould cavity.
- 3.Hot tears-cracks formed by contraction just after solidification.
- 4.shrinkage cavities- lack of molten metal in the last region of solidification.

- 5.Mismatch-shift of individual parts of casting with respect to each other.
- 6.Dross and slag inclusion-Oxides produced during melting.
- 7.Fins or flash-thin projections along the mould joint
- 8.Swell-expansion of mould cavity by metal pressure.
- 9.scabs-lumps of excess metal as a result of erosion of mould by stream of molten metal.

- 10.penetration-Molten metal penetrate into sand mould due to high fluidity.
- 11.warping or distortion-change in shape due to internal stresses.
- 12.runout- leak out of molten metal from the mould during pouring.
- 13.Drop-portion of sand falls from the top of the mould into the molten metal.