UNIT: 6
Foundry

STRUCTURE

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INTRODUCTION:

Manufacturing is the art of transforming raw materials into finished products. Foundry work deals with manufacture of products from molten metal and the products obtained are called castings. Castings are produced when the molten metal is poured into mould cavity and left to solidify. Casting or founding is one of the cheapest methods of producing parts to a given shape.

ADVANTAGES AND DISADVANTAGES OF CASTING

Advantages:

- Size of the casting is not a limitation. Castings may weight as much as200 tons or be as small as a wire of 0.5 mm diameter. In fact, casting is the only method available for producing massive objects in one single piece.
- The most simple or complex curved surfaces, inside or outside, and complicated shapes, which would otherwise be very difficult or impossible to machine forge, or fabricate, can usually be cast.
- As the metal can be placed exactly where it is required, large saving in weight is achieved.
- The casting process is ideally suited to the production of models or prototypes required for creating new designs.
- Castings offer the most complete range of mechanical and physical properties available in metals.
- Casting is usually found to be the cheapest method of metal shaping.
- Castings can be made to fairly close dimensional tolerances by choosing the proper type of moulding and casting process.

- Casting is adaptable to all types of production, i.e job, batch or mass production.

Disadvantages:

- The strength and toughness of casting is usually inferior to forgings.
- The process is not suitable for the metals having high melting point and low fluidity.
- A large number of defects occur in sand castings produced through various methods.
- Uneconomical for producing castings is small quantities and not expecting repeat orders.

FOUNDRY EQUIPMENT AND HAND MOULDING TOOLS:

Foundry tools and equipment may be classified into three groups namely hand tools, flasks and mechanical tools.

Hand Tools in Moulding:

1. Moulding Board:

It is a smooth wooden board, made slightly bigger size than moulding box. Pattern is placed on a moulding board and Moulding box placed found it, at the starting of mould. It also supports foe mould until the casting is solidified.

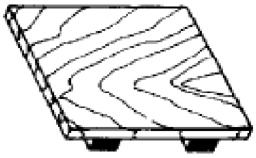

Fig 6.1 Moulding Board

2. Shovel:

It is used for mixing and tempering the moulding sand and loading the sand into flask.

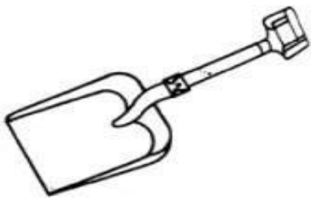

Fig 6.2 Shovel

3. Riddle:

It is a wire mesh fitted in to a wooden frame used for screening the sand and to scatter the fine moulding sand over pattern.

Fig 6.3 Riddle

4. Rammer:

These are used for packing the sand around the pattern in a flask. This is made of hard wood with one end flat and other wedge.

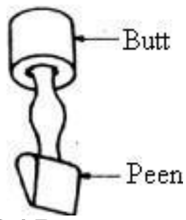

Fig 6.4 Rammer

5. Trowels:

These are used for cleaning, smoothing and patching the flat surface of the mould.

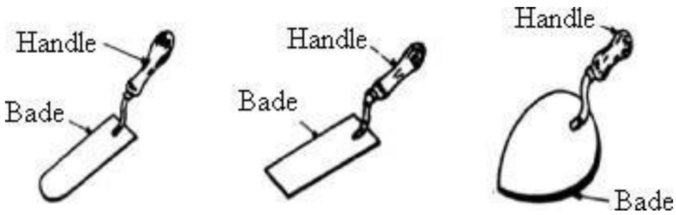

Fig 6.5 Types of Trowels

6. Slick:

It has a flat on one end and spoon on the other end. It is used for patching and smoothing the mould after the pattern has been drawn.

Fig 6.6 Slick

7. Lifter:

It is used for removing the sand particles from the mould.

Fig 6.7 Lifter

8. Strike of bar:

This is used to cutting off extra sand after ramming and bringing it to level with the surface.

Fig 6.8 Strike of bar

9. Bellow:

These are used to blow excess parting material form the pattern and also to blow loose sand particles from the mould.

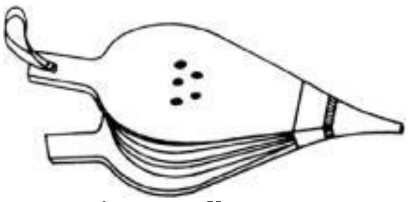

Fig 6.9 Bellow

10. Sprue Pin:

Pin used to make riser hole called riser pin.

Fig 6.10 Sprue Pin

11. Swab:

It is soft brush used for moistening the sand around the pattern.

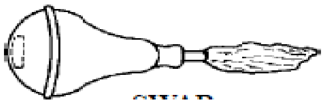

Fig 6.11 Swab

12. Gate Cutter:

It is a piece of steel sheet bent in the form used to cut gates.

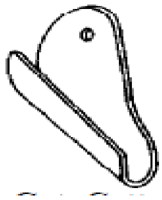

Fig 6.12 Gate Cutter

13. Mallet:

It is used to loosen the pattern to withdraw it from the mould and for stripping the core box from the cores.

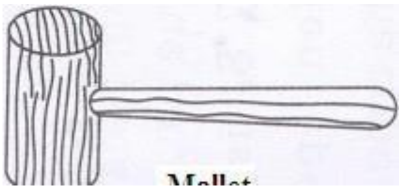

Fig 6.13 Mallet

14. Vent rod:

It is used to make series of small holes to permit gasses to escape while molten metal in being poured.

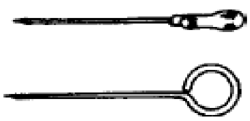

Fig 6.14 Vent Rod

15. Draw Spike:

It is used to rap and draw patterns from the sand.

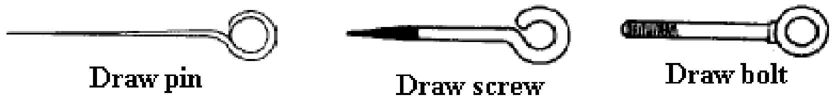

Fig 6.15 Types of Draw spike

16. Water Sprinkle:

It is a device used for wetting and tempering the mouldsand.

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Fig 6.16 Water sprinkler

17. Spirit Level:

It is used for aligning flasks and adjusting the straight edges in pit moulding.

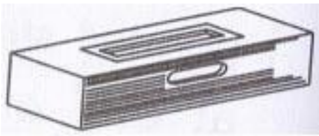


Fig 6.17 Spirit Level

18. Rapper:

Rapper is a fork-shaped rod used to drive the draw pattern, and then is used to rap the pattern from side-to-side, facilitate easy removal of pattern from mould.

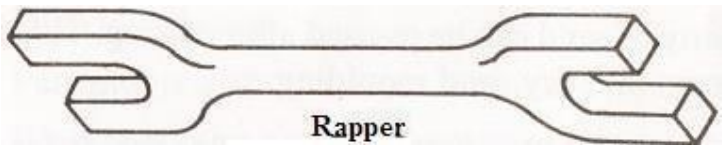


Fig 6.18 Rapper

19. Rapping plate or Lifting Plate :

Rapping or lifting plates are usually made of and used to facilitate the lifting the pattern from mould. It is fixed to large wooden pattern such that the top of plate is even with the parting line surface of the pattern.

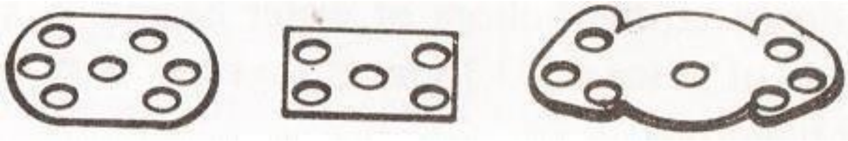


Fig 6.19 Rapping plate

20. Pouring weight:

It is a piece of metal placed on the mould to prevent the separation of the cope from the drag while the casting is being poured.

21. Gaggers:

These are iron or steel rods bent at ends, and are used to support the hanging masses of sand.

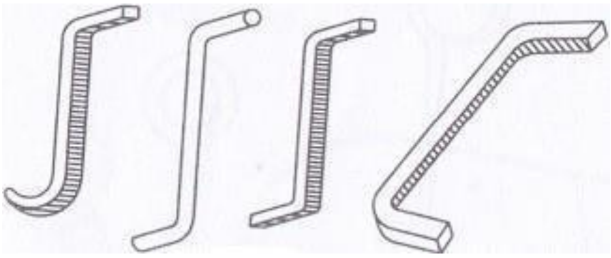


Fig 6.20 Gaggers

22. Clamps:

Clamps are locking devices used to hold the parts (i.e. cope and drag) of a completed mould together during the pouring.

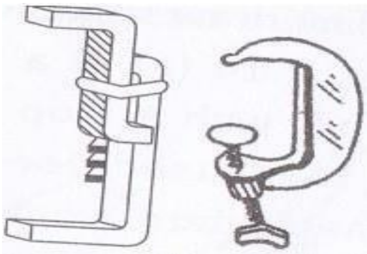


Fig 6.21 Clamp

23. Shake bag:

It is made from loosely woven cotton cloth and is used for dusting parting compound on the mould surfaces.

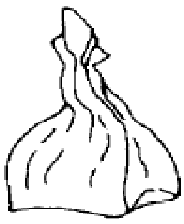


Fig 6.22 Shake bag

24. Flask

Sand moulds are prepared in specially constructed boxes called flasks. The purpose of flask is to impart the necessary strength to the sand in moulding. Moulding flask is generally made into two parts. The Cope (Top section) and the drag (bottom section). These two are held in position by pins. The common types of moulding boxes are snap flask, box flask and wooden moulding boxes.

25. Snap flask:

It is a small flask with open form. It is made with hinge on one corner and a lock on the opposite corner. It can be removed from the mould before it is poured.

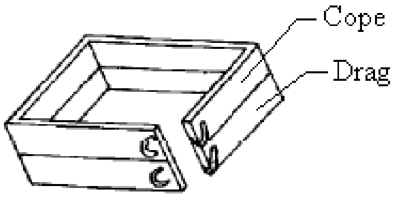


Fig 6.23 Snap Flask

26. Box Flask:

It is suitable for small and medium size castings, it is removed from the mould only after solidification of casting.

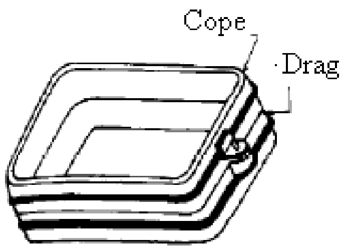


Fig 6.24 Box Flask

27. Wooden Moulding Boxes:

Wooden boxes are often used for making relatively large castings.

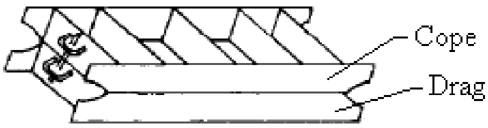


Fig 6.25 Wooden Moulding Flask

Mechanical Tools

These tools in the foundry include the many types of moulding machines that will ram the mould, roll it over and draw the pattern. Besides there are power operated riddles sand mixtures and sand conveyers etc.

TYPES OF MOULDING SAND AND PROPERTIES:

Probably the greatest advantage of sand as a moulding material is its versatility. A wide range of alloys can be cast into sand as it has a high tolerance for thermal shock. Thus relatively low melting point aluminum and magnesium alloys are sand cast as well as alloy steels. Furthermore, the mass of a casting is not a limiting factor. The majority of sand can be re- used after casting. This is particularly in the case of green and dry sand moulding.

Sand is formed by the disintegration of rocks under the action frost, wind and rain. In natural conditions, both large and small sand particles settle down on the bottom of water basins. Sand suitable for moulding consists of silica (SiO2) grains together with sufficient clay to act as binding materials.

Classifications of Moulding Sand

Moulding sand is classified as under:

1. According to the native of its origin.

1. Natural sand 2.Synthetic sand 3.Special sand

2. According to their initial condition (i.e. Green or dry) and use:

1. Greensand	2. Dry sand	3. Loam sand
4. Facing sand	5. Backing sand	6.System sand
7. Parting sand	8. Core sand	

Natural Sand

Natural sand is collected like river beds or it dug from pits Natural proportion of clay (5-20%) is referred as TSS 3TS requires only to mix water with aggregate (sand- clay mixture).The clay develops the strength and plasticity for moulding. They are less refractory than synthetic sand. But, they have the advantage of maintaining moisture content for a long time and permitting easy patching and finishing of mould. This sand is used for non-ferrous castings and gray iron castings.

Synthetic Sand

Synthetic sand is essentially high silica grains containing no clay in natural form. They are mixed with clay (3 to 5% bentonite) and water (3 to 4%) to develop required moulding properties. It is used for steel castings.

Special Sand

Special sands are high refractory materials used for obtaining smoother surface of castings. They include Zirconium ($ZrSiO_4$), Olivine ($MgSiO_4$), Chromite ($FeO.Cr_2O_3$), Magnesite ($MgCO_3$) and Chromate ($3Al_2O_3SiO_2$).

Properties of Moulding Sand

Proper moulding sand must possess seven important properties.

1. Porosity:

The sand should have sufficiently porous to provide a passage for steam and gases otherwise the gases penetrate into metal which leads to the formation of gas cavities in casting.

2. Plasticity:

It is the ability of as and to acquire shape from the pattern that is moulded and retains it during casting.

3. Flowability:

It is the ability to flow under externally applied forces in to deeper sections of pattern and uniformly fill the flask.

4. Collapsibility:

It is the property of sand that permits it to collapse easily during its knockout from the casting.

5. Adhesiveness:

It is the ability of sand to stick to the surfaces of moulding boxes. This enables the mould to retain in a box during handling.

6. Cohesiveness:

It is the ability of sand particles to stick each other. It refers to the strength of moldings and to hold the grains together.

7. Refractoriness:

It is the ability of sand to with stand the heat of molten metal without fusion.

MOULDING SAND MIXTURES

Sand mixtures are those materials which are added to the moulding sand to improve upon some of its existing properties or to impart certain new properties to it. Some commonly used mixtures are coal dust, wood flour, silica flour and iron oxide.

Coal Dust or Sea Coal:

It is finely pulverized bituminous coal. It improves the surface finish, aids in cleaning of castings and prevents burning on sand.

Wood Flour:

It is a finely pulverized or ground soft wood. It improves finish, prevents burning on sand. It aids cleaning and improves collapsibility.

Silica Flour

It is finely ground silica sand of less than 54 microns. It fills interstices (voids) and thus reduces metal penetration.

Iron Oxide

Generally iron oxide is available in powder form. It is added to moulding sand to increase dry strength. It is also added to core sand to improve collapsibility.

PATTERN

Pattern is the replica or full size model of castings to be made. It gives its shape to the mould cavity where the molten metal solidifies to the desired for sand size. The design of casting should be as simple as possible to the pattern easy to draw from the sand and avoid more cores than necessary

These are made in two parts. One part is produced in drag and the other in cope. They are kept in position by dowel pins, and the split is usually arranged along the parting line.

Classification of Patterns

The type of pattern used depends upon the design of casting, complexity of shape, the number of castings required, moulding process, surface finish and accuracy. The following types of patterns are in common use.

1. Solid (single piece) pattern
2. Split pattern
3. Match plate pattern
4. Gated pattern
5. Sweep pattern
6. Cope and drag pattern
7. Skelton pattern
8. Loose piece pattern
9. Segmental pattern
10. Follow board pattern
11. Shell pattern

Solid Pattern

It is made in single piece and is best suited for limited production.

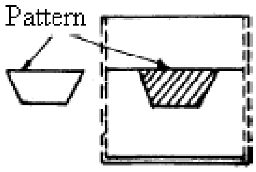


Fig 6.26 Solid Pattern

Split Pattern

It is used for intricate casting of unusual shapes. Split pattern may be two or three piece.

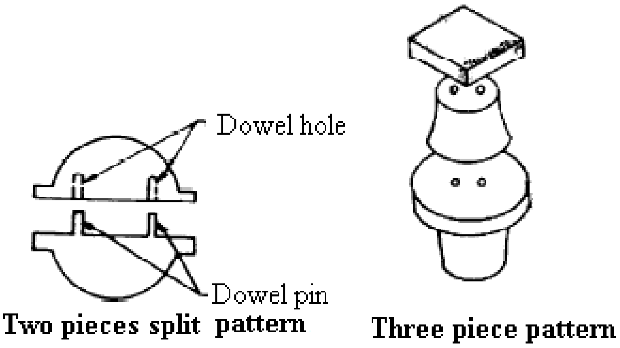


Fig 6.27 Split pattern

Match Plate Pattern

These patterns are mostly used in machine moulding as well as for producing large number of small castings by hand moulding.

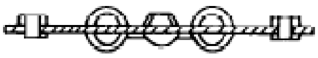


Fig 6.28 Match plate pattern

Gated Pattern

These patterns include gates and risers for producing casting. The use of gated pattern eliminates the time required to cut the gating system by hand.

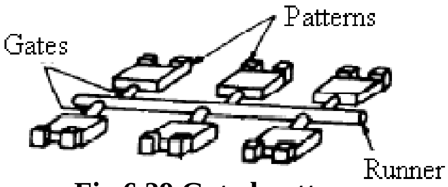


Fig 6.29 Gated pattern

Sweep Pattern

The template made of wood or metal revolving around a fixed axis in the mould shapes the sand to the desired contour. It is suitable for production of symmetrical castings.

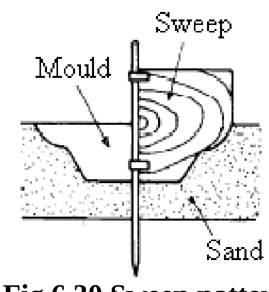


Fig 6.30 Sweep pattern

Cope and Drag Pattern

This pattern is made of two halves which are mounted on different plates. In this case, cope and drag parts of the mould are made separately.

Skelton Pattern

Skelton pattern is used for making large castings in small number. This consists of a simple wooden frame outlining the shape of casting. This frame work is filled with loam sand and rammed.

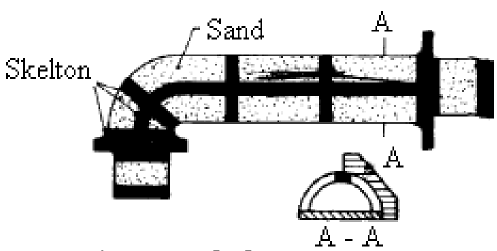


Fig 6.31 Skeleton pattern

Loose Piece Patterns

Loose piece pattern is used to produce the castings having projections in the sides. Such design makes impossible to draw the pattern from the mould. It is therefore necessary to make such projection in loose piece and fastened to main pattern by means of anchor. During the moulding the anchor pin is removed keeping loose piece in place. After completing mould, the main pattern is drawn, the loose piece remains in the mould but it is later removed with the help of pointed lifter.

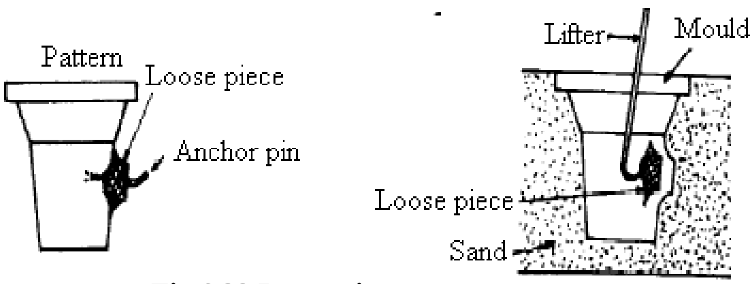


Fig 6.32 Loose piece pattern

Segmental Pattern

It is actually in the form of segment and used for moulding parts having circular sections such as rings, wheel rims and gears. This pattern revolves about centre and after ramming one section, it moves forward to another section to complete mould.

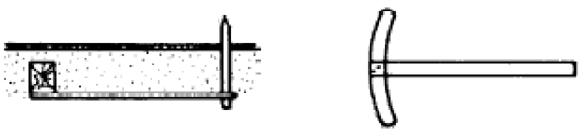


Fig 6.33 Segmental Pattern

Follow Board Pattern

It is used for making thin walled castings. Ramming of thin walled pattern may present problems such as sagging, breakage of pattern etc. It is therefore necessary to support pattern on block (follow board) that fit inside the pattern. Follow board is removed after ramming drag and the ramming of the cope then proceeds.

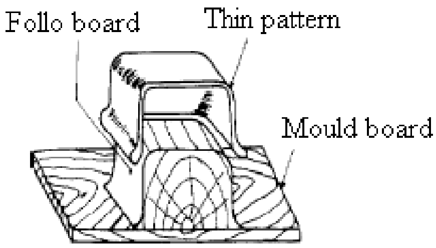


Fig 6.34 Follow Board Pattern

Shell Pattern

It is a hollow construction and its outside shape is used as pattern while in side is used as core box for making cores. The patterns are made in two halves and are accurately doweled together along parting line. It is mostly used for drainage fittings and pipe work.

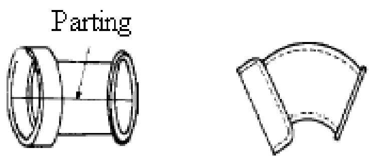


Fig 6.35 Shell Pattern

CORE AND TYPES OF CORE

Core is defined as bodies of sand, designed to form holes and cavities in castings. Cores are placed in the mould cavity before pouring to form the interior surface of the casting and are removed from finished part during shakeout and further processing.

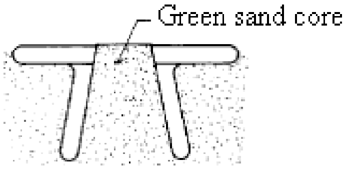
Types of Cores

Core may be classified as

1. **According to the Material used for Core.**
   a. Green-sand Core
   b. Dry-sand Core
2. **According to the position of Core.**
   a. Horizontal Core
   b. Vertical Core
   c. Balanced Core
   d. Cover and hanging Core
   e. Wing Core or Stop off Core
   f. Ram-up Core
   g. Kiss Core

Green sand Core

Green sand Core is formed by the pattern and made from the same sand as the rest of the mould. They require no Core prints. But green sand Cores have a relatively low strength. For more complex shapes, green sand Cores are not used,



because it is not possible to withdraw pattern from the mould.

Fig 6.36 Green sand Core

Dry sand Core

Dry sand Core is formed separately and inserted in the mould after pattern is withdrawn. These are held and positioned at a proper seat (formed by the Core prints) in the mould.

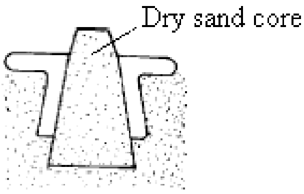


Fig 6.37 Dry sand Core

Horizontal Core

This Core is usually in cylindrical form. Horizontal Cores are laid down horizontally at the parting line of the mould.

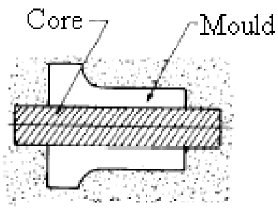


Fig 6.38 Horizontal Core

Vertical Core

Vertical Core is placed vertically in cope and drag of the mould. Taper is provided at top (i.e. at cope Core print) and bottom (i.e. at drag Core print). The amount of taper at the top is about 10 to 15° and at the bottom30.

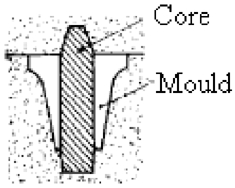


Fig 6.39 Vertical Core

Balanced Core

A balanced Core has a single Core print in the mould and is used to make a casting with blind hole (not through hole). To support long Cores in the mould cavity, chaplets are often used.

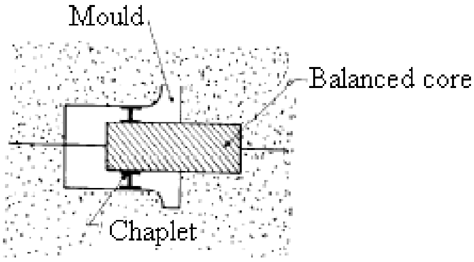


Fig 6.40 Balanced Core

Cover and hanging Cores

These are used when the pattern is rammed in the drag. A Core having its support at the drag is called cover Core and a Core hanging from the cope and does not have any support at the bottom (i.e. in the drag)is called hanging Core.

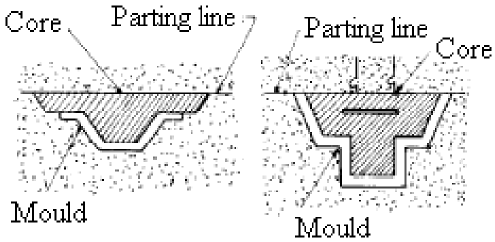


Fig 6.41Cover and hanging Core

Wing Core or Stop-off Core

It may be used when a hole is desired in the casting either above or below the parting line. A part of the Core that is placed in the seat becomes a stop-off (i.e. prevents the flow of metal into a cavity) and forms a surface of casting.

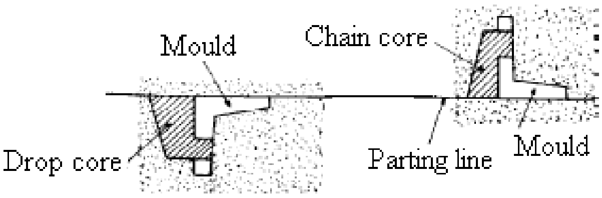


Fig 6.42 Wing Core

Ram-up Core

Ram-up Core is set in the mould along with pattern before ramming. It is used to make details in an in accessible position of casting.

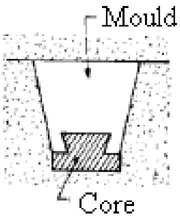


Fig 6.43 Ram-up Core

Kiss Core

When the pattern is not provided Core prints (i.e. no seat is available in the mould), the Core is held between cope and drag by the pressure of the cope. It is known as kiss Core and used to make holes in the casting in which the relative location of holes is not important.

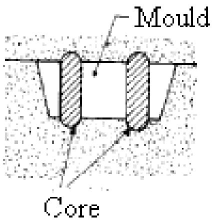


Fig 6.44 Kiss Core

MOULDING PROCESS

The Moulding processes may be classified as follows

1. According to the material used

a. Bench Moulding
b. Floor Moulding
c. Pit Moulding
d. Machine Moulding

2. According to the mould materials used

a. Green sand Moulding
b. Dry sand Moulding
c. Ceramic Moulding
d. Shell Moulding
e. Loam Moulding
f. Cement bonded Moulding
g. Skin-dried sand Moulding
h. CO_2 – process

3. Special casting methods

a. Die casting b. Centrifugal casting c. Investment casting

Bench Moulding

It is employed for small castings. In bench Moulding, Moulding flasks are kept on a bench of convenient height and mould is prepared as usual.

Floor Moulding

This method is adaptable to the production of large castings. In this case the mould is made on the foundry floor. It is simple and does not require equipment. However, it requires large manual work.

Pit Moulding

In this case mould is made in a pit, dug in a foundry floor. The pit acts as drag of Moulding box and a separate cope may be used. It is preferred for extremely large castings.

Machine Moulding

Machine Moulding is largely employed in batch and mass production. It enables higher output, accuracy of casting sand elimination of hard work of moulder. The Moulding machines perform the number of operations such as ramming of sand, removal of pattern and cutting the gates.

Green sand Moulding

This Moulding uses moist added to withstand the forces as the molten the mould. Green sand moulds are widely used metal is Poured medium castings. In this case no drying process of mould and the molten metal is poured as soon as the mould is prepared necessary is in the moist state at the time of metal pouring. The term green mould the moisture and not the colour of the sand.

Advantages:

- It is the least expensive method.
- It requires less time to prepare.
- It does not require any baking operation.
- Flasks are ready for reuse in minimum time.
- Less distortion of mould.
- Less danger of hot tearing of castings.
- Versatile-sand is reusable.

Disadvantages:

- Sand control is more critical.
- Moisture in the sand may causes defects like blowholes.
- Surface finish and dimensional accuracy of large castings.
- Mould lacks strength and erosion of mould is more common in the production of large casting.

Dry sand Moulding

Dry sand moulds are prepared in similar way green sand moulds except that the mould is dried before pouring molten metal. Drying (or baking) is usually carried in oven at about 240°C. The time of baking is depends on the binders used in the sand mixture and the amount of mould surface to be dried. The removal of moisture makes the mould stronger, improves erosion resistance and surface conditions.

Advantages:

- Stronger than green sand moulds, and less susceptible to damage in handling.
- Defects caused by the presence of moisture are avoided.
- Dimensional accuracy and surface finish are better than green sand mould.

Disadvantages:

- Cost of production is high.
- Production rate is slower.
- Mould distortion is greater.
- Castings are more susceptible to hot tears.
- It is not suitable for light and intricate castings.

Ceramic Moulding

Ceramic Moulding techniques employ a metal pattern and the pattern is kept in a flask. Thick slurry of refractory material (fine grained Zircon and alumina or silica) is applied to exposed pattern surfaces. The coating becomes tacky almost on contact and is ready to receive backing material. An in expensive, coarse backing slurry is poured rapidly over the facing coat until the flask is filled. It sets in about 3-5 minutes. The pattern is then withdrawn, and the ceramic mass removed from the flask is treated with catalyst (hardening fluid) to stabilize it chemically. The mould is then heated at about 980°C in a furnace to expel the liquid binder completely. The molten metal is then poured and the moulds are allowed to cool down slowly.

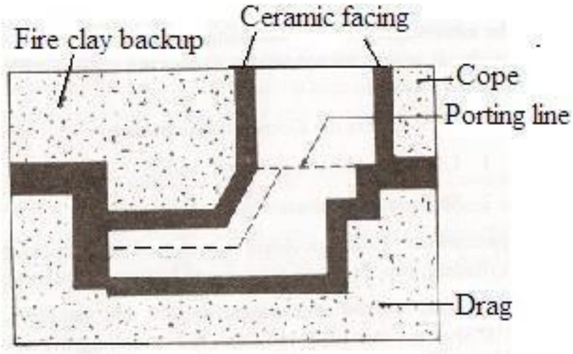


Fig 6.45 Ceramic Moulding

Advantages:

- Produce castings of highest precision and extremely high surface finish.
- A casting produced does not require machining.
- Process is suitable for all types of cast metals including highly reactive metals, such as titanium and uranium.
- Intricate castings with thin section can be produced.

Disadvantages:

- The process is expensive, because mould materials are costly and not reusable.
- Likely to produce parting line defects.

Shell Moulding

It is basically a sand Moulding in which the clay is replaced by resin bonding agent. It consists of the following steps.

Preparation of thin shell:

Fine silica sand (free from clay) is thoroughly mixed with about 5% thermosetting resin binder such as phenol-formaldehyde and placed into a container (dump box). The metal pattern plate is heated to about 250° C in an oven and is clamped to the top of the dump box as in Fig. (a). The metal patterns incorporates ejector pins to facilitate stripping of the completed mould. The dump box is inverted so that the sand resin mixture covers the pattern. After about 30 seconds, the resin cures causing the bonding of sand grains to form a shell around a pattern.

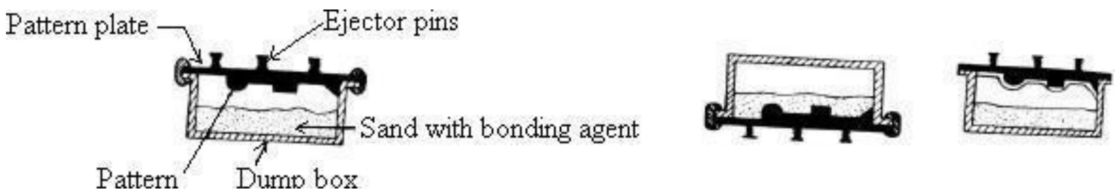


Fig 6.46 Partition of shell

Separating the shell from pattern:

The dump plate is returned to its original position and the surplus sand mixture falls back into the box. The pattern plate is removed and the shell is released by the ejector pins. The shells are light and thin, usually 5-10 mm thick.

Fig 6.47 Separation of shell

Mould formation:

The shell is further hardened by final curing for a few minutes at about 320°C. The two halves of shell are joined together by adhesive to form the mould. It is placed in suitable box and is supported by coarse sand or steel shots held in a box. The mould is ready. The molten metal is poured into the completed mould. After solidification the castings are removed from the sand.

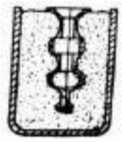


Fig 6.48 Clamping of shell to mould

Advantages:

- Produce accurate castings with very good surface finish.
- In most cases, machining operation is not required. Because sizes are very close enough to acceptable.
- Thin wall sections can be produced.
- Small Core holes can be produced.
- Shells can be stored for long time and can be reused.

Disadvantages:

- Cost of metal patterns is high.
- Cost of resin is high.
- Many equipment and control facilities are needed.
- Casting size and weight are limited.

Die casting or Injection Moulding

It involves the forcing of molten metal into die cavity under pressure and maintains this pressure until it solidifies.

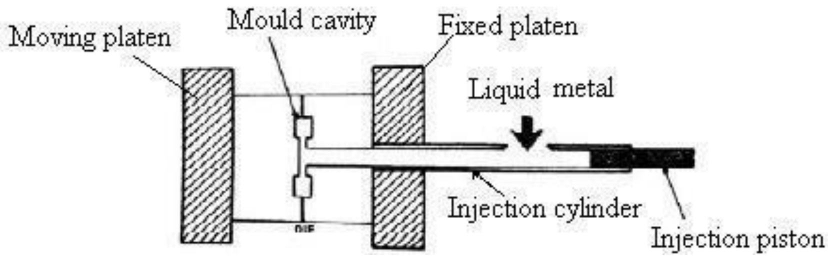


Fig 6.49 Die casting or Injection casting

Centrifugal casting

It is the variety method of producing castings in a rotating mould. The molten metal is poured in to the mould which is rotating at a speed of 1500 rpm and the centrifugal force spreads the molten metal uniformly along the entire length of the mould and holds it there until solidification is completed.

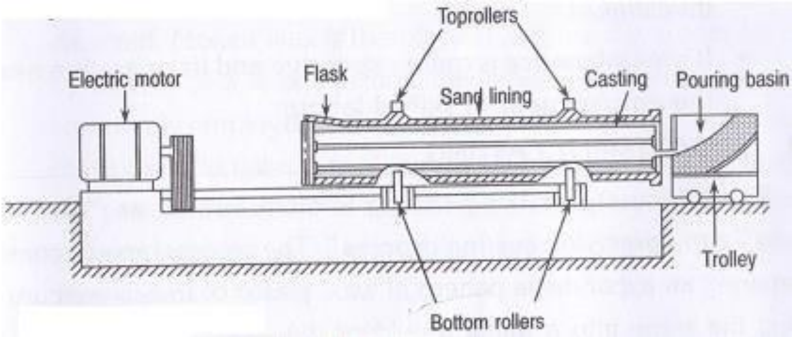


Fig 6.50 Centrifugal casting

Investment casting

This process of making casting is often termed as "lost wax process and precision casting process". The process broadly consists of preparing an expandable pattern of wax plastic or frozen mercury by pouring the same into a metal mould or die. This pattern is used for making the mould of investment material, which consists a refractory material and a liquid binder.

DEFECTS IN CASTING

Various defects in casting results due to improper sand preparation and process techniques the defects that commonly occur in castings are explained below.

Blow holes

Blow holes are spherical voids having a clean and smooth surface. They appear near to the surface. These defects are due to poor venting and lack of permeability in a Moulding sand. Proper venting, not too hard ramming and adjusting the moisture content in the sand may eliminate these defects.

Cold shuts and misruns

Cold shut and misruns are discontinuities in the casting as a result of poor fluidity of the molten metal. Misruns are formed when the entire section is not filled during pouring before solidification. Cold shuts formed when two streams of metal do not fuse together. These defects can be minimized by proper gating system and increasing in-pouring Temperature and increasing the fluidity of metal).

Hot tears

Hot tears are 'cracks' in the casting as a result of contraction stresses after solidification. An improvement in the casting design, proper ramming and increasing the collapsibility in the Core and mould may help elimination of hot tears.

Mismatch

Mismatch is a shift of the individual parts of a casting with respect to each other. The defect results from mismatching of cope and drag. To eliminate the defects, the flask should be properly closed and secured.

Shrinkage cavities

Shrinkage cavities are voids in the casting. They appear as a result of insufficient feeding, poor casting design, incorrect arrangement of gates and risers and high temperature of pouring metal. The defect can be eliminated by locating the riser at correct place and promoting the directional solidification by using chills (pieces of metals kept in mould to extract heat in certain location).

Fins or flash

Fins or flash are thin projections of metal, not intended as a part of the casting. They commonly appear along the mould joint because of much wear of flask halves or improper clamping of flasks.

Slag inclusions or slag holes

Slag inclusions or slag holes are cavities filled with slag, and produced when the slag gets into the casting when pouring metal into the mould. These defects are due to a poor skimming of metal in the ladle and in correct gating system.

Swell

Swell is an expansion of the mould cavity by metal pressure. It is thus, insufficient ramming and too rapid pouring of molten metal.

Scabs

Scabs are lumps of excess metal (i.e. irregular projections containing embedded sand) on the casting as a result of erosion of mould &y the stream of molten metal. The defect can be eliminated by proper ramming, using fine facing sand and controlling the flow of metal.

SHORT ANSWER QUESTIONS

1. Write the advantages of Casting.
2. Write the names of hand tools used in moulding.
3. Write the classification of moulding sand.
4. Write the commonly used mixtures in moulding sand mixtures.
5. Write the advantages of green sand moulding.
6. Write the disadvantages of dry sand moulding.

LONG ANSWER QUESTIONS

1. Write the properties of moulding sand.
2. Explain the types of patterns.
3. Write the types of cores and explain any three of them..
4. Explain the moulding process.
5. Explain ceramic moulding and write its advantages and disadvantages.
6. Explain defects in casting.