FOUNDRY

CASTINGS: Casting is a process for making components by pouring molten metal into a cavity and allow to solidify. The solidified metal is called Casting.

PATTERN: Pattern is the model of the required casting.

MOULD: Mould is a cavity or the required shape made in moulding sand.

CLASSIFICATION OF PATTERNS: Patterns are classified into Size and Shape, Number of parts to be produced and Method of castings.

TYPES OF PATTERNS:

Solid or Single piece Patterns: Exact shape is obtained.

Split pattern: Made into two halves i.e. Upper pattern and lower pattern. A line separating is called parting line.

Loose piece Patterns: After making mould fist solid piece is removed and loose piece is removed.

Match plate Patterns: Runner and gates are required. Used in machine moulding and for large volume.

Sweep Patterns: Surfaces like cylinder, cone and spheres these patterns are used.

Skeleton Patterns: Larger in size. Used for water pipes, turbines.

Segmental Patterns: Circular parts like rings, wheels, rims are produced by using segmental patterns.

Shell Patterns: Hollow pattern and used in pipes and short bends.

PATTERN MATERIALS: The materials used for making patterns are Wood (Teak, Mahogany, White pine), Metals (Cast iron, Steel, Brass, Aluminium), Plasters, Plastics and wax.

Wood: Advantages: Light weight, cheap, easily available, repairs are easily made.

Disadvantages: Absorbs water, High wear and tear, Not used for mass production & M/c moulds.

Metal: Used for mass production. It can be used in machine moulding. Advantages : Long life, Used for mass production, Not absorbing moisture, Resistance to wear and abrasion. Limitations: Costly, Not easily repaired.

Plasters: Plaster of paris or gypsum cement, Difficult shapes can be made easily, Not affected by moisture and used for small patterns.

Plastics: Made from master pattern, light weight, Not affected by moisture.

Wax: Paraffin wax, Shellac wax, and Micro crystalline wax are used. Good surface finish can be obtained. Not affected by moisture. Cost is less and used for small patterns.

PATTERN ALLOWANCES: Extra size given to the pattern is called Pattern Allowance. Various allowances are Shrinkage allowance, Machining allowance, Draft or Taper allowance, Distortion & Shake allowances

Shrinkage allowance: Metal shrinks during solidification and contracts on cooling. Compensation is required. For Cast iron 1mm per 100mm, Aluminium 1.7 mm per 100 mm, Brass 1.5 mm per 100 mm, Steel 2 mm per 100 mm are the recommended shrinkage allowances.

Machining Allowance: Extra size given for machining. For Cast iron 2.5 mm and for non ferrous metals 1.6mm and for cast steel3 mm are the recommended machining allowances.

Draft or Taper allowance: For removal of pattern from the mould.

Distortion allowance: The metal get distortion during cooling and not shrinks uniformly. To avoid the bend the distortion allowance is provided in the pattern.

MOULDING SAND: The reason for using sand is to maintain the shape at very high temperatures, can be used again and again, Less expensive.

Constituents: The constituents are Sand, Binder and Additives.

Sand: Silica sand is used 80 to 90 %. It gives refractoriness to sand. Cheap and easy availability. Easily moulded, reusable and withstand high thermal stability. Clay content – Silica sand 2%, Lean sand 2-10%, Medium sand 10-20% and loam sand 50%.

Types of Sand: Three types of sands are normally used. They are Natural sand, Synthetic sand and Special sand.

Natural Sand: Obtained from river beds and used for light castings. Advantages are – cheap and easy availability and wide range of grain sizes are available. Limitations are—Less refractoriness, may be fused with metals.

Synthetic sand: Used in machine moulding. It has higher refractoriness. More uniform grain size.

Special sands: Zircon and Chromite sand. Good refractoriness and hence used for facing sand.

BINDERS: Used to bring the property of cohesiveness to the sand. To bind the sand grains together and to give strength of the sand. Two types are used. 1.

Organic binders:- Used for core making. Cereal, resins, drying oils and molasses.
2. In organic binders:- Common clays are Kaolinite and Bentonite.

ADDITIVES: It is added to moulding sand to improve the properties of strength, refractoriness, permeability and to give surface finish. Common additives are Sea coal (smoother surface), Saw dust (to improve permeability), Cereals (to improve dry strength and green strength), Silica flour (to improve surface finish). at the sand bed. After melting enough quantity of molten metal the clay plug is removed and collected in ladles.

Then the molten metal is poured into the moulds. The floating slag on the top layer of the molten metal is tapped out through the slag hole. Again the furnace is charged to the full level for repeating.

PROPERTIES OF MOULDING SAND:

1. **POROSITY OR PERMEABILITY**: Permeability is a measure of moulding sand by which the sand allows the steam and gases to pass through it.The sand allows the steam and gases to pass through it.

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2. **PLASTICITY OR FLOWABILITY**: It is the property of moulding sand by which the moulding sand flows around and over the pattern and fills the flask.
3. **ADHESIVENESS:** The moulding sand by which it stick or adheres to another body.
4. **STRENGTH OR COHESIVENESS**: It is the property by which it sticks together. It hould have sufficient strength so that the mould does not collapse.

5. **REFRACTORINESS** : It is the property of moulding sand to resist high temperature of the molten metal.

MOULDING SAND PREPARATION:

Sand is prepared by the steps 1) Mixing of sand 2) Tempering of sand 3)Conditioning of sand.

Mix with sand, binders, moisture and other additives

Tempering of sand: The process of spraying and mixing adequate amount of water with the sandin muller is called tempering.

Conditioning of sand: Removing foreign materials, Distributing the binder uniformly,

Controlling the moisture, Aerating the sand, Delivering at proper temperature.

MOULDING TOOLS:1. Shovel, 2)Riddle 3) Rammer 4) Trowel 5) Slick 6) Strike off bar 7) Lifter

8) Vent wire 9) Spruepin 10) Riser pin 11) Gate cutter 12) Draw spike 13) Swap 14) Bellows

15) Mallet 16) Moulding boxes.

MOULDING PROCESSES:

Moulding is defined as the process of making a cavity similar to the product required in sand is called Moulding.

Types are : i) Green sand ii) Dry sand iii) Loam mould. Depends size, surface finish and accuracy.

Moulding sand contains 10 to 15% of clay, 4 to 6% of water & remaining silica sand.

GREEN SAND MOULD: cope and drag box, pattern, sand, aligning pin etc. The advantages are a) need lesser time for making mould b) less expensive c) can be used for all metals d) mould distortion is less Disadvantages are i) surface finish is less, Strength of the mould is low and blow holes may occur.

DRY SAND MOULD: If the green sand mould is dried after making the mould it is called dry sand mould. Drying is done with OA flame. It is used for large castings like engine block, cylinders and machine tools. Advantages: a) stronger than green sand mould b) better dimensional accuracy c) Permeability is more d) can be stored for long time. Disadvantages are i) time consuming process required heating ii) cost is high iii) subject to hot tear.

LOAM MOULDING: For very large castings moulding boxes and patterns cannot be used. Loam is a mixture of silica sand, water, graphite powder and more amount of clay. The mould made by the loam sand is called loammoulding. Advantages: i) large castings can be made with less cost. Ii) It has good surface finish. iii) Accurate castings can be produced. Disadvantages are i) Time consuming process ii) Skilled labours are required.

MOULDING METHODS:

1) BENCH MOULDING: For small castings. Moulds are shifted to pour metals.
2) FLOOR MOULDING: Medium and large castings. Large moulds handling is difficult. Floor level itself moulds are prepared.
3) PIT MOULDING : Heavy castings. Gate, runner, riser, sprue, pouring basin, riser are in the cope box.
4) SWEEP MOULDING: If the casting has similar profile with respect to the vertical axis sweep mould is prepared.

5) PLATE MOULDING : A match plate is used for plate moulding. Different patters can be fitted in the plate. Cope box having sprue and riser.

PROCEDURE FOR MAKING GREEN SAND MOULD

a. Two piece split pattern. The pattern is placed at the centre of the moulding board.

b. The drag box is placed around the pattern, Dowel pins are connected to the box.

c. 20 mm layer of facing sand is first placed around the pattern and then drag is filled with green sand.

d. Sufficient ramming is done by the rammer and add sand if necessary.

e. Excess sand is removed by strike of bar.

f. Vent holes are made by vent wire to escape the gases during pouring of metal.

g. The top surface is made smooth by trowel.

h. Then the drag is tilted upside down as shown in figure.

i. The parting sand is sprinkled over the drag box.

j. Top half of the pattern is placed correctly in position.

k. Cope box is placed correctly in position on the drag using dowel pins.

l. Riser pin and sprue pins are correctly placed in position.

m. Filling and ramming and venting of the sand are done similar to that of drag.

n. Sprue and riser pins are removed.

o. The pattern is removed from the box slowly.

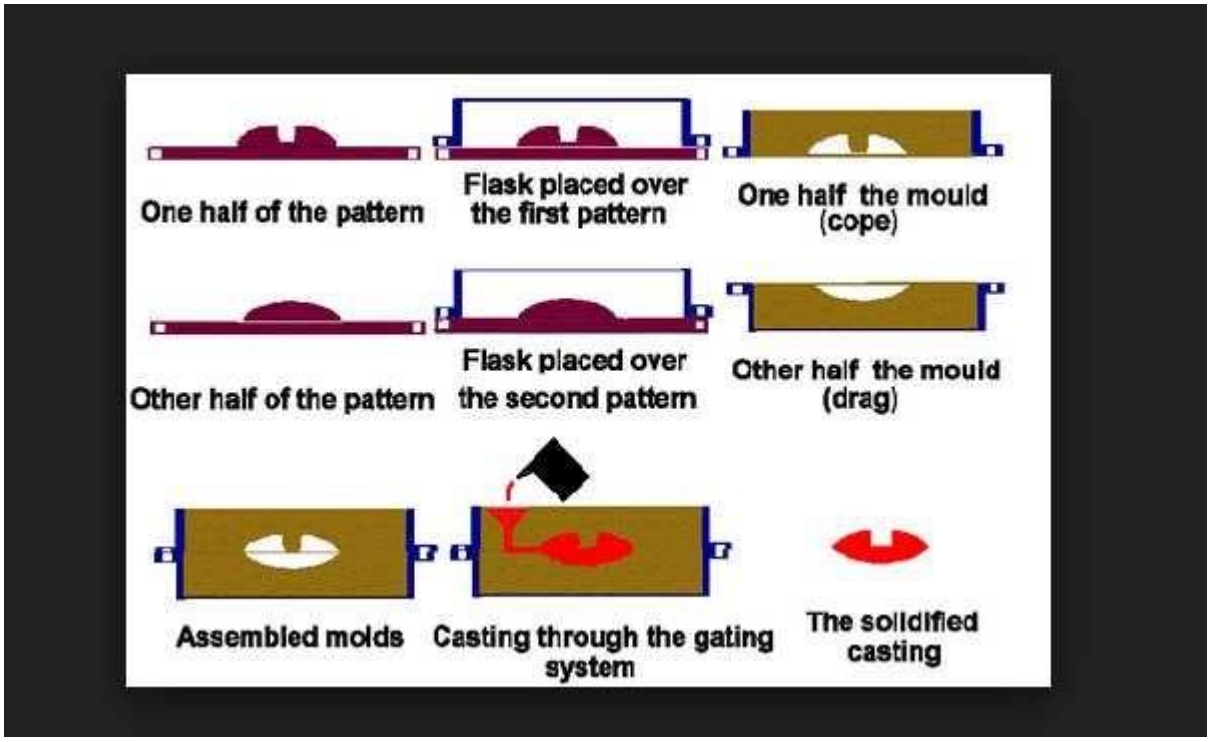
p. A gate is cut on the top surface of the drag. It should be exactly below the sprue.

q. The mould surfaces are coated with coating material like graphite to get smooth surface to the casting.

r. The core is set in position if necessary.

s. Finally, the cope and drag box are assembled. Weight is placed on the cope to prevent the cope from floating or lifting up when the molten metal is poured.

t. The mould is ready for pouring the metal.

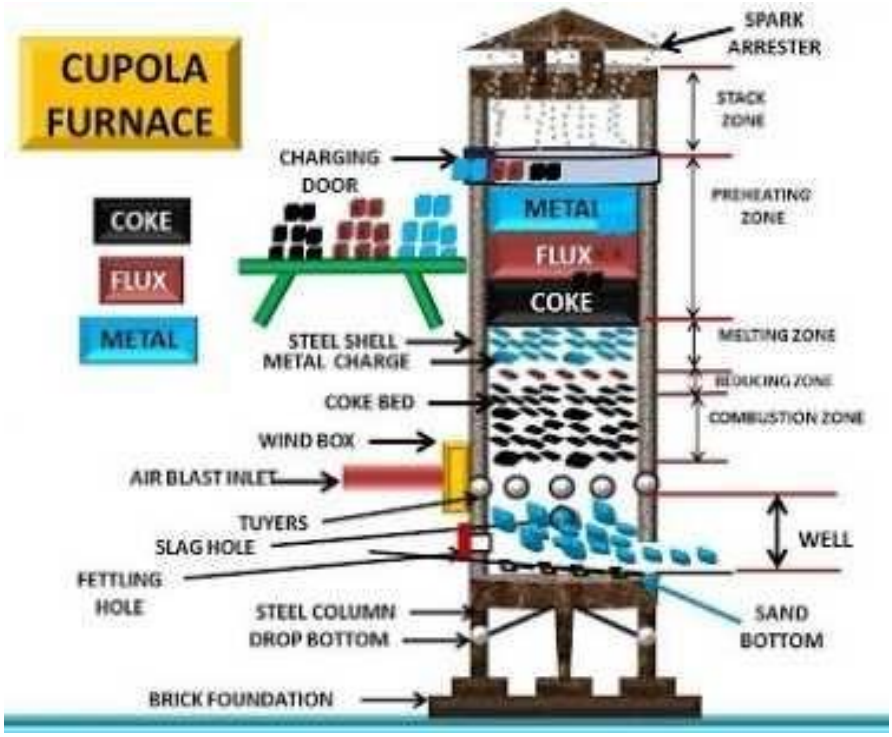


MELTING FURNACES: i) Cupola furnace - Cast Iron ii) Open hearth furnace - Steel iii) Crusible - Non ferrous. (Pit type, coke fired stationary, oil fired tilting) iv) Pot furnace v) Electric furnace – (Direct arc, Indirect arc, Induction furnace)

CUPOLA FURNACE:

It is a vertical cylindrical shell made of 10mm thick steel plate. It is lined with refractory bricks inside. The bottom doors close the bottom of the cupola. A sand bed is laid over the bottom doors sloping towards the tap hole. Molten metal stays over this bed. The legs are set at the bottom of the furnace using concrete. There is a tap hole for taking molten metal. A plug made of clay closes the tap hole. The slag hole is provided in the shell above the tap hole. The slag floating over the molten metal is removed through this slag hole.

The opening called tuyeres are provided one meter above the bottom. Fuel is supplied through this tuyeres for making complete combustion of fuel. There is wind box and blower for the supply of air into the furnace. For charging metal and fuel into the furnace a separate charging door is provided.



Preparation: The slag and waste from previous melting are cleaned. Broken bricks are repaired or replaced if necessary. The bottom doors are closed. A sand bed with sloping towards tap hole is prepared upto a height of 200mm. A tap hole is formed and lined with clay. Then a slag hole is prepared. Finally the cupola is dried thoroughly.

FIRING: Oil waste and wooden pieces are placed at the bottom and fire is started. Now sufficient amount of air is supplied. When the wood starts burning the coke is charged at several portions. Now the coke burns and more coke is added up the tuyere level. The blast is turned off. Again coke is added up to the level of bed charge. Then the coke is allowed to burn for half an hour, finally the charging is done through the charging door.

CHARGING AND MELTING: Pig iron and scrap are charged into the furnace through the charging door. The coke is charged alternatively. Limestone is added to the charge to remove the impurities and also to ensure through mixing of molten metal. The ratio of pig iron to limestone is 25:1 and the ratio of pig iron to coke is 10:1. Cupola is fully charged. The iron is soaked for one hour. After that the blast is turned on. The molten metal will begin to collect at the sand bed. After melting enough quantity of molten metal the clay plug is removed and collected in ladles.

Then the molten metal is poured into the moulds. The floating slag on the top layer of the molten metal is tapped out through the slag hole. Again the furnace is charged to the full level for repeating.

Advantages are initial cost is vey less when compared to other furnaces, simple design, less floor area, maintenance is easy, it can be operated continuously for many hours.

WELDING

Welding: The process of joining similar metals by the application of heat is called "Welding".

Welding can be obtained with or without application of pressure and with or without addition of filler metal which is known as 'electrode'.

Classification of welding process: 1. Fusion welding 2. Plastic welding.

Fusion welding: The metal at the joint is heated to a molten state and then it is allowed to solidify. Pressure is not applied during the process and hence it is called "non pressure welding". Filler material is required for this welding.

Plastic welding: The metal parts are heated to a plastic state and are pressed together to make the joint. It is called as "pressure welding". No filler material is required.

TYPES OF WELDING: Thermit welding

Fusion welding ---- Arc welding ------Submerged,Plasma,Automic hydrogen,MIG, Metal, Carbon,Electro slagWELDING

Gas welding ------ Oxyacetylene, Oxyhydrogen

Plastic welding ------Explosive welding

Ultrasonic welding

Electric resistance—Butt, Spot, Seam,

Projection,Percusion

Friction welding

Forge welding