

## Experiment - 5

Aim :- Study the foundry & its tools.

Introduction:- The place where jobs are prepared by melting & pouring the molten metal in to moulds is known as foundry. Foundry means pouring molten metal into a refractory mould with a cavity of the shape to be made and allowing it to solidify. It is used to cast molten into desired shaped objects. Castings of iron, steel, light metals (such as aluminium) and heavy metal (such as copper & zinc) are made in units some of which are independent units while others may be a part of a production line. Auto manufacturing facilities usually have foundries within their production facilities or as ancillaries. The main production steps includes:

- Raw material preparation
- Metal melting
- Mold preparation
- Casting & finally
- Finishing (which includes fettling & tumbling)

Pattern making :- A pattern is a model or the replica of the object (to be casted). It is embedded in molding sand & suitable ramming of molding sand around the pattern is made. The pattern is then withdrawn for generating cavity.

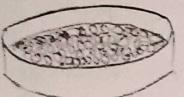
(known as mold) in molding sand. Thus it is a mould forming tool. Pattern can be said as a model or the replica of the object to be cast except for the various allowances a pattern exactly resembles the casting to be made. It may be defined as a model or form around which sand is packed to give rise to a cavity known as mold cavity in which when molten metal is poured, the result is the ~~to~~ cast object. When this mould / cavity in which when molten metal is poured, the result is the cast object. When this mould / cavity is filled with molten metal, molten metal solidifies & produces a casting (Product). So the pattern is the replica of the casting.

Molding & Core making:- A suitable & workable material possessing high refractoriness in nature can be used for mould making. Thus, the mold making material can be metallic or non-metallic. For metallic category the common material are cast iron, mild steel & alloy steels. In the non-metallic group molding sands, plaster of paris, graphite, silicon carbide & ceramics are included. But, Out of all the molding sand is the most common utilized non-metallic molding material because of its all, the molding sand is the most certain inherent properties namely refractoriness, chemical & thermal stability at higher temperature, high permeability & workability along with good strength. Moreover, It is also cheap & ~~can't~~ available.

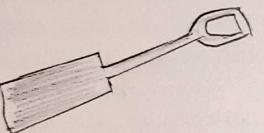
Cores are compact mass of core sand (special kind of molding sand) prepared separately that when placed in mould cavity at required location with proper alignment does not allow the molten metal to occupy space for solidification in that ~~process~~ position & hence help to produce hollowness in the casting. The environment in which the core is placed is much different from ~~than~~ that mold. In fact the core has to withstand the severe action of hot metal which completely surrounds it. They may be of the type of green sand core & dry sand core.

Melting :- Melting & pouring are the processes of preparing molten metal of the proper composition and temperature & pouring this into the mold from transfer ladles.

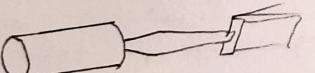
Casting :- Casting process is one of the earliest metal shaping techniques known to human being. It means pouring molten metal into a refractory mold cavity & allows it to solidify. The solidified object is taken out from the mold either by breaking or taking the mold apart. The solidified object is called casting & the technique followed in method is known as casting process.



Hand riddle



Shovel



Rammers



### Equipment:-

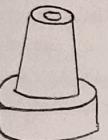
Hand riddle:- Hand riddle is shown in fig. It consists of a screen of standard circular wire mesh equipped with circular wooden frame. It is generally used for cleaning the sand for removing foreign material such as nails, short metal, splinters of wood, etc from it. Even power operated riddle are available for riddling large volume of sand.

Shovel:- Shovel is shown in fig. It consists of a steel pan fitted with a long wooden handle. It is used in mixing, tempering & conditioning the foundry sand by hand. It is also used for moving & transforming the molding sand to the container & molding box or flask. It should always be kept clean.

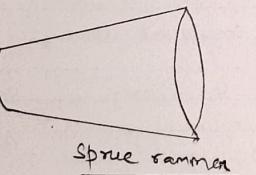
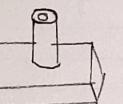
Rammers:- Rammers are shown in Fig. They are required for striking the molding sand mass in the molding box to pack or compact it uniformly all around the pattern. The common forms of rammers used in ramming are hand rammer, peer rammer, floor rammer & pneumatic rammer which are briefly described as:-



hand rammer



Floor rammer



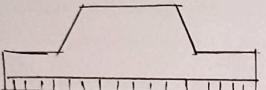
Sprue rammer

Hand rammer :- It is generally made of wood or metal. It is small & one end of which carries a wedge type construction, called peen & the other end possesses a solid cylindrical shape known as butt. It is used for ramming the sand in bench molding work.

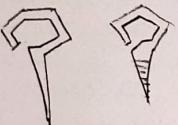
Peen rammer :- It has a wedge-shaped construction formed at the bottom of a metallic rod. It is generally used in packing the molding sand in pockets & corners.

Floor rammer :- It consists of a long steel bar carrying a peen at one end and a flat portion on the other. It is heavier & longer in comparison to hand rammer. Its specific use is in floor molding for ramming the sand for larger molds. Due to its large length, the molder can operate it in standing position.

Sprue pin :- Sprue pin is shown in fig. It is a tapered rod of wood or iron which is placed or pushed in cope to join mold cavity while the molding sand in the cope is being rammed. Later its withdrawal from cope produce a vertical hole in molding sand, called sprue through which the molten metal is poured into the mould using gating system. It helps to make a passage for pouring molten metal in mold through gating system.



Strike off bar



Draw spike

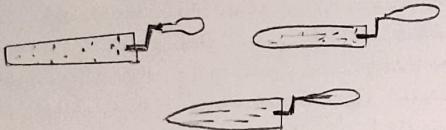


Vent rod

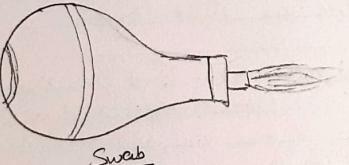
Strike off bar :- Strike off bar is a flat bar having straight edge & is made of wood or iron. It is used to strike off or remove the excess sand from the top of a molding box after completion of ramming thereby making its surface place be smooth. Its one edge is made bevelled & the other end is kept perfectly smooth & plane.

Draw spike :- Draw spike is shown fig. It is a tapered steel rod having a lapsoring at its one end & a sharp point at the other. It may have screw threads on the end to engage metal pattern for it withdrawal from the mold. It is used for driven into pattern which is embedded in the molding sand & raps the pattern to get separated from the pattern & finally draws out it from the mold cavity.

Vent rod :- Vent rod is shown in Fig. It is a thin spiket steel rod or wire carrying a pointed edge at one end and a wooden handle or a heat loop at the other. After ramming & striking off the excess sand it is utilized to pierce series of small holes in the molding sand in the cope portion. The series of pierced small holes are called vent holes which allow the exit or escape of steam to gases during pouring mold & solidifying of the molten metal for getting a sound casting.



Trowels



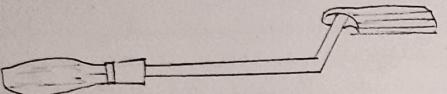
Swab

Lifters:- Lifters are shown in Fig. They are also known as cleaners or finishing tool which are made of thin sections of steel of various length & width with one end bent at right angle. They are used for cleaning, repairing & finishing the bottom & sides of deep & narrow openings in mold cavity after withdrawal of pattern.

Trowels:- Trowels are shown in Fig. They are utilized for finishing flat surfaces & joints & parting lines of the mold. They consists of metal blade of made of iron & are equipped with a wooden handle. The common metal blade shapes of trowels may be pointed or contoured or rectangular oriented.

The trowels are basically employed for smoothing & slicking the surfaces of molds. They may also be used to cut in-gates & repair the mold surface.

Swab:- Swab is shown in Fig. It is a small hemp fiber brush used for moistening the edges of used for sweeping away sand mould, which are in contact with the pattern before withdrawn the pattern. It is used for sweeping away the molding sand from the mold surface to pattern. It is also used for coating the liquid blacking on the mold faces in dry sand molds.



Gate cutter

Spirit level:- Spirit level is used by molder to check whether the sand bed or molding box horizontal or not.

Gate cutter:- Gate cutter is a small shaped piece of sheet metal commonly used to cut runners & feeding gates for connecting sprue hole with the mold cavity.

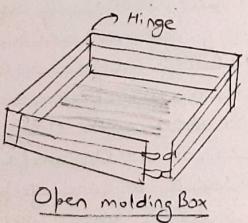
Gaggers:- Gaggers are pieces of wires or rods bent at one or both ends which are used for reinforced the downward projecting sand mass in the cope area known as gagger. They support hanging bodies of sand. They possess a length varying from 2 cm to 50 cm. A gagger is always used in cope area & it may reach up to 6 mm away from the function pattern. It should be coated with clay wash so that the sand adheres to it. Its surface should be rough in order to have a good grip with the molding sand. It is made up of steel reinforcing bars.

Spray gun:- Spray gun is mainly used to spray coating of facing materials etc. on a mold or core surface.

Wire pieces, spring & nail:- They are commonly used to reinforce thin projections of sand in molds or cores. They are also used to fasten cores in molds to reinforce stand in front of casting gate.



Common Hand tool used in Foundry.

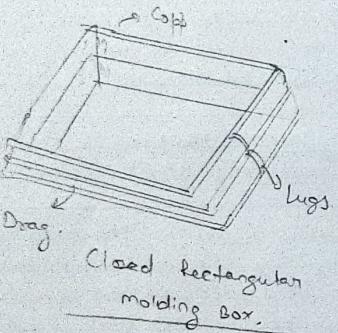


Open molding Box

Bellows:- Bellows gun is shown in Fig. It is hand operated leather made device & equipped with compressed air jet to blow or pump air when operated. It is used to blow away the loose & unwanted sand from the surface of mold activities.

Molding Boxes:- Mold boxes are also known as molding flasks. Boxes used in sand molding are two types:

Open molding Boxes - Open molding boxes are shown in fig. They are made with the hinge at one corner & a lock on the opposite corner. They are also known as snap molding boxes which are generally used for making sand molds. A snap molding is made of wood & is hinged at one corner. It has specially applications in bench molding in green sand work for small nonferrous casting. The mold is first made in the snap flask & then it is removed & replaced by a steel jacket. Thus, a number of molds can be prepared using the same set of boxes. As an alternative to the wooden snap boxes the cast aluminium tapered closed boxes are finding favor in modern foundries. They carry a tapered inside surface which is accurately ground & finished. A solid structure of this box gives more rigidity & strength than the open type. These boxes are also removed after assembling the mould.



large molding boxes are equipped with reinforcing cross bars & ribs to hold the heavy mass of sand to support gages. The size, material and construction of the molding box depend upon the size of the casting.

Closed molding boxes :- Closed molding boxes are shown in fig. which may be made of wood, cast-iron or steel to consist of two or more parts. The lower part is called the drag. The upper equipped with suitable means for clamping arrangement during pouring.

#### Foundry Sands:-

1. Green sand - Well prepared foundry sand contains just enough moisture to give "sufficient bond". Moulds in this sand called green sand.  
Moulds - MDO not requires any "baking", before pouring any molten metal into them.
2. Dry sand - Term indicates that moulding sand which was having ~~excess~~ excess moisture contains but the same have been evaporated from it by drying mould in a suitable oven.
3. Facing Sand (FAL SAND) : Sand which forms the face of the mould the fresh prepared sand to well tempered Foundry sand. Coating around the pattern surface is given by this sand.

4. Parting sand - Sand which is sprinkled on the pattern & parting others or to the pattern burnt sand is dry silica are used for this purpose.
5. Floor, Black or Baking sand - Used sand which is left after the casting have been removed from mould. Before re-sing - It is riddled, added
6. Core sand - Sand having silica contents used for making "CORES" called core sand.
7. Oil sand - Silica sand using oil binders is known as oil sand.
8. Molasses sand - Sand carrying molasses as binder useful for making small mould of small casting also used as core sand.

### Pattern shop:-

Pattern A pattern may be defined as a replica or facsimile in the desired casting which, when packed or embedded in a moulding material, produces a cavity called mould. This cavity when filled with metal produces the desired casting after solidification of the poured metal.

Types of pattern:- The type of pattern depends upon the many features like bulk of casting, type of moulding process, number of casting required & the anticipated difficulty of moulding etc.

Following are the pattern type commonly used-

1. Solid or single piece pattern
2. Two piece or split pattern
3. Multi plate pattern
4. Match plate pattern
5. Gated pattern
6. Skeleton pattern
7. Sweep pattern.
8. Pattern with loose Piece
9. Cope and drag pattern
10. Follow board pattern
11. Segmented pattern.

Single Piece Pattern - This is the simplest of the entire pattern made in one piece which carriage joints, partition or loose pieces. It can be moulded in one or two boxes. This pattern is the cheapest but its use can be done to a attend limited extend of production only because its moulding involves a large no. of manual operation like gate cutting providing runners & cores.

Two piece pattern : Some time there are differently in mould making & with drawed of pattern is solid pattern for such casting splits or two piece pattern are employed. They are made in two parts which able joined at the parting line by means of dovets. While moulding one

Allowances - A pattern is always made larger than required size of the casting in order to allow for various factors such as shrinkage machining, distortion -apping etc. The following allowances are provided in a pattern.

Shrinkage Allowance: Most of the materials used in the casting worms contract during cooling contraction, solidifying contraction, solid contraction. Thus the current amount of shrinkage allowance for a particular casting be obtained only after due taking into consideration all the factors.

Contraction of metal is always volumetric, but the contraction allowance are always expressed as linear measurement.

Machine Allowance: The portion or surfaces of the pattern are given adequate allowance in addition to shrinkage allowance by increasing the metal thickness, there to compensate for the loss of metal due to machine on these surface.

Draft Allowance: The patterns are given slight taper on all vertical surfaces. This taper is known as ~~extra~~ draft or draft allowance. The amount of draft surface is more then on external surface. The pattern of providing this taper or draft is to facilities easy withdrawal of pattern from the mould & without damaging the surface edges of the latter.

Rapping as Shake Allowance: When a pattern is to be withdrawn from the mould it is first rapped or shaken, by shaking over it from side to side so that its surface may be free of the adjoining sand wall of the mould.

## Moulding Sand Properties:-

Permeability - Allows gases to escape.

Refractoriness - Withstands high temperature.

Cohesiveness - Hold shape when moist (green strength)

Dry strength - Maintain shape when dry.

Plasticity - Flows & fills mould easily.

Adhesiveness - Stick to mould box walls.

Collapsibility - Break easily after casting for easy removal.

Flowability - Fills fine details of the mould.

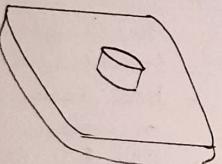
Grain fineness - Affects surface finish & permeability.

- It should be cheap & easily available.
- It should be reusable to affect economy.
- It should n't react chemically with molten metal.

Experiment - 5Part - 2

Aim: — To prepare a mould of given pattern.

Material required: Moulding sand, moulding box, pattern & other moulding equipment.

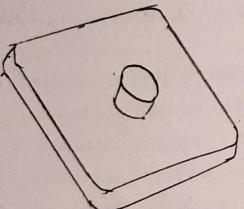


Procedure: — First take moulding box & place pattern into the moulding box.

- Spared moulding sand around the pattern.
- Proper ramming should be done.
- Insert the box with draw the pattern.
- Now the mould of the pattern is prepared.

Safety precautions:

- Necessary allowance must be provided.
- Proper care must be taken during ramming the mould.
- Select test and appear prepare the necessary sand mixture by adding ingredients in proper ratio.



Part - C

Aim: To prepare aluminium casting of a given pattern.

Metal required: Prepared mould, molten aluminium.

- Procedure:
- Melt the metal to be cast.
  - Pour the molten metal into the metal.
  - Allow the casting to solidify.
  - Remove the casting from the mould.
  - Clean and finish the casting.

Safety precaution:-

- Introduce the liquid metal into the mould with the velocity and little turbulence. So that mould erosion to get pick up is prevented.
- Fill the mould casting completely before freezing.
- Consume least metal i.e. that metal solidified in spur runners, gates & riser should be minimum.

### Viva Question

Q1 What are the allowances which are used in foundry?

Ans Shrinkage allowance - Extra size to compensate for metal shrinkage on cooling.

Machining Allowance Extra material for finishing machining after casting.

Draft Allowance Taper on vertical surfaces for easy pattern removal.

Distortion Allowance Adjusted shaped to counter expected warping.

Rapping Allowance - Slightly reduced size due to pattern shaking during sand removal.

Q2 Define different types of sands.

Ans Green sand - Moist sand used directly for moulding.

Dry sand - Green sand dried before use, for large casting.

Loam sand - Fine sand for big & heavy casting.

Facing sand - High-quality sand used near the pattern.

Batting Sand - Fills the rest of the mould; reuse sand.

Parting sand - Prevents sticking between mould parts.

Cope sand - Used to make cores for hollow casting.

Q3 What is pattern?

Ans A replica of the casting used to create the mould cavity in foundry. It's slightly larger than the final part to account for allowance.

Q4 Explain different types of rammer used in foundry shop?

- Ans.
- Hand Rammer - Used by hand, flat & peen ends
  - Peen Rammer - Wedge-shaped end, for corners & details
  - Floor Rammer - Heavy; used for large floor mould.
  - Pneumatic Rammer - Air-powered, fast & efficient for large scale work.

Q5 What is core, riser & gate system?

Ans

Core system - Creates hollow sections in the casting.

Riser system - Holds extra molten metal to compensate for shrinkage.

Gate system - Channels molten metal into the mould to ensure smooth flow.

Q6 What is ramming of mould sand?

Ans

Ramming of mould sand is the process of compacting sand around a pattern to form a strong, stable mould. It ensures the sand can withstand molten metal without collapsing.

Q7 Why molding sand generally used for mold making?

Ans

Molding sand is used for mould making because it is reusable, good permeability, can be shaped, withstand high temperature, and is adaptable to different casting patterns.

Q8

What is use of Vent Rod?

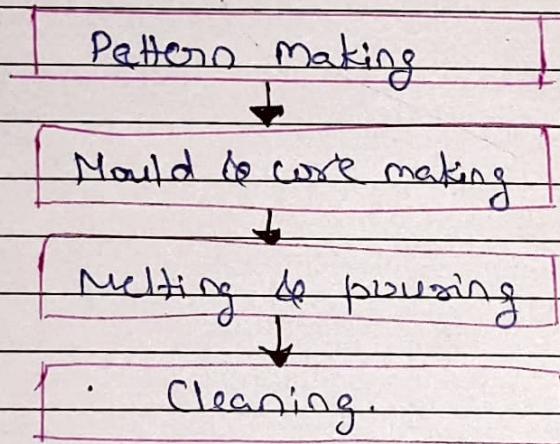
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A vent rod is used to create vent holes in the mould, allowing gases to escape & preventing defects like gas pockets during casting.

Q9

Draw the process diagram for casting process.

### Casting Process



Q10

What are different types of casting. List two examples by each casting.

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**Sand casting** - Uses sand molds.

examples - Engine blocks, pump housings.

**Die casting** - Uses metal under high pressure.

examples - Alloy wheels, camera bodies.

**Investment Casting** - Uses wax pattern, very precise.

examples - Turbine blades, jewelry.

**Centrifugal casting** - Mold spins to form hollow parts.

examples - Pipes, bushings.

**Shell molding** - Resin-coated sand mold.

Example - Gear housings, valve bodies.

Teacher's Signature.....