UNIT6
FOUNDRY

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FOUNDARY

- A **foundry** is a factory that produces metal castings. Metals are cast into shapes by melting them into a liquid, pouring the metal into a mold, and removing the mold material after the metal has solidified as it cools. The most common metals processed are aluminium and cast iron. However, other metals, such as bronze, brass, steel, magnesium, and zinc, are also used to produce castings in foundries. In this process, parts of desired shapes and sizes can be formed.
- Foundries are one of the largest contributors to the manufacturing recycling movement, melting and recasting millions of tons of scrap metal every year to create new durable goods. Moreover, many foundries use sand in their molding process. These foundries often use, recondition, and reuse sand, which is another form of recycling.

Metal casting processes

- Casting is one of the oldest manufacturing process. It is the first step in making most of the products.
- Steps:

- Making mould cavity
- Material is first liquefied by properly heating it in a suitable furnace.
- Liquid is poured into a prepared mould cavity
- allowed to solidify
- product is taken out of the mould cavity, trimmed and made to shape.

We should concentrate on the following for successful casting operation:

(i)Preparation of moulds of patterns

(ii)Melting and pouring of the liquefied metal

(iii)Solidification and further cooling to room temperature

(iv)Defects and inspection

Advantages

• Molten material can flow into very small sections so that intricate shapes can be made by this process. As a result, many other operations, such as machining, forging, and welding, can be minimized.

• Possible to cast practically any material: ferrous or non-ferrous.

• The necessary tools required for casting moulds are very simple and inexpensive. As a result, for production of a small lot, it is the ideal process.

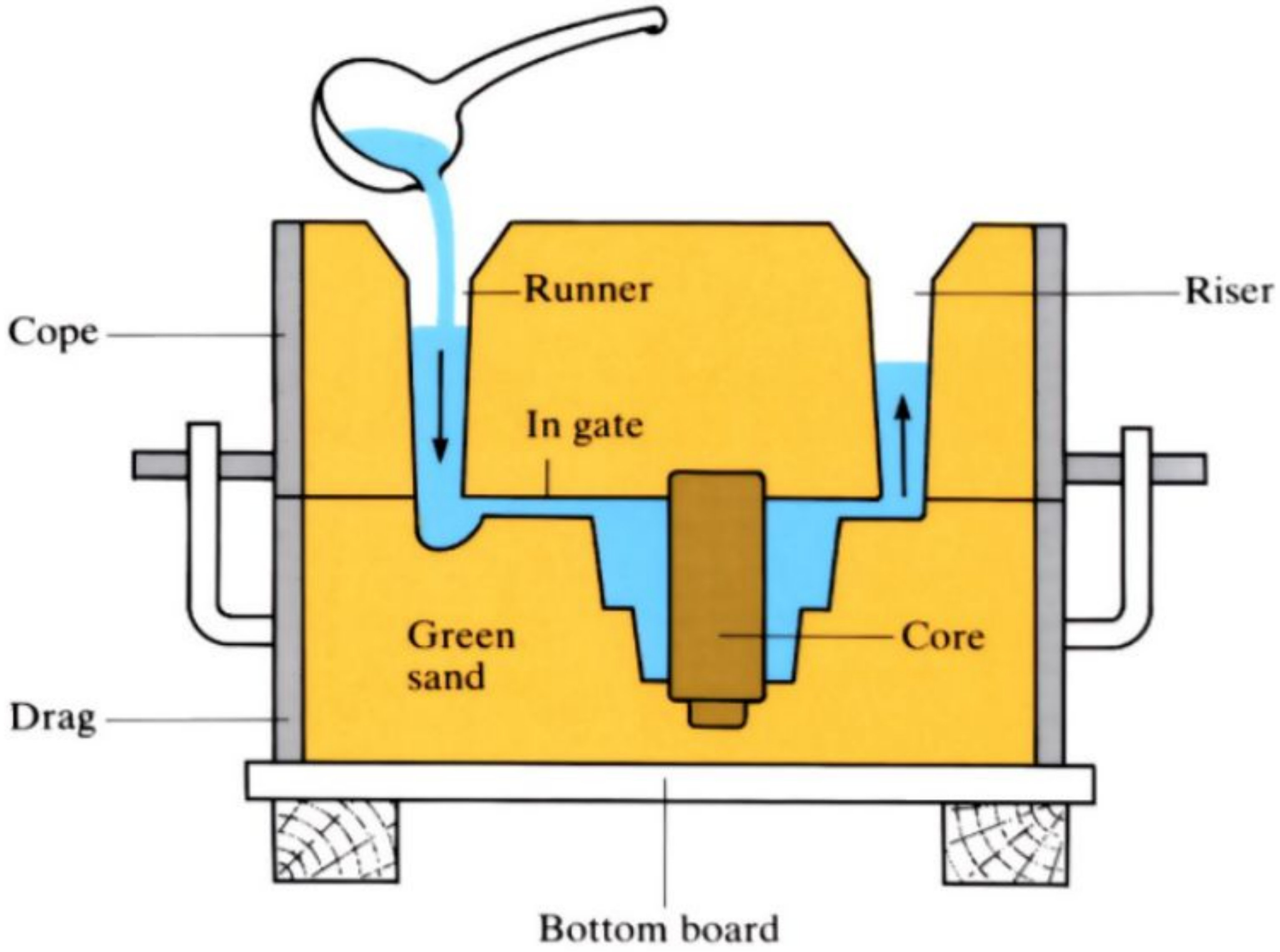
• There are certain parts (like turbine blades) made from metals and alloys that can only be processed this way. Turbine blades: Fully casting + last machining.

• Size and weight of the product is not a limitation for the casting process.

Limitations

- Dimensional accuracy and surface finish of the castings made by sand casting processes are a limitation to this technique.
- Many new casting processes have been developed which can take into consideration the aspects of dimensional accuracy and surface finish. Some of these processes are die casting process, investment casting process, vacuum-sealed moulding process, and shell moulding process.
- Metal casting is a labour intensive process
- Automation is difficult

Sectional view of a casting mould

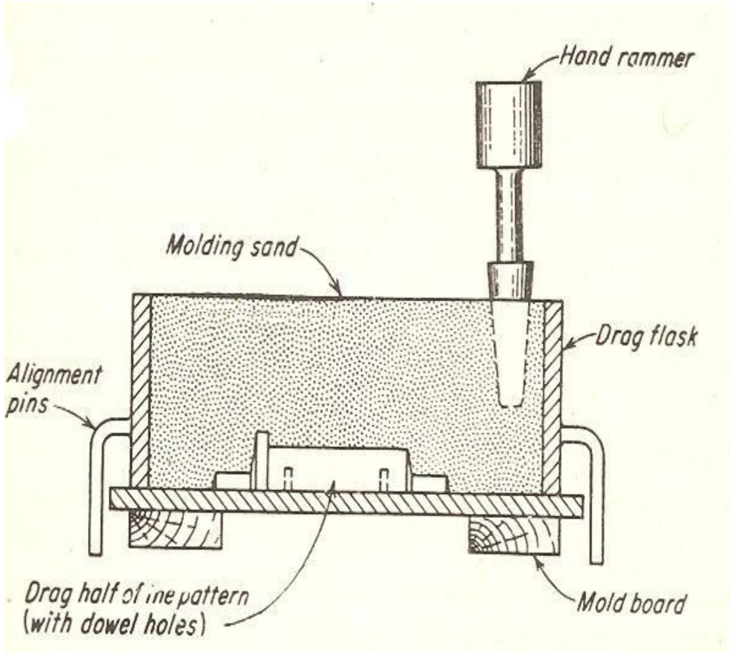


IMPORTANT CASTING TERMS

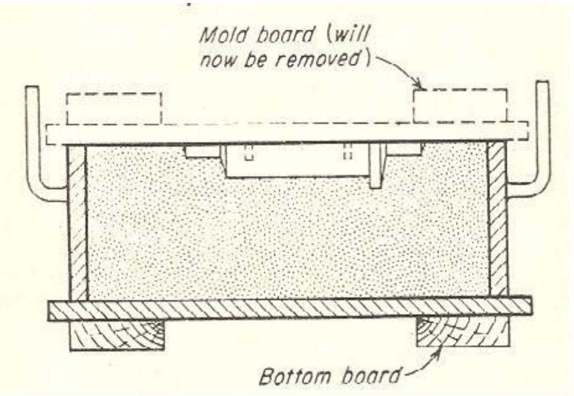
- Flask: A metal or wood frame, without fixed top or bottom, in which the mould is formed. Depending upon the position of the flask in the moulding structure, it is referred to by various names such as drag – lower moulding flask, cope – upper moulding flask, cheek – intermediate moulding flask used in three piece moulding.
- Pattern: It is the replica of the final object to be made. The mould cavity is made with the help of pattern.
- Parting line: This is the dividing line between the two moulding flasks that makes up the mould.
- Moulding sand: Sand, which binds strongly without losing its permeability to air or gases. It is a mixture of silica sand, clay, and moisture in appropriate proportions.
- Facing sand: The small amount of carbonaceous material sprinkled on the inner surface of the mould cavity to give a better surface finish to the castings.

- <u>Core</u>: A separate part of the mould, made of sand and generally baked, which is used to create openings and various shaped cavities in the castings.
- <u>Pouring basin</u>: A small funnel shaped cavity at the top of the mould into which the molten metal is poured.
- <u>Sprue</u>: The passage through which the molten metal, from the pouring basin, reaches the mould cavity. In many cases it controls the flow of metal into the mould.
- <u>Runner</u>: The channel through which the molten metal is carried from the sprue to the gate.
- <u>Gate</u>: A channel through which the molten metal enters the mould cavity.
- <u>Chaplets</u>: Chaplets are used to support the cores inside the mould cavity to take care of its own weight and overcome the metallostatic force.
- <u>Riser</u>: A column of molten metal placed in the mould to feed the castings as it shrinks and solidifies. Also known as "feed head".
- <u>Vent</u>: Small opening in the mould to facilitate escape of air and gases.

Making a simple sand mould



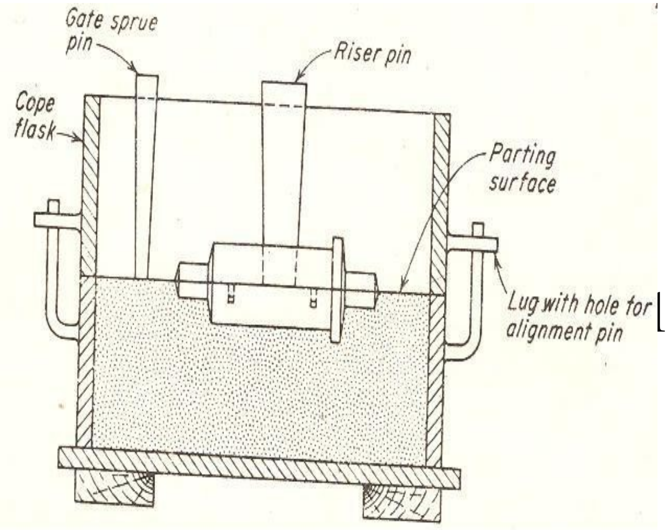
1) The drag flask is placed on the board
2) Dry facing sand is sprinkled over the board
3) Drag half of the pattern is located on the mould board. Dry facing sand will provide a non-sticky layer.
4) Molding sand is then poured in to cover the pattern with the fingers and then the drag is filled completely
5) Sand is then tightly packed in the drag by means of hand rammers. Peen hammers (used first close to drag pattern) and butt hammers (used for surface ramming) are used.
6) The ramming must be proper i.e. it must neither be too hard or soft. Too soft ramming will generate weak mould and imprint of the pattern will not be good. Too hard ramming will not allow gases/air to escape and hence bubbles are created in casting resulting in defects called ‘blows’. Moreover, the making of runners and gates will be difficult.
7) After the ramming is finished, the excess sand is leveled/removed with a straight bar known as strike rod.



8)Vent holes are made in the drag to the full depth of the flask as well as to the pattern to facilitate the removal of gases during pouring and solidification. Done by vent rod.

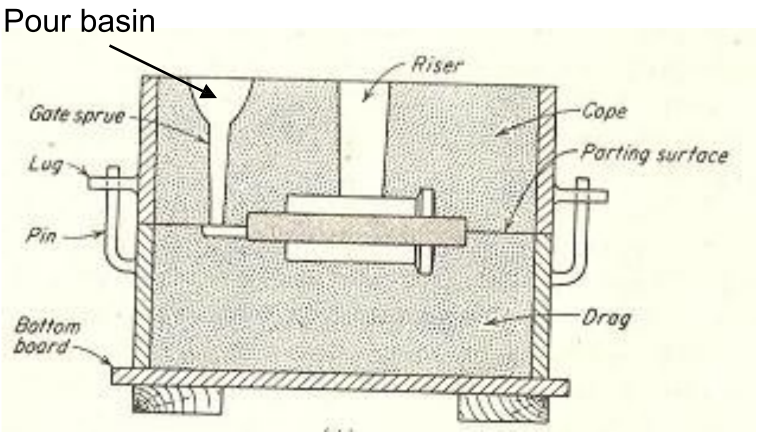
9)The finished drag flask is now made upside down exposing the pattern.

10)Cope half of the pattern is then placed on the drag pattern using locating pins. The cope flask is also located with the help of pins. The dry parting sand is sprinkled all over the drag surface and on the pattern.



11)A sprue pin for making the sprue passage is located at some distance from the pattern edge. Riser pin is placed at an appropriate place.

12)Filling, ramming and venting of the cope .



13) The sprue and riser are removed and a pouring basin is made at the top to pour the liquid metal.
14) Pattern from the cope and drag is removed.
15) Runners and gates are made by cutting the parting surface with a gate cutter. A gate cutter is a piece of sheet metal bent to the desired radius.
16) The core for making a central hole is now placed into the mould cavity in the drag. Rests in core prints.
17) Mould is now assembled and ready for pouring.

Different types of Molding Sand

Backing sand or floor sand

Backing sand or floor sand is used to back up the facing sand and is used to fill the whole volume of the molding flask. Backing sand is sometimes called black sand because of old, repeatedly used molding sand is black in color due to addition of coal dust and burning on coming in contact with the molten metal.

Core sand

Core sand is used for making cores and it is sometimes also known as oil sand. Core sand is highly rich silica sand mixed with oil binders such as core oil which composed of linseed oil, resin, light mineral oil and other bind materials. Pitch or flours and water may also be used in large cores for the sake of economy.

Dry sand

Green sand that has been dried or baked in suitable oven after the making mold and cores is called **dry sand**. It possesses more strength, rigidity and thermal stability. Dry sand is mainly used for larger castings. Mold prepared in this sand are known as dry sand molds.

Facing sand

Facing sand forms the face of the mould. It is next to the surface of the pattern and it comes into contact with molten metal when the metal is poured. Initial coating around the pattern and hence for mold surface is given by facing sand. Facing sand have high strength refractoriness. Facing sand is made of silica sand and clay, without the use of already used sand. Different forms of carbon are used in facing sand to prevent the metal burning into the sand. A facing sand mixture for green sand of cast iron may consist of 25% fresh and specially prepared and 5% sea coal. They are sometimes mixed with 6-15 times as much fine molding sand to make facings. The layer of facing sand in a mold usually ranges between 20-30 mm. From 10 to 15% of the whole amount of molding sand is the facing sand.

Green sand

Green sand is also known as **tempered or natural sand** which is a just prepared mixture of silica sand with 18 to 30% clay, having moisture content from 6 to 8%. The clay and water furnish the bond for green sand. It is fine, soft, light, and porous. Green sand is damp, when squeezed in the hand and it retains the shape and the impression to give to it under pressure. Molds prepared by this sand are not requiring backing and hence are known as green sand molds. Green sand is easily available and it possesses low cost. Green sand is commonly employed for production of ferrous and non-ferrous castings.

Loam sand

Loam sand is mixture of sand and clay with water to a thin plastic paste. Loam sand possesses high clay as much as 30-50% and 18% of water. Patterns are not used for loam molding and shape is given to mold by sweeps. Loam sand is particularly employed for loam molding used for large grey iron castings.

Parting sand

Parting sand without binder and moisture is used to keep the green sand not to stick to the pattern and also to allow the sand to the parting surface the cope and drag to separate without clinging. Parting sand is clean clay-free silica sand which serves the same purpose as parting dust.

Properties of Molding sand

The **basic properties required in molding sand and core sand** are adhesiveness, cohesiveness, collapsibility, flowability, dry strength, green strength, permeability, refractoriness described as under.

Adhesiveness

Adhesiveness is a property of molding sand to get the stick or adhere to foreign material such sticking of molding sand with the inner wall of molding box.

Cohesiveness

Cohesiveness is property of molding sand by virtue which the sand grain particles interact and attract each other within the molding sand. Thus, the binding capability of the molding sand gets enhanced to increase the green, dry and hot strength property of molding and core sand.

Collapsibility

After the molten metal in the mould gets solidified, the sand mould must be collapsible so that free contraction of the metal occurs and this would naturally avoid the tearing or cracking of the contracting metal. In absence of collapsibility property the contraction of the metal is hindered by the mold and thus results in tears and cracks in the casting. This property is highly required in cores.

Dry strength

As soon as the molten metal is poured into the mould, the moisture in the sand layer adjacent to the hot metal gets evaporated and this dry sand layer must have sufficient strength to its shape in order to avoid erosion of mould wall during the flow of molten metal. The dry strength also prevents the enlargement of mould cavity cause by the metallostatic pressure of the liquid metal.

Flowability or plasticity

Flowability or plasticity is the ability of the sand to get compacted and behave like a fluid. It will flow uniformly to all portions of pattern when rammed and distribute the ramming pressure evenly all around in all directions. Generally sand particles resist moving around corners or projections. In general, flowability increases with decrease in green strength and vice versa. Flowability increases with decrease in grain size of sand. The flowability also varies with moisture and clay content in sand.

Green strength

The green sand after water has been mixed into it, must have sufficient strength and toughness to permit the making and handling of the mould. For this, the sand grains must be adhesive, i.e. they must be capable of attaching themselves to another body and. therefore, and sand grains having high adhesiveness will cling to the sides of the molding box. Also, the sand grains must have the property known as cohesiveness i.e. ability of the sand grains to stick to one another. By virtue of this property, the pattern can be taken out from the mould without breaking the mould and also erosion of mould wall surfaces does not occur during the flow of molten metal. The green strength also depends upon the grain shape and size, amount and type of clay and the moisture content.

Permeability

Permeability is also termed as porosity of the molding sand in order to allow the escape of any air, gases or moisture present or generated in the mould when the molten metal is poured into it. All these gaseous generated during pouring and solidification process must escape otherwise the casting becomes defective. Permeability is a function of grain size, grain shape, and moisture and clay contents in the molding sand. The extent of ramming of the sand directly affects the permeability of the mould. Permeability of mold can be further increased by venting using vent rods.

Refractoriness

Refractoriness is defined as the ability of molding sand to withstand high temperatures without breaking down or fusing thus facilitating to get sound casting. It is a highly important characteristic of molding sands. Refractoriness can only be increased to a limited extent. Molding sand with poor refractoriness may burn on to the casting surface and no smooth casting surface can be obtained. The degree of refractoriness depends on the SiO_2 i.e. quartz content, and the shape and grain size of the particle. The higher the SiO_2 content and the rougher the grain volumetric composition the higher is the refractoriness of the molding sand and core sand. Refractoriness is measured by the sinter point of the sand rather than its melting point.

Miscellaneous properties of molding sand

In addition to above requirements, the molding sand should not stick to the casting and should not chemically react with the metal. Molding sand need be economically cheap and easily available in nature. It need be reusable for economic reasons. Its coefficients of thermal expansion need be sufficiently low.