MOULDING

Moulding is the process of manufacturing by shaping the raw material using a rigid frame (pattern) called a mould. The process of making this cavity or mould in the compact sand is called moulding.

A mould is a hollowed-out block that is filled with a liquid material such as plastic, glass, metal or ceramic raw material.

Moulding Sand:

The common sources of collecting foundary sands are rivers, lakes, sea and deserts. All the foundary sands can be mainly grouped as:

(a) Natural Sand → which contain sufficient amount of binding clay.

(b) Silica Sand → which do not bosses the clay content and need addition of a suitable binder to make them usable for foundary work.

* When mixed with some other constituents like binder and additives, are also known as synthetic sands.

(c) Special Sand.

Main Constituents of Moulding Sand.

1.] Silica Sand

- 80-82 %. of the moulding sand.
- Silica sand is a product of the breaking up of quartz rocks or the decomposition of granite, which is composed of quartz and felspar.
- Silica sand grains imparts refractoriness, chemical resistivity and permeability to the sand.

2] Binders

(a) Organic binders

(b) Inorganic binders.

Batch Time: _____ Roll Number: _____

Date: _____ Name of Candidate: _____

Binder :

The purpose of adding a binder to the moulding sand is to impart the sufficient strength and cohesiveness. However, it produces an adverse effect on the permeability of sand mould.

The common binders used in foundry

(a) Organic binders
- Dextrin
- Linseed oil
- Molasses
- Resins
  - Phenol
  - Urea formaledhyde.

[increase strength & Hardness.]

(b) Inorganic binders.
- clay
- Sodium silicate
- Portland cement [usually originated from limestone]

CLAY -

⇒ 10-20% in moulding sand.
- Bentonite [$Al_2O_3 \cdot 4SiO_2 \cdot H_2O \cdot nH_2O$] [chemical name of clay]
- Contains bonding strength.

(3) Additives

⇒ 1-6% added in moulding sand.

Additives are those materials which are added to the moulding sand to improve upon some of the existing properties or to impart certain new properties to it.

The commonly used additives are.
- Coal dust.] good surface finish.
- Sea Coal]
- Corn flour
- Silica flour
- Wood flour
- cow dung
- Saw dust] increase permeability & Collapsibility.
- Pitch [distilled from soft coal at about 600°F]
- Asphalt [By product of petroleum distillation]

(4) Water

⇒ 2-8%.
- Clay content added to the foundry sand will not give the required strength and bond until a suitable quantity of water is added to it.

TYPES OF SAND

1. **Green Sand:** It is also known as *tempered sand.* It denotes a well prepared foundry sand which contains just enough moisture to give it sufficient bond. Moulds in this sand are known as *green sand moulds* and do not require any baking before pouring the molten metal into them.

2. **Dry Sand:** This term indicates that moulding sand which was originally having excess moisture content but the same has been evaporated from it by drying its mould in a suitable oven.

3. **Facing Sand:** It is also known as *'fat' sand.* These terms are used for that sand which forms the face of the mould, i.e., rammed around the pattern surface. It is nothing but the fresh prepared and well tempered foundry sand. Initial coating around the pattern surface is given by this sand and the remainder of the flask is filled with floor sand to effect economy.

4. **Parting Sand:** This term denotes that sand which is sprinkled on the pattern and the parting surfaces of the mould so that the sand mass of one flask does not stick to that of the other or to the pattern. The *'burnt' sand and dry silica sand* are used for this purpose.

5. **Floor, Black or Baking Sand:** These are interchangeable terms and all denote the used sand which is left on the floor after the castings have been removed from the mould. Before reusing, it is riddled to remove foreign material like nails and fins etc., and then used for filling the bulk of the moulding flask after the facing sand has been rammed around the pattern.

   In modern mechanised foundries, however, no facing sand is prepared separately, but the entire floor sand is riddled, added with binders and proper additives and properly tempered for being used again. Such a sand is called *unit sand.*

6. **Core Sand:** The sand which carries a high silica content and is used for making cores is known as *core sand.*

7. **Oil Sand:** Silica sand using oil binders is known as *oil sand.*

8. **Molasses Sand:** This term denotes the sand which carries molasses as binder. It is very useful for making moulds of small castings having intricate shapes and thin sections. Also it is used as core sand.

PROPERTIES OF MOULDING SAND.

(1) Permeability or Porosity:

- Ability of the moulding sand to allow the gases, water and steam vapour to escape from the mould.
- It depends upon the size of sand grain, Shaped of grain, Moisture content and density.

* The gas evoluing capacity of the moulding sand is called permeability number (P_n)

$$P_n = \frac{VH}{pAT}$$

where

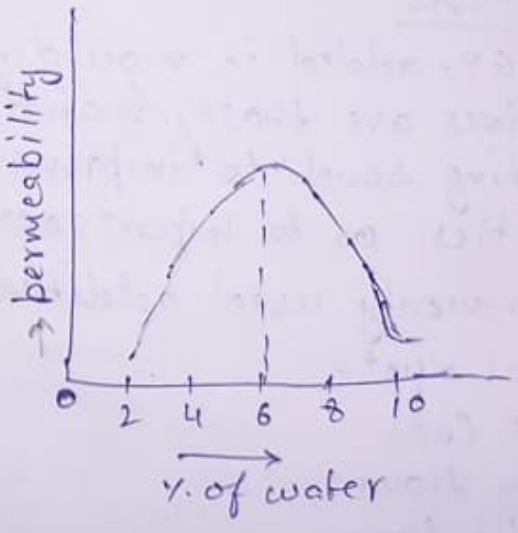
V = Volume of air passing through the specimen [cm^3]

H = Height of the specimen [mm]

A = Area of the specimen [mm^2]

p = Air pressure [gm/cm^2]

T = Time taken by the air to pass through the sand/ specimen [seconds]



$V = 2000\ cm^3$

$H = 2'' = 2 \times 2.54\ cm = 5.08\ cm$

$A = \frac{\pi}{4} D^2$

* Permeability → Property by which we can know the ability of material to transmit fluid/gases.

Roll Number: _____ Batch Time: _____

gases,

Flowability (Plasticity)
Ability to the moulding sand to flow into all around the ~~pattern and take~~ mould box due to ramming force.

(3.) Refractoriness
Ability of the moulding sand to withstand high temp. of the liquid metal without fusion (failure).

	Acid refractories	Fusion temperature
1.)	Silica (SiO_2)	1690° - 1710°C
2.)	Alumina (Al_2O_3)	2050°C
3.)	Graphite	3000°C

(4.) Cohesiveness:
Ability of the moulding sand to form Bond b/w similar materials.

(5.) Adhesiveness:
Ability of the moulding sand to form Bond b/w different materials.

(6.) Collapsibility:
Ability of the moulding sand ~~to allow~~ due to which the sand mould breaks (collapse) easily to allow free contraction of the solidfying metal.

(7.) Strength:
Ability of the moulding sand to withstand force applied by liquid metal on the mould surface.

Green Sand (Having Moisture) —Heating→ Dry Sand —(Above 100°C)→ Hot Sand

Green Strength ← Green Sand
Dry Strength ← Dry Sand
Hot strength ← Hot Sand

(8) Hardness:

Material's ability to withstand friction, abrasion, etc to force applied by the liquid metal on the mould surface. It is a surface property.

- Mould hardness number lies b/w 0 to 100.
- Average hardness number: 60 to 80.
- If hardness is less than 60 dimensional change can takes place in casting.
- If it is more than 80, permeability will be decreased.

(9) Durability:

Capacity of stand to withstand repeated cycles of heating and cooling during casting operations.

NOTE

- Sea Coal, Coal dust and Ash is mixed in the moulding sand to increase the surface finish of mould cavity and to the casting also.
- Cow dung and Saw dust are mixed in the moulding sand to increase permeability and collapsibility.
- Aluminium oxide (Al_2O_3) used to increase the strength.
- Linseed oil, Molasses and Dextrine used to increase the strength and hardness.

SOLIDIFICATION AND COOLING

- A metal in molten condition posseses high energy.
- As the molten metal cools, it loses energy to form crystals.
- Since heat loss is more rapid near the mould walls than any other place, the first metal crystallites called nuclei form here.
- Nuclei formed as above tend to grow at the second stage of solidification.
- Crystal growth occurs in a dendrite manner.
- Dendrite growth takes place by the evolution of small arms on the orginal branches of individual dendrites.
- Slow cooling makes the dendrite to grow long whereas fast cooling causses short dendrite growth.
- Since eventually dendrite become grains, slow cooling results in large grain structure and fast cooling in small grain structures in the solidified metal.