



LEARNING OBJECTIVES

1. To know about the Foundry, materials using in Foundry , pattern materials, types of patterns, Moulding tools and Moulding sand.
2. To know about the classification and properties of moulding.

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- 5.4. Core

5.1 INTRODUCTION

- Various manufacturing processes are available for producing a component with required shape. Casting is one the processes used for making component of complicated shapes in large numbers. The parts obtained by pouring the molten metal into the mould cavity and solidification are known as castings. The processes of making required shape in moulding sand with the help of a patterns is known as moulding. The cavity produced by pattern is known as mould or mould cavity. The place where moulding, melting and casting are done is known as foundry

5.2. PATTERN

Pattern is the model of casting. It is made of wood, metal or plastics. Mould is produced in moulding sand by using pattern.

5.2.1. Pattern Materials

The following materials are used for making patterns.

- Wood
- Metal
- Plaster of Paris
- Plastic
- Wax



Figure 1 Foundry Work

Wood: Wood is widely used for making pattern. It is easy to work and readily available. Generally pattern is made from teak wood, mahogany, Pine and rose wood. The surface finish of the pattern and its life can be increased by applying metal coating on the wood pattern. Zinc, Aluminium are used as coating material on the surface of the wood upto 2.5mm.

Metal: Metal pattern is used for producing large number of castings. Metal pattern is made by using a master pattern. The master pattern is made of wood. Cast iron, Brass, Aluminium and white metal are commonly used for making Metal pattern. Aluminium is the best metal for pattern making. Brass is suitable for small size patterns. White metal can be used for making patterns for complicated shapes.

Plaster of paris: The gypsum cement is known as Plaster of Paris. Pattern is made by pouring the mixture of Plaster of Paris and water into the mould prepared by master pattern. It is used for making small patterns.

Plastics: Plastic patterns are produced from a master pattern made of wood. The two types of plastics materials are used for

pattern making namely, thermo setting and thermo plastics. Pattern made of thermo plastics used for producing less number of pattern. But Thermo setting plastics are used for large number of pattern.

Wax: The liquified wax or semi solid wax is injected into a split die. Then the die is cooled and the wax pattern is taken out. This type of patterns are smaller in size. This pattern is produced from paraffin wax, shellac wax, bees wax, ceresin wax and micro crystalline wax.

5.2.2. Factors for Selecting Pattern Materials

The following factors are to be considered for selecting the pattern materials.

- Number of castings to be produced
- Quality of the casting
- Size and shape of the casting
- The method of mould and casting
- Required surface finishing of casting
- Required accuracy of casting
- Cost of the casting material
- Easily available in the market
- Withstand high temperature
- Does not change its shape.

5.2.3. Types of Patterns

The following types of pattern are generally used in foundry.

- Single Piece Pattern
- Split Pattern
- Match Plate Pattern
- Loose Piece Pattern

Single Piece Pattern: The pattern made of single piece without joints is known as solid pattern. This pattern is used for making small casting with simple shape. Solid pattern can be easily removed from the moulding sand.

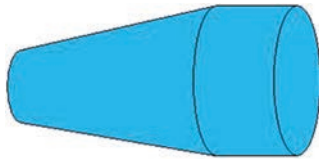


Figure 2 Single Piece Pattern

Split Pattern: Some patterns cannot be removed from the mould, if they are made in single piece. So, split patterns are used in that time. Split patterns are usually made of two parts. One part will make the lower half of the mould and the other part will make the upper half of the mould. These two parts are fixed correctly by dowel pins. Split pattern are also made in three or four parts. They are used for producing symmetrical casting such as cylinders, spindles, pipes, shafts etc.

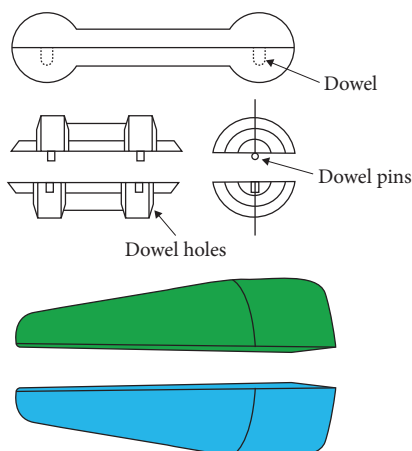


Figure 3 Split Pattern

Match Plate Pattern: This pattern has a match plate made of aluminium. split metal patterns are fitted on both sides of the match plate. One half of the pattern is fitted on one side of the match plate. The other half is fitted directly opposite on the other of the match plate.

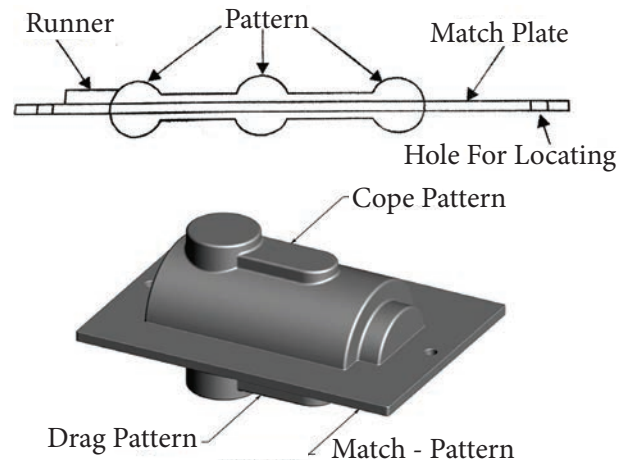


Figure 4 Match Plate Pattern

Loose Piece Pattern: Some patterns cannot be removed from the mould as single piece. So loose piece patterns are used with the solid pattern for the easy removal. After moulding, the solid pattern is removed first then the loose pieces are removed without damaging the mould. This pattern is used for producing complicated casting of large size.

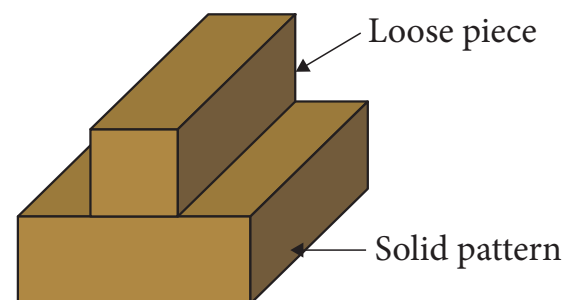


Figure 5 Loosen Piece Pattern

5.2.4. Pattern Making Allowances

Patterns are made to correct size of the required casting. They are made slightly larger than the required casting. This extra

dimension given to the pattern is called allowance. Pattern allowances are given to compensate the metal shrinkage, to avoid metal distortion, to withdraw the pattern easily from the mould. The various types of allowances are

- Shrinkage allowance
- Machining allowance
- Draft allowance
- Distortion allowance
- Rapping allowance





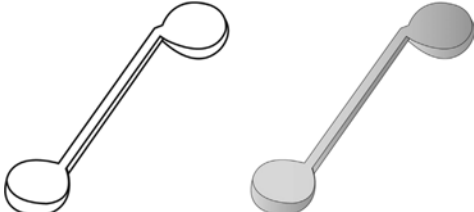
5.3. MOULDING PROCESS

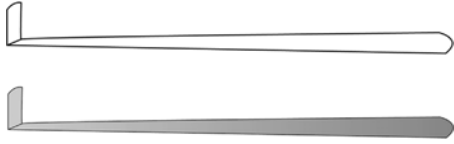
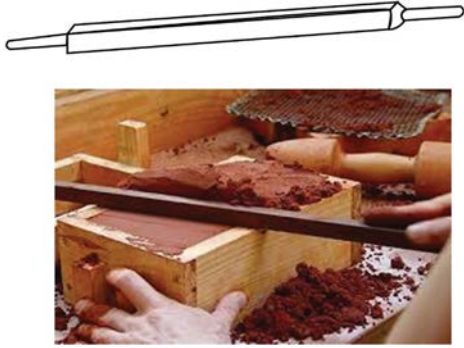







To make something into a desired shape by pouring molten metal into a mould.

The process of making mould is called moulding. It includes filling of moulding sand around the pattern, ramming, removing the pattern, making runner, riser, gate and vent holes

5.3.1. Moulding Tools

The following moulding tools are used in the foundry.

Name of the tools	Picture	Uses
Shovel		For mixing and transferring the moulding sand into moulding box.
Riddle		It is used to clean the mould sand by removing unwanted materials
Rammer		Rammer is used for packing or ramming the moulding sand in the moulding box.
Trowel		It is used to smoothen the mould surface and to repair the damaged portions of the mould
Slick		For finishing mould surface and for repairing the round corners of the mould.

Lifter		To remove the loose sand from the mould and to repair the broken surface of the mould.
Strike Off Bar		For removing excess sand from the mould after ramming.
Sprue Pin		For making holes for runner and riser in the mould.
Bellows		For blowing off loose sand particles from the mould.
Swab		for applying small amount of water around the pattern before removing it from the mould
Gate Cutter		For cutting gate in the mould.
Draw Spike		For removing the pattern from the mould
Vent Rod		For making small holes on the mould. During casting, the steam and gases escape through these holes
Mallet		To fix the draw spike into the pattern by hammering

5.3.2. Moulding Boxes

Moulding box is used to prepare Sand mould. It is a frame, made of wood or metal. It is box with both the bottom and top surfaces are opened. If the moulding is done with two boxes, the upper box is called cope and the lower box is called drag. The two box are aligned correctly with the help of dowel pin. If the moulding is done with three boxes, the middle box is called cheek.

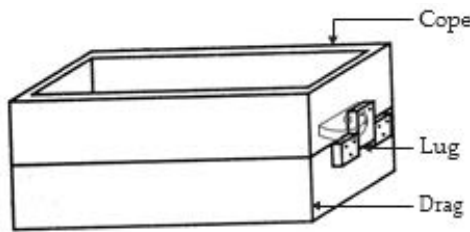


Figure 6 Box

5.3.3. Moulding Sand

Moulding sand is an important in foundry. It can withstand the high temperature of molten metal. It does not react with molten metal. It permits the gases and air to escape from the mould when the molten metal is poured. Due to these properties of moulding sand, it is used for casting.

5.3.4. Moulding Sand Ingredients

Moulding sand has the following ingredients

- Sand
- Binder
- Additive

Sand: It contains silica, clay and moisture. Sand has 80 to 90% silica which gives refractoriness. It contains 5 to 20% clay which gives binding strength. 2 to 3% of water is added with the sand to give moisture.

Binder: Binder is added with the moulding sand to obtain strength and plasticity. Clay binders are commonly used.

Additives: Additives are added with the moulding sand to improve the properties like strength, permeability and thermal stability. The following three types of additives are used.

- **Reducing Agents:** Coal dust, fuel oil and sea coal are some reducing agents.
- **Fibrous Material:** Straw, cow dung, asbestos and saw dust are some fibrous materials.
- **Special Additive:** Dextrin and molasses are some special additives.

5.3.5. Classifications of Moulding Sand

Moulding sand are classified as follows:

1. Natural Sand
2. Synthetic Sand
3. Special Sand

Natural Sand: Natural sand is available at river beds. It contains 80 to 90% silica, 5 to 10% alumina or clay and small amount of lime and magnesia. Natural sand is used to make casting in ferrous and non-ferrous metals.



Figure 7 Natural Sand or Green Sand

Synthetic Sand: Synthetic sand is prepared to obtain required properties by adding some ingredients with the natural sand. Bentonite, water, ironoxide, calcium

and magnesium are mixed with natural sand. Synthetic sand is used in machine moulding and high pressure moulding.



Figure 8 Synthetic Sand

5.3.6. Properties of Moulding Sand

A good moulding sand should have the following properties.

- | | |
|-----------------|-------------------|
| 1. Porosity | 4. Cohesiveness |
| 2. Plasticity | 5. Refractoriness |
| 3. Adhesiveness | 6. Collapsibility |

5.3.7. Parting Sand

It is a sand without binder and moisture. It is used to avoid sticking of moulding sand on the patterns and act as a parting surface between cope and drag boxes. Mostly this will be clean clay-free silica sand.

5.3.8 Gating System

Gating system consists of pouring cup, sprue, runner, gate and riser.

Pouring Cup: It is the funnel shaped portion on the top of the sprue. Molten metal is poured easily through this cup.

Sprue: It is the hole which connects the pouring cup to the runner. Molten metal passes through the sprue to the runner.

Runner: Runner supplies molten metal from sprue to different gate.

Gate: It connects the runner and the mould. Molten metal enters the mould through the gate.

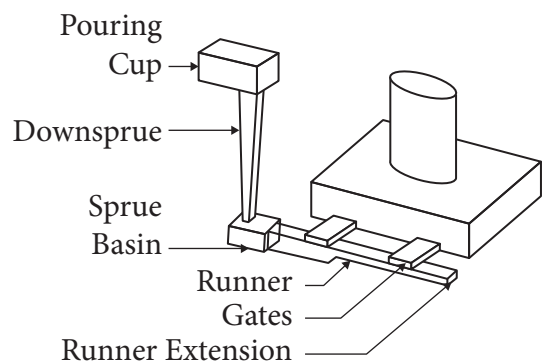


Figure 9 Gating System

Riser: It is a hole on the cope portion. After the mould is filling up, the excess molten metal overflow through the riser.

5.3.9. Types of Moulding

The various types of moulding are follows:

1. Green Sand Moulding
2. Dry Sand Moulding
3. Bench Moulding
4. Floor Moulding
5. Machine Moulding

Green Sand Moulding: The green sand does not mean that it has a green colour. But the sand which is moist condition at the time of pouring the molten metal. The following is the step by step procedure of making green sand mould using a split pattern.

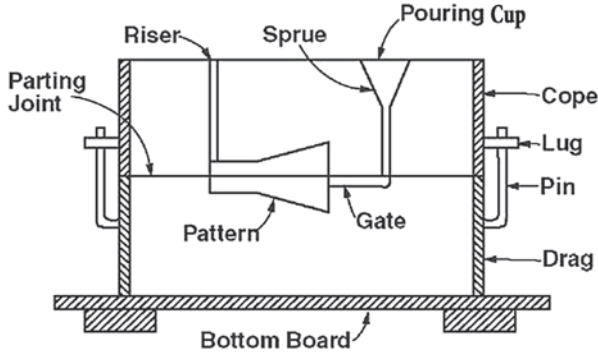


Figure 10 Green Sand Moulding

1. One half of the pattern is placed on the moulding board.
2. Drag box is placed upside down on the board and parting sand is sprinkled over the pattern.
3. 20mm layer of facing sand is filled around the pattern. Then green sand is filled in the box.
4. Ramming is done uniformly by using rammer.
5. Excess sand is removed and leveled by strike off bar.
6. Vent holes are made. The box is tilted upside down.
7. The cope box and another half of the pattern are placed correctly. Parting sand is sprayed over the pattern.
8. The runner pin and riser pin are placed in the cope box at correct position. Then facing sand and moulding sand are filled.

9. Ramming is done uniformly. Vent holes are made.
10. Runner pin and riser pin are removed and pouring cup is made.
11. Cope and drag boxes are separated so as to remove the pattern.
12. Draw spike is driven into pattern pieces and shaken lightly in all direction. Then pattern pieces are withdrawn slowly.
13. Runner and gate are cut in drag portion.
14. Core is placed in the mould if necessary.
15. The cope and drag boxed are assembled in correct position and weight is placed over the cope. Now molten metal can be poured in the mould for producing casting.

5.4. CORE

A core is used for making hollow casting. Any hollow shape can be produced by using Core.

Core making: The shape of the core must be similar to the required hollow in the casting. Core sand is used for making core. The core sand is a mixture of dry silica sand 94%, water 2.3% core oil 1.4% and starch 1.4%.

GLOSSARY

1. Pattern	மாதிரிவடிவம்	7. Slinger	வீசுதல்
2. Mould	அச்சு	8. Porosity	புரைமை
3. Casting	வார்ப்பு	9. Plasticity	நெகிழித்தன்மை
4. Riddle	கம்பிவலை சல்லடை	10. Cohesiveness	ஒட்டுத்தன்மை
5. Squeezing	அழுத்துதல்	11. Refractoriness	வெப்பந்தாங்கும் தன்மை
6. Jolt	குலுக்குதல்		

ACTIVITIES

1. Visit near the foundry and watch how moulding is performed.
2. Use clay and plastic container or box to make a moulded model.

QUESTIONS



PART A

I. Choose the correct option :

1. Which material is used for making master pattern
 - a) Wood
 - b) Metal
 - c) Wax
 - d) Plastic
2. Material is used for producing less number of patterns
 - a) Wood
 - b) Thermo plastic
 - c) Wax
 - d) Casting
3. This instrument is used to clean the mould sand by removing unwanted materials
 - a) Shovel
 - b) Bellows
 - c) Slick
 - d) Riddle
4. The raw material of the moulding sand is
 - a) Wax
 - b) Glass
 - c) Binder
 - d) Rubber

5. Which is used for making hollow casting
 - a) Dowel pin
 - b) Core
 - c) pattern
 - d) Moulding box

PART B

II. Answer the following questions in one or two sentences:

6. What are the materials used to make pattern?
7. What are the types of moulding box?
8. How do you choose the material used for making 'pattern'?
9. What is the use of 'Rammer'?
10. What are the types of 'Moulding Sand'?

PART C

III. Answer the following questions in about a page?

11. List out the moulding Tools?
12. Explain characteristics of 'Moulding Sand'?
13. List out the types of moulding?
14. What are the raw materials to make the moulding Sand? Explain any one.
15. Explain the parts of the 'gating System'?

PART D

IV. Answer the following questions in detail:

16. List out moulding tools and draw the neat sketch of any two and explain it?
17. Draw and Explain moulding boxes and give their uses?
18. Explain the methods of green sand moulding?
19. List out the materials for making patterns and explain any two of it?