SRI VIDYA COLLEGE OF ENGINEERING&TECHNOLOGY VIRUDHUNAGAR

ME-6302 MANUFACTURING TECHNOLOGY-1
UNIVERSIT QUESTION BANK WITH ANSWERS
UNIT –I
METAL CASTING PROCESS
PART –A (2 Marks)

1 **State any four types of patterns. (May 2006)**

Ans: The various types of patterns which are commonly used are as follows:

1) Single piece or solid pattern
2) Two piece or split pattern
3) Loose piece pattern
4) Cope and drag pattern
5) Gated pattern

2 **Mention any two advantages and disadvantages of die casting. (May=2006)**

Ans: Advantages:

- It is a very fast process.
- Moulds have longer life.
- Better surface can be obtained.

Limitations:

- Moulds are much costlier.
- This method is not suitable for small quantity production.
- Shape and weight of the casting is limited.

3 **Write the requirements of good pattern. (May 2007)**

Ans: Simple in design

- Cheap and readily available
- Light in mass
- Surface id smooth
- Have high strength

4.What is core venting? (May 2007)

Ans: While pouring the mould with molten metal mould walls and cores heat up rapidly and releases large amount of gases. In order to prevent casting defects these gases must be vented out. For this purpose core venting are used. Core venting are incorporated in the core box itself.

5.What function of core ? (May 2008)

Ans: Functions of core are:

- Core provides a means of forming the main internal cavity for hollow casting.
- Core provides external undercut feature.
- Cores can be inserted to obtain deep recesses in the casting.
- Cores can be used to increase the strength of the mould.

6. Which process is called lost waxing method? Why? (May 2008)

Ans: Investment casting process is also known as Lost-wax process. The term investment refers to a clock or special covering apparel. In investment casting, the clock is a refractory mould which surrounds the precoated wax pattern.

7. What is the function of core prints? (Dec. 2008)

Ans:

1. Core prints are basically extra projections provided on the pattern.
2. They form core seats in the mould when pattern is embedded in the sand for mould making.
3. Core seats are provided to support all the types of cores.
4. Though the core prints are the part of pattern, they do not appear on the cast part.

8. What are the advantages and applications of ceramic moulds? (Dec. 2008)

Ans: Advantages:

- It is less expensive
- Intricate objects can be casted.
- Castings of thin sections and which do not require machining can be produced.

Applications:

- It is mainly used for all material using better ingredient in slurry.

9. What are the pattern materials? (Dec. 2008)

Ans:1) Wood 2) Metal 3) Plastic
4) Plaster 5) Wax

10. Explain the term fettling. (Dec. 2009)

Ans: Fettling is the name given to cover all those operations which help the casting to give a good appearance. It includes the removal of cores, sand, gates, risers, runners and other Unwanted projections from the casting.

11. What are the applications of casting?

Ans: Transportation vehicles (in automobile engine and tractors)

- Machine tool structures
- Turbine vanes and power generators
- Mill housing
- pump filter and valve

12. Mention the specific advantages of Co2 moulding Process.

1.Gives strength and hardness to core.
2.Process cost is less.
3.It saves time on heating.

Part-B (16 Marks)

1. **What are the pattern allowances? Explain briefly each.** (Nov/Dec- 2013) (16)

Five types of allowances were taken into consideration for various reasons. They are

1.Shrinkage allowance

Any metal when heated to liquid stage and solidified will undergo change in dimension. Mostly the dimension of the product will be reduced, then the actual size of the pattern. Hence the patterns are made slightly in larger dimensions.(3%-5%)

2.Draft allowance

It will be difficult to remove the pattern from the mould cavity (without disturbing the mould) after ramming of sand. Hence the pattern (wooden or metal pattern) is slightly given $2^{o} – 3^{o}$ TAPER in the z - axis or vertical direction.

3. **Finish allowance**

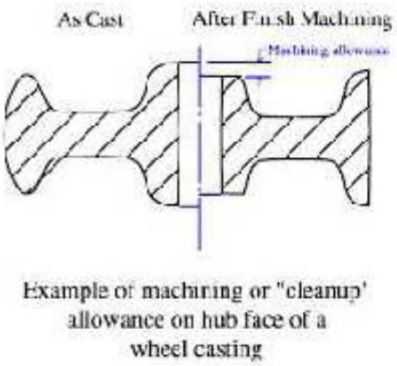
It is otherwise called as machining allowance .The pattern is made slightly 5mm -10mm large in dimension than the required final part dimension. After casting the extra material is removed from the solidified material by machining.

4.Shake or Rapping allowance.

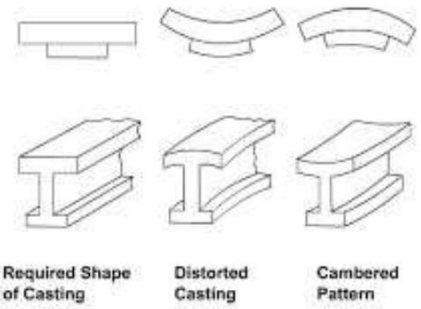
Before withdrawing the pattern it is rapped and thereby the size of the mould cavity increases. Actually by rapping , the external sections move outwards increasing the size and internal sections move inwards decreasing the size. This allowance is kept negative and hence the pattern is made slightly smaller in dimensions 05.1.0 mm.

5.Distortion allowance.

Some material might tend to bend or distort from the actual size or dimensions. Hence the pattern is give counter balance degree or angle of recess so that the material will be in the required dimension when solidified in the mould cavity.



Example of machining or "cleanup" allowance on hub face of a wheel casting



2. Explain the CO2 process of core making state its advantages and applications. (16)

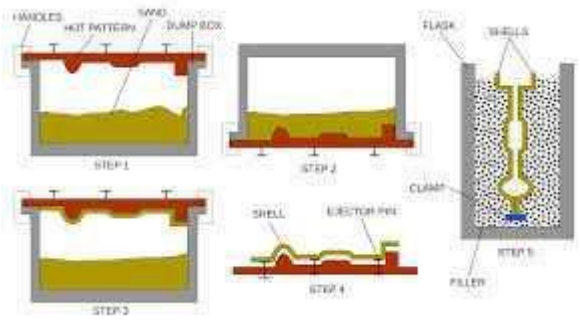
Working Principle

The highly flowable mixture of pure dry silica sand and sodium silicate binder is rammed or blown into the mould or core box. Carbon –dioxide gas at a pressure of about 1.5 bar is diffused through the mixture (of sand and sodium silicate) to initiate the hardening reaction which takes from a few seconds to a few minutes depending upon the size of core or mould.Passage of carbon-dioxide through the sand containing sodium silicate produces carbonic acid in the aqueous solution, this causes a rise in the SiO_2- Na_2O ratio and the formation of a colloidal silica gel which hardens and forms a bond between the sand grains. The reaction is represented by the following equation.

$NaSiO_3 + CO2 \text{ ---------} \rightarrow NaCO_3 + SiO_2$
(Sodium Silicate) (Silica Gel)

Carbon Dioxide Moulding Operation

This sand is mixed with 3 to 5 % sodium silicate liquid base binder in Muller for 3 to 4 minutes. Additives such as coal powder, wood flour sea coal, and dextrin may be added to b improve its properties. Aluminium oxide Kaolin clay may also added to the sand.



Patterns used in this method may be coated with Zinc of 0.05 mm to 0.13 mm and then spraying a layer of aluminium or brass of about 0.25 mm thickness for good surface finish and good results.

Advantages

- Operation is speedy since we can use the mould and cores immediately after processing.
- Heavy and rush orders
- Floor space requirement is less
- Semi skilled labor may be used.

Disadvantages

Difficult in reusing the moulding sand.

3. Write a short note on 'Green sand mould' and shell Moulding.

Sand Casting (Green sand mould) is simply melting the metal and pouring it into a preformed cavity, called mold, allowing (the metal to solidify and then breaking up the mold to remove casting. In sand casting expandable molds are used. So for each casting operation you have to form a new mold.

- Sand with a mixture of water and bonding clay
- Typical mix: 90% sand, 3% water, and 7% clay
- to enhance strength and/or permeability
  Sand – Refractory for high temperature.

TYPES OF SAND

a) Green-sand molds - mixture of sand, clay, and water; "Green" means mold contains moisture at time of pouring.

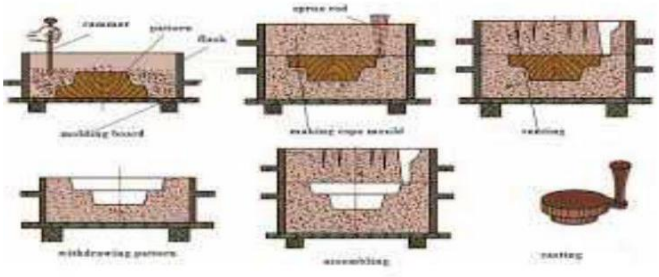
b) Dry-sand mold - organic binders rather than clay and mold is baked to improve strength

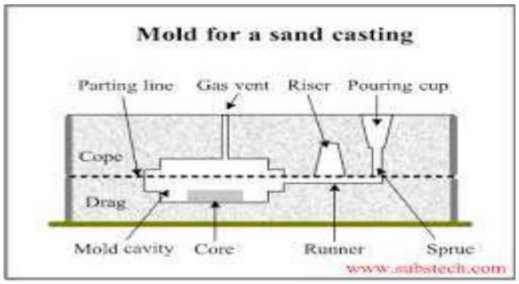
c) Skin-dried mold - drying mold cavity surface of a green-sand – mold to a depth of 10 to 25 mm, using torches or heating

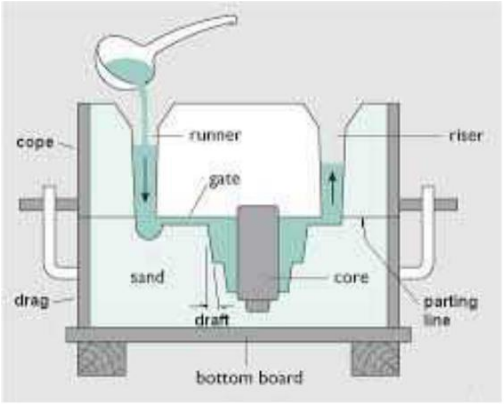
Steps in Sand Casting

The cavity in the sand mold is formed by packing sand around a pattern, separating the mould into two halves.The mold must also contain gating and riser system For internal cavity, a core must be included in mold A new sand mold must be made for each part

1. Pour molten metal into sand mold
2. Allow metal to solidify
3. Break up the mold to remove casting
4. Clean and inspect casting
5. Heat treatment of casting is sometimes required to improve metallurgical properties





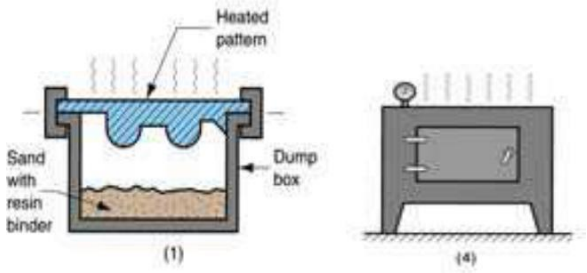


Steps in shell-molding

Shell-mold casting yields better surface quality and tolerances.

The process is described as follows:

The 2-piece pattern is made of metal (e.g. aluminum or steel), it is heated to between 175°C-370°C, and coated with a lubricant, e.g. silicone spray. Each heated half-pattern is covered with a mixture of sand and a thermoset resin/epoxy binder. The binder glues a layer of sand to the pattern, forming a shell. Th e process may be repeated to get a thicker shell.The assembly is baked to cure it.The patterns ar e removed, and the two half-shells joined together to form the mold; metal is poured into the mold. When the metal solidifies, the shell is broken to get the part.



Advantages of shell moulding

- Smoother cavity surface permits easier flow of molten metal and better surface finish on casting

Good dimensional accura cy

Machining often not required

Mold collapsibility usuall y avoids cracks in casting Can be mechanized for m ass production

Disadvantages of shell moulding.

More expensive metal pattern

Difficult to justify for sma ll quantities

4. Briefly explain about Investment ca sting.

Investment Casting

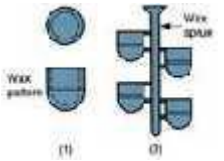
Investment casting produc es very high surface quality and dimensional accuracy. Investment casting is com monly used for precision equipment such as su rgical equipment, for complex g eometries and for precious metals.

This process is commonly used by artisans to produce highly detailed art work.

The first step is to prod uce a pattern or replica of the finished mou ld. Wax is most commonly used to fo rm the pattern, although plastic is also used.

- Patterns are typically mass-produced by injecting liquid or semi-liquid wax into a permanent die.
- Prototypes, small production runs and specialty projects can also be undertaken by carving wax models.
- Cores are typically unne cessary but can be used for complex interna l structures. Rapid prototyping techniques have been developed to produce expendabl e patterns.
- Several replicas are ofte n attached to a gating system constructed of the same material to form a tree assembly. In this way multiple castings can be pro duced in a single pouring.

Casting with expendable mould: Investment Casting



advantages

– Parts of grea t complexity and intricacy can be cast

– Close dimensional control and good surface finish

– Wax can usually be recovered for reuse

– Additional machining is not normally required - this is a net shape process

Disadvantages

– Many processing steps are req uired

– Relatively expensive process

5.Explain about MPT Magnetic Parti cle testing in detail.

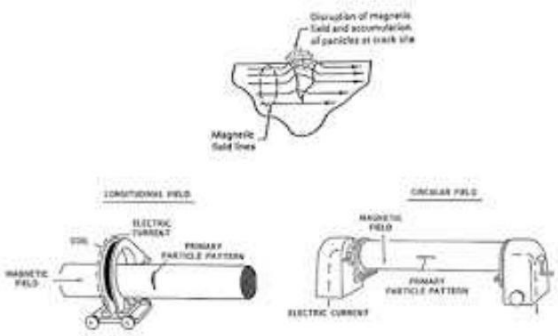
This method of inspection is used on magnetic ferrous castings for detectin g invisible surface or slightly subsurface defects. Deeper subsurface defects are not satisfactorily detected be cause the influence of the distorted lines of magnetic flux (o wing to a Discontinuity) on the magnetic particles spread over the casting.

The defects commonly reveale d by magnetic particle inspection are quenching cracks, overlaps, thermal cracks, seams , laps, grinding cracks, fatigue cracks, hot tears Etc,

Working Principle.

When a piece of metal is place in a magnetic field and the lines of magnetic flux get intersected by a discontinuity such as a crack or slag inclusion in a casting, magnetic poles are induced on either side of the discontinuity. The discontinuity causes an abrupt change in the path of magnetic flux flowing through the casting normal to the discontinuity, resulting in a local flux leakage field and interference with the magnetic lines of force. This local flux disturbance can be detected by its effect upon magnetic particles which are attracted to the region of discontinuity and pile up and bridge over the discontinuity.

A surface crack is indicated (under favorable conditions) by a line of fine particles following the crack outline and a subsurface defect by a fuzzy collection of the magnetic particles on the surface near the discontinuity. Maximum sensitivity of indication is obtained when the discontinuity lies in a direction normal to the applied magnetic field and when the strength of magnetic field is just enough to saturat e the section being inspect ed.



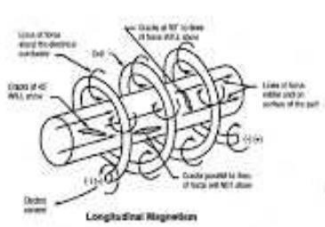


Figure 10.22—Longitudinal Magnetism

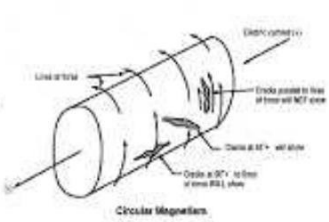


Figure 10.23—Circular Magnetism