Plaster Molding, Permanent Mold Casting and Die Casting

Plaster Molding

• Similar to sand casting except mold is made of plaster of Paris (gypsum - $CaSO_4$-$2H_2O$)
• Plaster and water mixture is poured over plastic or metal pattern to make a mold

Advantages

– Good dimensional accuracy and surface finish
– Capability to make thin cross-sections in casting

Disadvantages

- Moisture in plaster mold causes problems:
- Mold must be baked to remove moisture
- Mold strength is lost when is over-baked, yet moisture content can cause defects in product
- Plaster molds cannot stand high temperatures

Permanent Mold Casting

Basic Permanent Mold Process
– Uses a metal mold constructed of two sections designed for easy, precise opening and closing
– Molds for lower melting point alloys: steel or cast iron and Molds for steel: refractory material, due to the very high pouring temperatures

Permanent Mold Casting Process

- The two halves of the mold are made of metal, usually cast iron, steel, or refractory alloys. The cavity, including the runners and gating system are machined into the mold halves.
- For hollow parts, either permanent cores (made of metal) or sand-bonded ones may be used, depending on whether the core can be extracted from the part without damage after casting.
- The surface of the mold is coated with clay or other hard refractory material – this improves the life of the mold. Before molding, the surface is covered with a spray of graphite or silica, which acts as a lubricant. This has two purposes – it improves the flow of the liquid metal, and it allows the cast part to be withdrawn from the mold more easily.
- The process can be automated, and therefore yields high throughput rates.
- It produces very good tolerance and surface finish.
- It is commonly used for producing pistons used in car engines; gear blanks, cylinder heads, and other parts made of low melting point metals, e.g. copper, bronze, aluminum, magnesium, etc.

Advantage

- Good surface finish and dimensional control and Fine grain due to rapid solidification.

Disadvantage

- Simple geometric part, expensive mold.

Example

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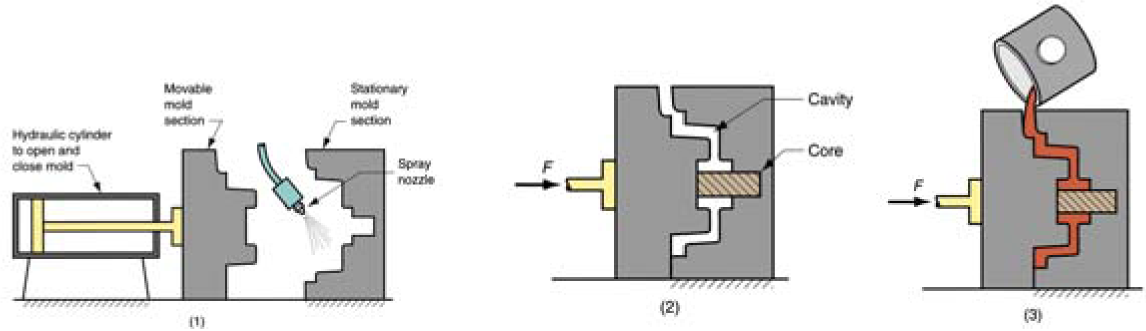
Basic Permanent Mold Process



Advantages

– Good dimensional control and surface finish

– More rapid solidification caused by the cold metal mold results in a finer grain structure, so stronger castings are produced

Limitations

- Generally limited to metals of lower melting point
- Simple part geometries compared to sand casting because of the need to open the mold
- High cost of mold
- Due to high mold cost, process is best suited to automated high volume production

Testing of Mould & Core sand

1) Preparation of standard test specimen
2) Mould hardness test
3) Core hardness test
4) Moisture content test on foundry sand
5) Sieve analysis
6) Clay content test
7) Permeability test
8) Compression, shear test

Die Casting

• Die casting is a very commonly used type of permanent mold casting process.

• It is used for producing many components of home appliances (e.g rice cookers, stoves, fans, washing and drying machines, fridges), motors, toys and hand-tools

• The molten metal is injected into mold cavity (die) under high pressure (7-350MPa).
Pressure maintained during solidification.

• Hot Chamber (Pressure of 7 to 35MPa)

• The injection system is submerged under the molten metals (low melting point metals such as lead, zinc, tin and magnesium)

• Cold Chamber (Pressure of 14 to 140MPa)

• External melting container (in addition aluminum, brass and magnesium)

Molds are made of tool steel, mold steel, maraging steel, tungsten and molybdenum.

• Single or multiple cavity

• Lubricants and Ejector pins to free the parts

• Venting holes and passageways in die
• Formation of flash that needs to be trimmed

Properties of die-casting

1) Huge numbers of small, light castings can be produced with great accuracy.
2) Little surface finishing is required.
3) Permanent mold (dies can be used over and over)

Advantages

– High production, Economical, close tolerance, good surface finish, thin sections, rapid cooling

Hot-Chamber Die Casting

In a hot chamber process (used for Zinc alloys, magnesium) the pressure chamber connected to the die cavity is filled permanently in the molten metal.

The basic cycle of operation is as follows:

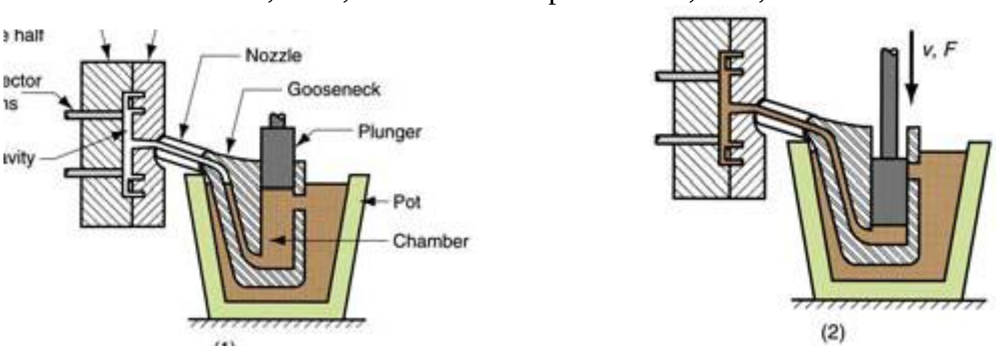
(i) die is closed and gooseneck cylinder is filled with molten metal;

(ii) plunger pushes molten metal through gooseneck passage and nozzle and into the die cavity; metal is held under pressure until it solidifies;

(iii) die opens and cores, if any, are retracted; casting stays in ejector die; plunger returns, pulling molten metal back through nozzle and gooseneck;

(iv) ejector pins push casting out of ejector die. As plunger uncovers inlet hole, molten metal refills gooseneck cylinder.

The hot chamber process is used for metals that (a) have low melting points and (b) do not alloy with the die material, steel; common examples are tin, zinc, and lead.



Cold Chamber Die Casting

In a cold chamber process, the molten metal is poured into the cold chamber in each cycle. The operating cycle is

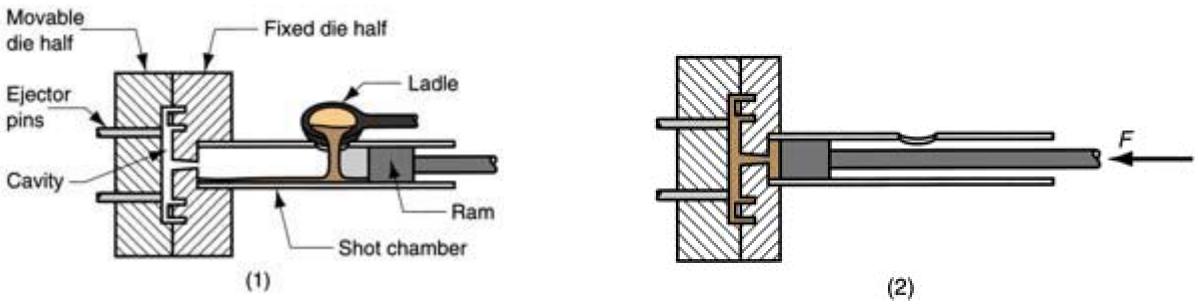
(i) Die is closed and molten metal is ladled into the cold chamber cylinder;

(ii) plunger pushes molten metal into die cavity; the metal is held under high pressure until it solidifies;

(iii) die opens and plunger follows to push the solidified slug from the cylinder, if there are cores, they are retracted away;

(iv) ejector pins push casting off ejector die and plunger returns to original position

This process is particularly useful for high melting point metals such as Aluminum, and Copper (and its alloys).



Advantages

– Economical for large production quantities
– Good dimensional accuracy and surface finish
– Thin sections are possible
– Rapid cooling provides small grain size and good strength to casting

Disadvantages

– Generally limited to metals with low metal points
– Part geometry must allow removal from die cavity

Source : http://nprcet.org/e%20content/mech/MT.pdf