



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

SPECIAL CASTING PROCESS

Permanent Mold Casting, Hot and cold chamber die casting

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PERMANENT MOLD CASTING

- Molds are used repeatedly.
- Better surface characteristics (close tolerance & good finish).
- High rate of production (mechanization possible with ease).
- Mostly used for small sized castings (Al & Mg).
- Usually known as **Gravity die casting**.
- **Cycle:**
 - Dies closed & mechanically clamped
 - Molten metal poured & allowed to solidify
 - Dies opened & casting taken out
 - Dies cleaned for next cycle of operation

Dies

- Usually in pair
- Have vents (clamping & ejection mechanism)
- Taper allowance provided (for ease in extraction)
- Extra allowance for thermal expansion of dies

Types of Dies

- Simple die: two part die or block die
- Recessed die: hollow, ribs may be provided
- Hinged die: two halves open about a hinge, small die for simple & small castings
- Multi-staged die: made up of a number of pieces which are either joined together firmly or kept loose to facilitate sliding or lifting, suitable for complex shape

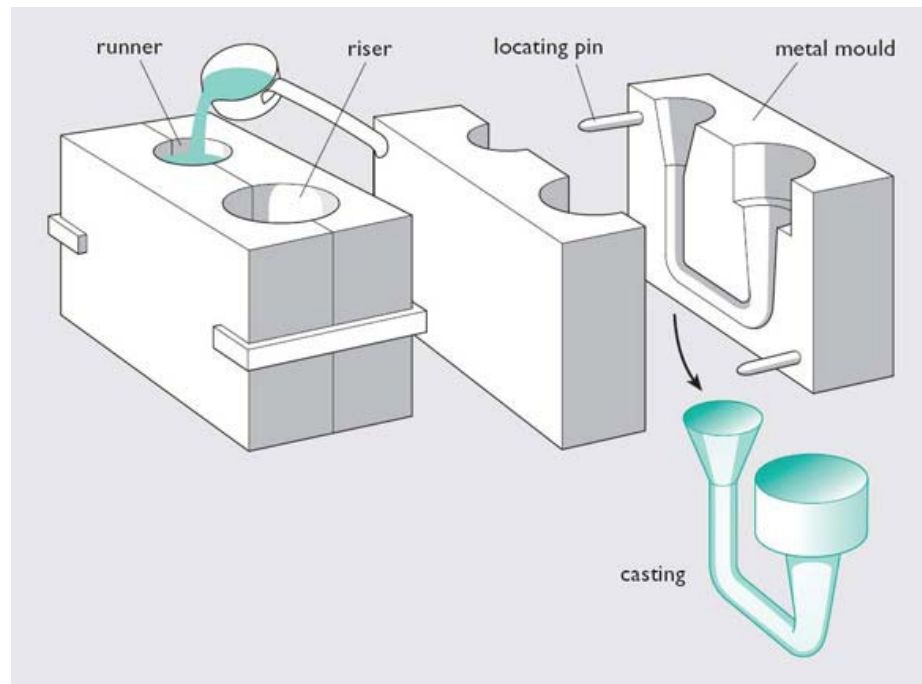
Cores

- Cores may be of either sand or metal.
- Sand cores used (simplify die construction, in case of small number of castings or not possible by metal core).
- Metal are made of steel/CI (either fixed or movable).
- May be solid or hollow.
- May be even water cooled (if high cooling rate is desired).
- Most favored material for dies is Pearlitic Grey CI, Forged die steel [Nimonic 80 (Ni-Cr alloy) for casting Cu-Al & other non ferrous alloys]

METALS CAST

- All cast metals (except steel)
- Al- alloys, Cu-alloys, Lead alloys, Zn- alloys
- Grey iron castings can be produced by using thin refractory coating/lining on mold surfaces (coating has a base of sodium silicate or phosphoric acid)
- Castings are normally limited to 10 Kg.

PERMANENT MOLD CASTING



PRESSURE DIE CASTING

- Good for mass production
- Good accuracy
- Low cost
- Good finish & close tolerances
- Suited only for non-ferrous castings (small sized)

- **Dies:**
 - Die just that for permanent mold casting, however two halves of die : cover die (stationary) & ejector die (which opens & closes)
 - Made of alloy steel
 - As no coating is employed, good finish & close tolerances achieved.

DIE CASTING

Die Casting Machines

- Function
 - closing two die halves
 - securing them together
 - forcing molten metal into die
 - opening the size
- Method used for closing & locking of die may be mechanic, hydraulic or combined.

Types of Die Casting Machines

Hot Chamber Die Casting Machine

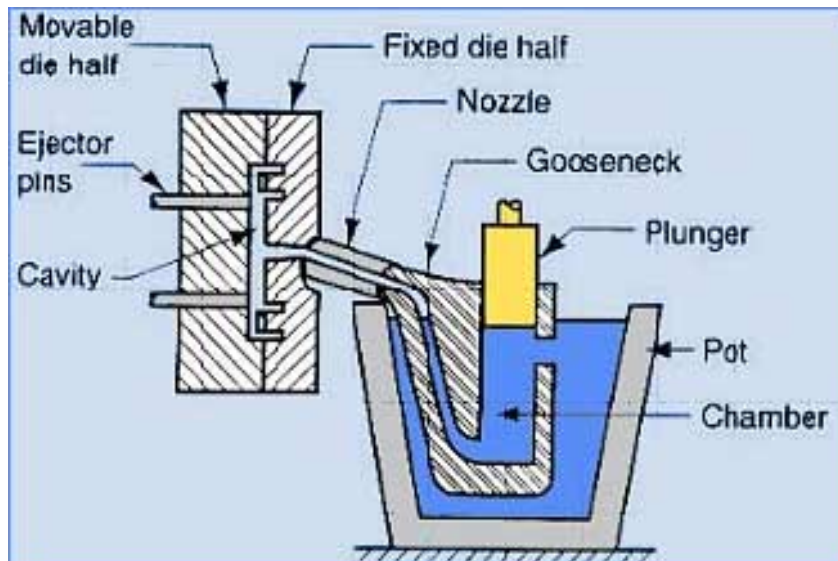
- Has a suitable furnace for melting & holding the metal.
- Pressure ~ 150 Kg/cm²

Cold Chamber Die Casting Machine

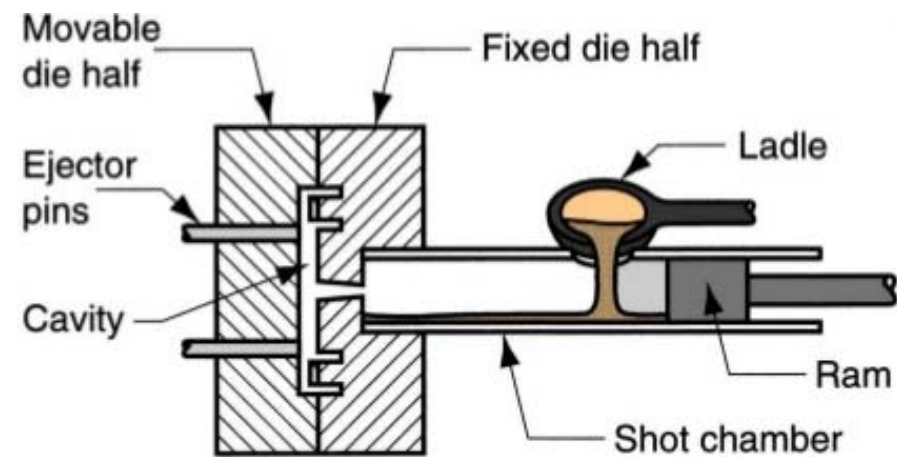
- It has a horizontal steel cylinder in which molten metal is introduced
- Pressure ~ 300 Kg/cm²



Hot and cold chamber die casting



Hot Chamber Die Casting



Cold Chamber Die Casting

PRESSURE DIE CASTING

- **Metals for Die Casting** → Zn, Al, Mg, Cu-base, Tin-base, lead,...
- **Design of Die Casting Dies**
 - Arrangement of die cavity & parting line
 - Cores may be used to avoid thick sections
 - Cores may be integral with dies or may be placed separately. (may be fixed, moving or collapsible).
 - Vents fitted on die parting (~ 0.2 mm deep)

Design of Die Casting Dies

- Sprue, runner & gates should be provided such that they facilitate removal of castings, runners cut at die parting & gates join the runner with die cavity.
- Over flow wells are sometimes included (to collect extra metal & facilitate escape of air)
- Large dies are normally water cooled (same for large cores)

ADVANTAGES

- ❖ High production rate (300-350 casting/hr with hot chamber & 75-150 casting/hr with cold chamber)
- ❖ Close dimensional tolerance : $\pm 0.075\text{mm}$ (up to 25mm size)
- ❖ Thin section can be cast (0.5mm for Zn & 0.8mm for Al)
- ❖ Surface finish (0.8 to 3 microns)
- ❖ Dies retain accuracy for ~ millions of casting (5 millions for Zn alloys)
- ❖ Saving of labour & time (for machining), so economical

Disadvantages

- Only certain alloy can be cast
 - Weight
 - High cost
 - May have porosities because of entrapped air
 - May have metal loss
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- Total Metal Loss: Weight of metal charged into furnace minus weight of saleable castings

THANKS

