



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

SPECIAL CASTING PROCESS

Low pressure die casting, vacuum casting etc.

Dr Pradeep Kumar Jha

MIED



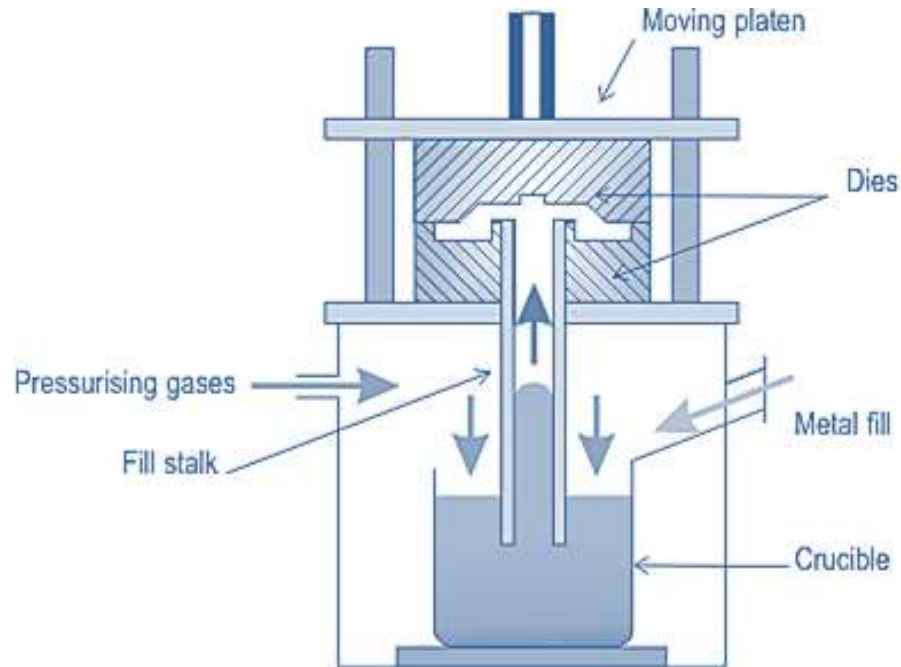
LOW PRESSURE DIE CASTING

- For metals like Al or Mg (for thin sections), mold filled by upward displacement of molten metal from a sealed melting pot or bath.
- Pressure: $0.5 - 1.0 \text{ Kg/mm}^2$
- Dies are filled with ample venting (to allow escape of air).
- Upward filling requires no runner & risers, so no loss of air.



- Low pressure eliminates turbulence & air aspiration.
- Cores may be used.
- Manufacturing of automobile & air craft components, impeller for pumps etc.
- Dies preheated ($\sim 250^{\circ}\text{C}$) & holding down pressure on dies ($\sim 30\text{Kg/mm}^2$, pneumatically applied).
- Cores (Sand / Shell / Parts).

LOW PRESSURE DIE CASTING

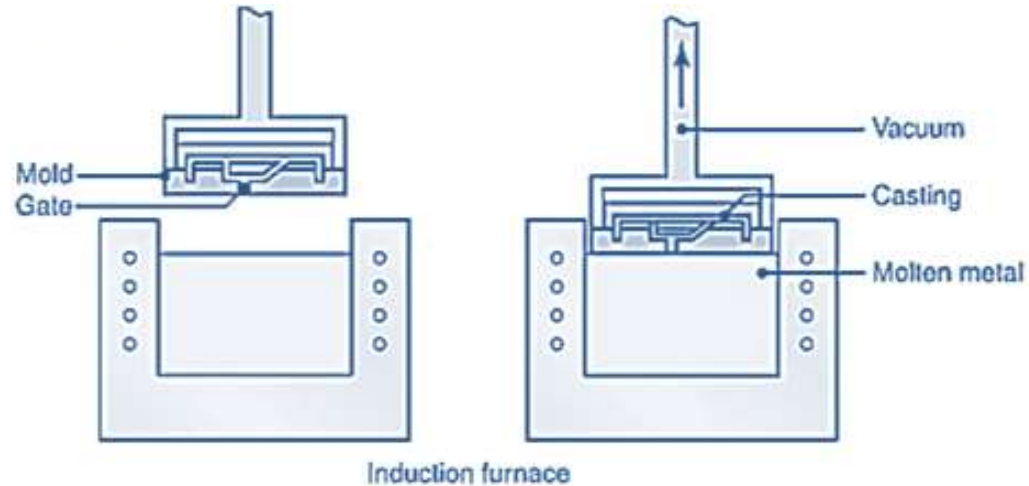


VACUUM DIE CASTING

- Evacuation of die cavity is aimed at reducing porosity, assisting flow in thin sections & improving finish while reducing injection pressure required.
- Vacuum employed to fill chamber through a suction pipe from holding furnace below.



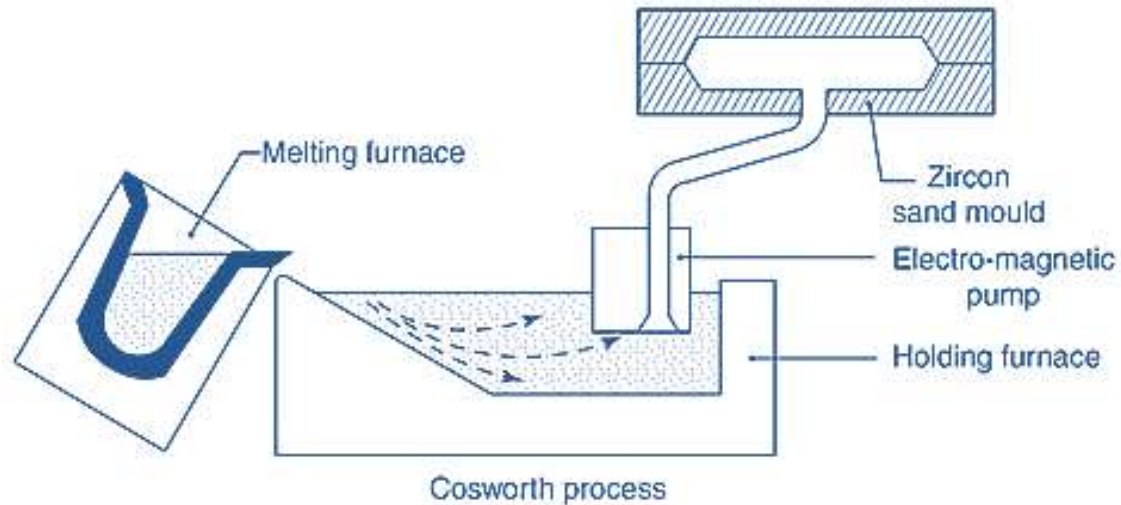
VACUUM DIE CASTING



COSWORTH PROCESS

- Overcomes problem related to entry turbulent metal into casting furnace
- Metal allowed to stand in holding furnace & then transferred by means of a pump without moving parts into a resin bounded sand from below, displacing air progressively.
- Minimum porosity
- For high quality aerospace & cylinder head castings in Al-alloys.

COSWORTH PROCESS



SQUEEZE CASTING

- Combination of gravity die casting & close die forging (in a single operation).
- Also known as liquid forging (a hybrid metal forming technique).
- Produces near net shape components in metals, alloys & composites.
- **Advantages** → free from shrinkage & porosity
 - fine grained structures
 - higher yield (no gating & risering required)
 - better mechanical properties
 - near net shape manufacturing capacity

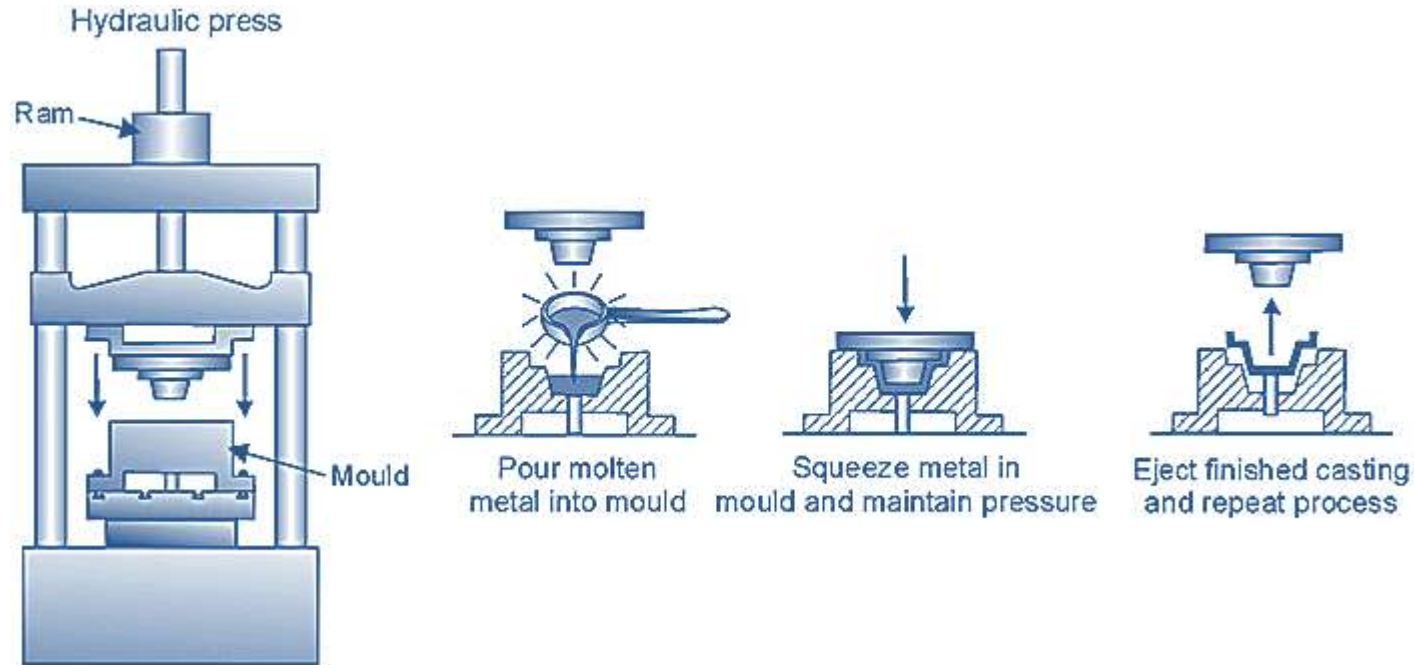


Process Parameters

- Pouring temperature
- Melt volume
- Tooling temperature (Die temperature 190-315°C, punch temperature 15-30°C below die temperature)
- Melt quality
- Time delay (to prevent shrinkage by cooling of metal ~6sec)
- Pressure level (0-75 MPa) for Al-alloys
- Process duration: 30 sec to 120 sec (thumb rule: 1Sec/mm of section thickness of casting)



SQUEEZE CASTING



SEMI SOLID METAL WORKING PROCESS

- Rheocasting:
 - ❖ Melt agitation (by impellers, multi paddle agitators)
 - ❖ Shear promotes formation of non-dendritic structure
 - ❖ Processing Variable: Shear rate, cooling rate, stirring time, volume fraction of solid.
- Thixoforming: Thixotropic fluids shear when material flows, but thicken when standing. It is done between solidus & liquidus temperature.
 - ❖ MHD casting
 - ❖ Strain induced melt activation
 - ❖ Spray casting

THANKS

