# Materials Engineering Department
# General Materials Branch

Fourth Class

Casting Technology II

Lecture Seven :Squeeze and Semi-Solid Casting

# SQUEEZE CASTING AND SEMISOLID CASTING

Advantages of semisolid metal casting include the following

1. Complex part geometries,
2. Thin walls in parts,
3. Close tolerances,
4. Zero or low porosity

- While the majority of applications involve alloys of aluminum ,each of the processes has been successfully applied to magnesium ,zinc, copper, and a limited number of ferrous alloys.

# SQUEEZE CASTING AND SEMISOLID CASTING

**Thixocasting**

- The prefix in thixocasting is derived from the word thixotropy, which refers to the decrease in viscosity of some fluid-like materials when agitated.
- the starting work material is a precast billet that has a non-dendritic microstructure; this is heated into the semisolid temperature range and injected into a mold cavity using die casting equipment

**Rheocasting**

- The prefix in rheocasting comes from rheology, the science that relates deformation and flow of materials
- In rheocasting, a semisolid slurry is injected into the mold cavity by a die casting machine, very much like conventional die casting.

# SQUEEZE CASTING AND SEMISOLID CASTING

**Thixocasting**

- When applied to magnesium, the term is thixo molding, which utilizes equipment similar to an injection-molding machine

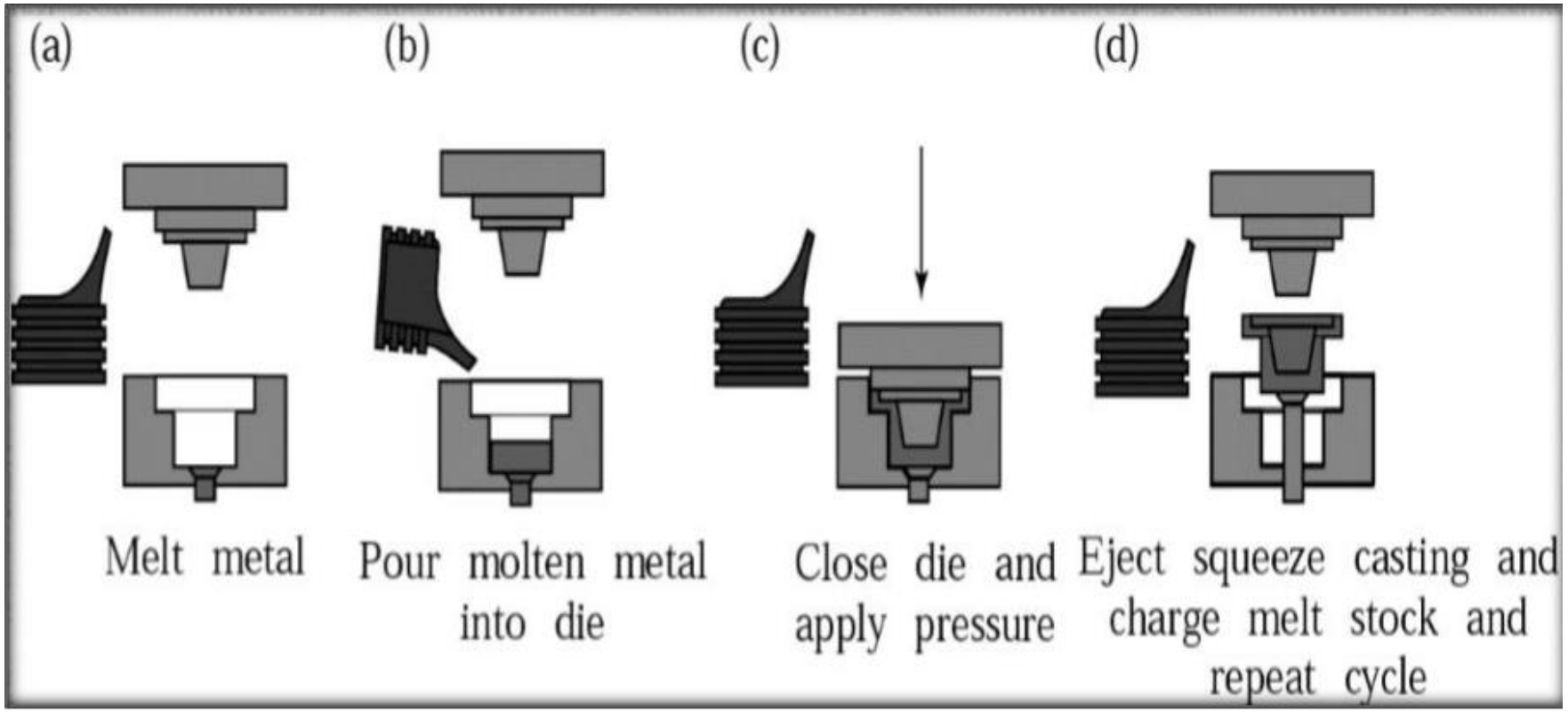
**Rheocasting**

- The difference is that the starting metal in rheocasting is at a temperature between the solidus and liquidus rather than above the liquidus. And the mushy mixture is agitated to prevent dendrite formation.

# SQUEEZE CASTING AND SEMISOLID CASTING

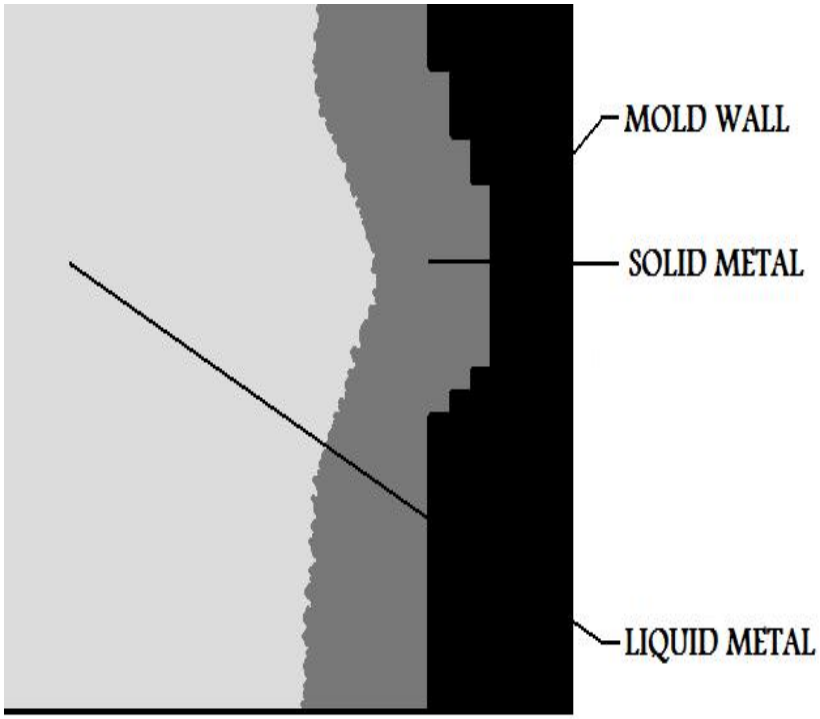
- Squeeze casting and semisolid casting are methods that enable the production of high quality, near-net-shape, thin-walled parts with good surface finish and dimensional precision as well as properties that approach those of forgings
- Both processes can be viewed as derivatives of conventional high-pressure die casting, since they employ tool steel dies and apply high pressure during solidification

# SQUEEZE CASTING AND SEMISOLID CASTING



# Slush Casting

- Slush casting is a permanent-mold process in which a hollow casting is formed by inverting the mold after partial freezing at the surface to drain out the liquid metal in the center .

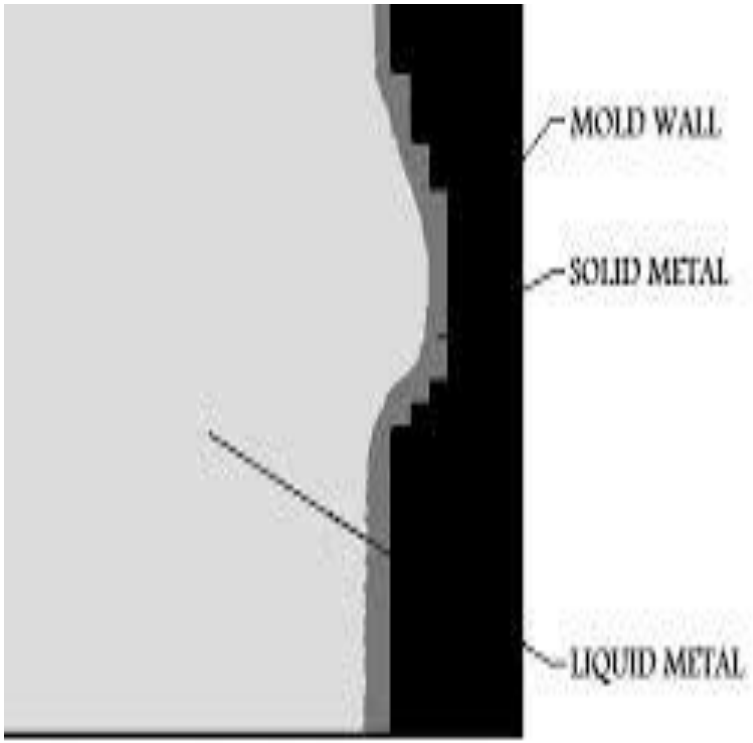



SECTION OF CASTING NEAR MOLD WALL
LONGER TIME AFTER POURING

SOLIDIFICATION PROGRESSES FROM MOLD-CASTING INTERFACE TOWARRDS INNER REGIONS OF THE MATERIAL
THICKNESS OF THIS SOLID SECTION INCREASES WITH TIME

# Slush Casting

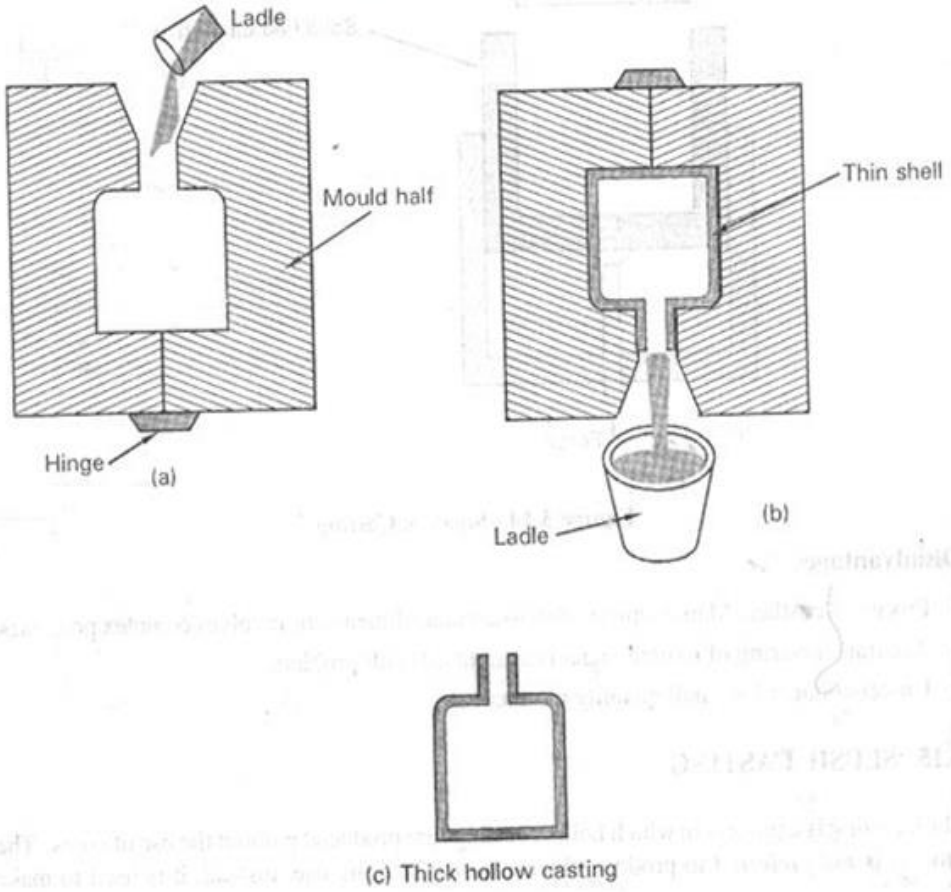
- Slush casting is used to make statues, lamp pedestals, and toys out of low-melting-point metals such as zinc and tin




SECTION OF CASTING NEAR MOLD WALL SHORT TIME AFTER POURING

SOLIDIFICATION CAN BE SEEN TO START AT INTERFACE BETWEEN MOLTEN METAL AND MOLD SURFACES

# Slush Casting



# Low-Pressure Casting

- In the basic permanent-mold casting process and in slush casting, the flow of metal into the mold cavity is caused by gravity.
- In low-pressure casting, the liquid metal is forced into the cavity under low pressure—approximately 0.1 MPa(14.5lb/in2)—from beneath so that the flow is upward, as illustrated in
- The advantage of this approach over traditional pouring is that clean molten metal from the center of the ladle is introduced into the mold, rather than metal that has been exposed to air. Gas porosity and oxidation defects are thereby minimized, and mechanical properties are improved.

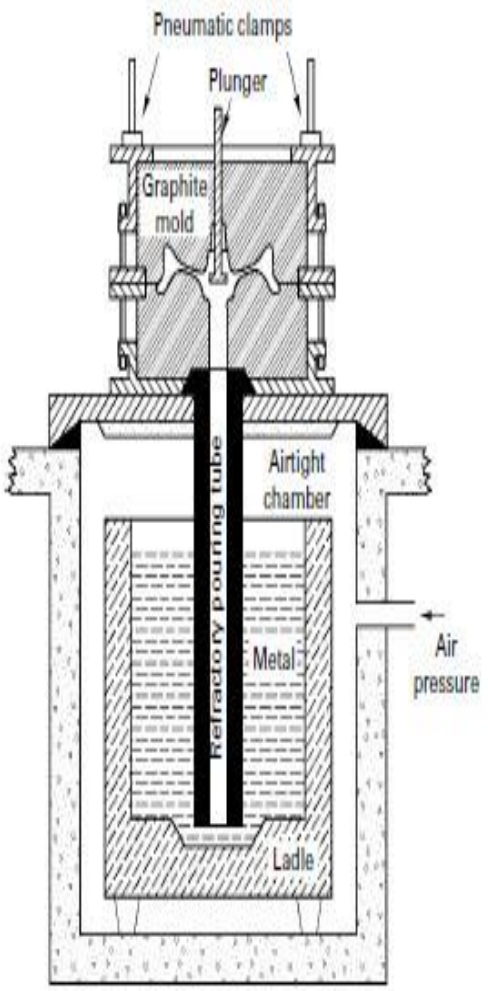



**FIGURE 13-2** Schematic of the low-pressure permanent-mold process. *(Courtesy of Amsted Industries, Chicago, IL.)*

# Vacuum Permanent-Mold Casting

- Not to be confused with vacuum molding ,this process is a variation of low-pressure casting in which a vacuum is used to draw the molten metal in to the mold cavity.
- The general configuration of the vacuum permanent mold casting process is similar to the low-pressure casting operation .
- The difference is that reduced air pressure from the vacuum in the mold is used to draw the liquid metal into the cavity, rather than forcing it by positive air pressure from below.
- There are several benefits of the vacuum technique relative to low-pressure casting: air porosity and related defects are reduced, and greater strength is given to the cast product.