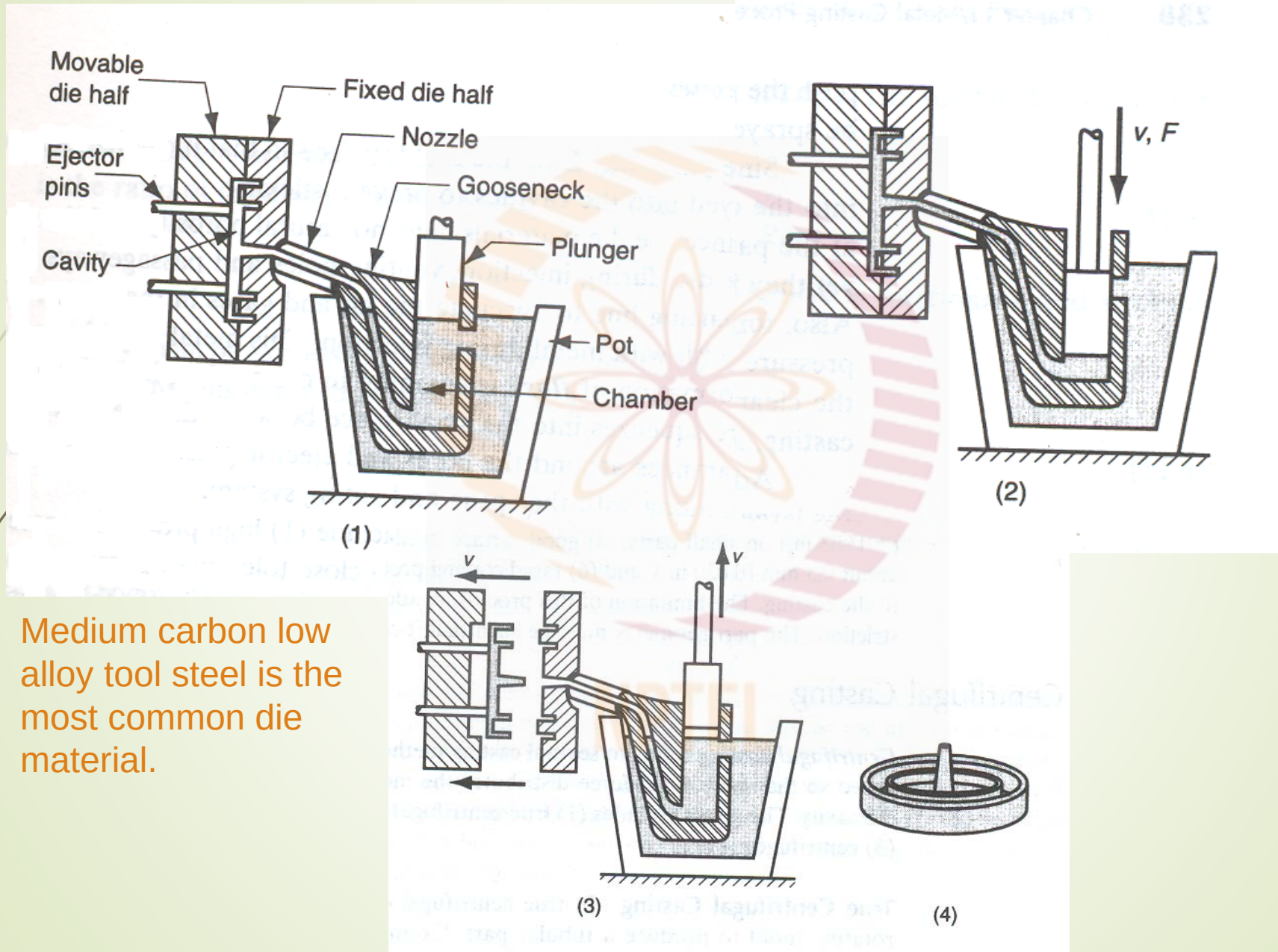


Die Casting

89



Hot-Chamber Die Casting

Metal is melted in a container, and a piston injects liquid metal under high pressure into the die

- **High production rates - 500 parts per hour not uncommon**
- **Applications limited to low melting-point metals that do not chemically attack plunger and other mechanical components**
- **Casting metals: zinc, tin, lead, and magnesium**



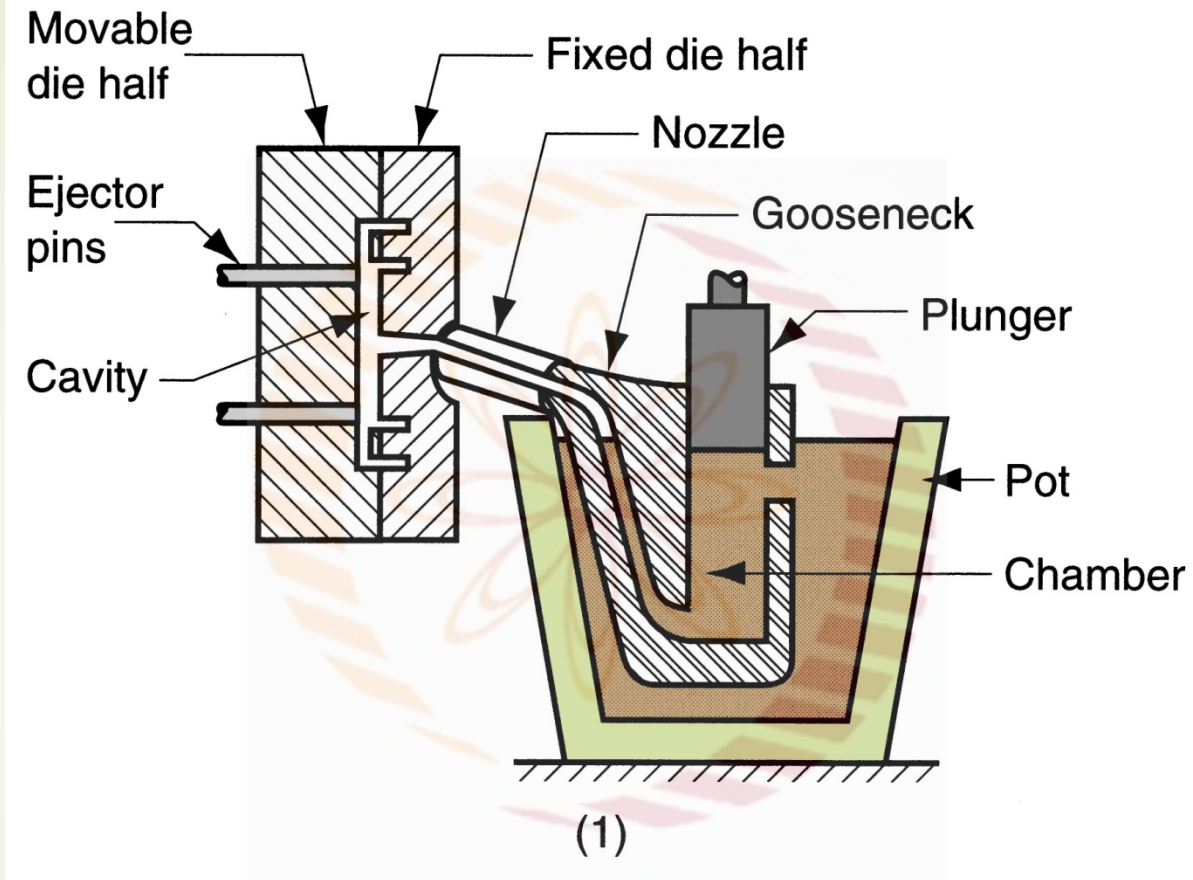


Figure - Cycle in hot-chamber casting:

(1) with die closed and plunger withdrawn, molten metal flows into the chamber

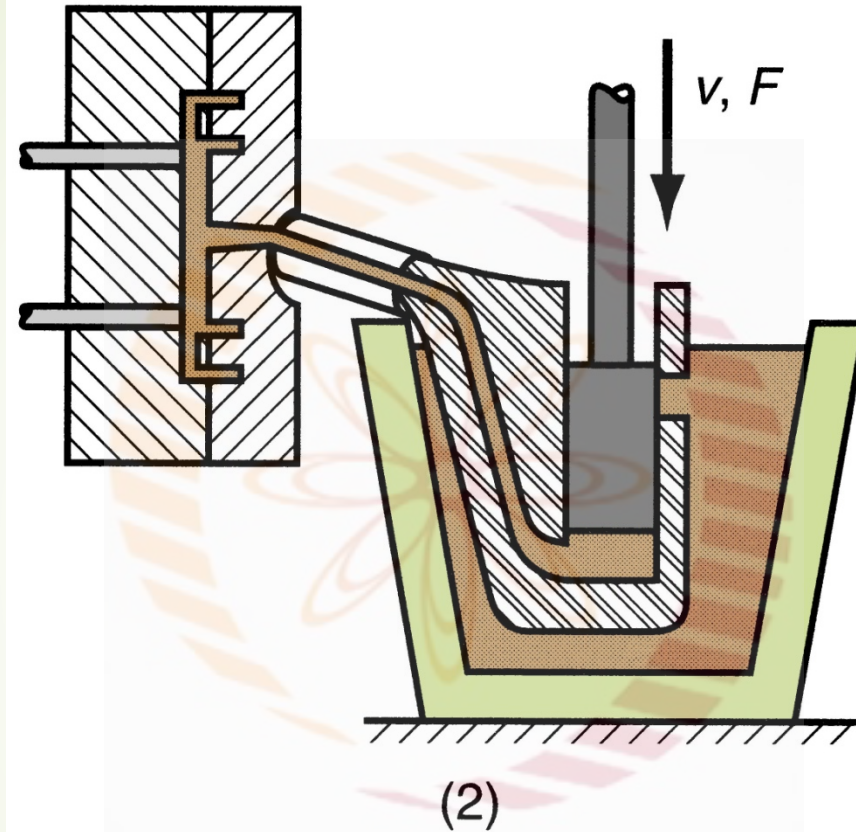


Figure - Cycle in hot-chamber casting:

(2) plunger forces metal in chamber to flow into die, maintaining pressure during cooling and solidification

Cold-Chamber Die Casting Machine

Molten metal is poured into unheated chamber from external melting container, and a piston injects metal under high pressure into die cavity

- **High production but not usually as fast as hot-chamber machines because of pouring step**
- **Casting metals: aluminum, brass, and magnesium alloys**
- **Advantages of hot-chamber process favor its use on low melting-point alloys (zinc, tin, lead)**



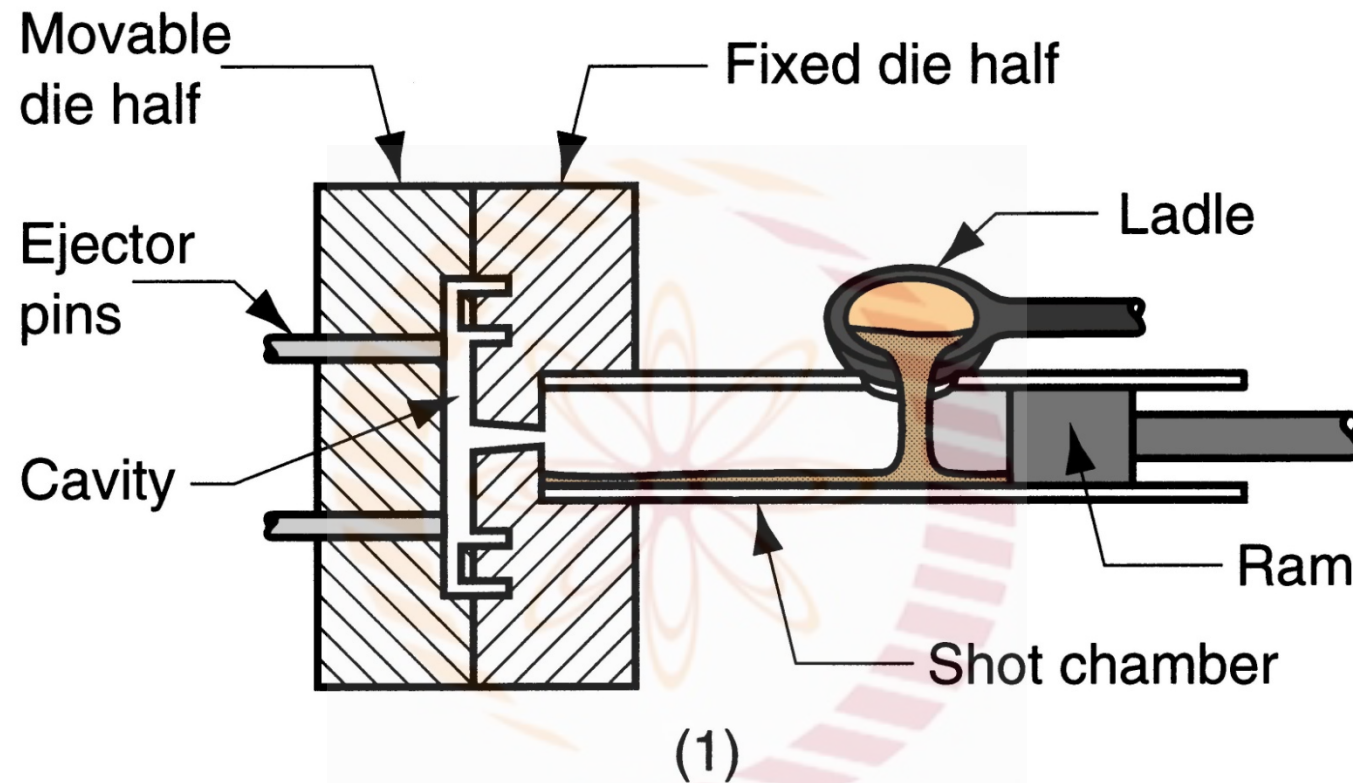


Figure - Cycle in cold-chamber casting:

(1) with die closed and ram withdrawn, molten metal is poured into the chamber

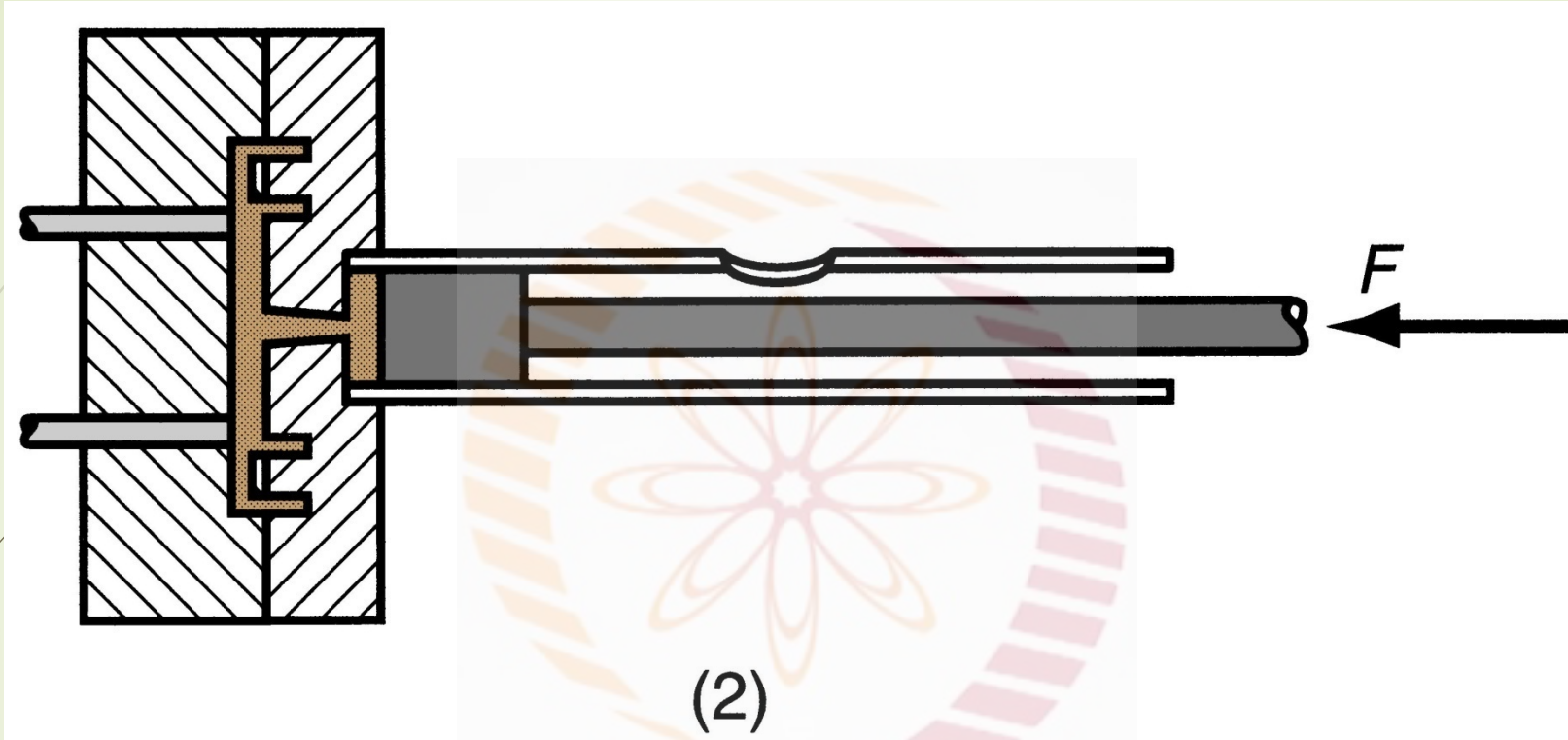
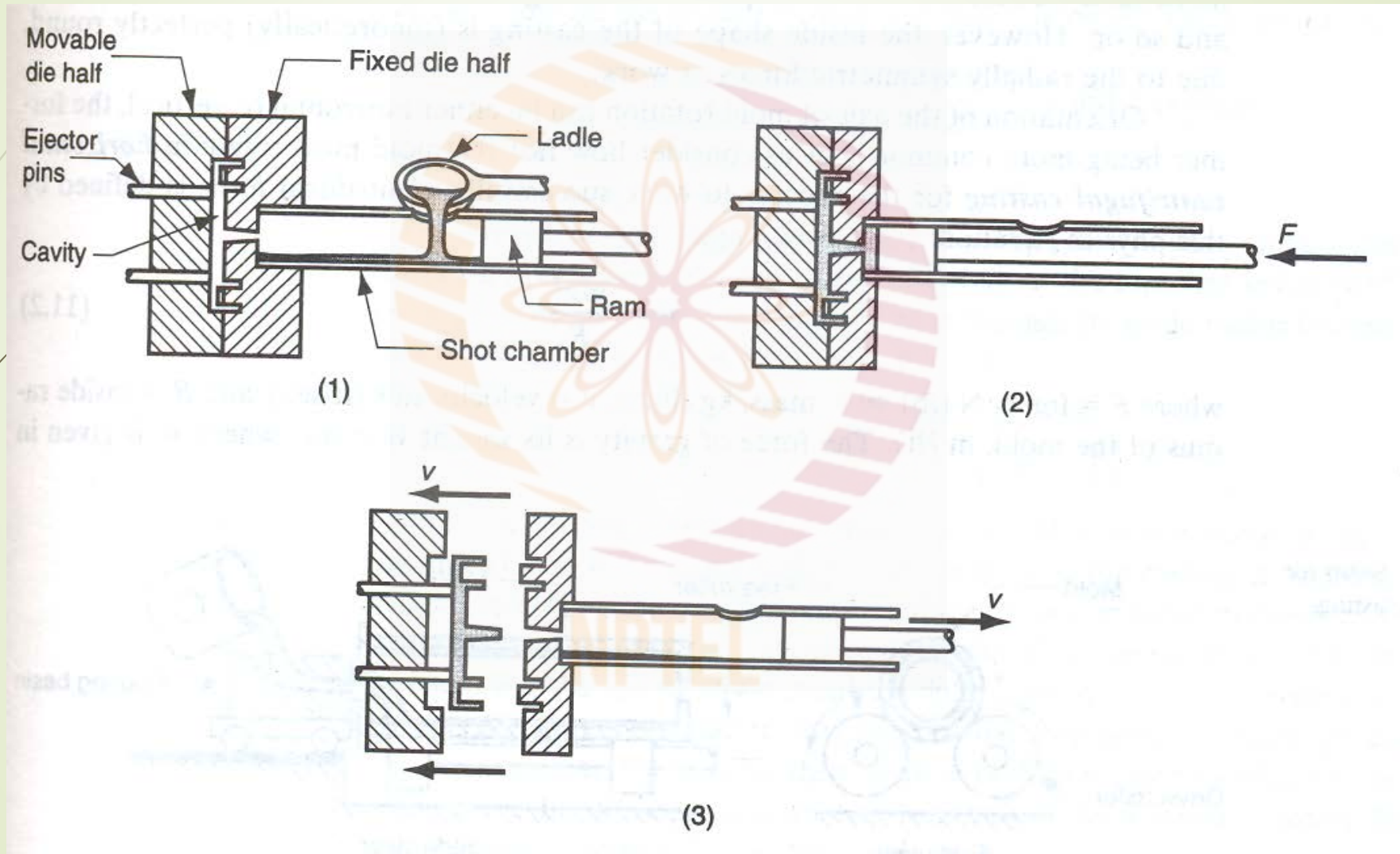


Figure - Cycle in cold-chamber casting:

(2) ram forces metal to flow into die, maintaining pressure during cooling and solidification

Die Casting

96



Advantages and Limitations of Die Casting

Pressure Die Casting

➤ 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 melting points
- Part geometry must allow removal from die cavity



Centrifugal Casting

A group of casting processes in which the mold is rotated at high speed so centrifugal force distributes molten metal to outer regions of die cavity

- **The group includes:**
 - **True centrifugal casting**
 - **Semi centrifugal casting**
 - **Centrifuge casting**



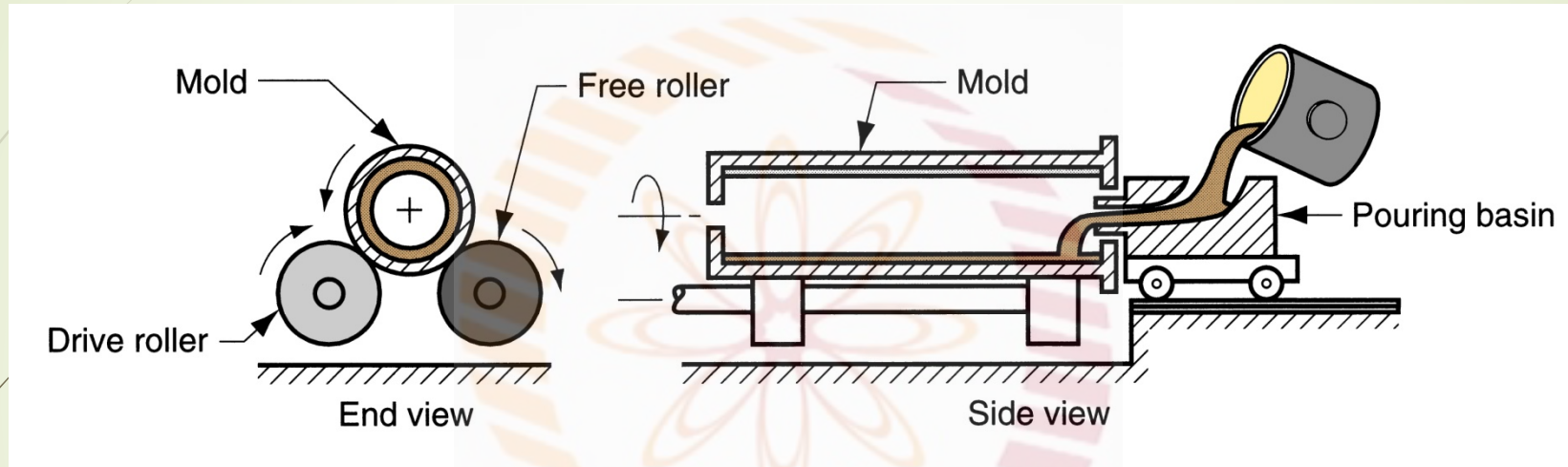
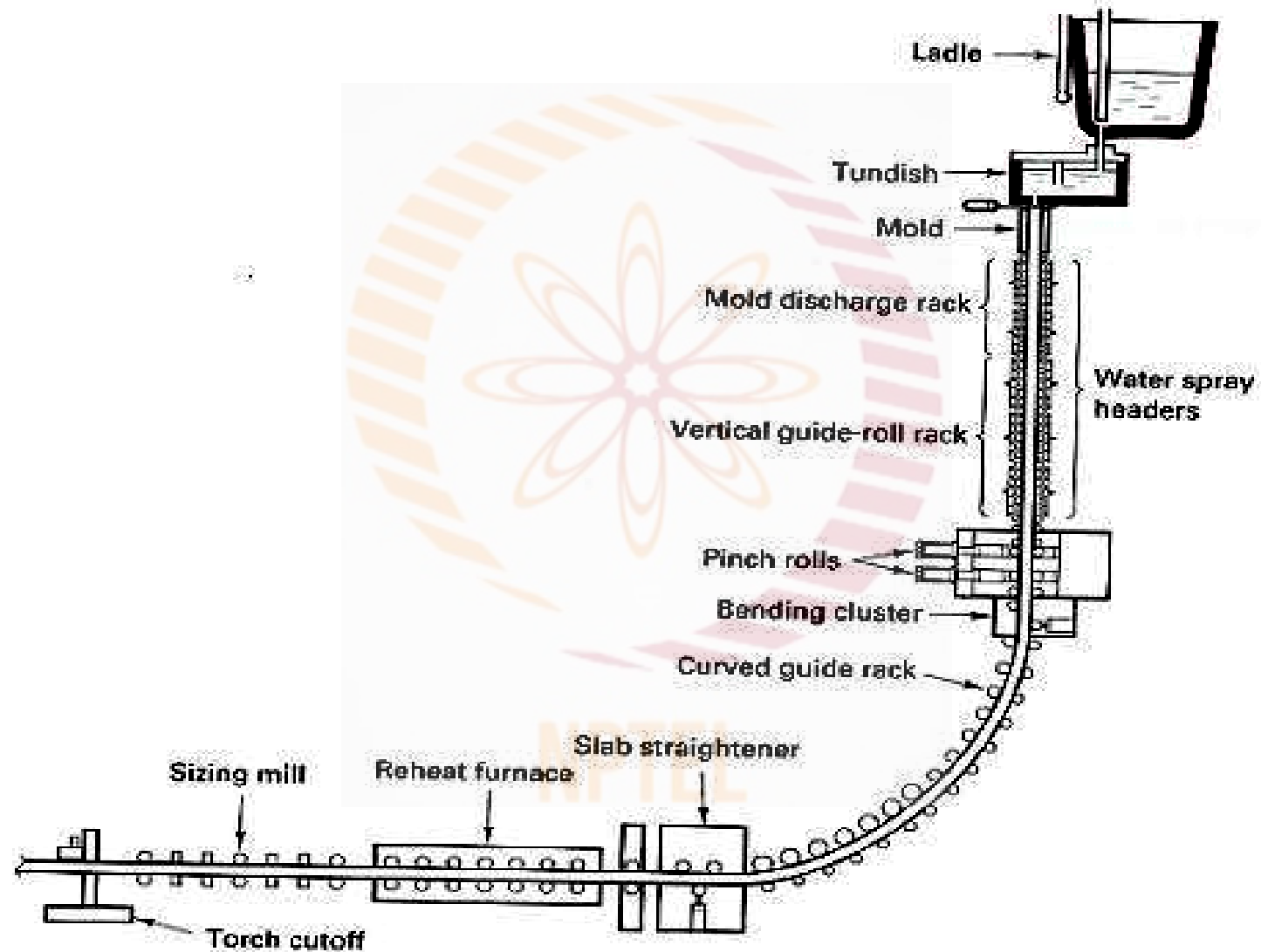


Figure - Setup for true centrifugal casting

CONTINUOUS CASTING

100



Cost Analysis of casting

Total cost of casting includes all costs, both the direct and indirect, that result from the design, production, distribution, use, and salvage of the casting over its lifetime. Total cost can be calculated on a per unit basis as follows

$$Cost = \frac{C_T}{N} + C_c + V C_m + \frac{C_0 t_{cycle}}{Y} + C_s$$

where:

C_T = total tooling cost (Rs.)

N = lifetime number of castings

C_c = cost of coring (Rs./unit)

V = total casting volume (cm^3)

C_m = alloy cost (Rs./ cm^3)

C_0 = casting equipment and labor cost (Rs./hr)

t_{cycle} = total casting lead time (hr)

Y = yield (useable castings/ N)

C_s = cost of secondary processing (Rs./unit)

Cost Analysis of casting

102

It is important to note that total tooling cost (C_T) includes all cost associated with tooling including the cost of pattern and core box construction, the cost of producing and inspecting the first article, and the cost of iteratively modifying the tooling to meet specifications. Also, material volume (V) includes not only the volume of the casting, but also the volume of the risers, runners, and sprues used to feed the casting.

Total casting cycle time (t_{cycle}) is given by the following,

$$t_{cycle} = t_{np} + t_{build} + t_{cast} + t_{cool} + t_{trim}$$

where:

t_{np} = non-productive time (hr)

t_{build} = mold build time including core placement (hr)

t_{cast} = time to pour the casting (hr)

t_{cool} = time to cool to ambient temperature (hr)

t_{trim} = time to remove gates, risers, etc. (hr)

Cost Analysis of casting

103

Since many castings involve more than one core, the per unit cost of coring (CC) is calculated as,

$$C_c = \sum_{i=1}^{n_c} \left(V' C'_m + \frac{C'_0 t'_{cycle}}{Y'_c} \right)_i$$

where:

n_c = number of cores

V' = volume of core material (cm^3)

C'_m = cost of core material (Rs./ cm^3)

C'_0 = core making equipment and labor cost (Rs./hr)

t'_{cycle} = core making cycle time (hr)

Y'_c = yield (useable cores/lifetime number of cores)

Cost Analysis of casting

104

Similarly, secondary processing may involve more than one process such as machining, heat treating, welding, painting, and plating. In addition, processes such as machining might involve several different operations (e.g., drilling, milling, grinding, etc.).

The per unit cost of secondary processing is therefore calculated as

$$C_s = \sum_{i=1}^{n_s} \left(C_T'' + \frac{C_0'' t_{cycle}''}{Y_S''} \right)_i$$

where:

n_s = number of secondary processes

C_T'' = secondary process tooling cost (Rs/unit)

C_0'' = secondary process equipment and labor cost (Rs/hr)

t_{cycle}'' = secondary process cycle time (hr)

Y_S'' = secondary process yield (useable castings/N)