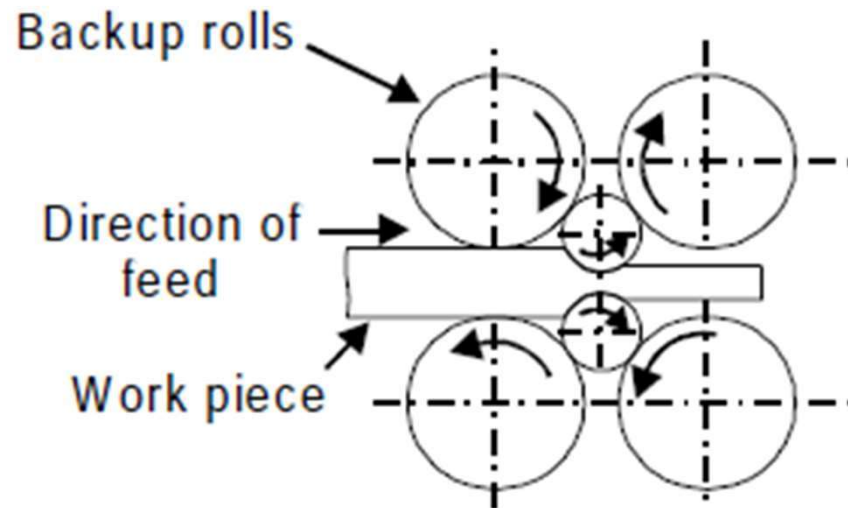


# Cluster Mill

In cluster mill each of the two smaller working rolls are backed up by two or more of the larger back-up rolls. For rolling hard thin materials, it may be necessary to employ work rolls of very small diameter but of considerable length. In such cases adequate support of the working rolls can be obtained by using a cluster-mill.



# EXTRUSION

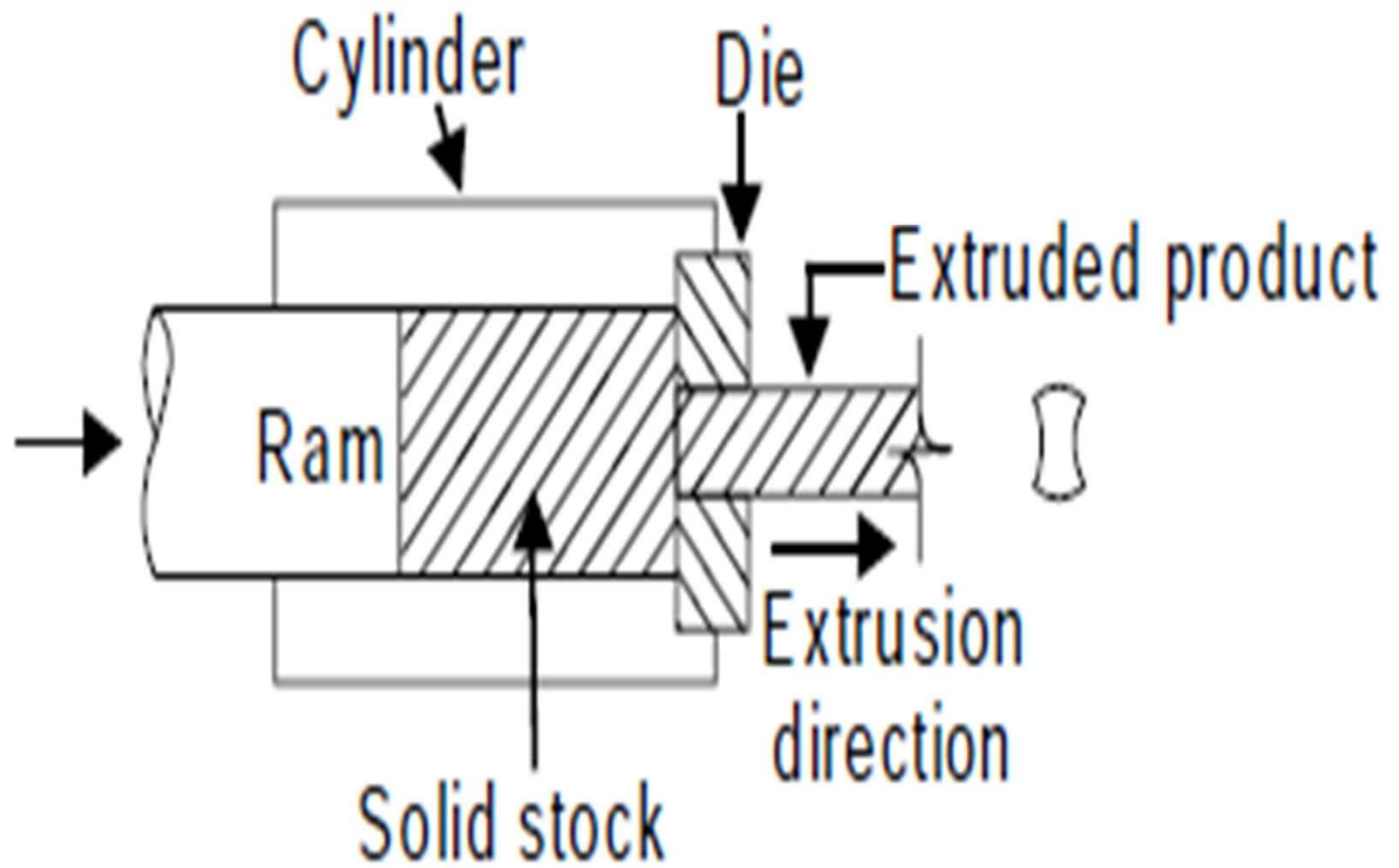
Extrusion process is identical to the squeezing of tooth paste out of the tooth paste tube. In this process the heated billet of metal is enclosed in a closed cavity and then pushing it to flow from only one die opening so that the metal will take the shape of the opening. Pressure force is applied through hydraulically or mechanically.

Some common extrusion processes are-

1. Direct or forward extrusion
2. Indirect or backward extrusion
3. Hydraulic extrusion

### **Direct or Forward Extrusion-**

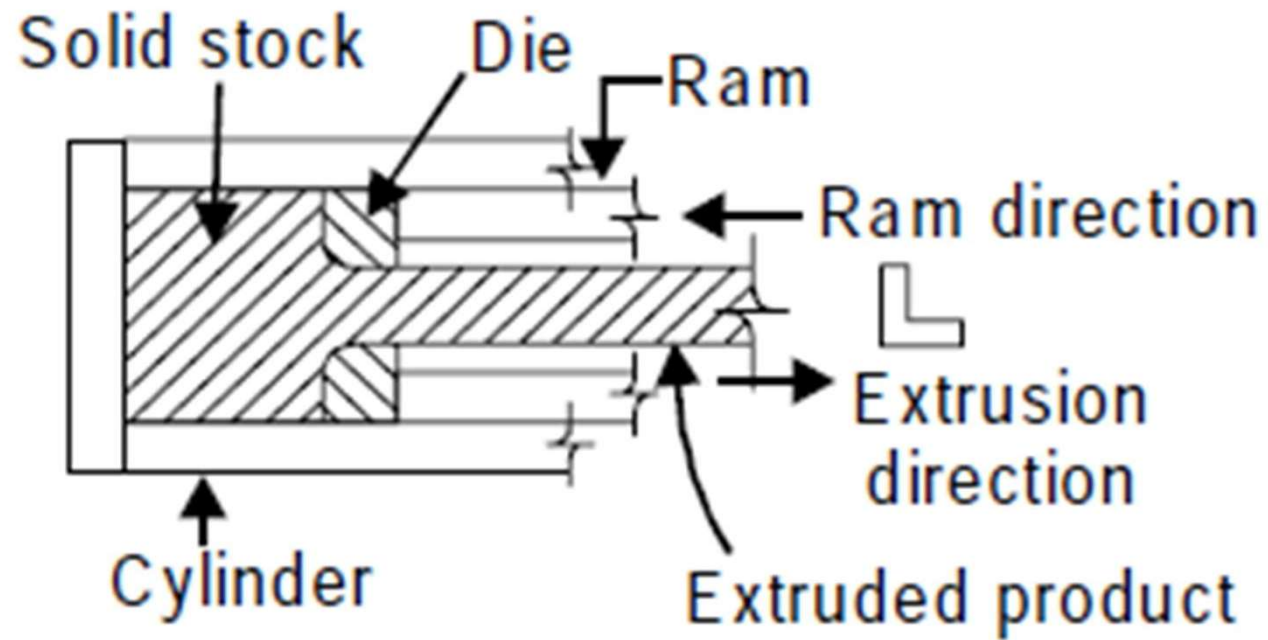
In direct extrusion method, the heated metal billet is placed in to the die chamber and the pressure is applied through ram. The metal is extruded through die opening in the forward direction, i.e. the same as that of the ram. In forward extrusion, the problem of friction is prevalent because of the relative motion between the heated metal billet and the cylinder walls.



Direct extrusion

# Indirect or Backward Extrusion

In indirect extrusion, the billet remains stationary while the die moves into the billet by the hollow ram (or punch), through which the backward extrusion takes place. Since, there is no friction force between the billet and the container wall, therefore, less force is required by this method. However this process is not widely used because of the difficulty occurred in providing support for the extruded part.



Indirect or Backward Extrusion

# Hydraulic extrusion

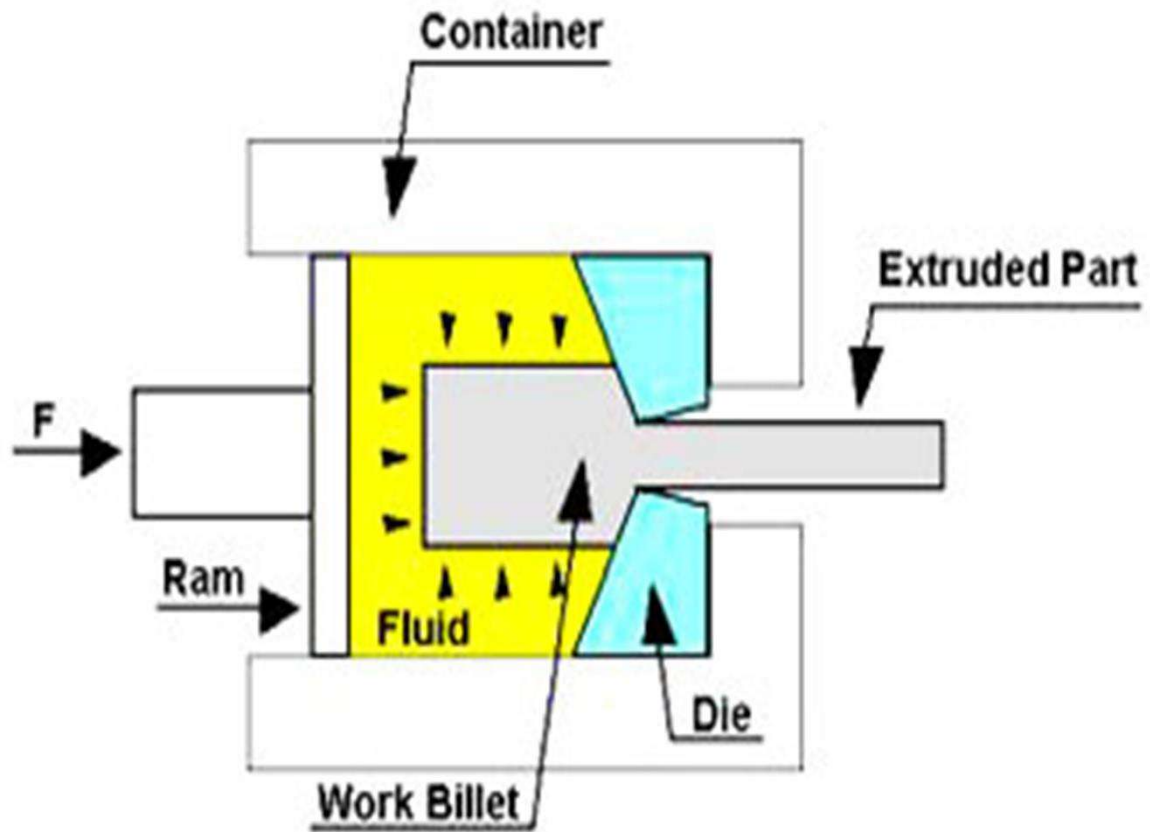
Hydraulic extrusion is a process in which the billet is completely circumscribed by a pressurized liquid in all the cases, with the exception being the case where billet is in the contact with die. This process can be carried out in many ways including warm, cold or hot but due to the stability of the used fluid, the temperature is limited. Hydrostatic extrusion has to be carried out in a completely sealed cylinder for containing the hydrostatic medium.

# Conti..

The fluid may be pressurized in following two ways:

1. Constant-Rate Extrusion: A ram or plunger is used for pressurizing the fluid in the container
2. Constant-Pressure Extrusion: A pump with a pressure intensifier is used for pressurizing the fluid, which is then pumped into the container





Hydraulic extrusion

# Advantages

- No friction amidst the container and billet. This minimizes the force requirements, allowing higher reduction ratios, faster speeds, & lower billet temperatures.
- Friction of the die can be largely reduced by a film of pressurized lubricant amidst the die surface and deforming metal.
- On applying high pressures, the ductility of material increases.
- Large billets & large cross-sections are extruded.
- Uniform hydrostatic pressure inside the container eliminates the requirement of billets being straightened and extrusion of coiled wire.
- No billet residue is left on the walls of container.