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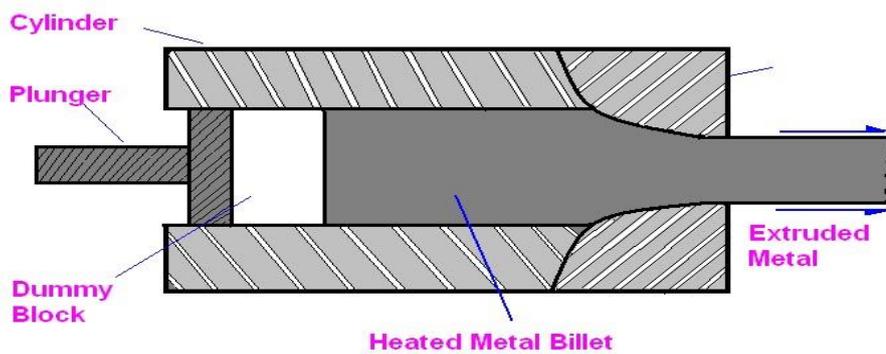
Subject: ME-405 (Manufacturing Technology)

Unit: V, Topic: Extrusion

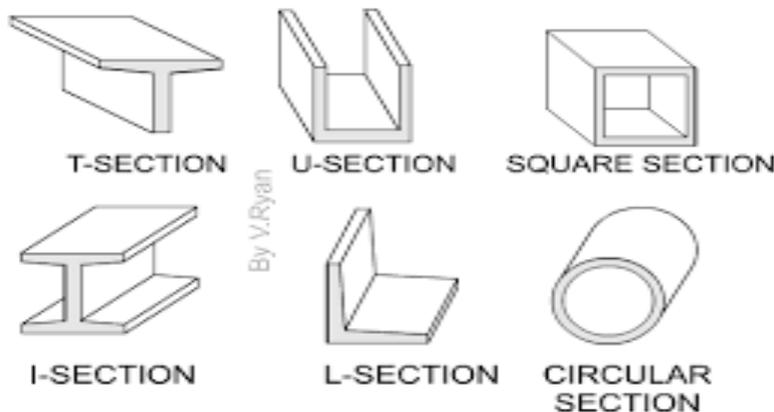
**Extrusion Process:** It is a manufacturing process, in which a block of metal enclosed in a container is forced to flow through the opening of die. Extrusion is the process of confining the metal in closed cavity and then forcing it to flow from one opening (die), so that metal will take the shape of the opening. The operation of extrusion is similar to the squeezing of toothpaste out of toothpaste tube. The paste inside the toothpaste has no shape, when the toothpaste tube is squeezed the paste flows out of the circular opening takes the shape of the opening.

The equipment consists of a cylinder or container into which dummy block and heated metal billet are placed into position. On one end of the cylinder the die plate with necessary opening is fixed. The shape of the opening resembles the shape of the cross section of extruded compound. From the other end plunger compresses the hot billet against the container walls and die plate thus forcing it to flow through the die – opening acquiring the shape of opening.

**Direct Or Forward Extrusion Process**



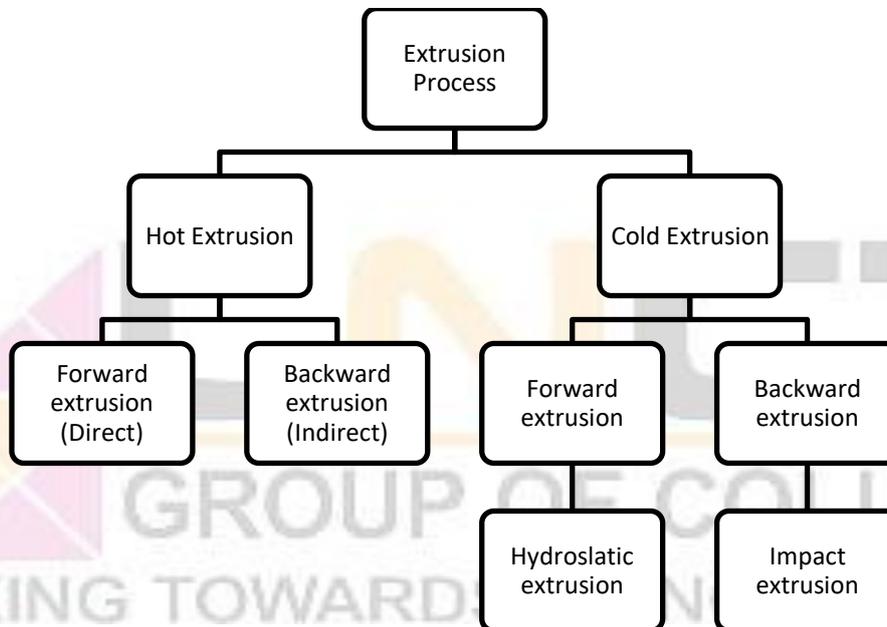
**Extruded Shapes:** Roads, tubes, structural shapes, spined shafts and bars of different cross sections are the typical applications of extrusion process. Almost unlimited length of cross section can be produced with extrusion process. However, only shapes with constant cross section can be produced in this process.



**Advantages of the extrusion process are as follows:**

1. Extrusion is a single pass process unlike rolling.
2. Dies are easy to manufacture.
3. Variety of shapes of high strength, good accuracy and surface finish can be obtained.
4. High production rate with relatively low die cost.
5. Complicated cross sectional shapes which is not possible to achieve by rolling can be achieved by extrusion.
6. Larger deformation can be achieved by this process than other processes (except casting).
7. Dies can be easily replaced and removed with no lost of time.

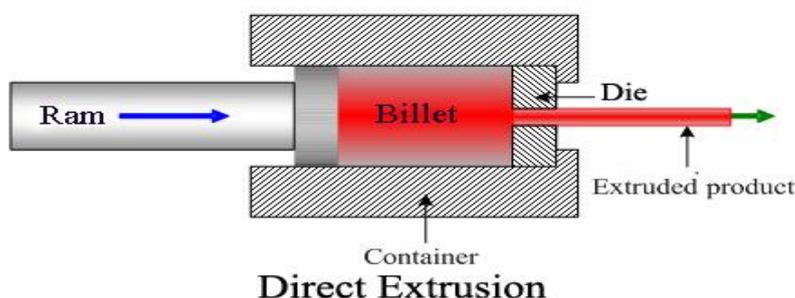
**Classification of Extrusion Process:**



**Hot Extrusion**

**a) Forward Extrusion:**

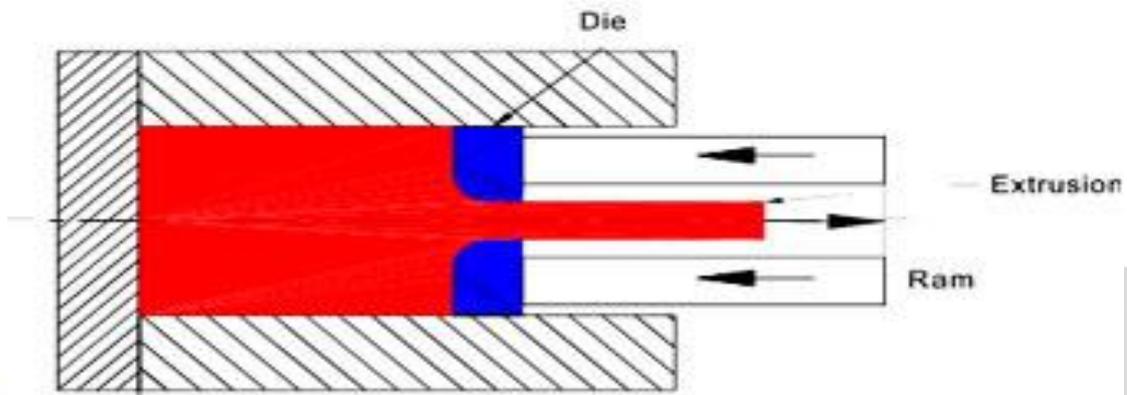
In this case the flow of metal is in the direction of movement of ram or plunger. Here the problem of friction is predominant because of relative motion between heated metallic billet and cylindrical walls. To reduce friction lubricants are used. But at high temperature the lubricants get compounded. Molten glass is generally used as lubricant and thermal insulator for extruding steels.



**b) Backward Extrusion:**

In this case the problem of friction is eliminated as billet does not move in cylinder or container. A hollow ram compresses the metal against container, forcing it to flow backward through the die in hollow plunger. Less force is required in this method. Since there is no frictional force between metallic billet and container.

The limitations of the process are the weakening of ram because it is hollow and difficulty of providing proper support for the extruded metal.

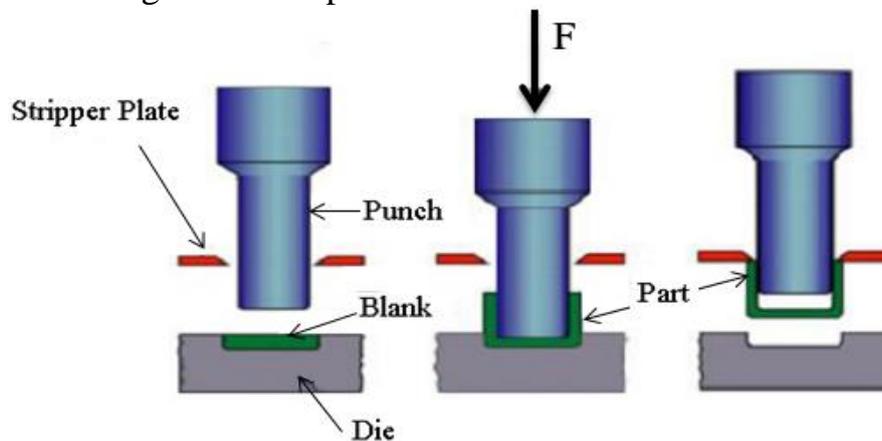


**Backward or Indirect Extrusion**

**Cold Extrusion**

**a) Forward cold extrusion:**

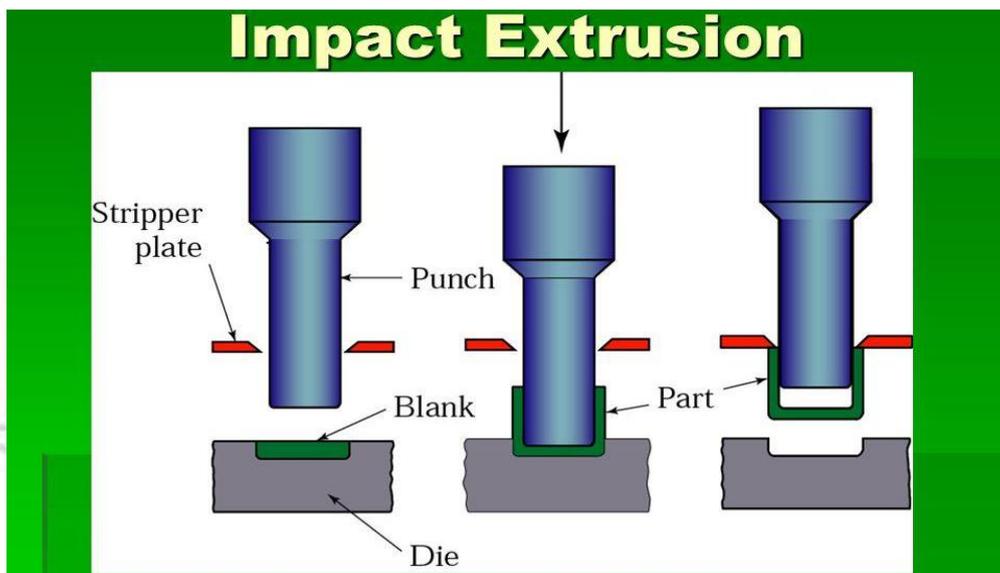
The Forward cold extrusion is similar to forward hot extrusion except that temperature is comparatively lower and extrusion pressures are higher than hot extrusion. It is usually used for simple shapes. The cold extruded products have better surface finish and improved mechanical properties. The common applications of cold extrusion are aluminum brackets, tubes shock absorber cylinders etc. Now a day's cold extrusion has also been used for forming mild steel parts often in combination with cold forging.



**Cold Extrusion**

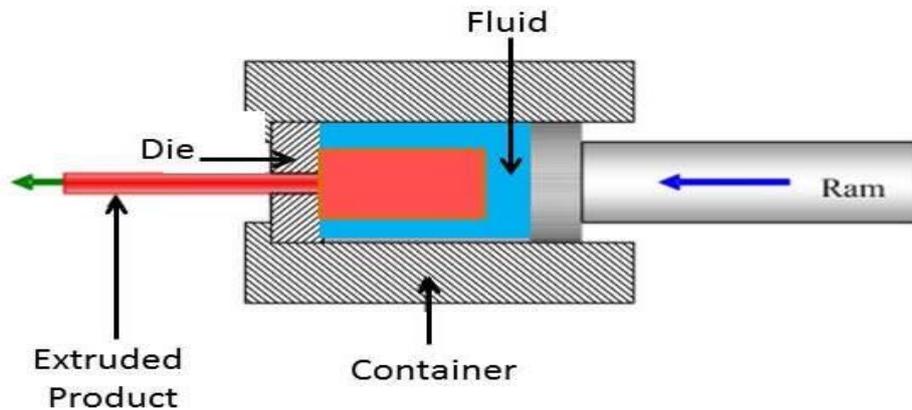
### b) Impact extrusion:

Impact extrusion is used for manufacturing collapsible tubes for shaving cream, toothpaste and thin walled cans. The process is limited to soft and ductile materials such as aluminum and its alloys. The set up consists of die and punch. A slug of metal of suitable thickness is kept on the die. The outside dia. of tube is same as that of diameter of hold in die. Punch strikes a single blow causing the metal to flow through the annular space between the punch and die. The metal is extruded in the direction opposite to punch movement because of impact force. The process is conducted at room temperature. In recent years the process has been developed and now also applied to production of components for air craft, cars and domestic appliances of Al, copper alloy and steels.



**c) Hydrostatic Extrusion:**

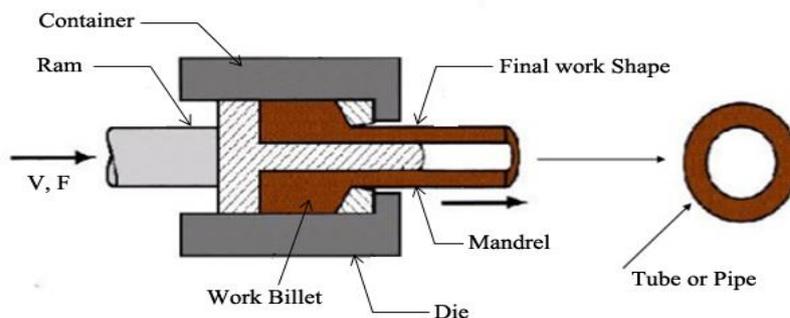
It is another extrusion process which makes possible to cold extrude many difficult to form materials such as high strength super alloys, molybdenum etc. Here instead of applying the load directly by ram a liquid medium is used. The presence of liquid inside the container eliminates the need of lubricant and also force transmitted is uniform from all sides throughout the deformation zone. Because of this brittle materials such as grey cast iron can also be extruded. Applications include extrusion of reactor fuel rods, making wire of less ductile materials.



**Hydrostatic Extrusion**

**Tube Extrusion**

Hollow objects such as tubes and other shapes can be produced by forward extrusion. For tubular sections mandrel is used along with the ram to shape the inside of the tube. After the billet is placed inside the extrusion container, the ram with mandrel advances and extrudes the metal through the die and around the mandrel. The entire operation must be rapid. Speeds upto 3m/second are used in making steels tubes. Low carbon steel can be extruded cold but for most of alloy billet is heated to around 1250° C.



**Tube Extrusion**

