

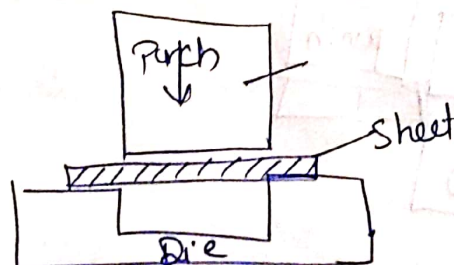
## Sheet metal

- Sheet metal is a thin pieces which are produced by forming process like rolling.
- The thickness of metal is in b/w 0.15mm to 4mm is called sheet metal. If more than 4mm then it is called as ~~thin~~ plate.
- Some of the sheet metal operation are.
  - Punching
  - Blanking
  - Piercing.
  - Bending.

For these operations we required 2 ~~group~~ Elements which are.

- Die
- Punch

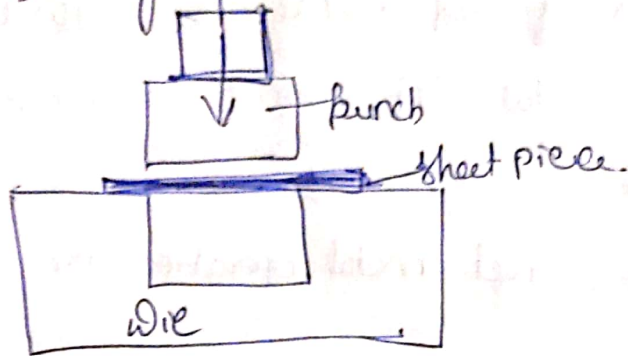
Die: Die having negative shape of contour. The metal piece is kept over the ~~the~~ die



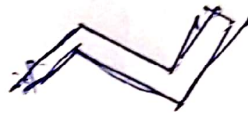
Punch: punch has the positive contour of shape of ~~product~~. The force applied through the punch.

Bending Bending is metal forming in which force is applied to the piece of the sheet metal caused to bend from a desired shape

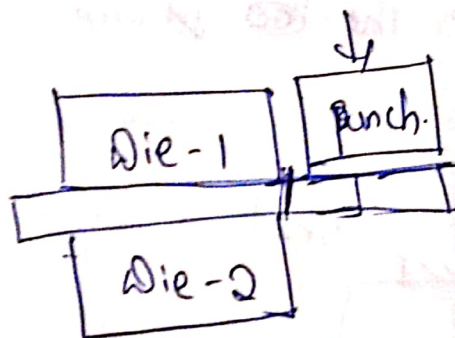
Channel Bending



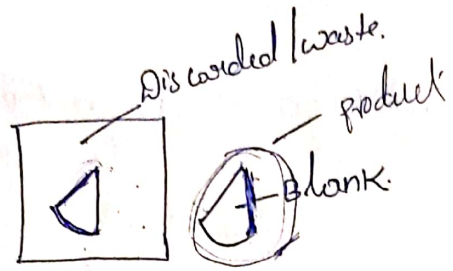
- Edge Bending
- Channel Bend
- U-Bend
- V-Bend
- off-set



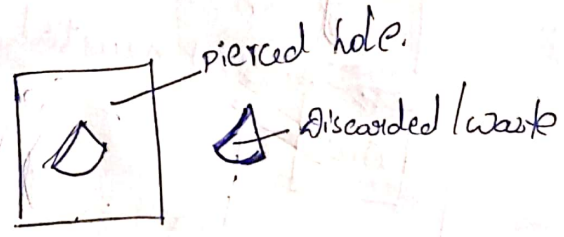
Shearing: Shearing is process of separating the material into two parts. / two piece.



Blanking: Blanking is the operation of cutting a piece of the required shape from a sheet using punch and die.



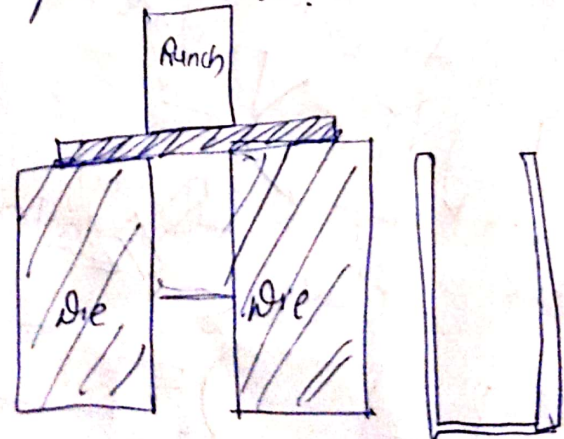
Piercing. In Piercing the material pushed out to form the hole constitutes the waste and sheet with hole is required part.



Deep drawing:

Drawing is process of deform the material into the shape of die. Like cup shape.

then Deep drawing is also process of deform the material into the cup shape but in which diameter reduces and ~~thickness~~ length increase.



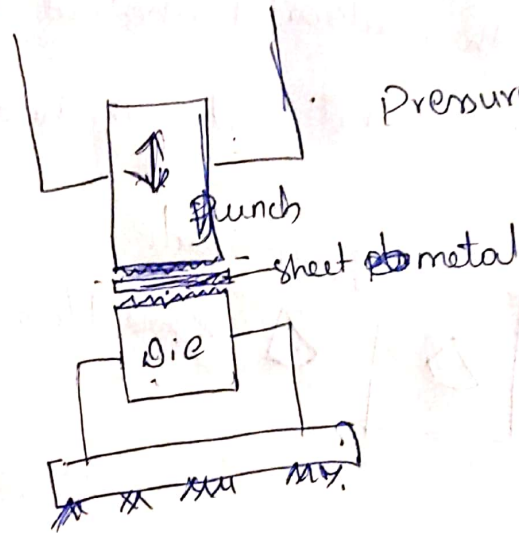


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Coining: Coining is used to create raised surfaces and impressions in metal. It is used for making coins and medals.

- the required impression is inversely imprinted on the punch and die.

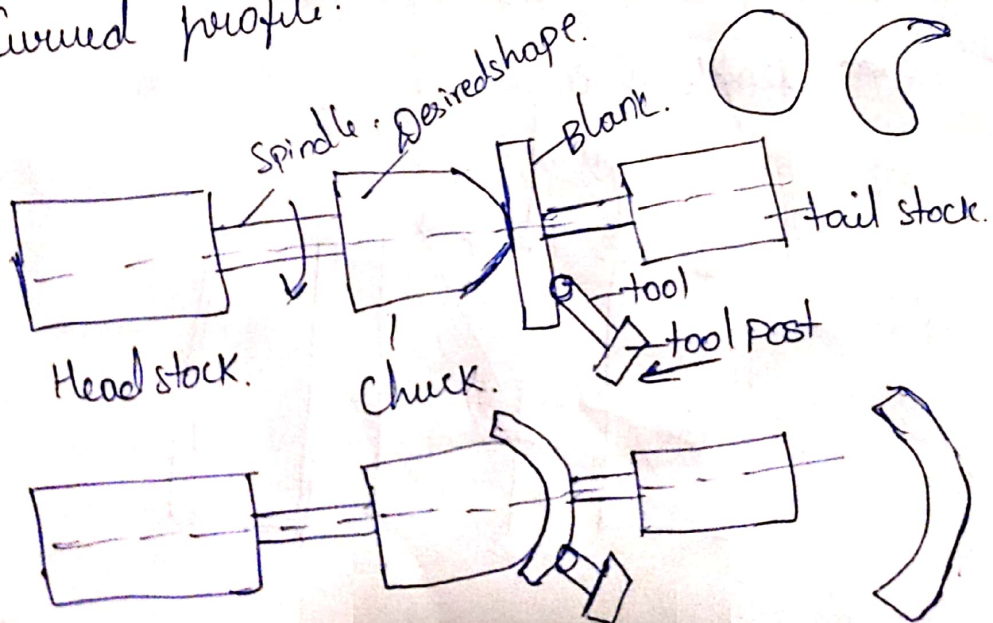
- A sheet plate piece is placed on the die and force is applied through punch.



Pressure applied is around 1600 MPa.

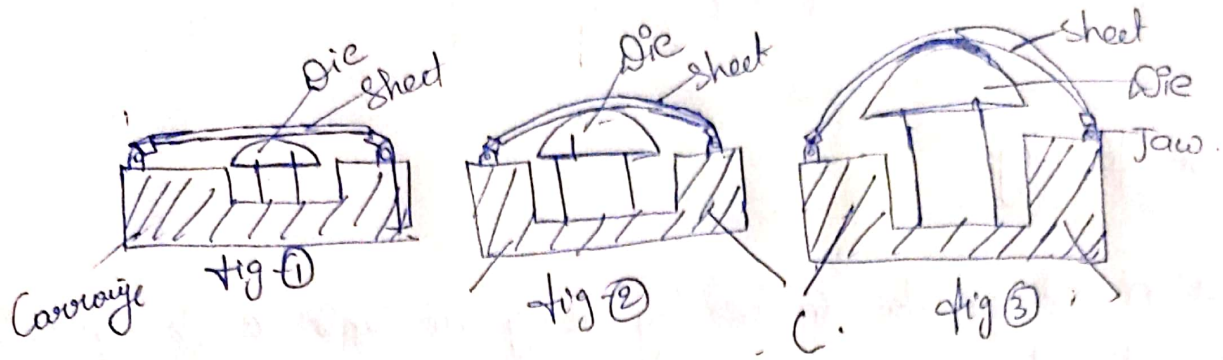
- In this process a circular blank coin is placed b/w punch and die.

Spinning: In spinning a circular blank piece is cut into a curved profile.



- Tool is used to apply the pressure.

Stretch forming In stretch forming the material stretches over the workpiece.



Carriage

- Die moves upward and the carriage moves downward side.
- When die moves upwards the tensile load is applied on the sheet.

Types of presses

→ Press-tool is used in hydraulic pneumatic and mechanical presses to produce the sheet metal components in large volumes.

There are three types of press tools.

1. Cutting tools
2. Non-cutting tool.
3. miscellaneous tool

In cutting ~~press~~ tools the material gets sheared.  
Ex: shearing tools, trimming tools, compound tool.

In Non cutting ~~press~~ tools the material gets deformed.  
Ex: Bending, Drawing etc.,

(5) Miscellaneous tools - Containing variety of things.

Ex: Combination tool, prograde tool, impregnated

- These are all Base tools.

## Explosive forming

Sheet metal parts in dies by using an explosive charge to generate forming pressure. The shaping or modifying of metals by means of Explosions

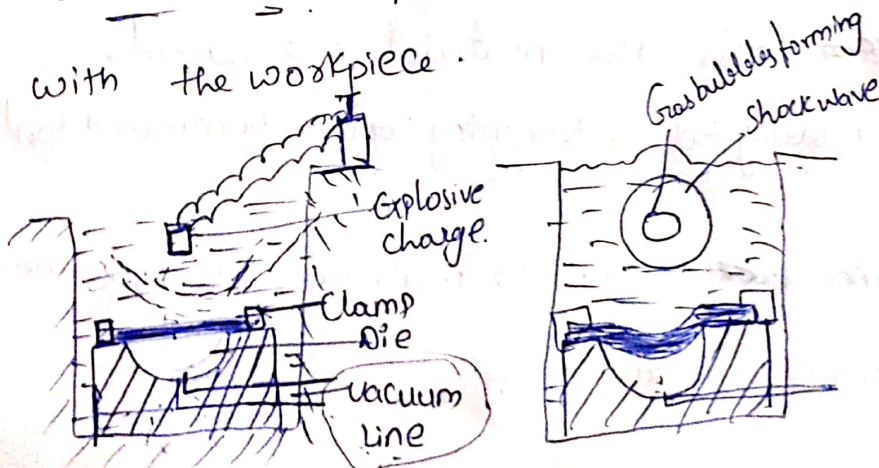
Explosive forming operation divided into two methods based of position of explosive charge with respect to workpiece.

1. Stand off method

2. Contact method

\* Stand off method: They maintain a some distance b/w the workpiece and explosive charge. This is used for complicated shapes

\* Contact method The explosive charge held in direct contact with the workpiece.



— Explosive forming —



## Advantage

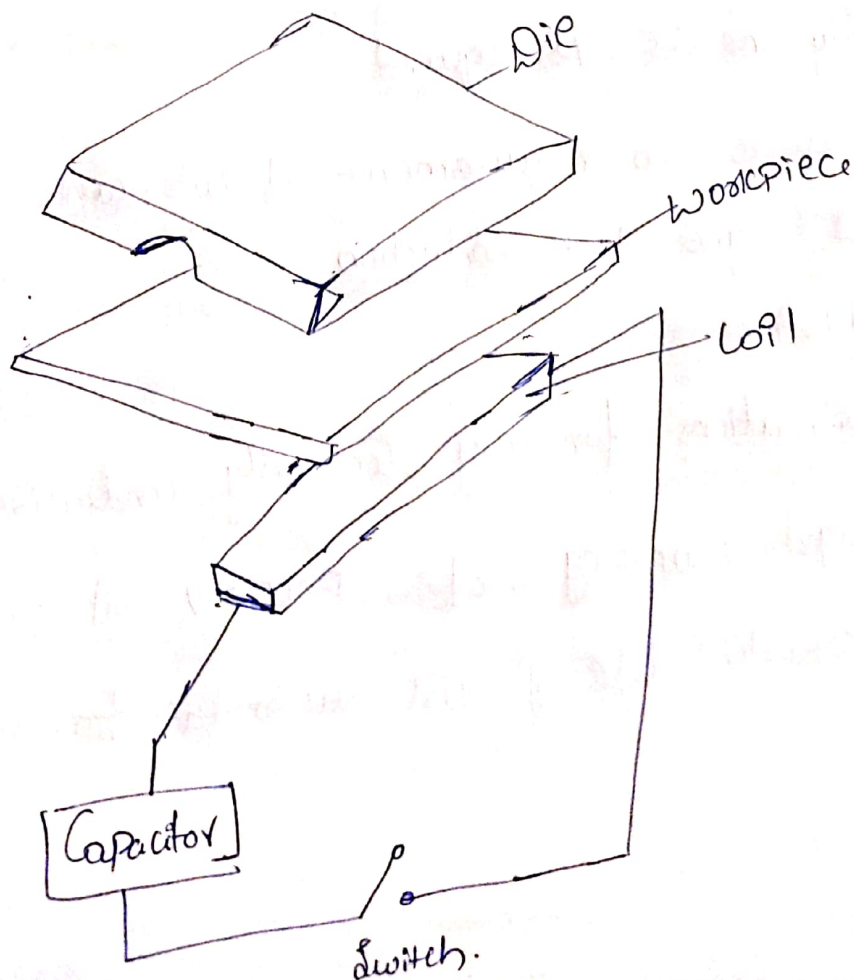
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- It can simulate a variety of other conventional metal forming techniques
- It is particularly suitable for short production runs of a large parts such as occurs in aerospace application.
- It maintain precise tolerances and eliminate costly welds

## Disadvantages

- Low tooling cost (but high labor cost)
- Suitable for low-quantity production
- Due to shock waves and spillage of water it is not suitable to carry out indoor.

## Electromagnetic forming



- Die is placed ~~over~~ the metal sheet.
- The coil is attached to downward side of w/p.
- The coil is ~~not~~ connected to capacitor and to power supply.
- When the power switch is on the power is supplied to the coil which generates the electromagnetic field with which is induced  $B$  in the workpiece.
- The current induced in the workpiece is and current induced in coil generates the repulsive force which is used to apply a impact load on the workpiece.
- In this setup there are two conductors one is workpiece and another one is coil.

Advantage:

- Only one die is required
- There is no requirement of lubricants
- It gives high production

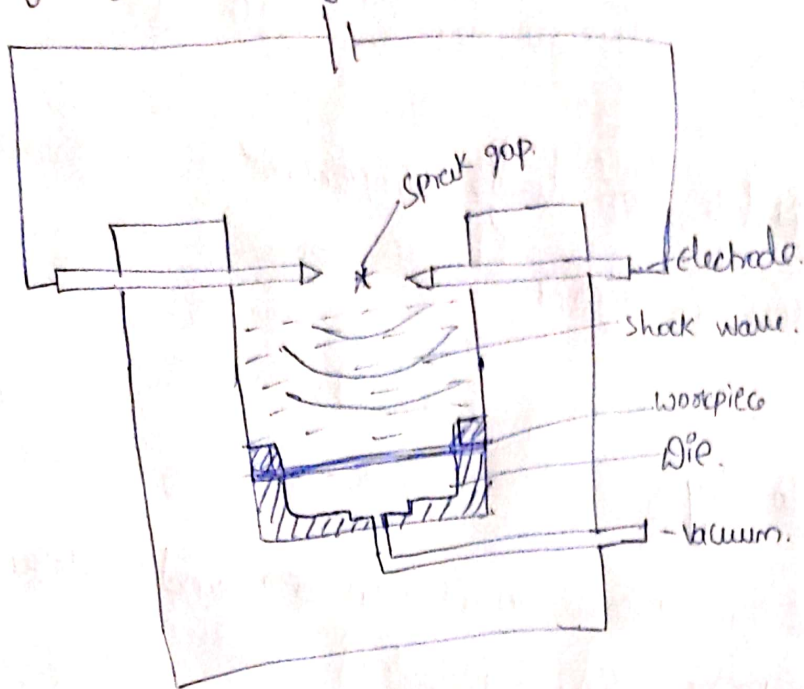
Limitation

- Applications for only electrically conductive materials
- Rigid clamping of primary coil is costly
- Shorter life of coil due to large force acting on it.



# Electrohydraulic forming

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- Vacuum is required to reduce the damage. Due to shock wave large amount of pressure produces, heat produces and reduces the loss.
- The two electrodes are joined with respective the capacitor.
- The electricity is supply to the two electrodes through capacitor which generates the spark when the two electrodes touched ~~to~~ together.
- This spark generates the shock wave. in the liquid which hits the workpiece with high pressure. and the material deforms.
- The Basic principle of the process involves the conversion of Electrical Energy to mechanical Energy in a liquid medium i.e., discharging of the electric spark in a liquid produced in shock waves.

## Advantage

- It is used for small operations.
- It has high production rate.

- It has less tooling cost

Disadvantage

- Not suitable for large components
- Initial cost is high.

Rubber pad forming :-

- sheet metal is pressed in between die and Rubber block under the pressure.
- Rubber pad forming process is a kind of Deep drawing process.
- Rubber pads having general purpose shape.
- It is used produce small and medium size products.

## Various forces required in sheet metal forming operation

Punching force. The force required to be exerted by the punch in order to shear out the blank.

$$P = L \cdot t \cdot \tau$$

where  $P$  = Punching force, N

$T$  = Shear strength MPa

Shear force:

Maximum shear force when shear is applied to the punch or the die the following equation may be used

$$P = Lt \left( t \times \frac{P}{t} \right)$$

where

$P$  = Penetration of punch as a fraction

$t$  = Shear on the punch or die mm.

Bending force

The bending load may be calculated from the knowledge of material properties and die characteristics

where.

$$F_b = \frac{K \times L \times S}{t^2} \times W$$

$K = 1.33$  for die opening of  $8t$

$= 1.20$  for die opening of  $16t$

$= 0.67$  for U bending

$= 0.33$  for a wiping die.



$L$  = length of the bent part, mm (12)

$S$  = ultimate tensile strength, MPa

$T$  = blank thickness, mm

$W$  = width b/w the contact points, mm.

## Types of plastics

Plastics are synthetic material which are made by polymerization of small organic molecules having high molecular weight

for eg: Bakelite, Polythene, Teflon, PVC etc.

## Classification of plastic

On the basis of structure plastics are of two types

- a. Thermoplastic.
- b. Thermosetting plastic

Thermoplastic The plastics which become softer on heating and harder on cooling are known as thermoplastic.

- They retain their plasticity even after repeated heating and cooling

- Eg: PVC, polystyrene etc.,

- Bottles, combs and bucket etc are made up of such plastic

b Thermosetting plastic : The plastics which become harder on heating and do not melt again i.e., when such plastic once set after being melted, cannot be moulded again. These are brittle and cannot be recycled.

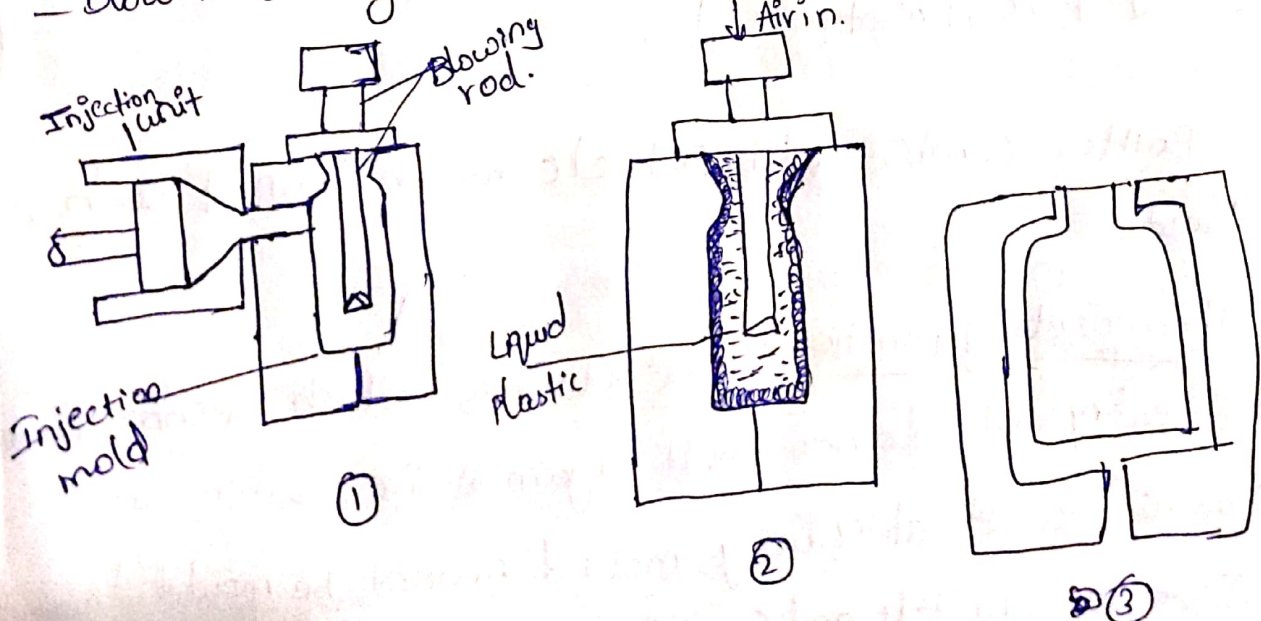
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- They can bear high temperature

- Bakelite is used in making electrical insulators, electrical switches, batteries of vehicles etc.,

Thermoplastic	Thermosetting plastic
<ol style="list-style-type: none"><li>1. Soften on heating</li><li>2. Long chain linear</li><li>3. By addition polymerisation</li><li>4. can be reshaped and reused</li><li>5. Soft weak and less brittle.</li><li>6. Soluble in organic solvents</li><li>7. Reclaimed for wastes</li></ol>	<ol style="list-style-type: none"><li>1. Do not soften on heating</li><li>2. 3-D structure.</li><li>3. By Condensation polymerisation</li><li>4. Can not be reshaped</li><li>5. Hard and strong</li><li>6. Insoluble in org. solvents</li><li>7. Cannot be reclaimed</li></ol>

### Blow injection moulding

Blow moulding used to form hallow parts





- In first step the plastic granules are heated and converted into the molten state.
- And then molten plastic is injected into the die.
- Once the molten plastic is filled the die from air hose the air will be pumped.
- Due the force of air the molten plastic moved ~~step~~ to wards the surface die and create hollow at the center.

Blow molding is the plastic processing technique where air is blown in a heated plastic until it fills a mold and forms the desired shape to produce hollow parts.

Advantage

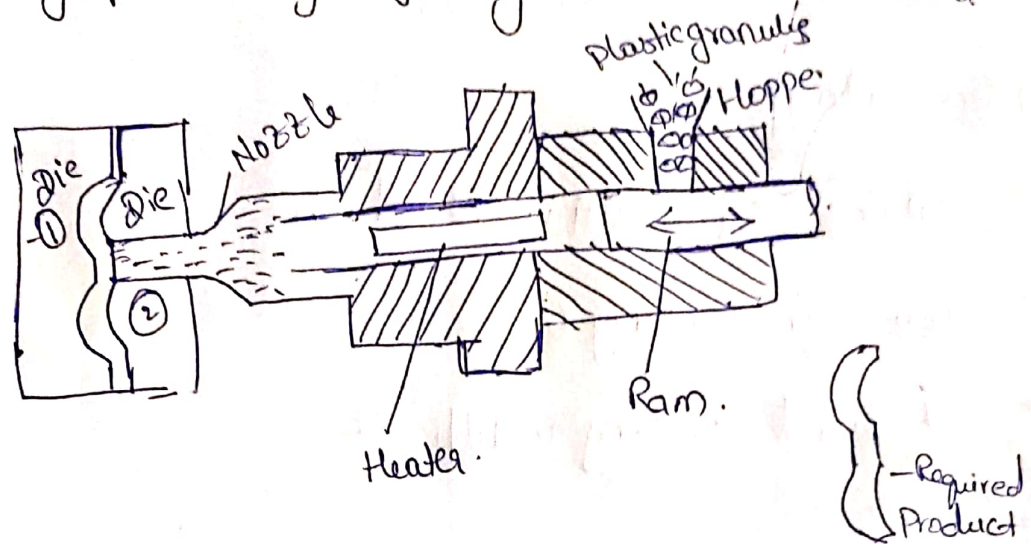
- Intricate shapes can be formed such a screw heads on bottles.
- moulds produce accurate products.
- High Automated processes.
- Product required very little finishing
- Suitable for high volume production.
- low unit cost for long production runs.

Disadvantages

- + High initial setup costs.
- + process and material limitation.
- + Trimming required.

## Injection moulding

- Injection moulding is a manufacturing process for producing parts by injecting material into a mold.



## Procedure

- The plastic used in injection moulding is thermoplastic.
- In this the plastic are taken in the form of granules or powder.
- First the plastic granules are poured into the hopper, and the Ram will moved backward side.
- These granules are pushed into the heater where the the granules is converted into liquid form.
- slowly the molten plastic is passed towards the die while injecting through Ram.
- the molten plastic occupy the space in the die and final product is produced.

## Advantages

- Fast Production. it can produce a large number of products per hour.

- Design flexibility is good.
- It can produce complex products
- Higher production output while having low labor cost

### • Disadvantages

- ~~The~~ Cost of Equipment is high
- ~~the~~ High tooling cost
- Accurate costing is difficult