

# **Thermoplastic Technology**

- Thermoplastic is a common term that is used for the polymers which can be reshaped by melting with the heat effect.
- The polymers including PE, PP, PVC, PS, PET, and Nylon 6,6 are the most well known thermoplastic polymers.
- These polymers are linear or branched but do not contain cross-links.
- The only forces that keep polymer chains together are London forces, dipole-dipole forces, and H-bonds. Thus, these polymers are soluble in most of the solvents and can melt when they are heated.
- The common usage fields of the polymers are;

Daily households, toys, hoses, pipes, films, coatings for textiles, and etc.

# forming of thermoplastics:

- Extrusion,
- Injection,
- Blowing forming,
- vacuum forming,
- Rotational forming.



## Comparison of thermoplastic/thermosetting sh

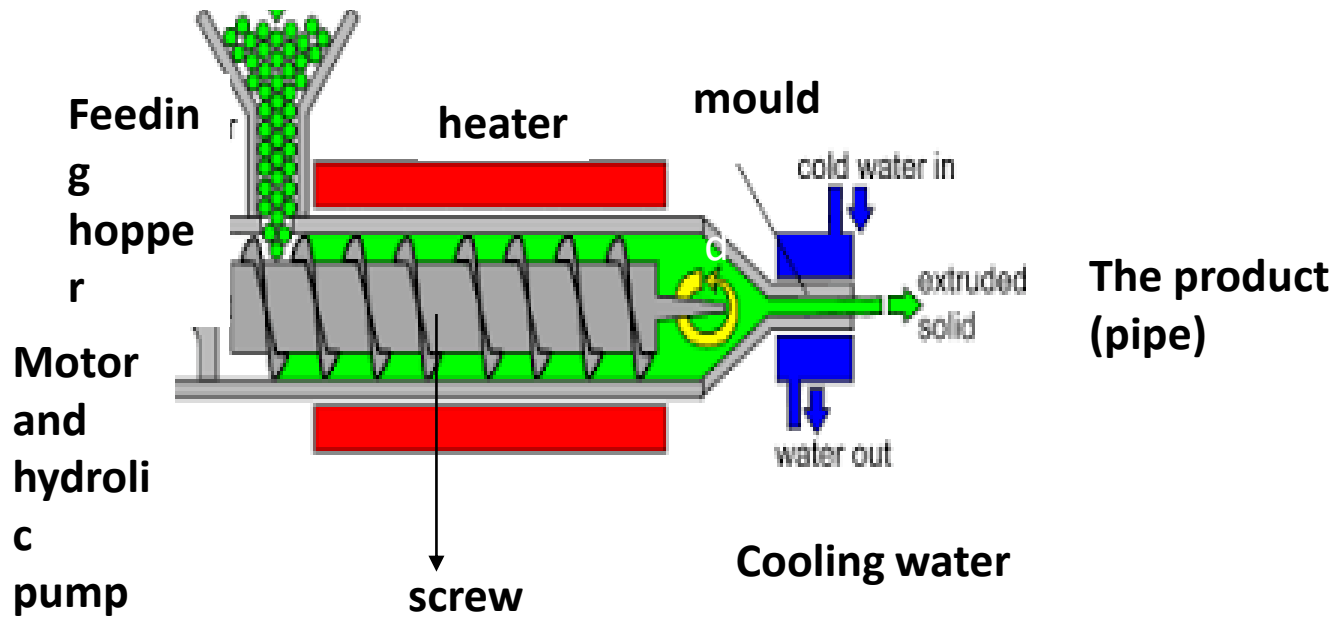
- a. Thermoplastics are used in the pellet or powder form before feeding to the shaping instrument and shaped by melting. Whereas, the thermosettings are shaped by using mol molecular weighted liquids, sheets, pulps, and powders.
- b. The waste materials occurred during the shaping of thermoplastics (can be shaven from the product) can be reused after melting. The termosetting wastes can not be reused in the shaping.
- c. During the shaping of thermosets, further chemical reactions take place, but only melting happens when thermoplastics are shaped.
- d. Thermoplastics are transparent/colorless when

# Extrusion

Feeding unit

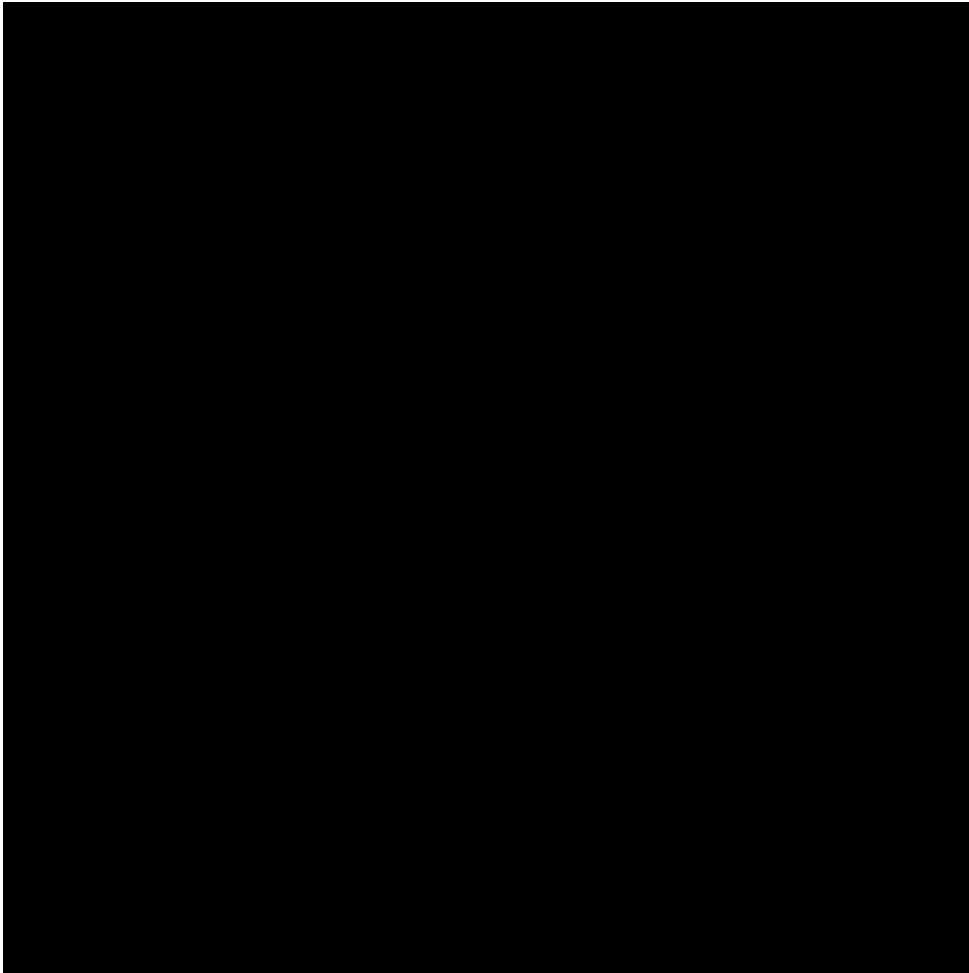


Thermoplastic granules



The product (pipe)

- The extrusion process includes the shaping of materials by continuously passing the fluid material (in the molten state) through a mold that is shaped of purpose under pressure.
- The process is performed on an instrument that is called extruder.
- The products such as films ( 0.04-0.4 mm in diameter), sheets, pipes, rods, and profiles can be obtained.
  
- The extruder comprises of 4 main parts including;
  - **A feeding unit,**
  - **Screw (archimedean screw),**
  - **burrel (contains screw),**
  - **Head (contains die).**



<https://www.youtube.com/watch?v=Tp2Rdx69SSo>

# Injection

- In this method, a polymer material in the fluid state (molten) is filled through a closed mold under pressure and the product is taken after a cooling process.

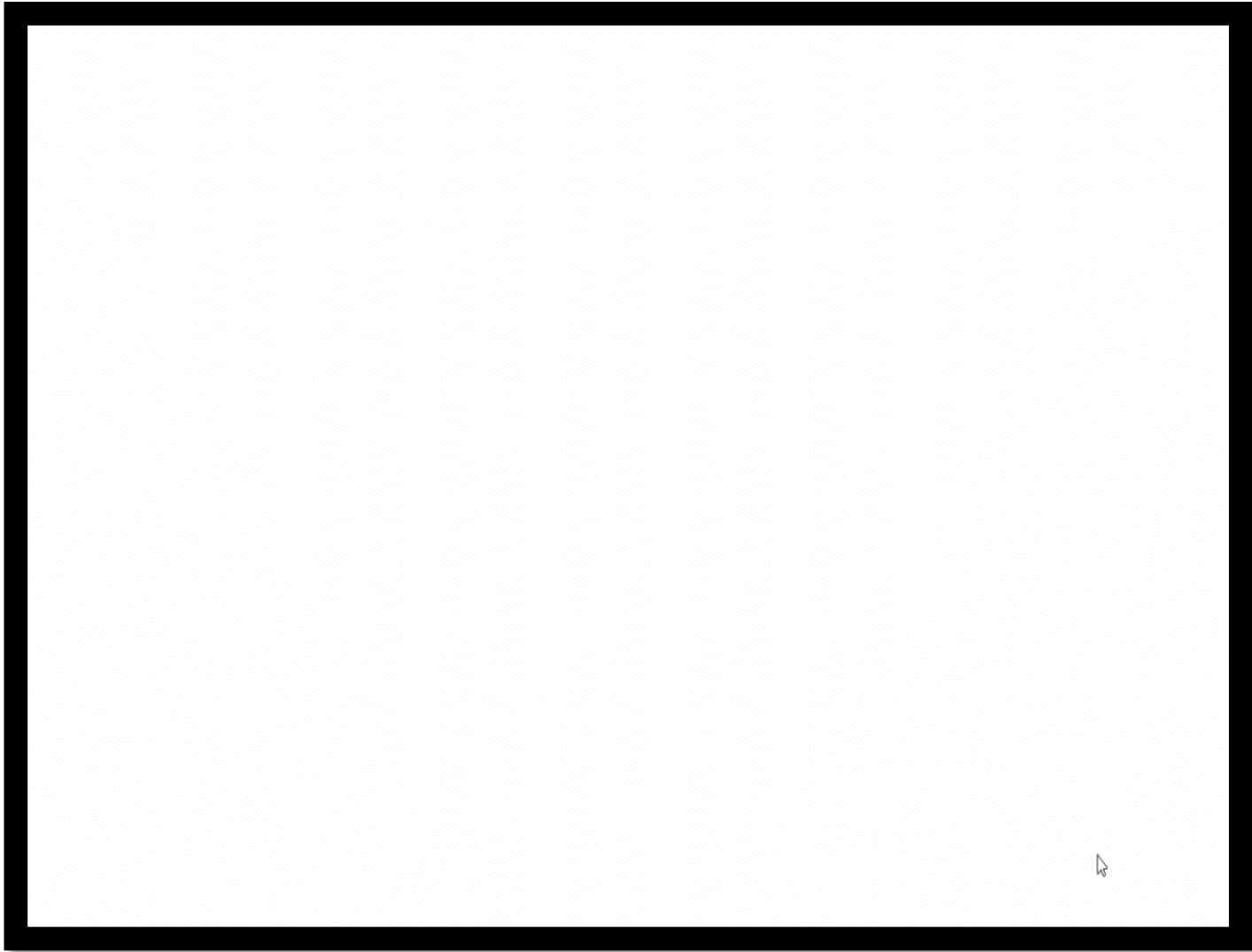
It can be used for thermoplastics, thermosets, elastomers and composites by changing the conditions.

This process is performed by using an instrument, called **injection machine**.

- The machine is comprised of five units including:

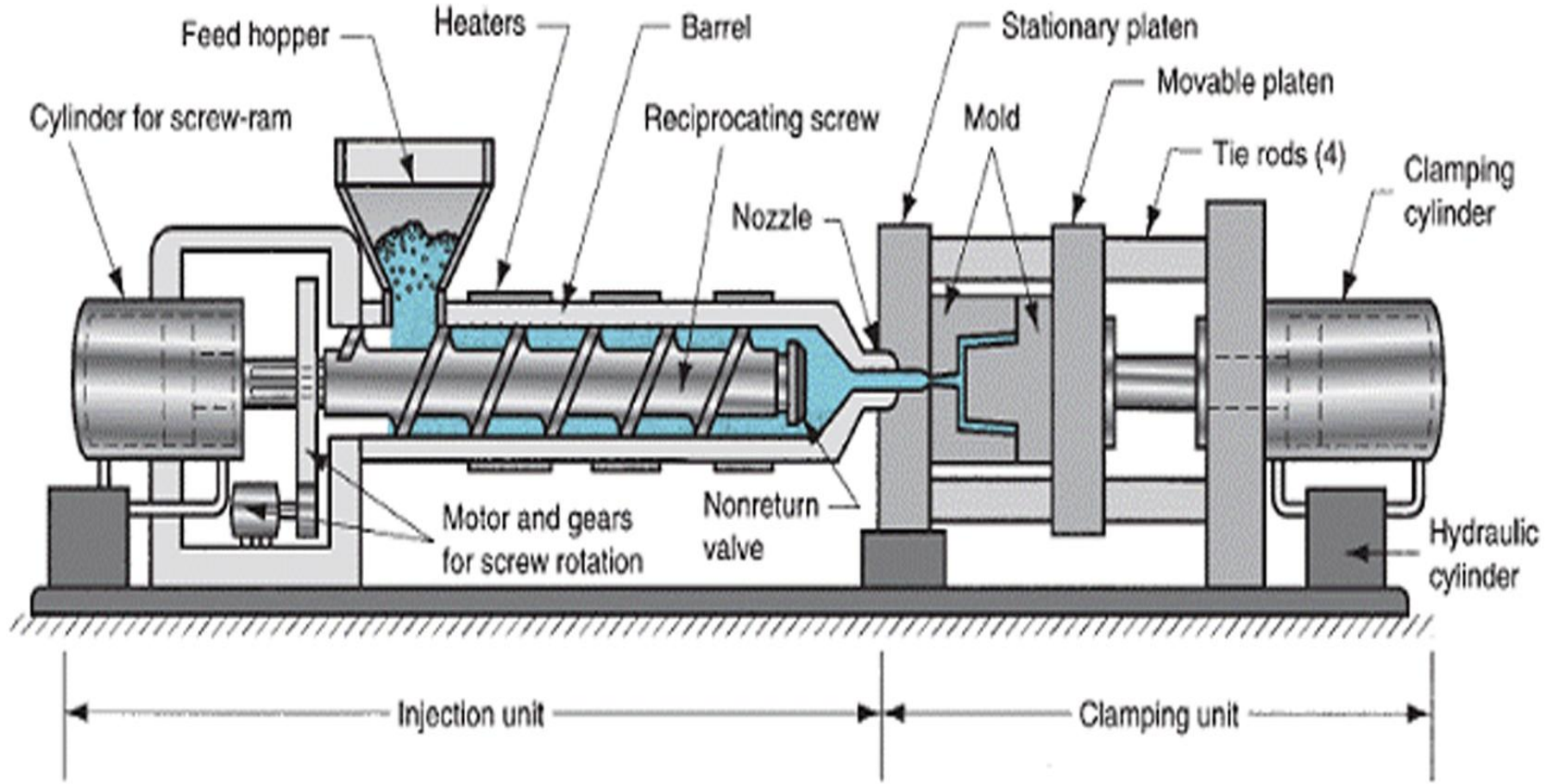
*injection system, hydrolic system, mold system, driving system, and control system.*

- **injection system**>>>feeding hopper, bucket and screw (or piston)
- **hydrolic system**>>> rotating of worm gear, the closing of mold by pushing system, and provides the required power for keeping the mold under pressure
- **mold system**>>> contains the connection elements and parts, cooling equipments, mold space, and injection hole.
- **Pushing system**>>> opens/closes the mold and carries the moving elements of the mold.
- **Control system**>>> controls and adjusts the process parameters such as temperature, pressure, injection rate, screw place, and rotating rate.



<https://www.youtube.com/watch?v=QgIJLrwDPxE>







The polymer wastes after injection molding




# Vacuum forming

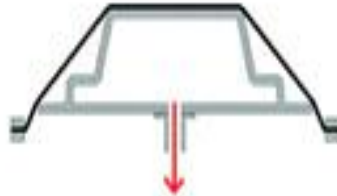
- This method is suitable for the shaping of thermoplastic materials in the form of film or thin sheet.




Thermoplastic sheet



Step 1: Sheet is heated and brought over a male mold.



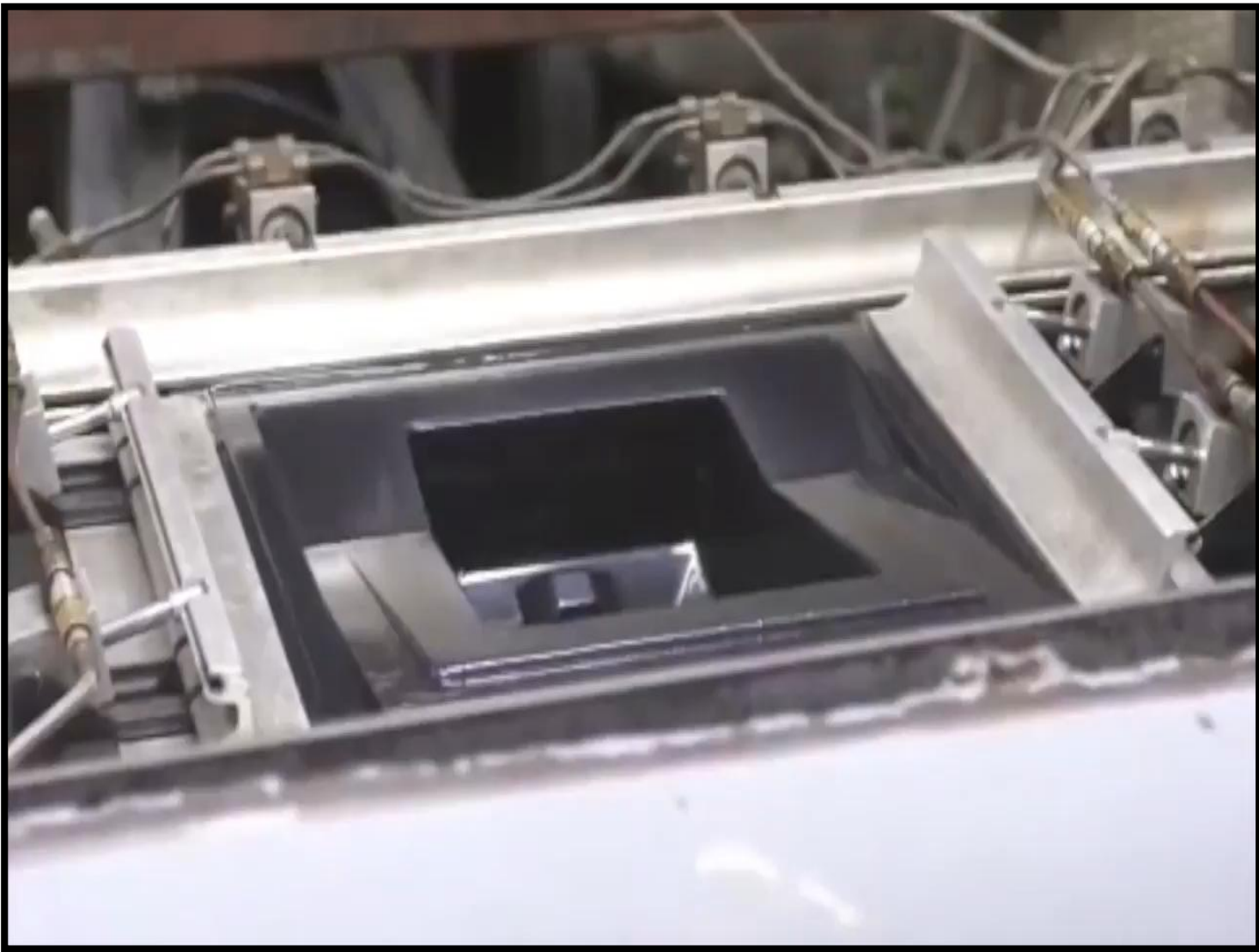
Step 2: Heated sheet is sealed to the mold and vacuum is applied through a thin channel.



Step 3: Sheet conforms the geometry of the tool

The method comprises of three steps:

- a. softening of the polymer by heating,
- b. shaping on the mold using vacuum,
- c. removal of the product from the mold.



[https://www.youtube.com/watch?v=HWX\\_XxS4zY8](https://www.youtube.com/watch?v=HWX_XxS4zY8)

- hollow materials,
- transparent light-weighted packaging materials,
- Toy package materials,
- Food packages,
- Disposable plates,
- Fridge inner panels,



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