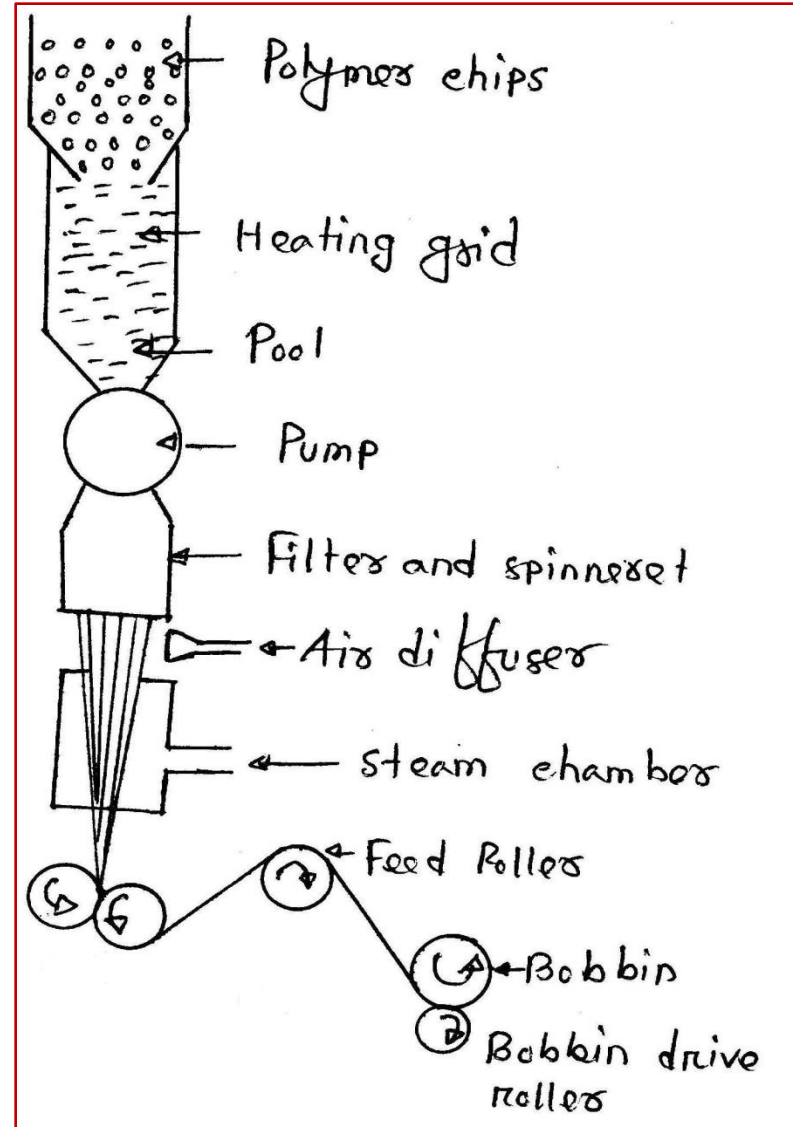


# Man Made Melt Spun Method of Fibres Manufacturing

# Process of Filament manufacturing (Melt Spinning)

- In melt spinning the fibre-forming material is melted and extruded through spinnerets, and the jets harden into solid filaments as they cool on emerging from the spinneret.
- Number of filament depends on number of holes in spinneret.

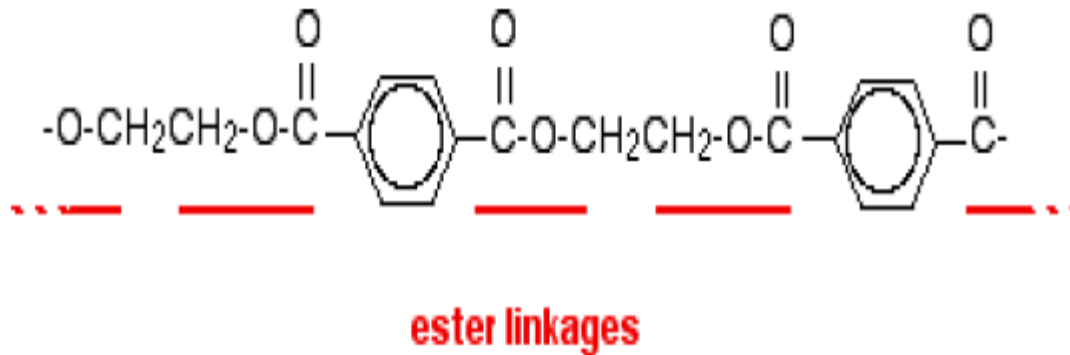


# 1. Manufacturing of the fibre forming polymer:

- All man made fibres are composed of long chain molecules known as polymer which are formed by chemical processing.
- It is the most critical operation in the production of nylon polyester, and polyolefin, poly propylene fibres as number of fibre properties such as uniformity, crystallinity, and orientation are imparted to the yarn during processing.

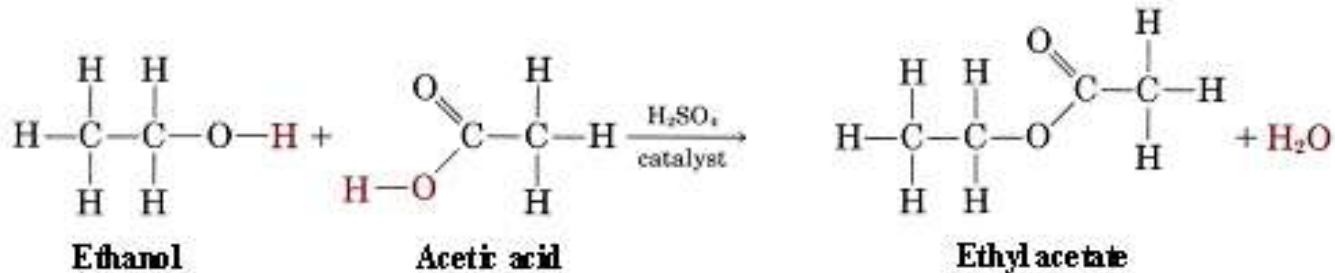
# Polyester Filament/fiber

- The name “polyester” refers to the linkage of several monomers (esters) within the fiber.
- Polyester (Terylene) is a category of polymers which contain the ester functional group in their main chain.



# Polyester Filament/fiber

- Esters are formed when **alcohol reacts** with a **carboxylic acid**:



- Example : Long chain polymers chemically composed of at least 85% by weight of an ester and a dihydric alcohol and terephthalic acid”.

# Polymerization of Polyester

- 1. Polymerization:** To form polyester, dimethyl terephthalate is first reacted with ethylene glycol in the presence of a catalyst at a temperature of 302-410°F (150-210°C).
- 2. The resultant polymer:** Polyethylene Terephthalate which is clear and molten, is extruded through a slot to form long ribbons

# Melt Spinning of Polyester Filament/fiber

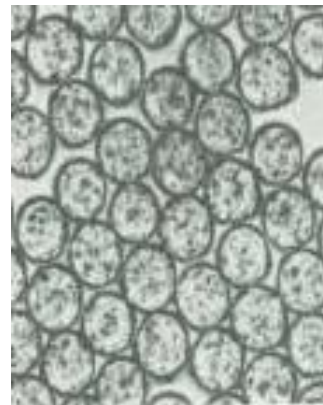
- **3. Melt spinning:** Polymer chips are melted at 500-518°F (260-270°C) to form a syrup-like solution.
- **4. Dope Dyeing (If Required):** At the spinning stage, other chemicals may be added to the solution to make the resulting material flame retardant, antistatic, or easier to dye.

# Polyester Filament Extrusion (Shape and Size)

## 5. Filament Extrusion:

The solution is put in a metal container called a spinneret and forced through its tiny holes, which are usually round, but may be pentagonal or any other shape to produce special fibers.

The number of holes in the spinneret determines the size of the yarn, as the emerging fibers are brought together to form a single strand.





# Drying and Drawing (Stretching) process of Polyester Filament

- 6. Drying:** When polyester emerges from the spinneret, it is soft and easily elongated up to five times its original length. This increases the strength, tenacity, and resilience of the fiber. This time, when the filaments dry, the fibers become solid and strong instead of brittle.
- 7. Drawing:** Drawn fibers may vary greatly in diameter and length, Also, as the fibers are drawn, they may be textured or twisted to create softer or duller fabrics.

# Forms of Polyester (Winding/Packaging)

## filament form :

polyester fiber continuous in length, producing smooth-surfaced fabrics



## Staple form :

filaments are cut to short, predetermined lengths.

easier to blend with other fibers



## Tow :

A form in which continuous filament are drawn loosely together



## Fiberfill :

the voluminous form used in the manufacture of pillows and outerwear



# Polyester Fiber General Properties

- Colorless and transparent, Smooth and lustrous, Shiny glass rod like
- Shape as we require
- Strong and durable
- Resistant to stretching and shrinking
- Easily washed and Quick drying
- Good Wrinkle resistant and Retains its shape good
- Good Resistance to Weather for making outdoor clothing
- Long life and high Rot Resistance
- Alkali Resistance: It damaged by CON alkali
- Acid Resistance is excellent
- Insects and mildews: no effect

# Polyester Fiber Characteristics Values

- **Fineness :** 0.5 – 15 Denier
- **Strength (Tenacity):** Dry or wet 3.5 - 7.0 g/dtex
- **Elongation at break :** Dry 15 – 45% and wet 15 - 45%
- **Moisture Regain:** 0.2-0.5%
- **Specific Gravity:** 1.36 - 1.41%
- **Elastic Recovery :** @2% =98 : @5% = 65
- **Melting point :** 260 - 270 degree C
- **Effect of Sunlight :** turns yellow, retains 70 - 80 % tenacity at long exposure

# Uses of Polyester Fiber/filaments

- Apparel: Every form of clothing
- Home Furnishings: Carpets, curtains, draperies, sheets and pillow cases, wall coverings
- Other Uses: hoses, power belting, ropes and nets, thread, tire cord, auto upholstery, sails, floppy disk, liners, and
- Fiberfill for various products including pillows and furniture



**Nylon  
Manufacturing**

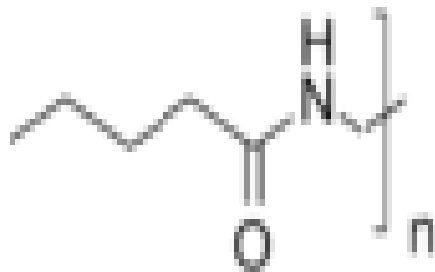
# Nylon Filaments

- Belonging to a class of polymers called polyamides
- It is made of repeating units linked by amide bonds and is frequently referred to as polyamide
- Developed in the 1930s as an alternative to silk
- Developed by Wallace Carothers at the Dupont Chemical company

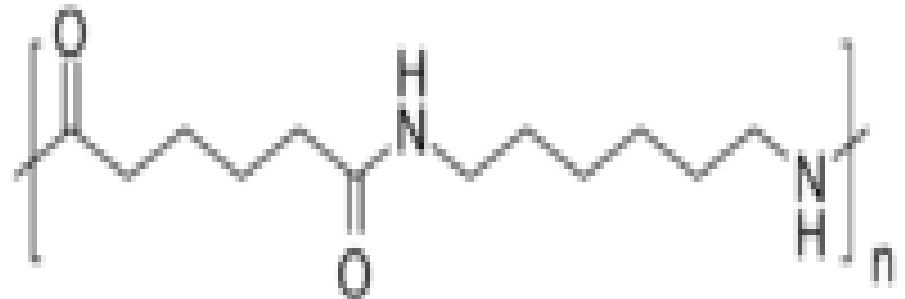
# Type of Nylon and its Manufacture

- In nylon, the repeating units contain chains of carbon atoms.
- There are various types of nylon depending on the nature of those chains for example:

## Nylon 6



## Nylon 6-6





# Nylon 6,6 Manufacturing

- Synthesized by **Poly-condensation of hexa-methylene-diamine and adipic acid.**



Hexamethylenediamine top and Adipic acid bottom, monomers used for polycondensation of Nylon 6-6.

# Nylon 6,6 Manufacturing Process

Reactor

- **Poly Condensation:** Hexamethylene diamine and adipic acid are combined with water in a reactor. This produces nylon salt that sent to an evaporator

Evaporator

- **Evaporation:** In evaporator excess water is removed, The nylon salt goes into a reaction vessel

Reaction  
Vessel

- **Polymerization:** There a continuous polymerization process takes place. This chemical process makes molten nylon 6-6.

Spinneret

- **Spinning/Extrusion:** The molten nylon 6-6 is extruded and sent through a spinneret to extrud molten nylon to fine filament.

Cool Air

- **Drying:** The nylon filament is then air-cooled to form filaments

Package

- **Winding:** Formation of Packaging in form of Bobbin or Tow

# Comparison Polyester and Nylon

Nylon	Polyester
Functional group is amide	Functional group is ester
Absorbs most water	Absorbs some water
Greater stretchability	Resistant to stretching
Dries slower	Dries quickly
smoother and softer fabric than polyester	polyester has always been a rougher fabric than nylon
Somewhat UV resistant	More UV resistant
lightweight and durable synthetic fabrics	
Mildew resistant	
Soluble in concentrated formic acid	Soluble in hot meta cresol