

5. NYLON AND POLYESTER



Can you tell?

What are tooth-brushes bristles made of?

What are hosiery made of?

Have you seen how fishing nets are made?

Introduction :

Man-made fibres were invented in 20th century only but in less than 100 years. They have become an integral part of our clothing and household. Today we are using various man-made fibres in many different fields. The popularity of man-made fibres is due to their easy availability, cheaper price, good look, easy care and maintenance and not being easily affected by natural elements.

In this chapter we will be learning about two fibres which are most popular amongst all the man-made fibres - Nylon and Polyester.

5.1 Nylon :

Nylon is the first man-made fiber which is made from Non-Fibrous Material. In this sense, it was the first truly 'man-made' fibre.

A peek in the History :

In 1928, the DuPont Company gave funds to a small group of scientists headed by Dr. Wallace H Carothers to do a the research. He accidentally invented a long, silky filament. Finally in 1938 Nylon was manufactured and introduced in the market. The name Nylon was given to this fiber because it was marketed from two branches of DuPont Company from New York and London.

Nylon is mainly of two types – Nylon 6 and Nylon 66. The numbers refer to the no. of carbon atoms present in the chemicals used for making

the fibre. Nylon 6 is made from **Caprolactum**. Nylon 66 is the most popular type and is made from two chemicals –

1. Hexamethylene Diamine
2. Adipic Acid



Do You Know ?

Man-made fibres are used widely in various fields of life because of their many good properties. One of the biggest drawback of these fibres is that **they are not biodegradable and hence are responsible for environmental pollution**. Because of this reason, scientists and governments are trying out ways of reducing their usage and substitute them with other natural fibres about which we learnt in standard XI.

Manufacturing Process :

Both the above mentioned chemicals are taken in required quantities and mixed in an **autoclave** which is like a giant pressure cooker. Polymerization takes place under high temperature and pressure. The melted liquid is solidified into **Ribbons**. These ribbons are cut into **chips**. The chips are melted again and Nylon 66 fibres are spun.

Properties of Nylon:

5.1.1 Microscopic Properties:

Smooth, lustrous fibre.

Even diameter.

Transparent, like glass rod.

Pigments can be seen (grainy appearance)
(For diagrams see practical no. 6)

Physical Properties:

Length: the length of Nylon can be controlled as it is man-made fiber. It is manufactured as a filament fiber but can be cut to staple lengths.

Lustre: Nylon has good Luster. Luster can be controlled by the addition of delusterants like Titanium Dioxide.

Texture: Nylon is very smooth and transparent.

Strength: It is a very strong fiber. The strength does not decrease under wet condition.

Elasticity: Nylon has the best elasticity amongst all textile fibers. Because of this property Nylon is used extensively in Hosiery industry.

Resiliency: Nylon has excellent resiliency. The wrinkles or creases go away readily and ironing is not required.

Moisture Absorption:- Nylon has poor absorption power. Nylon fabric do not get wet. The water remains on the surface and runs off because of the smooth surface. It dries quickly. The one disadvantage of lack of moisture absorption is that it does not absorb perspiration and hence is not comfortable to wear in summers.

Density: the density of Nylon is very low. It is light in weight.

Biological Properties:

Effect of mildew: Nylon is resistant to effect of mildew.

Effect of moth: Nylon is resistant to effect by most insects and microorganism.

Thermal Properties:

Effect of heat: Nylon is a thermoplastic fiber. It changes shape and melts when heated. Because of this reason, it cannot be ironed with a hot iron. When burnt, it forms a black uncrushable bead and smells like that of a chemical or plastic.

Heat Conductivity: Nylon is a bad conductor of heat.



You Should Know ?

Pilling is a special property found in manmade fibers only. The long filaments present inside a yarn breaks under friction but cannot come out of the yarn and so they form a “Pill” on the surface. This does not affect the strength but spoils the appearance of the fabric.

5.1.2 Uses of Nylon:

Apparel Uses: Dress materials, shirtings, sarees, sportswear, etc. Nylon is extensively used in hosiery industry for making socks, stockings and under garments.



Pic. No. 5.1 Nylon Sarees



Pic. No. 5.2
Sportswear



Pic. No. 5.3
Socks

Household Uses : Curtains, Carpets, upholstery.



Pic. No. 5.4 Nylon Curtains

Miscellaneous Uses: Brushes, fishing nets, toothbrushes, ropes, umbrellas etc.



Pic. No. 5.5 Fishing Net



Pic. No. 5.6 Nylon rope

Polyester

This was the second man-made fibre invented after Nylon. Nowadays, it has become more popular than Nylon as it is more versatile, can be used in a number of ways and can make blends with all man-made as well as natural fibres.

The two chemicals used in making Polyester are :

Ethylene glycol.

Terephthalic acid.

When an Alcohol and an Acid meet, an Ester link is formed. During polymerization of this fibre, many alcohol molecules link with many acid molecules. A number of ester links are formed, So the fibre has been given the name – Polyester. The fibre has two other names; in England it is called **Terylene** and in America it is called **Dacron**.

A peek in the history :

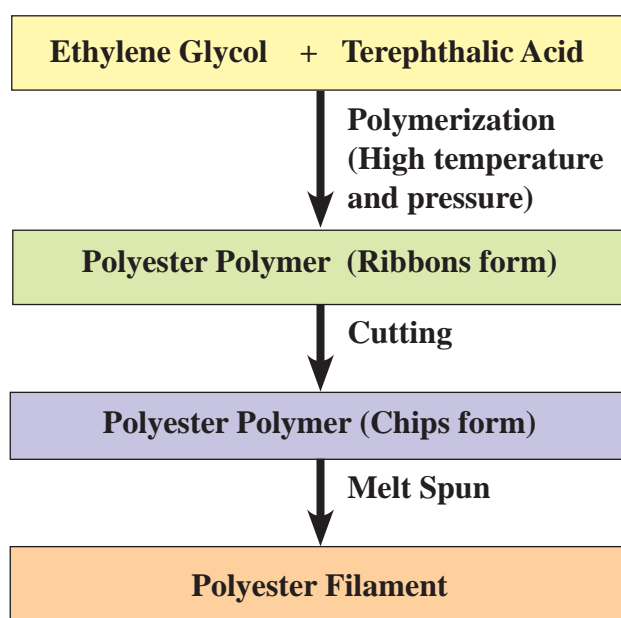
The initial work for polyester fibre was done by Dr. W. H. Carother. Later the idea was developed by the British scientists John Whinfield and James Dickson, who made **polyester** in 1941 in England. They called it "**Terylene**" based on the two chemicals used in manufacturing it –**Terephthalic Acid** and **Ethylene Glycol**.

In 1945, Du Pont Co. acquired the rights of manufacturing Polyester fibre in America. They named it "**Dacron**" to rhyme with their first fibre Nylon.

Manufacturing Process

It is very similar to that of Nylon. Ethylene Glycol and Terephthalic acid is taken in required quantity and mixed in an autoclave. Polymerization takes place under high temperature and pressure. The polymer liquid is solidified into Ribbons which are cut into Chips. The chips are again melted and Polyester fibres are spun.

Chart no. 5.1 Manufacturing Process of Polyester



5.3.2 Properties of Polyester

Microscopic Properties:

- 1) Smooth, glass rod like fibre.
- 2) Even diameter.
- 3) When delustered Pigments can be seen (grainy appearance). (For microscopic diagram, refer practical no. 6)

Physical Properties:

1. **Length:** As it is a manmade fibre, polyester can be produced in any length. It can be manufactured as a filament fibre and can be cut to staple length.

Can you tell?

Polyester dress can be worn directly after washing. Why?

Polyester garments are not so comfortable in summers. Why?

Polyester is called an 'Easy Care' fabric. Why?

Hint : the answers lie in the properties.

2. **Lustre:** Originally fibre is lustrous. Lustre can be controlled by the addition of a delustering agent called Titanium Dioxide.
3. **Texture:** It is a smooth texture fibre.
4. **Strength:** It is the strongest fibre. In wet condition, the strength does not change. It is abrasion resistant too and so polyester fabrics are very strong and durable.
5. **Elasticity:** The elasticity of polyester fibre is very good.
6. **Resiliency:** The property of resiliency and recovery from creasing is outstanding. It does not wrinkle when wet and also when dry. It is known as '**wash-n-wear**' fabric.
7. **Moisture Absorption:** Polyester has very low moisture absorption. It is therefore well suitable for making water repellent clothes such as raincoats. Due to poor absorbency it cannot be dyed with simple techniques. It dries quickly but is not very suitable for summer wears as it does not absorb moisture from the body.
8. **Density:** The density of polyester is 1.38 gm/cc. Fabrics made from polyester are light in weight.



You Should Know ?

- The Pilling property described earlier with the properties of Nylon is seen in Polyester also.

New Wicking Polyester:

- Polyester also has a unique property called '**Wicking**', which means that the fibre allows moisture to pass through one end to other without actually absorbing it. This property makes Polyester a more comfortable wear in summers as compared to Nylon.

Biological Properties:

1. **Effect of Mildew:** Polyester is not affected by Mildew in any condition.
2. **Effect of Moth:** Polyester is not affected by moth or any other insects.

Thermal Properties:

1. **Effect of Heat:** Hot water and hot iron should not be used for polyester. Polyester is a thermoplastic fibre. Like Nylon it softens and melts with heat and smells like chemical or plastic. It forms a hard residue bead like which is hard and uncrushable.
2. **Heat Conductivity:** It is not a good conductor of heat.

5.3.3 Use of Polyester

- 1) **Apparel Uses:** Shirts, Slacks, Trousers and Sarees.



Pic. No. 5.7 Polyester shirt



Pic. No. 5.8 Polyester Saree

- 2) **Household Uses:** Curtains, draperies, carpets, upholstery etc. pillows, comforters, quilts.



Pic. No. 5.9 Polyester curtains



Pic. No. 5.10 Polyester quilt

- 3) **Industrial Uses:** Tents, ropes, cording, fishing nets, disposable diapers, paintbrush, badminton rackets, parachutes, sails, etc.



Pic. No. 5.11 Tents



Pic. No. 5.12 Disposable diapers



Pic. No. 5.13 Parachutes



Pic. No. 5.14 Badminton racket

- 4) **Medical Uses:** Artificial artery, veins, and sutures.



Pic. No. 5.15 artificial veins



Pic. No. 5.16 Sutures

Internet my friends

Find out about other manmade fibers used in Textile Industry.

Table No 5.2 Similarities between Nylon & Polyester

PROPERTIES	NYLON	POLYESTER
Microscopic	Smooth, even glass rod like, grainy if delustered	Smooth, even glass rod like, grainy if delustered
Length	Filament: Can be made in staple form.	Filament: Can be made in staple form.
Lustre	Highly Lustrous but lustre can be controlled.	Highly Lustrous but lustre can be controlled.
Strength	Very Good	Very Good
Elasticity	Excellent	Very Good
Resiliency	Very Good	Excellent
Moisture Regain	Very Low	Very Low
Density	Low (light in Weight)	Low (Light in weight)
Effect of Mildew	No Harmful Effect	No Harmful Effect
Effect of Moth	No Harmful Effect	No Harmful Effect
Effect of Heat	Thermoplastic Fibre. Cannot withstand high temperature. Burning fibre smells like chemical. Melts and forms hard black bead.	Thermoplastic fibre. Cannot withstand high temperature. Burning fibre smells like chemical. Melts and forms hard black bead.
Heat Conductivity	Very Low	Very Low
Pilling	Small 'pills' of fibre are formed on the surface due to friction spoiling the appearance.	Small 'pills' of fibre are formed on the surface due to friction spoiling the appearance.
The manufacturing Process is also similar in case of both Nylon & Polyester.		

Table No 5.3 Differences between Nylon & Polyester

DIFFERENCES	NYLON	POLYESTER
Chemicals used in making them are different.	Hexamethylene Diamine + Adipic Acid	Ethylene Glycol + Terephthalic Acid
Elasticity	Excellent	Elasticity of Polyester is second to that of Nylon.
Resiliency	Nylon is second to Polyester in this property.	Polyester is best and so is called 'wash-n-wear' fabric.
Wicking	Not found in Nylon.	A speciality of Polyester.
Uses	Especially used for making socks, stockings and hosiery material.	Has a wider application. Especially used for medical purposes.
Blends	Nylon is usually used as 100% Nylon, can be blended with wool, and cotton.	Makes blends easily with all natural and man-made fibres.



Use Your Brain Power

I. Who am I?

1. I am used to make Nylon.
2. I am a property which makes polyester comfortable to wear in Summer.
3. Water does not enter me because I am made from polyester.
4. I am the property responsible for small balls being formed when nylon socks are worn continuously.
5. I am a man-made fibre known as Terylene in England and Dacron in America.

II. Put a cross or tick mark in the given table appropriately:

	Nylon	Polyester
Adipic Acid		
Autoclave		
Ethylene Glycol		
Wicking		
Hosiery		
Thermoplastic fibre		
Blends		
Bio degradable		

EXERCISE

Objective Type Question

1. Match the following :

A		B	
1	Titanium dioxide	a.	Du Pont Company
2.	W.H.Carothers	b.	Pilling
3.	caprolactum	c.	Delusterant
4.	Dacron	d.	Nylon
		e.	Polyester

2. Select and write the most appropriate answer from the given alternatives for each question :

1. Raw material used for manufacturing Nylon 6 is _____.
a. Wax b. Caprolactum
c. Cellulose

2. Man-made fibre is _____.
a. Polyester b Silk c. Linen
3. Fibre produced by melt spinning method _____.
a. Viscose Rayon b. Polyester
c. Silk
4. The delusterants used for reducing the lustre of man-made fibre is _____.
a. Citric Acid b. Caustic Soda
c. Titanium dioxide.
5. _____ is a thermoplastic Fibre.
a. Rayon b. Nylon
c. Cotton

3. State whether the following sentences are true or false: -

1. Man-made fibres are non-thermoplastic fibres.
2. Nylon and Polyester Fibers are suitable for rainy season.
3. Nylon fabric requires ironing.
4. Polyester fibres are strong and durable.
5. Man made fibres are uniform in diameter.
6. Man-made fibres are harmful for the environment.

Short Answer Type Question

4. Define the following terms: -

1. Pilling
2. Thermoplastic fibre.
3. Wicking

5. Give Reasons:

1. Nylon is used to make hosiery garments.
2. Polyester fabrics are used for rainy season.
3. Man-made fibres start melting beyond a certain temperature.
4. People are trying to find substitutes for man-made fibres.

6. Answer in short

1. Microscopic properties of Nylon Fibre.
2. Give the biological properties of Polyester Fibre.
3. Distinguish between the chemicals of Nylon and Polyester.
4. Give the use of polyester fibre.
5. Give the thermal properties of Nylon fibre.

Long Answer Type Question

1. A) Write the raw materials used to manufacture Nylon fibre?
B) Explain the physical properties of Nylon Fibre.(any four)
2. A) State the 2 chemicals used to manufacture Polyester Fibre?
B) Explain the thermal properties and microscopic appearance of Polyester fibres?

Project / Field Work

1. List the textile items made of man-made fibres in your home which can be substituted by eco-friendly fibres.
2. Find out the newly invented man-made textile fibres and its use in the house hold.

