chapter 3

Synthetic Fibres and Plastic

We wear different types of clothes during different seasons. Clothing serves many purposes: it can serve as protection from the elements and can enhance safety during hazardous activities such as hiking and cooking. It protects the wearer from rough surfaces, rash-causing plants, insect bites, splinters, thorns and prickles by providing a barrier between the skin and the environment. Clothes can insulate against cold or hot conditions and they can provide a hygienic barrier, keeping infectious and toxic materials away from the body. Clothing also provides protection from ultraviolet radiation.

We are probably passing through the plastic age. Almost everything around us is made of one or other kind of plastic.

In this chapter, we will learn about :

1. Synthetic fibers
2. Plastics

FIBRES

Long strands of molecules interwoven to form a linear, string-like structure are known as 'Fibres'. Fibers are natural or man-made such as cotton, silk, jute, etc.

Fibers were discovered when early people realized the need to cover and protect their own hair and skin from the weather. Since early people would live in cold climate they hunted animals with skins (fur and food) that kept them warm. When used continuously this skin becomes harder and made it hard for the early men to hunt and hence later they started to treat this skin to maintain its softness. In a much later time, they started using the bones of animals as needle and nerves as the thread to stitch. And now decades later we finally know how to grow our own fibres and make clothes or fabrics out of them.

Characteristics of Fibers

Fibers used in clothing are used to cover the body, to protect our body, etc. Everyone wears clothes for different reasons. Some of the other characteristics of fibres are:

- Fibers can be repeatedly stretched more than 500% of its original size and can also recover back; immediately to its original size and shape once the tension is relaxed.

- In comparison to rubber, it is stronger and more durable.
- It is lightweight.

Fibers are of two types, natural and synthetic fibers.

NATURAL FIBRES

Fibres obtained from plants and animals that can be spun into filament, thread or rope are termed as 'Natural fibres'. They may be woven, knitted, matted or bonded.

Decades later even though the methods used to make fabrics from fibres may have changed greatly, their functions remain the same :

- Most natural fibres are still used to make clothing and containers.
- To insulate, soften and decorate our spaces.

SYNTHETIC FIBRES

Fibres that are man-made are termed as 'synthetic fibres'. Mostly these fibres are made using raw materials from petroleum and these materials are known as 'petrochemicals'. These fibres are made out of small units termed as 'polymer' and each polymer is made up of an individual unit known as 'monomer'.

Interesting Fact

It is not advisable to wear synthetic clothes while working in a laboratory or in a kitchen because these clothes melt on heating and stick to the body of the person wearing it.

Fibres which are originally deriving from naturally-occurring fibres and occurring through a chemical process are known as 'semi-synthetic fibres'. The naturally occurring fibre is harvested, broken down and then reconstructed. This is usually done using cellulose. Cellulose is a component that is abundant in plants. This cellulose is extracted from the plants, made soluble and then spun into fibre.

Types of Synthetic Fibres

There are four main types of synthetic fibers :

- Nylon
- Rayon
- Polyester
- Acrylic

Nylon : Nylon (PA) 6 and 66 are both synthetic polymers called polyamides, with the numbers describing the type and quantity of polymer chains in their chemical structure. Most nylons, including 6 and 66, are semi-crystalline and possess good strength and durability for demanding applications.

Nylon Properties : As polyamides, Nylon 6 and 66, whilst having their own separate and distinct benefits, do share many of the same core properties :

- High mechanical strength, stiffness, hardness and toughness.
- Good fatigue resistance.
- High mechanical damping ability.
- Good sliding properties.

- Excellent wear resistance.
- Good electrical insulating properties.
- Good resistance to high energy radiation (gamma and x-ray).
- Good machinability.

Nylon Fibre

Activity 1

Aim : To compare tensile strength of different flibres.

Materials required : An iron stand with a clamp, threads of different fibres, a pan, weights.

Procedure : Take an iron stand with a clamp. Tie one end of a thread to the clamp. To the other end of the thread tie a pan. Keep the smallest weight on the pan. Now add a little weights in the same pan. Keep on adding weight till the thread finally breaks.

Observation : Note down the total weight required to break the thread. Repeat the same experiment with all the other threads and note down the weights in each case. Fill the weights in the following table. All threads/fibres should be of the same length and almost of the same thickness.

S.No.	Types of fibres	Total weights required to break the thread
1.	Wool	
2.	Nylon	
3.	Cotton	
4.	Rayon	
5.	Silk	

Conclusion : Different types of fibres have different tensile strength. The force that should be applied on per unit area of a material to break, is called the tensile strength of the material.

Differences : So whilst Nylon 6 and 66 are very similar materials, they do provide slightly different characteristics. The reason for the differences is largely due to their differences in chemical structure. Nylon 6 is made from one monomer which has 6 carbon atoms whilst Nylon 66 is made from 2 monomers with each one having 6 carbon atoms, hence the name Nylon 66 is given.

NYLON 6	NYLON 66
Less crystalline	More crystalline
Lower mold shrinkage	Exhibits greater mold shrinkage
Lower melting point	Higher melting point
Lower heat deflection temperature	Higher heat deflection temperature
Higher water absorption rate	Lower water absorption rate
Poor chemical resistance to acids	Better chemical resistance to acids
Withstands high impact and stress and better stands up to hydrocarbons	Better stiffness, tensile modulus and flexural modulus
Lustrous surface finish, easy to colour	More difficult to colour

An important difference between Nylon 6 and 66 is mold shrinkage. Nylon 6's lower mold shrinkage adds reliability to final part dimensions which is beneficial whilst Nylon 66's greater mold shrinkage, as it is exposed to cool air and solidifies, means the material's shape changes more after processing, which must be accounted for.

Other key differences between the two nylons are water absorption rates and heat deflection temperatures. As Nylon 6 absorbs more water than Nylon 66 and has lower heat deflection temperatures, it is not suited to applications that are exposed to water at high temperatures. Nylon 66 would be a better choice between the two.

Typical Material Applications

- Sleeve and slide bearings
- Support and guide wheels
- Hammer heads
- Gear wheels
- Cutting boards
- Wear pads
- Cable sheaves
- Scrapers
- Seal rings
- Track plates

Rayon

Rayon is a semi-synthetic or artificial fiber. Rayon is recognized by the name viscose rayon and art silk in the textile industry.

Rayon fibre is a synthetic textile material which is fully the collection of cellulose acquired from cotton linters or from the soft tissue of trees such as spruce. Rayon was introduced in the year 1900 approximately, since it has been used in several textile fields.

Very first rayon was called artificial silk because it is in filament form and somewhat resembles like silk material. However, this similarity is deceptive because the chemical composition of rayon is totally varied from the chemical composition of silk fibres.

Purpose of Using Rayon Fibre :

- Rayon typically has an elevated luster quality giving it a brilliant gloss.
- Mainly, Rayon fibres are used in apparel industry such as Aloha shirts, blouses, dresses, jackets, lingerie, scarves, suits, ties, hats and socks....,
- Some rayon fibres are for filling in Zippo lighters, furnishings including bedspreads, bedsheets, blankets, window covers, upholstery and slipcovers....,
- For industrial purposes such as medical surgery products, non-woven items, tire cord and some other uses like diapers, towels, feminine hygiene products....,

Interesting Fact

Rayon burns with a large flame leaving hard, slobular mass. It burns with a smell like that of a burning paper.

Properties of Rayon :

- Rayon is a versatile fiber.
- Rayon is very soft, cool, comfortable and very good absorbent property but could not be able to protect body heat and used in humid steamy climatic conditions.
- Rayon fibre has the same comfort property as natural fibres.

- Rayon can replicate the feel and texture of silk, cotton, linen and wool.
- Rayon can easily be dyed in variety of colours.
- Rayon has very lower elastic recovery of any fibre.
- HWM rayon is very strong and reveals good durability. HWM rayon can be machine washed.
- Usual rayon fibres are recommended care for dry cleaning purpose only.


Rayon Fibre

- Rayon is a major feedstock in the manufacture of carbon fibre. Grasim of India is the major producer of rayon in the world which is claiming 24% market share.

Major End Uses of Rayon Fiber

1. **Apparel :** Accessories, blouses, dresses, jackets, lingerie, linings, millinery, slacks, sportshirts, sportswear, suits, ties, work clothes.
2. **Home Furnishings :** Bedspreads, blankets, curtains, draperies, sheets, slipcovers, tablecloths, upholstery.
3. **Industrial Uses :** Industrial products, medical surgical products, non-woven products, tire cord.
4. **Other Uses :** Feminine hygiene products.

Polyester

It is a term often defined as "long-chain polymers chemically composed of at least 85% by weight of an ester and a dihydric alcohol and a terephthalic acid". In other words, it means the linking of several esters within the fibers. Reaction of alcohol with carboxylic acid results in the formation of esters.

Polyester also refers to the various polymers in which the backbones are formed by the "esterification condensation of polyfunctional alcohols and acids".

Polyester can also be classified as saturated and unsaturated polyesters.


Polyester Fibre

Activity 2

Aim : To check whether plastic objects get deformed in boiling water or remain unaffected.

Materials required : 1 litre water, a plastic cup and a bakelite switch.

Procedure : Boil 1 litre of water in a container. Put a plastic cup and bakelite switch in it.

Observation and Conclusion : The plastic cup deforms in boiling water but bakelite switch has no effect of hot water.

Saturated polyesters refer to that family of polyesters in which the polyester backbones are saturated. They are thus not as reactive as unsaturated polyesters. They consist of low molecular weight liquids used as plasticizers and as reactants in forming urethane polymers and linear, high

molecular weight thermoplastics such as polyethylene terephthalate (Dacron and Mylar). Usual reactants for the saturated polyesters are a glycol and an acid or anhydride.

Unsaturated polyesters refer to that family of polyesters in which the backbone consists of alkyl thermosetting resins characterized by vinyl unsaturation. They are mostly used in reinforced plastics. These are the most widely used and economical family of resins.

Characteristics of Polyester

Polyester fabrics and fibers are extremely strong.

Polyester is Very Durable : Resistant to most chemicals, stretching and shrinking, wrinkle resistant, mildew and abrasion resistant.

Polyester is hydrophobic in nature and quick drying. It can be used for insulation by manufacturing hollow fibers.

Polyester retains its shape and hence is good for making outdoor clothing for harsh climates.

It is easily washed and dried.

Uses of Polyester : The most popular and one of the earliest uses of polyester was to make polyester suits. All the rage in the 70s, polyester clothes were very popular. Due to its strength and tenacity polyester was also used to make ropes in industries. PET bottles are today one of the most popular uses of polyester.

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Polyester Care Tips : Taking care of polyester clothing is really easy and very time efficient.

Polyester clothing can be machine washed and dried. Adding a fabric softener generally helps. Dry the fabric at low temperatures to get maximum usage from the clothing.

Though polyester does not require much ironing, if you must, then iron warm.

Polyester can be dry-cleaned with no hassles.

Acrylic

Acrylic is a very good weather-proof material, with high clarity and great UV resistance. It can withstand force, is non-toxic, waterproof and can be recycled (even though not effortlessly). Acrylic sheets can be heated and molded utilizing plastic machining, to turn it into a vast assortment of various shapes and sizes (i.e. a bath tub). A plastic machine shop can develop a wide range of exclusive styles and purposes employing plastic machining, plastic milling and plastic turning. Its rewards more than glass are that it is lightweight, flexible and less unsafe if broken, an excellent substitute for windows, doors (especially shower doors), skylights and aquariums. It has the benefit of getting many times stronger and numerous times lighter than glass, as nicely as a lot more effect resistant. Acrylic also has the advantage of getting moldable, all of which make it a wonderful alternative over glass. It is used to make articles such as dishes and cups.

Acrylic Fibre

Acrylic plastic may be any plastic derived from acrylic

compounds such as acrylic acid or methacrylic acid. They generally have similar properties and are commonly used in Plexiglas, lacquer and adhesives.

Transparency

Acrylic plastic is extremely transparent and transmits 92 per cent of white light. This is equal to the transparency of the finest optical glass.

Impact Resistance

Acrylic sheets (Plexiglas) have six to 17 times the impact resistance of ordinary glass, depending on the specific preparation. Plexiglas also breaks into relatively dull pieces compared to glass.

Weather Resistance

Acrylic plastic is highly resistant to variations in temperature and humidity, making it useful in outdoor applications.

Chemical Resistance

Acrylic plastic is highly resistant to inorganic acids and bases but can be dissolved by organic substances, especially petroleum products.

Combustibility

Acrylic plastic is combustible and will self-ignite at approximately 860 degrees Fahrenheit. It will burn with an open flame at about 560 degrees Fahrenheit.

Characteristics of Synthetic Fibers

- **Length :** Length of the fibres is controllable since it is man-made. They are filament fibres but can be cut into staple fibre for different usage.
- **Comfort :** Synthetic fibres are not comfortable as natural fibres in clothing.
- Dust and impurities are absent or minimum in synthetic fibres.
- **Hydrophobic :** Most of the synthetic fibres are hydrophobic in nature, Rayon is an exception. Dyeing or colour application is difficult in synthetic fibres comparing to natural fibres.
- **Durable :** Synthetic fibres are more strong and durable, that is why the use of synthetic fibres is much wider than natural fibres (other than textiles).
- **Multi Task :** Synthetics fibres are used in multi task than natural fibres, the use of natural fibres is limited in comparison to synthetic fibres.
- **Burning :** Synthetic fibres burn and melt and smell chemical.
- **Economical :** Synthetic fibres are more economical.
- **Sustainability :** Synthetic fibres are less environment friendly, decomposition is an issue specially with polypropylene.

Advantages of Synthetic Fibres

- Synthetic fibres have good elasticity.
- They don't wrinkle up easily.
- Fabrics from synthetic fibres are less expensive, durable and readily available in comparison to natural fibres.

- Synthetic fibres can handle the heavy load without breaking.
- They don't shrink.
- Synthetic fibres blend well with other fibres.
- They're very absorbent.

Disadvantages of Synthetic Fibres

- Synthetic fibres require attention while ironing since they tend to melt away easily.
- Most of these fibres absorb very little moisture and hence it sticks to the body while sweating on hot summer days making it uncomfortable to wear during such days.
- Synthetic fibres are prone to catch fire very easily.
- These fibres are non-biodegradable.

PLASTICS

Plastic is the term commonly used to describe a wide range of synthetic or semi-synthetic materials that are used in a huge and growing range of applications. Everywhere you look, you will find plastics. We use plastic products to help make our lives cleaner, easier, safer and more enjoyable. We find plastics in the clothes we wear, the houses we live in and the cars we travel in. The toys we play with, the televisions we watch, the computers we use and the DVDs we watch all contain plastics.

Various Products Made of Plastics

Plastics are organic materials, just like wood, paper or wool. The raw materials used to produce plastics are natural products such as cellulose, coal, natural gas, salt and of course, crude oil. Plastics have become the modern material of choice because they make it possible to balance today's needs with environmental concerns.

The term "plastic" is derived from the Greek word "plastikos", meaning fit for moulding. This refers to the material's malleability, or plasticity during manufacture, which allows it to be cast, pressed, or extruded into a variety of shapes—such as films, fibres, plates, tubes, bottles, boxes and much more.

Interesting Fact

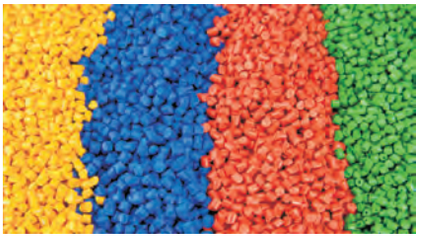
Food do not stick to a special type of plastic 'Teflon'. It is used for non-stick coating on cook wares.

Based on the structure, plastics are divided into two groups :

1. Thermoplastics
2. Thermosetting Plastics

1. Thermoplastics

Thermoplastics are organic materials that melt when heated. They should be differentiated from thermoset materials which cure, or become set, when they are heated. Thermoplastic materials are melt processable, that is they are formed when they are in a melted or viscous phase. This generally means they are heated, formed, then cooled in their final shape.



Thermoplastics

Properties : Thermoplastics have wide ranging properties. Depending upon their chemistry they can be very much like rubber, or as strong as aluminium. Thermoplastics are light weight, with densities of 0.9 to 2 gm/cc. Some high temperature thermoplastic materials can withstand temperature extremes of up to 600°F, while others retain their properties at –100°F. Some thermoplastic materials have no known solvents at room temperature. Most thermoplastic materials are excellent insulators, both electrical and thermal. On the other hand, thermoplastic composites can be made to be electrically conductive with the addition of carbon or metal fibers. In general, the combination of light weight, high strength and low processing costs make thermoplastics well suited to many applications.

Processing : The most common methods of processing thermoplastics are injection molding, extrusion and thermoforming.

Advantages : Thermoplastics have a good range of properties and are energy efficient, both in their manufacture and processing. Thermoplastic components can be made in very high volume with high precision and low cost. Thermoplastics can replace metals with a considerable weight savings, providing proper care is taken in design. Most thermoplastics have better fatigue properties than metals and will tolerate larger deflections than metals without deforming.

Disadvantages : Thermoplastics melt. Some degrade in direct sunlight or under high U.V. light levels. Many materials have poor resistance to hydrocarbons, organic solvents and highly polar solvents but others have excellent resistance to these materials. Thermoplastics suffer from creep, a relaxation of the material under long term loading. Many thermoplastic materials, especially composites, tend to fracture rather than deform under high stress levels.

2. Thermosetting Plastics

Thermoset plastic or Thermosetting plastics are synthetic materials that strengthen during being heated but cannot be successfully remolded or reheated after their initial heat-forming, called as thermoset material.

Thermosetting Plastics

Properties of a Thermoset Plastic Material :

1. By heating the polymer, it turns as hard material.
2. It is available in the form of liquid at room temperature.
3. It is a Non-recyclable process.
4. Thermoset plastic material in the form of liquid is converted into thermoset plastic material in the form of solid which is done by the action of heating and its vice-versa is not possible.
5. Gains Strength : By the action of heating, the thermoset plastic material gains strength.
6. No change in strength of the thermoset plastic by the action of cooling.
7. Shape Change : During heating only, the thermoset plastic material changes its shape.
8. Temperature : The servicing temperature of a thermoset plastic material is 300°C.
9. Structure : The thermoset plastic material exhibits cyclic structure.

Interesting Fact

Uniforms of firemen have a coating of melamine to make them fire-resistant.

10. The thermoset plastic material is hazardous to the environment which is more when compared to the thermoplastic and less than the rubber.

Examples of a Thermoset Plastic Material :

- Epoxy Resin
- Vinyl Ester Resin
- Poly Ester
- Phenolic (Bakelite)
- Cynate Ester

Advantages

Thermosetting plastics, however, have a number of advantages. Unlike thermoplastics, they retain their strength and shape even when heated. This makes thermosetting plastics well-suited to the production of permanent components and large, solid shapes. Additionally, these components have excellent strength attributes (although they are brittle) and will not become weaker when the temperature increases.

Disadvantages

It is a compound that is indestructible, even when it is melted the compound gas that it gives off is very harmful to our health and environment; it weakens the ozone layer. Most plastic is produced from oil. The world is gradually running out of oil. Scientists are now developing plastics that are made from vegetable oil and other organic matter. This means that the plastic is more likely to be degradable, so it will be less of a problem in future. Threatening Disadvantage : Another disadvantage is pollution. Plastic accumulation in the environment is a looming catastrophe! Think about this: Plastics are manufactured from petroleum. This brings a host of issues (destruction of habitat, extraction of crude oil, security issues from the volatile countries where oil is produced, processing of petroleum, chemical manipulation into various types of plastics). The manufacture involves many chemicals, many of which have not been sufficiently tested for their toxicological impact on humans or animals. The final plastic product is often a chemical entity that in and of itself has had insufficient toxicological and ecotoxicological testing. An example would be PVC, forms of which are banned in Europe but exist widely in children's toys in America. Recent controversies over plastic bottles (many toxicologists recommending not re-using plastic water bottles and not storing food in Tupperware) have highlighted the potential risks.

Difference Between Thermoplastic and Thermosetting Plastic

Thermoplastic	Thermosetting Plastic
Thermoplastic can be synthesized by the process called addition polymerization.	Thermosetting plastics are synthesized by condensation polymerization.
Thermoplastic is processed by injection moulding, extrusion process, blow moulding, thermoforming process and rotational moulding.	Thermosetting Plastic is processed by compression moulding, reaction injection moulding.
Thermoplastics have secondary bonds between molecular chains.	Thermosetting plastics have primary bonds between molecular chains and held together by strong cross links.

Thermoplastic	Thermosetting Plastic
Thermoplastics have low melting point and low tensile strength.	Thermosetting plastics have high melting point and tensile strength.
Thermoplastic is lower in molecular weight, compared to thermosetting plastic.	Thermosetting Plastic is high in molecular weight.

Properties of Plastics

The properties and characteristics of most plastics (though not always fulfilled in certain special plastics) are these:

Following are the general properties of plastics.

1. Strength

The plastics are sufficiently strong and can be used for load bearing structural members. The strength of plastics can further be increased by reinforcing them with various fibrous materials.

Plastic as structural material has not gained much popularity because of the following reasons.

- High cost of construction.
- High temperature susceptibility.
- Poor stiffness.
- Being subjected to creep under constant load.

2. Weather Resistance

The plastics, prepared from phenolic resins, are only good in resisting weather effects. Certain plastics are seriously affected by ultraviolet light.

3. Fire Resistance

Plastics, being organic in nature, are combustible. But the resistance to fire temperatue depends upon the plastic structure.

- Cellulose acetale plastics burn slowly.
- Polyvinyl chloride (PVC) plastics are non-inflammable.
- Phenol formaldehyde and urea formaldehyde plastics are used as fire proofing materials.

4. Durability

Plastics generally possess sufficient durability, provided they offer sufficient surface hardness. Thermoplastic varieties are found to be attacked by termites and rodents.

5. Dimensional Stability

Plastics easily maintain its shape and do not go under plastic deformations.

6. Chemical Resistance

Plastics offer great resistance to moisture, chemicals and solvents. Many plastics are found to possess excellent corrosion resistance. Plastics are used to convey chemicals.

7. Thermal Resistance

The plastics have low thermal conductivity and therefore foamed or expanded varieties of plastics are used as thermal insulators.

8. Working Conditions

All operations like drilling, sawing, punching, clamping, etc. are carried out easily on plastics, just like wood.

9. Moisture Resistance

This property depends upon variety of plastics used, for example, cellulose plastics are considerably affected by the presence of moisture, whereas polyvinyl chloride plastics offer high resistance to moisture.

10. Ductility

Plastics, generally, have low ductility and hence plastic structural members may fail without prior warning.

11. Miscellaneous Properties

In addition to above properties, plastics have following qualities.

- Plastics are available in variety of colours, both opaque and transparent.
- Plastics possess excellent insulating property, so used as electric insulators.
- Plastics are clean, light and shining, so they need not be given any finish such as painting, polishing, etc.
- Normally thermo-plastics have low melting point and cannot be used where temperature or heat condition persists.
- They possess good optical and sound absorption qualities.

Disadvantages of Plastics

1. Environmental Damage

Plastic bags have been known to cause a lot of environmental damage. A single plastic bag can take up to 1000 years, to decay completely. This makes the bags stay in environments longer, in turn leading to great build-up on the natural landscape (much more than degradable materials like paper). In other words, the more plastic bags you use, the greater the chances of environmental damage.

2. Threat To Animal Life

As per Marrickville Council of Australia, as many as 1,00,000 whales, turtles and birds have been reported to die every year, mainly because of plastic in their environment. Plastic bags not only have adverse effects on our natural habitats, but have also been found to be responsible for the death of many animals, mainly on account of the suffocation encountered on eating them.

Plastic Bags in Garbage

3. Suffocation

Not only animals, infants and young children have also been reported to have lost their life, on

account of plastic bags. Since plastic bags are thin and airtight as well, children often end up blocking their mouths and nostrils with them. In case they are not being monitored by an adult, this leads to suffocation and, in some cases, even death.

4. Pollution

Plastic bags are extremely durable. In case you are thinking of this as an advantage, just bring to mind an image of the huge landfill that you visited on the city outskirts, the other day. In most probability, majority of the rubbish present there will comprise of plastic bags only. In other words, plastic bags have led to a great increase in the pollution levels.

5. Fumes

Since plastic bags are not bio-degradable, the only way to get rid of them is to burn them up. Though lighting a match to them is easy, it has more than its fair share of disadvantages. The biggest of them is that smoldering plastics can release toxic fumes into the environment, in turn taking the air pollution to much higher levels.

6. Non-renewable

One of the main disadvantages of plastic bags is that they are not renewable. The reason behind this is that they are made of petrochemicals, a non-renewable source of energy. They can be recycled, but not as easily as paper bags. Plastic bags can last for as much as hundred of years. In other words, long after you are no more, the plastic bag used by you will be in existence. Hope it will helps u a lot!

7. Plastic Releases Toxic When Burned

In many rural and even urban areas, people set old plastic objects on fire in hope to get rid of it. Plastic contains a lot of chemicals which gets released into the atmosphere and mixes with the natural air. This makes the air we breathe toxic and harmful. As a result, the air we breathe is not pure and contains many types of hazardous chemical. When we breathe contaminated air, it hurts our lungs and overall health in the long run.

How Can We Contribute

1. Use Jute Bag Instead of Polythene

Polythene bags contribute a significant percentage to the usage of plastic. We use polythene bags most of the time. From buying vegetables from market to carrying goods. Polythene bags are very hazardous to the environment. They are non-biodegradable and it is hard to get rid of this material. It can also cause harm to water life, human beings and the environment. So, try to use jute bags when you go for shopping.

2. Reuse Reusable Plastic Bottle

Nowadays, reusable plastic is used, which means you can refill these bottles with water and use them again. However, make sure that bottle is reusable otherwise toxic chemicals from the bottle may mix with the water.

3. Avoid the Use of CDs

Mostly CDs are made of poly-carbonate plastic. Every year, millions of CDs are sold. We can use pen drives or portable hard disks for carrying data as they can carry a large amount of data compared to CDs and are reusable too.

4. Cook More

Not only is it healthier, but making your own meals doesn't involve takeout containers or doggy bags. For those times when you do order in or eat out, tell the establishment you don't need any plastic cutlery or, for some serious extra credit, bring your own food-storage containers to restaurants for leftovers.

5. Purchase Items Secondhand

New toys and electronic gadgets, especially, come with all kinds of plastic packaging from those frustrating hard-to-crack shells to twisty ties. Search the shelves of thrift stores, neighbourhood garage sales, or online postings for items that are just as good when previously used. You'll save yourself a few bucks, too.

6. Recycle (duh)

It seems obvious, but we're not doing a great job of it. For example, less than 14 per cent of plastic packaging is recycled. Confused about what can and can't go in the bin? Check out the number on the bottom of the container. Most beverage and liquid cleaner bottles will be #1 (PET), which is commonly accepted by most curbside recycling companies. Containers marked #2 (HDPE; typically slightly heavier-duty bottles for milk, juice and laundry detergent) and #5 (PP; plastic cutlery, yogurt and margarine tubs, ketchup bottles) are also recyclable in some areas.

Reuse of Plastics

7. Support a Bag Tax or Ban

Urge your elected officials to follow the lead of those in San Francisco, Chicago and close to 150 other cities and counties by introducing or supporting legislation that would make plastic-bag use less desirable.

8. Buy in Bulk

Single-serving yogurts, travel-size toiletries, tiny packages of nuts—consider the product-to-packaging ratio of items you tend to buy often and select the bigger container instead of buying several smaller ones over time.

9. Stop Buying Water

Each year, close to 20 billion plastic bottles are tossed in the trash. Carry a reusable bottle in your bag and you'll never be caught having to resort to a Poland Spring or Evian again. If you're nervous about the quality of your local tap water, look for a model with a built-in filter.

10. Put Pressure on Manufacturers

Though we can make a difference through our own habits, corporations obviously have a much bigger footprint. If you believe a company could be smarter about its packaging, make your voice heard. Write a letter, send a tweet, or hit them where it really hurts: Give your money to a more sustainable competitor.

11. Boycott Microbeads

Those little plastic scrubbers found in so many beauty products, facial scrubs, toothpaste, body

washes might look harmless, but their tiny size allows them to slip through water-treatment plants. Unfortunately, they also look just like food to some marine animals. Opt for products with natural exfoliants, like oatmeal or salt, instead.

Apart from this, governments need to take some serious actions as well to stop the plastic usage where alternatives are available. It's high time that the world understands the negative impact of plastic on nature.

Key Words

Synthetic Fibre	:	Man-made fibres from simple, small molecules
Nonbiodegradable	:	Substances which do not decompose to harmless substances by the action of air, water and bacteria
Polymer	:	Long chain-like molecule consisting of a large number of smaller molecules joined to each other by chemical bonds
Insulator	:	Substances which do not allow heat and electricity to pass through them
Plastic	:	A polymer which can be easily moulded into shape on heating

Important Points

1. Synthetic fibre and plastics, like natural fibres, are made of very large units called polymers. Polymer are made up of many smaller units.
2. Synthetic fibres find uses ranging from many household articles like ropes, buckets, furniture, containers, etc. to highly specialized uses in aircrafts, ships, spacecrafts, healthcare, etc.
3. Depending upon the types of chemicals used for manufacturing synthetic fibres, they are named as Rayon, Nylon, Polyester and Acrylic.
4. Natural fibres are obtained from plants and animals, synthetic fibres are obtained by chemical processing of petrochemicals. Like natural fibres these fibres can also be woven into fabrics.
5. The different types of fibres differ from one another in their strength, water absorbing capacity, nature of burning, cost, durability, etc.
6. The waste created by plastic is not environment friendly. On burning, plastics release poisonous gases. On dumping in the ground they may take years to degenerate. This is because of their non-biodegradable nature.
7. Today, life without plastics cannot be imagined. Be it home or outside, plastics is everywhere.
8. We need to use synthetic fibres and plastics in such a manner that we can enjoy their good qualities and at the same time minimise the environmental hazards for the living communities.

Exercise

Multiple Choice Questions (MCQs)

A. Tick (✓) the correct option :

1. Which of the following is hydrophobic?

(a) linen ☐ (b) cotton ☐ (c) jute ☐ (d) polyester ☐

2. Which of the following is a characteristic of plastics?
   (a) heat conductors ☐ (b) non-biodegradables ☐ (c) electrical conductor ☐ (d) biogradable ☐
3. Acrylic fibres are not easily acted upon by :
   (a) chemicals ☐ (b) moisture ☐ (c) bacteria ☐ (d) all of these ☐
4. Which of the following is a natural polymer?
   (a) cellulose ☐ (b) acrylic ☐ (c) polyester ☐ (d) nylon ☐
5. Plastics, that retain their plasticity on repeated heating are called :
   (a) thermoplastic ☐ (b) thermal plastic ☐ (c) thermosetting ☐ (d) none of these ☐
6. Which of the following is non biodegradable?
   (a) paper ☐ (b) grass ☐ (c) cotton ☐ (d) polyester ☐

B. Fill in the blanks :

1. _____ is called artificial silk.
2. A plastic that can be remoulded by heating is a _____.
3. Bakelite and melamine are examples of _____.
4. The handle of a pressure cooker is made up of _____.
5. _____ was the first synthetic fibre made by man.
6. Nylon gets its name from _____ and _____.

C. Match the following :

Column A	Column B
1. Cotton	(a) Bakelite
2. PET	(b) Summer wear
3. Ropes	(c) Nylon
4. PHBV	(d) Polyester
5. Thermoset	(e) Biodegradable

D. Very Short Answer Questions :

1. Name different types of synthetic fibres.
2. Give two examples of thermoplastics.
3. Name the polymer from which cotton is made.
4. Which fibres are non-biodegradable?
5. Which type of plastic cannot be processed again and again?

E. Short Answer Questions :

1. Mention two advantages of synthetic fibres in comparison to natural fibres.
2. Mention few uses of nylon.
3. Mention two differences between the thermosetting plastic and thermoplastic.
4. Write two ways by which we can avoid plastics.
5. Write two disadvantage of using plastics.
6. Mention two main uses of polyester fibre.

F. Long Answer Questions :

1. State the properties of plastics.
2. Mention the advantages and disadvantages of thermoplastic.
3. Mention two advantage and two disadvantages of synthetic fibres.
4. Mention a few problems associated with the excessive use of plastics.

Assignments

A. Read the passage and answer the following questions.

Rayon is a manufactured fiber made from regenerated cellulose fiber. The many types and grades of rayon can imitate the feel and texture of natural fibers such as silk, wool, cotton and linen. The types that resemble silk are often called artificial silk. Since rayon is manufactured from naturally occurring polymers, it is not considered to be synthetic. Technically, the term synthetic fiber is reserved for fully synthetic fibers. In manufacturing terms, rayon is classified as "a fiber formed by regenerating natural materials into a usable form". Specific types of rayon include viscose, modal and lyocell, each of which differs in manufacturing process and properties of the finished product.

Rayon is made from purified cellulose, harvested primarily from wood pulp, which is chemically converted into a soluble compound. It is then dissolved and forced through a spinneret to produce filaments which are chemically solidified, resulting in fibers of nearly pure cellulose. Unless the chemicals are handled carefully, workers can be seriously harmed by the carbon disulfide used to manufacture most rayon.

1. What is rayon?
2. What do you mean by artificial silk?
3. How rayon is made?
4. By which substance workers can be harmed?