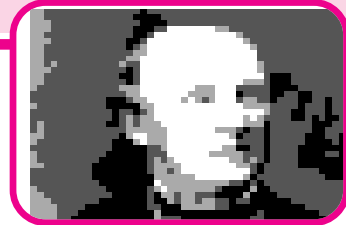


# Chapter 3

# SYNTHETIC FIBRES AND PLASTICS



In previous classes, you have become familiar with different types of fibers.

You know that clothes can be made from natural fibres such as cotton, silk and wool (figure 1). You also know how they are prepared.

We wear a wide variety fabrics in our daily life.

- Are all of them made of natural fibres?

You heard about fabrics such as polyester, nylon and acrylic etc. They are examples of synthetic fibres.

- Why do we call them synthetic?

These fibres are not obtained from plant or animal source they are made by the raw materials obtained from petroleum. Synthetic fibres are not only used for fabrics but also used in preparing many house hold articles.



*Fig-1: Clothes from Natural Resources*

## Activity-1

### Identify household articles made up of natural and synthetic fibre

Identify the articles around you in your class room or at your home and write their names against relevant category table-1.

**Table -1**

Source	Articles
Natural fibres from plants	
Natural fibres from animals	
Synthetic fibres	

What do you observe from the list made by you? You notice that the list of household articles made of synthetic fibres is very long. It encompasses all our day to day activities.

What do you know about synthetic fibres? How is it manufactured? Let us discuss about synthetic fibres in detail.

### What is synthetic fibre?

Have you seen a bead necklace? (Figure 2 a) Do you observe any pattern in arrangement of beads? Can you describe the pattern?



Fig-2(a):  
bead necklace



Fig-2(b):  
one paper clip



Fig-2(c):  
paper clips chain

### Activity-2

#### Beads and paper clips pattern

Take few paper clips (Figure 2b) and join them together as shown in figure 2(c). Observe the pattern of clips. Do you find any similarity between the pattern of beads in necklace and the pattern of paper clips in the chain?

Each unit of paper clips or beads can be joined together to form a long chain like structure. Each bead (or clip) is a separate

unit but when many such units are joined together, they form a new, different structure.

Similarly, synthetic fibres have chain like structure formed by joining small units together. Each small unit in the chain is a chemical substance. Many small, identical units combine to form a large unit called **polymer**. The small units are called monomers. Synthetic fibres are made of polymers.

Unlike natural fibers, synthetic fibres are made from petroleum based chemicals or petro chemicals. Petrochemicals are subjected to various chemical processes to obtain synthetic fibres. Due to this, they are called **Synthetic fibres** or **artificial fibres**.

### ? Do you know?

*What does Polymer mean?*

‘Poly’ means many and ‘mer’ means part/unit. The word is derived from Greek. So we can say polymer is a structure made up of many small repeating units.



### Think and Discuss

- What made the human beings to search for the alternative for natural fibres?
- Which fibre source is not exhaustible? Why?

## Some synthetic fibres

How do you find whether a fabric is synthetic or not? Take a piece of cloth and pull out a thread. Unravel this thread (yarn). How long is the fibre? Does it lustrous or not? Do these characteristics help in identifying a fibre?

You can't identify the fibres by simple visual inspection alone in the absence of brand label. Then how to identify them? Let us see.

### Activity-3

#### Identifying fibres – burning test

You can do a fibre burning test. Unravel several warp and weft yarns. Using tweezers hold the yarn to the edge of a flame. Observe, the changes.

If it smells like burning hair, the yarn is wool or silk.

If it smells like burning paper, the yarn may be cotton, or rayon.

If the yarn melts in the flame, it is a synthetic fibre such as nylon and acrylic.

You learnt how natural fibres are obtained and fabrics are made from them in the previous classes. Do you know how various synthetic fibres are obtained? Let us learn about it.



#### Think and Discuss

How synthetic fibres evolved to the present position?

## Nylon

Can you name few synthetic fabrics that you wear or observed? Have you heard nylon?

Nylon is a synthetic fibre. It is prepared from coal, water and air. It was the first fully processed synthetic fibre. It became

popular during Second World War and replaced silk in most hosiery articles such as stockings.

## How is nylon made?

Nylon is a polymer made of chemical units called polyamides. Polyamides are made with monomers hexamethylene diamine and adipic acid. Solid chips of these polyamides are melted and forced through a heated spinneret which has very, very tiny holes.

Have you ever heard a crackling sound when you take off certain types of clothes? Or did you see sparks in them when it is dark? This is due to static electricity. Learn from your teacher about it.

The size and shape of the holes changes, the characteristics of the resulting fiber. The fibre solidifies as it cools and can be spun or woven.

Nylon fibre is strong, elastic and light weight. Cloth made of Nylon are lustrous and easy to wash. So it has become very popular. Nylon does not absorb water - this fact explains many of its uses. But static electricity is easily created in nylon fabrics. It also easily catches fire. So we should not wear nylon clothes while cooking, welding, working near a fire or using heavy machineries. Why do we wear apron during cooking or working near the fire?

Many articles that we use in our daily life are made up of nylon.

Can you name the few things made of nylon? Tooth brush bristles, ropes, fishing nets, tents, sarees, stockings and socks, car seat belts, sleeping bags, curtains etc are made of nylon. Can you add some more to this list?



**Fig-3: Articles made of nylon**

Nylon has replaced wool as the fiber which is used in carpets. Nylon is also used in making parachutes. Rock climbers use nylon ropes to climb mountains. It is used in making of swim suits, sheer hosiery, sails, umbrella cloth, dress materials, car tires, etc, (Figure 3). What kind of material will make a good parachute or a climbing rope? Let us find out!

nylon. Fill the data in table 2. (Precaution: Note that all the threads should be of the same length and almost of the same thickness.)

**Table 2**

S.No.	Type of thread/ fibre	Total weight in (gr / kg) required to break the thread
1	Cotton	
2	Wool	
3	Silk	
4	Nylon	

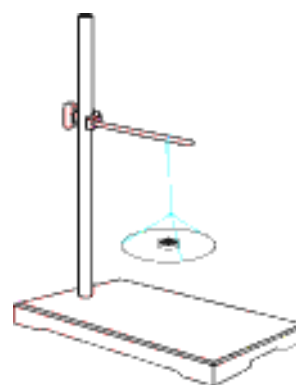


**Fig-4: Use of Nylon Fibers**

### Activity -4

#### How strong is nylon?

Take an iron stand with a clamp. Take cotton, wool, nylon and silk thread about 50cm in length. Tie cotton thread to stand so that it hangs freely from it. At the free end attach a pan so that a weight can be placed on it (Figure 5). Add weight starting from 10 grams one by one till the thread breaks. Note down the total weight required to break the thread. Repeat the same activity with threads of wool, silk and



**Fig-5: An iron stand with a thread hanging from the clamp**

Arrange the threads in order of their increasing strength. What do you observe from the above activity?

Do you know that if you compare a nylon thread with a steel wire of same thickness, nylon will be as stronger as steel wire?



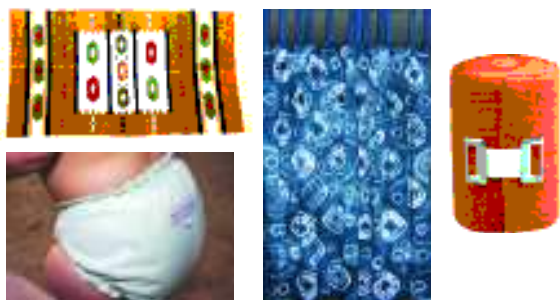
### Think and discuss

- If we use cotton cloth and cotton ropes in preparing a parachute what will happen?
- Traditionally fishermen used cotton nets. Now they are using nylon nets. What could be the advantage of using nylon nets?
- Nylon sarees are much better than the cotton sarees. It is better to use only nylon sarees. Do you agree with this? Why?

## Rayon

We know about natural silk which is obtained from silkworms. Fabrics made of silk are very costly. It is not even accessible to all. Production and maintenance of silk clothes are also very difficult and time taking process. But its texture fascinates everyone.

For many years scientists attempted to make silk artificially and their efforts were successful towards end of the nineteenth century. The first commercial production of artificial silk was achieved in USA in 1911. But this fibre was named as rayon only in 1924. The first rayon factory in India was established in Kerala in 1946.



**Fig-6: Articles made from rayon.**

Where do we find rayon factories in our state? Discuss with your teacher.

Let us now discuss how rayon is prepared.

### How rayon is prepared?

We noted that petrochemicals are the source material for many polymers and synthetic fibres. But the source material for rayon is wood pulp. It is the only synthetic fibre obtained from plant's cellulose and so it is called cellulose fibre.

If rayon is obtained from plant cellulose then why do't we call it as a natural fibre? Let us find out the process of preparing rayon to decide whether rayon is natural or artificial.

The cellulose that was collected from wood or bamboo pulp, is treated with several chemicals. First sodium hydroxide is added and then carbon disulphide to the cellulose. The cellulose dissolves in chemicals added to it and gives a syrup called **viscose**. Viscose is forced through a Spinneret (Metal plates with very, very tiny holes) into a solution of dilute sulfuric acid. This gives us silk like threads. The threads are cleaned with soap and dried. This new fibre is called **rayon** which is an **artificial silk (man made silk)**. Some kinds of rayons are made from the short cotton fibres left on cotton seeds after ginning.

Rayon is cheaper than silk and can be woven like silk fibre. It can be dyed in a wide variety of colours.

Is rayon used only for clothes? What are the other things that are made from rayon fabric?

Rayon is mixed with cotton to make bed sheets. Rayon is mixed with wool in making of carpets. Rayon is often used in fashion and home furnishings. Rayon is also found in sanitary products, diapers and bandages and lints for dressing wounds (Fig-6).

Rayon is not perfect fibre to prepare all fabrics. Because as it is made up from plant cellulose, it absorbs water easily. Absorbing water makes rayon weak and cause the fibre to break.



### Think and Discuss

- What characteristics make artificial rayon better than natural silk?
- If you want to purchase a door mat made of synthetic fibre. Which synthetic fibre door mat will you select? Why?
- If sanitary diapers and bandages are made of nylon, what happens?

### Activity-5

#### Why we combine fibres?

Whenever you buy clothes or readymade garments observe the brand label. What do you notice? Or Visit a nearby garment shop and look at the labels on the clothes (Figure 7).

What do you see?

Record the percentage of different fibres mentioned on labels.

You may find rayon mixed with wool and cotton, polyester is mixed with cotton

and wool. Even Nylon is mixed with polyester. Why do we combine fibres? What is this process called?



Fig-7: Labels showing different blend percentages

Any synthetic fibre can be combined with two or more other fibres. This is called **blending**. Natural and synthetic fibres are often blended for preparing better fabric.

A blend does not simply mean alternating threads of cotton and polyester. Unique and different textures can be created through blending. When a fibre is combined with other fibre, certain qualities of first fibre are combined with the qualities of other fibers and give us a blended fabric which possess the best qualities of both. Blending helps us to reduce the limitations of both fibres. For example if you consider, cotton and polyester blend, cotton is comfortable to wear but it forms wrinkles. But polyester is wrinkle free. Therefore when these two are combined. The end result is a comfortable and wrinkle free fabric. Cotton

shrinks in wash while polyester generally does not. So when these two are combined in proper ratio, the resultant material does not shrink to a large extent when compared with a pure cotton fabric. The more the percentage of natural fibre in blending of fibres the more would be the comfort to the skin.

When natural fibres contribute to a fabric, it allows the skin to breathe easily. Also natural fibres are generally free from irritating chemicals.

## Acrylic

- What type of clothes do you wear in winter? All of us wear clothes which give warmth to our body. We use sweaters, shawls or blankets. People feel that all these are made up of natural wool. Wool is very costly and generally is not affordable and accessible to everyone. Think! How many sheep would be needed to obtain the wool to prepare sweaters for everyone in India?

All the winter wear nowadays is made of a synthetic fibre called **acrylic**. It became commercially available in 1941. It looks like natural wool. It can be considered as artificial wool. It is generally called '**fake fur**'.

It is made from the combination of coal, air, water, oil and limestone. It is spun by either dry spinning or wet spinning. In dry spinning the dissolved polymers are extruded into warm air. The fibres solidify by evaporation. In wet spinning the

polymers are dissolved and extruded into a bath and then dried. The wool obtained from natural sources is quite expensive, whereas clothes made from acrylic are relatively cheap.

Can you list out the things made up of acrylic? It is used in knitted apparels such as fleece, socks, sportswear and sweaters. It is also used in craft yarns, upholstery fabric, carpets, luggage awnings and vehicle covers. Do you have any of them in your home?

*(Here, we just introduced a new word 'polyester'. You will learn about this in detail in later part of this chapter).*



### Think and Discuss

- Which type of blended fabrics do you find more comfortable in winter? Why?
- The fabrics namely natural, synthetic and blended are available for garments. Which fabrics will you prefer to wear for rare occasions like functions and in routine? Why?

## Why synthetic fibres?

What kind of umbrella would you use on a rainy day? Would you use an umbrella made of cotton or wool?

We have learnt about three different synthetic fibres. How are they different from natural fibres? Synthetic fibres absorb less water and dry at a faster rate. Some are even water proof. Most of them

possess several unique characteristics. They are durable, less expensive, readily available, affordable and are easy for maintenance.

In activity 3, when you burn synthetic fibre you find that their behavior is different from that of natural fibres. Synthetic fibres melt on heating. This is the disadvantage of synthetic fibres. If the synthetic fabric catch fire, it can be disastrous. The fabric melts and sticks to the body of the person who wears it. So we shouldn't wear the synthetic clothes while working in the kitchen or in a laboratory. Washing and ironing also different for synthetic clothes. Have you ever observed the labels given in the figure-8 on the collars of your shirts or inside the frocks and trousers? What does it indicate?



Fig-8: Laundry label codes



### Think and Discuss

- Which fabrics do you prefer? Natural or synthetic? Why? Discuss comparatively?
- What is the difference between washing of cloths at home and washing by dry cleaning at laundry?

## Polyesters

You might have heard about polyester cloths. You might have also heard about terylene. What type of fabrics are they?

Polyester is the most commonly used synthetic fibre. Polyester fibres revolutionalized the fabric industry and changed the costume culture. Fabric made from polyester fibre doesn't get wrinkled easily. It remains crisp and are easily washable. So it is quite suitable for making dress material. Terylene is a popular polyester. It can be drawn into very fine fabric fibres. That can be woven like any other fibres. This fibre blends well with natural fibres. Terylene is often mixed with cotton to make terricot and with wool to give terriwool. Like nylon, pure polyester or terylene easily catches fire.

Polyester is made by reacting dicarboxylic acid with dihydric alcohol. Polyester can be melted and spun. This property allows the fibre to convert into different shapes, sizes. Polyester fibres of these days are ultra thin, microfibers which gives them a smoother, softer feel than the polyester of twenty years ago. This base material can be used to make not just fibres for fabric but many other things: from soda bottles to boats.

Have you seen or heard of PET bottles? PET is a very familiar form of polyester. It is used for making bottles, utensils, films, wires and many other useful things.



## Activity-6

### How can you say a bottle is PET bottle?

Collect different kinds of water bottles of your classmates and look at them carefully. Do you observe any triangle shaped symbol at the bottom of the bottle or on the brand label sticker? What number is marked in the center of the triangle? Look at figure 9 You will find that many of the bottles will have 1 in the center of the triangle. If it is 1, then it is a PET bottle.

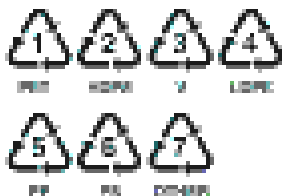


Fig-9 : Resin identification codes

Code No.s

1. Polyethylene Terephthalate (**PET, PETE**)
2. High Density Polyethylene (**HDPE**)
3. Vinyl (**Polyvinyl Chloride or PVC**)
4. Low Density Polyethylene (**LDPE**)
5. Polypropylene (**PP**)
6. Polystyrene (**PS**)
7. **Other** (The category of “Other” includes any resin not specifically numbered 1, 2, 3, 4, 5, or 6, or combinations of one or more of these resins.)

## Activity -7

### Identification of various articles with recycling codes

Collect bottles of soft drinks (500 ml or more), bottles of juice, and containers of fruit jam, Ketchup, shampoo, **Boost or**

**Bournavita** and try to look for the triangle. You can also go to a nearby shop and request the shopkeeper to show you the bottle. What do you notice? What are these codes? What is the use of these codes? Are all bottles found with codes?

First look at the soft drinks and juices. You may observe that irrespective of the brand name, the number 1 is marked in the middle of the triangle. It indicates that it is a PET bottle. What about Boost or Bournavita bottles? There are other numbers as shown in figure 9.

- Where do you find these codes?

Explore from various sources and try to know more about coded articles.

### Do you know?

Why are soft drinks stored in these PET bottles? Soft drinks are carbonated so they should be stored in the containers with which they will not react.

### Plastics around us

Observe various articles around you, in your house, kitchen, rooms, and bathrooms. What is the most common material used in making these objects? Milk and oil pouches, containers to store pickles and rice, buckets to store water, chairs, water pipes, electric appliances, television, radio and computers, mobile phones—everything seems to be made of plastic.

Talk to the elders in your family about the materials they used in the past. Particularly, what do they think about buying

water in polythene pouches? What did they use to bring milk, oil, other liquids from shop to home in the past? What were the containers, buckets, mugs, chairs and tables used in the past made of? What do we use to make these articles?

Plastic has taken over the place that occupied by metals and wood earlier. Plastics have also replaced glass items. If we continue to write the list, it will be endless. Plastics completely occupied our life because of their characteristic properties.



**Fig-10: Articles made of plastics**

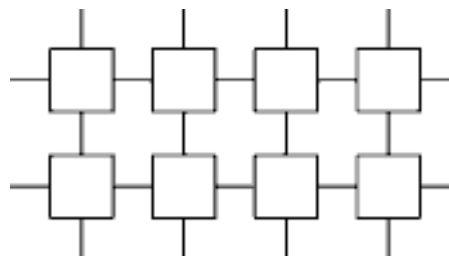
## What is plastic?

Plastic is also a polymer like many synthetic fibers we have studied so far. But the monomers in plastic can be arranged in two ways. Some are in linear chains (Figure 11 a) and others cross linked (Figure 11 b).

Plastics are available in different shapes and sizes. They have a wide variety of uses. We also observed that they have different code numbers as mentioned in activity 6. Does the arrangement of monomer units in plastics has any relation for this diversity in plastics?



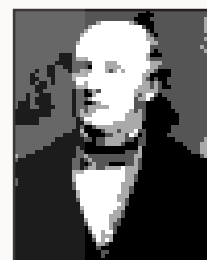
**Fig-11(a): Linear arrangement of monomers**



**Fig-11(b): Cross-linked arrangement**

### ? Do you know?

**Alexander Parkes (1813-1890)**- Creator of first man made Plastic - "Parkesine"



One of many triumphs of modern

science which is completely encompassed the day to day life across the world is invention of plastics. The synthetically produced material was first presented in 1862 in London by Alexander Parkes. To prepare this material Parkes heated nitrated cotton which previously soaked in sulfuric acid and made fabric soft and elastic with oil and camphor. The end product was an ivory – colored material that became distorted when subjected to heat. This is named as **Parkesine**. Based on these initial efforts plastic evolved as main base for many modern materials. But at that time people were not interested on this alternative to natural substances. Now it is the basis for all the modern materials.

## Activity-8

### Types of Plastics

Let's take two bottles made up of plastic. One is **Tupperware** and another ordinary. Pour some hot water in both. What changes do you notice? Have you experienced such instances in your daily life (Figure 12)? See the code of the bottle that gets deformed?

Plastics which get deformed easily on heating and can be bent are known as **thermoplastics**. Some of the thermoplastics are polythene and PVC. These are used in manufacturing toys, combs and various types of containers.

There are some plastics which molded once can't be softened by heating called as **thermosetting plastics**. Bakelite and melamine are examples for this type. Now can you tell whether Tupperware is thermosetting plastic or thermoplastic?

Thus we can conclude that different types of plastics have different properties. Plastics are easily moldable, and can be converted into any shape, can be recycled, reused, coloured, melted and rolled into sheets and wires. Do all kinds of plastics show above properties? Let us see.



Fig-12  
deformed bottle



### Lab Activity

**Aim:** Identifying thermoplastic and thermosetting plastics by flame test.

**Materials required:** Tong, spirit lamp, samples of plastics (Collect small pieces of plastics from the objects like comb, tooth brush handle, plastic bucket, handle of utensil, and electric switch, piece of melamine of meals plate and coffee mug)

#### Procedure:

- Take a spirit lamp and light it.
- Clamp one piece of plastic sample say piece of tooth brush with tong.
- Place the sample on spirit lamp flame. See fig. 13.
- Observe the changes during the burning of sample.
- Note your observations, like whether sample is being softened or burnt with smell or become hard etc.
- Repeat procedure with other samples.
- Record your observations sample wise in the following table - 5

**Note:** While doing this activity if needed cover your nose and mouth with a mask to avoid breathing of fumes. And also keep yourself away from spirit lamp flame when you put sample on the flame by stretching your hand.



Fig-13: Conducting flame test

Table-3

Sl.no.	Name of the plastic sample	Softened/burnt with burning smell and become hard	Thermoplastic/thermosetting plastic
1.	Tooth brush handle		
2.	Comb		
3.	Piece of bucket		
4.	Handle of utensil		
5.	Electric Switch		
6.	Meals plate		
7.	Coffee mug		

In the above activity we have taken the known samples and tested. If unknown samples are given how do you decide whether it is thermoplastic or thermosetting plastic?

If you burn a piece of wood, paper, clothe, steel rod do you notice similar observations as like plastic material. How are they different from plastics?

Based on the observations can you write a note on the properties of thermoplastics and thermosetting plastics?

### Thermoplastic

This is a plastic which will soften when heated and harden when cooled. A thermoplastic is a polymer that turns in to a liquid when heated and freezes to a very

### Do you know?

Hermann Staudinger (1881-1965) :

Hermann Staudinger a German Chemist , in 1920 made an important step forward in the processing of synthetic materials when he developed thermoplastics which are stable in themselves. Hermann Staudinger won Nobel Prize in 1953 for demonstrating that **Polymers are long-chain molecules.**



glassy state when cooled sufficiently.

### Thermosetting Plastics

Thermosetting plastics are simply plastics when moulded into a shape and allowed to cool down will remain in moulded form and will not change their shape. When heated again they will char or burn. Thermosetting plastics are synthetic materials which gain strength during moulding by heating, but cannot be re moulded or reheated after their initial heat, moulding. Thermoseting plastics are not re-mouldable. Strong cross links are formed during the initial moulding process that gives the material a stable structure. They are more likely to be used in situations where thermal stability is required. Where do we use this type of plastics?

Observe the kitchen ware in your house or visit any home appliances shop. What do you notice? Is all kitchen ware totally made up of metal? With what materials are the handles of utensils made? Utensils are made of metals like aluminum, copper or steel. Then what is the additional material? Bakelite is used for making handles of various utensils due to its poor conductivity of heat and electricity. It is also used for making electrical appliances including switch boards. Bakelite is used

as an alternative for pearl and jade. You can see the Bakelite made articles in figure 14.



**Fig-14: Articles made of Bakelite**

The other thermosetting plastic, Melamine used for making kitchen ware. Utensils and other grocery of kitchen are made by melamine. It is also used for making of floor and dress material for their nature of fire resistance. Computer and TV cabinets are made by melamine. *Now List out the melamine products in your house.* You can see few melamine articles in figure15.



**Fig-15: Articles of Melamine**

### Why do we prefer plastics?

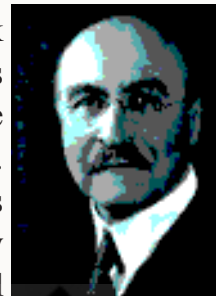
**Plastics are non-reactive:** You might have experienced that iron gates and nails exposed to atmosphere, soon get rusted. But does this happen to plastic articles? Plastic material will not corrode easily. That's why they are used to store various kinds of materials including chemicals.

Plastic is very light, strong, durable and can be moulded into different shapes and sizes. Plastics are generally cheaper than metals

### Do you know?

#### Father of Plastic Industry

A Belgian scientist named Dr. Leo Hendrik Baekeland was responsible for the invention of Bakelite. In 1907 he was working as chemist by



accident he discovered the compound of carbolic acid and formaldehyde. When he tried to reheat the solidified compound he discovered it would not melt, no matter how high the temperature would be. Dr. Baekeland is considered as the father of the present plastics industry.

#### Hot Pin Test

To test if a piece is Bakelite, get a very very hot pin from an open flame source, then touch the pin to the item. If it is Bakelite it will not penetrate. It may give off the acid smell and it may leave a purple burn mark. If the pin penetrates or melts the plastic then it is not genuine Bakelite.

Why do electrical wires have plastic covering? You might have seen pans, pressure cookers and screw drivers handles. Why are they made of plastic? Plastics are poor conductors of heat and electricity.



### Think and Discuss

- Certain fry pans are said to be non-stick. What made them as non-stick.?
- Firemen wear dress which does not catch fire. What type of fabric is it made of?

## Plastics and environment

You must have seen garbage (waste) dumps. Some articles there seem to remain for a long time while some other disappear. You may notice that most of the material that does not disappear are the polythene bags. Polythene is a plastic. It is mainly used for making carry bags.

The polythene bags thrown around are responsible for clogging drains. Animals in urban areas, particularly cows, eat polythene bags containing food material. Can you imagine the consequences? See the Fig-16 and read the comments of Supreme Court of India about effect of plastic on environment.



**Fig-16: Plastic bags found in the stomach of cow after a postmortem**

With the direction of Supreme Court, very thin polythene bags have been banned to stop indiscriminate usage of polythene bags. What is the difference between the banned polythene bags and the bags using presently in place of previous? What do you notice on that bags?

Some efforts are taking place to reduce negative consequences of plastics on the environment.

If we burn plastics, it creates a lot of air pollution.

***“Plastic bags are more danger than atom bomb for future generations”:  
Supreme Court of India.***

*“Excessive use of plastic bags and their unregulated disposal has been choking lakes, ponds and urban sewerage systems, the Supreme Court said while warning that it posed a threat more serious than the atom bomb for the next generation. Andhra Pradesh-based NGOs drawing the court’s attention to 30-60 kg of plastic bags recovered from the stomachs of cows because of irresponsible disposal of plastic bags and defunct municipal waste collection system. But the bench wanted to address the larger questions arising from indiscriminate use of plastic bags, which not only posed a grave threat to nature and environment but also to the human race itself. “All of us are watching how our lakes, ponds and urban sewerage systems are getting choked by plastic bags. Unless we examine a total ban on plastic bags or put in place a system for manufacturers mandating them to collect back all plastic bags, the next generation will be threatened with something more serious than the atom bomb,” Justices Singhvi and Mukhopadhaya said. Large quantities of water packed in plastic pouches, which were thrown around in undisciplined and uncivil manner across the country every day. “A rough estimate shows more than 100 million water pouches are thrown all over the cities and towns,” the bench said”.*

## Activity-9

### Biodegradable – Non-bio degradable

Let's take peels of fruits and vegetables, leftover food stuff, waste paper, cotton cloth and plastic bag. Keep this material in a pit. List the material which remain a long time and those that disappear quickly.

Table-4

Type of waste	Approximate time	Change
Peels of fruits and vegetables		
Leftover food stuff		
Waste paper		
Cotton cloth		
Plastic bag		

You observe that certain materials can break down into smaller fragments in the presence of water, sunlight and oxygen. These fragments get further broken down by bacteria. This is called decomposition. A material which is easily decomposed by natural process is called bio-degradable, and one which is not decomposed by natural processes is called **non-bio degradable**.

The time taken for decomposition depends upon whether a material is bio-degradable or not. Explore various sources of material to know the time required for them to decompose.

Plastics take several years to decompose as compared to other materials like peels of fruits, vegetables and waste

food stuff which decompose within a short period. Slow decomposition causes environmental pollution. The burning process of synthetic material is also very slow and can't be burnt completely. The process of burning, releases a lot of poisonous fumes into air causing air pollution. So it is better to avoid or minimize the use of plastics. Make a list of some occasions where you can avoid the plastics and use alternatives.

Note : Explore various resources to know approximate time taken for the decomposition of various materials including plastic.

### Reduce, Recycle, Reuse and Recover – 4R principle

Can we avoid using plastics altogether? The entire civilization is enveloped with them. Every walk of life is linked with plastics. Now you can understand that you cannot avoid use of plastics completely but we can reduce, recycle, and reuse plastics and avoid indiscriminate uses of plastics. We can also adopt recovery mechanisms to convert waste in to a usable resource. Let us discuss about **4R** principle for creating an eco friendly environment.

#### Reduce

What do you observe when you attend a marriage or function? What plates they use to serve food? By which type of glasses for the drinking water is supplied? What containers do they use to serve sweets and ice cream? What are the spoons made up of? Everything is made of plastic. Imagine how much plastic garbage will be accumulated in this single function. Is there a way to stop this "Use and throw"

culture? Discuss and write the ways and means where we can reuse the plastic and reduce the usage of plastic to avoid its negative consequences on environment. Land filling of plastics and burning of plastics in incinerators is the other way of disposal of plastics. They too have negative consequences. Therefore we should use plastic with great care and also reuse it and reduce its usage whenever it is possible.

## Reuse

Have you observed that when we go to market to buy something we go without any bag? With the result that we come back with lot of plastic bags. Every time we go to market, we accumulate lot of plastic bags. Some of these can be used again and again. Are we doing so? Articles made of plastics may be used again and again for its optimum utilization. This should be every body's concern for an eco friendly environment. If anything you feel now out of fashion and you want to buy a new one, give it to others instead of putting it idle at home or throwing it out. Can you give certain instances where we reuse plastics?

## Recycle

You might have noticed your mother selling old plastic articles which are broken and not useful, to the local vendor. What will they do with that? They collect all plastics from the households and send it for recycling. From this recycled plastic new products are prepared, after giving it a proper treatment.

- Are all types of plastics recyclable?

There are 60,000 types of plastics available in the world as on today (the synthetic fibers that we discussed are also plastics). There are only 6 from these 60,000 that we use regularly. We have seen that each of these six plastics is given a code. These codes help us in recycling.

PET (code 1) and HDPE (code -2) are commonly recycled. But LDPE (code - 4 used for carrier bags) is not recycled commonly. Similarly PVC (code-3) which is used for pipes are currently not recycled. The PS (code -6), used for making coffee cups, egg boxes, packing peanuts and "take out" food packing can be recycled. Recycling can be used to obtain materials from which the original products were made.

## Recycling code

In activity 7 we raised certain questions regarding recycling symbol code and its use. Now let us discuss them in this section.

The Society of the Plastics Industries, Inc. (SPI) introduced its voluntary resin identification coding system in 1988 to assist recycling programs. The SPI coding system offered a way to identify and sort the resin content of containers commonly found in the household waste stream. Plastic household containers are marked with a number that indicates the type of resin, or plastic as shown in fig-9.

To identify the plastic, look at the recycling icon, the chasing arrows. Inside the arrows, these will be a number that



identifies the polymer. When the number is omitted as seen in the figure 17, the symbol is known as the **Universal Recycling Symbol**, indicating generic recyclable materials.



*Fig-17: Universal recycling symbol*

### **What is role of codes in recycling process?**

Each plastic is manufactured with different processes. During recycling process if same codes are not sorted out separately the whole lot meant for recycle will spoil the process. Therefore it is essential to recycle the same codes in one lot. If you add a simple PET bottle in the lot of others plastics during recycling process, the entire lot will be spoiled.

### **Uncoded plastics**

Are all the plastics having resin indemnification code on it? Plastic tarps, toys, computer key boards and many other

products simply do not fit in the coding system adopted for recycling. Wide variety of plastic materials are made to suit the needs of consumer by using different varieties of plastic resins or mixtures of resins. Is it possible to code thousands of plastic varieties? Recycling of various types of plastics is not commercially viable because their production when compared to coded plastics is less. Code 1 and 2 plastics occupy major share in recycled plastics.

### **Recover**

Supreme Court gave a judgment on ways and means of solid waste management and gave order to implement this in all the cities of India by 2003. In the solid waste garbage of municipalities plastic occupies major share. The principle of recover plays major role in this solid waste management. The solid waste should be converted into resources such as electricity, heat, compost and fuel through thermal and biological means. Is any such efforts for solid waste management is taking place in your village/town.? How do you appreciate 4R principle?



### **Key words**

*Acrylic, artificial fibre, Bakelite, biodegradable, blend, cellulose, incinerators melamine, natural fibres, non-biodegradable, nylon, petro chemicals, plastics, polymer, polyamide, polythene, polyester, rayon, recycling, silkworm, spinneret, synthetic fibre, terricot, terylene, terriwool, thermoplastics, thermosetting plastics, universal recycling symbol.*



## What we have learnt?

- Synthetic fibres are made of very large units called polymers.
- Rayon is an artificial silk made up of cellulose fibre.
- Nylon is made artificially by using raw material like coal, water and air
- Polyester is a synthetic fibre.
- Acrylic is artificial wool made from coal, air, water, oil and limestone.
- Petro chemicals are used to manufacture synthetic fibres.
- Commonly used synthetic fibres are rayon, nylon, polyester and acrylic.
- The different types of fibres differ from one another in their strength, water absorbing capacity, nature of burning, cost, and durability.
- Synthetic fibres and plastics enveloped our life.
- The waste created by plastics is not environment friendly.
- Plastics take years to decompose.
- Enjoy the good qualities of synthetic fibres and plastics and reduce the indiscriminate use of plastics to minimize environmental hazards.
- Synthetic fibres find uses ranging from house hold articles to healthcare.
- Synthetic fibres blend with natural and artificial fibres.



## Improve your learning

1. Take hair, wool, silk, paper, cotton thread, piece of plastic, thread of sweater, piece of rope and carefully conduct a flame test. Based on smell and type of melting classify them as natural, artificial fibres. (AS<sub>1</sub>, AS<sub>3</sub>)
2. How synthetic fibres changed our everyday life? (AS<sub>7</sub>)
3. Explain why some fibres are called synthetic? (AS<sub>1</sub>)
4. Prepare a table of various synthetic fibers which are used to make household articles from them? (AS<sub>4</sub>)
5. Nibha wants to buy clothes to parents for winter wear. What type of clothes would you suggest? Specify reasons? (AS<sub>7</sub>, AS<sub>1</sub>)
6. Give reasons why plastic containers are used as storage devices? (AS<sub>1</sub>)
7. Explain the differences between the thermoplastics and thermosetting plastics with help of a diagram explaining in terms of arrangements of monomers? (AS<sub>1</sub>, AS<sub>5</sub>)
8. Classify following materials which can be recycled or not. (AS<sub>1</sub>)

*Plastic toys, electrical switches, plastic chairs, ball point pens, telephone*

- instruments, plastic containers, cooker handles, plastic bottles, carry bags, tumblers, tooth brush, plastic chapels', plastic plates, plastic buckets (AS<sub>1</sub>)*
9. If electric switches are made by thermoplastics what would happen? (AS<sub>1</sub>)
  10. Thermoplastics are eco friendly than thermosetting plastics. What do you say? Why? (AS<sub>1</sub>)
  11. Prepare a chart which can explain recycling codes, full name and acronym of plastic and its usage for various household articles, recycled or not, if recycled what will be made from that? (AS<sub>3</sub>)
  12. If plastic is not properly disposed, what could be the consequences? (AS<sub>7</sub>)
  13. Explain following. (AS<sub>1</sub>)
    - a) Blending    b) Biodegradable    c) Recycling    d) Decomposition
  14. Match the following. (AS<sub>1</sub>)
    - i) Polyester    (a) kitchenware
    - ii) PET (b) artificial silk
    - iii) Rayon    c) many monomers
    - iv) Nylon    d) electric switches
    - v) Melamine f) Code 1
    - vi) Polythene g) popular dress material
    - vii) Bakelite    h) stronger than any fiber
  15. Fill in the blanks. (AS<sub>1</sub>)
    - i) Synthetic fibres are called as \_\_\_\_\_ fibres.
    - ii) Synthetic fibres are synthesized from raw material called \_\_\_\_\_
    - iii) Like synthetic fibre, plastic also \_\_\_\_\_
    - iv) Clothing labels are \_\_\_\_\_
      - a) Required by law    b) Identify fabric content
      - c) Both a and b    d) None of the above
    - v) Rayon is made of
      - a) Coal    b) Oxygen    c) Flax d) Cellulose
    - vi) A silk fiber's smooth surface absorbs light
      - a) yes    b) no    c) can't say
  16. Introduction of synthetic fibres in the textile industry brought revolutionary change across the world in the dressing patterns irrespective of culture and customs. How do you appreciate this? (AS<sub>6</sub>)
  17. Indiscriminate usage of plastic is a serious threat to bio-diversity. What are the efforts of Government and Non-Government organization in this regard? (AS<sub>7</sub>)
  18. Where do we use the process of recycling? How is it useful? Give examples.