MATERIALS

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Different things contain different kinds of matter. All these different kinds of matter may be called by a common name materials.

CLASSIFICATION OF MATERIALS

- **Natural Materials :** The materials which occur in nature and used as such are called natural materials.

  For example, Wood, Cotton, Coal, Graphite, Diamond and many minerals of metals and non-metals are natural materials. The man-made materials are also called synthetic materials.

- The materials obtained from natural materials (also called raw materials) by chemical processes are called man-made materials.

SYNTHETIC MATERIALS

The synthetic or man-made materials are of following two types :

(i) Synthetic Plastics (ii) Synthetic Fibres

SYNTHETIC PLASTICS

We are probably passing through the plastic age. Almost everything around is made of one or the other kind of plastic. Here we describe some commonly used plastic materials.

A synthetic material which can be easily moulded into any desired shape on heating is called a plastic. Plastics are synthetic (man-made) actually polymers.

Some common plastics are,

(i) Bakelite (ii) Nylon

(iii) Terylene (iv) Polythene

(v) Polyvinyl chloride (PVC) etc.

Kinds of Synthetic Plastics

Plastics are of two types, viz . : (i) Thermoplastics (ii) Thermosetting plastics

- **Thermoplastics :** A plastic which can be softened on heating and moulded repeatedly in the desired shapes is called a thermoplastic. PVC, Polystyrene, Nylon, Polythene are some common thermoplastics. Thermoplastics are good for making pipes etc.
- **Thermosetting Plastics :** A plastic substance which once moulded into a shape cannot be softened or melted on reheating is called a thermosetting plastic. Thus, thermosetting plastics can be processed only once and

cannot be reprocessed. This is due to the formation of cross-links between the adjacent polymer chain on heating.

Bakelite, Melamine-formaldehyde are common thermosetting plastics.

- Thermosetting plastics are suitable for making handle of pressure cooker etc.

◈ **Difference between thermosetting plastics and thermoplastics**

Thermosetting plastics and thermo-plastics differ from each other in many ways.

S.No.	Thermosetting plastic	Thermoplastic
1.	Thermosetting plastics are the polymers in which chains get highly cross-linked on heating.	Themoplastics are long chain polymers with no cross-linking. Heating also does not produce any cross-linking between the chains.
2.	Once molulded, thermosetting plastics cannot be reprocessed. Example : Bakelite, Melamine-formaldehyde resin.	Thermoplastic can be processed repeatedly. Example : Polythene, PVC, Polystyrene, Nylon, Polyesters, etc.

➢ RAW MATERIALS FOR MAKING SYNTHETIC PLASTICS

All synthetic polymers are obtained from small organic molecules or from their suitable compounds. These small molecules are obtained from petroleum, and natural gas.

For example, the compounds which are used as raw materials for making synthetic polymers/synthetic fibres / synthetic plastics are :

- Methane
- Methanol
- Ethane
- Ethanol
- Ethene
- Propene
- Ethyne
- Butene
- Vinyl chloride etc.

➢ SOME COMMON SYNTHETICS PLASTICS AND THEIR USES

Some common synthetic plastic of general use are described below :

◈ **Polythene (or polyethylene)**

Polythene (or polyethylene) is obtained from ethylene ($CH_2 = CH_2$) under high temperature, high pressure and in the presence of a catalyst.

Properties

- Polythene is a thermoplastic polymer. So, it can be moulded into any shape and any number of times.
- Polyethene is a whitish, translucent material.
- It is light weight and can be transported easily.
- It is unbreakable, corrosion-resistant, tough and flexible.
- It is not affected by acids, alkalies and most organic solvents.
- It is an insulator that is it does not allow electricity to flow through it.
- It is impermeable to water.

Uses : Polythene is used

- for making sheets, sachets for packaging.
- for making containers for storing water, oil and other materials.
- for making pipes for transporting water and other liquids.
- for water proofing.

◈ **Polyvinyl chloride (PVC)**

Polyvinyl chloride (PVC) is also a thermoplastic. It is obtained by the polymerisation of vinyl chloride. PVC is tougher than polythene.

Uses : Polyvinyl chloride is used

- for the manufacture of rain coats, hands bags, plastic dolls, bathroom curtains etc.
- for manufacturing flooring and floor / ceiling tiles.
- as an insulation cover in electrical wires / cables.
- for making shoe-soles, and shoes.

Polystyrene

Polystyrene is obtained from the monomer styrene ($C_6H_5 - CH = CH_2$). Polystyrene is a thermoplastic. It is lighter than polythene. Polystyrene is a highly transparent polymer.

Uses : Polystyrene is used

- for making hot drink cups, toys, household articles, etc.
- as safe packaging material.
- for making styrofoam (or thermocole).
- as an insulating material.

Acrylic (or perspex)

Properties :

- It is a highly transparent plastic resembling glass.
- It is soft and can be scratched.
- It dissolves in organic solvents.

Uses : Acrylic is used

- for making lenses, aircraft window screws
- for making transparent domes and skylights.

Teflon

Teflon (PTFE) is a polymer of tetrafluoroethylene.

Properties

- is quite inert. Almost all chemicals has no effect on it.
- has very high melting point.
- has very low friction.

Uses : Teflon is used

- for making non-stick cookware.
- in chemical industry as corrosion proof coating.

Bakelite

Bakelite is a thermosetting polymer. Once set into a shape, bakelite does not melt/soften and retains its shape. Bakelite is obtained by reacting phenol with formaldehyde in the presence of a catalyst.

Properties

- Bakelite is hard and stiff.
- Bakelite is an insulator.

Uses : Bakelite is used

- for making electrical switches and plugs.
- for making gear wheels and table top laminates.
- for making combs, fountain pen bodies, phonograph records

Melamine

Melamine is also a thermosetting polymer. It is hard and a high polish polymer. Melamine is used for making unbreakable dinnerware, and decorative objects.

SYNTHETICS CLOTHING MATERIALS: SYNTHETIC FIBRES

A fibre is a thread-like (thin and long) material. Broadly, fibres can be classified into the following classes.

- **Naturally-occurring fibres :** Cotton wool, silk fibres and naturally-occurring fibres.
- **Synthetic fibres :** Rayon, Nylon, Terylene are synthetic (man-made) fibres.

In this section, we will describe the synthetic fibres, or synthetic clothing materials.

Rayon

Rayon has a silky texture. Therefore rayon is also known as artificial silk. Rayon is made from cellulose obtained from wood pulp.

Cellulose is soaked in a 20% sodium hydroxide solution for about 3 hours. The purified cellulose is then treated with carbon disulphide (CS_2) to get a pale-yellow syrup-like liquid called viscose.

This viscose solution is forced through fine pores in a metal cylinder kept inside a dilute sulphuric acid bath.

Here, cellulose is regenerated in the form of lustrous continuous fibre, called rayon.

Uses : Rayon is used

- In the textile industry for making fabrics.
- In the manufacture of carpets.
- for the manufacture of type cord.

Nylon

Nylon is a synthetic polyamide fibre. In this respect, nylon resembles silk and wool. Silk and wool are natural polyamide fibres.

Properties

- Nylon fibres are very strong.

- Nylon fibres are elastic.
- Nylon can be drawn into very thin fibres.
- Nylon does not absorb water.
- Nylon is wrinkle resistant.
- Nylon is abrasion resistant.
- Nylon is abrasion resistant.
- Nylon is not attacked by fungus, moth etc.
- Nylon is insoluble in all common solvents.

Uses : Nylon is used

- for the manufacture of tyre cords, fabrics and ropes.
- for making fishing nets and parachute ropes.
- for fabricating sheets, bristles for brushes.
- for making sarees, socks, neckties.
- for making elastic hosiery.
- for making machine parts.

◈ Polyesters

Terylene, Decron, and Terene are polyesters fibres. Polyesters are made from petroleum products.

Properties

- Polyester fibres are quite strong. So, the fabrics made from polyesters last longer.
- Polyester fibres absorb very little water. Therefore, clothes made of polyester dry quickly after washing.
- Polyesters are wrinkle resistant. Therefore, the fabrics made from polyesters retain their crease.

Uses : Polyesters are used

- for manufacturing sarees, dress materials, curtain cloth etc.
- for making blends with other fibres e.g., terylene with cotton gives terycot, with wool it gives terywool. Clothes made from blends are more comfortable to wear.
- for making sails for sail boats.
- for making water hoses for fire fighting.
- for making conveyer belts.

◈ Acrylic fibre

Acrylic fibre has a feel similar to that of wool. It is used for making sweaters, shawls, blankets and carpets.

➢ GENERAL CHARACTERISTICS OF SYNTHETIC PLASTICS/FIBRES

Synthetic polymers (or synthetic plastics) show the following general characteristics.

- **Light weight :** Synthetic plastics are much lighter in weight as compared to wood, metals etc.

  Synthetic fibres are much lighter than natural fibres such as cotton, jute, wool etc.
- **Toughness or Tensile strength :** Synthetic plastics vary in their tensile strength from material to material. In general, synthetic plastics have much less toughness as compared to metals and alloys like steel.

  Synthetic fibres have very high tensile strength as compared to the natural fibres such as cotton, silk, wool, jute etc. as compared to the natural fibres such as cotton, silk, wool, jute etc.
- **Insulating property :** Synthetic plastics/synthetic fibres are insulators. These do not allow heat and electricity to flow through them.
- **Reactivity towards air and water :** Synthetic plastics / synthetic fibres are not affected by water, air, soil etc. Thus these are biodegradable.
- **Chemical reactivity :** Synthetic plastics / synthetic polymers are not affected by acids and alkalies. The natural polymers such as cotton, wool etc. are damaged by acids and alkalies.
- **Appearance and workability :** Most plastics (except bakelite, melamine etc.) are transparent / translucent. These can be coloured in any colour and be given any shape.