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VIII

Science

Synthetic Fibres and Plastics

1. What are Synthetic fibres?

Ans. The artificial fibres that are man-made are called Synthetic fibres. They are made in laboratories using petroleum products and coal as raw materials.

Semisynthetic fibres are prepared by chemical synthesis from natural materials.

2. Define:

i) Monomers - It is a simple unit of a given chemical molecule. Eg. the monomer of cotton is a simple molecule of ~~glucose~~, ~~cellulose~~ glucose.

ii) Polymer - It contains molecules of the same substance joined together to form a long chain or a bigger molecule. Eg. the monomers of cotton i.e. glucose are joined together to form polymer of cotton i.e. cellulose.
Haemoglobin is a protein formed by joining many amino acid.

iii) Plasticity - The property by virtue of which a substance can be moulded into various forms is called plasticity. The substance by itself is called plastic.

iv) Polymerisation - The process by which artificial fibres are made from simple molecules is called polymerisation.

3. Write short note on polymers?

Ans. Polymer (Greek word - poly means many and meros means parts) is a large molecule comprised of repeating structural units (monomers). Monomers are either linked in a linear fashion or in a cross-linked fashion.

Polymers may be inorganic or organic. Most of the polymers are carbon compounds. Polymers are tough and strong. Eg. Jute, Cotton, silk, wool, nylon, rayon etc. Polymers are of two types: Natural - like jute, cotton and Synthetic - like rayon, nylon.

Synthetic polymers can be classified into fibres and plastics.

4. Describe the general characteristics of synthetic fibres.

Ans. Synthetic polymers have better qualities than natural polymers on the basis of:

- i) tensile strength
- ii) resistant of chemical
- iii) resistant to water
- iv) are very strong
- v) synthesized chemically.

5. Describe the various types of synthetic fibres?

Ans. The various types of synthetic fibres are:

i) Rayon (Artificial Silk)

It is made from pure cotton or wood cellulose. It is sometimes called regenerated fibre because it is produced by modifying the natural fibre. Three varieties are viscose, cupro and acetate rayon. It is cheaper than silk and can be dyed.

Properties

- a) It absorbs sweat, so it is preferred in summer.
- b) It is shiny and lustrous and resembles silk in appearance.

Uses

- Rayon is used for making shirt, ties, home furnishing and for making reinforced automobile tyres.
- It is mixed with cotton to make bed linen and mixed with wool to make carpets.

ii) Nylon (Polyamides)

in 1931

First true synthetic fibre made from coal, water and air at DuPont Company. Nylon (Ny - New York, Lon - London). First used to make parachute in world war II.

Properties

- a) It is elastic and does not lose strength even after repeated use.
- b) Strong and water resistant. Nylon thread is stronger than steel wire.
- c) It is lustrous and easy to wash.

Uses

- a) Nylon is used for making sails, socks, stockings, tents, umbrellas, parachutes and tarpaulins.
- b) Nylon fibres are used for making toothbrush bristles.
- c) Nylon threads are used for making fishery nets, climbing

ropes and strings of badminton and tennis racquets.

iii) Polyesters

Esters are the compounds formed, when alcohol is made to react with organic acids, such as acetic acid, phthalic acid. The esters have fruity smell. The ester molecules can be polymerised to form polyester.

Terylene or Terene or Dacron polymers are obtained by polymerising the molecules of phthalic acid and ethene glycol.

There are number of varieties of esters, depending upon the alcohol and the organic acid used to form the molecules of ester.

Polyester is blended with natural fibres to improve its properties. Terrycot \rightarrow Terylene + cotton, has better absorbing power. Terylene + wool \rightarrow Terry wool, which is warm. Terry silk

Properties

- It is strong, lightweight, and has good elasticity
- It resists wrinkling
- Polyester fabrics can be washed and dried easily.

Uses

- Making light weight sails
- Polyester films (called Mylar) are used for making magnetic recording tapes in audio cassettes, video cassettes, etc.
- To make conveyor belts as it is very elastic
- Terrycot is used for making shirts, skirts etc.
- Terry wool is used for making formal suits.
- PET (polyethylene terephthalate) is actually a polyester.

iv) Acrylic

Acrylic fibres, also known as Oxlon and Acrilan, closely resemble wool. It is light, soft and weather resistant.

Acrylic fibre is obtained by the polymerisation of molecules of acrylonitrile.

Acrylic fibres account for about 50% of all synthetic fibres. Nylon is the second major synthetic fibre.

Properties

- It is warm, soft, light and flexible
- It is resistant to moths and chemicals

Uses

- For making sweaters, socks, shawls, carpets, blankets.
- v) Spandex

Spandex, also known as Lycra, was invented by the Dupont. It is a long chain fibre.

Properties

It has excellent elasticity, which makes it suitable for use in clothes that require snug fitting. It is soft and rubber-like.

Uses

- For making swimming costumes, undergarments etc.
- For making caps, t-shirts by mixing with cotton to get stretch fabrics.

vi) Koroseal

It is a trade name of high polymer of vinyl chloride.

Uses

Koroseal is water proof as well as air proof. It is used for coating fabric of silk, rayon or cotton to make them waterproof. Waterproof fabrics can be used on rainy days or as bathroom curtains.

6. Write the advantages of synthetic fibres?

Ans. The advantage of synthetic fibres are:-

- Most synthetic fibres have good elasticity.
- Most fabric made of synthetic fibres do not wrinkle easily. They retain the pleats and folds even after washing.
- They are durable, less expensive, more readily available than those made of natural fibres.
- Most synthetic fibres can handle heavy loads without breaking.
- They have a high lustre and do not become yellow with age.
- They do not shrink and are easy to clean and dry quickly.
- They are not affected by chemicals, moisture or bacteria.
- They are thin, fine and continuous while natural fibres are short.
- They are thin, fine and continuous while natural fibres are short.
- They are thin, fine and continuous while natural fibres are short.
- They are thin, fine and continuous while natural fibres are short.



Write the disadvantages of synthetic fibres?

Ans. The disadvantages are:-

- i) They require careful ironing as they melt easily.
- ii) They absorb very little moisture. ^(hydrophobic) They become sticky when the body sweats. This drawback can be overcome by blending them with natural fibres.
- iii) They catch fire easily.
- iv) They get electrically charged in dry weather.
- v) They are not biodegradable.

8. What are plastics? Name its types?

Ans. Like synthetic fibres, plastics are also polymers but they are of very high molecular mass. They are generally not affected by acids or alkalis.

In plastics, the arrangement of the individual units may be linear  or cross linked . Cross linked polymers have side chains which connect different polymer chains.

Plastics are of two main types: thermoplastics and thermosetting plastics. Special plastic cookware is used in microwaves, which heats the food without getting damaged.

9. Write various types of thermoplastics and their uses?

Ans. Thermoplastics are formed by linear and lightly cross-linked polymers. They can be melted by heating and thereafter moulded into desired shapes. This is a reversible process.

The main types of thermoplastics are:-

- i) Polythene or polyethylene
It is prepared by the polymerisation of ethene gas. It is tough but flexible and strong. Polythene which has been moulded into desired shapes soften again on heating, but regains its properties on cooling. Because of this property, it is classified as a thermoplastic. It is chemically almost inert, and is water resistant. It is insoluble in all kinds of solvents, and is poor conductor of electricity. It is not biodegradable.

Uses

- It is used for making thin films which are used for making carry bags, adhesive tapes etc.
- It is used as insulation for electric wires.
- It is used in making food containers, bottles.
- It is used as anti-corrosion coating on the articles made from iron or copper.

ii) Poly styrene

It is a lighter polymer of polythene. When air is blown through molten polystyrene, it forms a very light foam called Thermo col. It is an excellent insulating and packaging material.

Uses

- It is used for making disposable cups and packaging material.
- In insulating refrigerators, making ice-box.
- Packaging expensive items, such as cellphones, TV etc.

iii) Polyvinyl chloride or PVC

It is a strong and durable plastic material. It is tougher than polythene. It is prepared by the polymerisation of vinyl chloride molecules.

Uses

- for making handbags, raincoats, decorative vinyl flooring.
- for making soles of shoes, water pipes, gramophone records.
- used as superior insulation of electric wires.

iv) Poly propylene

It is a rigid and tough plastic. It is prepared by the polymerisation of propene gas molecules.

Uses

- For making fishing nets, gloves used by surgeons.

- b) For making ropes, packaging materials and containers;
- c) For making the body of automobile batteries.
- d) For making collapsible toys.

vi) Teflon (Polytetra Fluoroethene) (1938)

It does not stick to materials easily and has a high melting point. It is very expensive.

Uses

- a) It is coated on the surface of baking or frying utensils
- b) Used as a lubricant in those parts of machine, where oil cannot be easily applied.

vii) Acrylic or Perspex

It is a clear transparent plastic used to replace glass in some situation. It is soft and easily scratched. It also dissolves in organic solvents.

Uses

- a) transparent material in place of glass
- b) synthetic textile fibre.

viii) Celluloid

It is a commonly used plastic which is highly inflammable. It is used for making photographic films, combs, soap boxes etc.

ix) PET (Polyethylene terephthalate) is actually a polyester

Making containers for microwave cooking, bottles of carbonated beverages and other food containers.

x) HDPE (High-density polyethylene)

Making containers for strong and corrosive household and industrial chemicals like bleaches and acids.

xi) LDPE (Low-density polyethylene)

Making polybags, grocery bags, and packaging of food and bread.

10. Describe various types of Thermosetting plastics?

Ans. Thermosets are also plastics which once set, do not soften on heating. They retain the shape of original moulding. They are harder and stiffer than thermoplastics.

Some of the thermosetting plastics are:

i) Bakelite

It is used for making electrical accessories such as plugs and switches. It is a bad conductor of electricity.

It is used for making handles of kettles and sauce pans. It is also used for making radio and TV castings.

ii) Formica

It is used to form a smooth surface on articles of furniture such as a table.

iii) Melamine

It is used for making cups, saucers and other crockery. Also to make floor tiles and fire-resistant fabrics.

11. Write the general properties of plastics?

Ans. The following properties are common to most of plastics:

i) ~~Thermoset~~ conductivity - bad conductors of heat & electricity

ii) Solubility in water - insoluble in water. Used to make bottles and buckets.

iii) Effect of flame - Most plastics are inflammable.

iv) Reactivity - do not corrode or rust. Used to make storage chemicals like acids and bleaches.

v) Plastics are chemical resistant, weather resistant, light weight, toughness or tensile strength and can be made of desired colour, texture and transparent as glass.

vi) Plastics have plasticity i.e. they are mouldable.

12. Describe the way to identify various fibres?

Ans. Various fibres can be identified by observing how they behave on burning.

Fibre	Result of burning
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i) Cotton

burns vigorously. No bead is formed

ii) Rayon

burns readily with a smell of burning paper

iii) Wool and silk

burns slowly with a smell of burning hair. No bead is formed.

i) Nylon

burns with difficulty, shrinks from flame, forms hard beads and produces a smell of burning hair.

ii) Terylene

burns with difficulty, produces black smoke on burning and forms hard beads.

iii) Acrylic

shrinks from flame forming a black bead and produces a sooty flame.

13. Describe the problems with excessive use of plastics?

Ans. Plastics are non-biodegradable. Their overuse causes such problems:

- i) Plastics along with manure get spread on the field. It reduces the water seepage into the soil.
- ii) Stray cows and other animals sometimes eat plastic carrybags. This chokes the digestive tract thereby causing death.
- iii) Plastic carrybags and other articles clog the city drainage as well as small freshwater drains.
- iv) Plastic, if burnt, produces very harmful gases.
- v) Plastic waste becomes a home for many disease-causing germs.

14. Write the measures to control the problems caused by plastics?

Ans. The measures are:

- i) Use bags made of cloths to avoid plastic bags.
- ii) Do not throw plastic wastes at roadside or in water bodies.
- iii) Biodegradable wastes like food items should be thrown in the green bin. Recyclable wastes like plastic and glass should be thrown in the blue bin.
- iv) Polyester soft drink bottles could be melted down and the resulting material could be spun into fibres.
- v) Scientists have been able to make environment-friendly biodegradable bioplastics from natural materials like vegetable oil and corn starch. Bioplastics are especially useful for making disposable items like packaging and catering items. They are also trying to produce photodegradable plastic (decomposed by sunlight).

EXTRA NOTES

Rayon - also known as Art silk

Nylon - disadvantages:- discolour in sunlight or oxidizing pollutants, easily stained by foods or items containing dyes, sensitive to heat and melts on catching fire. Does not allow air to pass through it.
main nylon is Nylon 6 and nylon 6,6

Polyster - Disadvantages:- highly inflammable, not summer friendly. Best worn in winter or rainy season.

Acrylic fibres - Disadvantages:- develops fuzz (fuzz) not as warm as wool.

Other items made of acrylic are:-
Acrylic paint, Acrylic resin and transparent acrylic can be alternate to glass.
It is also used in optical lenses.

- Rayons:
- i) Viscose - cellulose + NaOH + CS₂ (carbon disulphide) = a viscous liquid;
 - ii) Cuprammonium (Cupro) - Copper sulphate (blue) + ammonia solution = cuprammonium hydroxide → this + cellulose
 - iii) Acetate - acetic acid + sulphuric acid + cellulose.

Rubbers - Natural rubber is made of latex from rubber plant.
But rubbers like neoprene, vinyl rubber and poly (butadiene-styrene) are synthesised

Raw materials for Synthetic polymers

