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SOAP, DETERGENTS AND POLYMERS

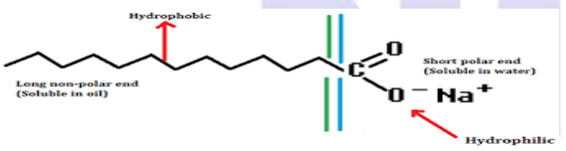
- Polymers are made from monomers linked by chemical bonds. They are produced by polymerization, and occur either naturally or synthetically. Examples of natural polymers are cellulose, shellac and amber. Biopolymers such as proteins and nucleic acids play crucial roles in biological processes.

CLEANSING AGENTS (SOAPS AND DETERGENTS)

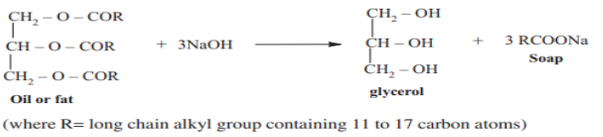
- Soap and detergent, substances that, when dissolved in water, possess the ability to remove dirt from surfaces such as human skin, textiles, and other solids.

Hydrophilic and Lipophilic Parts

- Hydrophilic group makes soaps and detergents soluble in water. The other part of the soap or detergent molecule is non polar (nonionic) that is lipophilic. The lipophilic part (a long chain alkyl or a long chain substituted aryl group) makes the molecule oil soluble.



- **Soaps:** Soap are cleansing and emulsifying agent made usually by action of alkali on fat or fatty acids and consisting essentially of sodium or potassium salts.
- **Saponification:** Saponification is the process of making soap. Saponification is done by hydrolysis of oils or fats (of vegetable or animal origin) with the help of alkali like sodium hydroxide (NaOH) or potassium hydroxide (KOH).

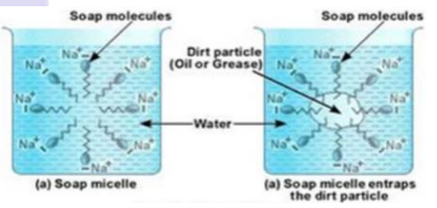


(where R= long chain alkyl group containing 11 to 17 carbon atoms)

- Synthetic Detergents: **Synthetic detergents** are composed by surfactants that mobilize organic particles in water by forming micelles, builders that facilitate the action of the surfactant by sequestering Ca2+ and Mg2+, and different softeners and fragrances.

Cleansing action of soap and detergents

- Most of the dirt is oily in nature and oil does not dissolve in water. The molecule of soap constitutes sodium or potassium salts of long-chain carboxylic acids. In the case of soaps, the carbon chain dissolves in oil and the ionic end dissolves in water.



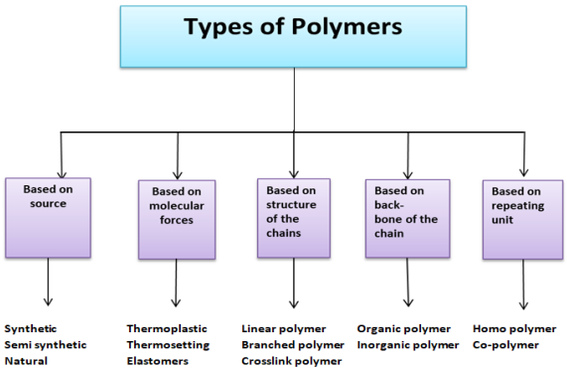
Advantages and Disadvantages of Synthetic Detergents

- Unlike soaps, **detergent** can work in hard water.
- They also have a stronger cleansing action than soap.
- **Detergents** may be used in saline or acidic water.
- **Detergent** is most soluble in water than soap.

WHAT ARE POLYMERS

- It is a very large molecule having molecular mass 103 -107 g mol^{-1}. They are formed by joining together repeating structural units, called monomers.

Types of Polymers



POLYMERIZATION

- The process by which the monomers get linked up is called polymerization. Polymerization is represented as:

$$M+M \longrightarrow \underset{\text{Dimer}}{M-M} \xrightarrow{+M} \underset{\text{Trimer}}{M-M-M} \xrightarrow{+M^{*}} \underset{\text{Polymer}}{M-(M)_n-M}$$

Where M stands for the monomer

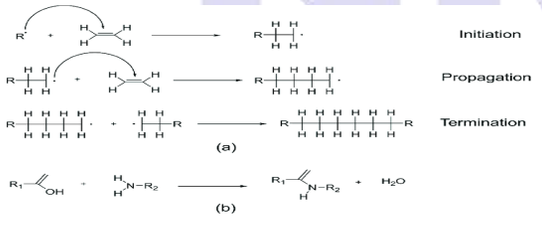
Types of Polymerization

- Depending upon the mode of reaction, polymerisation is classified as:

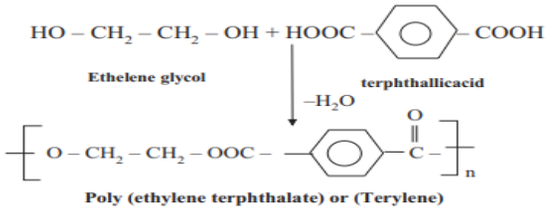
(a) Addition polymerization and

(b) Condensation polymerization.

(a) Addition Polymerization: This process involves the addition of monomer units to themselves to form a growing chain by a chain reaction mechanism. It is for this reason that the process is also known as chain growth polymerization.



(b) Condensation Polymerization: In this, the monomers combine with the elimination of a small molecule like H_2O, ROH or NH_3 etc. The reaction is called (step growth) condensation polymerization and the product formed is called condensation polymer.



CLASSIFICATION OF POLYMERS

(a) Based on Source : (i) Natural: Found in plants and animals, e.g., Proteins, cellulose, natural rubber, silk, wool.

(ii) Synthetic: Man-made, e.g., Nylon, polyster, neoprene, bakelite, te on, PVC, polystyrene.

(b) Based on Structure: (i) Linear polymers: This consist of long and straight chain repeating units, e.g., Polythene (HDPE), PVC, nylon, polyester.

(ii) Branched polymers: This contain linear chains having some branches, e.g., amylopectin, glycogen etc.

(iii) Cross-linked polymers: Strong covalent bonds are present between various linear polymer chains, e.g., Bakelite, urea-formaldehyde polymer, melamine, formaldehyde polymer etc.

(c) Based on mode of polymerization:

(i) Addition polymers: These are formed by the repeated addition of monomer molecules possessing multiple bonds, e.g., polythene, polypropene, polystyrene, PMMA (polymethyl metha crylate).

(ii) Condensation polymers: These are formed by the repeated condensation reaction of different bifunctional or trifunctional monomers with the elimination of small molecules like water

HCl, NH_3, alcohol, etc., e.g., Bakelite, nylon, polyster, urea-formaldehyde resin.

(d) Based on molecular forces:

(i) Elastomers: Forces of interaction between polymer chains is weakest, e.g., natural rubber, neoprene, vulcanized rubber.

(ii) Fibers: Strong hydrogen bonds are present between the polymer chains. They have high tensie strength, e.g., Nylon, polyster, silk, wool, orlon, rayon etc.

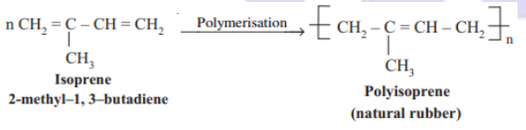
(iii) Thermoplastics: They are linear/slightly branched chains molecules capable of repeated softening on heating and hardening on cooling, e.g., Polythene, PVC, polystyrene, polypropene.

(iv) Thermosetting plastics: They are cross-linked or heavily branched molecules, which on heating undergo extensive cross-linkages and become infusible, e.g., Bakelite, urea-formaldehyde resin.

SOME COMMERCIALLY IMPORTANT POLYMERS

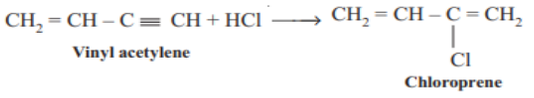
Polydiens

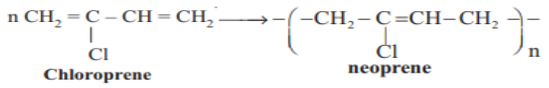
(1) Natural Rubber:



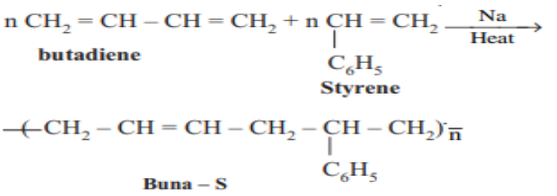
(2) Synthetic Rubbers

(a) Neiprene:

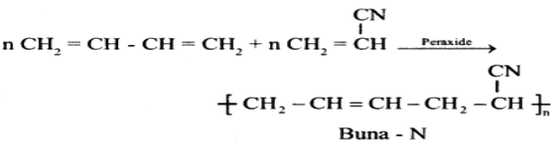




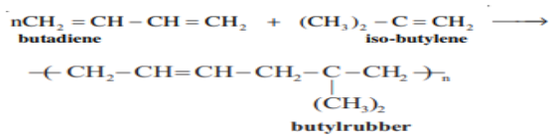
(c) Buna – S:



(d) Buna – N:



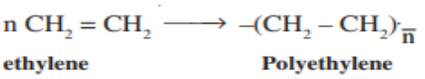
(e) Butyl Rubber: This is obtained as a result of co-polymerization of butadiene and isobutylene.



Polyolefins

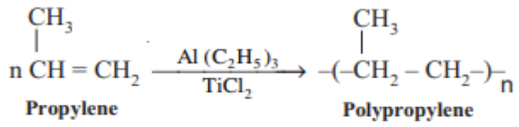
- **Polyolefins** are a family of polyethylene and polypropylene thermoplastics. They are produced mainly from oil and natural gas by a process of polymerisation of ethylene and propylene respectively. Their versatility has made them one of the most popular plastics in use today.

(1) Polyethylene or polyethene: It is formed by polymerization of ethylene (CH_2 = CH_2). It is manufactured in large quantities and is the most common polymer which you find almost everywhere.

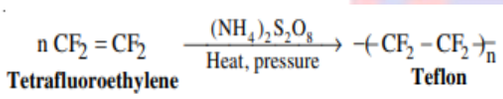


(2) Polypropylene: The monomer units are propylene molecules. It is generally Chemistry in Everyday Life manufactured by passing propylene through n-hexane

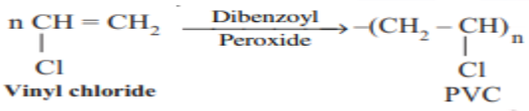
(inert solvent) containing Ziegler-Natta catalyst (a mixture of triethyl aluminium and titanium chloride)



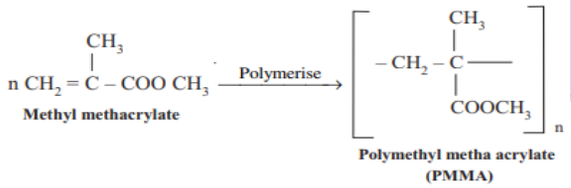
(3)Teflon or Polytetrafluoro ethylene (PTFE): The monomer unit is terafluoroethylene molecule. Teflon is prepared by heating tetra fluoroethylene under pressure in the presence of ammonium peroxosulphate. [$(NH_4)_2S_2O_8$].



(4) Polyvinylchloride (PVC): The monomer units are vinyl chloride molecules. PVC is prepared by heating vinyl chloride in an inert solvent in the presence of dibenzoyl peroxide.



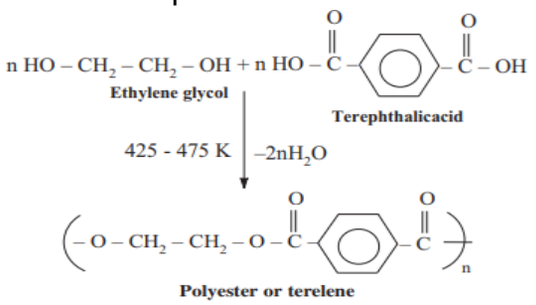
(5) Polymethyl Methacrylate (PMMA): Its monomer unit is methyl methacrylate.



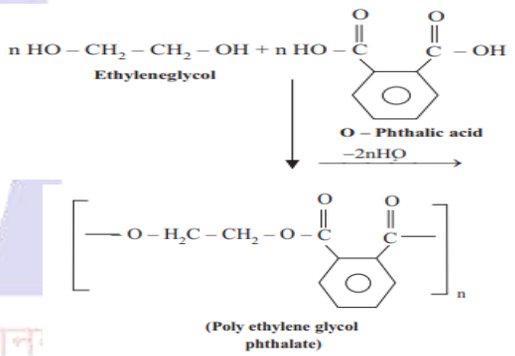
Polyester

- Some synthetic polymers have ester group $\overset{(-C-O-)}{\underset{O}{\|}}$ in them. These are condensation polymers. The important members of this class are polyester and glyptal resins.

(a) Terelene: It is a polymer obtained by the condensation reaction between ethylene glycol and terephthalic acid.



(b) Glyptal or Alkyl resin: Glyptal is a general name of all polymers obtained by condensation of di-basic acids, and polyhydroxy alcohols. The simplest glyptal is (poly ethelene glycol phthalate) which is obtained by a condensation reaction between ethylene glycol and ortho-phthalic acid.



Test Yourself

Question: Name the important by-products of soap industry.

Answer: Glycerol is the important by-product of soap industry.

Check Yourself

1. Bakelite is an example of

(A) Elastomer (B) Fibre

(C) Thermoplastic (D) Thermosetting

2. The S in buna-S refers to

(A) Sulphur (B) Styrene

(C) Sodium (D) Salicylate

3. Identify the type of polymer

(i) -A-A-A-A-A-A-

(ii) -A-B-B-A-A-A-B-A-

(A) (i) Homopolymer, (ii) Copolymer

(B) (i) Natural polymer, (ii) Synthetic polymer

(C) (i) Linear polymer, (ii) Branched polymer

(D) (i) Fibre, (ii) Elastomer

4. Which of the following are thermoplastic polymers?

(A) Polythene, urea-formaldehyde, polyvinyls

(B) Bakelite, polythene, polystyrene

(C) Polythene, polystyrene, polyvinyls

(D) Urea-formaldehyde, polystyrene, bakelite

5. Which of the following is a condensation polymer?

(A) Teflon (B) PVC

(C) Polyester (D) Neoprene

Stretch Yourself

1. What are limited spectrum antibiotics? Give one example.

2. What are food preservatives? Name two such substances.

3. Explain the cleaning action of soap. Why do soaps not work in hard water?

4. Explain the following terms with suitable examples:
(a) Cationic detergents
(b) Anionic detergents

5. What are the following substances? Give one example of each type.
(i) Antacid
(ii) Non-ionic detergents
(iii) Antiseptics

Answers

Check Yourself

Answer: 1(D); 2(B); 3(A); 4(C); 5(C)

Stretch Yourself

1. Those antibiotics which are specific for certain diseases are called limited spectrum antibiotics. Example: Streptomycin for tuberculosis.
2. Food preservatives: Food preservatives are the compounds which prevent spoilage of food due to microbial growth.

   Two substances: Example: Sodium benzoate, vinegar.
3. Do it by yourself.
4. Do it by yourself.
5. Do it by yourself.