جامعة جنوب الوادي

كلية العلوم

قسم الكيمياء

مقرر الكيمياء الصناعية لطلاب الفرقة الرابعة كيمياء

كلية العلوم

اعداد

د. ابوبكر هريدي عبد المنصف

-:POLYMER:-

[redacted]

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CONTENT:-

1. INTRODUCTION
2. CLASSIFICATION OF POLYMER
3. TYPES OF POLYMERIZATION
4. CHARACTERISTICS OF POLYMERS
5. APPLICATION OF POLYMERS

INTRODUCTION

- A WORD POLYMER IS A COMBINATION OF TWO GREEK WORDS, "POLY" MEANS "MANY" AND "MEROS" MEANING "PARTS OR UNITS".

A POLYMER IS A LARGE MOLECULE OF WHICH IS FORMED BY REPEATED LINKING OF THE SMALL MOLECULES CALLED "MONOMERS".

MORE MONOMER MOLECULES JOINED IN UNITS OF LONG POLYMER.

$$N(CH_2\text{-}CH_2) \longrightarrow (\text{-}CH_2\text{-}CH_2\text{-})_N$$

ETHYLENE → POLYETHYLENE

CLASSIFICATION OF POLYMER

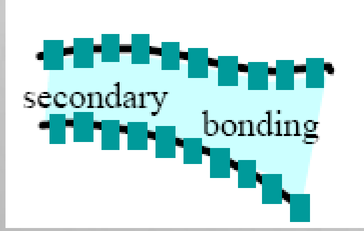
- CLASSIFICATION BASED ON SOURCE
- CLASSIFICATION BASED ONSTRUCTURE
- CLASSIFICATION BASED ON POLYMERISATION
- CLASSIFICATION BASED ON MOLECULER FORCE

CLASSIFICATION BASED ON SOURCE

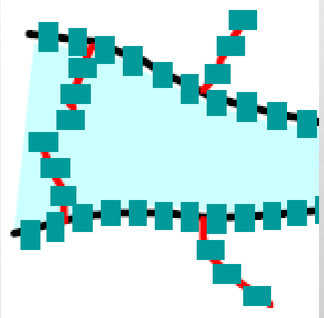
1. **NATURAL POLYMERS**:- THE DEFINITION OF A NATURAL POLYMER IS A POLYMER THAT RESULTS FROM ONLY RAW MATERIALS THAT ARE FOUND IN NATURE. EXAMPLE:- PROTEINS, CELLULOSE, STARCH, RUBBER.
2. **SEMI-SYNTHESIS POLYMERS**:- CELLULOSE DERIVATIVES - CELLULOSE ACETATE (RAYON).
3. **SYNTHESIS POLYMERS**:- BUNA-S, BUNA-R, NYLON, POLYTHENE, POLYESTER.

CLASSIFICATION BASED ON STRUCTURE

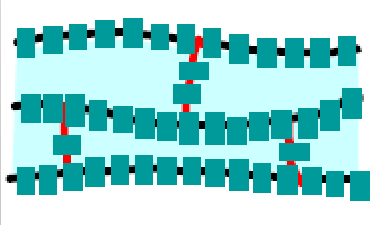
1. **LINEAR POLYMERS:-** CONSIST OF LONG AND STRAIGHT CHAINS. EXAMPLE:- PVC
2. **BRANCHED CHAIN POLYMERS:-** CONTAIN LINEAR CHAINS HAVING SOME BRANCHES, E.G., LOW DENSITY POLYMER.
3. **CROSS LINKED CHAIN POLYMERS:-** FORMED FROM BI-FUNCTIONAL AND TRI-FUNCTIONAL MONOMERS AND CONTAIN STRONG COVALENT BONDS E.G. BAKELITE, MELAMINE.



LINEAR



BRANCHED



CROSS-LINKED

CLASSIFICATION BASED ON POLYMERIZATION

1. ADDITION POLYMERS

FORMED BY THE REPEATED ADDITION OF MONOMER MOLECULES POSSESSING DOUBLE OR TRIPLE BONDS

$N(CH_2=CH_2) \longrightarrow -(CH_2-CH_2)-$

ETHYLENE　　　　　　　　POLYETHYLENE

2. CONDENSATION POLYMERS

FORMED BY REPEATED CONDENSATION REACTION BETWEEN TWO DIFFERENT BI-FUNCTIONAL OR TRI-FUNCTIONAL MONOMERIC UNITS.

EG. TERYLENE (DACRON), NYLON 6, 6, NYLON 6.

$N(H_2N(CH_2)_6NH_2) + N(HOOC(CH_2)_4COOH) \longrightarrow [-NH(CH_2)_6NHCO(CH_2)_4CO-]_N + NH_2O$

(NYLON 6:6)

CLASSIFICATION BASED ON MOLECULER FORCE

1. NYLON:- Nylon is used as general name for all synthetic fiber forming polyamides,i.e., having a protein like structure. These are the condensation polymers of diamines and dibasic acids a number is usually suffixed with the nylon which refers to the number of carbon atoms present in the diamine and the dibasic acids respectively.

   Example: Nylon 6,6

   NYLON-6,6: Nylon-6,6 is obtained by the polymerisation of adipic acid with hexamethylene diamine.

$nHOOC(CH_2)_4COOH + nH_2N(CH_2)_6\ NH_2 \xrightarrow[\text{High pressure}]{553K} [-N-(CH_2)_6-N-C(CH_2)_4-C-]_n$

(N–H bond below the first N; C=O bonds below each C: H, O, O)

2. THERMOPLASTIC POLYMERS:-

THESE ARE LINEAR OR SLIGHTLY BRANCHED LONG CHAIN POLYMERS, WHICH CAN BE SOFTENED ON HEATING & REVERSIBLY HARDENED ON COOLING REPEATEDLY. THEIR HARDNESS IS A TEMPORARY PROPERTY & VARIES WITH TEMPERATURE.

EXAMPLE:- POLYVINYL CHLORIDE.

POLYVINYL CHLORIDE:- IT IS A VINYL POLYMER CONSTRUCTED OF REPEATING VINYL GROUPS (ETHENYLS) HAVING ONE OF THEIR HYDROGENS REPLACED WITH A CHLORIDE GROUP.

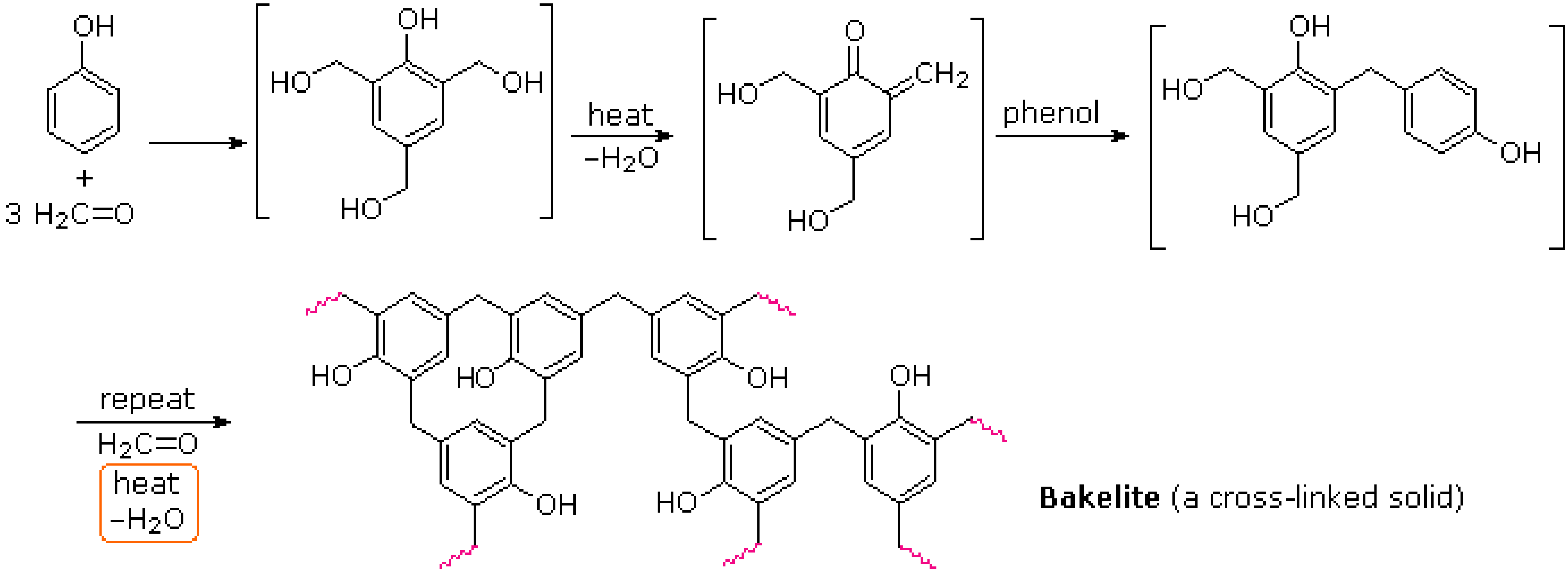
3. THERMOSETTING POLYMERS:-

INITIAL MIXTURE OF REACTIVE, LOW MOLAR MASS COMPOUNDS REACTS UPON HEATING IN THE MOLD TO FORM AN INSOLUBLE, INFUSIBLE NETWORK.

EXAMPLE: BAKELITE

BAKELITE: BAKELITE IS FORMED OF PHENOL AND FORM-ALDEHYDE POLYMERIZATION.

Phenol-Formaldehyde Resin



Bakelite (a cross-linked solid)

TYPES OF POLYMERIZATION

1. ADDITION POLYMERIZATION
2. CONDENSATION POLYMERIZATION
3. ADDITION POLYMERIZATION:-

- THE POLYMER IS FORMED FROM THE MONOMER, WITHOUT THE LOSS OF ANY MATERIAL, AND THE PRODUCT IS THE EXACT MULTIPLE OF THE ORIGINAL MONOMERIC MOLECULE.
- ADDITION POLYMERIZATION PROCEEDS BY THE INITIAL FORMATION OF SOME REACTIVE SPECIES SUCH AS FREE RADICALS OR IONS AND BY THE ADDITION OF THE REACTIVE SPECIES TO THE OTHER MOLECULE, WITH THE REGENERATION OF THE REACTIVE FEATURE.

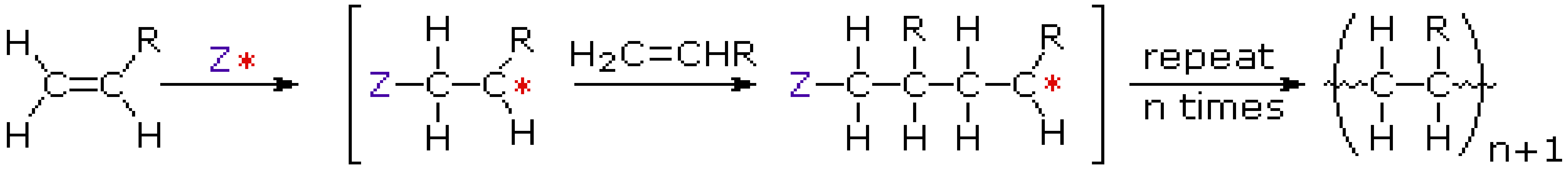
1. FREE RADICAL MECHANISM:- ALKENES OR DIENES AND THEIR DERIVATIVES ARE POLYMERIZED IN THE PRESENE OF A FREE RADICAL GENERATING INITIATOR (CATALYST) LIKE BENZOYL PEROXIDE, ACETYL PEROXIDE, T-BU PEROXIDE, ETC.

THIS PROCESS INVOLVES THREE STEPS:-

A) CHAIN INITIATION STEP - ADDITION OF PHENYL FREE RADICAL FORMED BY THE PEROXIDE TO THE ETHENE DOUBLE BOND ,THEREBY FORMING A LARGER RADICAL.

B) CHAIN PROPAGATION STEP - REPETITION OF THIS SEQUENCE WITH NEW AND BIGGER RADICALS.

C) CHAIN TERMINATING STEP - THE PRODUCT RADICAL THUS FORMED REACTS WITH ANOTHER RADICAL TO FORM THE POLYMERIZED PRODUCT.



Z* is an initiating species

* may be a radical, a cation or an anion

EXAMPLE: POLYTETRAFLOUROETHYLENE(TEFLON)

TEFLON:-

IT IS OBTAINED BY POLYMERIZATION OF WATER-EMULSION OF TETRAFLUORO ETHYLENE, UNDER PRESSURE AND IN THE PRESENCE OF BENZOYL PEROXIDE AS A CATALYST.

2. CONDENSATION POLYMERIZATION:-

PROCESS IN WHICH TWO MONOMERS REACT TO FORM A LARGER MOLECULE AND **ELIMINATE A SMALLER MOLECULE** (USUALLY WATER, AMMONIA, METHANOL OR HYDROGEN CHLORIDE).

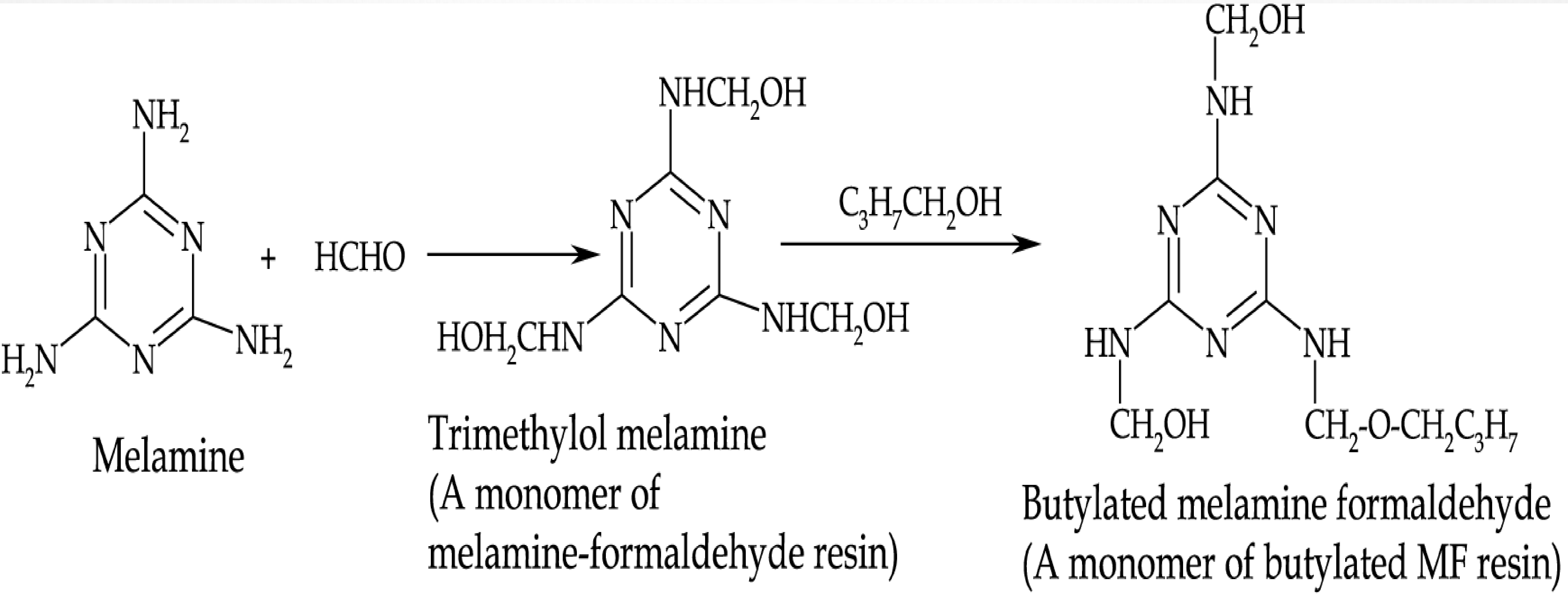
IT ALSO CALLED AS STEP-GROWTH POLYMERIZATION.

EXAMPLE:-

1. POLYAMIDE:- NYLON 6-6, NYLON 6.
2. POLYESTER:- TERILIN
3. BAKELITE POLYMER
4. MALEMIN POLYMER

MALEMIN POLYMER

THE RESIN IS FORMED BY CONDENSATION CO-POLYMERISATION OF MELAMINE AND FORMALDEHYDE.



CHARACTERISTICS OF POLYMER

- LOW DENSITY.
- LOW COEFFICIENT OF FRICTION.
- GOOD CORROSION RESISTANCE.
- GOOD MOULD ABILITY.
- EXCELLENT SURFACE FINISH CAN BE OBTAINED.
- CAN BE PRODUCED WITH CLOSE DIMENSIONAL TOLERANCES.
- ECONOMICAL.
- POOR TENSILE STRENGTH.
- LOW MECHANICAL PROPERTIES.
- POOR TEMPERATURE RESISTANCE.
- CAN BE PRODUCED TRANSPARENT OR IN DIFFERENT COLOURS

APPLICATION OF POLYMERS

1. **MEDICINE:-** MANY BIOMATERIALS, ESPECIALLY HEART VALVE REPLACEMENTS AND BLOOD VESSELS, ARE MADE OF POLYMERS LIKE DACRON, TEFLON AND POLYURETHANE.
2. **CONSUMER SCIENCE :-** PLASTIC CONTAINERS OF ALL SHAPES AND SIZES ARE LIGHT WEIGHT AND ECONOMICALLY LESS EXPENSIVE THAN THE MORE TRADITIONAL CONTAINERS. CLOTHING, FLOOR COVERINGS, GARBAGE DISPOSAL BAGS, AND PACKAGING ARE OTHER POLYMER APPLICATIONS.
3. **INDUSTRY:-** AUTOMOBILE PARTS, WINDSHIELDS FOR FIGHTER PLANES, PIPES, TANKS, PACKING MATERIALS, INSULATION, WOOD SUBSTITUTES, ADHESIVES, MATRIX FOR COMPOSITES, AND ELASTOMERS ARE ALL POLYMER APPLICATIONS USED IN THE INDUSTRIAL MARKET.
4. **SPORTS:-** PLAYGROUND EQUIPMENT, VARIOUS BALLS, GOLF CLUBS, SWIMMING POOLS, AND PROTECTIVE HELMETS ARE OFTEN PRODUCED FROM POLYMERS.

THANK YOU

Sugar & sugar manufacturing

Dr. Aboubakr Hegap

Topics

Intro to sugar → Types of sugar → Extraction sugar process from sugar cane

What is sugar?

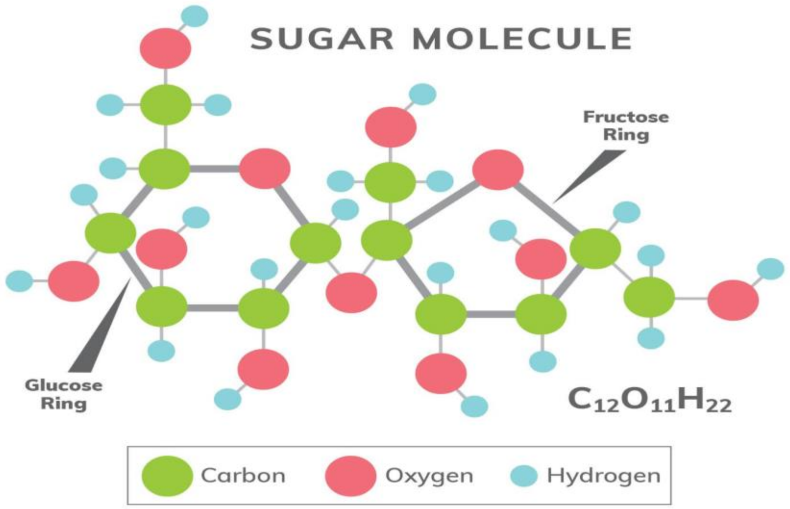
Sugar: is the name for a group of carbohydrates which have a short chain, generally cyclic structure, and are sweet tasting. However, there are several other substances that can also be used to sweeten foods.

-It has three type :

- **Monosaccharides:** The simplest of all the sugars

these form the building blocks of the other types of carbohydrates they are more commonly found bonded in pairs to form the rest of the range of sugars.

- **Disaccharides:** they are a mixture of two of the monosaccharides .
- **Polysaccharides** .



SUGARS, BROKEN DOWN

MONOSACCHARIDES
(one-molecule sugars)

Glucose (dextrose)

Fructose (levulose or fruit sugar)

Galactose (occurs in milk)

DISACCHARIDES
(two monosaccharides linked together)

Sucrose (table sugar) = glucose + fructose

Lactose (milk sugar) = glucose + galactose

Maltose (malt sugar) = glucose + glucose

POLYSACCHARIDES
(more than 10 monosaccharides linked together)

Starch (glucose polymer)

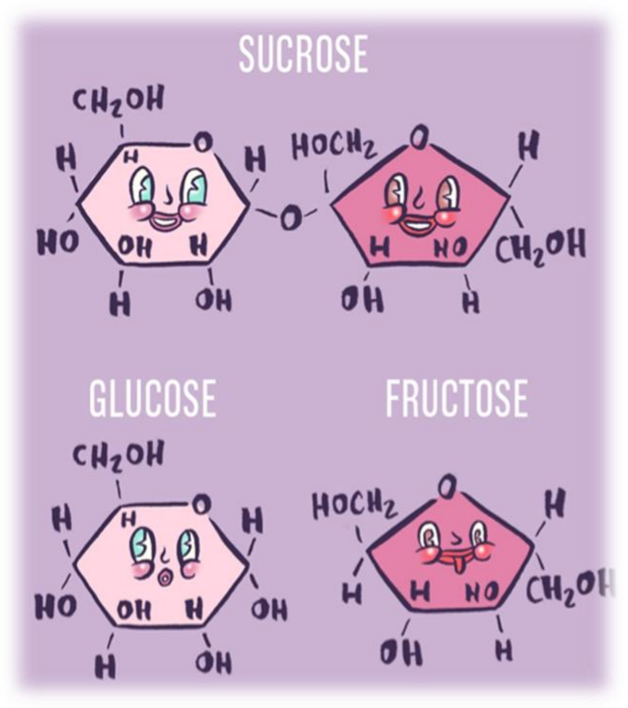
Sucrose (Table sugar)

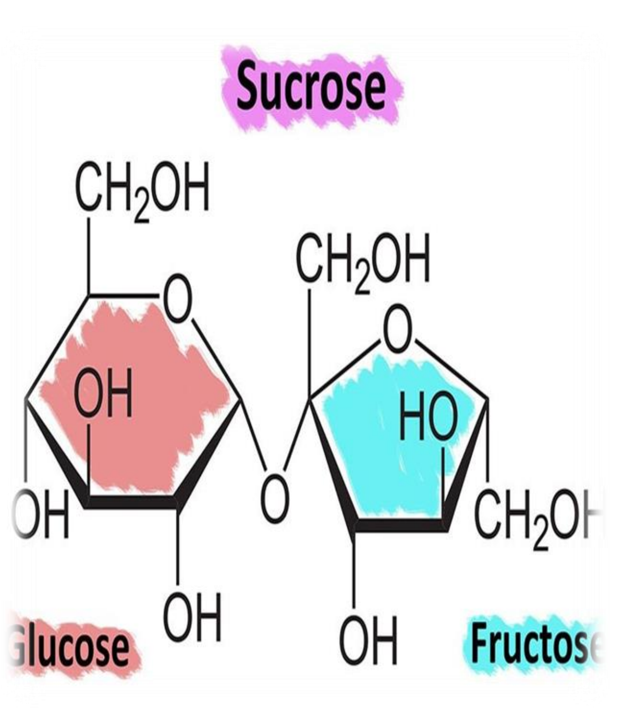
- **Common name** : Table sugar , sucrose , saccharose
- **Iupac name** : β-d-fructofuranosyl α-d glucopyranoside
- **The chemical or molecular formula :**

is **$C_{12}H_{22}O_{11}$**, which means each molecule of sugar contains 12 carbon atoms, 22 hydrogen atoms and 11 oxygen atoms.

- **Source :**

It is a saccharide that is made in many different plants. Most table sugar comes from sugar beets or sugarcane. The purification process involves bleaching and crystallization to produce a sweet, odorless powder.





Types of sugar

White sugar

Also known as granulated sugar, table sugar or refined sugar. Is one of the world's purest foods. It's 99.9% sucrose, is essentially the naturally occurring sugar from the sugar cane but with all 'impurities' such as mineral ash and polyphenols completely removed. Quite a multipurpose sugar used for baking, sprinkling, creaming and adding to hot drinks.

Icing sugar

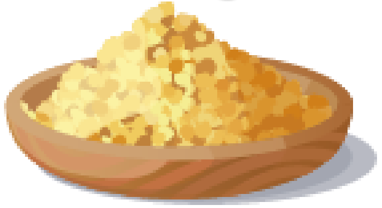
You may have noticed that icing sugar is either called 'pure' or 'soft'. Both are finely ground, and sifted sugar made from sugarcane, the difference is the soft version will often be mixed with corn starch to prevent it clumping التكتل. As the name might suggest, it is used for icing, but also buttercream and dusting cakes.

Sugar caster

This really has the same make up as table sugar, just a lot finer. Because of this you might also see it being called superfine sugar. Caster sugar is generally used in meringues or pavlovas where a smooth texture is needed.

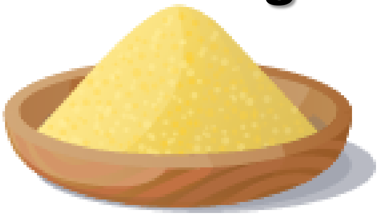
Types of sugar

Raw sugar



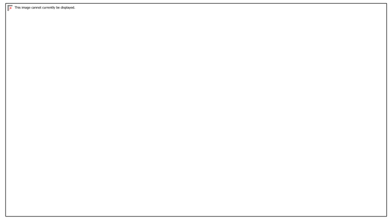
Raw sugar has a slightly darker color compared to white sugar. This comes from the molasses that is left on the sugar crystals. It is usually partially refined, retaining 4% molasses. Because of this it has a slightly different flavor as well. Most commonly, it is used in coffee, baking, chutneys or relishes. The only difference between this and coffee crystals is the size.

Brown sugar



Brown sugar can come in many different names and varieties. It can therefore come by many different names such as light brown, dark brown, golden brown or golden yellow sugar. They are all just blends of white sugar with different amounts of molasses added. It can therefore have quite a different taste compared to white sugar. The uses of brown sugar range from biscuits, gingerbread, carrot cakes and mince tarts.

Glucose sugar



Not commonly found in the home cooks kitchen, glucose powder is a white crystalline powder with a GI at the maximum of 100. It is the standard by which other carbohydrates are ranked. At 100, this means that glucose is rapidly absorbed into the bloodstream and stimulates a fast insulin response.

Extraction sugar process from sugar cane

8.White sugar

1.Cleaning &Washing

2. Juice Extraction

3.Raw juice

4.Juice Purification

5. Clarified Juice Purification

6.Multiple Effect Evaporation

7.Crystallization & centrifugation

Steps in producing raw sugar from cane

- Cane receiving and unloading (receive the cane at the factory and unload it from the transport vehicles)
- Cane preparation (cutting and shredding cane to prepare it for juice extraction)
- Juice extraction (two technologies are in common use; milling or diffusion)
- Juice clarification (remove suspended solids from the juice, typically mud, waxes, fibers)
- Juice evaporation (to concentrate the juice to a thick syrup of about 65°brix)
- Syrup clarification (remove suspended solids from the syrup, typically colloid size of mud, waxes, fibers, etc.)

Crystallization

- Centrifugation (Separation of the sugar crystals from the mother liquor, done by centrifugal machines)

Sugar drying

- Packaging and delivery

✓ **These processing steps will produce a brown or raw sugar**. Mill white sugar also known as plantation white sugar can be produced by introducing some form of color removal process (often solicitation) between the juice clarification and the juice evaporation stages mentioned above.

➢ The raw sugar produced is often refined to produce white sugar.

➢ This sugar refining can be done either at a separate factory or at a back-end refinery which is attached to the raw sugar factory.

Juice extraction

There are two processes for extracting juice from cane :Milling & Diffusion.

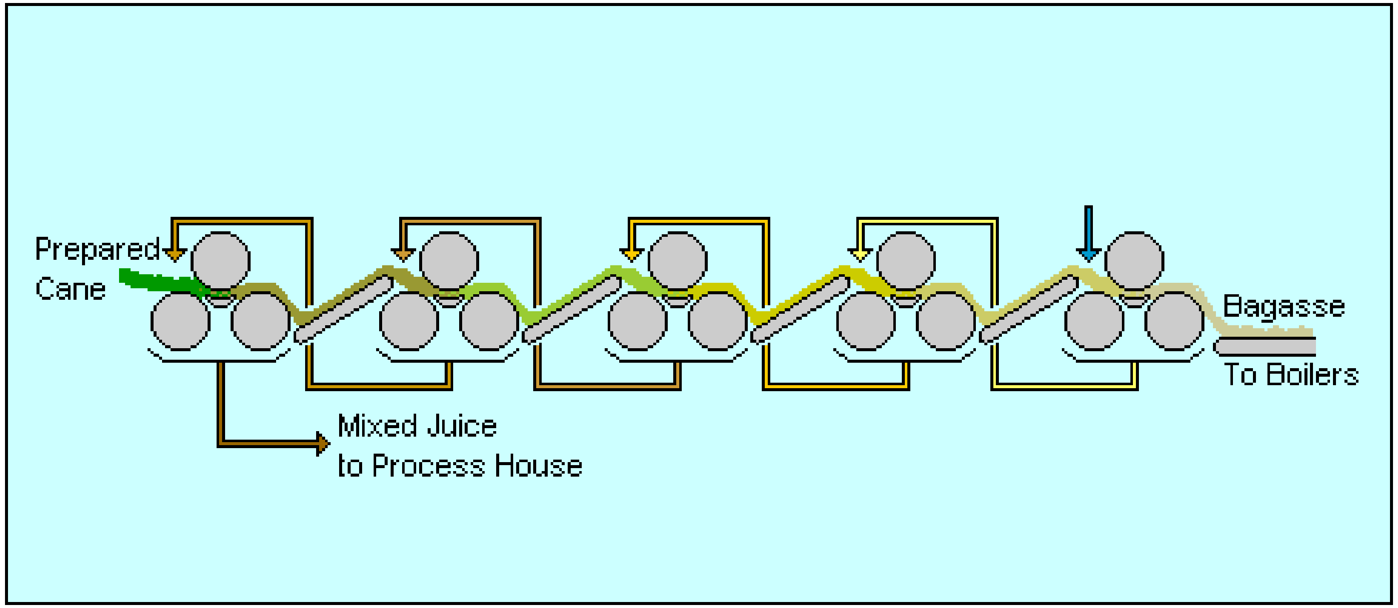
1.Milling

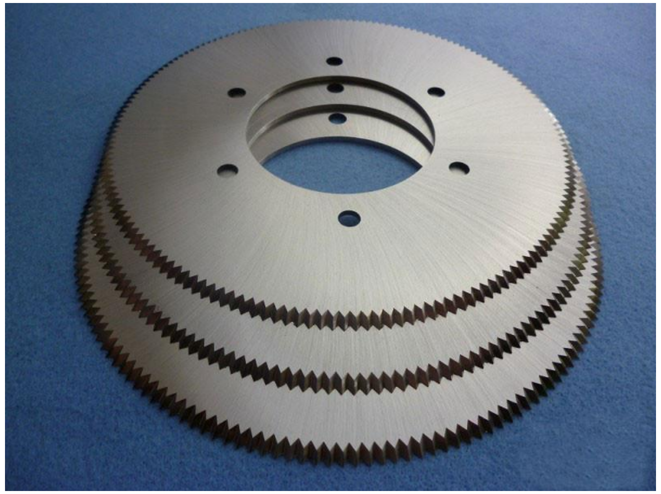
- Juice extraction by milling is the process of squeezing عصر the juice from the cane under a set mills using high pressure between heavy iron rollers.
- Those mills can have from **3 up to 6 rolls**; every set of mills is called a tandem mill or mill train.
- **To improve the milling extraction efficiency**, imbibition water مياه الشرب is added at each mill. Hot water is poured over the cane just before it enters the last mill in the milling train and is recirculated up to reach the first mill.
- The juice squeezed from this cane is low in sugar concentration and is pumped to the preceding mill and poured onto the cane just before it enters the rollers, the juice from this mill is the same way pumped back up the milling train.
- Mixed juice (that is to say cane juice mixed with the water introduced at the last mill) is withdrawn from the first and second mills and is sent for further processing.
- **Milling trains typically have four, five or six mills in the tandem:**

To improve the milling extraction performance before the cane reaches the first mill, knife and shredder preparation equipment is normally used

2. Diffusion

- **Sugarcane diffusion is the process of extracting the sucrose from the cane with the use of imbibition water but without the squeezing by mills.**
- يتم تحقيق ذلك باستخدام سكاكين دوارة وأحيانًا مطاحن مطرقية تسمى "آلة تمزيق الورق".
- Shredded cane is introduced into the diffuser at the feed end, Hot water is poured over the shredded cane just before the discharge end of the diffuser.
- The hot water percolates through the bed of cane and removes sucrose from the cane.





- **This dilute juice is then collected in a compartment under the bed of cane and is pumped to a point a little closer to the feed end of the diffuser and this dilute juice is allowed to percolate through the bed of cane.**
- **At this point the concentration of sucrose in the cane is higher than the concentration of sucrose in the dilute juice just mentioned and so sucrose diffuses from the cane to the juice.**
- **this now slightly richer juice is pumped back up the diffuser and the process is repeated, typically, 12 to 15 times (compared with the four to six times for the milling process)**

Juice clarification

- Sugar cane juice has a pH of about 4.0 to 4.5 which is quite acidic.
- Calcium hydroxide, also known as milk of lime or limewater, is added to the cane juice to adjust its pH to 7.
- The lime helps to prevent sucrose's decay into glucose and fructose.
- The limed juice is then heated to a temperature above its boiling point.
- The superheated limed juice is then allowed to flash to its saturation temperature: this process precipitates impurities which get held up in the calcium carbonate crystals.
- The flashed juice is then transferred to a clarification tank which allows the suspended solids to settle.
- The supernatant, known as clear juice is drawn off the clarifier and sent to the evaporators.

Juice evaporating

- The clarified juice is concentrated in a multiple-effect evaporator to make a syrup of about 50 percent sucrose by weight

Crystallization and centrifuging

- **This syrup is further concentrated under vacuum in a vacuum boiling pan until it becomes** supersaturated, finely ground sugar crystals suspended in alcohol are introduced into the vacuum pan as seed crystals around which sucrose is deposited and these crystals then grow in size until they are ready to be discharged (typically about 1 millimeter (0.039 in))
- Several boiling schemes are possible, the most commonly used boiling scheme is the three-boiling scheme. This method boils the sugar liquors in three stages, called A-, B- and C-.

- A batch type sugar centrifuge separates the sugar crystals from the mother liquor. These centrifuges have a capacity of up to 2,200 kilograms (4,900 lb) per cycle. The sugar from the centrifuges is dried and cooled and then stored in a silo or directly packed into bags for shipment.
- The mother liquor from the first crystallization step (A-product) is again crystallized in vacuum pans and then passed through continuous sugar centrifuges. The mother-liquor is again crystallized in vacuum pans. Due to the low purity the evapo-crystallization alone is not sufficient to exhaust molasses, and so the so-called **massecuite** (French for “boiled mass”) is passed through cooling crystallizers until a temperature of approx. 45 °C (113 °F) is reached.
- Then the massecuite is re-heated in order to reduce its viscosity and then purged in the C-produced centrifugals. The run-off from the C- centrifugal is called molasses.
- The spun-off sugar from the B-product and C-product centrifuges is re-melted, filtered, and added to the syrup coming from the evaporator station.

- Some sugar cane mills have so-called back-end refineries.
- In back-end refineries, raw sugar produced in the mill is converted to refined sugar with a higher purity for local consumption, export, or bottling companies.
- Wastage is used for heat generation in the sugar mills.
- The remaining fibrous solids, called Bagasse مصاص القصب, are burned for fuel in the mill's steam boilers.
- These boilers produce high-pressure steam, which is passed through a turbine to generate electrical energy (cogeneration).
- The exhaust steam from the turbine is passed through the multiple effect evaporator station and used to heat vacuum pans in the crystallization stage as well as for other heating purposes in the sugar mill.
- **Bagasse makes a sugar mill more than energy self-sufficient; surplus bagasse goes in animal feed, in paper manufacture, or to generate electricity for sale.**

References

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- *White- sugarcane-production by Peter Rein l ResearchGate*

Soap Industry

Content

1- What is Soap ?
2- Composition of Soap
3- Mechanism of Action
4- Examples
5- Saponification

What is SOAP?

- Soap is a cleansing agent created by the chemical reaction of a fatty acid with an alkali metal hydroxide.
- Raw materials mostly obtained from animal kingdom (fat) and plant kingdom (oils).
- Soap is of natural origin, so it is biodegradable and eco friendly.

Raw Materials:

- Traditionally, soap has been manufactured from alkali (lye) and animal fats (tallow),
- Although vegetable products such as palm oil, coconut oil, almonds oil are used nowadays.

SOAP

- In chemistry, **soap** is a salt of a fatty acid.
- Consumers mainly use soaps as surfactants for washing, bathing, and cleaning, but they are also used in textile spinning and are important components of lubricants.
- Soaps for cleansing are obtained by treating vegetable or animal oils and fats with a strongly alkaline solution.
- Fats and oils are composed of triglycerides; three molecules of fatty acids attach to a single molecule of glycerol.
- The alkaline solution, which is often called lye (although the term "lye soap" refers almost exclusively to soaps made with sodium hydroxide), brings about a chemical reaction known as saponification.

Composition Of Soap

- AlKali Material

(50%of fats)

- Fat

(Tallow with 20% Grease)

- Oil

(Coconut 15%)

Alkali Material:

- The Alkali most commonly used today is NaOH.
- KOH can also be used. Potassium based soap creates a more water soluble product than sodium based soap, and so it is called "Soft soap". Soft soap, alone or in combination with sodium based soap in commonly used in Shaving products.

Fat or Tallow :

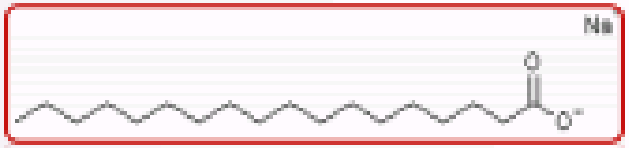
- Tallow is obtained from suet and used in making soap.
- Tallow is the fat obtained by rendering beef or mutton.
- Tallow is the harder and less fusible fat in animals and vegetables.
- Tallow is the white (nearly tasteless) solid rendered fat of cattle and sheep used for making candles, soap, and pet foods.

Oil:

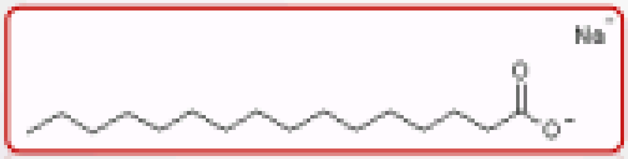
- Almond Oil , extracted from the seeds of sweet almonds is used as an emollient in high quality soap.
- Almond oil prevents dehydration of skin.
- Palm oil, coconut oil, produced by processing of palm fruit and coconut can be used in soap.
- Soap from coconut frim and lather well ,
- Coconut reduce hardness to increase solubility
- Coconut contain large proportion of lauric and myristic acid as well as small quantity of oleic, stearic, palmitic etc .
- Fish oil can also be used and better in processing of soap

EXAMPLES OF SOAPS

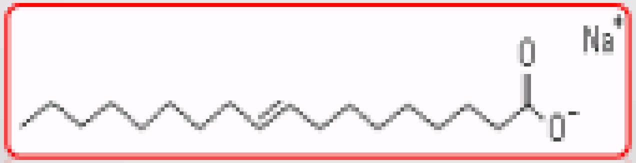
- ***Sodium stearate*** (Chemical formula: $C_{17}H_{35}COO\text{-}Na\text{+}$)



- ***Sodium palmitate*** (Chemical formula: $C_{15}H_{31}COO\text{-}Na\text{+}$)

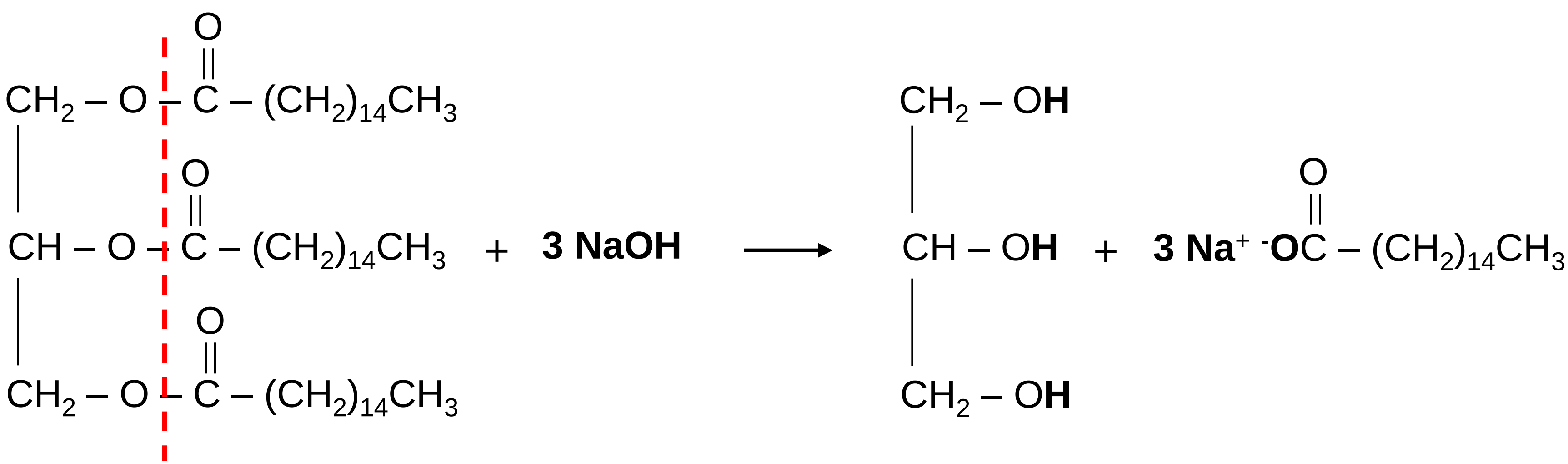


- ***Sodium oleate*** (Chemical formula: $C_{17}H_{33}COO\text{-}Na\text{+}$)



Saponification

Process of making soap from animal fat or vegetable oil using a base.



glyceryl tripalmitate (tripalmitin)

sodium hydroxide

glycerol

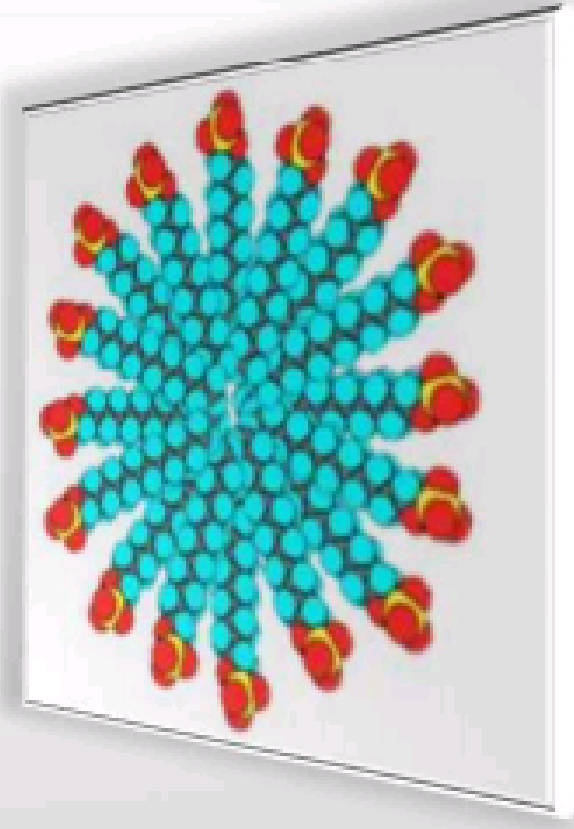
3 sodium palmitate (soap)

- In this reaction, the triglyceride fats first hydrolyze into free fatty acids, and then these combine with the alkali to form crude soap: an amalgam of various soap salts, excess fat or alkali, water, and liberated glycerol (glycerin).
- The glycerin, a useful by-product, can remain in the soap product as a softening agent, or be isolated for other uses.
- Soaps are key components of most lubricating greases, which are usually emulsions of calcium soap or lithium soap and mineral oil.
- These calcium- and lithium-based greases are widely used. Many other metallic soaps are also useful, including those of aluminium, sodium, and mixtures of them.
- Such soaps are also used as thickeners to increase the viscosity of oils. In ancient times, lubricating greases were made by the addition of lime to olive oil

MICELLES – SOAP MOLECULES

- A soap molecule has two ends with different properties:

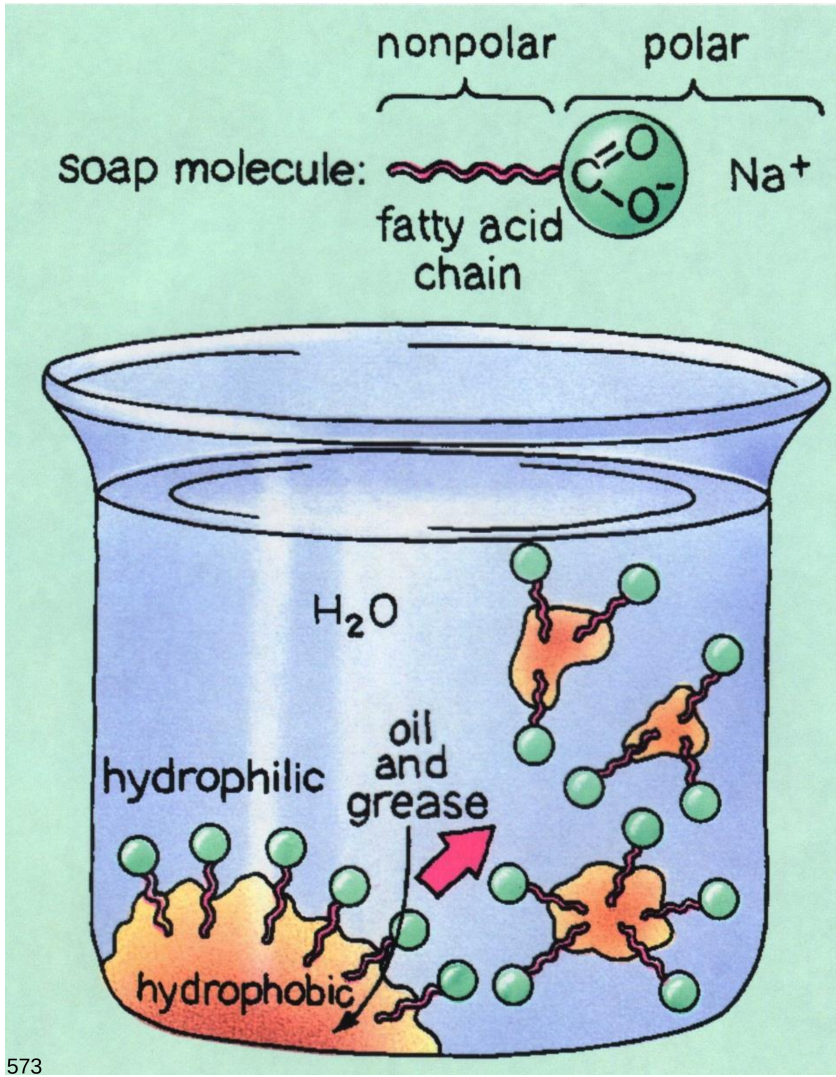
1. A long hydrocarbon part which is hydrophobic (i.e. it dissolves in hydrocarbon).
2. A short ionic part containing COO-Na+ which is hydrophilic (i.e. it dissolves in water).

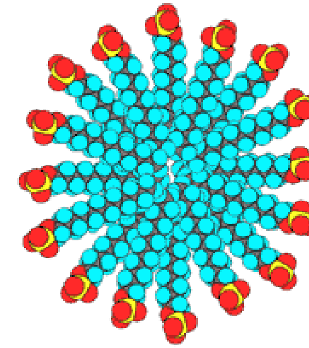


CLEANING ACTION

- Soap molecule is made up of two very different ends.
- One end love the water called hydrophilic
- Other end hate the water called hydrophobic .
- Hydrophobic end attached to the dust, dirt, oils or the materials which we want to remove, detaching takes place, get suspended in water and can be easily removed.
- while hydrophilic end remains in water.

Cleaning Action of Soap



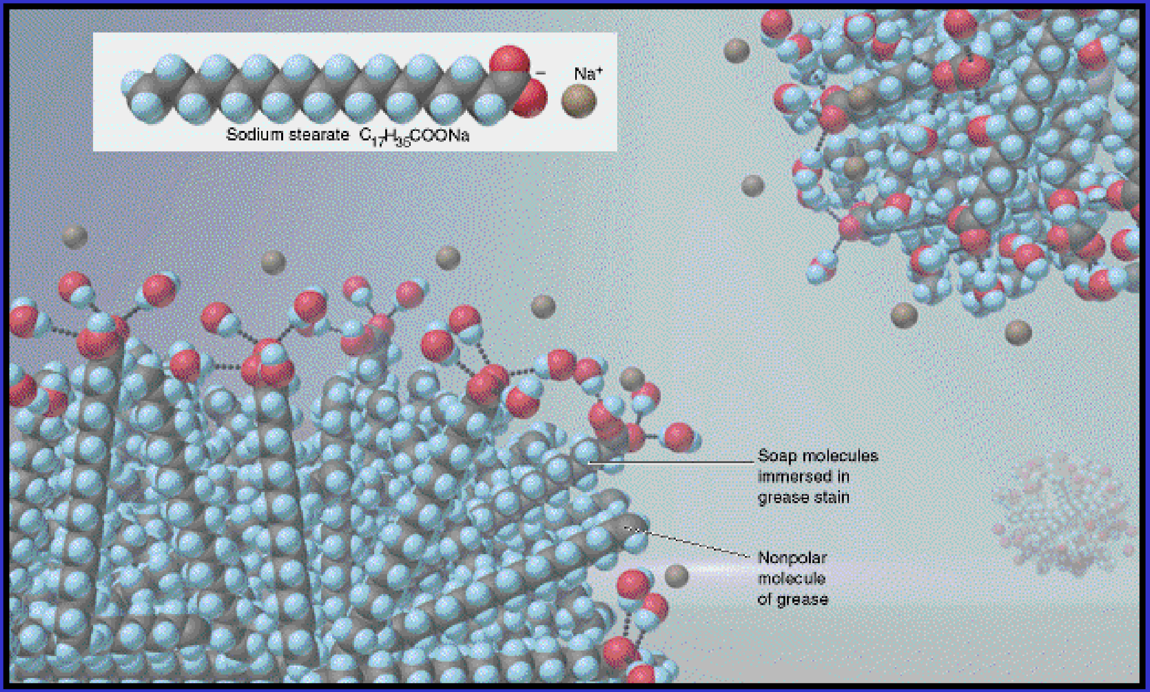


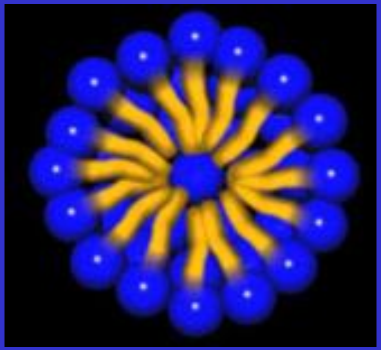
Micelle

Timberlake, Chemistry 7th Edition, page 573

Solvation

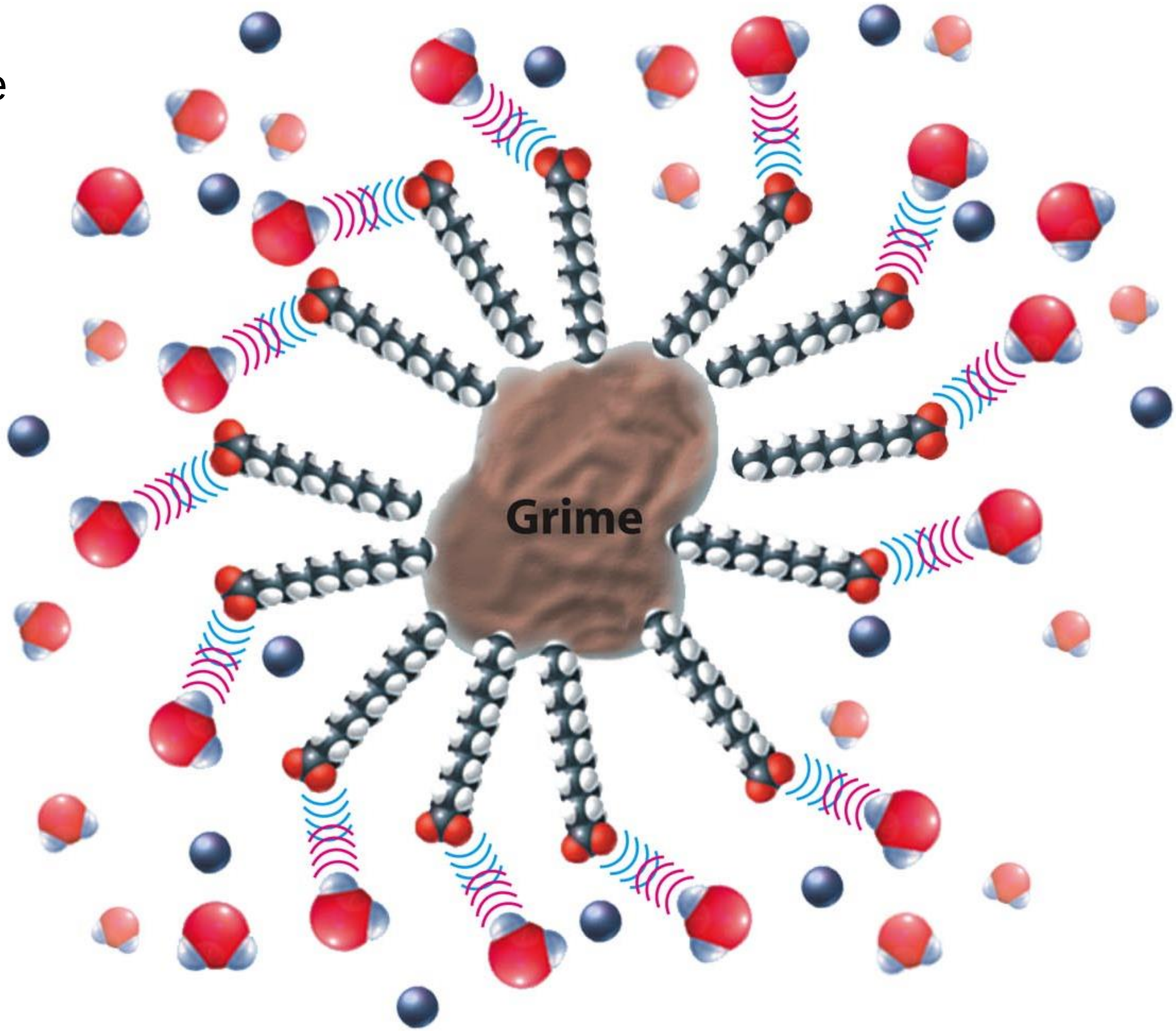
- **Soap / Detergent**
  – *polar* "head" with long *nonpolar* "tail"
  – dissolves nonpolar grease in polar water





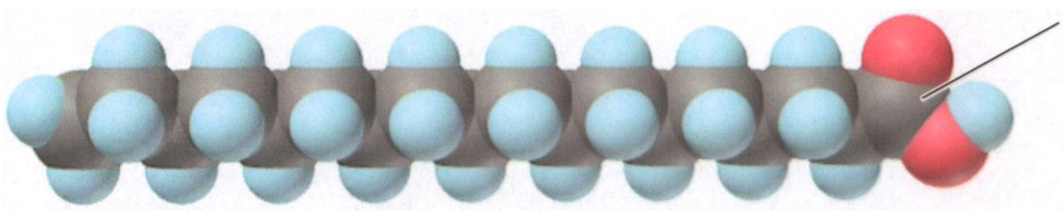
micelle

Micelle

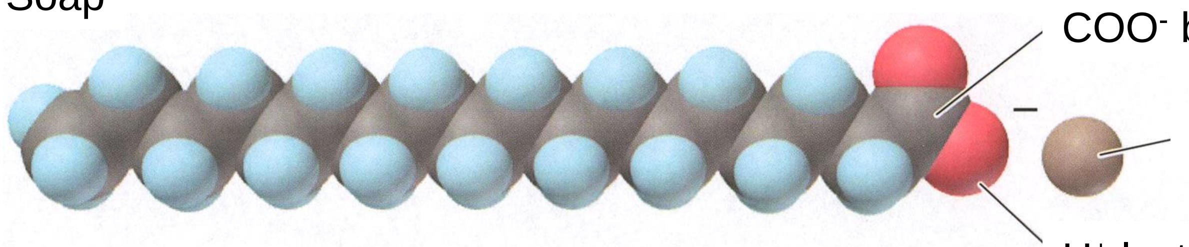


Stearic Acid

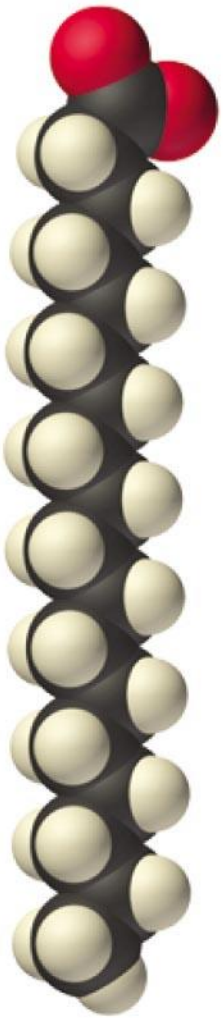
Fatty acid



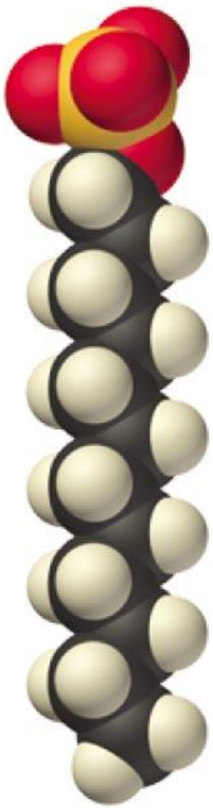
Soap



Kelter, Carr, Scott, Chemistry A Wolrd of Choices 1999, page 257

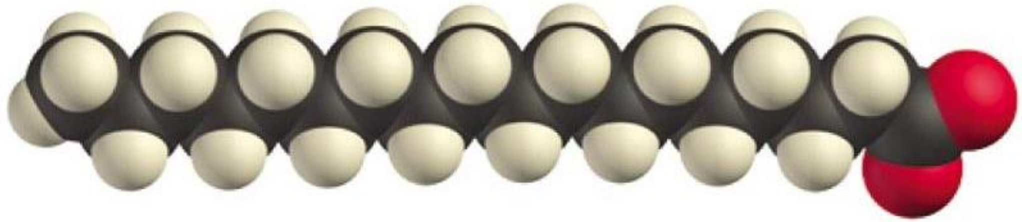


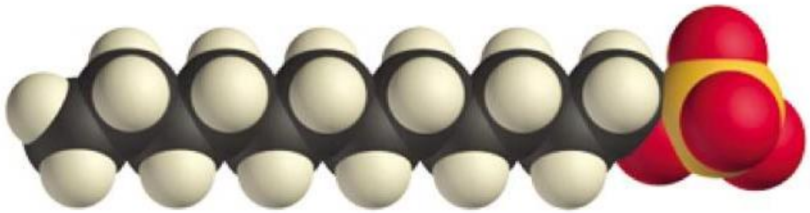
Sodium stearate: a soap



Sodium dodecyl sulfate: a detergent

Sodium stearate: a soap





Sodium dodecyl sulfate: a detergent

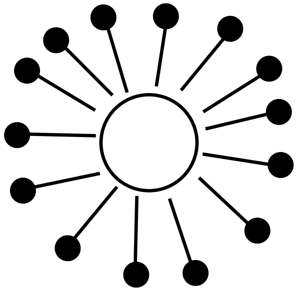
SOAP vs. DETERGENT

SOAP
-- made from animal and vegetable fats

DETERGENT
-- made from petroleum
-- works better in hard water

Hard water contains minerals ^{w}/ions like Ca^{2+}, Mg^{2+}, and Fe^{3+} that replace Na^{1+} at polar end of soap molecule. Soap is changed into an insoluble precipitate (i.e., soap scum).

micelle: a liquid droplet covered ^{w}/soap or detergent molecules



Pharmaceutical Industry (companies)

also called

Pharmaceutical Manufacturing Industry,

or Drug Production Sphere

„Pharmacy“

is a **health profession** concerned with:

- discovery,
- development,
- production,
- distribution,
- dispensing

of drugs

Pharmaceutical

Industry

The Pharmaceutical Industry

undertakes

the research, development, **production**

and supply of

pharmaceutical products

needed to save lives,

prevent disease,

and otherwise assist in maintaining

quality of life.

The Pharmaceutical Industry

notable contributes to human progress, including the development of miracle drugs for treating diseases.

By the 19th century,

many of the public (hospital) pharmacies

(drug stores)

in Europe and North America

have eventually developed into larger pharmaceutical companies.

The modern era of the pharmaceutical industry

of isolation and purification of compounds, chemical synthesis, and computer-aided drug design

is considered to have begun in the 19th century,

thousands of years after intuition and trial and error

led humans to believe that plants, animals, and minerals contained medicinal properties.

Most of today's major pharmaceutical companies were founded in the late 19th and early 20th centuries.

Key discoveries of the 1920s and 1930s, became mass-manufactured and distributed.

Switzerland, Germany and Italy had particularly strong industries, with the UK, US, Belgium and the Netherlands following suit.

The Pharmaceutical Industry spans a spectrum of activities

- from the ultra-high research and development segment associated with human-use **prescription medicines**

through

- to the production of the **generic over the counter medicines**.

There are **3 main types** of pharmaceutical companies:

1. **Large pharmaceutical companies.**
2. **Smaller pharmaceutical companies.**
3. **Generic pharmaceutical companies**

Large, or mainline, pharmaceutical companies

are established firms that **have many approved drugs already on the market**.

These companies often have significant numbers of R&D (research and development) laboratories

throughout around the world.

Many of the largest pharmaceutical companies

are **multinational**,

having research, manufacturing, and sales taking place in multiple countries.

The phrase **Big Pharma**

is often used to refer to companies with revenue in excess of $ 3 billion

In contrast, smaller pharmaceutical companies

are usually newer firms that often do **not have any approved drugs on the market.**

As a result, these firms almost exclusively perform R&D. In addition to developing their own drugs, some small pharmaceutical companies perform contract research for other pharmaceutical companies.

Finally, **generic pharmaceutical companies**

manufacture drugs that are no longer protected by patents.

Because their products are all established drugs, they devote fewer resources to R&D

and more to manufacturing.

„mass-produced medicines“

MPM

(mass-produced drugs MPD)

They are manufactured in large quantities often by or as if by assembly-line techniques (batches).