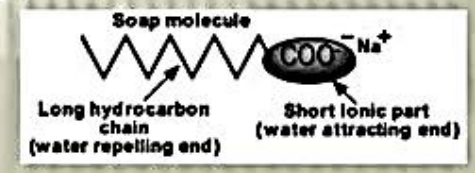
CHEMISTRY NOTES S.4

CHEMICALS FOR CONSUMERS

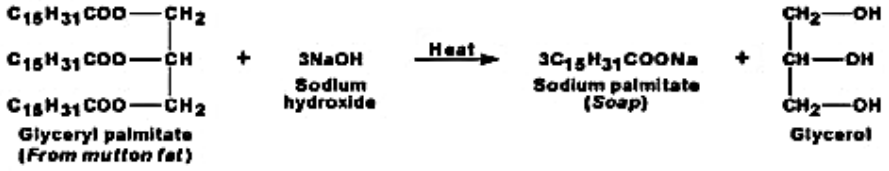
STRUCTURE OF SOAP

- A soap anion consists of a long hydrocarbon chain with a carboxylate group on one end.
- It consists of two parts known as a **head** and a **tail.**
- Hydrocarbon chain – **hydrophobic** (soluble in oils / grease)
- Ionic part of carboxylate group – **hydrophilic** (soluble in water)

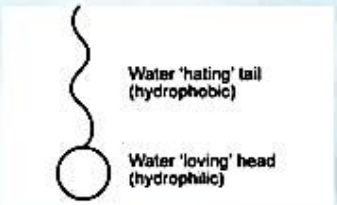


SOAP PREPARATION PROCESS (SAPONIFICATION PROCESS)

- Can be made from animals fats (cows & goat) and vegetable oil(palm oil/olive oil/coconut oil).
- Prepared by hydrolysing fats/oils under alkaline condition.
- Involves boiling fats/oils with concentrated sodium hydroxide solution/potassium hydroxide solution.
- Fats/oils are hydrolyzed first to form glycerol & fatty acids.
- Acids then react with an alkali to form corresponding sodium/potassium salts.

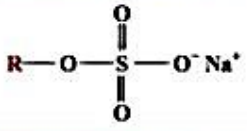


Detergents

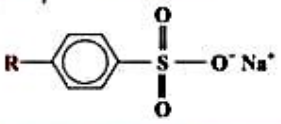


- Any cleaning agent that is not a soap.
- Produced from synthetic resources such as petroleum fractions.
- Sodium salts of sulphonic acid.
- Anion part of a detergent also consists of a hydrophobic part & a hydrophilic part.
- Has a sulphonate group / sulphate group as the ionic structure instead of carboxylate group.
- Examples:

i. Sodium alkyl sulphate



ii. Sodium alkylbenzene sulphonate



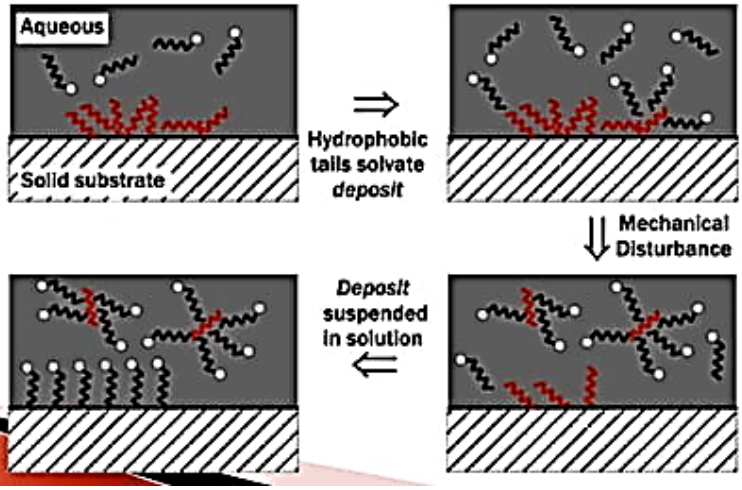
PREPARATION OF DETERGENT (SULPHONATION PROCESS)

- A long-chain hydrocarbon obtained from petroleum fractions is converted into an organic acid through a series of steps.
- Two important steps:
- Sulphonation using concentrated sulphuric acid (Formation of organic acid)
- Neutralization using sodium hydroxide

Sulphonation ≠ Saponification

The Cleansing Action Of Soap & Detergent

- Results from their ability based on the structure of soaps and detergents to lower the surface tension of water, emulsify oil / grease & hold them in suspension in water.



The Cleansing Action Of Soap & Detergent

1. Soap or detergent is added to water.
2. This has lower the surface tension of water and increases the wetting ability of water.
3. Hydrophilic part of the anion dissolves in water.
4. Hydrophobic part dissolves in grease.
5. Scrubbing helps to pull the grease free and break the grease into small droplets.
6. These droplets do not coagulate and redeposit on the surface of the cloth. It is because there is pulsion between negative charges on the surface.
7. The droplets are suspended in water forming an emulsion.
8. Foam produces to float the emulsion.
9. Rinsing helps to remove these droplets.

ADVANTAGES AND THE EFFECTS OF DETERGENTS ON THE ENVIRONMENT

- Advantages over soap :
  a. More soluble in water.
  b. Work well in hard water (do not form scum as they form soluble salts with Ca^+ and Mg^+ ions).
  c. Can be modified for multiple purposes.
  d. Do not form precipitates in acidic water.
- Bad effects :

1. Non - biodegradable (detergents with branched hydrocarbon chains).
2. The uses of addictive such as sodium tripolyphosphates can cause eutrophication.
3. Phosphates in water can increase algae growth.
4. Causes low concentration of dissolved oxygen in the water – the decaying algae & vegetation by bacteria require oxygen.

Comparisons between soap and detergent

Condition	Soap	Detergent
Soft water and Hard water (contain calcium & magnesium ion)	Effective cleaner in soft water. Form an insoluble precipitate in hard water = soap scum (formation of soap scum causes wastage of soap)	Detergent is effective cleaner in soft water. Form soluble substances in hard water = calcium or magnesium salts (do not form scum)
Sources	Made from natural resources (animals fat & vegetable oils).	Made from synthetic resources such as petroleum fractions.
Acidic water (contain hydrogen ion)	Form insoluble long-chain fatty acids (reduces the amount of soap used for cleaning)	Detergent is effective cleaner. Form soluble substances (Do not form scum)
Environment	Soap is biodegradable & do not pollute environment.	Soap is non-biodegradable & give thick foams that kills aquatic lives.

Additives In Detergent (Effeciency Enhancer)

Additives	Function	Example
Biological enzyme	Remove protein stains	Amylase, lipase , cellulases & protease
Foam control agent	Control foaming in detergent	Silicones
Builder	Enhance the surfactant efficiency	Sodium phosphate, sodium tripolyphosphate.
Filler	Make the solid detergent dry and enable the liquid detergent to be poured easily	Sodium silicate, sodium sulphate
Fragrance	Add fragrance	-
Optical brightener/whitener	Add brightness by convert UV radiation to blue light and whiteness	Fluorescent dye
Stabilizing agent	Lower the production of foam	Silicones
Suspension agent	Prevent the dirt particles removed from redepositing onto cleaned fabrics	Sodium carboxymethylcellulose, carboxymethylcellulose
Whitening agent	Bleach stains	Sodium hypochlorite, sodium perborate

Food Additives

- A natural or synthetic substance which is added to food to prevent spoilage or to improve its appearance, taste or texture.
- Commonly used are
  - Preservatives
  - Flavouring Agents
  - Thickeners
  - Antioxidants
  - Stabilizers
  - Dyes / Colourings

Preservatives

- Substances added to food to slow down or prevent the growth of microorganisms.
- Retarded the growth by introducing conditions that interfere with the metabolism of microorganisms.
- extend food storage life.
- Natural preservatives : Salt, sugar, vinegar & smoking.
- Smoking is a process of allowing warm air containing smoke (formaldehyde & phenols) to pass over food.

Alternative ways: freezing and refrigeration

Examples of Preservatives

Preservatives	Functions	Example	Side effect
Salt	Draws the water out of the cells of microorganisms. Retards the growth of microorganisms.	Salted vegetables, fish, meat	Increase the risk of cardiovascular diseases
Sugar		Fruit jam, condensed milk	Tooth decay, diabetes and obesity
Vinegar	Lowers pH to inhibits the growth of microorganisms (grows at pH 6.6 – 7.5).	Pickled cucumber	-
Sodium nitrite / sodium nitrate	Slows down the growth of microorganisms. Stabilize red colour in meats.	Sausage	Carcinogenic
Benzoic acid / sodium benzoate	Slows down the growth of microorganisms.	Tomato sauce	-
Sulphur dioxide		Grape juice	Asthma and allergies

Antioxidants

- added to food as food additives to prevent rancid fats and brown fruits.
- This prolonged the edible period of food and retain its nutrient by inhibiting the effects of excessive oxygen on food (oxidation), which is directly beneficial to human health.
- Natural antioxidants may include ascorbic acid and tocopherols, while common synthetic antioxidants include TBHQ, BHA and BHT.

Examples of Antioxidants

Antioxidant	Functions	Example	Side effect
Vitamin E (tocopherols)	Prevent oils from turns rancid	Palm oil & sunflower oil	No
Vitamin C (ascorbic acid)	Preserve the colour of fruit juice and the formation of nitrosamines	Fruit juice & cured meat	No
Sodium citrate	Stop rancidity in fats	Ice-cream	-
BHA (Butylated hydroxyanisole) BHT (Butylated hydroxytoluene)	Retard rancidity in fats, oils and oil-containing foods	Margarine & cereal	Carcinogenic

Flavourings

- Food additives which gives / strengthen the taste/smell of a particular food.
- It restores taste loss due to processing & allows food to be sweet, sour, salty, bitter and so on.
- 2 types of flavouring agents :
- Natural flavourings (Extracted from natural resources – orange, peppermints & screw pine [pandan] leaves)
- Synthetic flavourings (Substances derived from sources other than natural resources – MSG)

Examples of Flavourings

Flavouring	Functions	Example	Side effect
MSG (monosodium glutamate)	Bring out the flavour	Salad dressing, frozen food, spice mixes, meat / fish-based products & canned / dry soup	Headache, allergy, thirsty, nausea & chest pain.
Aspartame & Saccharine (non-sugar sweetener)	Sweeten food (about 180 – 200 times than sugar). Fewer calories than sugar.	Soft drinks, low-calories frozen desserts & diet drinks	Increase the risk of leukemia, cancer and neurological problems.
Synthetic essences (esters)	Produce artificial flavours which resemble natural flavour. Cheaper to use than the real fruits.	Methyl butanoate (apple flavour), octyl ethanoate (orange flavour), pentyl ethanoate (banana flavour), Ethyl butanoate (pineapple flavour)	-

Stabilisers

- Used in production of food which contain water and oil to provide a firmer texture to food & prevent an emulsion from separating out.
- Works by stabilising emulsions through the inhibition of reactions between chemicals in food.

Examples of Stabilisers

Stabilisers	Functions	Example
Mono-glycerides/ Di-glycerides of fatty acids	Mix oil and water	Ice-cream, chewing gum, beverages, whipped topping and margarine
Acacia gum	Mix two liquids that do not mix together. Forms an emulsion.	Marshmallow, gumdrop, edible glitter, carbonated drink syrup & gummy candies
Lecithin	Reduces viscosity. Replaces more expensive ingredients. Controls sugar crystallisation and the flow properties of chocolate. Helps in the homogeneous mixing of ingredients. Uses as a coating.	Margarine, dough, candy bar & cocoa powder
Gelatin	Mixture of peptides and proteins of collagen extracted from the boiled bones, connective tissues, organs and some intestines of animals	Fruit jam, jelly babies, shells of pharmaceutical capsules, margarine & yogurt

THICKENERS / THICKENING AGENTS

- Increases the viscosity of food without significantly altering other physical or chemical properties and give the food dense, smooth and uniform texture.
- Usually based on proteins (such as collagens, gelatins and egg whites) or polysaccharides (such as pectin, starches and vegetable gums).
- Relatively specific to the type of food due to the different responses in the physic-chemical conditions of the food.

EXAMPLES OF THICKENERS

Thickeners	Functions	Example	Side effect
Acacia gum (as well as stabilizer)	Reduces the surface tension of liquid. Leads to increased fizzing. Mix two liquids that do not mix together. Forms an emulsion.	Marshmallow, gumdrop, edible glitter, carbonated drink syrup & gummy candies	-
Gelatine (made from the boiled bones, skins and tendons of animals)	Mixture of peptides and proteins of collagen extracted from the boiled bones, connective tissues, organs and some intestines of animals	Fruit jam, jelly babies, shells of pharmaceutical capsules, margarine & yogurt	-
Pectin	Dietary fiber	Fruit jam	-
Starch	Thicken food	Soup, custard, pudding, noodles and pasta	-
Modified starch	Increase their visco-stability	Instant soups & cheese sauce granules	-
Xanthan gum	Helps to prevent oil separation. Increase in the viscosity of a liquid	Sauce & salad dressing	Allergies

FOOD DYES / FOOD COLOURINGS

- Substances added to food (include solid food and drinks) to give it a new colour.
- Functions :
  - Enhance the looks of food, especially when their natural colouring are loss during the processing and packaging of the food.
  - Add colour vanished and replace colour vanished during food processing
  - Make food appear more attractive
- Can be synthesised / can also be obtained naturally.
- Effects from food dye include hyperactivity, allergic reactions and many other side effects.
- Examples:
  - Chlorophyll (dark green)
  - Turmeric (yellow)

EXAMPLES OF FOOD DYES

Dyes / Colourings	Function	Examples	Side effect
Tartrazine E102 / Sunset yellow E110 (artificial dye)	Yellow azo dye	Orange drinks, sweet & custard powder	Hyperactive in children
Brilliant blue FCF Blue 1 (artificial dye)	Blue triphenyl dye	Ice-cream, beverages, jellies & blue raspberries flavoured product.	Allergic
Carmosine E122/ Azorubine (artificial dye)	Red azo dye	Sweet, jellies & confections	Carcinogenic & allergic
Anthocyanin (natural dye – red grape, red cabbages, sweet potatoes and tomatoes)	Natural red colouring	Ice-cream & sweet	-
Carotenoids / saffron (natural dye – carrots, sweet potatoes and palm oil)	Natural red colouring	Cooking oil & confections	-
Paprika	Natural red colouring	Dessert food	-
Butterfly pea (clitoria ternatea)	A blue food dye	Dessert food & confections	-
Pandan (pandanus amaryllifolius)	A green food dye	Noodles & confections	-

Advantages & Disadvantages Of Food Additives

- Advantages :
- Make the food stay fresh longer, look nicer & taste better.
- Make seasonal crops & fruits available throughout the year.
- Disadvantages :
- Some of them are associated with diseases like cancer, allergies & hyperactivity.
- Make the food less nutritious.

MEDICINE (DRUG)

- Chemicals that help to cure infection and maintain our health and well being.
- Can be obtained from natural sources or synthetic chemicals.
- 2 types of medicine :
- Traditional medicines
- Modern medicines – medicines that are made by scientists in laboratories which are based on substances found in nature that is identified, extracted and purified.

Traditional Medicine

- Medicines obtained naturally from animals and plants without processing them.
- Side effects :
  - High doses of quinine may cause hearing loss.
  - Medical plant containing alkaloid is toxic to the liver.
- Examples :
  - Ginger(halia) – to treat colds and flu, remove wind from stomach
  - Garlic(bawang putih) – treat colds, asthma and flu, prevent high blood pressure and lower glucose level.
  - Lycopodium ceruum(rumput serani) - To treat coughs and rheumatism

Other Examples :

Traditional medicine	Uses
Aloe vera (lidah buaya)	•To treat skin wounds/itchiness •Used in cosmetic industry
Centella asiatica (pegaga)	To treat depression and for longevity
Eurycoma longifolia (tongkat ali)	To increase the male libido booster
Orthosiphon aristatus (misai kucing)	To treat gout, diabetes and rheumatism
Andrographis paniculata (hempedu bumi)	To treat diarrhoea, fever and diabetes
Ocimum basilicum (selasih)	To treat coughs, colds and bronchitis

Medicinal animal	Functions
Sea cucumber (gamat)	To treat Japanese encephalitis and hole in the heart
Centipede	To treat lockjaw and convulsions
Ant	To treat hepatitis B

MODERN MEDICINES

- Medicines that are made by scientists in laboratories which are based on substances found in nature.
- Classified into analgesics, antibiotics and psychotherapeutic medicines.

Analgesics

- Medicines used to relieve pain without causing numbness or affecting consciousness.
- Relieve pain but do not cure the disease.
- Common analgesics :

a. Aspirin (mild analgesics)
b. Paracetamol (mild analgesics)
c. Codeine (strong analgesics)

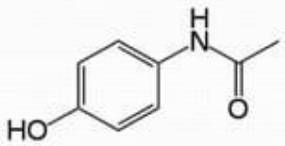
Aspirin

- Used for relief, particularly where there is inflammation involved, such as arthritic pain and dental pain.
- Also used in preventing blood clotting and relieving fever.
- Active ingredient : acetylsalicylic acid
- Acidic in nature.
- Side effects:

→ Can cause bleeding in the stomach as aspirin is very acidic.
→ Can cause allergic reactions, skin rashes and asthmatic attacks.
→ Can cause brain & liver damage to chlidren with flu / chicken pox. (Never be given to children)
→ Can cause ulcers & internal bleeding.

Paracetamol

- Taken to relieve mild to moderate pain – headache, muscle & joint pains, backache & period pains.
- Can be taken by children (do not irritate/bleed the stomach)
- Side effects (regular basis for a long time) :
  - Causes skin rashes, blood disorders and acute inflammation of the pancreas
- Overdose of paracetamol can cause liver damage.



Codeine

- Analgesic used in headache tablets and in cough medicines.
- Most codeine is synthesized from morphine.
- May cause drowsiness when it is taken.
- Abuse of this medicine may lead to skin rashes, addiction, depression and nausea.

ANTIBIOTICS

- Chemicals that destroy or prevent/slow down the growth of infectious microorganism.
- Used to treat diseases caused by various bacteria.
- Not effective against diseases caused by viral infections such as influenza, measles, or small pox.
- Examples of antibiotics are penicillin & streptomycin.
- Both penicillin and streptomycin are broken down by the acid in the stomach.
- Usually given by injection and are not taken orally.
- Patient take full course of the antibiotics to make sure that all the bacteria are killed. Otherwise, he may become ill again and the bacteria may become more resistant to the antibiotic.
- Side effects of antibiotics : headache, allergic reaction, diarrhoea.

Penicillin

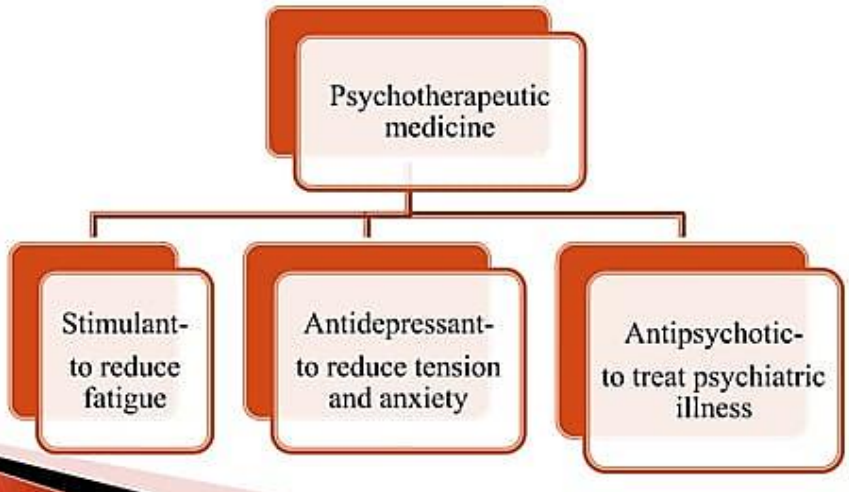
- Derived from the mould Penicillium notatum.
- Used to treat diseases, caused by bacteria, such as pneumonia, gonorrhea and syphilis.
- Only effective on certain bacteria. For example, it cannot be used to treat tuberculosis.

Streptomycin

- An antibiotic produced by soil bacteria of the genus *Streptomyces*.
- is used to treat tuberculosis(TB), whooping cough and some forms of pneumonia.

PSYCHOTHERAPEUTIC MEDICINE

- Used to alter abnormal thinking, feeling or behaviours in people with mental illness.
- Do not cure mental illness, but reduces the symptoms and help a person to get on with life.



Stimulant

- Used to reduce fatigue and elevate mood.
- Examples :
  - Methylphenidate,
  - Dextroamphetamine,
  - Amphetamine.
- High dose or excessive use of stimulants over long periods of time can lead to anxiety, hallucinations, severe depression, or physical and psychological dependence.

Antidepressant

- Used to treat depression, reduce tension and anxiety.
- Examples:
- Tranquilisers
- Barbiturates

Examples of Antidepressant

Example	Side effects
Tranquilisers	Tranquilisers cause drowsiness, poor coordination or light-headedness. Overdose of these drugs can lead to respiratory difficulties, sleeplessness, coma and even death.
Barbiturates	Barbiturates cause addition. People who rely on barbiturates to fight against insomnia sometimes kill themselves accidentally by taking an overdose.

Antipsychotic

- Used in treating psychiatric illness like schizophrenia.

Example	Side effects
Chlorpromazine, haloperidol and clozapine	Antipsychotic medicines cause drowsiness, rapid heartbeat and dizziness.