Chemistry in day to day life (U21CH6OE)

Unit I- Adulteration of food

Simple methods to find adulteration of milk, food, oils (edible and mineral) and honey- food laws- food poisoning and its prevention - Food preservation- Food colours - permitted and non- permitted – Toxicology. Flavours – natural and synthetic – Toxicology – Sweetening agents- Toxicology of other functional additives.

Unit II- Chemicals in Pharmacy

Definition, examples and therapeutic uses of the following (an elementary study only) - Antiseptics, Mouth washes, Antibiotics,Antacids, Analgesics, Antipyretics, Antimalarials, Anaesthetics, Haematinics, Laxatives, Sedatives, Cardiovascular drugs, Neoplastic drugs, Hypoglycemic drugs, Anti-convulsant drugs and Sulphonamides

Unit III- Soaps and Detergents

Soaps – Basic chemical composition of soaps- classification of soaps-manufacture of soap by continuous process- Toilet soap, bathing bars, washing soaps, liquid soap manufacture – Batch process, cold process, hot process.

Detergents-Introduction- types of detergents – Detergent action- Common detergent chemicals. Enzymes used in commercial detergents- Environmental Hazards

Unit IV- Cosmetics

Basic concept– composition and classification of creams- face creams, sun screen and sun tan lotions, deodorants, talcum powder, skin care products, dental cosmetics, hair dyes, shaving cream, shampoo, lipsticks. General formation for each type - Toxicology of cosmetics.

Unit V- Plastics in daily use:

Introduction to polymers–types of polymers- thermoplastics and thermosetting plastics - advantages of plastics - uses of LDPE, HDPE, PP, PS, PET, Bakelite and melamine- Recycling of plastics- International Universal recycling codes and symbols for identification. Environmental Hazards of plastics-Biodegradable plastics.

References

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UNIT-I
ADULTERATION OF FOOD

Definition

Adulteration of food is defined as the process by which the quality of a food stuff is reduced through addition of a cheaper or by removing any one of its nutritive components. For example, milk is said to be adulterated when water is added or butter (fat) is removed from it. Food adulteration by unscrupulous traders is a widely prevalent menace all over the world.

Modes of Adulteration of food:

i. Addition of cheaper or inferior substance.
ii. Removal of quality ingredient from the food item.
iii. Preparation of food under unhygienic conditions.
iv. Obtaining food from a diseased animal.
v. Incorporating a poisonous component.
vi. Entry of harmful constituents from the container used.
vii. Use of non-permitted food additives (e.g. colorants, sweeteners).

Food adulterants and their ill-effects

In India, almost all foods - milk, edible oils, honey, ghee, liquors, soft drinks, cereals, pulses and spices are adulterated. Adulteration lowers the nutritive value of food. It also causes health hazards ranging from minor skin allergy to fatal caner.

Food Adulterants and Food borne diseases

i.	Milk	Dirty water	Vomiting, Diarrhoea
ii.	Edible oils	Mineral oil Argemone oil	Damage to liver, Cancer Loss of eye sight, Cardiac arrest
iii.	Ice Cream	non permitted colourants	Diarrhoea,
iv.	Liquor	Methanol	Blindness
v.	Turmeric	lead chromate powder	Abortion, Paralysis, Cancer

vi.	Chilly Powder	Brick Powder	Damage to digestive system
		Non-permitted colourants	Stomach trouble
vii.	Coriander powder	Nor-permitted colourants	Stomach trouble

Simple tests to detect Adulteration of food

1. **Adulteration in Milk :**

   i. **Food** : Milk
   Adulterant : Water
   Test : The specific gravity of cow's milk as measured by a lactometer is 1.032. Addition of water decreases the Specific gravity well below 1.026.

   ii. **Food** : Milk
   Adulterant : Starch
   Test : (Iodine test) A drop of iodine solution is added to a small quantity of the milk sample - Blue colour

   iii. **Food** : Milk
   Adulterant : Removal of fat
   Test : Unadulterated cow's milk contains 3.7gms of fat per 100ml. Removal of butter (fat) decreases the value.

   iv. **Food** : Milk
   Adulterant : Removal of protein
   Test : Unadulterated cow's milk has a protein content of 3.3 grams per 100ml. If casein is removed from the milk sample, the protein content will be lower than 3.3 grams.

2. **Adulteration in Oils**

   i. **Food** : Vegetable oil (e.g. coconut oil)
   Adulterant : Mineral oil

Test : (Holde test) About 2ml of the oil sample is refluxed with 50ml of N/2 alcoholic potash till the solution becomes Clear. The solution is cooled and 10ml of warm distilled water is added through the sides of the distillation flask - Turbidity.

ii. **Food** : Edible oil (e.g. mustard oil)
Adulterant : Argemone oil
Test : About 5ml of the oil sample is heated with 5ml of conc HNO_3 for 2-3 minutes - Red colour.

iii. **Food** : Edible oil (e.g. coconut oil)
Adulterant : Allyl isothiocynate (flavor)
Test : (Lassaigne's test) Air is passed through the oil sample. HCN is carried away by the air and absorbed in aqueous NaOH. The solution is mixed with 2ml of freshly prepared $FeSO_4$ solution and 2 drops of $FeSO_3$ solution – Blue or Bluish green ppt or solution.

iv. **Food** : Edible oil (e.g. coconut oil)
Adulterant : Cheaper edible oil (e.g. castor oil)
Test : About 5ml of the oil sample is dissolved in petroleum ether and the solution is cooled in freezing mixture (ice+salt) - Turbidity within 5 minutes.

3. Adulteration in Ghee

Food : Ghee
Adulterant : Vanaspati
Test : Unadulterated quality ghee has an acid content of 3%. Old or adulterated ghee has a much higher value.

4. Adulteration in Honey

Food : Honey
Adulterant : Cane sugar syrup

Test : A cotton wick soaked in the honey sample is lighted. The wick burns with cracking noise.

5. Adulteration in Ice-cream, Confectionery and Soft drinks

i. **Food** : Ice cream, confectionery or soft drink.
Adulterant : Metanil yellow (colourant)
Test : About 2gm/2ml of the food sample is mixed with 5ml of alcohol. A few drops of conc. HCl are added and the solution is shaken with water - Magenta red (violet) colour.

ii. **Food** : Ice-cream, confectionery or soft drink
Adulterant : Saccharin (sweetener)
Test : A small amount of the food sample is treated with ferric chloride - Deep red colour.

6. Adulteration in Condiments

i. **Food** : Turmeric powder
Adulterant : Metanil yellow
Test : Same as 5 (i)

ii. **Food** : Turmeric powder
Adulterant : Lead chromate (colourant)
Test : A tea-spoonful of the food sample is boiled with conc. HCl and filtered hot. The failure is treated with KI solution - Yellow ppt.

iii. **Food** : Chilly powder
Adulterant : Brick powder
Test : A tea-spoonful of the food sample is added to water taken in a beaker - Grittiness is felt on touching the sediment.

iv. **Food** : Chilly powder

Adulterant : Red coal tar dye

Test : A pinch of the food sample is sprinkled on liquid paraffin taken in a beaker - Red colour

7. Adulteration in Coffee powder

Food : Coffee powder

Adulterant : Chicory (colourant)

Test : A few ml of coffee decoction is boiled with an equal amount of conc. HCl. To the solution,1ml of Seliwanoof's reagent is added - Red colour.

8. Adulteration in Tea dust

Food : Tea dust

Adulterant : Brown coal tar dye

Test : A pinch of the adulterated tea dust is sprinkled on a wet blotting paper - Brown colour

9. Adulteration in Asafoetida

Food : Asafoetida

Adulterant : Resin (natural or synthetic)

Test : About 1gm of the sample is powdered and extracted with alcohol. To 5ml of the extract, a few drops of 10% aqueous ferric chloride are added- Olive green colour

10. **Adulteration in Sugar**

Food : Sugar

Adulterant : Fine sand

Test : Same as 6 (iii)

11. Adulteration in Wheat flour

Food : Wheat flour

Adulterant : Chalk powder

Test : Same as 6 (iii)

12. Adulteration in Rice

Food : Rice

Adulterant : Find sand

Test : Same as 6 (iii)

13. Adulteration in Pulses

Food : Pulses

Adulterant : Kesari dal

Test : To about 2gms of the sample 5ml of dil. HCL are added and the solutions is kept in simmering (boiling) water for 15 minutes- pink colour.

Food poisoning

Contamination of food with natural toxic substances is called food poisoning. It may be caused by toxic plants or microbes, toxins produced microbes and metal contaminats. Ingestion of poisoned food causes stomach pain, vomiting, diarrhoea and paralysis.

Food poisoning is of two types, namely food intoxications and food infections. Food intoxications: It is due to the presence of toxins produced by certain microbes like bacteria or fungi in the food. It may also be caused by poisonous metals like arsenic, antimony, lead and tin.

Examples:

a. The growth of Aspergillus flavous (fungus) in groundnut and coconut copra produces a toxin aflatoxin. It causes carcinoma (cancer).
b. Clostridium botulinum is an anaerobic bacterium which can grow in meat, fish and other protein foods producing a toxin called botulinum. It causes a disease called botulism which is characterised by the symptoms - blurred vision or double vision, dialated pupils, paralysis of eye muscles, difficulty in speaking, swallowing and breathing.
c. The bacterium staphylococcus aureus (S. aureus) produces a toxin which poisons milk, processed meat, potato salad and sandwich. The staphylococcal food poisoning causes nausea, vomiting and diarrhoea. The sources of S.aureus are nasal secretions of human beings suffering fever sinus infection, boils and infected wounds.
d. Food is poisoned with arsenic through pesticide sprays on fruits like apples and grapes.
e. Lead could get into food through lead pipes used to carry drinking water.

f. Canned foods are likely to be contaminated with poisonous antimony and tin.

ii. Food infections: It refers to the illness caused by eating food contaminated with toxic or living microbes. Examples:

(i) Snakeroot is a toxic weed and drinking milk from cows that have fed on this weed is harmful.

(ii) Salmonellosis is a disease caused by eating food contaminated with the bacterium Salmonella. The symptoms of salmonellosis include chills, headache, nausea, vomiting, abdominal pain and severe diarrhoea.

Prevention of Food poisoning

1. Food should be handled under strict hygienic conditions. This can be achieved by adopting the following precautions by the food handlers.
   i. Should wash hands frequently.
   ii. Should wear clean clothes.
   iii. Should not smoke during food preparation
   iv. Sneezing and coughing should be avoided.
   v. Should be free from communicable diseases like cold, cuts, boils and sinus infection. If not, the cuts, boils and septic lesions should atleast be dressed properly.
2. Cooking utensils should be kept clean.
3. Fruits, vegetables and cereals should be washed thoroughly before use.
4. Milk should be pasteurized before use.
5. Potable water should be used in food preparation.
6. Cooked food should be stored in closed containers.
7. Left over foods should be stored in a refrigerator.
8. Dried food grains and oil seeds should be used.
9. Perishable foods like meat and fish should be canned in air tight and properly coated containers.
10. Use of non permitted food additives like flavors, colorants, sweeteners and preservatives should be avoided.

Food additives

The various substances used to improve the quality of food are called food additives. They are sweeteners, flavours, colorants and preservatives.

i. Sweeteners : Sugar, jaggery and honey are the naturally occukrring substances used for sweetening food stuffs. Now -a-days, synthetic sweeteners are comkmercially used in pharmaceuticals, jams, jellies, ice creams, sweets, chocolates and soft drinks. Examples: Saccharin, sodium cyclamate (sodium N-cyclohexyl sulphamic acid) Synthetic sweeteners are non – nutritive as well as carcinogenic. Therefore, avoiding food containing synthetic sweeteners is advisable.

ii. Flavours : The various substances used to impart a pleasant smell and taste to food are called flavours. spices (e.g. asafetida, omum, cloves, cardomum, curryleaves, coriander leaves) are used to give pleasant smell to the cooked food. Condiments such as coriander, chilli, turmeric, tamarind, garlic, cumin and black pepper add taste to food. At present, about 1000 chemical flavours mostly synthetic are commercially prepared and used.

Examples :

i. Essential oils like clove oil, jasmine oil, lavender oil, sandalwood oil, lucalyptus oil, rose oil, peppermint oil etc. These are usually called food essences.

ii. Vanillin, linalool and coumarin are synthetic food essences used in ice creams, beverages, jams and bakery.

iii. **Colourants** : In olden days, various substances of plant origin were used to give attractive colours to foodstuffs. They include chlorophyll, cochineal, saffron and turmeric.In modern days, they have been largely replaced by synthetic colourants (dyes). Examples : Amaranth, tartrazine, erythrosine, naphthol orange, naphthyl yellow, sunset yellow quinoline yellow, food green – S, indigo carmine, carmoisine, patent blue – V, crystal red – F, fast red – E, Victoria scarlet 3R etc., These are used in chocolates, peppermints, jam, ice cream, sweets and soft drinks.

iv. **Preservatives** : These are chemicals which preserve food by preventing the growth or killing bacteria, molds etc. Examples :

Food	**Preservative used**
Eggs	Sodium benzoate, water glass
Meat	Sorbic acid, propyl gallate
Vegetables	Diphenyl, ozone & Fruits

Carcinogens

Chemicals capable of causing cancer (carcinoma) are called carcinogens. More than 800 such substances (both natural and synthetic) have been identified. Examples :

i. Aflatoxin derived from the fungus Aspergillus flavus is a carcinogen.
ii. Sodium nitrite, a preservative of meat, is capable of producing nitrosoamines which are carcinogenic.
iii. The antificial sweeteners like dulcin and cyclamate are known to cause liver cancer.
iv. Rose milk is coloured with Rhodamine B which is carcinogenic.
v. Turmeric powder is adulterated with the carcinoger lead chromate.

QUESTIONS

1. How do you detect adulteration of oils?
2. What are food preservatives? Give examples.
3. Explain the simple methods to detect adulteration of food stuffs and oil.
4. Give a brief account of food additives.
5. What are the sources of food poisoning ? Mention the preventive measures for food poisoning.
6. How are edible oils adulterated? How will you detect the presence of mineral oil in edible oil?
7. How is milk adulterated? Give any two methods to measure the quality of milk.

UNIT-II

CHEMICALS IN PHARMACY

2.1 ANTISEPTICS

The drugs (chemical substances) which are used to kill or to prevent the growth of microorganisms are called antiseptics. Mild doses of chemical substances are used in living tissues. High doses of the same chemical substances are used as disinfectant in non-living objects and they kill the organism immediately.

Examples:

Alum, Boric acid, Zinc oxide, Dettol etc.

2.2 Alum (potash alum)

Potassium Aluminium sulphate (potash alum) is commonly known as Alum. It is represented as $K_2SO_4.Al_2(SO_4)_3.24H_2O$

Therapeutic uses of Alum

i) Alum is used as a mild antiseptic

ii) It is used as an astringent

iii) It is also used to arrest bleeding from small cuts.

2.3 Boric Acid

Ortho boric acid is commonly known as bori acid. It is represented as H_3BO_3.

Therapeutic uses of Boric acid

i) with liquid paraffin, boric acid used as skin ointment

ii) Dilute aqeous solution of boric acid(4%) is used as an eye lotion, ear drops and mouth washes

iii) It is used as a dusting powder to heal wounds.

iv) It is common ingredient of prickly heat powders

2.4 MOUTH WASHES

Mouth washes are oxidising chemicals which antiseptic properties due to liberation of nascent oxygen**.** It oxidises the protein of the bacteria responsible for bad breath in the mouth and kills them.

Examples: Mild doses of H_2O_2, $KMnO_4$

2.5 Therapeutic uses of Hydrogen peroxide

i) A 30% solution of hydrogen peroxide is used as an antiseptic for washing wounds

ii) A mild Dose of 0.2 to 0.5 % solution of hydrogen peroxide is used as mouth wash.

2.6 ANTIBIOTICS

Antibiotics is a drug derived from living matter or micro-organism which either prevents the growth of other micro organism or destroy them. Antibiotics are effective in curing infectious diseases produced by protozoa, bacteria and fungi. The antibiotics are very specific in their action. A given antibiotic is effective against certain types of micro-organisms only. Penicillin (in 1940) is the first antibiotic to be used therapeutically.

Examples:

i) Antibiotics which are effective against gram-positive bacteria**:**

Penicillin, Fucidin, bacitracian etc.,

ii) Antibiotics which are effective against gram-negative bacteria:

Streptomycin, cycloserine etc.,

iii) Antibiotics which are effective against both gram-positive bacteria and gram-positive bacteria: Tetracyclines, chloremphenical ec.,

iv) Antibiotics which are effective against protozoa:, paromomycin, Tetracyclines

v) Antibiotics which are effective against fungi: Nystatin, Amphotericin B etc.,

Therapeutic uses of Penicillin:

i) Penicillin is effective against gram positive bacteria.

ii) It is used for the treatment of Tetanus.

iii) It is used for the treatment of pneumonia and Rheumatic fever.

iv) It is used to cure gangrene.

v) It is also used for the treatment of venereal diseases.

Therapeutic Uses of Tetracyclines

i) Tetracycline is a popular broad spectrum antibiotic.

ii) It is used for the treatment of infection in the urinary track.

iii) It is used for the treatment of Anthrax and plague.

iv) Tetracyclines are used in veterinary medicine.

v) It is used for the prevention of malaria fever, bronchitis, pneumonia

2.7 ANTACIDS:

Chemical substances which are used to balance the excess acid in stomach or duodenum and relieving the pain due to peptic ulcer are called antacids.

Examples: Aluminium hydroxide, Magnesium silicate

Therapeutic uses of Aluminium hydroxide

i) Aluminium hydroxide gel is used for treating peptic ulcer. It is a slow acting antacid. It can control gastric acidity for a long period.

ii) It is also used for acute hyperacidity

Therapeutic uses of Magnesium silicate

Magnesium silicate is an effective antacid. It neutralises the excess acidity of the gastric juice in stomac and gives relief from peptic ulcer.

2.8 ANALGESICS

Analgesics are the drugs which relieve pain by acting on the central nervous system without loss of consciousness.

Examples:

Natural Analgesics: Morphine, Codeine, heroin, etc.,

Synthetic analgesics: Paracetamol, Aspirin, Pethidine, methadone, morphinan, benzomorphan etc.,

Therapeutic uses of Aspirin

i) Aspirin is a popular nonsteroidal anti-inflammatory drug. (NSAID)

ii) It is used to reduce fever.

iii) Aspirin is used for the treatment of common cold and Headaches.

iv) It is used to reduce pain and swelling in conditions such as arthritis.

v) Aspirin is effective for the primary and secondary prevention of cardiovascular disease and stroke.

vi) It is one of the most widely used OTC drug (Over counter drug)

vii) Aspirin is effective for the treatment of cancers and Alzheimer's disease.

Therapeutic uses of paracetamol

i) paracetamol is a popular drug for reducing fever.

ii) paracetamol is used to treat headache, muscle ache etc.,

iii) It is used for the treatment of backpain, tooth pain and cold.

iv) It relieves pain in mild arthritis.

2.9 ANTIPYRETICS

Drugs that reduces fever or quells it are called as Antipyretics**.** Many antipyretics have analgesic action also.

Example: Analgin, novalgin, Ibubrufen, Acetaminophen, Diclofenac, Phenacetin

2.10 ANTIMALARIALS

Antimalarials are a type of antiparasitic drugs used for the treatment and prevention of malaria infection caused by protozoa plasmodium species. Most antimalarial drugs target the erythrocytic stage of malaria infection, which is in a phase of infection that causes symptomatic illness.

Examples:

Quinine, Quinine sulphate are Natural cinchona alkaloids

Chloroquine, Atovaquone, proguanil are synthetically derived

Therapeutic uses of antimalarial drugs:

i) Antimalarial drugs are used to treat malaria fever caused by protozoa like plasmodium vivox transmited through musquitos bites. (anabeles species)

2.11 ANAESTHETICS

Medicines that cause anaesthesia are called Anaesthetics**.**

Anaesthetics are used during tests or surgical operations to numb sensation in certain areas of the body or induce sleep. This prevent pain and discomport, and enables a wide range of medical procedures to be carried out.

Examples:

Local Anaesthetics are medicines that block the conduction of impulses in nerves that relay pain signals. Benzocaine, Lidocaine, mepivacaine etc.

General Anaesthetics are medications that induce and maintain state of unconsciousness. Propofol etc.,

2.12 HAEMATINICS

Drugs used for the treatment of anaemia are called anti-anaemic drugs or Haematinics**.** Shortage of iron in the diet is the common cause of anaemia. It may be treated either with iron rich diet or by administering iron in ferrous form orally or by injection.

Examples:

Ferrous Gluconate, Ferrous fumarate etc.,

Therapeutic uses of Ferrous Gluconate

It is used to treat anaemia

2.13 LAXATIVES

Mild doses of Purgatives are called laxatives. Purgatives are drugs used in the treatment of constipation

Examples:

Epsom salt, Milk of magnesia, etc.,

Epsom Salt:

Hydrated magnesium sulphate is known as Epsom salt**.**

Therapeutic uses of Epsom Salt:

i) It is used as an Osmotic laxative.

Milk of magnesia:

A suspension of magnesium Hydroxide in water is known as milk of magnesia.

Therapeutic uses of Milk of Magnesia

i) it is used as an antacid to neutralise stomach acid.

ii) It is used as a laxative

iii) Milk of magnesia is useful against canker sores(ulcer)

iv) It is used as a deodorant.

v) It is also used to relieve indigestion and heartburn

2.14 SEDATIVES

Sedatives are drugs which act as depressants of the central nervous system and reduce excitement without inducing sleep. In heavy doses they act as hypnotics which act on central nervous system and induce sleep. Sedatives are used to get relief from tension, anxiety and restlessness.

Examples:

Diazepam, Biurets, Alkyl ureas etc.,

Therapeutic uses of Diazepam

i) Diazepam is an anti-anxiety drug. It is used to get relief from mental depressions, anxiety, tension, worry apprehensions etc.,

ii) It is used to treat Neurological disorders in patients

iii) It is used as an psychostimulant and skeletal muscle relaxant

iv) in the management of agitation during withdrawal from alcohol

2.15 CARDIOVASCULAR DRUGS

Drugs that are used to regulate an abnormal heart rhythm are called Cardiovascular drugs. A wide range of medications are used to treat various heart conditions.

Anticoagulants or blood thinners: Heparin , warfarin, etc.

Antiplatelet Agents: play important role in blood clotting. Aspirin, ticlopidine, lopidogrel, dipyridamole.

Angiotensin-converting enzyme inhibitors: these agents expand blood vessels. Captopril, enalapril etc.,

Angiotensin II receptor blockers: These agents are useful in the treatment of high blood pressure, heart failure and heart attacks. Candesartan, valsartan etc.,

2.16 NEOPLASTIC DRUGS

Anti neoplastic drugs are medications used to treat cancer**.** They may be anticancer, Chemotherapeutic, cytotoxic or hazardous drugs

Examples:

Platinum coordination complexes like cisplatin, carboplatin, Oxaliplatin etc.,

2.17 HYPOGLYCEMIC DRUGS

The drugs which lowers the blood sugar level and treat symptoms of diabetes mellitus are known as hypo glycemic drugs.

Examples:

Insulin, Tolbutamode, Chloropropamide, Glybenclamide,Tolazamide, Phenformin, Metformin etc.,

2.18 ANTI-CONVULSANT DRUGS

Anti-conversant or anti-epileptic drugs or antiseizure drugs are used to treat seizures occurring due nerve damage. They also prevent the spread of the seizures within the brain

Examples:

Paraldehyde, Aromatic allylic alcohols, Barbiturates

2.19 SULPHONAMIDES

Sulphonamides are functional groups that is the basis of several groups of drugs which are called sulphonamides or sulpha drugs inhibit the spread of pathogenic bacteria

Examples: Sulphacetamide, sulphadiazine etc.

Therapeutic uses of Sulphonamides

Salphonamides are used in the treatment of infections caused by pathogenic bacteria

Questions

1. Define: Antiseptics, Analgesics and Antipyretics. Explain the Therapeutic uses of Aspirin, Paracetamol, Boric Acid and Aluminium Hydroxide
2. Write note on Mouth washes and Antacids with suitable examples. Give brief definition of sedatives, laxatives and Hematinics
3. What are antibiotics? Discuss its types with suitable examples
4. Write notes on

i) Hypoglycemic drugs ii) cardiovascular drugs iii) Anti conversant drugs and iv) Neoplastic drugs

5. What are antimalarials and suphonamides. Discuss the therapeutic uses of quinines and sulpha drugs
6. What are anesthetics? Discuss the types Anesthetics with suitable examples.
7. What are Hematinics/ Give the therapeutic uses of i) Ferrous Gluconat ii) Ferrous fumarate
8. Discuss the therapeutic uses of i) Penicillin ii) Diazepam iii) Milk of Magnesia iv)Potash Alum v) Hydrogen peroxide

UNIT-III

SOAPS AND DETERGENTS

SOAPS

3.1. Definition

Soaps are the sodium or potassium salts of higher fatty acids (such as lauric, palmitic or stearic acids). The are prepared by the hydrolysis(saponification) of oils and fats with sodium or potassium hydroxide.

Oil or fat + NaOH $\longrightarrow$ Glycerol +soap

Fats and oils are triglycerides (three molecules of fatty acids attached to a single molecules of glycerol)

During saponification the fats and oils are first hydrolysed into free fatty acids. These fatty acids combine with sodium hydroxide (caustic soda) to give soap and glycerol. Glycerol is the by-product in the manufacture of soap.

$$\begin{array}{l} CH_2\text{-O-COR} \\ CH\text{-O-COR} + 3NaOH \\ CH_2\text{-O-COR} \\ \text{Oil or fat} \end{array} \longrightarrow \begin{array}{l} CH_2OH \\ CHOH + 3RCOONa \\ CH_2OH \\ \text{Glycerol soap} \end{array}$$

3.2. **Classification of soaps:**

Soaps are broadly classified into *hard soaps* and *soft soaps.*

1)**Hard soaps:**

Sodium salts of higher fatty acids are called hard soaps.

Examples: Toilet soaps, Laundry soaps and Industrial soaps.

Hard soaps are prepared from coconut oil, animal fats,etc.

They are moderately soluble in water and do not produce lather easily.

2) **Soft soaps:**

Potassium salts of higher fatty acids are called soft soaps.

Examples: Shaving creams, Liquid soaps etc.,

Soft soaps are prepared from linseed oil, castor oil etc.,

They are easily soluble in water and produce lather or foam readily.

3) **Shaving soap:**

Shaving soap contains a considerable amount of potassium salt with an excess of stearic acid.

4) **Medicated soap:**

Medicated soaps contain some phenolic antiseptics added to ordinary toilet soap.

5) **Liquid soaps:**

Liquid soaps contain mainly potassium salt of fatty acids. It also contains same amount of sugar, borax and glycerine.

6) **Metal soaps:**

Metal soaps are the metal salts of commercial stearic acid.

Calcium and magnesium soaps are used as lubricants and driers in Paint industry.

3.3 Raw materials used in the manufacture of soap

The followings are the important raw-materials used in the manufacture of soap.

I. **Oil or fat:**

The main raw-material used in the manufacture of soap is oil or fat.

Example: Coconut oil, palm oil, castor oil, tallow,etc.,

II. **Caustic soda(NaOH) or Caustic potash (KOH):**

The important substance used for the hydrolysis of oil or fat is sodium hydroxide (NaOH) or potassium hydroxide KOH.

(NaOH for toilet and laundry soaps.KOH for liquid soap).

III. **Common salt (Sodium chloride):**

In soap industry, common salt is used for salting out soap.

IV. **Perfumes:**

The common perfumes used in soap manufacture are

Sandal wood oil

Lemon grass oil

Clove oil

Jasmine, rose, musk, etc.

V. **Colouring matter:**

Organic dyes and inorganic pigments are generally used as colouring matters.

Dye	Colour
Chrome green	Green
Cadmium yellow or matanil yellow	Yellow
Ultramarine or methylene blue	Blue
Eosin	Pink
Zinc oxide	White

VI. **Super fatting agents:**

Examples: Lanolin (a fatty material isolated from sheep's wool)

It improves the texture of the soap.

VII. **Disinfectants:**

Examples: Neem and eucalyptus extracts

VIII. **Germicide:**

Example: Hexa chloroprene, mercuric iodide etc.,

IX. **Fillers:**

Example: Talc, Starch, etc.,

Weight of soaps is increased by the addition of fillers.

X. **Binding materials:**

Binding material improves soap texture and prevents the formation of precipitate in hard water.

Example: Sodium silicate.

3.4 Manufacture of Toilet soaps

Toilet soaps are manufactured by hot process (batch or kettle type).

1. A mixture of melted fats and oils is taken in a kettle. A solution of 10% NaOH (soda lye) is added and steam is passed to heat the mixture.
2. Fats and oils are hydrolysed by NaOH and a homogeneous viscous solution containing soap, water and glycerol is obtained.
3. The steam is then cut off and dry sodium chloride is scattered over the surface. Soap is precipitated in the upper layer and unreacted alkali settles in the lower layer.
4. The dry neutral soap is taken from the kettle and is pumped into chilling rolls.
5. Then colouring material, perfumes and germicide are added to the soap and thoroughly mixed.
6. Finally the soap formed is converted into bars and the bars are cut into cakes, stamped and wrapped.

DETERGENTS

3.5. Definition

Detergents are sodium salts of sulphonic acid or long chain fatty alcohols. They are surfactants with cleaning properties similar to soap. Detergents are commonly available as powders or concentrated solution.

Example:

a. **Sodium lauryl sulphate –** $C_{12}H_{25}$ O-SO_3Na
b. **Sodium stearyl sulphate -** $C_{18}H_{37}O$-SO_3Na

3.6. Types of detergents:

Detergents are classified into four types

I. Anionic detergents

II. Cationic detergents

III. Non-ionic detergents and

IV. Zwitterionic or Amphoteric detergents

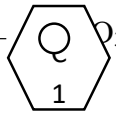
Anionic detergents:

Anionic detergents have an acidic group (anion) like sulphates or sulphonates.

Examples:

a. Sodium lauryl sulphate – $C_{12}H_{25}$ O-SO_3Na

b. Sodium stearyl sulphate - $C_{18}H_{37}O$-SO_3Na

c. $C_{12}H_{25}$ —  SO_3Na

Sodium dodecyl benzene sulphonate (SDS)

Uses: Anion detergents are used for washing fabrics such as cotton, wool, silk.

I. Cationic detergents:

Cationic detergents have tetra alkyl ammonium or pyridinium salts.

Examples:

a. $C_{12}H_{25}N^+(C_2H_5)_3Cl^-$ Triethyl dodecyl ammonium chloride

b. $C_{14}H_{29}N^+(CH_3)_3Br^-$ Cetrimide

Uses: They are used as softeners in textile industry.

II. Non-ionic detergents:

Non-ionic detergents have a non-ionic part like a polyester or polyether group.

Examples:

1. Sugar surfactants
2. Sucrose fatty acid monoesters

Uses:

They are used as grease emulsifiers.

III. Amphoteric or Zwitterionic detergents:

Amphoteric detergents have both cationic and anionic groups.

Examples:

$CH_{12}H_{25}NHC_2H_4COONa$

Deriphat (Sodium lauryl sarcosinate)

Uses: They are widely used in the preparation of shampoos and cosmetics.

3.6. Advantages of detergents over soap:

The important advantage of detergents over soaps are summerised below:

i. Detergents clean well even in hardwater. Soap is not good for washing when the water is hard.

ii. Detergents are made from hydrocarbons obtained from petroleum. Soap is prepared from vegetable oil or animal fat that are usually edible.

iii. Detergents is good even in acidic medium. Soaps cannot be used in such medium.

iv. Soaps form a scum in hardwater and this scum will not rinse away easily. Detergents react less with minerals in water and do not leave any residue.

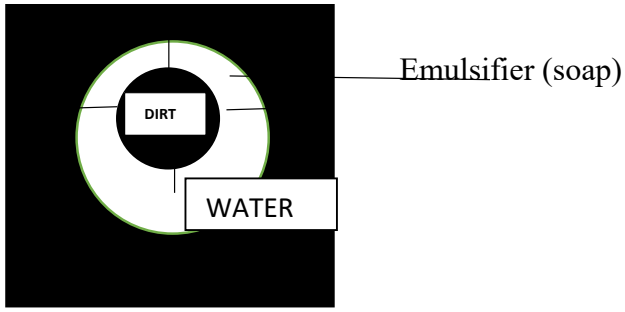
v. The cleaning power of soap decrease with storage. At the same time the cleaning power of the detergents is maintained for a considered period.

vi. Detergents will leave the laundry clean compared to soap.

vii. The main disadvantage of detergents is that, it is non-biodegradable while soap is bio-degradable.

3.8. Cleaning action of soap:

Soap is an emulsifying agent. It has a long hydrocarbon chain and a polar group. When soap is added to a fibre containing grease (dirt) in water, the hydrocarbon chain of soap (non-polar) gets strongly adsorbed on the grease (dirt). During washing it is displaced from the fibre. The grease (dirt) thus displaced assumes a globular shape and it is detached into water. Thus cleaning action of soap is an emulsification process.



The emulsifiers (soap)

get adsorbed at the interface between the dispersed droplets (dirt) and the dispersion medium (water). They lower the interfacial surface tension between dirt and water and help the mixing of the two liquids.

Questions:

1. What are soaps? How are they classified?
2. Explain the manufacture of soap.
3. Explain the cleaning action of soap.
4. What are detergents? How are they classified?
5. Discuss the advantages of detergents over soaps.

Unit – IV

Cosmetics

Cosmetics has been used, since ancient times, for enhancing the beauty and self- care.

Definition:

The word *cosmetics* derives from the Greek meaning "technique of dress and ornament",. Cosmetics are constituted from a mixture of chemical compounds derived from either natural sources, or synthetically created ones.

Skin care products:

A variety of skin care products exist in market. They fulfil a variety of functions by either acting directly on the skin (moisturizers) or being a cosmetically elegant vehicle for the delivery of specific active ingredients (sunscreens of anti-acne medicaments).

These skin care products are categorized into three functional groups:

- **Drugs:** To prevent diseases by altering the structure and function of the body.
- **Cosmetics:** To beautify and improve the skin.
- **Anintermediate** classification for cosmetic products that may enhance the function of the skin.
- The skin care product groups can also be classified by their physical properties. Emulsions, lotions, paste, suspension, tablet, powder, gels sticks and aerosols.
- Most common forms of skin care products are emulsions.

- **Water soluble ointment bases:** polyethylene glycol(PEG) polymers are water soluble and do not hydrolyze of support mold growth, for this reason polyethylene glycol make good washable ointment.
- Absorption bases can serve as concentrates for w/o emollients; water may be added to anhydrous absorption bases to form a cream-like consistency
- Petrolatum: a component of anhydrous absorption bases, absorbed into delipidized skin and to accelerate barrier recovery.

Skin care product manufacturing process:

- Mixing of the raw materials is carried out at specific temperature (about 70-75 C)

and the entire solution is agitated inside the vessel to form a homogeneous mixture.

- In a separate vessel oil phase is prepared by adding most of the chemical ingredients at a specific temperature (around 70-75 C) . Subsequently, fragrances, dyes and preservatives are added in the solution
- The solution thus formed is mixed continuously to form homogenous mixture.

  Subsequently, fragrances, dyes and preservatives are added in the solution.

Ingredients Used in Skin Creams

a. **Water:**

- Water, which is free of any toxins, pollutants, microbes, etc. is the most important and widely used raw material used in preparation of creams.
- **Purified water** is used.

b. **Oil, fates and waxes**

Waxes act as an emulsifier, fats act as a thickener and oil act as a perfuming agent, preservative, etc. according to its function. Oil may be two types' mineral and glyceride.

c. **Mineral oil**

- clear, odorless, and heavily refined oil and it is widely used in cosmetic.
- consists of hydrocarbons derived from petroleum oil.
- rarely causes allergic reactions and it cannot become solid and clog pores of the skin.

- Example
  - Light liquid paraffin
  - Heavy liquid paraffin
  - Liquid petroleum

d. Glyceride oil

- mostly vegetable oils
- Examples
  - almond oil, arachis oil, castor oil, coconut oil, olive oil etc

e. **Waxes**

- Used in preparation of cream includes beeswax, carnauba wax, ceresin, spermaceti.

f. Fats

- May be obtained from animals, plants or mineral origin
- consist of combinations of higher fatty acids and glycerin.
- fatty acid are lauric, margaric, plamitic, stearic, saturated group.
- Oleic acid is liquid and most popular unsaturated fatty acid.

g. Lanolin

- It is derived from wool fat of a sheep.
- Lanolin are of two types-
  - **Hydrous lanolin** contains between 25%- 30% water.
  - **Anhydrous lanolin** has point of 38°C- 42°C and has a slight odour.
- These are act as a lubricant on the skin surface, which gives the skin soft and smooth appearance.

h. **Emollients**

- Also commonly referred to as **moisturizers,** help to soften skin or to treat dry skin.
- Oil or grease, such as mineral oil, squalene, and lanolin work by increasing the ability of the skin to hold water, providing the skin with a layer of oil to prevent water loss, and lubricating the skin

i. Humectants

- are hydroscopic organic compound
- can absorb or retain moisture
- Example
  - glycerin, Hydroxyethyl urea, betaine, sodium PCA, Sodium-L-Lactate,

j. **Perfumes**

k**. Vitamins**

l. Preservatives

- To prevent alteration caused by microorganism and contamination during formulation, shipment, storage and consumer use.
- Antioxidants can also be used to protect alteration caused by exposure to oxygen.

Face creams

Types:

1. All purpose cream
2. Night cream
3. Cold cream
4. Vanishing cream

Preparation of creams

Following ingredients and procedures will be used for the preparation of different types of creams

All purpose cream:-

The ingredients and their proportion will be as follows:

	Parts
Lauryl alcohol	110
Bees Wax	80
Paraffin	70
Mineral oil	10
Sodium lauryl sulphate	10
Triet hanolamine	4
Water	456
Preservative	10

Perfurme

In one beaker heat first four ingredients to 82°C (180°F). In second beaker add sodium lauryl sulfate, preservative and triethanolamine to water and heat to the same temperature. Add mixture of Beaker 1 slowly to the 2nd beaker with continuous stirring. Continue stirring until the mixture has cooled to 60°C then add perfume. A homogenous paste of cream.is obtained which can be transferred in a bottle.

Night Cream: -

The ingredients and their preparation for this cream will be as follows: -

	Parts
1. Mineral oil	280
2. Olive oil	45
3. Lanolin	125
4. Stearic acid	40
5. Sp & maceti	65
6. Cetyl alcohol	125
7. Triethanolamine	109
8. Water	400
9. Preservative	10
10. Perfume	

Heat water to 70°C with triethanolamine in one beaker. Heat first six ingredients together to some temperature in the second beaker. Mix the contents of beaker 1 to the beaker 2 with continuous stirring until mixture cools to 50°C than add preservative with stirring and finally add the perfume. Store the paste in a bottle and use it as a night cream.

Cold Cream:

There are four main ingredients of the cold cream.

1. Water
2. Oil
3. Emulsifier
4. Thickening agent

Water Phase

- 160g Distilled Water

- 4g Glycerine
- 2g Colloidal Oatmeal

Oil Phase

- 6g Avocado Butter
- 18g Grapeseed Oil
- 10g Emulsifying Wax BP

Cool Down

- 2g Leucidal Liquid SF (Natural Preservative)
- 2g Vitamin E Oil (Antioxidant)
- Fragrance Blend [15 drops Vanilla Essential Oil + 7 drops Lavender Essential Oil + 7 drops Bergamot Essential Oil]

Method

1. Measure out your water phase ingredients: Distilled water, glycerine & colloidal oatmeal and your oil phase ingredients: avocado butter, grapeseed Oil & emulsifying wax
2. Over a low heat (e.g. double boiler), melt both phases in separate heat proof glasses
3. Once the oil and water phases have completely melted, mix together and transfer to a flat surface
4. To create a light and airy emulsion, use an immersion blender or whisk. As the mixture cools and more air is incorporated, it will start to thicken and change to a pale cream colour
5. When you're happy with the consistency, you can move onto preserving and adding fragrance
6. Use a scale to add your Cool Down ingredients: natural preservative, antioxidant & the fragrance blend (above) or any essential oils you prefer for fragrance
7. Briefly mix again either by hand or using a blender to ensure that all the ingredients are evenly distributed
8. Store your natural face cream in a tinted or dark-coloured glass container.

Vanishing cream

A vanishing cream is essentially a stearic acid soap with excess suspended stearic acid dispersed in water.

	Parts
1. Stearic acid	140

2. Lauryl alcohol 30
3. Triethanolamine 7
4. Sodium lauryl sulfate 5
5. Glycerine 50
6. Water 770
7. Preservative 10
8. perfume

Preparation of Face Cream Mix the first 3 ingredients and heat to 82°C. Add the sodium lauryl sulfate and the glycerin to the water and heat to same temperature and add to previous mixture with stirring. Continue stirring until cools the mixture to 60°C than add preservative and perfume.

Sun Screen and Sun tan lotions

Sunscreen preparations are rated (evaluated) with a sun protection factor (SPF), which indicates how much protection against UV rays product provides. Calculated by

$$\frac{\text{Period of protection (with sunscreen)}}{\text{Period of natural protection (without sunscreen)}}$$

PHYSICAL SUNSCREENS	CHEMICAL SUNSCREENS
Mineral Actives Zinc oxide or titanium dioxide	**Chemical Actives** Organic, carbon-based compounds
Block Sunlight Create a barrier that blocks and reflects UV rays before they reach the skin's surface	**Absorb Sunlight** Absorb UV rays and convert them to heat, which is then released by the skin
Penetrate Skin on application	Penetrate Skin on application

Suntan lotions and tanning oils won't provide enough sun protection, children should only use a sunscreen or a sunblock that provides broad-spectrum UVA and UVB protection.

Instead, a product that is considered to be a suntan lotion is usually a sunscreen with an SPF of less than 15. These "tanning" sunscreens, which typically have an SPF 4 to SPF 8, do not provide enough sun protection, especially for kids.

The terms 'sun lotions' and 'sunscreens' are used interchangeably to describe many of them. 'Suntan lotion' is sometimes used to refer to substances designed to accelerate tanning with little or no sun protection factor. Some people use the term 'sunblock' to refer to sunscreens that reflect rather than absorb UV rays.

Deodorants:

Deodorant creams are mostly made up of natural ingredients and have a consistency similar to moisturisers.

What Is a Deodorant Cream?

As the name suggests, deodorant cream is a soft cream-based deodorant which comes in a small tub or container. Unlike a spray or lotion, deodorant cream can be used with your fingers on your underarms to prevent sweating. This cream can also be applied over the wrists and elbows to stay fragrant all day.

Ingredients Required

- 1/4 Cup Shea Butter
- 2 Tbsp Coconut Oil
- 2 Tbsp Baking Soda
- 2 Tbsp Arrowroot Powder
- Few Drops of Essential Oil Of Choice

Directions

- In a big bowl, add all the ingredients and mix well.
- Do a patch test on your hand to check for any skin allergies.
- Store in a container.

Shaving Cream

Shaving cream is applied to the skin to facilitate removal of hair. Shaving cream softens and moistens the skin and the hair, thus making shaving more comfortable and contributing to smoother skin.

Lather Shaving Cream :

- Have same ingredients as that of soap with inclusion of greater amount of water to give cream consistency.
- Playing with the ratio of Na/K soaps not only affect lather but also consistency and stability of cream.
- Supper fatting agents and borax

- are added to maintain stability.

Brushless Shaving Cream:

- Not meant to produce foam
- It is o/w emulsion
- Comfortable shave is because of greater lubricating ability and subsequent reduction in razor pull or drag
- Leaves face with thin coating of oil
- Wetting agents are employed to improve beard softening

Raw Materials:

A standard ingrediants contains approximately

1. Aqua / water
2. Stearic Acid
3. Triethanolamine
4. Lanolin
5. Glycerin
6. Polyoxyethylene sorbitan monostearate
7. Laureth 23
8. Lauryl Sulfate
9. Waxes and cocamides
10. Methyl paraben
11. Ethyl parben

Manufacturing process:

The modern manufacture of shaving cream is a carefully controlled process. There are two main phases to the manufacturing process.

1. In the first phase, the fatty or oily portions of the formula - stearic acid, lanolin, and polyoxyethylene sorbitan monostearate are heated in a jacketed kettle to a temperature of approximately 179 to 188 F(80 to 85 C) for 40 minutes.
2. Then the steam is released from the outer container of the kettle, and the mixture is allowed to cool

3. The second phase of maurfacture begins when the mixture has cooled to about 152F(65C). Most of the remaining ingredients – water, glycerin and triethanolamine are added now, and mixing continues for approximately 40 minutes.
4. When the mixture reaches a temperature of 125 to 134F (50 to 55C), preservatives and perfumes of other scents can be added. Because perfumes consist primarily of highly volatile oils , thery would evaporate if added when the blend was still warm.
5. The mixture, still being stirred, is allowed to cool further, until it reaches a temperature of 89F (30C).
6. Then the mixture is ready for fillling and sealing.

Dental cosmetics:

What is cosmetic dentistry?

Cosmetic dentistry focuses on improving the appearance and aesthetics of your smile. Common cosmetic dental procedures include teeth whitening, dental bonding and veneers.

What's the difference between cosmetic dentistry and general dentistry?

A general dentist is a primary dental care provider. They offer preventative care, like teeth cleanings, and restorative dentistry treatments, such as dental fillings, crowns and bridges. Most dental treatments restore appearance as well as health and function. However, a cosmetic dentist focuses on beautifying your smile. They offer treatments aimed at improving the appearance of your teeth and gums.

Who benefits from cosmetic dentistry?

Cosmetic dentistry might be an option if you have:

- Chipped or cracked teeth.
- Small gaps or spaces between your teeth.
- Tooth discoloration and staining.
- Misshapen teeth.
- Misaligned teeth.
- Common cosmetic dental services include teeth whitening, dental bonding, veneers, and tooth and gum contouring.
- **Teeth whitening**

Over time, dark-colored foods and drinks (like coffee, tea and berries) can stain your teeth. Professional teeth whitening can dramatically and safely lighten the shade of your teeth and brighten your smile.

- **Dental bonding**
  Dental bonding involves the application of tooth-colored composite resin. Your dentist uses this material to cover up and conceal cracks, craze lines (hairline cracks), discoloration and other cosmetic imperfections. Dental bonding can change the shape of a tooth to make it longer, wider or more uniform.
  Dental bonding usually needs replacing every five to seven years. It doesn't require the removal of natural tooth enamel either, which means it's completely reversible.
- **Porcelain veneers**
  Made of medical grade ceramic, porcelain veneers are thin, strong shells that adhere to the front surfaces of your teeth. Like dental bonding, veneers can conceal a wide range of cosmetic flaws, including chips, cracks and discoloration.
- There are many types of veneers, including traditional and minimal prep. All veneers require at least some removal of natural enamel, which means they could be reversible depending on which kind you choose. In most cases, porcelain veneers need replacing every 10 years or so.
- **Tooth contouring**
  This procedure removes small amounts of enamel to change the shape of your teeth. Because you only have so much natural enamel, there's a limit to how much tooth structure your dentist can remove. Your dentist can complete tooth contouring during a single office visit.
- **Gum contouring**
  Some people are born with excess gum tissue. When this happens, it can make your smile appear "gummy" or unbalanced. During gum contouring, your dentist removes excess gum tissue and reshapes your gum line for a more symmetrical, balanced appearance.

What are the advantages of cosmetic dentistry?

Cosmetic dentistry services can:

- Enhance your smile.
- Brighten dull, stained teeth.
- Improve the shape of your teeth.

- Conceal chips and cracks.
- Bring balance and symmetry to your smile.
- Boost your confidence.

What are the disadvantages of cosmetic dentistry?

Cosmetic dentistry costs aren't usually covered by insurance. This is because insurance companies don't consider cosmetic procedures essential or necessary from a health standpoint.

You'll also need a certain level of commitment to maintain your smile. Some treatments — like porcelain veneers — are irreversible and require replacement every few years.

Lipsticks

- Most widely used cosmetic item by women to give an attractive color & appearance to lips.
- In that pigments dissolved or dispensed in fatty base i.e. fats, waxes with suitable perfume.
- Idea qualities:

  Nontoxic

  Non-irritant

  Stable both physically and chemically

  Free from gritty particles

  Free from sweating

  Should not break easily

  Shiny and smooth appearance

  Maintain color of lips for long period & remove easily

  Should not break during storage.

Formulation of Lipsticks:

1.Bases: Oily, fatty materials and waxes like mineral oil, veg oil (65 ml), cocoa butter, lanolin (5 gm),, carnauba wax (1.0 gm), beeswax (15 gm), etc.

2. Coloring materials: Titanium dioxide, soluble eosin, halogenated derivatives of fluorescein and tetra bromofluorescein.

3. Perfumes: Floral fruity and light spicy fragrances

4. Antioxidants: They are used for prevent rancidity BHA, BHT,Propyl gallate etc.

Formula:

- In a bowl, add all the ingredients and mix well.

- Store in a container.

Method of Preparation of Colorant:

Formula	Quantity for 100 gm
Quaternary ammonium compound (color)	10 – 12 gm
Anionic surfactant (surfactant)	8 – 10 gm
Acid (buffer)	6 – 8 gm
Alkanolamide (surfactant)	4 – 6 gm
Dye stuff (colour)	1 – 2 gm
Water (solvent)	To make 100 gm

- A mixture of alkanol amide and anionic surfactant is prepared.
- The dye is added to the above mixture and is dissolved.
- The acid and quaternary ammonium compounds are dissolved in water.
- This aqueous solution is added to the solution of dye with stirring.
- This dye is investigated for the effects of quaternary ammonium compound, pH, aldehydes and alcohols additions.
- Now the viscosity of the dye is adjusted by adding hydrophilic colloids like methylcellulose, natural gum etc.
- The viscosity of the colourant is increased by the addition of a non-ionic thickener in its composition. The addition of amphoteric surfactant in the colourant is accompanied by basic dyes.

Evaluation of Hair Colorant

The following tests are carried out to evaluate hair colourants:

1. The Sensitization Test: The test is carried out on animal skin. The colourants are applied to the skin and are kept under observation for 24 hrs. If no reaction occurs, then the colourant is said to be non-sensitizing or non-irritant. The histopathological study is carried out as per requirements.

The Toxic Effect Test: Toxic effects are studied in animals to know about the long term effects of the preparations.

The major classification is listed as follows:

1. Temporary hair colourants.
2. Semi-permanent hair colourants/Direct dyes
3. Oxidative dyeing systems: It includes: (a) Semi-permanent hair colourants. (b) Permanent hair colourants.
4. Gradual hair colourants.
5. Natural dyes.

1. Temporary Hair Colourants: They are leave-in preparations. The hair is not rinsed after the application of the colourant. The colourant is easily removed with one wash using shampoo because they are absorbed into the cuticle and cannot enter into the cortex of the hair. They are rarely called water rinses.

Temporary hair colourants consist of dyestuff and acid. The different dyestuff is acid dyes, basic dyes, metalized dyes and disperses dyes. Chemically the dyestuff is azo dyes, anthraquinone dyes, benzoquinone imine dyes, triphenylmethane dyes, phenazine dyes and xanthenic dyes. The hair colourants are available in different formulations like powders, crayons, liquids and shampoos.

2. Semi-permanent Hair Colourants / Direct Dyes: These colourants have a long-lasting. colour retaining ability when compared to colour shampoos. The colour produced is stronger as well. Dark colours are obtained with the colourants though they do not contain H2O2. This offers an advantage that the melanin of the hair doesn't get bleached but is only masked with the colourant. The colour obtained on the grey hair is different from the black (pigmented) hair because of which the hairs are highlighted. The colourants are easily applied. This colour is not lost with one wash but is gradually lost in 5 – 8 washes with shampoo. Fragrance may be added to the composition of the colourant.

Ingredients: The semi-permanent hair colourants are composed of the following constituents.

- Dye
- Water
- Organic solvent like alcohol, derivatives of glycol.
- Fatty acid, fatty acid amide.
- Thickener.
- Surfactant
- Perfume
- Aliphatic primary amines which work as co-solvent and buffer.

- **3. Oxidative Dyeing Systems:** These dyes are also called ‘para dyes’. At the time of application, these dyes are colourless but turn to a particular colour after undergoing chemical reactions on the hair. The chemical reactions include the following reactions in alkaline pH, which are oxidation and coupling and condensation.
- **Ingredients:** The ingredients of these dyes which render the above reactions are bases, couplers and oxidizing agents.
- **4. Gradual Colourant:** It includes heavy metals in its composition. The hair is gradually coloured with several applications of the colourant. The heavy metals used are lead or bismuth in their salt forms. The salts of the heavy metals are made into solutions and are used in the preparations. The preparation is applied many times because the colour develops gradually.
- **Demerit:** Since the preparation includes heavy metals, it offers negative effects on health.
- Therefore, the use of these colourants is declined.
- **5. Natural dyes:** Since, antiquity, plant materials are looked upon as beneficial sources for various ailments and other purposes. The leaves are used as colourants:
- **(a) Henna:** The leaves of henna are powdered and sold. The paste is formed by mixing the henna powder in hot water. The paste is directly applied to the hair and a warm towel is wrapped around the head to enhance the colouring effect. lt gives the reddish colour to the hair. Henna is non-toxic and non-sensitizing.

Formulation and Evaluation of Hair Dyes: Hair dyes (colourants) are cosmetic preparations that are used by men and women either to change the natural hair colour or to mask grey hair. The properties of typical hair colourants are:

- The formulation of the hair colourant should be stable.
- They should colour the hair evenly.
- They should not lead to loss of the natural shine of hair.
- The shaft of the hair must not be damaged.
- The natural moisture of the hair must not be lost.
- Must possess properties like non-irritant and non-sensitizing.
- Must be non-toxic. Must impart stable colour to the hair.
- The coloured hair must be unaffected by air, water, sunlight, sweat, friction, shampoos, lotions, gels, oils etc.

Talcum powder:

a) Ingredients:

i) Absorbent: It absorbs sweat and suppresses the foul smell.

Eg. Talc, Chalk powder, Boric acid

ii) Antiseptic: Zinc oxide

iii) Binder: Magnesium stearate

iv) Perfume: Lavender oil

b) Method:

All the ingredients except lavender oil are mixed thoroughly in an enameled vessel. The power is filtered through a muslin sieve.Now, lavender oil is added to the powder and stored in air tight container for three days. After three days, the powder is packed.

c) Uses:

1. It helps to beautify the face.
2. Talcum powder removes oil content in the faace
3. It absorbs sweat and reduces the foul smell.
4. It can be used a deodorant.

Shampoo:

a) Ingredients:

Sodium lauryl sulphate ($C_{12}H_{25}$-O-SO3Na) – Surfactant

Cocamidopropyl betaine – Co – Surfactant

Sodium chloride – Viscosity adjuster

Glycol distearate – shiner

Silicone – Conditioner

b) Preparation:

Shampoo is generally prepared by mixing the sodium lauryl sulphate (surfactant) and cocamidopropyl betaine (cosurfactant) in water to form a thick, viscous liquid. Other essential ingredients like sodium chloride (viscosity maintainer), small amount of glycol distearate (shiner) and silicone (conditioner) are added.

Uses:

1. It produces lather readily with water. Hence it is used to clean the hair and scalp thoroughly
2. It helps to keep hair soft, lustrous and nanageable.

Toxicity in cosmetics

A cosmetic toxicologist can provide a clear-eyed view of the potential hazards and quantifiable risks of a product based on its composition. The forensic cosmetic toxicologist will then compare the observed adverse event to the causal mechanism of action of the ingredients present to determine if the claim has merit.

Most Common Chemicals Found In Cosmetic Products

Coal Tar Dyes

One of the most important coal-tar dye is p- phenylenediamine which is used in most hair-dyes. Darker the color of hair dye more is the amount of phenylenediamine it leads to cancers.

Diethanolamine (Lauramide DEA and Cocamide DEA)

Used in shampoos, soaps and cleansers. It leads to liver cancers and precancerous alterations in skin and thyroids and can also root eye annoyance and moderate skin

DBP (Dibutyl Phthalate)

Dibutyl phthalate is mainly used as a plasticizer

Phthalates are also related to less sperm count in men and reproductive deficiencies in the developing male fetus.

Parabens

It one of the most common constituents and preservatives in cosmetics

They are related to neurotoxicity and cancer among other contrary health effects

Polyethylene Glycols (PEGs)

Used in creams as solvents, thickeners, moisture-carriers and softeners. PEGs have shown evidences of gene toxicity and if applied over damaged skin can lead to systemic toxicity and allergies

Petroleum

It is used in hair care products to give a shiny luster to hairs. PAHs(polycyclic aromatic hydrocarbons) in petrolatum can also lead to skin irritation and allergies

Siloxanes

They are commonly used in facial treatments and skin moisturizers. A ffecting working and functioning of human hormones.

Health Hazards Related with Heavy Metals

Heavy metals have been used in cosmetics frequently used by women and also in face makeups heavy metals which can accumulate in the body over time and can lead to cause various health issues, such as; cancer, developmental and different reproductive issues, neurological problems; blood, skeletal, cardiovascular, renal problems; nausea, immune system, headaches, vomiting, and diarrhoea; lung and respiratory diseases; and hair loss and brittle hair. Some are toxic to the respiratory system while others are disruptors of hormones

Lead (Pb)

Miscarriage, hormonal changes, menstrual irregularities, infertility in women and men,

Cadmium (Cd)

It cause bone deformity, kidney damage and the capability of bones to breakdown smoothly

Mercury (Hg)

It is one of the very communal components which is existing in skin complexion fairing creams and soaps**.** Hg is also used in other cosmetic products, like as eye cleansing products and beautifying agents and mascara and leads skin discoloration, skin rashes and scaring as well as a contraction in the skin resistant to fungal and bacterial infections.

Nickel (Ni)

Due to the affluence of this metal in the environment, everybody is bare to very less amounts, usually via air, food, soil, skin contact and portable water, including cosmetics Hypersensitivity to Ni is also common and it might be cause acute contact dermatitis.

Side Effects Caused by Cosmetics

Skincare products such as nail polish, perfumes, make up, etc., can cause skin irritation and allergic reactions; these products can endure on the body for an extended period of time and cause substantial adverse reactions. Moisturizers raise the hygroscopic stuffs of the skin specifically when the amount of these materials is high in the body.

It can cause exfoliation and irritation. Skin lessening agents such as hydroquinone (HQ) is one of the life- threatening harmful chemicals. However, there have been reports of potential mutagenicity and ochronosis. Ochronosis is an unusual contrary effect of HQ, categorized by liberal darkening of the part to which the cream holding high concentrations of

HQ is useful for many years.

Sun-screening agents can cause allergic, irritant, photo-allergic reactions or phototoxic. Benzophenones are the utmost common while dibenzoyl methane's, sensitizers, cinnamates may cause photo-allergic dermatitis and para-aminobenzoicacid (PABA).

The sensitive reactions associated with anti-perspirants / deodorants and fragrances are frequently caused by the other ingredients or fragrances. Fragrances can arrive the body through lungs, air ways, skin(adsorption), ingestion and through pathways from the nose directly to the brain and can cause dizziness,headaches, irritation to eyes, fatigue, throat and nose, forgetfulness and other symptoms.

Fragrances scattered in the air or present in air can cause air-borne contact dermatitis. Chemicals like phethleugenol, coumarin found in fragrances are supposed carcinogens, while phthalates are assumed hormones disrupters.

UNIT-V
PLASTICS IN DAILY USE

Introduction to polymers:

Polymer is a Greek word and its literal meaning is a combination of **poly (very) + mer (piece or pieces)**, which is why it is often called "Baspar" in Persian dictionaries. In fact, a polymer is a large molecule which is made up of a large number of smaller molecules, and these small molecules that make up a large molecule are called monomers.

TYPES OF POLYMERS

On the basis of the type of the backbone chain, polymers can be divided into:

- **Organic Polymers**: Carbon backbone.
- **Inorganic Polymers**: Backbone constituted by elements other than carbon.

On the basis of their availability, polymers can be divided into:

- ✓ Biopolymers or Natural Polymers
- ✓ Synthetic Polymers

a) Biopolymers (Natural Polymers)

Biopolymers (natural polymers) that have two sources of plant and mineral, the humans have no role in its production. **Plant-based polymers**, such as polysaccharides and its subcategories: cellulose, starches and gums used in the paper, wood, eyewear and

textile industries. **Mineral polymers** are included of diamond, graphite, most metal oxides …etc.

b) Synthetic Polymers

- There are polymers that are generally derived from **monomers** of crude oil and coal tar, and we make very useful polymers by processes that would not be possible to live without today.

Based on Molecular Forces, polymers can be divided into:

❖ **Elastomers:** Elastomers are rubber-like solid polymers that are elastic in nature. When we say elastic, we basically mean that the polymer can be easily stretched by applying a little force. The most common example of this can be seen in rubber bands (or hair bands). Applying a little stress elongates the band. The polymer chains are held by the weakest intermolecular forces, hence allowing the polymer to be stretched. But as you notice removing that stress also results in the rubber band taking up its original form. This happens as we introduce crosslinks between the polymer chains which help it in retracting to its original position, and taking its original form. Our car tyres are made of Vulcanized rubber. This is when we introduce sulphur to cross bond the polymer chains.

❖ **Fibers:** In the classification of polymers, these are a class of polymers which are a thread like in nature, and can easily be woven. They have strong inter-molecules forces between the chains giving them less elasticity and high tensile strength. The intermolecular forces may be hydrogen bonds or dipole-dipole interaction. Fibers have sharp and high melting points. A common example is that of Nylon-66, which is used in carpets and apparels.

❖ **Plastics:** Plastics are high molecular weight substances, which can be moulded into any stable shapes by the application of heat and pressure. Based on the thermal behavior, plastics can be further classified as

a) Thermoplastics: Thermoplastic polymers are long-chain polymers in which inter-molecules forces (Van der Waal's forces) hold the polymer chains together. These polymers when heated are softened (thick fluid like) and hardened when they are allowed to cool down, forming a hard mass. They do not contain any cross bond

and can easily be shaped by heating and using moulds. A common example is Polystyrene or PVC (which is used in making pipes).

b) **Thermosetting polymers:** Thermosetting plastics are polymers which are semi-fluid in nature with low molecular masses. When heated, they start cross-linking between polymer chains, hence becoming hard and infusible. They form a three-dimensional structure on the application of heat. This reaction is irreversible in nature. The most common example of a thermosetting polymer is that of Bakelite, which is used in making electrical insulation.

Based on the Structure of the Monomer Chain, polymers can be divided into:

- ✓ **Linear Polymers**

The structure of polymers containing long and straight chains falls into this category. PVC, i.e. poly-vinyl chloride, is largely used for making pipes and electric cables.

- ✓ **Branched-chain Polymers**

When linear chains of a polymer form some branches, then such polymers are categorized as branched chain polymers. For example, Low-density polythene.

- ✓ **Cross-linked Polymers**

They are composed of bifunctional and trifunctional monomers. They have a stronger covalent bond in comparison to other linear polymers. Bakelite and melamine are examples in this category.

Based on Monomers, polymers can be divided into:

- **Homomer:** In this type, a single type of monomer unit is present. For example, Polyethene
- **Heteropolymer or co-polymer:** It consists of different types of monomer units. For example, nylon -6, 6

Advantages of Plastics

Plastics have numerous advantages and uses. Few of them are stated below

- Its production cost is low.
- It can be easily molded into various shapes.
- It is lightweight.

- It is resistant to corrosion.
- It can be translucent, transparent, and opaque as well.
- It is a poor conductor of heat and electricity.
- It can be used to make roads, utensils, wires, pipes etc.
- It is used in construction of buildings as well.

1. **Uses of LDPE:**

LDPE's first experimental preparation took place in the 1930s. It was brought to the commercial forefront as a consequence of its widespread use during the Second World War in the high-frequency radar cables.

Its success on the commercial front stems from the fact that this thermoplastic is very economical and has good moisture resistance.

As a high-branched polymer, it does have lower density, hardness, stiffness, or strength when compared to HDPE, which might appear to be shortcomings. This polymer is typically useful for making packing material such as wrapping foils, foam, trays, and plastic bags (the soft and non-crackly kind), both for food packaging, and otherwise.

This polymer plays an important role as one of the multiple layers of plastic in milk cartons. It is also useful for making bottles, pipes, garbage bags, utensils, processing material, wire insulation, and even toys. It is also useful as a thin protective layer over the paper, other plastics, or textiles.

LDPE is, however, not suitable for cook-in packs, as it softens at around (and sometimes lower than) 100°C. However, this makes it readily heat-sealable. It has also useful in the medical sphere, as it is effective for sterile blister packs, and as drug packaging.

This polymer is non-polar and its use for printing and lamination cannot take place, without undergoing surface-treatment. Overall, LDPE, a very affordable polymer to purchase or produce, has found multiple uses across the board.

2. **Uses of HDPE:**

The numerous advantages of this polymer make it an ideal choice in the production of many materials. Some uses of HDPE are listed below.

- Bottle caps and bottles are made of this polymer.
- It is also used in 3-D printing filaments
- HDPE is used in the fuel tanks of several types of automobiles.
- The piping system responsible for the distribution of natural gas is generally made of this polymer due to its resistance to corrosion and other attributes.

- It is used in plastic lumber and wood plastic composites.
- Skeletal and facial reconstruction surgeries (part of plastic surgery) involve the use of HDPE

3. Uses of Polypropylene

- Due to the high resistance of polypropylene towards fatigue, it is widely employed in the construction of plastic living hinges (especially the hinges on flip-top containers and flip-top bottles).
- This polymer is also used in the production of plastic piping systems. An important advantage of polypropylene for this application is the strength and the rigidity offered by the material. Another key advantage of polypropylene piping is that it is resistant to chemical leaching and corrosion.
- Since this plastic has enough heat resistance to withstand the heat levels in autoclaves, polypropylene can be employed for the manufacturing of plastic laboratory items and also plastic medical items.
- Polypropylene is also used in the manufacture of mats, rugs, and carpets for home use.
- Another important application of this polymer is in ropes (especially because the ropes made from polypropylene are so light that they actually float in water). Also, the strength of the ropes made from polypropylene is almost similar to the strength of the ropes made up of polyester.
- Polypropylene sheets are also employed in the production of storage boxes, stationery folders, and other packaging items.
- This thermoplastic polymer is also used in the manufacture of loudspeaker drive units.
- Fibres made up of polypropylene can be used to reinforce drywall joints.

4. Uses of Polystyrene

- Medically it is used for sterilizing test tubes, diagnostic components, and other medical devices.
- It is used to manufacture car parts which include knobs, instrument panels, sound dampening foam, etc.

- Polystyrene foodservice packaging keeps the food fresh for a longer period of time and is less expensive than alternatives.
- It is used in packaging consumer goods such as DVD cases, and egg cartons, to protect against spoilage or damage.
- It provides thermal insulation and is used in refrigerators, freezers, etc.
- Used in housing in all IT equipment such as Television, computer, etc.
- It is used for making polystyrene products like polystyrene sheets, polystyrene foam, brush handles, and combs.
- It is used for making talcum powder.

5. Polyethylene Terephthalate (PET)

It is used in several packaging applications as mentioned below:

- ✓ Polyethylene Terephthalate is an excellent water and moisture barrier material, plastic bottles made from PET are widely used for mineral water and carbonated soft drinks
- ✓ Its high mechanical strength, makes Polyethylene Terephthalate films ideal for use in tape applications
- ✓ Non-oriented PET sheet can be thermoformed to make packaging trays and blisters
- ✓ Its chemical inertness, together with other physical properties, has made it particularly suitable for food packaging applications
- ✓ Other packaging applications include rigid cosmetic jars, microwavable containers, transparent films, etc.
- ✓ PET monofilament is mainly used for making mesh fabrics for screen-printing, filter for oil and sand filtration, bracing wires for agricultural applications (greenhouses etc.), woven/knitting belt, filter cloth, and other such industrial applications.

6. Uses of Bakelite

- ❖ It is the commercial name for the polymer obtained by the polymerization of phenol and formaldehyde.
- ❖ It has a low electrical conductivity and high heat resistance it can be used in manufacturing electrical switches and machine parts of electrical systems.
- ❖ It is a thermosetting polymer and Bakelite has high strength meaning it basically retains its form even after extensive molding.
- ❖ Phenolic resins are also extensively used as adhesives and binding agents. They are further used for protective purposes as well as in the coating industry.

- ❖ Further, Bakelite has been used for making the handles of a variety of utensils.

7. Uses of Melamine

- Melamine resin is a very common additive applied to many of our everyday objects such as kitchenware, tile flooring, and laminates.
- It is used to Military applications, electrical parts.
- It is used to make fabrics that are fire-resistant and are mostly utilized by firefighters.

Recycling of plastics

Plastic can cause litter and pollution in the environment. These effects can put human beings and the environment in danger. Also, if you do not correctly manage plastic, making new ones can be a waste of resources. It is thus reasonable to reuse and reprocess plastic to prevent waste. For this reason, plastic recycling is an essential procedure in the production of plastic.

The method of recovering and reprocessing plastic scrap or waste into usable and functional goods is known as plastic recycling. The primary goal of plastic recycling is to reduce plastic waste as well as the pressure to create new plastic items.

Reduce, Reuse, and Recycle are the three Rs, and recycling is the third and most important. Recycling completes the purpose of keeping waste out of landfills by recycling them back into raw materials that can be used to produce new products or goods. The aggregation of waste materials, their manufacturing into new items, and the procurement of those products, which can then be recycled, are the essential processes of recycling.

International Universal recycling codes and symbols for identification:

The Society of the Plastics Industry (SPI) introduced a code system in 1988 that helps with recycling plastic by numbers. Almost all plastic products bear the general recycling symbol: a triangle formed by three circling arrows. The number in the triangle indicates the type of plastic. There are six common types of plastic and one miscellaneous category with the number 7.

Notes on Plastic Recycling Codes:

- The plastic recycling number system actually serves no purpose: the consumer cannot do much with it and the waste separators do not use it.

- The figure suggests that plastic is recycled per product group. This has not been the case (for a long time now) in practice.
- While the figure gives an indication of the type of plastic, it says nothing about hardness, shape or consistency. The same type of plastic can be used for plastic bags or bottles, for example, and there are different grades for each type.
- Not all types of plastic can be recycled equally well and only a very low percentage of plastic is recycled at all. Out of all the plastic produced worldwide since the 1950s, only 9% has been recycled.
- The regulations for displaying the plastic recycling symbols are inadequate. Often, the code stamps are very small, difficult to find, and difficult to read (especially when the plastic is transparent).
- Code 7 is a residual category that nobody can use. This plastic is simply burned.

Though it serves no real purpose in terms of waste separation, the recycling code can be used by consumers to make a distinction between plastics that would be safer to use than other plastics. For example, the site **Green Jump** presents an overview of the following classification:

PET 1
i.e. PET bottles for soft drinks. It is relatively safe. You should not refill PET bottles as the risk of additives leakage increase.

HDPE 2
i.e. plastic containers and pipes. It is considered safe and is easy to recycle.

PVC 3
i.e. sewage pipes and synthetic window frames. It is to be avoided. In the manufacturing process the toxic dioxin is released and softeners are often added.

LDPE 4
i.e. soft plastics such as cling film, plastic drycleaner covers, carry bags. It is considered safe.

PP 5
i.e. plastic furniture, jerry cans, car parts, bottle tops. It is considered safe.

PS 6
i.e. disposable cups, meat trays, packaging for electronics. It is to be avoided because of possible leakage of styrene.

Overige en gemengde kunststoffen 7
Code 7 is a miscellaneous category that nobody can do anything with.

Environmental Hazards of plastics:

The littering of plastics in open spaces creates unhygienic conditions, as it acts as a breeding ground for insects and mosquitoes that cause diseases like malaria and dengue. Plastics do not undergo degradation, thus, stay in the soil for many years, which affects soil fertility and degrades the soil quality. Plastic is **non-biodegradable.** The waste **plastic articles thrown here and there** carelessly get into dirty water drains and sewers, and clog them. This makes the dirty drain water to flow over the streets and roads causing unhygienic conditions. The **animals eat up the used polythene bags or plastic wrappers** along with the leftover food and vegetables wastes thrown on garbage dumps. The plastic wastes can choke the respiratory system of these animals or form a plastic lining in their stomach. When plastic bags are burnt they produce poisonous gases which pollute the air. When plastic artefacts enter the drainage and sewerage system, they block the pipes and the drains causing waterlogging. The improperly disposed of food bags, when eaten by animals, cause stomach and intestine related diseases which even lead to suffocation and death. Plastic items find their way to the river and other water bodies, which are then swallowed by fish, seabirds, and other marine species, thus leading to suffocation and death. The waste from the plastic manufacturing industry is

thrown directly into the water bodies, thus affecting the chemical property of water, causing hazards on a very large scale.

Biodegradable plastics:

These are those polymers which get decomposed under aerobic or anaerobic conditions, as a result of the action of microorganism/enzymes. The materials develop it like starch, cellulose, and polyesters. Aliphatic polyesters are the most commonly used polymers of this type.

Some examples are given as follows:-

Poly β-hydroxybutyrate – co-β-hydroxy valerate (PHBV): It is derived by combining 3-hydroxy butanoic acid and 3-hydroxy pentanoic acid, in which monomers are cross-linked by an ester linkage. It decomposes to form carbon dioxide and water. It is brittle in nature, and it can be used in the production of drugs and the manufacturing of bottles.

Nylon 2–Nylon 6: It is a polyamide copolymerization of glycine ($H_2N{-}CH_2{-}COOH$) and aminocaproic acid ($H_2N{-}(CH_2)_5{-}COOH$).

Polyhydroxybutyrate (PHB): It is formed by the condensation of hydroxybutyric acid (3-hydroxy butanoic acid) molecules.