

# CHEMISTRY IN EVERY DAY LIFE

Rijoy Kodiyan Jacob

March-2020



# FOOD ADDITIVES

Food is any substance, which when consumed, digested and assimilated, provides nutritional and energetic support for the body. Our cells, tissues, and organs work properly only by maintaining a proper balanced diet. Consumption of a good nutritious food in optimum quantities plays an important role in maintaining proper health, where as bad or unhealthy food can give rise to several diseases.





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# Food Preservatives

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Chemicals intentionally added to food, generally in small quantities, to prevent its microbial and/or catalytic decomposition and deterioration are called food preservatives.

Food preservative function by inhibiting the growth and activity of micro organisms(bacteria, fungi and others) or by preventing undesirable enzymatic and catalytic chemical reaction.

The most commonly used preservatives include sugar(sucrose), table salt(sodium chloride), vinegar(dilute acetic acid solution) and vegetable oils.







## EXAMPLE

E.g Fruit in a concentrated sugar solution and salted meat are both protected from micro organisms. In these cases, sucrose and sodium chloride create a hyper tonic solution in the environment of any micro organism present. Water flows from the organisms into this more concentrated solutions by osmosis, causing the organism to die from dehydration.

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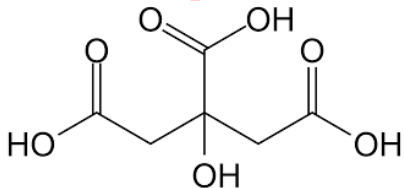
- 1 Sodium benzoate ( $C_6H_5COONa$ ) :- it is used in jams, jellies, fruit juices, pickles, etc. as an antimicrobial agent. In the acidic conditions that prevail in such substances, sodium benzoate yields benzoic acid which is active against bacteria, yeast, and certain other microbes.





# FOOD PRESERVATIVES - CONTD..

- 2 Citric acid is used in jams, jellies, drinks, syrups, etc. as a "sequestrant" for trace metals i.e. Citric acid reacts with trace metals in foods, tying them up in complexes so that these metals will not catalyse the decomposition of food.





# FOOD PRESERVATIVES - CONTD..

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- ③ Potassium metabisulphite( $K_2S_2O_5$ ) :- It is used for preserving mango chutney, lemon squashes, juices of colourless fruits like apple, etc. Potassium metabisulphite reacts with the acid of fruit or juice and produces  $SO_2$ , which kills the micro organisms. Other substances which can act as preservatives by producing  $SO_2$  include
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  - ② The bisulphites,  $NaHSO_3$  and  $KHSO_3$





# Artificial Sweeteners

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They are widely used in a variety of food and beverages because they are much sweeter than sucrose, only a small concentrations of such substances are required to sweeten the food product and their contribution to calorie intake is very low.





# SACCHARIN

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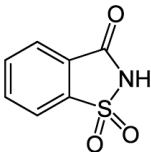
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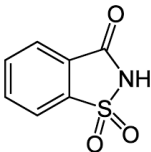






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- Saccharine contributes no calorie to the diet.
- It is entirely inert and completely harmless since it is excreted through urine when ingested.





# USES

Saccharin is stable towards heat and is a good choice for cooking, baking, and canning. It is extremely useful for diabetic patients and for people requiring low calorie diet. Saccharin is used in:

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- 5 Chewing gum, candy and desserts.
- 6 In toothpaste and pharmaceutical products.







# ASPARTAME

Aspartame has 150 to 200 times sweetness than cane sugar and is a commonly used sweetener. It has the advantage that it is digestible and its calorific value is insignificant compared to cane sugar.

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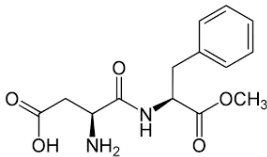




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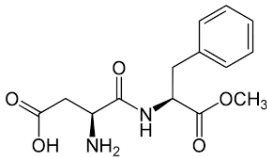


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Major disadvantages are :-

- People suffering from phenylketourea cannot use this.
- It is not stable to heat and hence used only with cold items.
- It is hydrolysable into constituent amino acids under aqueous solutions at a  $P^H$  of 7 and above.





# SUCRALOSE

Sucralose is a non nutritive sweetener. It is trichloro derivative of sucrose. It is 600 times sweeter than sucrose. White crystalline solid like sucrose.

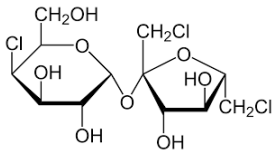
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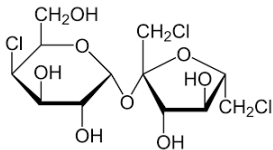




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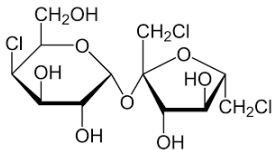
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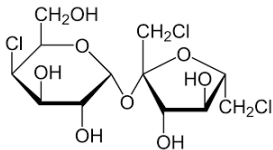
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- It resists dental cavities and hence used in chewing gums.







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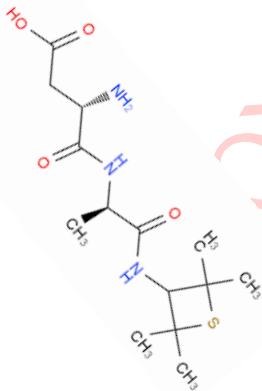




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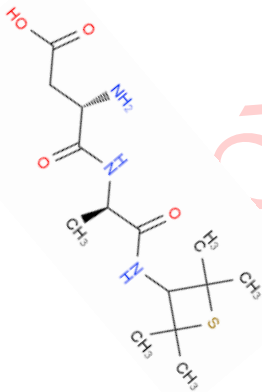
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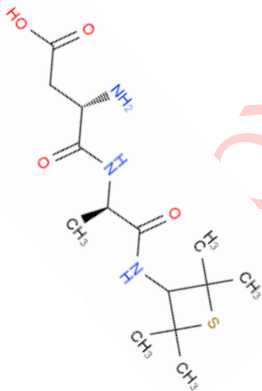
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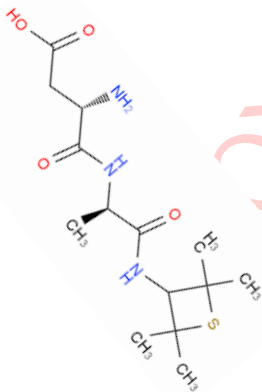
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It is used in a wide range of foods and beverages and some diabetic foods





# Antioxidants

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# ANTIOXIDANTS

An anti oxidant is a substance that inhibits oxidation process of other substances.

An antioxidant food additive is a substance which when added to foods even in very low concentration, prevents oxidative processes and thereby protects them against deterioration caused by oxidation and prolongs their shelf life.









# TYPES OF ANTIOXIDANTS

They are of two types: Natural and Synthetic antioxidants. They inhibit the oxidation of foods by scavenging free radicals, chelating pro-oxidative metals, quenching photosensitizers, chelating pro-oxidative metals and inactivating lipoxygenases.

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## NATURAL ANTIOXIDANTS

They include ascorbic acid or vitamin C (in cur fruits, jams and dried potatoes), citric acid (in biscuits, jams, tinned fruits, alcoholic drinks, cheese) and  $\alpha$ -,  $\beta$ - and  $\gamma$ - tocopherols (in oils, meat pies etc)



Most common synthetic antioxidants are Butylated Hydroxy Anisol(BHA) and Butylated Hydroxy Toluene(BHT).

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# Flavour Enhancers

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## EXAMPLE

This category of food additives is largely based on the salts of 5' nucleotides and amino acids.

e.g. disodium 5'-inosinate, inosine monophosphate, disodium 5'-guanylate.  
monosodium glutamate (commonly known as Ajinomoto), etc.





# MSG(AJI NO MOTO)

The monosodium salt of glutamic acid, namely monosodium glutamate(MSG), is one of the most commonly used flavour enhancers in food processing and is most popularly known by its Japanese brand name Aji no Moto. MSG belong to the category of flavour enhancers called flavour potentiators.

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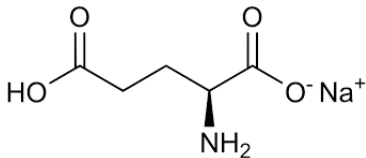


FIGURE: MSG





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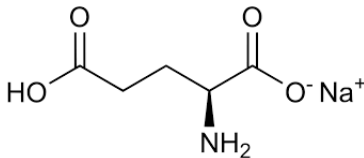


FIGURE: MSG

MSG is believed to function by stimulating taste buds of the tongue. It is used to enhance good flavours or mask the unwanted flavours in foods prepared from meat, fish, and even vegetables.





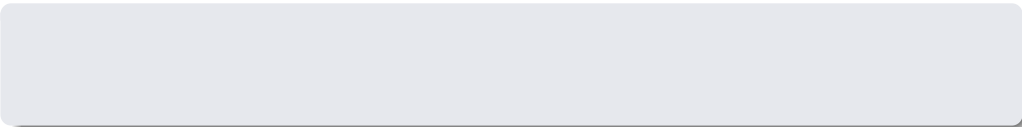
# Food Colours

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# FOOD COLOURS



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Food colours or food colourants are coloured substances added to food during or after its processing, to impart a colour, the purpose of which may be to maintain, restore or improve its appearance.

## PERMITTED COLOURS

Only those colours approved by the Governmental Agencies can be used as food additives, and that too in quantities not exceeding the safety limits prescribed for each. These substances are called permitted colours.







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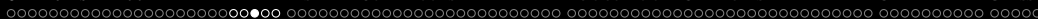
The permitted colour additives can be natural or synthetic.











# NATURAL COLOURANTS

These include pigments derived from natural sources such as vegetables and animals. Some examples are given:

- ① Annatto extract(yellow), from Annatto seeds.
- ② Canthaxanthin(Violet), a terpenoid from mushrooms algae etc.
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- 6 saffron(saffron), a hybrid of orange and yellow obtained from *Crocus Sativus* Linnaeus.

















# SYNTHETIC COLOURANTS

These artificial or manmade colourants are used widely because they are intense, less expensive and easily create a variety of hues with uniformity. Examples are

- 1 Fast green FCF, a green triarylmethane dye.
- 2 Indigo Carmine, a blue indigoid dye.
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# Fast Food and Junk Food



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## FAST FOOD

Fast food refers to the food sold in a place like a restaurant or snack bar, prepared using preheated or precooked ingredients after taking orders and served to the customer quickly for ready consumption.

There should not be anything wrong with fast food because any meal with low preparation time can be considered as fast food.

Most fast foods are designed for ready availability, use, or consumption but with little consideration given to quality or nutritional value or significance.



# JUNK FOODS

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Common junk foods include salted snack foods, fried fast food, and carbonated drinks. i.e. ready to cook, ready to serve, fried packaged items, bottled drinks irrespective of whether they are vegetarian or non vegetarian are considered as junk foods.

# HEALTH EFFECTS

Major health effects associated with junk foods are the following:

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- The excess amounts of fats carbohydrates and sodium present in them contribute to an increased risk of cardiovascular diseases, diabetes, blood pressure, stroke, kidney failure and many other chronic health conditions.
- Obesity is becoming the largest public health concern, especially among children. associated with fast/junk food, which may lead to high cholesterol levels and thereby clogging arteries and heart attacks.



# HEALTH EFFECTS - CONTD...

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- Unhygienic practices of preparing junk food leads to food poisoning.





# Artificial Ripening of Fruits

RIJOY K. J.





# ARTIFICIAL RIPENING OF FRUITS

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RIJOY V





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## 1. CLIMACTERIC FRUITS

Fruits like mango, banana, papaya sapota, apple, etc. continue to ripen after harvesting. Such fruits are called Climacteric fruits. The natural ethylene present in these fruits makes them ripen.







## ARTIFICIAL RIPENING OF FRUITS

Most climacteric fruits are plucked raw and transported to long distance destinations. In some cases by the time they reach the market, are readily eatable. Otherwise and in the case of non climacteric fruits people think of artificial ripening” .





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accelerating the process of natural ripening of fruits by physical or chemical means is called artificial ripening. Most of the methods are based on the action of ethylene or acetylene to induce ripening.







# METHODS OF ARTIFICIAL RIPENING

- 1 The unripe fruits and already ripe fruits are kept together inside an air tight container, Since the already ripe fruits release ethylene, ripening of the unripe fruits will be made faster.  
This has the draw back that uniform ripening is not possible and cannot be used commercially.





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- 2 Fruits are kept in hay lined wooden crates. These crates are stacked on shelves and then smoked in smoke chambers. The smoke emanates acetylene gas which induces ripening. This method is applied in the cases of banana and mango.





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Drawback: The fruits may not attain uniform colour and flavour. Smoke odour even persists on the fruit which affects the taste and quality.





## ARTIFICIAL RIPENING - CONTD...

- Fruits are dipped in dilute (0.1%) solution of the chemical called ethrel or ethephon(2-chloroethylphosphonic acid). They are then taken out wiped separately spread out and covered with a cotton cloth. The ethephon that has penetrated into the fruits decomposes to ethylene which accelerates the ripening process just as natural ethylene does.





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- The unripe fruits are placed in a room (filling about 1/3rd of the room). Requisite amount of ethephon is placed in a container inside the room, and calculated quantity of NaOH solution is added. The fruits are then exposed to the released ethylene gas which enhances their ripening. This is a safe method.





# ARTIFICIAL RIPENING - CONTD..

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Draw back : Ethylene is catalytically generated from ethanol and the setting up of the ripening chambers requires huge investment.
- Calcium carbide being a cheap and readily available chemical, is widely used in different parts of world for ripening fruits like mango, banana, papaya, plums, apples, pineapples, etc. Once applied to the fruits, the calcium carbide comes into the contact with the moisture and releases acetylene, which has fruit ripening characteristic somewhat similar to ethylene.









## ADVERSE EFFECTS CARBIDE USAGE

- 1 Calcium carbide is corrosive to the eyes, skin and respiratory tract. Its contact with mucous membranes may lead to ulceration and scarring. Inhalation of the substance may cause lung oedema. Its ingestion may lead to mouth ulcers and gastric irritation. The substance is suspected to have carcinogenic properties.
- 2 The calcium carbide used in India is generally off industrial grade and may contain highly toxic arsenic and phosphorous impurities. Further the generated acetylene can contain traces of highly toxic arsenic and phosphorous hydrides which may penetrate into the fruit, Ingestion of arsenic and phosphorus compounds can be quite harmful for the health and can lead to various ailments, including cancer.







# Natural Drinks

RIJOY K. J.









# MILK

Milk is generally regarded as one of the most complete and nutritious of all foods. Milk, which is high in proteins, calcium and a range of minerals and vitamins, contains most of the essential nutrients our bodies need. and in essentially the proper proportions.

Milk is the source of the following:

- 1 Vitamins and minerals.





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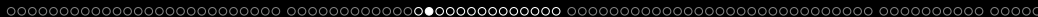
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- 2 Macro nutrients.
  - 1 Proteins.







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# VITAMINS AND MINERALS

## B-VITAMINS

Milk is a good source of Vitamin B<sub>2</sub> and Vitamin B<sub>12</sub>. Vitamin B<sub>2</sub> important for body growth and RBC production and helps in producing energy from food. Vitamin B<sub>12</sub> plays an important role in functioning of brain and nervous system. and for formation of blood.

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## CALCIUM

Milk is an excellent source of Calcium which is essential for the healthy growth and maintenance of teeth and bones. Calcium is important for normal blood coagulation, normal energy yielding metabolism, muscle, and nerve function, digestive function and regulation of cell division and differentiation.



# VITAMINS AND MINERALS - CONTD...

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# VITAMINS AND MINERALS - CONTD...

## IODINE

Milk is a good source of Iodine. Iodine is required for the production of the thyroid hormones,. Iodine is therefore essential for the normal thyroid function because these hormones play a vital role in the regulation of carious metabolic processes, particularly those involved in growth and energy expenditure. Iodine also contributes to the maintenance of normal skin.





# VITAMINS AND MINERALS CONTD...

RIJOY K.













# MACRO NUTRIENTS

## PROTEIN

Milk is a good source of high quality protein. Cow's milk, for example, contains about 3.5% protein by weight. Of this total protein, 80% is casein and 20% whey. Milk protein is highly digestible, It contains all essential amino acids in the right proportions.

## FAT

The fat content of milk varies depending on whether milk is whole(4%), semi skimmed(1.6%) or skimmed(0.1%). The health oriented essential fatty acids such as omega-3 linoleic acid are found in significant level in milk fat.









# COCONUT WATER

Coconut water, the liquid found inside a young tender coconut, contains a variety of nutrients including carbohydrates, vitamins, minerals, electrolytes, antioxidants, amino acids, cytokinins and enzymes.

Coconut water contains a good amount of potassium (250 mg) and sodium (105 mg) in the electrolyte form.

Also it has a better proportion of calcium, manganese, magnesium, and zinc in the electrolyte form than the juices of some of the fruits like orange which is easily absorbable by human body.





It is very food source of B-complex vitamins such as riboflavin, niacin, thiamine, pyridoxine, and the folates. It also contains Vitamin C. Coconut water is low in calories and is almost fat free and cholesterol free. It has a long history of use both as a food and as a medicine. It is not only regarded a refreshing beverage but also a health tonic.





















## BENEFITS - CONTD...

- 5 As it contains the minerals potassium and magnesium, it is regarded as capable of reducing high blood pressure and increasing circulation.
- 6 The cytokinins, a group of hormones that regulate growth, development and ageing in plants, present in coconut water are regarded as having an anti ageing effect on human cells and tissues. They are also supposed to have anti carcinogenic and anti thrombotic properties.
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- 7 It can provide a large number of vitamins essential for the healthy function of the body.
- 8 The naturally occurring bio active enzymes such as acid phosphate, catalase, dehydrogenase, diastase, peroxidase, RNA-polymerase, etc. present in coconut water help in the digestion and metabolism.





# NEERA

Neera(Sweet toddy) is the juice or sap obtained by tapping the unopened inflorescence/spadix of the coconut palm which is now available in the market in bottles. It is sweet,oyster white, in colour, translucent and high in nutritional value.

Neera is a natural, non-alcoholic beverage which is regarded as associated with amazing health benefits. Important are:





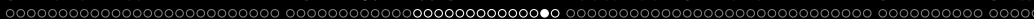
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- Neera contains around 16% of carbohydrates with sucrose as the main constituent and small amounts of glucose, fructose, inositol and raffinose. So it is an an energizing drink with low calories. It has very low glycemic index so that it does not raise the blood sugar levels like regular fruit juices, and even diabetic patients can drink it safely.





# BENEFITS OF NEERA - CONTD..

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## BENEFITS OF NEERA - CONTD..

- It has 16 amino acids, with glutamic acid, threonine and aspartic acid forming the major constituents. These aid muscle development as well as functioning of the central nervous system and immune system, and also combat fat build up.
- It has some amounts of vitamins, especially vitamin C. It also has significant amounts of minerals including iron and phosphorus. All these are essential for body functioning.
- Neera is considered to be beneficial to pregnant women for the healthy growth of the babies they carry.





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- It is a body cooler and is good for digestion.
- Since it is a non alcoholic drink, it doesn't induce intoxication and does not have any side effects.





# Chemicals Used in Agriculture

RIJOY K. J.





# CHEMICALS USED IN AGRICULTURE

A wide variety of chemicals are used in the field of Agriculture.

Out of these most important are Fertilizers and Pesticides.



# FERTILIZERS

Plants, like all other living things, need food for their growth and development. The elements required by plants for growth are generally referred to as plant nutrients.



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The elements required to grow plants is one aspect of successful crop production.



# ESSENTIAL NUTRIENTS FOR PLANTS

At least 16 elements are considered necessary for the growth of green plants; these elements are commonly referred to as essential plant nutrients.

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- 3 It must be directly involved in plant metabolism.



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- 9 Magnesium (Mg)
- 10 Boron (B)
- 11 Chlorine (Cl)
- 12 Copper (Cu)
- 13 Iron (Fe)
- 14 Manganese (Mn)
- 15 Molybdenum (Mo)
- 16 Zinc (zn)





Essential plant nutrients are divided into :

- 1 Non-mineral nutrients :- Of the essential plant nutrients, carbon, hydrogen, and oxygen are taken by plants from the abundantly available atmospheric carbon dioxide and water; these are called non-mineral nutrients.



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The essential mineral nutrients are classified as macro nutrients and micro nutrients.



## 1. MACRONUTRIENTS

Macro nutrients are those elements that plants require in large amounts. The mineral macro nutrients are N, P, K, Ca, Mg, and S. [The non - mineral nutrients C, H, and O are also macro nutrients.]

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## MICRO NUTRIENTS

They are those elements that are essential to plants but are needed only in small amounts. The mineral micro nutrients are B, Cu, Cl, Fe, Mn, Mo, Ni, Zn.



# FERTILIZERS

## Fertilizers

RIJOY K.J.





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Many naturally available substance like leaves, cow dung, bone meal, compost, wood ash, waste materials of sugar, beet crop, etc., are added to the soil to increase its supply of plant nutrients. These are called natural manures or natural fertilizers. The above mentioned substances are generally referred to as organic fertilizers. Some of the naturally occurring inorganic minerals are also used as fertilizers.





## FERTILIZERS

As a result of continuous cropping, the soil becomes deficient in the essential plant nutrients like N, P, K. Hence these have to be added to the soil in the form of fertilizers.

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**EXAMPLE**

Chile salt peter ( $\text{NaNO}_3$ ), rock phosphate [ $\text{Ca}_3(\text{PO}_4)_2$ ], and wood ash (mainly



Substances which are produced on a large scale and added to the soil to provide one or more of the essential plant nutrients are called artificial manures or artificial fertilizers of chemical fertilizers. These are generally inorganic in nature.





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### EXAMPLE

Calcium cyanamide, ammonium sulphate, superphosphate of lime, potassium nitrate, etc.





# INORGANIC FERTILIZERS

The primary nutrients are absorbed by plant roots as simple inorganic ions. nitrogen in the form of nitrate ( $\text{NO}_3^-$ ), ammonium ions ( $\text{NH}_4^+$ ), phosphorus as  $\text{H}_2\text{PO}_4^-$  or  $\text{HPO}_4^{2-}$  and potassium as the  $\text{K}^+$  ion. Chemical fertilizers are generally classified into:

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Fertilizers which provide only one of the primary nutrients are called straight fertilizers.





# NITROGENOUS FERTILIZERS

Nitrogenous fertilizers are substances added to the soil to supply nitrogen which is a primary nutrient required for healthy plant growth.

In the soil, most of them are hydrolysed to ammonia which is converted into soluble nitrates through the action of nitrifying bacteria and easily assimilated by plants.

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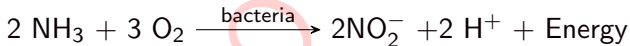




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## EXAMPLES OF NITROGENOUS FERTILIZERS

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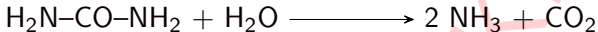
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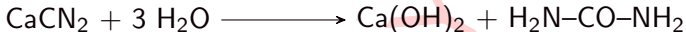


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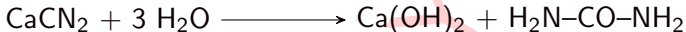


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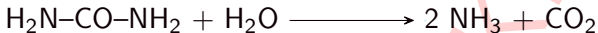
- Ammonium salts :- Ammonium sulphate $[(\text{NH}_4)_2\text{SO}_4]$ , and ammonium nitrate $[\text{NH}_4\text{NO}_3]$  are used widely as nitrogenous fertilizers. Another commonly used fertilizer is calcium ammonium nitrate or CAN



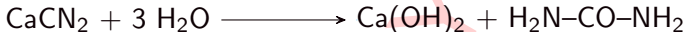


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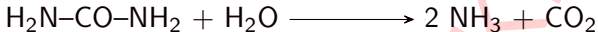




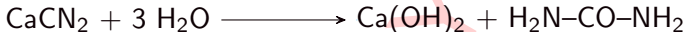
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# PHOSPHATIC FERTILIZERS

Phosphatic fertilizers are substances added to the soil to supply phosphorus which is a primary nutrient required for healthy plant growth. Typical examples are thus so called super phosphate mentioned below:

- 1 Super phosphate of lime or calcium super phosphate :- It is a mixture of water soluble calcium dihydrogen phosphate and calcium sulphate,  $\text{Ca}(\text{H}_2\text{PO}_4)_2 \cdot 2\text{CaSO}_4$ . It contains about 20%  $\text{P}_2\text{O}_5$ .





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Both the super phosphates are excellent phosphatic fertilizer which are easily assimilated by plants since they are soluble in soil moisture.









# MULTI NUTRIENT FERTILIZERS

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the most common NP fertilizers are the following:-

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A typical example for a fertilizer which provides both nitrogen and potassium to the plants i.e. an "NK Fertilizer", is potassium nitrate ( $\text{KNO}_3$ ).





## FERTILIZERS

# NPK FERTILIZERS

In some cases, nitrogenous, phosphatic and both potash fertilizers are mixed in suitable proportions to satisfy the requirements of the crop of which it is used; such "mixed fertilisers" are called "NPK Fertilizers" or "Complex fertilizers" or "Complete Fertilizers". Usually, the source of nitrogen in them is ammonium sulphate, ammonium nitrate or calcium ammonium nitrate, that of phosphorus is calcium super phosphate and that of potassium is potassium chloride or potassium sulphate.

The "NPK Value" of a complex fertilizer expresses its nitrogen phosphorus and potassium contents in terms of percentages of elementary  $N_2$ ,  $P_2O_5$  and  $K_2O$  respectively.





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## EXAMPLE

A complex fertilizer named "17:17:17" refers to an NPK fertilizer having a NPK value of 17:17:17, which means that it contains 17%  $N_2$ , 17%  $P_2O_5$  and 17%  $K_2O$ .



# PESTICIDES

RIJOY K.





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## DEFINITION

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## MAN-MADE PESTICIDES

DDT, Malathion, parathion etc.





# CLASSIFICATION

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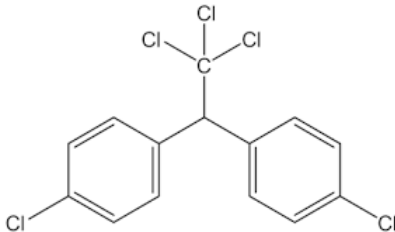
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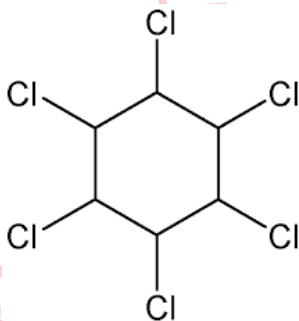
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### 3 Endosulphan

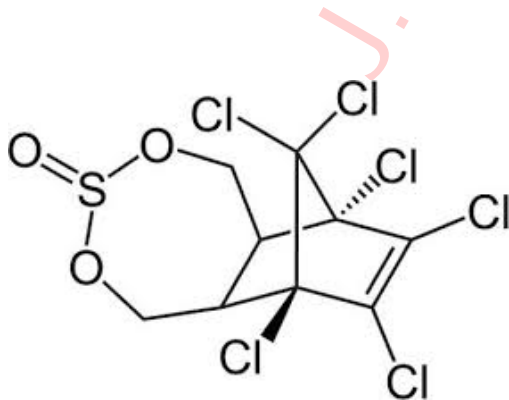
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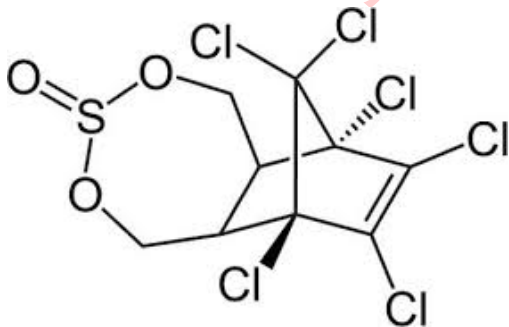


### 3 Endosulphan





### ③ Endosulphan



aldrin, endrin, heptachlor, chlordane etc are also organochlorine pesticides





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- 11 Organo phosphates :- Parathion, methylparathion, malathion, dichlorvos, etc.

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### EXAMPLE

2,4-dichlorophenoxyacetic acid (2,4-D), 2,4,5-trichlorophenoxyacetic acid (2,4,5-T), sodium arsenite ( $\text{Na}_2\text{AsO}_3$ ), methyl bromide etc.





# CLASSIFICATION - CONTD..

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PESTICIDES

# CLASSIFICATION - CONTD..

## C.RODENTICIDES

They are chemicals used to destroy rodents(mammals belonging to rodentia).

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# CLASSIFICATION - CONTD..

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### EXAMPLE

Zinc phosphide ( $\text{Zn-3P}_3$ ), sodium fluoroacetate ( $\text{CH}_2\text{F-COONa}$ ), thallium, warfarin, bromethalin, pival, etc.





# CLASSIFICATION - CONTD..

RIJOY K.







## CLASSIFICATION - CONTD..

### D. FUNGICIDES

They are specific types pesticides that control fungal diseases by specifically inhibiting or killing the fungi causing the diseases.

### EXAMPLE

Dithiocarbamate, Nabam[disodium ethylenebis(dithiocarbamate)], and methan sodium(sodium N-methyldithiocarbamate), Ziram, Captan, ethylmercuric bromide etc.





# HARMFUL EFFECTS OF PESTICIDES

RIJOY K.





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# HARMFUL EFFECTS OF PESTICIDES

## ENVIRONMENTAL EFFECTS

Contamination of the environment with harmful pesticides is known as pesticide pollution.

Pesticides are applied as aerial sprays or directly to the soil. After getting deposited, most of them (almost all organic pesticides) undergo biochemical modifications by heat, light, and water to yield derivatives, commonly known as pesticide residues. Many of these residues are stable, non-biodegradable, and persistent in nature. They can survive for long periods of time. DDT, BHC, Chlordan, aldrin, etc. are examples.

The pesticides do not stay in their points of deposition. They move through the component of the environment.







## ENVIRONMENTAL ISSUES....

A portion of the pesticide residues in soil get vaporised either directly or along with moisture into air. A portion seeps into the ground water. a significant portion moves in agricultural run off water to reach lakes, stream, rivers and oceans. Then they concentrate on food chain by the process of bio magnification, the concentration of the pesticide residues increases on moving up in the food chain, finally reaching the ultimate consumer, namely man in the most concentrated form.





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Presently residues of pesticide(e.g. DDT)are widely distributed. They are everywhere from the tissues of organism to oceans to polar ice caps, exerting their toxic influence, and they will continue to do so for many years to come.



# ENVIRONMENTAL EFFECTS - CONTD...

Another important environmental consequence of the use of the pesticides is that pests develop resistance to them with time. The population of such resistant pests grow faster necessitating the invention and application of more and more newer and strong pesticides thereby creating more and more pollution problems.

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# TOXIC EFFECTS OF PESTICIDES

- All synthetic pesticides are highly toxic and can kill all organisms including plants. They can enter human body orally, through skin, or by inhalation. The chlorinated pesticides affect nervous system while others affect circulatory or reproductive system. They have cumulative effect and can cause cancer, blood cancer, hypertension, sterility, kidney and liver damage etc.
- Excessive concentration of chlorinated hydrocarbon pesticides in human tissues cause hormonal imbalance, cancer of the organs, leukaemia etc.





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## PESTICIDES

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- Pesticides cause hypertension and damage to kidneys.
- In higher concentrations they cause death.





RIJOY K. J.

# Cement





## DEFINITION

Cement or Portland Cement is a fine grey powder consisting mainly of a mixture of calcium silicate and aluminate that hardens under water.





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# MANUFACTURING

## MANUFACTURE OF CEMENT

The raw materials for the manufacture of cement are limestone and clay (rich in silica and alumina and containing some  $\text{Fe}_2\text{O}_3$ )

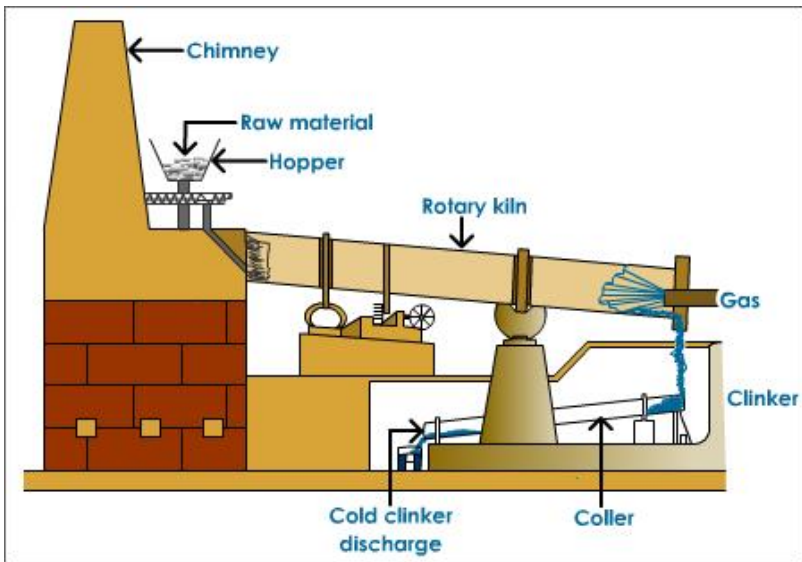
Finely powdered limestone is mixed with finely powdered clay and made into a slurry in water, This raw slurry is heated at  $1400 - 1500^\circ\text{C}$  in a large steel rotary kiln lined with fire bricks and heated by burning coal gas.







## MANUFACTURING





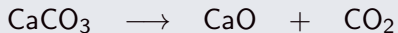
Dehydration occurs and then at the high temperature of the kiln, CaO (formed from the decomposition of limestone  $\text{CaCO}_3$ ) combines with silica and alumina of the clay to give a mixture of silicates, aluminates and aluminoferrites

RIJOY K J



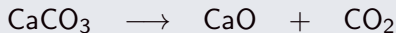


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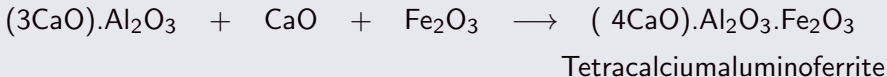


Dicalcium silicate











The resulting product is known as "Cement Clinker" which is in the form of marble sized lumps having a greenish black colour.

The clinker from the kiln is first cooled to about  $150^{\circ}\text{C}$  by circulating cold air. Then it is mixed with sufficient amount of (2 - 3%) of gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ) and ground to fine powder.

Gypsum acts as a retardant of quick initial setting of cement. By controlling the amount of gypsum added, we can control the setting of the final product which is portland cement.







# COMPOSITION OF PORTLAND CEMENT

The important ingredients present in Portland cement are 10 - 20% dicalcium silicate ( $(2\text{CaO})\cdot\text{SiO}_2$ ), 50 - 70% tricalcium silicate ( $(3\text{CaO})\cdot\text{SiO}_2$ ), 5 - 10% tricalcium aluminate ( $(3\text{CaO})\cdot\text{Al}_2\text{O}_3$ ) and 3 - 8 % tetracalciumaluminoferrite ( $(4\text{CaO})\text{Al}_2\text{O}_3\cdot\text{Fe}_2\text{O}_3$ ).

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APPROXIMATE COMPOSITION CAN ALSO BE SHOWN AS...

$\text{CaO} = 50 - 60\%$ ;  $\text{SiO}_2 = 20 - 25\%$ ;  $\text{Al}_2\text{O}_3 = 5 - 10\%$ ;

$\text{MgO} = 2 - 3\%$ ;  $\text{Fe}_2\text{O}_3 = 1 - 2\%$  and  $\text{SO}_3 = 1 - 2\%$





# SETTING OF CEMENT

Cement mixed with half its quantity of water is quite plastic and can be easily applied to the masonry or concrete. But as the mixture dries, it sets into a hard mass. This is called setting of cement and involves hydrolysis and hydration reactions.

RIJOY





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Setting of cement is due to the precipitation of colloidal gels formed by the hydration of the constituents and their rearrangement. The hydrated gels formed include the hydrated gel of dicalcium silicate ( $(2\text{CaO})\cdot\text{SiO}_2\cdot x\text{H}_2\text{O}$ ), the hydrated gel of tricalcium aluminate ( $(3\text{CaO})\cdot\text{Al}_2\text{O}_3\cdot 6\text{H}_2\text{O}$ ). These lose water slowly and eventually set to a hardened mass.





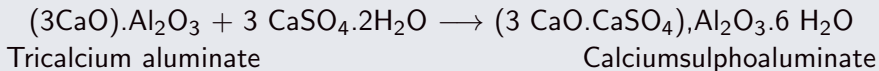
The gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ), added combines with the fast setting tricalcium aluminate to give calcium sulphoaluminate which does not have the property of quick hydration. This reaction thus increases the setting time and thereby improves the strength of the mass obtained after setting.

RIJO



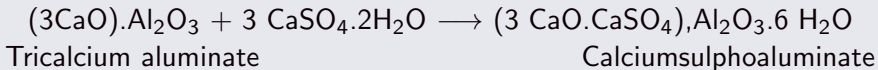


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## USES OF CEMENT

Cement is used in the construction of bridges, dams and buildings, and in plastering of walls.

It is used to make concrete and reinforced concrete.





RIJOY K. J.

# Glass







Glass is a transparent material obtained when a complex mixture of highly viscous molten silicates, upon moderately rapid cooling, solidifies to an amorphous rigid body without crystallisation. It is essentially a supercooled liquid.

Upon heating it gradually softens into a loose mass over a range of temperature and can then be moulded and blown into any desired shape, enabling the manufacture of a variety of differently shaped articles.





# MANUFACTURE OF GLASS

The raw materials required for making ordinary glass, which consists of silicates of sodium and calcium, are sand silica ( $\text{SiO}_2$ ), sodium carbonate ( $\text{Na}_2\text{CO}_3$ ), and calcium carbonate ( $\text{CaCO}_3$ ). These are powdered well and mixed well in proper proportions. A small amount of broken glass (Cullet) is also added to the mixture to reduce the melting point of silica and lower its viscosity.





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The mixture is fused in a furnace using producer gas as fuel. This leads to the following reactions.





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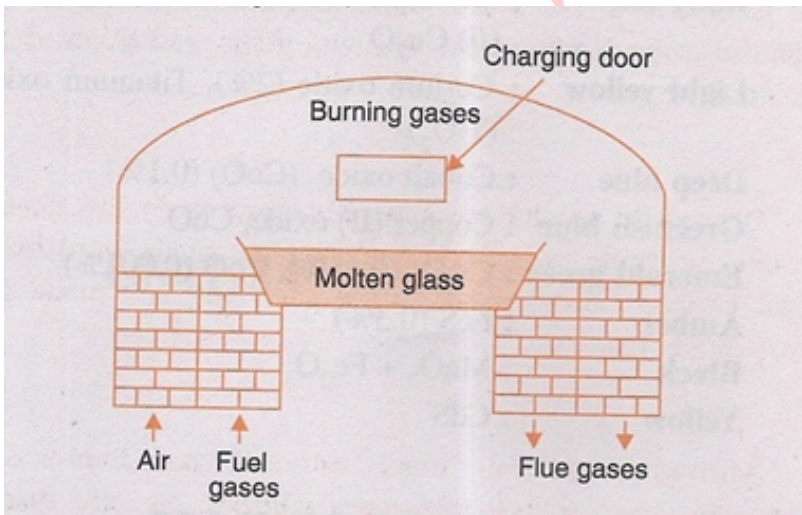
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## DIAGRAM





# MANUFACTURING - CONTD...

The evolution of  $\text{CO}_2$  gas causes the frothing of the mixture in the beginning, But when all the  $\text{CO}_2$  has been expelled, we get a clear, highly viscous liquid consisting of a mixture of sodium and calcium silicates, This is then poured into moulds or blown into desired shapes and cooled at an optimum rate (annealing).



# ANNEALING

The hot glass articles if cooled too quickly will become brittle and fragile due to internal strain and development of cracks. On the other hand, if cooled too slowly, they become devitrified and become opaque. This means that glass must be cooled at an optimum rate to get a quality product.





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## DEFINITION

The process of cooling of hot glass at an optimum rate is called annealing.





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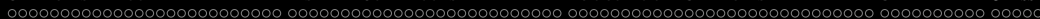
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## DEFINITION

The process of cooling of hot glass at an optimum rate is called annealing.

To cool the articles at an optimum rate, they are made to pass through an electrically heated tunnel like furnace, with 20 - 30 metres length and 2 - 3 metres width and height. The temperature of the furnace is adjusted so that it is hot at the beginning and colder toward the end.





# TYPES OF GLASSES

## 1. SODA GLASS(SOFT GLASS OR WINDOW GLASS)

It is obtained by the fusing together quartz/sand, sodium carbonate and calcium carbonate.

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### APPROXIMATE COMPOSITION

$\text{SiO}_2 = 75\%$ ,  $\text{Na}_2\text{O} = 15\%$ ,  $\text{CaO} = 8\%$ ,  $\text{Al}_2\text{O}_3 = 2\%$ .

This type of glass softens at a relatively lower temperature, and can be easily moulded into any desired shapes.





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This type of glass softens at a relatively lower temperature, and can be easily moulded into any desired shapes.

### USES

This mainly used to make window panes, cheap tableware, reagent bottles, etc., which is to be used at lower temperature.



## 2. POTASH GLASS(HARD GLASS)

This type of glass is obtained by fusing together quartz/sand, potassium carbonate and calcium carbonate. It has a higher melting point and hence is able to withstand higher temperatures than soda glass.







## 3. FLINT GLASS

It is obtained by fusing together mainly quartz/sand and lead carbonate, along with some sodium carbonate, potassium carbonate and calcium carbonate.

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It is obtained by fusing together mainly quartz/sand and lead carbonate, along with some sodium carbonate, potassium carbonate and calcium carbonate.

#### APPROXIMATE COMPOSITION

$\text{SiO}_2 = 45\%$ ,  $\text{PbO} = 44\%$ ,  $\text{Na}_2\text{O} = 4\%$ ,  $\text{K}_2\text{O} = 4\%$ ,  $\text{CaO} = 3\%$ ,







## 4. PYREX GLASS

This is borosilicate glass, which contains  $B_2O_3$  as one of the ingredients. It is obtained by fusing together mainly quartz/sand, sodium carbonate, aluminium oxide and boric oxide.



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### APPROXIMATE COMPOSITION

$SiO_2 = 80 \%$ ,  $B_2O_3 = 12\%$ ,  $Na_2O = 4\%$ ,  $Al_2O_3 = 3\%$ ,  $K_2O = 0.5\%$ ,  $CaO = 0.5\%$





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### USES

It has the lowest coefficient of thermal expansion and is able to withstand large temperature changes. Therefore it is used for making laboratory glassware and cook ware that can withstand high temperatures.

Thank You.....

