

Introduction:-

Glass is a super cooled liquid consisting of mixture of silicates. The basic building block of ordinary glass is tetrahedron built from a silicon atom at the centre and four oxygen atoms directed along the four corners of tetrahedron. The tetrahedra join together to give a three-dimensional interlocking structure that gives glass its high viscosity. When heated, glass does not melt sharply but it gradually softens until it becomes liquid. Thus glass can be molded into any desired shape.

Its composition may vary, in general it may be represented as: -



Where X and Y are the whole number, R is an atom like Na, K, etc i.e. monovalent alkali metal atom; M is an atom like Pb, Ca, Zn etc i.e. bivalent metal atom.

**Manufacturing Steps:** - It is divided into four steps

1. **Melting:** - Raw material in proper proportions mixed with cullet and finely powdered and intimate mixture (called batch). Melting of glass batches is carried out either in pot furnace or in tank furnace.
2. **Shaping and forming:** - Desired shaped articles are made from molten glass by blowing or by pressing between rollers or by moulding.
3. **Annealing:** - Annealing is the moderate or very slow cooling of manufactured glass articles, in order to reduce strain, either in annealing chamber or annealing lehrs.  
It is to be noted that quality of glass is better if it is annealed at its annealing temperature and for longer period.
4. **Finishing:** - After annealing, all glass articles are subjected to finishing process such as cleaning, polishing, cutting, sand blasting etc.

**Cullet:** - Cullet is a crushed glass from defective or broken glass articles. It makes the melting easy and utilizes waste glass.

**Coloring and decoloring agents:** - Coloring agents are  $Cr_2O_3$  (green),  $CrO_3$  (yellow-green),  $CoO$  (blue),  $CuO$  (red),  $Fe_2O_3$  (brown),  $CdS$  (lemon-yellow),  $Na_3AlF_6$  (opaque milky white) etc

Decoloring agents are Se,  $CeO$  etc

Types of glasses: - Some commercial glasses are discussed below

I. Soda Lime glass :-

Preparation: - It is made by fusing the sodium carbonate, calcium carbonate and  $\text{SiO}_2$ . Its approximate composition is  $\text{Na}_2\text{O} \cdot \text{CaO} \cdot 6\text{SiO}_2$   
As the carbonates decompose to oxide on heating

Applications: - i. Window glasses ii. Cheaper tableware. iii. Cheap laboratory glassware

II. Potash Glass or Hard glass:-

Preparation: - It is made by fusing  $\text{K}_2\text{CO}_3$ ,  $\text{CaCO}_3$  and  $\text{SiO}_2$ . Its approximate composition is  $\text{K}_2\text{O} \cdot \text{CaO} \cdot 6\text{SiO}_2$ .

Applications: - Chemical apparatus, combustion tube.

III. Lead glass or Flint glass:-

Preparation: - It is made by fusing  $\text{K}_2\text{CO}_3$ , red lead and  $\text{SiO}_2$ . The approximate composition is  $\text{K}_2\text{O} \cdot \text{PbO} \cdot 6\text{SiO}_2$ .

Applications: - It is widely used for (i). Making prism, lenses and other optical devices.  
(ii) Making high quality tableware and art objects, because of high lustre.

IV. Borosilicate or Pyrex Or Jenna Glass:-

Borosilicate glass contains boron trioxide ( $\text{B}_2\text{O}_3$ ) and very rich in silica and little amount of alumina and alkali metal oxide.

Component	$\text{SiO}_2$	$\text{B}_2\text{O}_3$	$\text{Al}_2\text{O}_3$	$\text{K}_2\text{O}$	$\text{Na}_2\text{O}$
%	80.5	13	3	3	0.5

Applications: - 1. Industry for pipelines for corrosive liquids 2. Superior laboratory apparatus like flask, beakers etc. 3. Electrical insulator etc.

V. Alumino silicate glass:-

Compared to borosilicate glass, alumino silicate glass has higher percentage of  $\text{Al}_2\text{O}_3$  and lower percentage of  $\text{B}_2\text{O}_3$

Component	$\text{SiO}_2$	$\text{Al}_2\text{O}_3$	$\text{B}_2\text{O}_3$	$\text{MgO}$	$\text{CaO}$	$\text{Na}_2\text{O}$
%	55	23	7	9	5	1

Applications: - 1. High- pressure mercury discharge tubes 2. Chemical combustion tube and certain domestic equipment, etc

VI. Optical or Crooks glass: - Optical glasses contain phosphorous and lead silicate in

which calcium oxide is replaced by oxides of Pb, phosphorous etc. They have high refractive index and used for the manufacture of lenses.

Crook's glass is special type of optical glass which contain little cerium oxide which is capable of absorbing UV light (Which is injurious to eyes).

Applications: - 1. Eye lenses.

VII.

Safety glass or laminated glass:-

Preparation:- Safety glass or cellulose glass is made by placing a thin layer of plastic (either acetal resin or cellulose acetate) between two sheets of ordinary glass. This sandwiched structure is then heated under slight pressure till the glass layer and plastic layers merge in to one another.