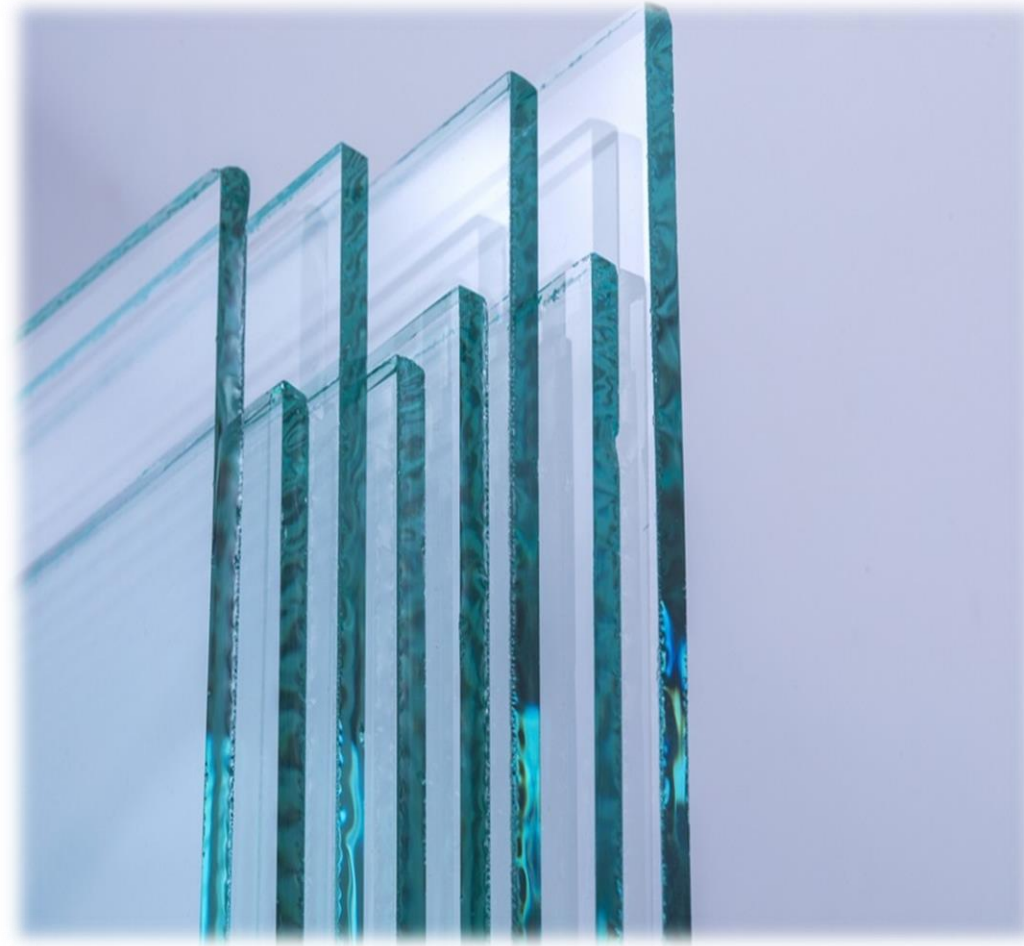


INTRODUCTION TO GLASS , TYPES OF GLASS AND THEIR COMPOSITION



DEFINITION

- ★ Glass is an amorphous , hard , brittle , transparent or translucent super cooled liquid of infinite viscosity , having no definite melting point obtained by fusing a mixture of a number of metallic silicates or borates of Sodium , Potassium , Calcium and Lead.
- ★ The most familiar and historically the oldest types of manufactured glass are “Silicate glasses” based on the chemical compound silica , the primary constitute of sand.
- ★ As per ASTM(American Society for testing and materials) standard for glass:-
“ Glass is an inorganic product of fusion which has been cooled to a rigid condition without crystallization.”

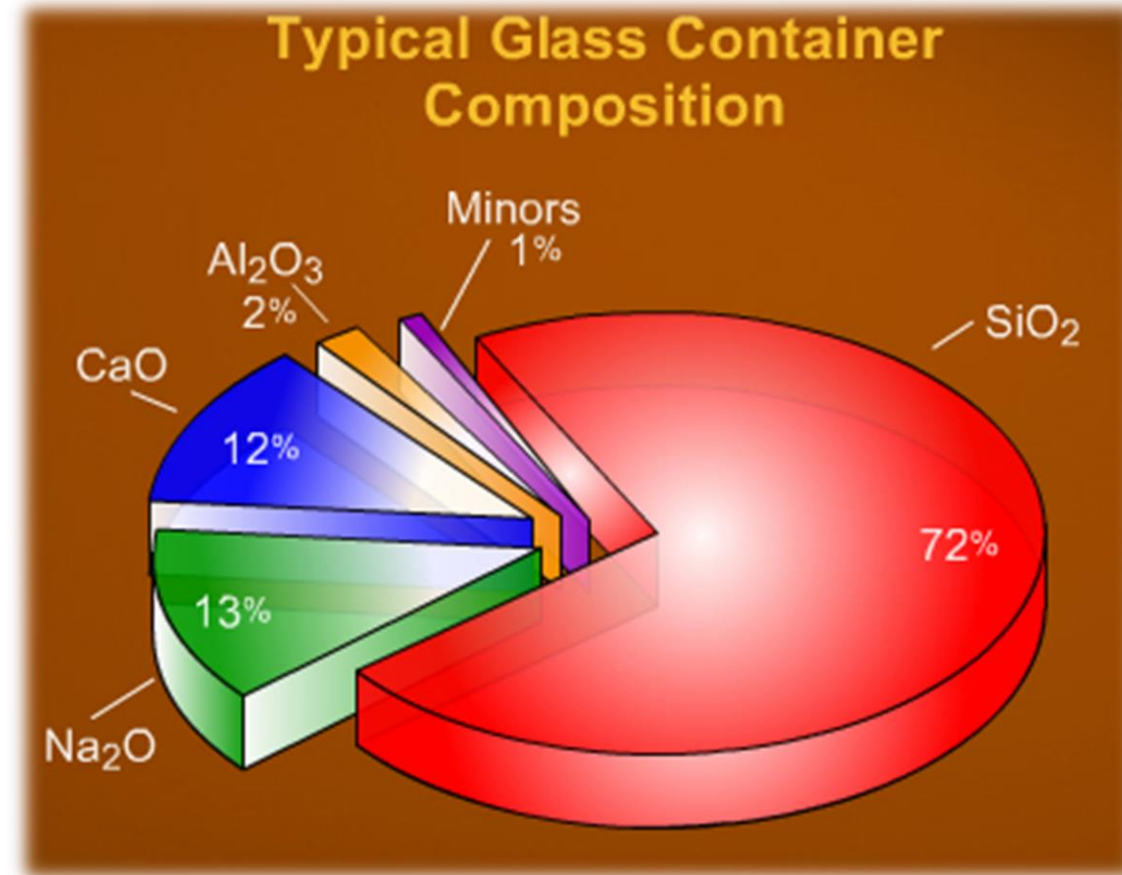


PROPERTIES OF GLASS

- ✓ Amorphous Solid
- ✓ No definite melting point
- ✓ Very brittle
- ✓ Softens on heating
- ✓ Can absorb , reflect and transmit light
- ✓ Good electrical insulator
- ✓ Not affected by air , water , acid or chemical reagents .

RAW MATERIALS USED IN MANUFACTURING OF GLASS

- Sodium as Na_2CO_3 (used in soft glass)
- Potassium as K_2CO_3 (used in hard glass)
- Calcium as lime stone , chalk and lime .
- Lead as litharge , red lead (flint glass)
- Zinc is zinc oxide (heat and shock proof glass)
- Borates are borax , Boric acid(heat and shock proof glass)



VARIOUS TYPES OF GLASS:-

- 1-Sodalime or soft Glass
- 2-Borosilicate / pyrex / Jena Glass
- 3-Lead Glass or Flint Glass
- 4-Aluminosilicate Glass
- 5-Toughened Glass
- 6-Potash lime or hard Glass
- 7-Wired Glass
- 8-Coloured Glass
- 9- Laminated Glass

1-Sodalime or soft Glass

- ➔ About 90% of all glass is sodalime glass made with silica(sand) , Carbonate and soda ash.
- ➔ The approximate composition is $\text{Na}_2\text{CO}_3 \cdot \text{CaO} \cdot 6\text{SiO}_2$.
- ➔ They are low cost , resistant to water but not to acids.
- ➔ They can melt easily and hence can be hot worked.

Composition

The composition of soda-lime glass varies marginally depending on the manufacturer. The typical composition of soda-lime glass is 73% SiO_2 – 15% Na_2O – 7% CaO – 4% MgO – 1% Al_2O_3 Refractive index - 1.46 Density, $2.5 \rho \text{ (g/cm}^3\text{)}$

Uses:-

Window glass, Electric bulbs, Plate glass, Bottles, Jars, Cheaper tablewares , Test tubes , Reagent bottles etc.



2-Borosilicate / pyrex / Jena Glass

- It is common hard glass containing silica and boron with small amount of alumina and less alkaline solids.
- These equipments are mainly known for resistant to thermal shock as compared to other ordinary glasses.
- The borosilicate glass is made by adding the boric oxide to the traditional glassmaker frit of the silicate soda , sand or to the ground lime .
- The glass normally requires a higher temperature to melt and thus for the industrial productions of borosilicate glass.



Composition

The borosilicate glass composition includes silicon dioxide (SiO_2) in a range from about 60% to 74% by total composition weight; boric oxide (B_2O_3) in a range from about 9% to 25% by total composition weight; aluminum oxide (Al_2O_3) in a range from about 7% to 17% by total composition weight; and at least one alkali oxide in a range from about 2% to 7% by total composition weight.

Uses:-

Kitchen wares, Chemical Plants, Electrical insulators, Superior Laboratory apparatus, Industrial pipeline for corrosive liquids , Gauge glass etc.

3-Lead Glass or Flint Glass

- It is made up of lead oxide fluxed with silica and K_2CO_3
- Its approximate composition is $\text{K}_2\text{CO}_3 \cdot \text{PbO} \cdot \text{SiO}_2$
- Lead glasses has lower softening temperature than soda glass and higher refractive index and good electrical properties . It is bright lustrous and possess high specific gravity.

Composition

Lead glass contains typically 18–40% (by weight) lead(II) oxide (PbO), while modern **lead crystal**, historically also known as flint glass due to the original silica source, contains a minimum of 24% PbO . Lead glass is often desirable for a variety of uses due to its clarity.

Uses:-

High quality table wares, optical lenses, Neon sign tubing, Cathode ray tubes, Electrical insulators, Crystal art objects or cut glass, Windows and Shields for protection against X-rays and Gamma rays in medical and atomic energy fields etc.



4-Aluminosilicate Glass

This type of glass possess exceptionally high softening temperature.

Aluminosilicate glass is one of the most rare glass, some of these types have been used in space shuttle windows , gauges and thermometers.

Composition:-

This mineral-based material contains 57-60% silicon dioxide (SiO_2) and 16-20% aluminium dioxide (Al_2O_3), along with small amounts of 5-7% lime (CaO), 6-12% magnesium oxide (MgO), boron trioxide (B_2O_3), among other cations.

Uses:-

It is used for high pressure mercury discharge tubes , chemical combustion tubes etc.



5-Toughened Glass

It is a type of safety glass processed by controlled thermal or chemical treatments to increase its strength compared with normal glass.

Tempering puts the outer surfaces into compression and the interior into tension .

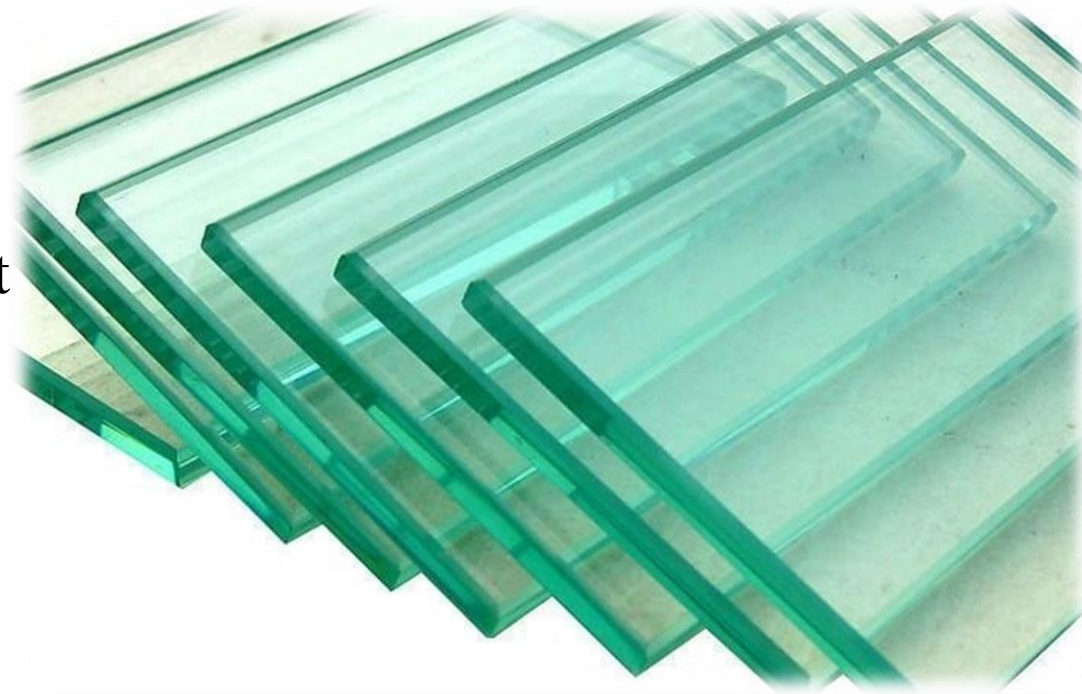
Toughened glass is a material that is extremely flexible and versatile which means that we can use it as per our needs and requirements.

Composition:-

Toughened glass or tempered glass is glass that has undergone processes of controlled thermal treatment to increase its strength. It is four times stronger than normal annealed glass. Toughened glass is made from annealed glass that has been heated to approximately 650°C and then rapidly cooled.

Uses:-

For making window shields of fast moving vehicles ,
Windows of furnace and automatic opening doors.



6) Potash lime or hard Glass

- ✓ Potash lime glass is made with silica (sand) , Calcium Carbonate and Potassium carbonate.
- ✓ The approximate composition is $\text{K}_2\text{CO}_3 \cdot \text{CaO} \cdot 6\text{SiO}_2$.
- ✓ They posses high melting point.

Uses:-

These glasses are costlier than sodalime glass and are used for chemical apparatus , combustion tubes and glassware which are used for heating operations.

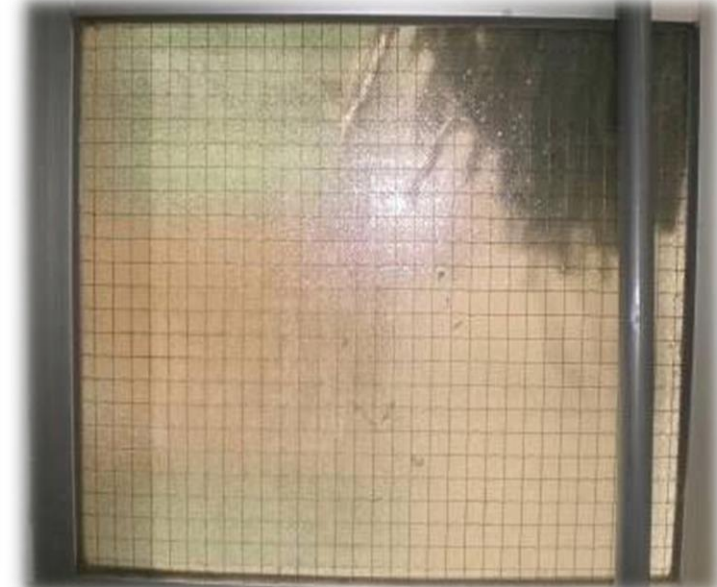


7-Wired Glass:-

Wired glass does not fall apart into splinters when it breaks and is fire resistant .It is made by fusing wire in between the two glass layers.

Uses:-

For making fire resistant doors , roofs , skylights and windows



8-Coloured Glass:-

These are produced by the addition of metallic oxides to soda lime silica glass.

Chromium oxide produces green colour, Cobalt produces blue colour, Iron produces greenish blue colour,& Gold, Copper, Selenium, Colloidal particles produces red colour.

Uses:- Used for window panels , fancy articles, decorative tiles etc.

9- Laminated Glass:-

It is a type of safety glass that holds together when shattered . In the event of breaking it is held in place by interlayer typically of polyvinyl butyral , ethylene-vinyl.

Uses:-

Car windshields, glass railings , skylights , roofs , glass floors etc.



Coloured tiles



Coloured window panels



Thank You!

