

## GLASS

Glass is a complete mixture of several silicates; all glass contains silica. Common soda glass contains sodium and calcium silicates and has the approximate composition  $\text{Na}_2\text{O}$ ,  $\text{CaO}$ ,  $5\text{SiO}_2$ . In addition to or in place of soda ( $\text{Na}_2\text{O}$ ) and lime ( $\text{CaO}$ ), special glasses may contain potash ( $\text{K}_2\text{O}$ ), baryta ( $\text{BaO}$ ), magnesia ( $\text{MgO}$ ), lead oxide ( $\text{PbO}$ ), and zinc oxide ( $\text{ZnO}$ ). They may also sometimes contain borate and phosphates. The properties of glass are profoundly modified by its composition, and hence based on composition glass can be classified into: -

1. Soft glass / Soda glass / Soda lime glass – It contains sodium and calcium silicates. It is used for general-purpose glassware – flat or hollow glassware.
2. Lead crystal glass / Flint glass – It contains potassium and lead silicates and has high density and refractive index. Hence it is used in making lens prisms. It is also used for decorative purposes (as cut glass). It is very expensive and used mainly for bowls, drinking glasses, vases, etc., which are not in constant use. In flint glass very soft lead is used in the form of litharge ( $\text{PbO}$ ) or red lead ( $\text{Pb}_3\text{O}_4$ ).
3. Borosilicate glass / Jena glass / Pyrex glass – They are highly resistant to the action of heat and chemical reagents and are used to make baking dishes.
  - Jena Glass – Contains zinc and barium oxides and boron trioxide in place of some silica.
  - Pyrex glass – Contains boron trioxide and is very rich in silica. It contains sodium and aluminium boro-silicates.
4. Flat glass – This is made from soda lime glass and is used for windows, shelves, etc. they are of two main types –

- Sheet glass – It is drawn continuously from the matter mass and passed through and annealing tower after which it can be cut into the required lengths.

- Float glass – It is like plate glass in many instances, but unlike plate glasses it doesn't need to be ground and polished after annealing.

Both are made from very refined ingredients and provide clear, undistorted vision and are used for shop windows, mirrors and protective coverings on furniture. The edges are often leveled; i. e. cut at an angle, while those on shelves are ground and corners rounded.

5. Silvered glass – They are used for mirrors. It is made by coating one side of the glass panel with silver and some case copper, followed by a coat of paint and a layer of stove enamel. Silvered glass maybe used as tiles or mosaics or as reflective sheets.

6. Laminated safety glasses – Much used in automobiles, it is made by enameling together two sheets of thin plate glass with a layer of non-brittle plastic material (e.g. transparent cellulose acetate or polyvinyl butyral) in between. When glass breaks under impact, the fragments are held in place by the flexible inner layer.

7. Fiberglass – Glass is reduced to flexible filaments or threads. It is an excellent heat insulator. Fiberglass is woven into fabric for fireproof curtains. Glass is also spun into short fibers, known as glass wool.

8. Coloured glass – This is made by adding various metallic oxides which yield coloured silicates or other substances to the molten glass in course of it's manufacture.

<b><i>Colour of glass</i></b>	<b><i>Colouring agent</i></b>
Ruby red	Gold, selenium, cuprous oxide
Blue	Cobalt oxide, cupric acid
Milky	Fluorspar with felspar, tin dioxide or calcium

	phosphate
Yellow	Cadmium sulphide, uranium oxide
Green	Chromic oxide, ferric oxide
Amber	Carbonaceous material with sulphur or iron sulphide
Black	Excess of ferric oxide

### MANUFACTURE

Ordinary glass is made by a fusion of a mixture of glass sand, soda ash and limestone ( $\text{SiO}_2$ ,  $\text{Na}_2\text{O}$ , and  $\text{CaO}$ ). Silica is the glass former, soda acts as flux, and lime is the stabilizer conferring durability to the glass. In addition small quantities of Sodium Sulphate, Sodium Nitrate, Fluorspar Arsenic Oxide, etc are added to act as melting refining aids. As glass in molten state is a viscous liquid, it entraps bubbles ( $\text{CO}_2$ ,  $\text{SO}_2$ , steam etc). Removal of these bubbles is called refining. Iron Oxide is the major impurity that enters into glass through raw materials and imparts unwanted colour to the glass.

The glass furnace is a rectangular chamber lined with superior quality refractory blocks that can withstand high temperature (1600degree C). It has two chambers – one for melting and refining; and the other for working where homogenised molten glass is withdrawn. A constant level of molten glass is maintained by introducing raw materials at one end and withdrawal of molten glass at other end. Somewhat colder molten glass is drawn from the working chamber and shaped into articles manually or by machine.

After shaping the glass article has to be cooled very carefully. This process is called annealing. Glass that is cooled rapidly is brittle due to the existence of internal strain and is liable to crack on heating, or receiving slight shocks or scratches. If cooled too slowly, glass denitrifies, i. e. some of the components start to crystallize out separately rendering the glass opaque. All glassware is therefore annealed to reduce the internal strain by heating for sometime at a temperature just below the softening point of glass (around 500 degrees C), so that the articles don't get deformed. Then they

are slowly and uniformly cooled. Annealing oven is a tunnel like furnace, hot at one end and provided with a slowly moving frame holding the glassware. This might sometimes take days.

### TYPES

- Obscured and Safety glass: - Both are made from sheet or flat glass. Obscured glass is required for bathrooms and other places where light requires passing without it being transparent, often having a pattern on one side. This is produced by passing molten glass between embossed rollers. Safety glass may be: -
  - Embossed glass with wire: Wire is incorporated during rolling process. Wire prevents glass fragments from falling when broken.
  - Laminated glass: Made by sticking two thin sheets of glass with a vinyl type plastic in between
  - Toughened glass: This is made by subjecting the glass to a temperature just below the softening point and then cooling the surface layer rapidly. This forms a skin on top of the glass and if broken the glass shatters into small, harmless fragments.
  - Toughened and laminated glass: This is five times stronger than any other types of safety glass.
  
- Enamels: - Enamels are fusible glass rendered opaque by pacifiers like tin dioxide, titanium oxide and zirconium oxide, which are applied cold; and fused to the metal surface at red heat. The raw material for the enamel glass includes quartz, felspar & fluxes, borax and soda ash. Enameling of Iron or Brass ware prevents atmospheric corrosion. Enameled wares are in large demand as sanitary and cooking ware, nameplates, signboards, refrigerator and dairy equipment, etc.
  
- Glaze: - Glaze is a thin coating of easily fusible glass molted on to the surface of the more or less porous ceramic ware. The glaze composition includes refractory ingredients (felspar, silica, china clay & lime) and fluxes (soda, potash, borax, lead oxide) in different proportions.

### MAINTAINING GLASS SURFACES

Daily care involves damp or dry dusting, preferably with lintfree cloth such as paper or scrim. High soiling and greasy finger marks can be removed by wiping with a solution of equal quantities of vinegar and water or a mixture of 18ml ammonia to half bucket of warm water. More stubborn marks such as make-up and toothpaste deposits found in mirrors can be removed by wiping with a solvent such as methylated spirit. Newspaper prints contain solvents and can be used to clean windowpanes and mirrors. Textured or engraved glass should be cleaned occasionally with a very soft brush.

Use of abrasives should be avoided.



IHM NOTES