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**Topic: Silicate Industries**

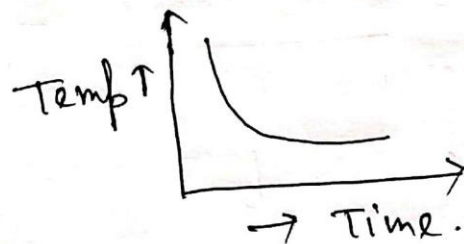
**PART 1**

## Glass.

Glass is an amorphous transparent or translucent supercooled solution of various silicate.

Properties: :-

- ① It does not possess sharp boiling point and melting point.
- ② It is not a true solid.
- ③ Constituent particles are not arranged in a regular way.
- ④ It has short range order.
- ⑤ It is isotropic.
- ⑥ Its cooling curve is continuous.

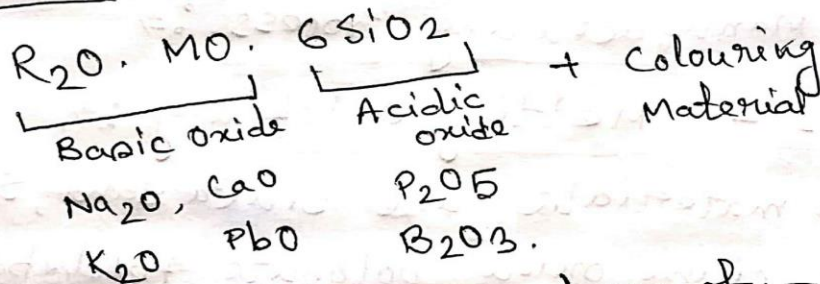


Common formula of glass (silicate) :-



R - Monovalent cation ( $Li^+$ ,  $Na^+$ ,  $K^+$ , ...)  
M - Divalent cation ( $Mg^{2+}$ ,  $Ca^{2+}$ ,  $Zn^{2+}$ ,  $Pb^{2+}$ , ...)

Raw material of glass -



Raw Material used in the form of -

(A) Basic oxide

- ① Sodium -  $Na_2CO_3$ ,  $NaNO_3$
- ② Potassium -  $K_2CO_3$ ,  $KNO_3$
- ③ Calcium -  $CaCO_3$ ,  $CaO$
- ④ Barium -  $BaCO_3$
- ⑤ Magnesium -  $MgCO_3$
- ⑥ Zinc -  $ZnCO_3$ ,  $ZnO$
- ⑦ Lead -  $PbCO_3$ ,  $PbO$



Raw Material used in the form of :

① Acidic oxide.

- ①  $\text{SiO}_2$  - Sand
- ②  $\text{H}_3\text{BO}_3$ ,  $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$  (Borax)
- ③  $\text{P}_2\text{O}_5$  -  $\text{Ca}_3(\text{PO}_4)_2$

Glass Manufacturing Process. :

Stage 1 - Melting & Refining. :

Raw materials like silica sand, sodium oxide, calcium oxide, Dolomite, Feldspar are mixed to make a batch and heated in a furnace at  $1500^\circ\text{C}$ . For getting different colour, certain metal oxide are added in the mixture.

e.g - oxide of ~~Fe~~ Iron is added for green.

Stage - 2 - Float Bath. : Next the mixture from the furnace gently flows over the refractory spout on the mirror like surface of the molten tin starting at  $1100^\circ\text{C}$  and leaving the float bath



at solid coating device at 600°C. In this stage the desired thickness of the glass is achieved.

State - 3 - Coating :-

Multiple coating will be deposited in a few seconds available on the glass.

State - 4 - Annealing - In this stage,

glass is cooled slowly and internal stresses are removed. so that the glass are more prone to cutting. The way in which the glasses cooled determined the strength.

If it is cooled over an extremely short duration of time, the glass can become too brittle to handle.

State 5 - Inspection and cutting :-

In this process at first, 100 million inspections per second is allowed

by inspection technology. Then a program is given to the computer and glass is cut to a required size.

### Types of glass. ⇒

① Soda glass ⇒. Sodium carbonate is a common additive and acts to lower the glass-transition temperature. Soda lime-glasses,  $\text{Na}_2\text{O} + \text{lime} (\text{CaO}) + \text{Mg} (\text{MgO}) + \text{Al} (\text{Al}_2\text{O}_3)$  account for over 70 to 74% of manufactured glass, containing about 75% silica by weight. Soda lime glass is transparent, easily formed and most suitable for window glass and tableware. But it has poor resistance to heat.

Use ⇒. Soda lime glass is typically used for windows, bottles, light bulbs and jars.



### Borosilicate glass. :->

Borosilicate glasses typically contain 5-13% boron trioxide ( $B_2O_3$ ). It has fairly low coefficients of thermal expansion as compared to soda lime glass. They are therefore, less subject to stresses caused by thermal expansion and less vulnerable to cracking from thermal shock.

Use - They are commonly used for labware, household cook-ware and sealed beam car head lamps.

### Silicate glass. :-> Silicon dioxide ( $SiO_2$ )

is a common fundamental constituent of glass. Fused quartz is a glass made from chemically-pure silica. It has very low thermal expansion and excellent resistance to thermal shock. But its high melting temperature ( $1723^\circ C$ ) and viscosity make it difficult to work with. Therefore other substances are added to lower the melting temperature and simplify the processing.

## Lead glass. :-

The addition of Lead (Pb) oxide into silicate glass lowers melting point and viscosity of the melt. The high density of Lead glass [silica + Lead oxide (PbO) + Zinc oxide (ZnO) + alumina] results in a high electron density making the look of glass ware more brilliant and causing more specular reflection and increased optical dispersion. But Lead glass cannot withstand high temperature well.

Use :- The most common uses of lead glass are drinking glasses, ornaments, decanters, optical lenses, enamels and lacquers.

## Potash glass/Hard glass. :-

It is the mixture of Potassium and calcium silicate.

The common formula is  $K_2SiO_3 \cdot CaSiO_3 \cdot 4SiO_2$ .

It does not melt so easily as its melting temperature is very high. So it is called hard glass.

Use - Potash glass is used for making laboratory apparatus.