

## **Glasses -structure, properties, examples-**

### ***Introduction:***

Glass is by definition an amorphous solid material made by fusing silica with a basic oxide. Glass is called amorphous because it is neither a solid nor a liquid but exists in a vitreous, or glassy, state.

### ***Composition, structure:***

Architectural glass is made from three principal raw materials, easily found in nature: silica ( $\text{SiO}_2$ ), lime ( $\text{CaCO}_3$ ) and sodium carbonate ( $\text{Na}_2\text{CO}_3$ ). The secondary materials are used to give special properties to glass or to facilitate the glass-making process.

A substance in its glassy form is said to be in its vitreous state. A glass is prepared by cooling a melt more quickly than it can crystallize. Thus cooling molten silica gives vitreous quartz. Under this condition the solid mass has **no long rang order** as judged by the lack of X-ray diffraction peaks, but spectroscopic and other data indicate that each Si atom is surrounded by a tetrahedral array of O atoms (**short range order**). The lack of long range order results from variations of the Si-O-Si angles

- Soda-lime glass: This is the most common commercial glass (90% of total production), and also the least expensive. The chemical and physical properties of soda-lime glass are the basis for its widespread use
- Lead glass: As the name already indicates, lead glass has a high percentage of lead oxide (at least 20% of the batch). Lead glass has a relatively soft surface, making it especially suited for decorating using grinding, cutting, and engraving processes. This glass will not withstand high temperatures or sudden changes in temperature.
- Borosilicate glass: The third major group, borosilicate glass, is any silicate glass having at least 5% of boric oxide in its composition. It demonstrates greater resistance to thermal changes and chemical corrosion. Thanks to its properties, borosilicate glass is suitable for use in industrial chemical process.

### ***Thermal properties:***

An instructive comparison between vitreous and crystalline material is seen in their change in volume with temperature.

When a molten material crystallizes, an abrupt change in volume occurs. By contrast, a glass-forming material that is cooled sufficiently rapidly persists as a metastable super cooled liquid. When cooled below the glass transition temperature, the super cooled liquid becomes rigid and this change is accompanied by only an inflection in the cooling curve rather than an abrupt change in slope.

### ***References:***

Shriver & Atkins, Inorganic Chemistry, Fourth edition 2006, page 616  
<http://www.glassonweb.com/articles/>