Collage of Engineering

Materials Department

Third Class

Lecture (10)

GLASS

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5-4-3 Chemically strengthened glass

It is a type of glass that has increased strength as a result of a post-production chemical process. Chemical strengthening is the name given to glass products that have been strengthened by means of an ion-exchange process. It is a surface treatment which occurs at a temperature lower than glass melting temperature. The process is particularly useful for thin glass, tiny glass and any shape glass which cannot be tempered by ordinary physical tempering. Chemically strengthened glass is typically six to eight times the strength of float glass. In the case of breakage, chemically strengthened glass breaks into bigger pieces which are not as sharp as those of non-toughened glass. The surface compression condition which is higher in the case of a chemically strengthened glass also involves an increase of flexion resistance, which is one of the main characteristics of chemically strengthened glass. Chemical strengthening results in a strengthening similar to toughened glass. Chemically strengthened glass has little or no bow or warp, optical distortion or strain pattern. This differs from toughened glass, in which slender pieces can be significantly bowed. Chemically strengthened glass may be cut after strengthening. When the surface of chemically strengthened glass is deeply scratched, this area loses its additional strength. Chemically strengthened glass retains its color and light transmission properties after treatment. Chemically strengthened glass offers an improved scratching, impact and bending strength.

5-4-3-1 Manufacturing process of chemically strengthen:

The glass is chemically strengthened by a surface finishing process. The glass to be treated is dipped into a bath of dissolved potassium salts at a temperature about 380oC for duration from 4 to 30 hours, producing an ionic exchange between the superficial sodium ions in the glass and potassium ions inside the bath. The time would be greatly reduced if the

glass is made of certain elements such as lithium or magnesium because ion mobility between potassium and these elements is a lot faster. The process parameters such as ion exchanging time and temperature would be modified according to the type of glass to be treated and the required strengthen specification.

The introduction of potassium ions which are larger in size than the sodium ions results in the establishment of residual stress, compression stretches on the surface counterbalanced by traction stretches within the glass Sodium ions and thus, creates stress on glass surface. During cooling, the potassium on surface shrinks little while the sodium in inner shrinks larger. Hence, stress is induced between glass surface and inside and consequently, the glass is strengthened. This process shows in figure (13).

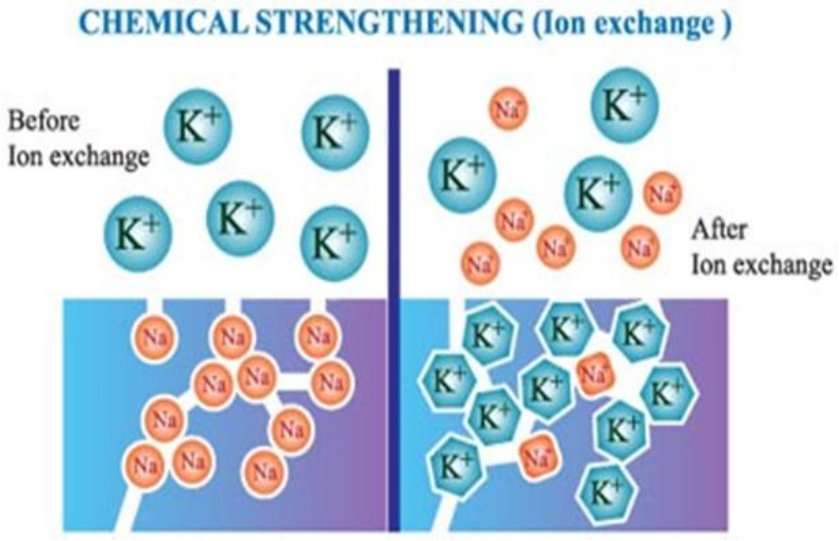

Figure 13: chemically strengthened of glass

5-4-3-2 Advanced process

There also exists a more advanced two-stage process for making chemically strengthened glass, in which the glass article is first immersed in a sodium nitrate bath at 450 °C, which enriches the surface with sodium ions. This leaves more sodium ions on the glass for the immersion in potassium nitrate to replace with potassium ions. In this way, the use of a sodium nitrate bath increases the potential for surface compression in the finished article.

5-4-3-3 Applications

Chemically strengthened glass was used for the aircraft canopy of some fighter aircraft. The chemically treated glass boasts a transparency range from the UV through the visible and into the infrared. This permits weapons systems designers to operate guidance devices whether, radio frequency, infrared or laser based. The materials proponents stress that chemically treated glass is not just for use in military applications. It can be used in numerous applications that demand toughness and optical clarity. The material is also useful for viewports, protective covers, and front surface optics in hostile environments whose elements may include high temperature, high pressure and vacuum conditions. Less demanding applications include point of sale scanner windows used in grocery store and retail scanners.