GLASSWORKING

Introduction

Glass is an amorphous solid with a non-crystalline structure. There are three major categories of glass products:

1. glass piece ware
2. flat glass
3. glass fibers

(a) Lead crystal makes beautiful glass products, (b) flat glass used in buildings turns entire walls into windows, (c) glass fiber optics uses glass fibers to transmit signals in communications and computers

Process sequence in glassworking

The typical process chain is pictured in the figure:

Preparation of raw materials

Preparation of silica sand

Silica sand (SiO$_2$) is the principal component of all glasses. Preparation of silica sand includes washing, drying and classification.
Additives
Various other materials, such as soda ash, potash, limestone etc. are added in the correct proportions to achieve the desired composition.

Recycled glasses
Recycled glasses are crushed and added to the mixture in a proportion of up to 100%.

Melting
Melting of starting raw materials is usually carried out at around 1500–1600°C in a melting cycle of 24–48 hours. Melting is performed in different furnaces, usually electric furnaces.

Shaping Processes
The shaping processes can be classified into three categories:

1. Processes for piece ware
2. Continuous processes for glass making
3. Fiber making processes

Shaping of Piece Ware

Casting
This process is similar to metal casting. Relatively massive parts, such as astronomical lenses and mirrors, are made by this process. The parts are cooled slowly after casting to avoid internal stresses and cracking. Finally, products must be polished.

Spinning
Spinning is similar to centrifugal casting. It is used to produce funnel-shaped components such as tubes for televisions and computer monitors.

Pressing
Pressing is a process for mass production of relatively flat items, such as dishes, bake ware, lenses, TV tube faceplates (the faceplate is assembled to the funnel using a sealing glass of low melting point).
Blowing

The blowing process is used to make thin-walled hollow glass items, such as bottles and glass containers.

**Stages in manufacturing an ordinary glass bottle**

### Drawing

The *Fourcault* process uses a special die made of fireclay and called *debituse* to draw the sheet from the molten glass. In *Colburn* process, the sheet is bent while the glass is still plastic so that it can be cooled in horizontal position.
Float process
The glass flows directly from the melting furnace onto the surface of a molten tin bath:

In all processes for flat glasses, the continuous sheet is cut into standard sizes after the glass has hardened significantly. Subsequent grinding and polishing removes tool marks and produces smooth and parallel surfaces.

Danner process
This process is used for glass tubing:
**PRODUCING OF GLASS FIBERS**

**Centrifugal Spraying**
Molten glass flows into a rotating bowl with many small openings around its periphery. The fiberglass made is suitable for insulation.

**Drawing**
This process is used to produce continuous glass fibers of high quality and small diameter used in fiber-optics communication lines.

Drawing continuous glass fibers