

# Glass as a Packaging Materials



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# Glass

- Glass has been defined by the American Society for Testing and Materials (ASTM) as "**an amorphous, inorganic product of fusion that has been cooled to a rigid condition without crystallizing**"



# Types of glass container

- Two types
  1. Bottles (which have narrow necks) and
  2. Jars (which have wide openings)



# Composition and Structure (1)

- Basic raw materials for glass making
- Come from mines or quarries
- Melted at 1500°C
- Principal ingredient is silica from sand, flint or quartz
- Silica melted at 1723C to form fused silica glass specialized application laboratory glass.
- Sodium in glass being loosely combined in silica matrix glass surface subjected to corrosion.



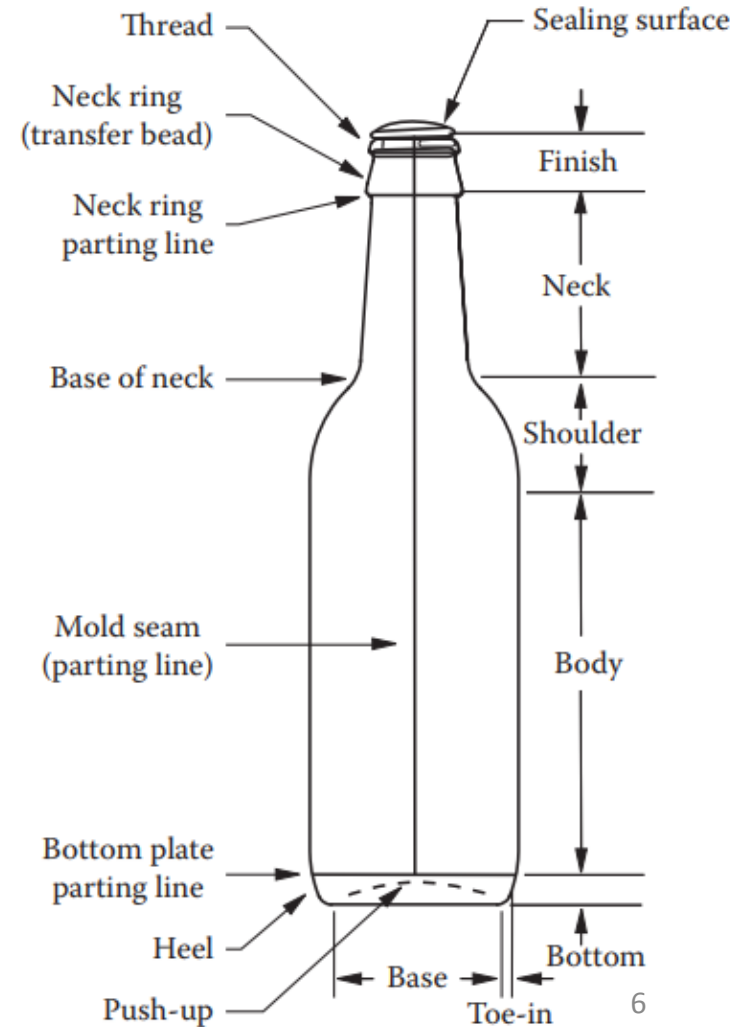
# Composition and Structure (2)

- **Three forms of corrosion occur**
  1. **Etching** – alkaline attack and slowly destroys the silica network then releases other glass components.
  2. **Leaching** – acid attack (hydrogen ions exchange for alkali or other positively charged mobile ions).The remaining glass (silica) retains its normal integrity
  3. **Weathering** – a mild weathering (Surface Bloom) occurs under extended storage conditions.



# Parts of glass container

- **3 basic Parts**
- **Finish** is the part of the bottle that holds the cap or closure, the glass surrounding the opening in the container.
- **Body** of the container is the portion that is made in the body-mold. It is, in most cases the largest part of the container and lies between the finish and the bottom.
- **Bottom** of the container is made in the bottom plate part of the glass-container mold.



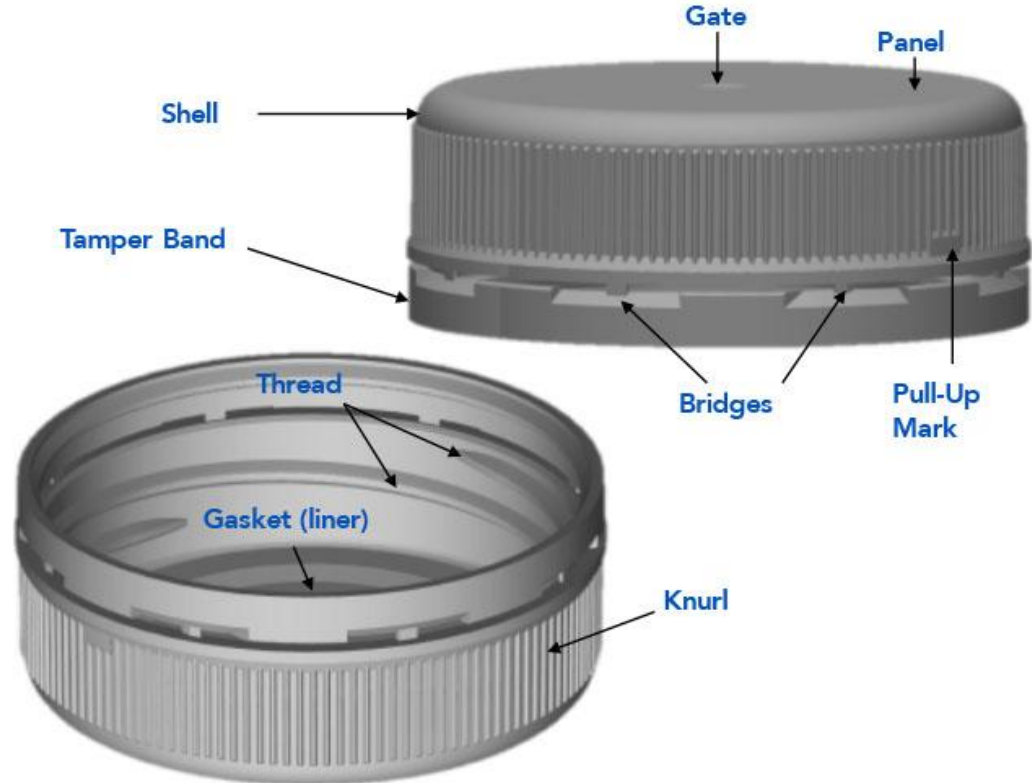
# Closures

- Closures consists of **cap**, **cork** or **plug** to seal the jar or bottle.
- **Function**
- Provide an effective hermetic (air-tight) seal to prevent the passage of solids, liquids or gasses out of container.
- Provide easy opening and resealing of container.
- Provide evidence of inviolability.



# Closures terminology

- Panel
- Radius
- Skirt
- Curl
- Lug
- Thread
- Face
- Reverse
- Gasket or liner





# Food container closures

- **4 chidings**

1. Closures to retain internal pressure. E.g. crown cork
2. Closures to contain and protect contents. E.g. bark cork
3. Closures to maintain vacuum inside container. E.g. twist cap
4. Closures to secure contents inside container.



# Various Closures



Lug/Twist off cap



Crown cork



Roll-on tamper evident aluminium closure

# Various Closures



Pry-off cap crown cap



Screw cap



Bark cork

# Properties of Glass

- Mechanical properties
- Thermal properties
- Optical properties



# Glass Manufacturing(1)

- In Glass Manufacturing it involves several processes depending on the type of glass container being manufactured
  1. Mixing and Melting
  2. Forming Processes
    - a. Blow and Blow (B&B)
    - b. Press and Blow (P&B)
    - c. Narrow Neck Press and Blow (NNPB)
  3. Annealing
  4. Surface Treatments



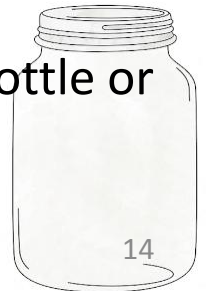
# Glass Manufacturing (2)

## Mixing and Melting

- The largest constituent is silica
- The second largest constituent is cullet (from glass scrap and recycled glass-postconsumer glass)
- Flint Glass – most color sensitive
- Use of cullet is economically desired since less energy is required to melt
- The preferred energy source for glassmaking is natural gas

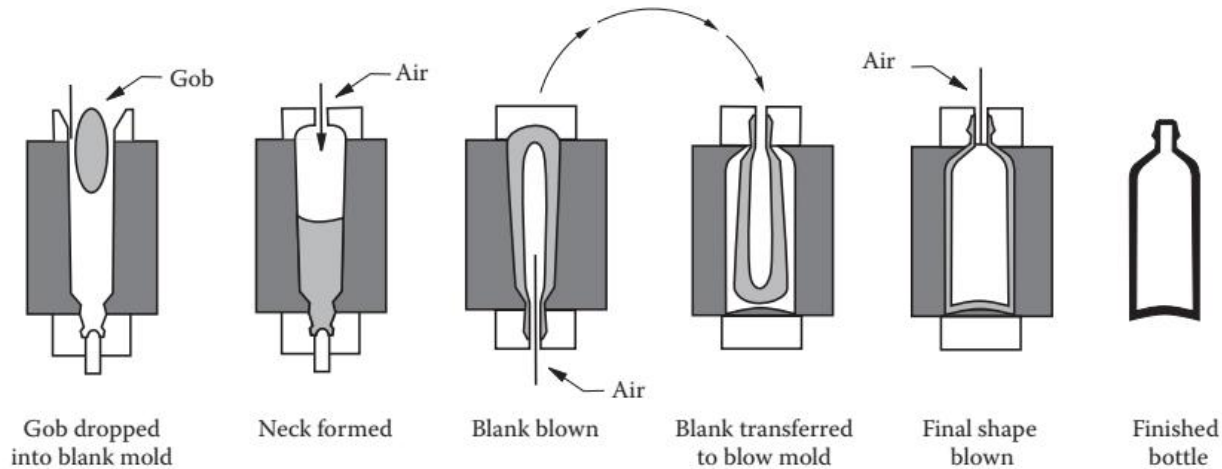
## Forming Process

- The glass is carried through a fore hearth to the forming machine
- Precise control of temp. and shape during formation is required
- Temperature is typically 1100°C
- Forming – process of converting a cylindrically shaped gob into a bottle or jar



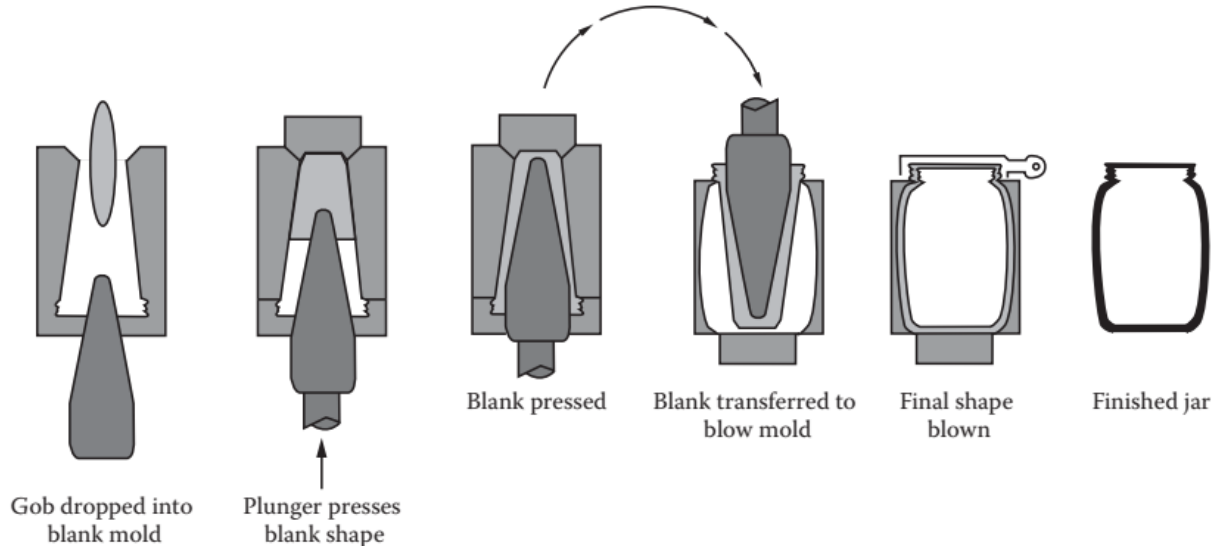
# Glass Manufacturing (3)

## Blow and Blow



# Glass Manufacturing (4)

- Press and Blow





# Glass Manufacturing (5)

- **Annealing**
- Refers to the removal of stress.
- The annealing temp. is the temp. at which stresses in the glass is relieved.
- The critical area of temp. is between the upper annealing point (softening point) and the lower annealing point.



# Glass Manufacturing (6)

- **Surface Treatments**
- The strength is reduced by moisture and abrasion
- Some surface treatment increase strength since glass is nonlubricious
- Surface Treatments is applied to modify mechanical properties



# Glass Manufacturing (7)

The background of the slide features three glass containers. On the left is a small glass jar with a white label. In the center is a taller glass bottle with a white label. On the right is another glass jar, similar in size to the one on the left, also with a white label. The containers are arranged horizontally across the slide.

- 2 General Types of Surface Treatments

- A. Hot-End Treatment

- Carried out while the glass container is at  $550^{\circ}C$
    - This prevents surface damage
    - Strengthen the surface and improve adhesion of cold-end coating

- B. Cold-End Treatment

- Carried out while the glass is at less than  $100^{\circ}C$
    - Designed to protect the container surface and assist its flow through the filling line
    - Typically involves spraying an organic material in an aqueous base containing either waxes, stearates, silicones, oleic acid or polyethylene onto the outside of the container
    - Increases lubricity – providing low coefficient of friction

- C. Shrink Sleeves

- Influence formation of imperfections leading to breakage due to surface contact
    - Made of oriented plastic films that shrinks around a glass container when heat is applied

# Defects in Glass Containers

- Defects in Glass Containers
  - Critical defects – “**bird-swings**” and “**spikes**”
  - Minor defects – “**wavy appearance**”
- Defects are “**critical**” when they are hazardous to the user and “**minor**” if they distract from its appearance or acceptability to the consumer





**Thanks to All...**