Manufacturing of Glass lenses

Manufacturing of optical glass

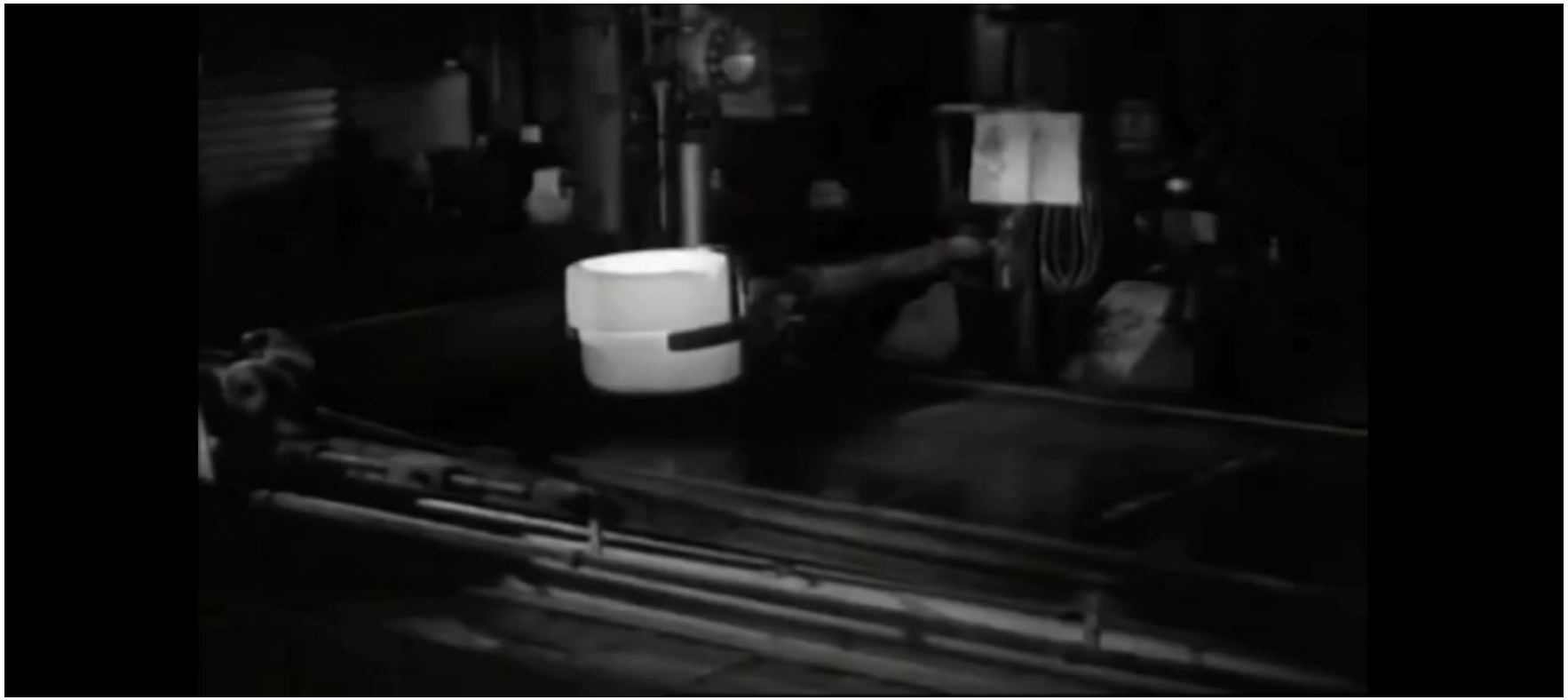
- The ingredient are put into a melting pot 36 inches in diameter and 32 inches high, sufficient to make about 1000 pounds of glass.
- Ingredient depends upon the type of glass to be made.
- Are principally oxide or salts of metals including silica, sodium and potassium, calcium and aluminium

- The batch materials, after mixing are placed in refractory clays pot. The special pots used have to be capable of withstanding both high furnace temperature and the corrosive action of molten glass.
- An additional ingredient, called cullet is waste glasses from previous metals
- Is added to save valuable raw material and to form a glaze on the surface of pot, which reduce the corrosive action of the pot by melting of raw materials
- The pot is gradually raised to temperature of 850 degree Celsius and kept there for 3 to 5 days before receiving the batch material.

- The pot is glazed by the use of small pieces of cullet
- The pot, charged with the glass, is placed in the melting furnace where it remains for some hours at a temperature approaching 1000 degree Celsius
- It is at this stage that high temperature chemical reaction take place, the oxide fluxing and fusing with the silica.
- At the highest temperature large bubble are formed encouraged by periods of rapid stirring with the refractory rod
- This escaping of the gas is known as fining.

- Scum, stones and other material rise to the top of batch and are skimmed off.
- During fining stage that the special fining agents (arsenic and antimony) react with the melt, clearing it of any residual impurities and fine bubble may be left.
- When the bubble have almost disappeared the glass now at a temperature in excess of 1000 degree Celsius passes through the fining stage where its is rapidly stirred for up to 8 hours to ensure complete and thorough mixing of the all ingredients.
- This process is known as stirring.

- After melting, fining and stirring processes are completed. The pot is removed from the furnace and allowed to cool gradually, the stirring continued until the glass has become so viscous that the further stirring is impossible.
- Then is poured onto a heated cast iron table and rolled by mean of heavy roller into sheets of various thickness and each sheet of glasses is placed in heated annealing oven in where it is gradually cooled down to room temperature.



- After annealing the glass cut into small pieces is reheated and is then either pressed or moulded into rough blanks
- After inspection the rough blank are blocked or grinding shells and the first surface ground and polished to the desired curvature
- The blanks are then reblocked and grounded & polished on the second side

- This process is called batch process
- Was formally used for manufacture of all optical glass
- Now it is used only for the production of relatively small quantities of glasses and many verities of coloured glasses

Continuous flow method

- An automated methods known as the continuous flow method
- Used for making large quantities of particular type of glasses.
- The process differ from the batch process in that the molten glass is not poured into sheets but it is extruded, by mean of continuous process and pressed into moulds to make the rough blanks
- The five essential stages are:

1. Melting
2. Fining
3. Stirring
4. Forming
5. Annealing

Desirable characteristics

- Homogeneity in the chemical and physical state
- Correct of index of refraction and chromatic depression values
- Freedom of colour
- A high degree of transparency
- A high degree of chemical and physical; stability

Ophthalmic crown glass

- Silica(sand) 70%
- Sodium oxide (Soda) 14-16%
- Calcium oxide (lime) 11-13%
- And small percentage of potassium, borax, antimony and arsenic
- Used to manufacture single vision lenses and distance portion of glass bifocal and trifocal lenses
- Refractive index is 1.523
- And abbe value is 59

- The material traditionally used for spectacle lens wear for several hundred years has been glass. Glass works well for ophthalmic materials because it resists scratching and is not easily affected by environmental factors.
- The main disadvantages of glass are weight and impact resistance. To pass FDA drop ball test requirements for impact resistance, glass must be hardened.
- The most commonly used clear glass lens material is made from a type of *crown glass* having an index of refraction of 1.523. This material is low in chromatic aberration.

Advantages

- Highly scratch resistant
- Resistant to solvent and temperature fluctuation
- Tinted by vacuum coating
- Good optical qualities
- High range curve blank & addition available
- Available in photochromic sunglasses option

Disadvantages

- Low impact resistance
- Heavier material
- Chips can easily from while edging and handling
- Not appropriate for children and sports wear
- U.V absorption not 100% (up to 280nm)

Flint glass

- Lead oxide 45% to 65%
- Silica 25% to 45%
- Mixture of soda and potassium oxide
- Refractive index 1.580 for light flint to 1.690 for dense flint
- An abbe value of 30 to 40
- Used for bifocal segment for fused bifocal and single vision lenes of high power because the high index makes the lenses thinner.

Barium crown glass

- Barium oxide 25% to 45%
- Barium oxide which has the same effect as lead oxide in increasing refractive index bit without great increase in chromatic dispersion
- Refractive index 1.514 to 1.616
- And abbe value of from 55 to 59

HI-index material

- HI-index lenses have higher than standard refractive index
- Glass HI-index

Available in 1.6, 1.7 ,1.8 & 1.9

Disadvantages

- Greater distortion away from optical centre
- Not available in larger blank size
- Less impact resistance
- More chromatic depression
- Off axis aberration are seen
- fragile