

Design Resource

Decorative Glass Work - Agra

Glass making process

by

Prof. Bibhudutta Baral, Divyadarshan C. S. and

Vijay. G

NID Campus, Bengaluru

Source:

<http://www.dsource.in/resource/decorative-glass-work-agra>

1. Introduction
2. Tools and Raw Materials
3. Making Process
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Introduction

Glass in nature is found in amorphous form by the rapid cooling of magma which is known as volcanic glass. Synthetic glass, an accidental discovery while the metallurgy or the similar process in the ancient time. Since the time of discover to the modern era, glass has remained as one of the essential material used in variety of industries. Egyptian and Mesopotamian can be called as the one of the first civilization to use glass products, they have been using glass from the third millennium B.C.E. Items such as glass beads were found in the grave of UR III (c. 2100 B.C.E) of Akkadian Empire and similar items are also found in Ziggurat, the large structure build by the Mesopotamian and Iranians. Some of the archeologist believe that, there were glass producing plants in Egypt at XVIII Dynasty. Colored glass beads are found in the hastinapur of (c. 1000 B.C.E) which are made of soda-lime-silicate compositing which different proportion of phosphates and potassium, glass of different colors are found depending upon the percentage of iron present in them. Similar to hastinapur, different color of glass like blue, red, green, amber, orange and black, dark green, ear-reels with a floral design, 'eye-beads', bangles and seals are found in Bhir mound, which was an important center of Mauryan Empire (322 – 185 B.E.C). Srikap (which is in Pakistan now) belonging to the mauryan empire was involved in the importing of glass items from Rome and Greek . Some of the well-known glass items which were imported were mosaic, milleflori, lace glass, ribbed and swirled ware, blue and white cameo.

The major development in the glass making industry could be seen during the Graeco-Roman period. Roman who were well versed with the glass blowing technique and glass sheet making technique. During the 11th to 16th century glass was used for the ornamental purpose and was used as a luxury items, which was used by the royals of Greek and roman. Venice was one of such place, where decorative and color full glass are considered as high value goods and items. These fabricating exquisite glassware was appreciated throughout the world and created a huge demand like never before. One of the early production of glass can be seen in kopia village of utter Pradesh, where archeologist have found furnace made out of clay and block of glass weighing about 50 kgs. This suggest that, even before the glass was commercially imported from other country, it was made in india. Indian glass maker has used different kind of method for blowing and making glass article. The type of glass article which were made using molding, folding, twisting and double-stripping. During the time when the trade between India and Portuguese, glass beads which were made in Kolhapur were exported to South Africa.

It is believed that, many of the items such as glass dishes and dish covers, spittoons, flat-bottomed vessels, mirrors and other objects like tiles and ear reels were brought to India by the Persian craftsmen, who were brought to india by the Mughals. Persian art was very famous among the indian royal dynasty. Many of the decorative glass article are used in the monument like taj mahal, jogun mohan place, royal place of Rajasthan, mysore place and other great monuments. Apart from the decorative glass, the glass was used for the industrial purpose like distillation, scientific use and other use.

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There were many articles and glass items which were brought from outside India, but was not accepted in the Indian market such, articles were melted in a locally made furnace Bhainsa Bhatti, which were established Firozabad. Even in the 21st century, these furnace are still operational in Aligarh and at Purdal Nagar. In the beginning of the glass making process, small size bottles and bangles were made. During the initial period glass bangles were made and these bangles were called Kadechhal Ki Chudi. Since then, Firozabad is well known of decorative glass work.



Prepared glass articles are passed through the kiln to heat the glass articles.

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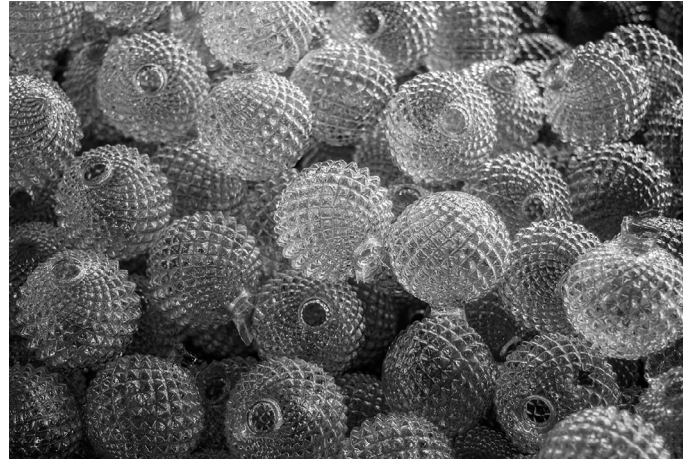
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Chandelier parts made of glass.



Lamp stands made of glass.



Decorative wine glasses made of glass.

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Most of the articles are exported to other countries.



Part of a Chandelier is prepared in the shape of a Christmas tree.



Mouth of the wine glass is being shaped.

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Shaped glasses are kept to dry.

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Tools and Raw Materials

Following are the tools and raw materials used for the process of Decorative Glass Work:

- **Used Glass Items:** Main raw material for decorative making.
- **Glass Washer:** For cleaning glass using water.
- **Grinder:** To grind the glass chunks into fine powder.
- **Furnace:** To melt the glass powder.
- **Blowing Pipe:** To shape the glass manually into required shape.
- **Gloves:** To protect the hands from the heat.
- **Goggles:** To protect the eye from the heat.
- **Casting Molds:** To obtain specific shape.
- **Oxygen Gas Torch:** To alter the glass article.



Molds with design used to emboss the design on the article.

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Screws used to rub on the glass articles to smoothen the surface.



Mold used to make glass lamp stands.

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Electric heated wire used to cut the unwanted parts of an article.



Various types of molds are used to make different shapes of articles.



Mold used to make drinking or wine glasses.



Mold to make design glass pieces for chandeliers.

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Rotating metal stand is used to check the products for damage.



Waste glass articles are smashed and broken which is melted and used to make fresh products.

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Making Process

Synthetic glass is made up of sodium oxide, calcium oxide and silicon dioxide (sand) mixture, which is heated in the furnace, where it is converted into molten state. Calcium oxide provides strength to the glass and make sure that is it not soluble in water. The glass obtained from the above mixture has a light green color and to remove the green color manganese oxide is added to obtain a transparent glass. Generally there are four types of glass. Soda lime glass (lowest quality), Lead glass, Borosilicate glasses, High silica content glasses (highest quality).

Soda lime glass are easy to work at low temperature compare to other type of glass and also cost less than other glass. Generally soda lime glass are used, where cost is a major factor, like light bulbs, bottles, fiberglass, building blocks and windowpanes.

Silicon Dioxide (silica)	72 %
Sodium Oxide (soda)	15 %
Calcium Oxide (lime)	9 %
Magnesium Oxide (magnesia)	3 %
Aluminum Oxide (alumina)	1 %

Lead glass has a good workability, high refractive index and high electrical resistance, it is also used as a shield from x-ray and ultraviolet ray. It is also used in light bulbs, crystal tableware, neon sign tubing and some optical components.

Silicon Dioxide	65 %
Lead oxide	15 %
Sodium Oxide	10 %
Potassium Oxide (potash)	6 %
Calcium Oxide	1 %

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Borosilicate glasses have high chemical stability, high heat shock resistance, low coefficients of expansion.

Silicon Dioxide	80 %
Boron oxide	14 %
Sodium Oxide	4 %
Aluminum Oxide	2 %

High silica content glasses resist extreme thermal stress and have a very high chemical resistance.

Silicon Dioxide	96 %
Boron oxide	3 %
Other Oxide	1 %

The job of the glass blower requires talent, experience, and precision, dexterity of a juggler and sensibility of an artist. Massive strength is required to create and handle large size items. No machine can substitute the masterly skill of human hand. Used glass (waste) is brought from the local market and washed in a cylindrical shaped glass cleaner using fresh water and loaded on the conveyor belt. With the help of the conveyor belt, glass is taken to a crusher, where the glass is converted into fine glass powder. Using a furnace, glass powder is melted.

Making of decorative glass is done with the help of glass blowing technique, there is no much change in this technique from the time it has been invented to the modern day. Glass blower knows as gaffers, use a four feet long hollow metal pipe, this pipe is dipped in hot molten mixture of glass (gather) and small amount of molten glass is rolled at the end of pipe. Gaffer then place the hot glass onto a metal plate, for the initial shape, this process is known as marvering and then blows in air through the pipe to create a bubble, this process is known as parison. Gaffer then insert parison into the furnace to reheat it, he then blows the air into the parison to create the final required shape. With the help of wooden paddles, which have hole and a pack of wet newspaper is used to give fine shape. Using shears, soften excess glass is removed. The hot glassware item is dipped into the mixture of molten colored glass mixture. Throughout the process, gaffer keeps on rotating the hot glass, otherwise there are chances of sagging. To get different texture and specific shape, mold are used.

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The color of the glass can be changed with the addition of metals, metal oxides or other compounds to the molten mixture. These coloring compound either fully dissolve or suspended in the molten glass mixture. Generally, there is no change in the physical property of the glass unless high concentrated coloring agent is added. The type of color which does not alter while blowing the glass is used for this process.

Compound Added to the Molten Glass	Color of the Glass Produced
Cobalt Oxide	Blue
Magnesium Oxide	Violet
Gold or Selenium	Red
Uranium, Iron or Silver Oxides	Yellow
Ceric Oxide	Brown
Iridium Oxide	Black
Copper or Chromium Oxides	Green
Calcium Fluoride or Stannic Oxide	White or Opal

Once the products is completely formed at the end of the pipe, the neck of the product which is attached to the rod is heated (if it has cooled down) and small amount of water is applied on it, which form micro- cracks on the neck's surface, craftsman carefully taps the glassware on to a solid surface to break and separate the glassware from the rod. Then it undergoes Annealing, it is the process where, the article is reheated at 580oC and held at this temperature for five minutes. During this process, any fine and microscopic cracked would be removed with the help of heat, this process also helps to avoid the internal stress of the glass.

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Next is the fire polishing, after the glassware is separated from the metal blow pipe, the uneven, shape and pointed glass still remains on the end of the pipe. The pipe is directed to the flame torch, as the flame heats the glass, it softens and starts to melt. The gaffer continuously rotates the rod at a constant speed due to which the hot and molten glass takes the shape of a golf ball. If the gaffer wants to continue the blowing process, he dips the hot molten glass into gather and repeats the blowing process otherwise the hot glass is heated at higher temperature, which falls off the metal pipe. Some of the important points to remember while shaping are:

1. Pulling decreases both the diameter and the wall thickness.
2. Blowing increases the diameter and decreases the wall thickness.
3. Heating decreases the diameter and increases the wall thickness.
4. Pushing an enlarged tube increases both the diameter and the wall thickness.
5. Pushing a constricted tube decreases the diameter and increases the wall thickness.

To remove excess glass from the formed glassware, it is introduced to the flame. The neck or the area which is supposed to be removed is heated at higher temperature and the excess part is separated from the glass wear. Glass wear then undergoes sanding process, the edge of glass wear is placed against the sanding belt, continuous flow of water is required while the sanding process, to avoid a formation of cracks. These glass wear items undergo inspection by the expert glass craftsman, he carefully inspects the glass for any cracks, dent, uneven surface or form. If any error is found, the glass wear is crushed and loaded on the conveyor belt. Rest of the selected items are sent for packaging and dispatching unit.



The material of the glass is heated at high temperature and is taken on a metal rod which is blown to a desired shape.

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While shaping it is rubbed on a set of wet newspaper.



The glass material is put into a mold and blown to acquire the mold shape.

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The process of blowing and shaping continues till the desired shape is acquired.



A base and shape is given to the article.



To shape the mouth of the glass the article is placed on round burner blowing flames.

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The flame melts the unwanted part and shapes the mouth of the glass.



The article is held with a holder to transfer it to keep it aside to dry.

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Crafts men checks whether the article is shaped properly or not.



The prepared articles are again heated to fix the joints or cracks.

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In another process molten glass is filled in molds.



Molds are rotated on automatic machines to give shape to article.

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Rotating process cools down the hot liquid and turns the material into sold glass shaped into the required shaped in the mold.



Some parts of the article is removed by the electric heated wire.



Hot wire is passed through the article.

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The heat slices the article separating the unwanted pieces.



Surface of the articles are rubbed with screws to smoothen the surface.



The shape and length of the articles are checked.



Products whose parts are made separately are joined together.

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Before packing the products are checked for any cracks or breakages.



Products are carefully packed in boxes.



Prepared articles are sold to different parts of India as well as outside the country.

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Products

- Hand Painted Golden Hand
- Glass Candle Votive
- Glass Tableware
- Glass Flower Vase
- Glass Toys
- Glass Knobs
- Glass Wall Lamps
- Glass Christmas Decorations
- Glass Lamps
- Candle Holder and Lantern
- Chandler
- Hanging Lamps
- Decorative Wine Glass

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Simple design wine glasses.

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Decorative pieces of a chandelier.



Lamp stands made of glass.



Another type of decorative pieces of a chandelier.



Spherical glass decorative parts of a chandelier.

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Decorative wine glass.



Designed water glasses.

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Plain drinking containers made of glass.



Verities of glass articles made of different designs and shape.

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