Educational Story of

"THE MANUFACTURE OF GLASS"

As Depicted At
A Century of Progress
Chicago.....1933

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O W E N S - I L L I N O I S G L A S S C O M P A N Y
T O L E D O, O H I O
"Largest Manufacturer of Glass Containers in the World"

60 YEARS OF LEADERSHIP IN GLASS MAKING

Back of Owens-Illinois bottles, which are contributing immeasurably to the health, comfort, and enjoyment of all the people, is sixty years of experience and research and the best effort and constructive thought of thousands of employees.

Owens-Illinois is the largest manufacturer of glass containers in the world and mainly through our developments, glass containers have become fine and durable as well as inexpensive enough to permit of universal use. Everywhere glass is known as the ideal container for all types of products - including foods, prescriptions, proprietaries, cosmetics, milks, and beverages.

Glass is rapidly being developed by our Industrial Materials Division in colorful block form as the most modern of building materials - in the form of glass wool as highly efficient insulation - and in similar form as filters which economically provide clean air for factory, office and home.

This is indeed the glass era and glass is becoming increasingly important to all phases of life and living, from infancy to old age.

OWENS-ILLINOIS GLASS COMPANY - TOLEDO
22 Factories - 30 Branch Sales Offices

THE MANUFACTURE OF GLASS BOTTLES

The manufacture of glass is a process which Man has carried on with varying degrees of skill almost from the beginning of authentic history. Its formation from comparatively crude, raw materials into the lustrous, transparent substance with which we are so familiar, is one of the most interesting instances of converting natural resources to serve a variety of uses.

One of the most plentiful elements in the earth's surface is silica, often occurring in the form of sand. The ordinary yellow sand contains some clay and small amounts of iron and is not suitable for glass making, but sand when it occurs with a high degree of purity, looks white in color, although the individual grains are in reality transparent. Although it is extremely hard and is not affected by water, silica has the property of dissolving if it is mixed with certain other materials and heated to a sufficiently high temperature. The melting of silica mixed with other materials is commonly referred to as "fusion".

Lime, another substance which is plentiful in the earth, is one of the materials which fuses quite readily with silica. There are several other quite common substances which also have this faculty of fusing with silica and among them are lead, borax, soda, magnesia and several others, some of which impart color to the glass. The principal materials used, however, are silica, lime and soda.

The sand and other materials are mixed thoroughly together in the proper proportions and are then placed in a furnace where the mixture is heated to a temperature of from 2600 to 2700° F. In view of this extremely high temperature, the furnace is constructed of specially burned clay blocks because there is no metal which will hold molten glass for a long period of time. Since the melting glass is contained in this large receptacle formed of clay blocks, the fire is not placed under it, as in most methods of heating, but burns above the melting glass, confined by a roof made of brick.

As the silica and other materials dissolve or fuse, a large amount of gas is given off so that when first melted the glass contains many of these bubbles of gas and is, therefore, not yet of good quality. After remaining at this high temperature for a sufficient period of time the glass gradually becomes more fluid and finally reaches about the same consistency as molasses. The bubbles of gas gradually escape, leaving the glass finally clear and transparent.

It usually requires about two to three days from the time the sand and other materials are placed in the furnace until the glass is thoroughly molten and the furnace is so constructed that the mixture of sand, soda and lime is continually added to the furnace at one end and the finished glass, still in a molten condition, flows out at the other. This completes literally, the making of the glass itself.

The forming of a bottle from this hot, fluid glass was for many centuries performed by the workman, who gathered the viscous

glass on the end of a metal pipe and by blowing into the molten glass through the pipe, also manipulating it in connection with a mold as the glass cooled, he formed it into a bottle. Under modern conditions this is performed mechanically.

A suitable amount of the molten glass, sufficient to make one bottle, is separated mechanically, either by drawing it up into a mold by vacuum or else cutting off a portion of a falling stream of glass. Having secured the correct quantity of glass to make one bottle, it is placed in a mold for a few seconds and allowed to cool partially. This mold shapes the glass in the form of a rod about the same length as the bottle. The outside of this rod of glass has become almost rigid while the interior is still liquid.

This rod of glass is then placed in another mold which is exactly the shape of the bottle it is desired to form and air is blown into the interior of the rod of glass. The outside, almost rigid but slightly plastic, stretches and blows out in the mold somewhat similar to the blowing of a soap bubble except that instead of being allowed to blow in spherical form, the mold causes it to blow in the shape of a bottle.

The blowing of a bottle from a ball of molten glass and the blowing of a soap bubble from a drop of water are very similar in principle except that in blowing a bottle we use a mold to make it blow into the shape we want.

If letters are desired on the bottle, they are formed by having letters carved in relief on the mold in which the bottle is formed. By controlling accurately the size of the mold it is, of

course, a comparatively simple matter to form a bottle that will hold any desired amount of liquid.

The finished bottle, when it it taken out of the mold, is still at a temperature of more than 1000° F. and while the outside surface is almost rigid, the interior portion is still plastic or viscous. If this newly formed bottle should be allowed to cool at the natural rate, the outside surface would become rigid first and then when the interior portion cooled and contracted, most of the bottles would break due to the sudden cooling. It is, therefore, necessary to resort to a process known as annealing, which consists of passing the bottles through a long tunnel and controlling the rate at which they cool down to ordinary temperature.

In this way the entire bottle, both the outside and inside, cool at about the same rate. At the completion of the annealing, the bottles are cool enough so that they may be handled with the hands. At this stage each bottle is examined carefully for any evidence of defect such as deformation of shape, small cracks or other flaws, which may arise during the time this glass is being shaped into the form of a bottle while its temperature is cooling rapidly. Bottles passing inspection standards are ready for packing, in the modern corrugated cartons to be delivered to the user. Corrugated cartons are modern shipping containers because of their cleanliness but wood cases are still in common usage for beverage bottles.

Glass, in addition to its many forms in common usage, is constantly being developed to new interesting and practical application. Some of the new products made of glass are the glass wool air filter, glass insulating wool and glass blocks used in the construc-

tion of the Owens-Illinois Glass Block Building at Chicago's "A Century of Progress".

It seems rather incredible that air can be filtered by means of glass; that an insulating wool is being made from glass; and that a glass block has been developed from which a World's Fair Building 100 feet long with a 50 foot tower could be constructed. However, such is the case due to intensive research and modern methods of glass production.

Man has paid some attention to air conditioning since the time that he first built a fire to keep himself warm, but air conditioning as a specialized industry is a recent development. An important phase of air conditioning is air filtration and the glass wool air filter was developed to this end. It consists of a mass of spun glass fibers laid down in a jack straw pattern. The fibers are coated with an adhesive and as the air travels through the filter over 98% of the dust, pollen, and bacteria which is being carried is removed. After a filter has collected its own weight in dirt, it is thrown away in the same fashion that one throws a bottle away after it has served its purpose - for the cost is low.

In developing an insulating wool the research engineers, had a material to work with, which was both fire and vermin proof two very important factors. Besides these characteristics the insulating wool as developed is very efficient, and has a high coverage per ton due to its low density. The appearance of the finished product reminds a person of the snow white, spun, cotton-like candy with which all of us are familiar.

The glass building block is the most modern of all building materials. It is a six sided unit, hermetically sealed,

is laid into a wall area in the same manner as is the common brick. There is no limit to the color range as the blocks are not made from colored glass (which is limited commercially to a few colors), but rather any color can be applied and fired onto the flint glass to remain permanently.

It is a sturdy unit, and while the block is translucent it is not transparent. There is no material which is easier to keep clean than glass which makes glass block construction ideal for buildings where a high degree of sanitation must be maintained such as meat packing plants, dairies, and the food industries in general. It is also an ideal construction material for airports, museums, hospitals, libraries, etc.

And so the story of the manufacture of glass continues; a romantic story with new progress written into its every word.

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