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INDUSTRY PROFILE #18

GLASS CONTAINERS
(Batch Process)

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Glass Containers (Batch Process)
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INDUSTRY PROFILES

Introduction

This Industry Profile is one of a series briefly describing small or medium-sized industries. The Profiles provide basic information for starting manufacturing plants in developing nations. Specifically, they provide general plant descriptions, financial, and technical factors for their operation, and sources of information and expertise. The series is intended to be useful in determining whether the industries described warrant further inquiry either to rule out or to decide upon investment. The underlying assumption of these Profiles is that the individual making use of them already has some knowledge and experience in industrial development.

Dollar values are listed only for machinery and equipment costs, and are primarily based on equipment in the United States. The price does not include shipping costs or import-export taxes, which must be considered and will vary greatly from country to country. No other investment costs are included (such as land value, building rental, labor, etc.) as those prices also vary. These items are mentioned to provide the investor with a general checklist of considerations for setting up a business.

IMPORTANT

These profiles should not be substituted for feasibility studies. Before an investment is

made in
a plant, a feasibility study should be conducted. This may require skilled economic and engineering expertise. The following illustrates the range of questions to which answers must
be obtained:

* What is the extent of the present demand for the product, and how is it now being satisfied?

* Will the estimated price and quality of the product make it competitive?

* What is the marketing and distribution plan and to whom will the product be sold?

* How will the plant be financed?

* Has a realistic time schedule for construction, equipment, delivery, obtaining materials and supplies, training of personnel, and the start-up time for the plant been developed?

* How are needed materials and supplies to be procured and machinery and equipment to be maintained and repaired?

* Are trained personnel available?

* Do adequate transportation, storage, power, communication, fuel, water, and other facilities exist?

* What management controls for design, production, quality control, and other factors have been included?

* Will the industry complement or interfere with development plans for the area?

*** What social, cultural, environmental, and technological considerations must be addressed regarding manufacture and use of this product?**

Fully documented information responding to these and many other questions should be determined before proceeding with implementation of an industrial project.

Equipment Suppliers, Engineering Companies

**The services of professional engineers are desirable in the design of industrial plants even though
the proposed plant may be small. A correct design is one that provides the greatest economy in
the investment of funds and establishes the basis of operation that will be most profitable in the
beginning and will also be capable of expansion without expensive alteration.**

**Professional engineers who specialize in industrial design can be found be referring to the
published cards in various engineering magazines. They may also be reached through their national organizations.**

**Manufacturers of industrial equipment employ engineers familiar with the design and installation
of their specialized products. These manufacturers are usually willing to give prospective
customers the benefit of technical advice by those engineers in determining the suitability of their
equipment in any proposed project.**

VITA

Volunteers in Technical Assistance (VITA) is a private, non-profit, volunteer organization
engaged in international development. Through its varied activities and services, VITA fosters
self-sufficiency by promoting increased economic productivity. Supported by a volunteer roster
of over 5,000 experts in a wide variety of fields, VITA is able to provide high quality technical
information to requesters. This information is increasingly conveyed through low-cost advanced
communication technologies, including terrestrial packet radio and low-earth-orbiting satellite.
VITA also implements both long- and short-term projects to promote enterprise development and
transfer technology.

GLASS CONTAINERS

(Batch Process)

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PREPARED BY: William B. Hillig
REVIEWED BY: Victor R. Palmeri
William D. Walker

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PRODUCT DESCRIPTION

The Product

The products are glass containers (bottles, jugs, and jars) needed by food, pharmaceutical, and other manufacturers for packaging their products. Glass containers are also used by households. A factory for making glass containers can be expanded to make such other items as tableware (cups, drinking glasses, pitchers) and building materials (glass blocks, electrical insulators).

Glass is a hard, brittle material produced by heating a mixture of sand, limestone, and soda ash (i.e., silica, calcium oxide or carbonate, and sodium carbonate) to very high temperatures (1,300[degrees]C to 1,600[degrees]C). Other minerals or metal oxides may be added for color or to improve the properties of the glass. Glass items can also be made by melting and re-forming used glass, or cullet, a process that can be used where the basic raw materials are unavailable.

In order to avoid induced fragility or even spontaneous breakage caused by stresses resulting from too rapid cooling, the glass products must be annealed--slowly and carefully cooled--as they change from a deformable material to a rigid state.

The Facility

There are many processes by which the hot, viscous glass can be formed into the desired shapes. Bottles are made by blowing a thick bubble of glass into a mold to give it the desired external shape and to form such features as screw threads or emblems. Such articles as dishes and electrical insulators

can also be made by forcing hot, soft glass into a die cavity. This can be done manually or with a
machine. Even sheet glass can be made in moderate quantities by flattening molten glass with a water-
cooled iron roller. However, making high quality window glass in large quantities requires an
investment that is beyond the scope of this paper.

This profile describes small batch production plants with a work force of 10 to 50 people that produce
500 to 25,000 containers a day. The two kinds of batch process are pot process and day-tank process.
In the pot process, the glass is produced in refractory clay "pots" that hold 25 to 1,500 kg of raw
materials. A circle of 6 to 24 pots is arranged just inside the walls of a large circular furnace. This
semi-continuous process can produce about 500 or more bottles a day.

The day-tank process is more continuous and requires some machinery; it can produce about 25,000
bottles a day. One day tank can hold up to 10 tons of molten glass. A refractory-brick-lined tank is
filled with the raw materials at the start of the operation. The tank is then heated to melt the materials
into glass. Usually on the day after melting and homogenization have occurred, a plug is removed
from the tank and the molten glass is directed into the bottle-blowing (or other) machinery. When the
tank is empty, it is cooled and the process is repeated. The process can be repeated every 2 or 3 days.

Oil or natural gas is used to produce the necessary temperatures needed to make the

glass. If they are
not available, coal or wood can be used to produce gas, which is then burned to heat the furnace or
tank. The availability of suitable refractory clay to make the pots or the linings of the tanks is crucial
in deciding whether to start a glass manufacturing business.

GENERAL EVALUATION

Outlook

Economic. The economics depend on local conditions and market opportunities. Fuel costs are a major
consideration. As in other industries, a good product with good quality and value-pricing can offer
good profits. There will be competition from plastic and metal containers. However, glass containers
will remain in demand because they do not contaminate their contents and they allow the consumer
to inspect the contents for quality.

Technical. Glass fabrication is a complex venture. The basic technology is not likely to change, but
the product can be improved through quality control. The composition of the raw materials should
be monitored as should the composition and reliability of the glass produced. The larger and more
mechanized the operation, the greater the need for control and for technical expertise of the
production workforce.

Manufacturing Equipment Flexibility

Once the glass melting capability is in place, a wide range of products can be made. As each new forming technique is introduced, many trials and adjustments will be required before the process can be expected to work reliably in a given plant.

Knowledge Base

Glass manufacture is an old art. Much information is available about glass composition, materials, and general procedures. However, practical experience remains an important factor in the successful operation of a glass plant. Entering glass manufacture is very risky without previous acquaintance with the technology of glass making. Anyone seriously considering it as a business venture is strongly advised to visit some small glass plants. In the United States there are a number of little factories producing glass products on the scale envisioned in this profile.

Quality Control

Depending on the buyer's requirements, the consistency and quality of the product may be crucial to the success of the business. For example, the appearance of the container and the contents as seen through the eye of the consumer may be important, as is consistency of the shape, which may affect the reliability in sealing the container. Furthermore, the more the desire to make products uniform and the more automatic the machinery for making the products, the greater the need for

controlling
temperature and the viscosity of the molten glass.

Constraints and Limitations

Because of their bulk and weight, raw materials should be conveniently and economically available
over an extended period. Glass making is fuel intensive, so particular attention must be given to
energy cost and availability of fuel. High temperature clays and refractories for containing the molten
glass must be available. Bricks can be shipped in, but it is not practical to transport clay pots; these
must be made locally, or as part of the glass plant operation itself.

The technical challenges are (1) generating the required high temperatures, 1,300[degrees]C-1,600[degrees]C,
economically and reliably, and (2) containing the hot, molten glass, which slowly dissolves the pot and
the tank materials. Nearby sources of raw materials and fuel are essential. Glass containers are fragile
and relatively beavy and bulky. To avoid excessive transportation and handling expense, the plant
should also be near major markets.

MARKET ASPECTS

Users

Food processors, medicine manufacturers, household products manufacturers, and beverage producers.

Suppliers

Three raw materials are required for glass fabrication--silica sand, calcium oxide, and soda ash (sodium carbonate). Of the three, silica sand occurs most widely, but a good source of iron- free silica sand is essential. Sometimes it is difficult to find two sands or other minerals of the same composition in the same region. Check with your local mining authorities for information. Calcium oxide can be obtained from shells, calcite, etc. Sodium carbonate is widely used and usually available in the market.

Sales Channels and Methods

Direct person-to-person contact with buyers for the food processing plants, or other manufacturers and wholesalers, is needed. Sales will probably be won on the basis of price rather than uniqueness of the product.

Geographic Extent of Market

The potential for supplying glass containers exists everywhere. However, the glass container producer should limit the market to nearby areas to reduce transport costs and remain competitive.

Competition

If glass-container producers are already established in the area, the competition will be based on price. Remember that transportation costs are a big factor in the final cost to the

customer. Otherwise
the competition will be from alternative materials. Plastics can often compete. Glass has the intrinsic
advantage where transparency and inertness are important.

Unless there is capacity to use recycled glass as the raw material, it is probably uneconomical to focus
mainly on the making of houseware items such as plates, cups, or bowls. Drinking glasses may be an
exception. In general, items of this kind can be made more cheaply from ceramics than from glass.

Market Capacity

Determined by local conditions, needs, and preferences.

PROCESS DESCRIPTION

<FIGURE>

07p04.gif (600x600)

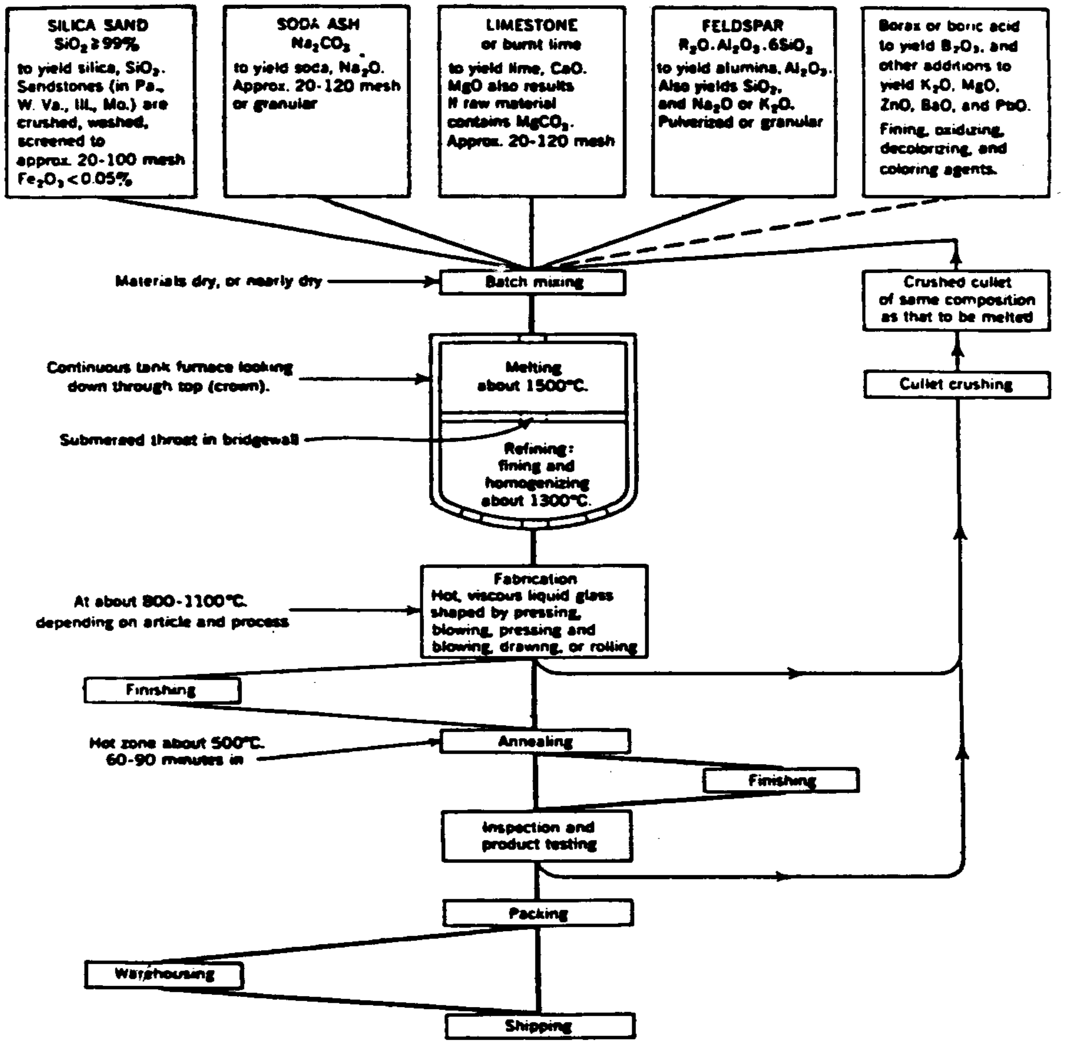

Figure 1: Schematic of Day-Tank Process

<FIGURE>

07p05.gif (600x600)

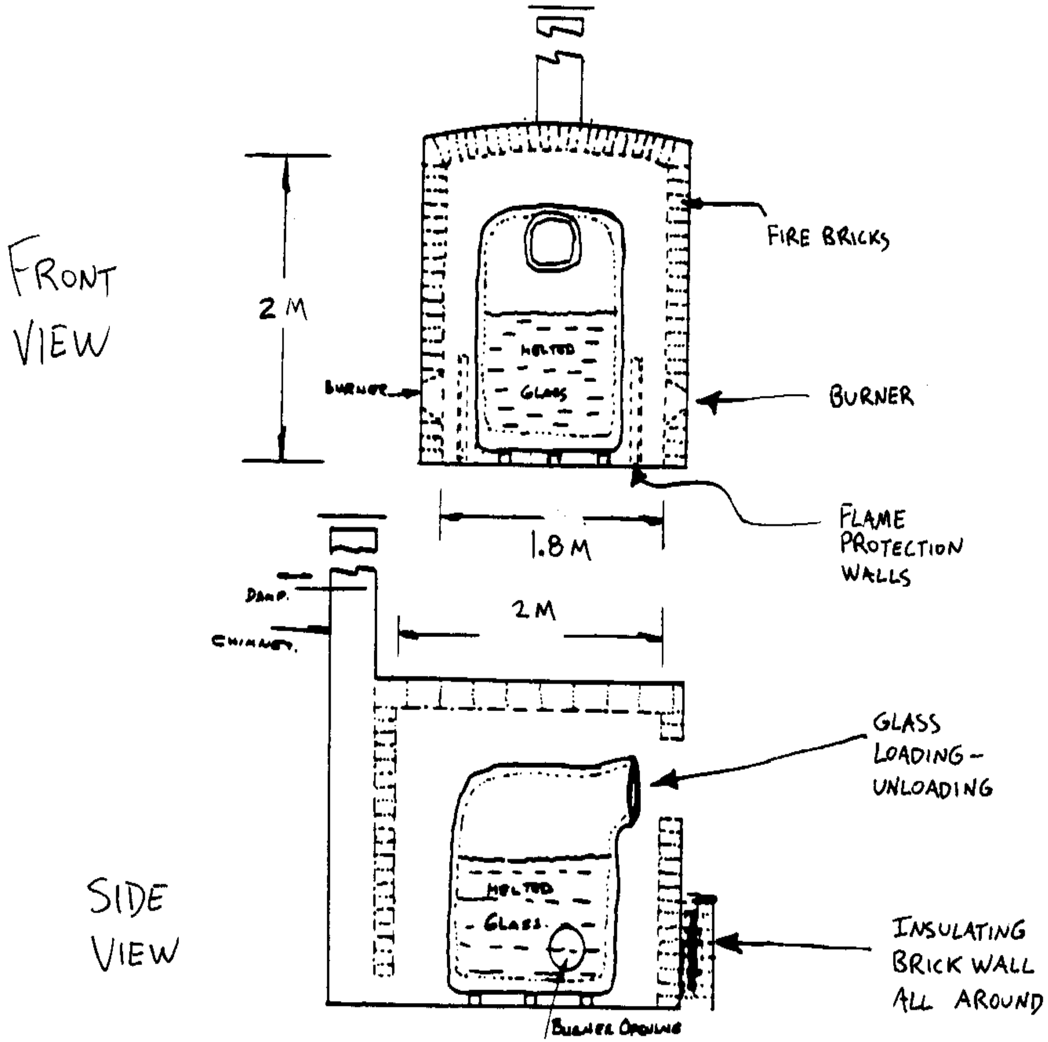

Figure 2: Furnace Used to Melt Glass in Pots

PRODUCTION AND PLANT REQUIREMENTS

Requirements Annual Output (bottles)
150,000 1,000,000

-
1. Infrastructure, Utilities Small Plant Medium Plant
(small pot (largest day-
process tank process)
Land, sq m 2,100 10,000
Building, sq m 200 500
Power, kW 50 200
Fuel (oil equiv., L/yr.)(*) 50,000 250,000
Water (no major quantities required)
Other
Space to get product out and raw material in

(*) As a rule of thumb, 1.5 kg of oil or coal are needed to produce 1 kg of glass.

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2. Major Equipment & Machinery Small Plant Medium Plant

Tools & Machinery; e.g.,
blowers for furnaces
bottle blowing machine
small machine shop for molds,
repairs, etc.
furnace for melting glass
annealer
mixer for glass batches
industrial weighing scale

Support Equipment & Parts
wheel barrows
carts
air blowers and burners

combustible storage facilities

(*) TOTAL ESTIMATED COST US$20,000 US$75,000
of equipment & machinery only

(*) Based on US$ 1987 prices. These are general guidelines on machinery costs. Actual costs may differ
according to locality and market conditions at the time of purchase.

3. Materials & Supplies Small Plant Medium Plant
refractory bricks for furnaces, tons 10 25
glass melting pots or glass tank liner

Raw Materials, tons/yr 48 240
silica sand 30 150
soda ash 12 60
limestone 6 30
iron oxide (no more than 0.15 % in all ingredients or
glass will be excessively colored)

Supplies
silica sand and calcite
(check with your local mining authorities for information)
packaging
wooden crates (for export)
straw, wood fibers, paper (for cushioning individual pieces)

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4. Labor(*) Small Plant Medium Plant

Skilled
college-trained engineer 0 4
other skilled people 3 6

Semi-skilled 5 15
Unskilled 8 25

(*) Estimated. Actual numbers vary according to the specific processes and local availability of labor.

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1980.

Periodicals

Bulletin of the American Ceramic Society, Columbus, Ohio USA.

Glass Technology, was Journal of the Society of Glass Technology, Society of Glass Technology,
Sheffield, U.K.

Glastechnische Berichte, Deutsche Glastechnische Gesellschaft, Mendelssohnstrasse 75-77, D-6000
Frankfurt 1, Germany.

RESOURCES

Equipment Suppliers, Engineering Companies

Elored Company, 2491 Fairwood Avenue, Columbus, Ohio 43207 USA

Emhart Machinery Corporation, Hartford Division, 123 Dayhill Road, Windsor, Connecticut 06002
USA

General Glass Equipment, General Glass Building, Absecon, New Jersey 08201 USA

Globe Trading Corporation, 1801 Atwater Street, Detroit, Michigan 48207 USA

Hanrez, 41 rue Trazegnies, B-6031 Monceau-sur-Sambre, Belgium USA

MOHR Industrial Group, P. O. Box 1148, Dearborn, Michigan 48121 USA

Directories

Ceramic Industry Data Book, American Ceramic Society.

**Handbook of the Glass Industry, Ogden-Watney Publishers, Inc., 11 West 42nd Street, New York, New
York 10941 USA**

VITA Resources

**VITA has a number of documents on file dealing with industrial processes. In addition, VITA can
assist with plant design, equipment acquisition, etc., on a fee-for-service basis.**

`INDUSTRY PROFILE SERIES'

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Before an investment is made in a plant, a feasibility study should be conducted. Each profile contains a list of questions to which answers must be obtained before proceeding with implementation of an industrial project.

All profiles are available in English only. They are priced at $9.95 each. You may take advantage of the introductory offer and order any three profiles for just $25.00 or order the entire set of nineteen profiles for a bargain price of only $150.00.

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(L/wk).
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Victor R. Palmeri
Describes a small plant operating with one shift and producing 16,000 pieces a year. It also describes a medium-sized plant running a single shift producing about 80,000 units a year.
(IP #11) 8pp.

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Peter K. Carrell

Describes a small plant operating with three shifts on a seven-day work schedule and processing about 200 tons of sorghum a day. Two shifts are down per week for maintenance. This facility may be considered a heavy industry because of the emission from the boiler and dryers and the noise from its high speed machinery.
(IP # 1) 8pp.

UNFERMENTED GRAPE JUICE
George Rubin
Describes a plant operating with one shift and producing 125,000 gallons of grape juice a year, and another that produces 260,000 gallons a year.
(IP # 7) 8pp.

WOMEN'S BROADCLOTH DRESSES
Edward Hochberg
Describes a plant operating with one shift and manufacturing 72,000 women's dresses a year (1,440/week, 288/day). It also describes a larger plant running a single-shift and producing 104,000 dresses a year.
(IP # 3) 8pp.

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