Project Planning for Small and
Medium Scale Industries No.6

Glassware Manufacturing Plant

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JAPAN CONSULTING INSTITUTE

This technical brochure was compiled to help in the drafting of a suitable plan for the construction of a Glassware Manufacturing Plant.

The production scale and manufacturing process have been described in this brochure on the basis of a typical instance.

The profitability was estimated by fixing certain required conditions, which may differ from country to country.

We hope that the data contained in the brochure will help you to draw up the most suitable plan for the industrialization of your project.

In case a government or public organization requests the Japan Consulting Institute to conduct a feasibility study of the above industry for the purpose of establishing the most suitable plan, it is possible for us to carry this out free of charge.

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1. History of Glass

With regard to the origin of glass, there is a story that when Phoenicians did cooking at a place along the coast of the Mediterranean, they found that saltpeter, which was used for an oven wall, happened to mix with coastal sand, and became glass. However, it is commonly said that, before that, glass had already existed in Mesopotamia, an ancient country, and in the 1500s B.C. Egyptians made small glass containers, and thus glass making paved the way for development.

Later in the Roman Empire, the glass making in Egypt was succeeded by Syria at the eastern end of the Mediterranean, where the glass making attained a remarkable development owing to the discovery of blowing.

With the breakup of the Roman Empire at the end of the 4th century, the center of glass production moved to Constantinople, present Istanbul, in the Byzantine Empire, where they chiefly manufactured containers and lamps to be used in the temples. The glass industry spread to European countries, manufacturing mosaic glass that decorated the ceilings and walls of temples.

In the 14th century polished sheet glass began to be produced in Venetia. It is said that the foundation of the modern glass making technique was established in Venetia during a period of the 13th to 16th centuries.

Later in the 16th to 17th centuries, the polished sheet glass casting technique was invented in France. In Germany they started making Bohemian crystal glass by using high quality silica sand and wood, which was abundantly present, as fuel. And in Britain they invented lead glass, which led to producing lead crystal glass superior in transparency. They applied elaborate cutting thereto, which resulted in developing cut-glass.

Over in America they developed the pressed glass manufacturing technique in the 19th to 20th centuries, thus succeeding in mass production. Further, with the growth of the machine industry, they began manufacturing the sheet glass drawing machine, automatic glass bottle forming machine, glass bulb automatic forming machine, etc., which served for spreading the modern glass making technique across the world.

2. Characteristics and Kinds of Glass

2-1 Characteristics of Glass

As was mentioned earlier, glass has come to be used in various fields because of the following characteristics of glass:

(i) Transparent
(ii) Glass can be made into any desired shape.
(iii) Glass can be easily washed, and is sanitary.
(iv) Any desired tone of color can be obtained for the products.
(v) Glass has chemical-proof
(vi) The progress of manufacturing technique has made it possible to mass-produce the products with the same quality and the same shape.

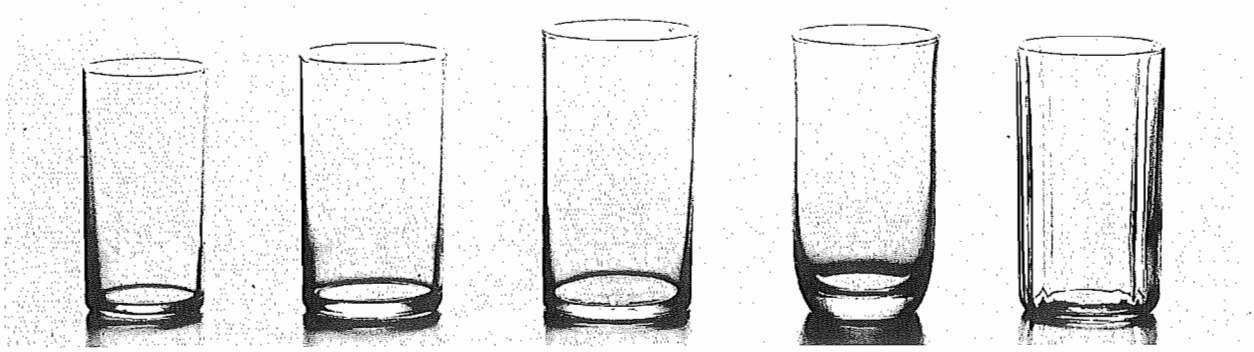

Photo 1 Tumblers

In old days glass was regarded as a valuable thing, but now various things are made of glass by utilizing its characteristics, for example, the window of houses or buildings, bottles, many kinds of containers, ornaments, optical things and so forth. In this way, glass is now indispensable for our life.

2-2 Kinds of Glass

Glass can be classified into various kinds according to its component, shape and physical properties. Of these, classification will be made here on the component, shape and purpose.

1. Classification by component

(a) Silicate glass

(i) Silica glass (fused quartz glass)
(ii) Alkali silicate glass = Silicate soda
(iii) Lead-alkali glass = Crystal glass
(iv) Soda-lime glass = Sheet glass, Bottle glass
(v) Potash-lime glass = Bohemian crystal glass
(vi) Barium silicate glass = Barium flint glass

(b) Borosilicate glass

Glass that contains B_2O_3 and SiO_2 as acid components.

(c) Phosphate glass

Glass that contains P_2O_5 as acid component together with B_2O_3 or SiO_2.

2. Classification by shape and purpose

(a) Flat glass

(i) Sheet glass
(ii) Plate glass
(iii) Safety and Tempered plate glass
(iv) Mirror glass

(b) Hollow glass

(i) Domestic glassware
- Soda-lime glass
- Crystal glass

(ii) Illumination glass
- Pressed glass
- Blown glass

(iii) Electronic tube glass

Photo 2 Ashtrays

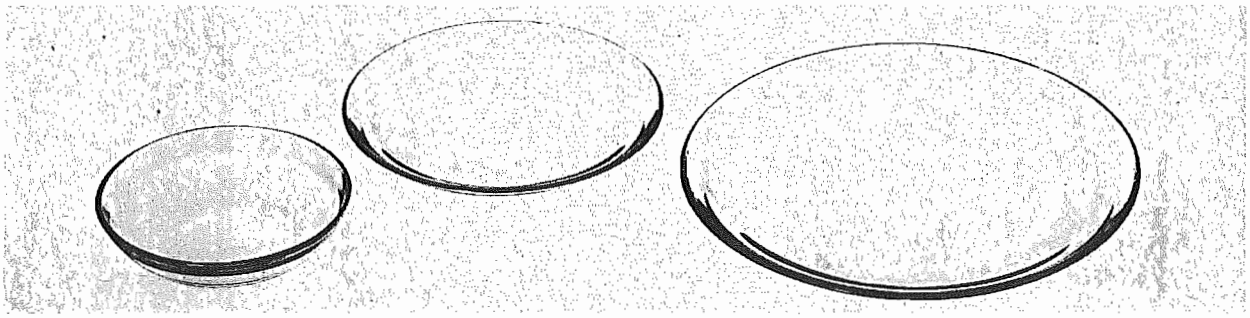

Photo 3 Plates

(iv) Laboratory glass
(v) Pharmaceutical or Medicinal glass
(vi) Bottle glass
- o Clear
- o Amber
- o Colored

(c) Fiber glass

(i) Long fiber
(ii) Short fiber

(d) Optical glass

(i) Crown glass
(ii) Flint glass
(iii) Filter glass
(iv) Artificial gems

3. Manufacturing Process of Glass

Glass is made very complicatedly from raw materials. Nevertheless, it can be said that the manufacturing process is quite simple conceptually. For example, the mixing ratio of raw materials, which fits the glass composition, is decided on. Then, the raw materials are mixed in the state of powder or granule, to which a proper rate of cullet is compounded and is melted. The temperature of molten glass is further raised so that melting becomes perfect and clean while releasing bubbles. Then, the temperature of the molten glass is lowered so that it gets viscosity suitable for forming. And in order to get rid of the thermal strain of the product, it is annealed, and if necessary, an appropriate processing is performed to make the product.

The glass products thus obtained are quite different in their component, shape, nature and purpose. And the manufacturing process has a delicate difference according to the kind of product. This difference brings about a delicate difference in the quality of product. In other words, the manufacturing process looks very simple conceptually, but each process is quite complicated itself. This strongly requires skillfulness except for the products that can be mass-produced by machinery.

4. Outline of Glass Industry

What characterizes the glass industry is that there are many kinds of products and purposes. There are such products as sheet glass, beer bottles, electric bulbs that have the same shape and nature, and are mass-produced under strict quality control. On the other hand, there are artistic glass like crystal glass and special medical and laboratory glass which require high precision to produce, and each of these products must be manufactured very carefully. In this way, according to the purpose, some require high precision in their manufacture, while others not.

The products to be manufactured in large quantities under strict quality control need a large production scale and a large amount of initial investment. On the contrary, the production scale of a cottage industry is considerably

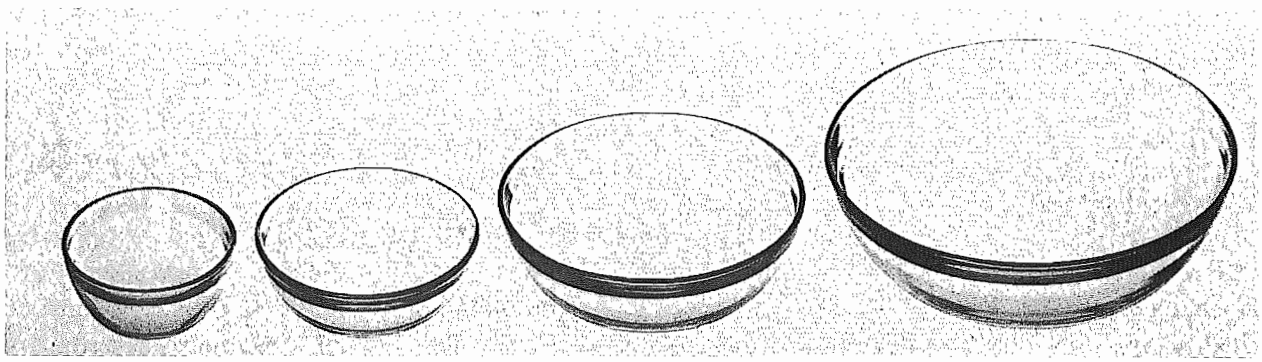

Photo 4 Bowls

small, which, however, requires high skillfulness on the part of workers.

Between the above two kinds of plants there exists a glass plant of a small and medium scale, the number of which is the overwhelming majority. These plants produce various kinds of daily miscellaneous goods such as cups, tableware, toilet bottles, medicine bottles and the like as well as ornaments. The following shows the classification of products by the type of a glass melting furnace:

Kinds of glass	Types of glass furnace
Glass container Medical and laboratory glass Lighting glass Glass bulb Ornament	Pot (Crucible) furnace or Small and medium scale tank furance
Sheet glass Bottle glass Optical glass T.V. glass	Large-scale tank furnace or Special-type tank furnace

The construction cost of a plant employing a small crucible or tank furnace will be from US$1,000,000 to US$2,000,000 depending on the scale. However, a plant using large-scale tank furnace or the special-type tank furnace will need from US$15,000,000 to US$70,000,000.

In this paper description will be made on a soda-lime glass plant that manufactures glass containers, especially tableware, while taking into considération the technique, demand and production scale which can be tackled easily by persons who have so far little experience in the glass production.

5. Model Glassware Manufacturing Plant

Description will be made here on a plant which is smaller in scale than a plant manufacturing sheet glass, bottle glass, optical glass and the like, and needs smaller initial investment, and employs a crucible furnace for melting, and performs the forming process by hand and also uses a semi-automatic machine, whereby the plant manufactures 1,400 kg/day of glassware or 7,000 pcs./day, which has an average weight of 200 grams.

At a glance, the crucible furnace looks like a plant out-of-date and inefficient because it is mainly operated by hand. However, it is the crucible furnace which helped grow the glass industry in Britain, and this furnace is still being used. This tells that the crucible furnace is the foundation of glass melting. It can be said that the crucible furnace is a means of production which the persons, who have little experience in the glass industry, can run at the minimum risk.

Moreover, the crucible furnace has such merits that although small in scale, it is suitable for the manufacture of various kinds of products, and the crucible furnace can manufacture small quantities of goods continuously throughout the year depending upon the market condition. This is still considered to be the safest and stabilized glass plant even in developed countries. Thus, the crucible furnace is playing a very important role in the glass industry.

As was mentioned earlier, although we say glassware in a word, it has a great variety in itself. For instance, high-grade glassware has quality similar to that of crystal glass. Such high-grade glassware requires specific technical skill. Even ordinary glass products also require skill and experience in its own way. Generally speaking, the glassware, that can be put on sale, requires the experience of from three to five years. It is therefore advisable to acquire the basic technique, skill and experience before starting the production of medium-grade or high-grade products.

5-1 Kinds of Products and Production Scale

The model plant furnished with a crucible furnace can manufacture various kinds of glassware such as tumblers, saucers, tea cups, etc. It takes much time and trouble to describe in detail the manufacture of each product and its produc-

tion quantity. Therefore, as a calculation basis, 200 grams per piece is considered the average weight of the various products.

The crucible furnace has a varied number of crucibles, for instance, the furnace having 6 crucibles or 8 crucibles. The size and capacity of a crucible are varied according to production quantity. For the plant under contemplation a crucible furnace having eight 500 lbs crucibles will be adopted from the point of furnace structure and the efficiency of fuel to be consumed.

A 500 lbs crucible can melt the raw materials of about 250 kg. In case a 250 kg batch is put into each of eight crucibles, it is possible to obtain the molten glass of 250 kg x 8 crucibles = 2,000 kg. This figure, however, indicates merely the raw material melting capacity of the crucible furnace, but actually approximately 15% of the molten glass batch vanishes in terms of gas. Hence, the 2,000 kg batch decreases in quantity like this: 2,000 kg x 85% = 1,700 kg.

Moreover, there occurs damaged or deformed glassware in the stage of being formed, annealed or processed, and there are some which are condemned in the final inspection, and are handled as cullet which was mentioned about earlier to be crushed for reuse. When such a loss is estimated to be 15%, the quantity of final products will become 1,700 kg x 85% = 1,445 kg or about 1,400 kg.

In case an average of 1,400 kg are obtained as final products, the quantity will become in terms of pieces like this: 1,400 kg ÷ 200 grams = 7,000 pieces, because the average weight of one piece is 200 grams.

Therefore, when the plant is operated for 300 days a year, the annual production will become:

1,400 kg x 300 days = 420,000 kg in weight.

7,000 pcs. x 300 days = 2,100,000 pieces. This is the production scale of the plant under contemplation.

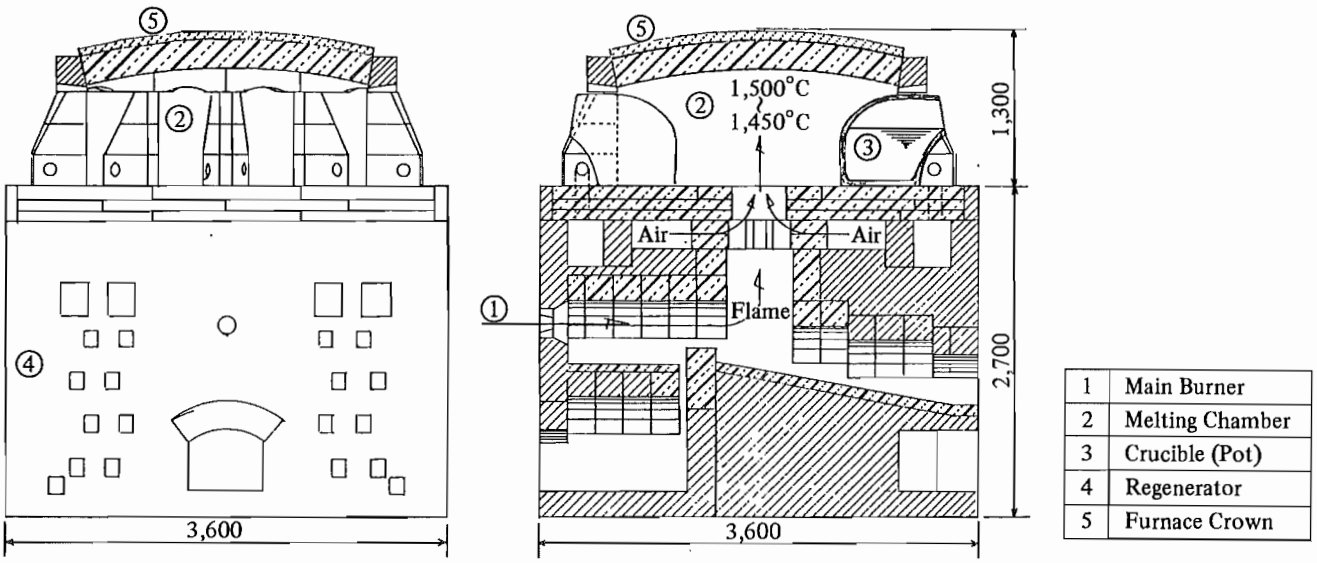

Fig. 1 Glass Melting Crucible Furnace

5-2. Manufacturing Process of Glassware

The diagram of the glassware manufacturing process is attached here. And the main points of which will be explained below one by one.

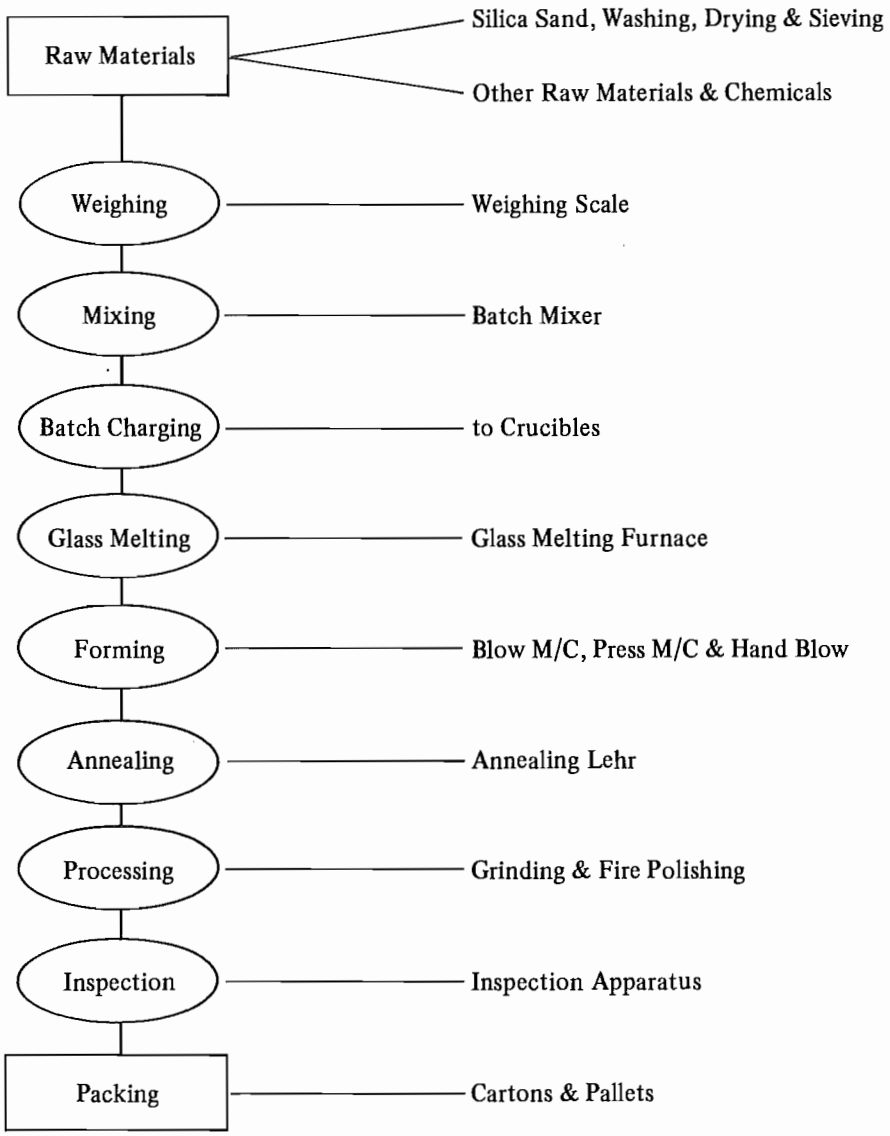

Fig. 2 Process Diagram of Glassware Manufacturing

5-2-1 Silica sand treatment

Most of the silica sand coming from outside the plant contain impurities of organic matter. The silica sand brought to the plant is stored in the sand storage area or is piled outdoors, from which the quantity to be used every day, that is 2 tons/day, is taken out, and is washed with water by a silica sand washing machine, and while being dried by a dryer, the sand is screened simultaneously through a sieve to gain the uniform grain size of from 30 to 80 mesh, and then is stored in the sand depot indoors.

5-2-2 Batch mixing

The silica sand in the sand depot is mixed with soda ash, limestone, aluminum hydroxide, sodium nitrate, arsenious acid and salt cake, which had been purchased. To obtain a given mixture, they are weighed by a weighing scale to mix into about 500 kg per lot, and are put into a batch mixer to be mixed well for about 20 minutes. It is essential to mix them sufficiently so that they become homogeneous because mixing will have a great effect on the following melting process and consequently on the quality of products.

5-2-3 Melting of glass

The batch thus mixed is poured intermittently into the eight crucibles in the glass melting furnace by a furnace operator at the rate of 50 kg for melting. The batch is usually is poured into the crucible during a period of from evening to the following morning after the glass forming of the day is finished. In melting, the temperature inside the furnace is kept at as high as about 1,450°C for 10 to 12 hours so that forming can be done in the following morning. In this case, the temperature is adjusted so that glass becomes colorless and contains no bubbles or seeds. The quality of glass is determined in that stage.

5-2-4 Forming of glass

The forming method of glass can roughly be classified into three, namely hand blow, air press and air blow.

The glass, which was melted perfectly in the crucible becoming suitable for forming, is rolled round an iron pole as much as the weight of a product. In the case of hand blow, the molten glass is put into a mould while being blown in the air and the pole being rotated. During that time, a man breathes into the glass and form it.

In the case of air press, the glass, which was rolled round the pole, is cut with scissors over the mould of a press machine, and is formed by pressing it with plunger. At this time, the temperature of glass is maintained by applying LP gas or air in order to keep coolness of glass and uniformity of forming.

For reference, the view of glass furnace and hand blowing are shown in Photo 5.

5-2-5 Annealing

The formed glass often has thermal strain inside. The strain causes damage in the subsequent process or breaks in transit in a way peculiar to glass when glass gets mechanical shock. Hence, glass must pass through the annealing process. As the product has still a high temperature after being formed, it is immediately put into an annealing lehr. Annealing of glass is performed continuously on the conveyor within the lehr, the temperature of which is kept at 500 to 550°C by gas or electricity, and glass passes through the lehr in one hour or so. The temperature curve, through which glass passes, is 500 to 550°C in the strain eliminating zone. The annealing lehr is so designed that glass is cooled very slowly.

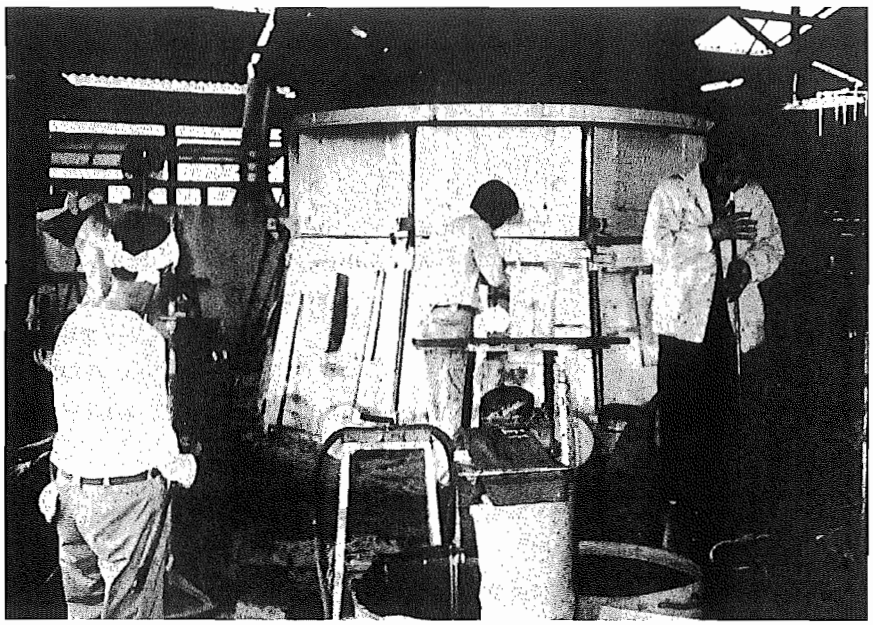

Photo 5 Glass Melting Furnace and Hand Blowing

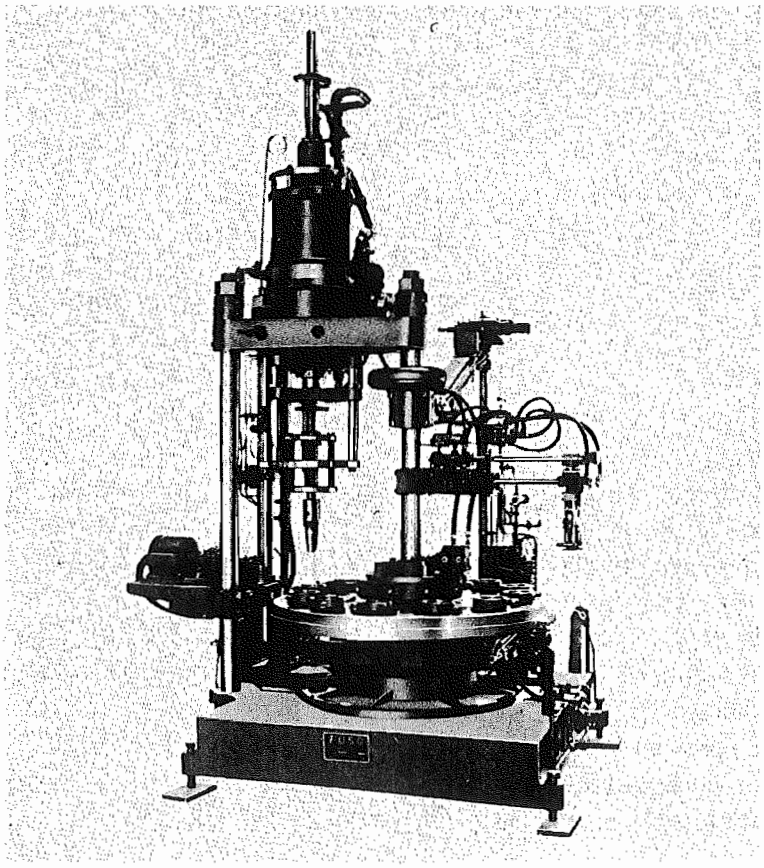

Photo 6 Glass Pressing Machine

5-2-6 Processing

The glass, that has passed through the annealing lehr, is cut, and fire polished, if necessary, and becomes a final product.

In the case of tumblers, the mouth is processed and finished elaborately so as to enhance their value. Even if such press products as an ashtray, which does not require to be processed elaborately, its edge is polished, and is made smooth and beautiful by gas.

5-2-7 Inspection and packing

The final products, that were processed, are carefully inspected with the naked eye, and the inferior goods are removed.

Whenever necessary, a sample of the products is taken out for inspection in the stage of forming, annealing or processing.

The products, that passed the inspection, are packed in corrugated cardboard boxes, and are kept in the product storage until the time of delivery.

5-3 Machinery and Equipment

The following show the machinery and equipment required in the plant under construction.

1. Silica Sand Treatment Facilities — Capacity 3–5 tons/day — 1 set

   Sand Washing Machine
   Sand Drying Machine
   Sand Sieving
   Sand Transfer Conveyors
   Handling Tools

2. Batch Mixing Section — Capacity 2–3 tons/day — 1 set

   Batch Mixer
   Hand Trucks
   Steel Buckets
   Handling Tools
   Weighing Scale

3. Glass Melting Crucible (Pot) Furnace — Capacity 2 tons/day — 1 set

   Refractory Bricks for Recuperator, Firing chamber, Pots chamber, Flue channel
   Furnace Steel Binding Structure

4. Furnace Combustion Equipment — 1 set

   Rotary Oil Burner 1.2–1.5 kl/day
   Oil Pre-Heater Unit
   Pumping Unit
   Service Tank
   Oil Piping Materials and Joint Fittings

5. Crucible (Pot) Pre-Heating Oven — One Crucible/Oven — 1 set

Refractory Bricks
Steel Binding Materials
Rotary Oil Burner
Crucible Handling and Transfering Equipment

6. Furnace Temperature Control Panel — 1 set

Temperature Recorder PR 0–1,600°C
Temperature Recorder CA 0–1,000°C
Temperature Indicator PR 0–1,600°C
Compensation Lead Wire PR & CA
Thermocouples PR & CA
Temperature Control Panel
Electric Wirings and Materials
Optical Pyrometer
Portable Thermometer 0–1,600°C

7. Glass Forming Machine and Equipment — 1 set

Press Machine
Blow Machine
Moulds of Several Kinds
Tool Set
Air Compressor 20–40 HP
Air Blower
Air Regulator
Air Piping Materials and Joints Fittings
Glass Processing Grinder & Fire Polishing Equipment
Melting Glass Hand Blow Equipment

8. Annealing Lehr and Inspection — 1 set

Annealing Lehr,W1,000 x L14–20 m Wire Net Belt System
Temperature Recorder & Indicator CA 0–800°C
Inspection Apparatus
Finishing Table

9. Electric Stand-By Generator — 1 set

Generator Set
Electric Wirings and Materials

10.

10. Machine Shop Equipment 1 set

Lathe
Milling Machine
Drilling Machine
Welding Machine
Gas Cutting Torches
Grinding Machine
Miscellaneous Tools

11. Transportation Equipment 1 set

Truck Lorry 4 tons Capacity
Fork Lift 2 tons

12. Office Facilities 1 set

13. Spare Parts 1 set

Estimation of one year spare parts for the plant

14. Auxiliary Facilities 1 set

Oil Storage Tank 10 kl
L.P.G. Supply System
Power Receiving Station
Flue Chimney 24 H
Water Receive & Supply Pipings
Lifts

5-4 Plant Layout

Fig. 3 shows the layout of a glassware manufacturing plant.

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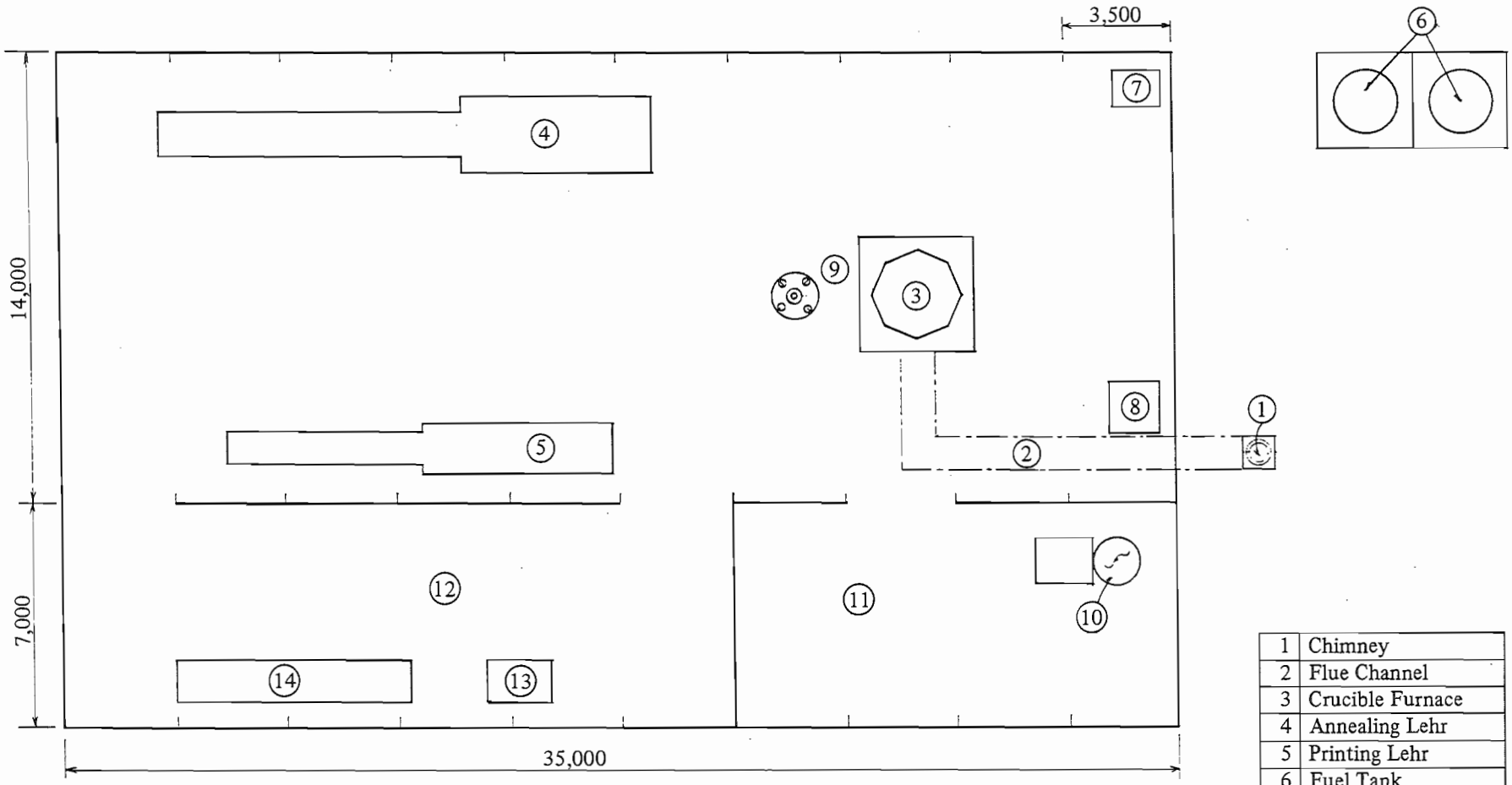

Fig. 3 Layout of Glassware Plant

5-5 Required Number of Employees

The following number of persons are required to operate the plant normally.

Division	Officer & Engineer	Skilled Worker (Technician)	Unskilled Worker
Silica Sand Treatment	0	0	1
Batch Mixing	1	1	1
Glass Melting Furnace		1	1
Glass Forming & Machines	1	6	7
Annealing Lehr & Inspection	0	1	2
Glass Processing	0	0	2
Machine Shop & Parts Store	0	1	0
Moulds	0	1	0
Transportation & Warehouse	0	1	2
Office	1	1	1
Total	3	13	17

Officer & Engineer	3
Skilled Worker (Technician)	13
Unskilled Worker	17
Total	33

5-6 Construction Cost of Model Plant

5-6-1 Cost of machinery and equipment

	Item	Amount in Yen
1.	Silica Sand Treatment Facilities	6,500,000
2.	Batch Mixing Section	3,000,000
3.	Glass Melting Crucible (Pot) Furnace	38,000,000
4.	Furnace Combustion Equipment	4,500,000
5.	Crucible (Pot) Pre-Heating Oven	5,000,000
6.	Furnace Temperature Control Panel	5,000,000
7.	Glass Forming Machine and Equipment	30,000,000
8.	Annealing Lehr and Inspection	20,000,000
9.	Electric Stand-by Generator	1,500,000
10.	Machine Shop Equipment	5,300,000
11.	Transportation Equipment	7,000,000
12.	Office Facilities	3,000,000
13.	Spare Parts	7,000,000
14.	Auxiliary Facilities	12,000,000
	Total	147,800,000

Note: Machinery and equipment cost is shown in FOB Japanese Port of December 1983.

5-6-2 Construction cost

(1) Preconditions

(a) Land cost, Import duty, and Training expenses are not taken into accounts.
(b) Freight and insurance cost are assumed to be 10% of the FOB price of machinery and equipment.
(c) Erection cost is assumed to be 5% of the FOB price of machinery and equipment.
(d) Factory building and Civil work cost are assumed to be 40% of the FOB price of machinery and equipment.
(e) Supervising fee is assumed to be 10% of the FOB price of machinery and equipment.
(f) Contingency is assumed to be 10% of the FOB price of machinery and equipment.
(g) The exchange rate of U.S. Dollar to the Japanese Yen is assumed as U.S.$1 = ¥235.

(2) Construction cost

		in Yen	in US$
(a)	Machinery and equipment	147,800,000	628,936
(b)	Freight and insurance	14,780,000	62,894
(c)	Erection cost	7,390,000	31,447
(d)	Factory building and Civil work cost	59,120,000	251,574
(e)	Supervising fee	14,780,000	62,894
(f)	Contingency	14,780,000	62,894
	Total	¥258,650,000	US$1,100,639

5-7 Production Cost and Profitability

5-7-1 Raw material cost

The cost of raw materials differs greatly depending on the availability and the method of obtainment in a country. In this paper, the following cost will be adopted, assuming that one ton of glass batch is worth ¥80,000 on the average:

¥80,000 x 2 tons x 300 days = ¥48,000,000 or US$204,255

5-7-2 Utilities cost

The annual quantity and cost of each utility in the plant under contemplation are estimated to be as below (The main fuel of the glass melting furnace is heavy oil).

	Required quantity per month	Per year (300 days)	Estimated cost per year
Water	600 m^3	7,200 m^3	US$6,200
Heavy oil	36 kl	432 kl	US$33,000
LPG	7 kl	84 kl	US$25,000
Electricity	8,000 kWh	96,000 kWh	US$14,000
Total			US$78,200

5-7-3 Personnel cost

	Wages per month per person US$	Wages per year per person US$
Unskilled worker	200	2,400
Skilled worker	300	3,600
Officer and engineer	500	6,000

When calculated on the basis of the above wages, the annual personnel cost will become as follows:

	Number of persons	Wages per month US$	Monthly total US$
Unskilled worker	17	200	3,400
Skilled worker	13	300	3,900
Officer and engineer	3	500	1,500
Total	33		US$ 8,800

US$8,800 x 12 months = 105,600 per year.

5-7-4 Production cost

(1) Preconditions

(a) Annual production: 420 tons of glass
(b) Repair and consumed articles costs are assumed to be 3% of the FOB price of machinery and equipment.
(c) Insurance cost is assumed to be 0.5% of construction cost.

(d) Selling and administration costs are assumed to be 5.0% of annual sales.
(e) Depreciation: Construction cost x 1/10

(2) Production cost

Raw materials	US$204,255
Utilities	US$78,200
Personnel cost	US$105,600
Repair and consumed articles	US$18,868
Insurance	US$5,503
Selling and administration cost	US$42,000
Depreciation	US$110,064
Total annual cost	US$564,490
Unit production cost per ton	US$1,344

5-7-5 Profitability

(1) Annual sales

Selling price (ex factory) of average weight of 200 grs. glassware was fixed at US$0.40.

Accordingly, the annual sales will be as follows:

US$0.40 x 2,100,000 pcs. = US$840,000

(2) Profitability

Annual sales of average weight of 200 grs. glassware and its production cost are as follows:

Annual sales	US$840,000
Annual production cost	US$564,490
Profit	US$275,510

Consequently, the annual profit of the glassware will be US$275,510.

Accordingly, the rate of profit (profit/annual sales x 100) of the glassware will be 32.8%.

This shows that the profitability of a glassware manufacturing plant is high.

5-8 Other Technical Matters

5-8-1 Mixing of raw materials

Exactly speaking, the mixing standard of raw materials is determined entirely by the quantities of SiO_2 and Fe_2O_3 which are contained in silica sand. Description will be made here on the mixing of soda-lime glass on the assumption that silica sand contains 98% SiO_2 and 0.1% Fe_2O_3.

The mixing of this batch is intended to produce one kind of clear glass a day.

This does not mean that the eight crucibles are employed only for melting one kind of glass batch. Two or three kinds of glass can be melted simultaneously in one crucible furnace. In this paper, however, melting of one kind of glass was taken up as a basis of calculation.

However, accoridng to the content of Fe_2O_3 in silica sand which is obtainable locally, it may not be able to produce clear glass. In this case, colored glass will be made by adding coloring agent so as to meet the demand.

Although this paper deals only with clear glass, it must be added that colored glass can also be manufactured when there is a brisk demand.

Batch Mixing for Clear Glass

	Ratio	Per day	Per year (300 days)
		kgs	tons
Silica Sand SiO_2	100	1,320	396
Soda-Ash Na_2CO_3	24	316	94.8
Lime Stone $CaCO_3$	25	330	99
Aluminum Hydroxide $Al(OH)_3$	2	26.3	7.89
Sodium Nitrate $NaNO_3$	0.23	3.1	0.93
Arsenious Acid As_2O_3	0.05	0.7	0.21
Salt Cake Na_2SO_4	0.3	3.9	1.17
		2,000 kgs	600 tons

5-8-2 Utilization of cullet (Scraps of waste glass)

As another source of raw materials, glass cullet or broken glass is used. The quantity of glass cullet that occurs is 15 to 30% of the quantity of a batch. Glass cullet is returned to the melting process mixed with a batch. Scraps of glass is not merely recovered for economic reasons, because when cullet is mixed with a batch, it helps make glass melting easier technically. Besides, cullet has many other merits.

Cullet is chiefly recovered in the form of broken and deformed in the manufacturing process or as condemned products. The cullet thus collected is used again. Cullet is also bought for use. In buying cullet, in needs to buy only the same kind, for example, clear glass or colored glass, and when it contains a foreign matter, particularly iron scrap, such a foreign matter must be removed. The cullet thus recovered is crushed into a proper size before it is mixed with a batch.

According to the condition of a country, the way of obtaining cullet may differ. In some countries, it may be difficult to get cullet. Therefore, in this paper, description will be made on the cullet to be recovered within the plant and on its melting. In the case of about 70% yield, 15 to 20% cullet is always generated in the process. The cullet thus generated will be changed into a batch at the rate of about 400 kg/day. Considering that cullet is utilized supplementing some of the batch, which scatters while being melted, the cost of cullet will be omitted. It must be mentioned that the effective use of cullet will bring about a great benefit to the glass manufacturing plant continuously.

Project Planning for Small and Medium Scale Industries

No. 1 Rice Milling Plant and Rice Bran Oil Manufacturing Plant
No. 2 Plastic Woven Bag Manufacturing Plant
No. 3 Container Board Manufacturing Plant
No. 4 Plastic Blow Bottle Manufacturing Plant
No. 5 Concrete Block Manufacturing Plant
No. 6 Glassware Manufacturing Plant

Project Planning for Small and Medium Scale Industries No. 6

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