



TOGETHER
for a sustainable future

OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.



TOGETHER
for a sustainable future

DISCLAIMER

This document has been produced without formal United Nations editing. The designations employed and the presentation of the material in this document do not imply the expression of any opinion whatsoever on the part of the Secretariat of the United Nations Industrial Development Organization (UNIDO) concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries, or its economic system or degree of development. Designations such as “developed”, “industrialized” and “developing” are intended for statistical convenience and do not necessarily express a judgment about the stage reached by a particular country or area in the development process. Mention of firm names or commercial products does not constitute an endorsement by UNIDO.

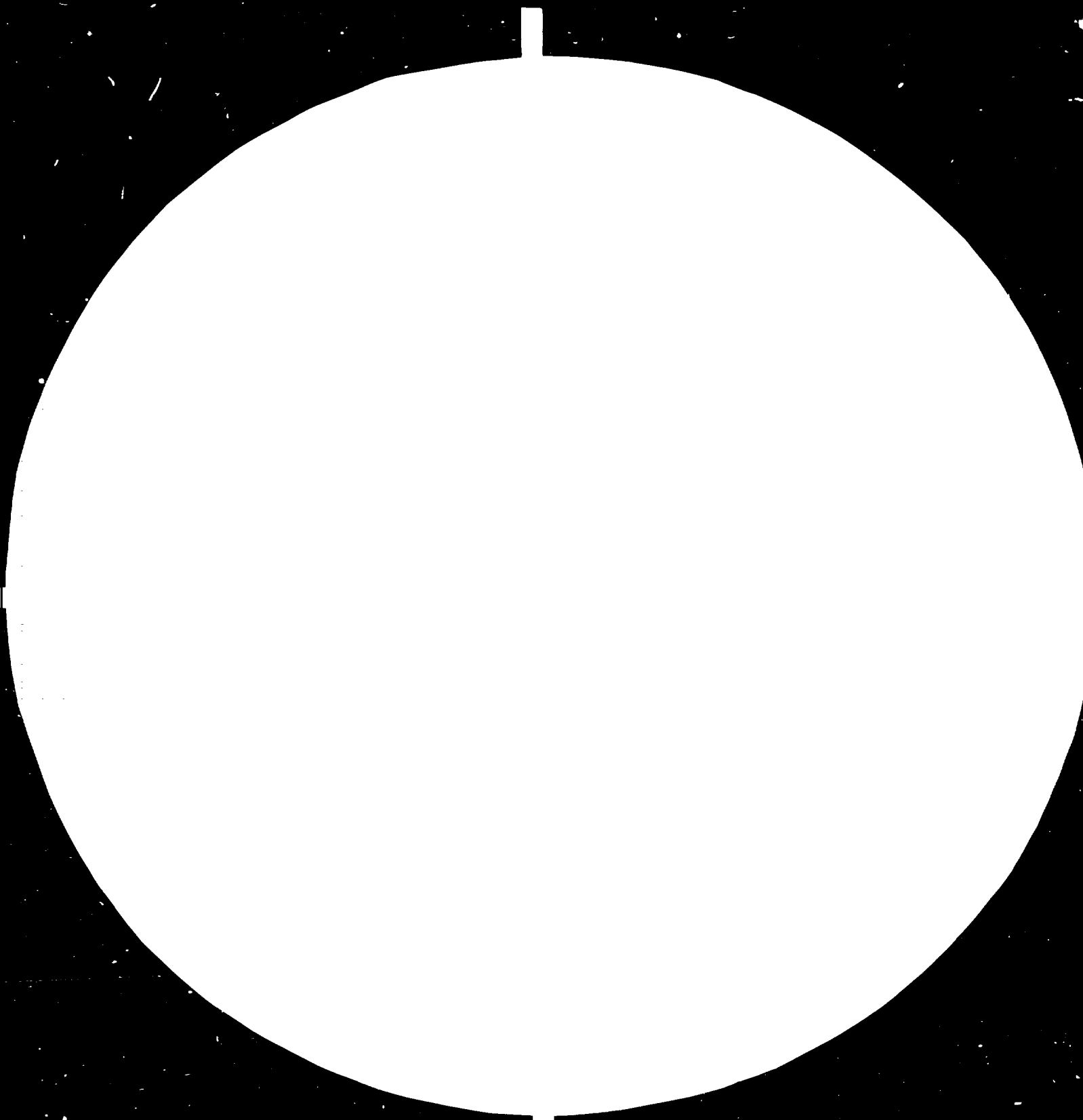
FAIR USE POLICY

Any part of this publication may be quoted and referenced for educational and research purposes without additional permission from UNIDO. However, those who make use of quoting and referencing this publication are requested to follow the Fair Use Policy of giving due credit to UNIDO.

CONTACT

Please contact publications@unido.org for further information concerning UNIDO publications.

For more information about UNIDO, please visit us at www.unido.org



1.0

1.1

1.25

1.4

1.6

11572

March 1961

Guyana. CONSULTANT IN GLASS MANUFACTURING .

DP/GUY/79/007/11-56/31.4 E

Report Prepared for the

GUYANA STATE CORPORATION
Republic of Guyana

by

H.R. Purser

This Report has not been cleared with the United Nations Industrial Development Organisation which does not therefore necessarily share the views presented.

CONTENTS

	SUMMARY	1
1.	JOB DESCRIPTION	3
	Duties	3
	Background Information	4
2.	INTRODUCTION	5
3.	MARKET EVALUATION	6
	Sheet Glass	6
	Pressed Glass	7
	Glass Containers	7
	The Price of Bottles	9
4.	THE CAPACITY OF THE GLASS CONTAINER PLANT	10
	The PRM Line	10
	The I.J. Container Line	11
	Fuel Consumption	13
	Raw Materials	14
5.	FINANCIAL SURVEY	15
	Profitability Analysis	15
	National Cost Benefit	18
	Foreign Currency Requirement	18
6.	PERSONNEL	20
	Organization	20
	Training of Personnel	23
7.	TECHNICAL ASSISTANCE	24
8.	RECOMMENDATIONS	26

SUMMARY:

The Guyana Glassworks Limited at Yarowkabra outside Georgetown has equipment installed for the production of glass containers and pressed glass articles since 1978.

Production could start approximately 6 months after a decision to go ahead has been taken. Several conditions must, however, be satisfied before production can be started.

Foreign currency must be made available for the glass company - approximately G \$ 12 million per year for a full capacity operation of the plant.

An agreement with a glass production company regarding technical assistance during at least three years should be signed.

It is recommended that a second glass container machine should be installed in the plant. With only one machine in operation, only half the capacity of the furnace is utilised. The production should start with two glass container machines. The installed glass press should then not be taken into production. As an alternative, production could start with one glass container machine and one press. A new glass container machine could then be installed as soon as the glass company can afford it or at the latest during the first furnace major repairs after 4 years.

It is most profitable to start with two glass container machines. Two machines will just about cover the local demand for bottles. If one machine is changed to a double gob operation, approximately 1/3 of the production of the glass company could be exported. Such a change could take place at the earliest after four years. The size of the furnace must be increased at the same time.

It does not seem possible that the sheet glass plant can give any profit. It is proposed that no further work should be done in the sheet glass plant. It may be an advantage to sell all the equipment if possible.

The cost of installing a new glass container machine is approximately G\$ 3 M. Starting production with two machines means that the total profit after 10 years of production will be approximately \$25 M. Production with one machine only would result in a loss of \$20 M. Having one machine for 4 years and two machines for 6 years gives a profit of \$9 M.

Using the plant at full capacity will also give rise to a substantial national cost benefit and saving in foreign exchange as compared with importing all the bottles required.

The glass company will employ approximately 240 people.

Glass manufacturing is complicated and the glass company is therefore advised not to take any decisions regarding technical activities without consulting an expert. The UNIDO glass consultant is prepared to assist whenever required.

...3...

1. JOB DESCRIPTION

Post Title:

Consultant in glass manufacturing.

Duration:

One month.

Purpose of project:

To assist in the establishment and operation, within Guyana State Corporation (GUYSTAC) of an internal consultancy service for its affiliated companies. The organisation includes 28 companies covering a wide range of commercial and industrial activities including fisheries, forestry, food, pharmaceuticals, textiles, mechanical workshops and public utilities.

Duties:

The consultant will make a technical assessment of the project concept and economic viability of the Guyana Glassworks Limited and, more specifically, is expected to:

- a) Examine the existing plant and make a technical evaluation of the present plant production against the designed capacity.
- b) Assess the current and future development of the plant operations in terms of production, productivity and cost efficiency.
- c) Review the existing maintenance system, carry out an audit and make recommendations for its improvement.
- d) Examine the organisational structure of the plant, taking into consideration the qualifications and availability of local manpower.

- e) Specify training needs for different categories of plant personnel and identify institutions which can provide such training and recommend programmes for on-the-spot training.
- f) Review the existing spare part inventory control system and make recommendations for improvement.

The Consultant will also be expected to prepare a final report, setting out the findings of the mission and recommendations to the Government on further actions which might be taken.

Qualifications:

Academic degree in science or engineering specializing in glass technology with extensive experience in the establishment and management of glass industries.

Background Information:

The factory has the capacity to produce containers and sheet glass. The process envisaged for container plant operations at Yarowkabra involves the following unit operations....

- a) Raw material handling and preparation - cullet crushing, screening of aragonite and drying of both sand and aragonite.
- b) Batch preparation - blending of raw materials according to strict formulae in batches of known weight; mixing the batches to ensure homogeneity.
- c) Melting - feeding batch mixed material to a furnace where molten glass is formed and partially conditioned.
- d) Feeding and forming - final conditioning and controlled feeding of the melt to the forming machines (I.S. and PBM machines).

...5...

- e) Annealing - conditioning - reheating and slow cooling of the formed product.
- f) Decorating - for those articles which require fired on labels or designs.

2. INTRODUCTION

The Guyana Glassworks is situated in Yarowkabra, 50 km south east of Georgetown. All equipment in the factory has been delivered and installed by General Glass Equipment Company, Atlantic City, New Jersey, USA. The contract with this company was signed in 1976.

The installation was finished in 1978. An outline of the plant is given in the Background Information of the Job Description.

The construction of the sheet glass plant has not been finished. The bottom and the lower parts of the furnace walls have been built. All the necessary refractory materials for the remaining part of the furnace is on the site. The drawing machines have not been installed. The construction was stopped since it was found that there was not a satisfactory market for the sheet glass produced according to the Fourcault method.

All installations have been finished in the container glass plant. There is one I.S.6 (Individual Section, 6 sections) machine and one PBM (Press-blow) machine installed at the furnace.

Five expatriates from General Glass were kept in the plant for technical assistance. The technical assistance agreement with General Glass was finalized on March 31.

As a total 82 people are employed by Guyana Glassworks Limited. This number may be decreased until a decision is taken to start production in the plant.

In total G\$ 43 M have been invested in the glass plant. Guyana Glassworks Limited is a state owned company and belongs to the Guyana State Corporation group.

The UNIDO Glass Consultant visited Guyana from February 25 to April 1.

3. MARKET EVALUATION:

A market survey was carried out by Guyana Glassworks in 1978. This covered the local demand in Guyana and some export markets. This survey can be summarized as follows:

Sheet Glass:

The following figures were presented for the local market and the export markets.

Thickness of glass	Quantity in square feet		
	Guyana	Export	Total
2 m m	63400	605000	668400
3 m m	52100	306000	358100
4 m m	4500	6000	10500
5 m m	1314000	3117100	4431100
6 m m	6000	7800	13800

This gives the following total weight in tons ...

Guyana market	1604 tons
Export market	<u>4131 tons</u>
Total market	<u>5735 tons</u>

...7...

If the total capacity of the furnace is 75 tons per 24 hours or 24000 tons per year (320 days) this means that the market in Guyana is approximately 7% and the total market 24% of the plant capacity. It would of course be extremely difficult to be the sole supplier for these export markets. If Guyana Glassworks could supply 1/3 of the demand to the export market, that means that the total tonnage of sheet glass supplied by the factory would be 1604 + 1377 = 2981 tons. This is equal to 12.5% of the total capacity of the plant.

Pressed Glass

The market study indicated that the domestic demand for pressed glass ware was 8000 pieces only in 1978. The export market was also found to be very small. Most of the table ware required (95% of it) was blown glass, It was estimated in the market survey that Jamaica had a demand for approximately 2 million pieces of pressed glass ware, however.

Before it is decided to start producing pressed articles it will be necessary to carry out a new market survey.

Glass Containers

The demand in Guyana for glass containers was found to be 24 million bottles per year. The export market within Caricom countries was estimated as 278 million bottles. Jamaica alone was found to have a demand of 223 million bottles.

...8...

The types of bottles in greatest demand were ...

284 ml Pepsi, flint	1.5 million
284 ml Banks Beer, amber	2.7 million
284 ml Heineken Beer, amber	14.4 million
284 ml Heineken beer, green	17.3 million
335 ml Jam jars, flint	3.2 million
750 ml Rum, flint	11.5 million
350 ml Rum, flint	9.2 million
200 ml Rum, flint	6.3 million
150 ml Sauce, flint	112.6 million
70 ml Sauce, flint	36.4 million
70 ml Spices, flint	47.5 million
Total number	<u>262.6 million</u>

The expected annual growth was 2 - 5 % per year.

A market study carried out by the UNIDO Glass Consultant indicated that the domestic requirements for glass containers in 1982 is 28.4 million bottles. Comparing the market demands for 1978 and 1982 it is seen that there is an annual increase of the market in Guyana of 4%.

With a market increase of 4% per year, the demand in Guyana for glass containers in the next 10 years will be as follows:

...9...

Year	Domestic Market No. 000
1982	28368
1983	29503
1984	30683
1985	31910
1986	33186
1987	34513
1988	35894
1989	37330
1990	38823
1991	40376

The Price of Bottles

When visiting the bottling plants and the Ministry of Trade various prices have been presented for imported bottles.

In general the prices were in the following regions.

For 10 oz. (284 ml) beverage bottles \$1703 - 2800 per ton of glass

For Rum bottles \$2483 - 4259 per ton of glass

Price average for 10 oz. bottles \$2251.50

Price average for rum bottles \$3371.00

Total average : \$2811.25 per ton of glass.

...10...

The reason for the lower price of the 10 cz. bottles is that these bottles in most factories are produced in large quantities by double gob machines. The quantities produced of the various sizes of rum bottles and other bottles are less and therefore these bottles are more expensive.

In this study it was decided to use a price of \$2400.00 per ton of glass. As an average price for Beverage bottles and Rum bottles this price level should be competitive with imported bottles. The export price will be less. Special agents should be contacted in order to finalize the export prices for different countries.

4. THE CAPACITY OF THE GLASS CONTAINER PLANT

The PBM Line

The PBM press operates with 6 moulds at a speed of 22.5 pieces per minute. If the press produces a 250 ml tumbler having a weight of 186 gram, the production during the first four years will be as follows ...

Year	Total number gobbs 000 per year	Total weight tons	Efficiency %	Accepted tumblers 000	Accepted weight tons	Furnace pull tons per 24 hrs
1	10360	1928	60	6221	1157	6.0
2	10360	1928	70	7250	1350	6.0
3	10360	1928	80	8294	1543	6.0
4	10360	1928	80	8294	1543	6.0

...111...

The I.S. Container Line

One I.B.6 single gob container line has been installed at the container furnace. This is a modern machine and the installation appears to be quite satisfactory. If a 284 ml soft drink bottle weighing 400 gram is taken as an example, the machine will produce 42.6 bottles per minute.

The average efficiency of the machine during its first year of operation can be assumed to be 60%. The efficiency is then gradually increased to 80%. In many plants with long experience the I.S. machines are operated at efficiencies exceeding 90%. In this report it is assumed that there is a maximum efficiency of 80%.

The annual (320 days) production of the I.S. machine of 284 ml bottles will be as shown in the following table.

Year	Total number 000 gobs	Total weight tons	Efficiency %	Number bottles accepted	Total 000 weight tons accepted	Output tons per 24 hours
1	19630	7852	60	11770	4711	24.5
2	19630	7852	70	13741	5496	24.5
3	19630	7852	80	15704	6282	24.5
4	19630	7852	80	15704	6282	24.5
5	14723	5889	70	10306	4122	24.5
6	19630	7852	80	15704	6282	24.5
7	19630	7852	80	15704	6282	24.5
8	19630	7852	80	15704	6282	24.5
9	19630	7852	80	15704	6282	24.5
10	14723	5889	70	10306	4122	24.5

The lower production rates in the 5th and 10th year indicate that there is a major furnace repair then.

The area of the melting chamber of the furnace is 31 sq metres. The capacity of the furnace, when controlled efficiently, should thus be 60 tons per day. When only one I.S. machine is in operation it is seen that less than half of the capacity (24.5 tons) is used. This is of course very unsatisfactory from a fuel efficiency point of view. When the PBM machine is in operation the daily output will increase from 24.5 tons to 30.5 tons. The radical solution would of course be to install a new I.S.6 machine at the feeder of the PBM machine. This new installation could be arranged before operation of the plant starts or at the first furnace repair during the 5th production year.

The capacities of the plant would then be as follows ...

A. Installation of a second I.S. Machine during the fifth year of operation

Year	Total number 000 gobs	Total Weight Tons	Efficiency %	Number 000 bottles accepted	Total Wt. tons accepted	Output tons per 24 hours
1	19630	7052	60	11770	4711	24,5
2	19630	7052	70	13741	5496	24,5
3	19630	7052	80	15704	6202	24,5
4	19630	7052	80	15704	6202	24,5
5	29445	11770	70	20612	8245	49.1
6	39260	15704	80	31400	12563	49.1
7	39260	15704	80	31400	12563	49.1
8	39260	15704	80	31400	12563	49.1
9	39260	15704	80	31400	12563	49.1
10	29445	11770	70	20612	8245	49.1

...12...

B. Installation of a second I.S. machine from the beginning

Year	Total number 000 gobs	Total Weight tons	Efficiency %	Number 000 bottles accepted	Total wt tons accepted	Output tons per 24 hrs
1	39260	15704	60	23556	9422	49.1
2	39260	15704	70	27482	10993	49.1
3	39260	15704	80	31400	12563	49.1
4	39260	15704	80	31400	12563	49.1
5	29445	11770	70	20612	8245	49.1
6	39260	15704	80	31400	12563	49.1
7	39260	15704	80	31400	12563	49.1
8	39260	15704	80	31400	12563	49.1
9	39260	15704	80	31400	12563	49.1
10	29445	11778	70	20612	8245	49.1

Fuel Consumption

When the furnace output is 49 tons per day the consumption of fuel can be estimated at 100 litres/ton of glass output. The oil consumption will be increased to 270 litres per ton of glass when the furnace output is reduced to 24.5 tons per day. The oil consumption is shown in the following table.

Glass pull tons/day	Fuel ratio litre/ton	Oil litre/day	Oil m ³ per 365 (250) days
24.5	270	6615	2414.5 (1653.8)
49.1	100	0030	3225.9 (2209.5)

Raw Materials

Unfortunately only one of the glass raw materials is available in Guyana, A good quality sand is available adjacent to the plant. All other raw materials have to be imported.

It is proposed that the batch should have the following composition ...

Sand	1000 kg
Soda Ash	334 kg
Limestone	295 kg
Feldspar	140 kg
Salt cake	9 kg
Assenic	300 gram
Selenium	0 gram
Cobaltoxide	2 gram
Cullet	450 kg

The glass composition from this batch will be the following ...

SiO ₂	72.5%
Na ₂ O	14.0
K ₂ O	0.5
Al ₂ O ₃	2.0
CaO	10.0
MgO	<u>1.0</u>
Total	100.0%

...15...

The final decision regarding the batch composition must be taken by the consulting company starting up the glass operation. The limestone called Aragonite imported by the Guyana Sugar Corporation can be used as a raw material.

The glass raw materials in the batch excluding the cullet will give 1504 kg of glass. Including the cullet the total weight of glass from the batch will thus be 1954 kg. This means that for an output from the furnace of 24.5 tons of glass per 24 hours a total of 13 batches must be prepared. If there are two I.S. machines working the daily output of glass will be 49.1 tons and 26 batches must be prepared. The feeding to the furnace must of course be controlled by checking the glass level in the furnace.

5. FINANCIAL SURVEY

Profitability analysis

Three different alternatives regarding capacity of the glass container plant were mentioned in chapter 4. These alternatives were:-

1. One I.S. machine only in operation during 10 years.
2. One I.S. machine is in operation during the first 4 years. A second I.S. machine is installed during the 5th year.
3. Two I.S. machines are in operation from the first production year.

Both I.S. machines have six sections and work with single gobs.

Profit and loss analysis have been done for all these three alternatives. The figures for the production cost, the depreciation and the interest have been obtained from the finance controller of the glass factory. All figures in the following tables are in G\$ 000.

Alternative 1. One I.S. machine only is in operation during 10 years.

Year	Sales Revenue	Production cost	Depreciation	Interest	Profit/(Loss)
1	11306	15143	1400	2356	(7593)
2	13190	14560	1400	1799	(4569)
3	15077	13021	1400	—	(144)
4	15077	13096	1400	—	(219)
5	9093	10230	1550	479	(2374)
6	15077	13096	1550	319	(600)
7	15077	13096	1550	160	(529)
8	15077	13096	1550	—	(369)
9	15077	13096	1550	—	(369)
10	9093	11262	1660	— 537	(3566)

Alternative 2. One I.S. machine during the first 4 years and two I.S. machines from the 5th Year.

Year	Sales Revenue	Production cost	Depreciation	Interest	Profit/(Loss)
1	11306	15143	1400	2356	(7593)
2	13190	14560	1400	1799	(4569)
3	15077	13021	1400	—	(144)
4	15077	13096	1400	—	(219)
5	19730	17575	1670	479	64
6	30151	22916	1670	316	5249
7	30151	22916	1670	160	5405
8	30151	22916	1670	—	5565
9	30151	22916	1670	—	5565
10	19700	17575	1700	537	(104)

Alternative 3. Two I.S. machine in operation from the beginning

Year	Sales Revenue	Production cost	Depreciation	Interest	Profit/(Loss)
1	22613	23243	1670	2254	(4554)
2	26303	23243	1670	1042	(372)
3	30151	24205	1670	121	4155
4	30151	21996	1670	-	6405
5	19700	17575	1700	479	(46)
6	30151	22916	1700	319	5136
7	30151	22916	1700	160	5295
8	30151	22916	1700	-	5455
9	30151	22916	1700	-	5455
10	19700	19363	1900	537	(2012)

The following figures will be obtained if the profit and loss figures are accumulated for the 10 years (\$000)

Year	Alternative 1	Alternative 2	Alternative 3
1	(7593)	(7593)	(4554)
2	(12162)	(12162)	(4926)
3	(12306)	(12306)	(771)
4	(12575)	(12525)	5714
5	(14099)	(12461)	5660
6	(15507)	(7212)	10004
7	(16116)	(1007)	16099
8	(16425)	3750	21554
9	(16054)	9323	27009
10	(20420)	9219	24997

National Cost Benefit

A glass company will give some commercial profitability to its shareholders.

There will also be a national benefit from a glass company.

The volume added to the cost of raw materials, fuels, spare parts and expatriates, is one way of expressing a cost benefit. The value added for the third alternative using two I.S. machines for the ten years is shown below.

Year	Sales Revenue	Depreciation Raw materials, fuels expatriates etc.	Value Added
1	22613	13333	9200
2	26303	13590	12705
3	30151	14174	15977
4	30151	12613	17530
5	19700	10909	0079
6	30151	14994	15157
7	30151	14994	15157
8	30151	14994	15157
9	30151	14994	15157
10	19700	12320	7460

It is seen from this table that the value added expressed in this way gives a national benefit over the 10 years' period of \$132.6 million.

Foreign Currency Requirement

Foreign currency will be required for the import of raw materials (except sand), heavy oil, light oil, spare parts, moulds, decorating screens, expatriates etc.

The annual requirements is approximately G\$ 7 - 0 million, when one I.S. machine is in operation. When two I.S. machines produce glass the annual demand of foreign currency is approximately G\$ 10-13 million.

When the bottling companies import glass containers they have to pay a duty of 30%. In addition there is a consumption tax of 0% on the duty total paid thus a total tax payment of 40.4% on C.I.F. Assuming all bottles produced by two I.S. machines were to be imported, it can then be estimated that the foreign currency paid for the bottles would be equal to 71.2% of the total sales revenue for the glass factory.

The foreign currency required to import bottles can then be compared with the foreign currency necessary for importing raw materials and fuels etc. for producing bottles in Guyana.

The following table gives a very approximate comparison (in G\$000)

Year	Foreign currency for importing bottles	Foreign currency for importing materials, fuels, expatriates etc.
1	16106	11663
2	10791	11920
3	21475	12504
4	21475	10943
5	14094	9129
6	21475	13214
7	21475	12214
8	21475	13214
9	21475	13214
10	14094	10420
Total	191935	119443

The foreign currency saved by producing bottles in Guyana is thus G\$ 72.5 million over the 10 years period.

6. PERSONNEL

Organisation

It is estimated that the glass company when using two I.S. machines will need 244 people. The functions of these people are shown below ...

Function	Number
General Manager	1
Production Manager	1
Finance Manager	1
Sales Manager	1
Personnel Manager	1
Purchasing Manager	1
Office Supervisor	1
Cost Accountant	1
Security Officer	1
Salesmen	3
Office Staff	14
Engineers	0
Supervisors	34
Production Staff	14
Skilled Labours	84
Unskilled labours	70
	<hr/>
	244
	<hr/>

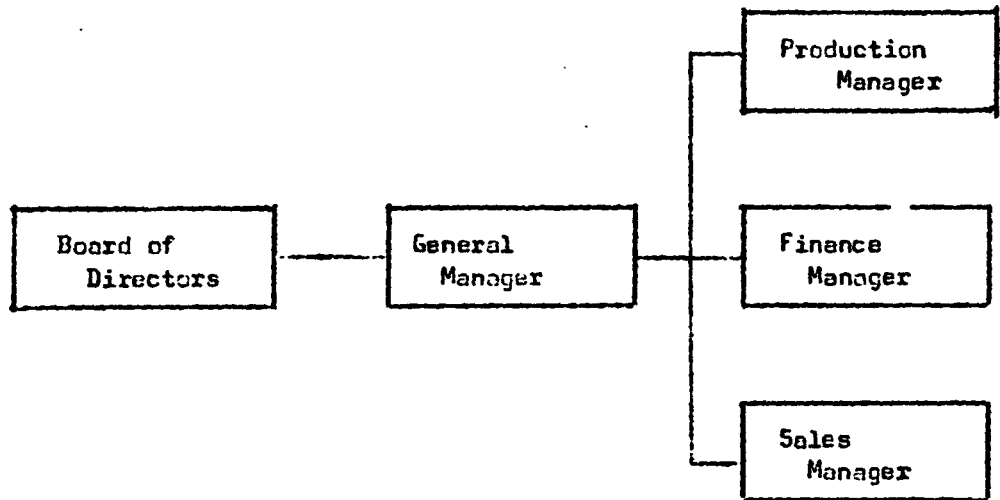
...21...

The production will be based on a three shift basis. The functions in the various production departments are as follows ...

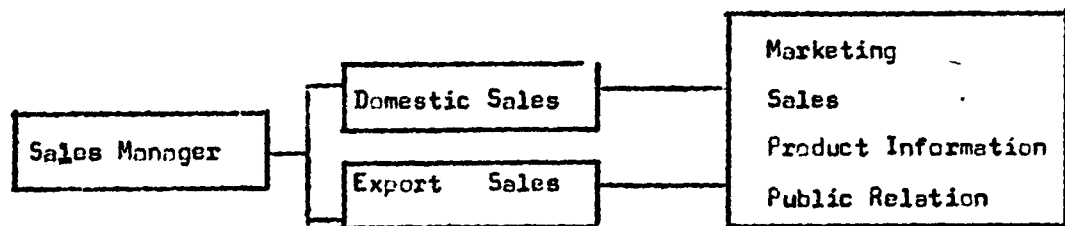
Department	Engineer	Supervisor	Staff	Skilled labour	Un-skilled labour
Raw material		1		2	4
Batch house	1	1		2	4
Furnace	1	1		4	4
Forming dept	1	4	2	0	0
Annealing		1		4	
Inspection	1	4	2	12	0
Packaging		1	1	4	4
Screen Printing	1	2		4	6
Ware House		1	1	2	4
Tech Dept & Quality Control	1	4	0	6	4
Work shops		2		6	4
Maintenance	1	4		6	0
Electric station	1	1		4	4
Fuel Station		1		2	2
Compressor Station		1		2	2
Service Group		1		4	4
Security		4		12	0
Total	0	34	14	04	70

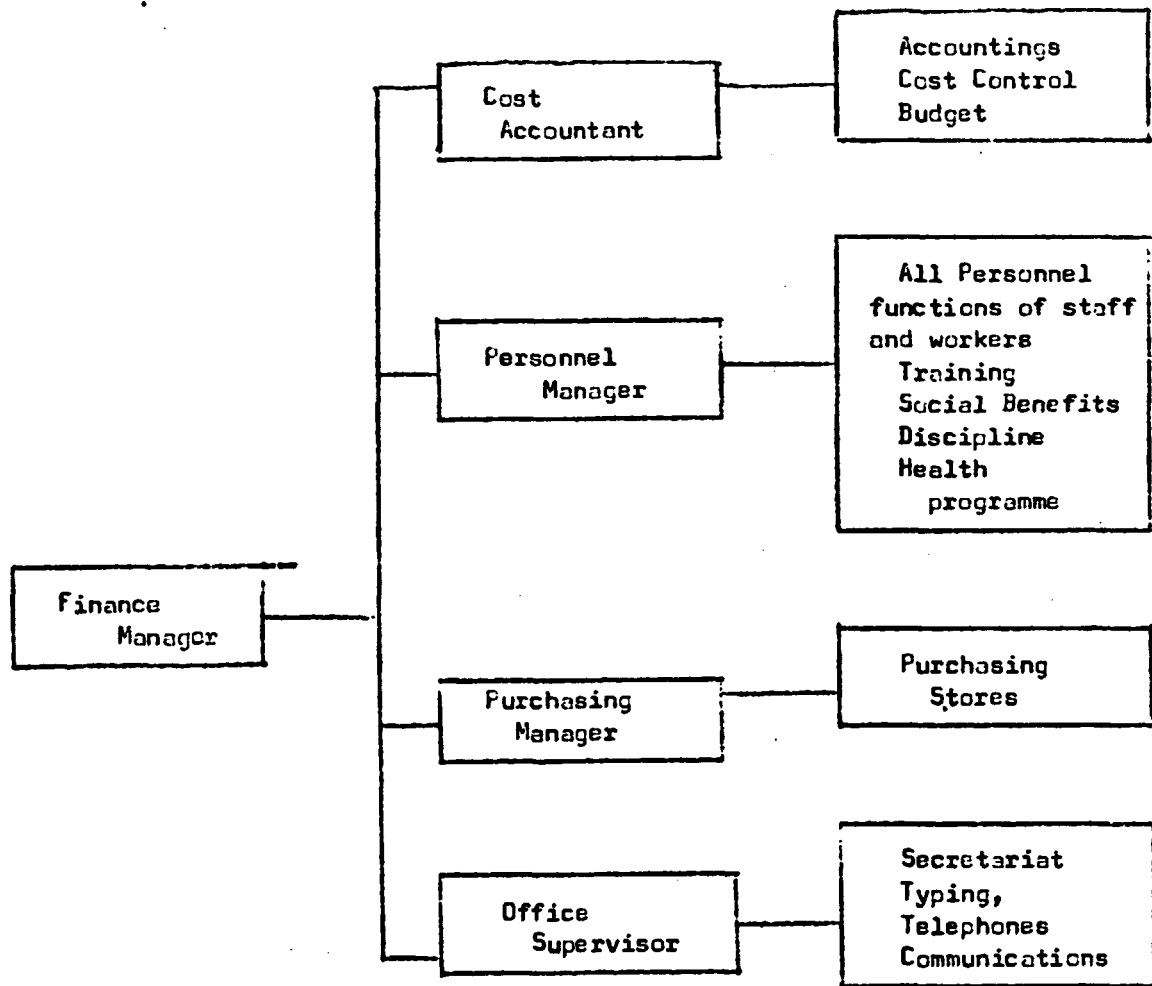
...22...

The following chart is a proposal for an organization of the company ...



Eight engineers report directly to the production manager as is shown on a previous chart.





Training of Personnel

All the personnel has to be trained for their new functions. The key personnel should be employed 1 - 3 months before start of operation.

Since all the equipment is installed in the glass factory, most of the training can be carried out there. A good introductory training can be arranged before the factory starts to produce bottles.

Expatriates must be employed for this training.

It would be an advantage if the production manager and some of the engineers could be sent to a glass container factory for some training before production starts in Guyana Glassworks.

The details of the training programme should be discussed and finalised with a well-qualified glass container company.

7. TECHNICAL ASSISTANCE

It will be necessary for Guyana Glassworks to have an agreement with a well-qualified glass container production or engineering group for the operation of the glass factory. Preferably such an agreement should be in force for at least three years.

Various suitable parties should be invited to visit the glass factories. Their offers for technical assistance should then be evaluated. No further equipment should be purchased for the glass factory before the partner for the technical assistance has been selected. This company should be consulted regarding new equipment. The foreign company may also be interested in supplying part of the equipment.

The foreign company should also be informed about the PBM press and the equipment in the sheet glass plant. Some company may have an interest in acquiring part of this equipment. Such secondary business could make it more interesting for a glass company to sign a contract regarding technical assistance.

...25...

For assistance in starting up the factory with two I.S. machines the following expatriates may be required.

<u>Classification</u>	<u>No.</u>
1. <u>Team Leader</u>	1
2. <u>Raw Materials and batch mixing</u> Foreman	1
Operator	1
3. <u>Furnace Operation</u>	
Engineer	1
Assistant	1
4. <u>Machine Operation</u>	
Foreman	1
Operators	6
5. <u>Annealing</u>	
Operator	1
6. <u>Inspection</u>	
Foreman	1
Inspectors	6
7. <u>Decoration</u>	
Foreman	1
Operators	2
8. <u>Quality control</u>	
Engineer	1
Assistants	2
9. <u>Packaging</u>	
Foreman	1
	• Total 27
	...26...

As soon as domestic people are trained the expatriates should leave. The number of expatriates that have to remain depends on the various technical problems, that have to be solved. This should be stated in the technical agreement.

After the starting up period it may be advisable to keep at least four expatriates in the plant, a production manager, a glass technologist, a machine supervisor and a maintenance engineer.

All details regarding expatriates must of course be discussed with the foreign glass company. It may also be advisable at an early state to offer shares in the Guyana Glassworks to the foreign company.

Suggestions regarding companies that can be contacted regarding technical assistance have been given to the management of the Glass company.

0. RECOMMENDATIONS

The glass container line can be started as soon as the following conditions have been satisfied.

- a) Foreign currency for the import of raw materials, heavy oil, light oil, spare parts, moulds etc. must be available. The appropriate amount for a two machine line is \$11 - 12 million per year.
- b) An agreement regarding technical assistance should be signed with a qualified glass production company. The agreement should cover the first three years of production.

- c) Local people must be employed and trained.
- d) The Glassworks must arrange transportation for all its personnel between Georgetown and Yarowkabra.
- e) Since a careful planning is necessary it is recommended that start of production should not take part within 6 months after a decision to go ahead has been taken.

Main spare parts for one year of operation were included in the agreement with the equipment supplier. Normally this is not satisfactory. It is recommended that there should be spare parts for two years in a new glass factory. A thorough investigation must be done by the foreign company that will give technical assistance to Guyana Glassworks. More spare parts should then be ordered.

Raw materials for six months are available in the plant. New raw materials must be ordered before the production is started in the plant.

Aragonite (limestone) should be used instead of dolomite. Aragonite is cheaper (73) than dolomite. There is thus a saving in foreign exchange and in the cost of the raw materials.

A second I.S. 6 machine should be installed. The best alternative is to install the machine before the start of production. Another convenient time may be during the first furnace repair (after 4 years). One machine will only utilize half of the melting capacity of the furnace. The profitability of the operation will be much improved with two machines. The total price for installing a new I.S. machine is approximately G \$ 3 million.

If it is decided to install a new I.S. Machine from the beginning, then the PBM machine should be removed and offered for sale. Otherwise the PBM machine can be used until the new I.S. machine is installed.

No further work should be done in the sheet glass plant. The equipment can be offered for sale.

Two I.S. machines can just meet the local demand of bottles. It is recommended that later on one of the machines be changed to double gob operation. The total capacity of the machines is then almost equal to that of three I.S. machines. To do this, however, it will be necessary to increase the size of the furnace. This can be done at the first or second main repair of the furnace. Before a change to double gob is carried out, it is important to evaluate the skill of the machine operators.

It may be advisable to have one or two of the consultants from General Glass present for a short while, when the representatives of the new foreign company arrive at the plant.

It is important to have a good maintenance of the plant equipment and material before the production starts. A maintenance engineer (may be part time) could be employed for this or an agreement could be signed with a local company regarding maintenance. This should also include the raw materials. A considerable part of the soda ash is not usable at present. The lumps must be crushed and screened.

The equipment in the plant appears to be satisfactory. It is at present impossible to control if the flow of material and glass products will be satisfactory when production starts. Some indications about defects have been given by the glass consultant to the glass factory engineers.

If so desired the UNIDO glass consultant is prepared to come back for a new short mission - the glass factory in 1982 and for the longer mission in 1983. The time of the visits should coincide with important decisions or change of working conditions in the glass factory.

U-941

