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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

REPORT ON

GLASS INDUSTRY IN MAURITIUS

BY

FINN GJESSING

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We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.

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FINAL REPORT CONCERNING GLASS INDUSTRY IN MAURITIUS

1. Introduction

The final report has not grown so complete as it ought to be. The time has been a little too short, as localising of furnishers and correspondence have taken a disproportionate length of time. (For example, air letters from Madagascar have taken five days, from Western Australia one week and so on). Hence, it has not been possible to verify exactly the values of a lot of the equipment. Figures and data have therefore been based upon a very good local report on the subject, viz. a report from Kemp, Chatteris & Co. (5.6.66), and upon figures from Norwegian glass factories, recalculated for the conditions in Mauritius.

2. Raw Materials

It is very important to have cheap sources of raw materials and shortest way of transport. For the most common articles the main raw materials are: silica sand, soda ash, limestone and if possible dolomite, felspar. Of these materials only limestone, calcium-carbonate, has been found in Mauritius as unconsolidated and consolidated coral sand. All the other materials have to be imported.

2.1 Silica Sand

Pure silica has been found in Mauritius as quarts crystals near the Trachyt in the central area and Grand Port (for instance Chamarel, Piton du Milieu). However, quantitites are small and not sufficient for glass manufacture.

Along the coastal line only a mixture of coral sand, rocky grains and silicious sand has been found, for instance on the southern coast. However, this is not useful as a base material for glass manufacture.

From Europe, for instance Belgium, silica sand will cost around 200 Rs/ton. (The freightage is calculated to 145 Rs/ton). Very expensive.

From Western Australia it is possible to get silica sand through the Readymix Group, P.O. Box 20, Bently, W. Australia 6102. They can offer silica sand with: SiO_2: 99,5%, Al_2O_3: 0.1%, Fe (Fe_2O_3): 0.05%, CaO: 0.01%, Cr_2O_3: nil.

A typical grading of the sand reads:

B.S. sieve	Retained
14	-
25	6%
36	30%
52	42%
72	17%
100	4%

The sand is a bit coarse-grained, but acceptable.

However, the firm can only quote shipments above 2,000 tons in bulk, due to the extremely high costs of loading for smaller shipments. As the freightage from Western Australia to Mauritius will be around 90 Rs/ton, it will mean a high investment in the storage of sand. (The freightage only will amount to 180,000 Rs for a 2,000 tons shipment). Hence, this quotation has been dropped for the time being.

Furnishers in Kenya have been contacted and quotations expected. It concerns: John Heffer (Minerals), P.O. Box 11944, Nairobi and The Export Promotion Council, P.O. Box 3137, Nairobi.

As an indication of the cost of silicious sand from East Africa, it can be mentioned that three glass factories in 1967 paid respectively 25-35 and 55 Rs/ton. As the freightage from East Africa (Mombasa) is around 42 Rs/ton, the price of silicious sand from there seems to be reasonable.

Also China National Chemicals, Tientsin, China, has been asked for a quotation.

In Madagascar there are sources of silica sand but they are not exploited yet.

2.2 Soda ash

From Europe (U.K.) soda ash will cost around 500 Rs/ton, CIF Mauritius. Too expensive.

From China National Chemicals, Tientsin, soda ash is offered at £25.10s. 0d. per ton, CIF Port Louis. (Equals ~ 325 Rs/ton). It is a light soda ash of 98% purity.

The Magadi Soda Ash Company, Magadi Township, Kenya, is asked for a quotation, which is expected in the near future. (490 Rs/ton, CIF, Port Louis).

It seems that soda ash must be taken from Kenya or China.

The soda ash must be packed in plastic bags.

2.3 Lime, Coral Sand

This material is found in sufficient quantities for years to come and the analyses are acceptable. The best quality of coral sand is found at Belle Mare on the east coast of the island. Analyses by C. H. Thomas (Report No. 76 by Mineral Resources Division of Institute of Geological Sciences, (1968), page 12), shows the following: CaO: 52.9% - MgO: 2.7% - CO_2: 43.9% - P_2O_5: 0.06% - SO_3: 0.4% - Al_2O_3, TiO_2, Fe_2O_3: 0.12% - Ac. insol.: 0.04%.

The cost of the sand will be around 8 Rs/ton + transport to factory site 10 Rs/ton. The coral sand has to be dried and ground before use in glass manufacture, Maximum corn grain 0.8 mm (1/32").

2.4 Felspar

John Meffer (Minerals) in Nairobi has been asked for quotation on felspar.

Also The Export Promotion Council, Nairobi, has been contacted (see 2.1).

From Europe the felspar will cost around 300 Rs/ton which is expensive.

Hence, one has to rely upon Kenya. (May be Madagascar later on will be able to furnish felspar, but not exploited at present).

In dark coloured glass it will be possible to use some small amounts of the Trachyt from Chamarel, Piton du Milieu, Mount Lasalle. Analyses of Trachyt from Chamarel made by R. Pickup (Mineral Resources Division report No. 76, page 6) show the following:

SiO_2: 60.14% - Al_2O_3: 19.0% - Fe_2O_3: 2.44% - FeO: 1.94% - MgO: 0.34% - CaO: 0.95% - Na_2O: 7.26% - K_2O: 5.16 - H_2O^+: 1.15 - H_2O^-: 0.68% - CO_2: 0.39% - TiO_2: 0.14 - ZrO_2: 0.13 - P_2O_5: 0.08 - MnO_3: 0.23% -

The costs will be around 12.00 Rs/ton. FOB.

The consumption may be around 50-100 tons/year.

2.5 **Minor raw materials**, Na_2SO_4, $NaNO_3$, $BaCO_3$, As_2O_3 etc. must be imported via Nairobi and a local agency. The agency is asked for quotations.

Estimated consumption 25 to 75 tons/year.

The average cost per ton is estimated at 350 Rs.

2.6 **Bagasse Ash**

For dark coloured glass bagasse ash can be used to a certain degree. However, the analyses seem to vary from area to area and from year to year. The ash also contains a lot of P_2O_5 which can make the glass opalescent. Yet, it can be used in a quantity of up to 5% in the batch, which means around 20-60 tons per year.

Three samples from the years 1956-1965-1968 in Mauritius show the following:

SiO_2: 70.6 - 74.4%; Al_2O_3: 1.3 - 1.6 ; Fe_2O_3: 1.2 - 2.2%;
CaO: 4.3 - 12.0%; MgO: 3.8 - 4.0%; K_2O: 6.5 - 11.4%;
Na_2O: 0.3 - 0.8%; P_2O_5: 2.4 - 3.4%.

The ashes contain some free carbon from the ashing of the sugar canes. The bagasse ash may be delivered at factory site at ~ 18-20 Rs/ton.

3. **Fuels**

Fuel oils are relatively expensive. Light fuel oil (Redwood viscosity: 35-36 sec./100°F) can be delivered at 1.55 Rs/imp. gallon (0.43 Rs/imp. gallon is tax). The oil contains 0.78% Sulphur. Heavy fuel oil (Redwood viscosity: 1,000 sec/100°F) costs 1.20 Rs/imp. gallon. Sulphur content: 2.5 - 3%. A mixture of light and heavy fuel oil (Redwood viscosity: 600 sec/100°F) can be delivered at 1.27 Rs/imp. gallon. A long term contract may admit a discount. The use is foreseen of mixture oil for the furnaces and light fuel oil for the lehrs and kilns.

It might also be necessary to use some Butane gas, which can be delivered in 25 kilos and 12½ kilo cylinders at 2.10 Rs/kg.

4. **Electric Power**

Electric power can be delivered at factory site with 240 or 415 volts. The most convenient today will be 240 volts. The cost to industry: 8.58 Rs/KVA + 7.15 cts/kwh.

5. Packing Materials

Corrugated pasteboard boxes and cartons can be delivered from factories in Mauritius, for instance Mauritius Stationery Manufacturers Ltd. The packing materials seem a bit expensive.

Bottles may be packed in paper bags or wood/plastic boxes, which may be reused.

6. Glass market in Mauritius

A broad spectrum of glass articles is being imported to Mauritius every year, in relative small amounts of each kind. The total consumption is small (only 1/6 per capita compared with Norway), and there is no indication of an increase, even the population augments with around 2% per year. However, this may change with an extended industrialisation and an alteration in the social life.

The tables 1-3 annexed show the import values for the last 4 years, concerning three of the most common glass groups, viz. window glass, bottles and household ware.

As to window glass the yearly consumption is so small that it can be produced on a single Fourcault machine within 3-4 months. Hence a window glass production is not recommended at present. (A window glass plant ought to have at least two Fourcault machines to secure a stable and economic production, as a single machine plant very often effect technical difficulties in the production).

As to bottles and household ware, the domestic consumption of these is also very small and will not justify the erection of a modern, fully automatic glass plant. If cheap sources of raw materials, fuels, power, etc. had been found in Mauritius, then a larger fully automatic plant could have been built, based upon export. However, this is not the case, and hence, the production must be based primarily on the domestic market and only the surplus production on export (packing, freightages and political aspects also taken into view).

One must also bear in mind that glass manufacturing belongs to the heavier chemical industries which require relative high investments and offer a big risk for the invested capital. Markets with high prices on the products and only a slight

competition may give a good profit. On the other side, markets with low prices, strong competition and requirements to good quality, may easily result in loss of capital. Of course there is the possibility of the Government warranting and subsidising the economy, yet, this is not a good solution. (The situation has occurred in Norway where, for example, a big States-owned iron factory has operated with loss for years, and has been subsidised with the equivalent of several million rupees every year - heavily critisised by the Opposition.

As Réunion and Madagascar are positioned not too far from Mauritius the possibility has been favoured of making a larger common market out of those three countries (populations: R. 0.4 mill., Mad: 6.5 mill., Mau: 0.8 mill.). We understand that negotiations are going on but will take a long time to settle.

A difficulty has appeared in the picture. We have brought to mind that a bottle glass factory for 7,000 tonns/year is being built up in Tamatave and is expected to be in operation during 1969. The name of the factory is: Société Verrière de Madagascar, and the principal shareholders are: Société Nationale d'Investissements, and Verrerie de Graville, the last mentioned also furnishing the machines.

The factory intends to produce beer, wine, coca and pepsi cola bottles, and later on also window glass and crystal glass.

As important deposits of silica sand, dolomite and pegmatite are found on the island, they will be in a good position for glass manufacture.

There is also another difficulty. Since the Malagasy factory has got the rights to make coca and pepsi cola bottles, it may be difficult for Mauritius to get the same rights. (A cable has been sent to Coca Cola Exporting Co. in New York asking for claims and specifications for permission to make the bottles in Mauritius, and an answer is expected). If the result is negative, then a bottle glass factory in Mauritius is not recommended, as Coca and Pepsi Cola make a significant deal of the production.

7. Specifications of the market for bottles and household ware in Mauritius

A market investigation was made by an investment officer of the Development Bank in Mauritius in 1966. The conclusion was that a production of 460 tons of bottles and 300 tons of pressed household ware would be possible. These figures have been reviewed once more.

(a) Bottles

Conferences held with the leading industrials, using bottles for beer, soft drinks, Coca - Pepsi Cola, rum and wine show the need for around 600 tons a year. (See table 4 annexed). A further increase may be recognised as the wine producers may need new bottles. They are at present utilising only used bottles which they buy at 3-5 cents, for small and 7-10 cents for full bottles. Due to this buying up of used bottles, there seems to be a shortage in the near future and an import will be necessary. However, as a bottle of wine is very cheap, the producers are interested in only the cheapest bottles.

From table 4 is seen that the market consumption of bottles will be around 1.4 million per year. (Small amounts of other bottles may come into the picture, for instance, milk, flacons, jars, etc. but time has been too short to get these figures fixed. They are not so significant, either).

The 1.4 million bottles refer to:

345 tons white flint bottles at 825 Rs/ton CIF and
275 tons green and amber bottles at 740 Rs/ton CIF

Total 620 tons of a value 485,000 Rs CIF

(b) Pressed household ware

The investment officer of the Development Bank made a survey of the import within three months in 1966, facing orders larger than 500 Rs. Based upon this it was assumed a yearly import of 190 tons of tumblers at a cost of 0.64 Rs/lbs. CIF and 180 tons of other pressed household glassware at a cost of 0.525 Rs/lbs. CIF.

Since the market conditions have not changed very much during the past few years, and compared with similar circumstances in Norway, it has been found advisable to face the following figures:

Tumblers = 2/3 x 190 tons = 125 tons/year
Other glassware = ½ x 180 tons = 90 tons/year

Total: 215 tons/year at a value of 255,000 Rs.

8. Production capacity of a plant

Based upon the consumption figures in chapter 9, the costs of building a factory have been studied, with a yearly production of 835 tons, composed of:

345 tons white flint bottles
275 tons green and amber bottles
125 tons white, flint tumblers
90 tons pressed general household wares

The production is too small for automatic machines and continuous tanks, but production is foreseen using semi-automatic machines and day tanks which require more labour. (See table below).

With 300 working days per year, the following rates of production are found:

White flint glass: 1.88 tons/day = (1.16 tons bottles
(0.72 tumblers etc.

Green and amber glass: 0.92 tons/day bottles etc.

Dispersions of costs by handmade and fully automatic production. (From Sprechsaal 61 (1959)) in percentages

	Raw Material	Fuel	Other Materials	Wages	Social Expenditure	Tax	Amortisation
Handmade	6-8	10-11	5-10	41-43	6-7	4-5	7-9
Fully Automatic	15-16	12-17	8-14	21-30	5	4	7-17

9. Short description of plant

The Town and Country Council has recommended a factory site at Cassis, not far from Port Louis, where all necessary facilities are present. Three acres (12,000 m^2) may be sufficient in the first instance. Nominal rate for the first five years - 10 Rs/year. For the next five years 500 Rs/acre/year.

Raw materials handling

Silica sand is stored in bulk or in bags. Dried and sieved sand is stored in a 15 m^3 silo. Coral sand is stored in bulk. Dried, ground and sieved coral is stored in a 15 m^3 silo. Cullet is crushed and stored in 10 m^3 silos, one for white, another for coloured glass. All the other materials are stored in bags. They are sieved in a vibrating screen, B.S. No.25, before use. The raw materials are weighed, mixed and transported manually in open bins to the furnaces.

Furnace plant

1 day tank, 2-3 tons capacity for white flint.

1 day tank, 1.5-2 tons capacity for coloured glass.

The batch is charged, molten and refined during 16 hours and the glass worked out during 8 hours day-time.

Glass machinery

The following machines are used for production: 3 semi-automatic suction and blow for bottles, 2 rotary presses, 3/4 oil hydraulic, for tumblers, one spring cage, hydraulic operated, for ashtrays, dishes, jugs, bowls etc.

Blown and pressed glass are transferred to a 1.3 x 23 m cooling lehr; after cooling down, inspection and control of the glass. Glass for printing is transferred to a print machine with thermosetting colours and then to kiln, then inspected, packed at both lehr and kiln, then sent to store or sale.

It is calculated with a production effect of 80%.

The glass cullet after gathering, pressing, inspections at lehr and kiln, is then taken back to cullet crusher and stored in silos.

10. Labour

The various grades of labour is shown in the "chapters on plant and manufacturing costs". Generally it will not be difficult to get the various kinds of skilled and unskilled labour in Mauritius. But it may be difficult to get labourers to work at the furnace and glass machines during the warmest season. That problem is very common in other countries too, during summer time.

The following glass workers are categorized skilled labourers: batch mixer, furnace operators, gatherers, pressers, inspectors at lehr.

11. Management

A glass factory in Mauritius will have to rely upon itself in most cases, it concerns glass, chemical and mechanical problems. Hence, a manager must have some knowledge about glass technology, obtained either from experience in a foreign glass factory or through a glass technologist required for starting the factory.

Further, it will be necessary to have a chemical and a mechanical engineer. They can be chosen amongst graduates from the technical or physico/chemical courses at the Kennedy College.

As the college started these courses in 1965 it may take a few years before graduates are available.

12. Starting of the glass production

It is recommended to engage a foreign glass technologist for 6 months to follow up the start of the glass production and train the native management.

Further, it is recommended to have 2 trained operators for six months, training the labourers in handling machines, materials and glass. There are always unexpected difficulties appearing when starting a new glass plant.

13. Plant and manufacturing costs for a small factory of 835 tons per year

From the following Chapters I to IX may be seen the investments and manufacturing costs. (Not all the items are exactly settled and they are given with a margin). That is due to the fact that it has been too short a time to get all values verified. Hence, they have been based partly upon figures in Kemp Chatteris & Co.'s very good report, partly on quotations in 1968 from

H. Putsch, Germany, and partly on figures from similar items in Norway, with conditions in Mauritius taken into view.

It is seen that the total investments will amount to = 1,640,000 Rs plus starting of plant = 210,000 Rs.

The manufacturing costs will exceed the sales values to a large degree, even if the raw material costs are reduced as much as possible.

A plant for 835 tons of bottles and pressed household wares is not recommended.

14. Enlarged plant for 2,500 tons glass per year

If the market consumption could be increased to ~ 2,500 tons per year, the production would be more profitable, yet not good enough to pay interests and profits when raw material costs are high, but better when raw materials may be had at lowest prices. However, it seems necessary to warrantee the economic results by eventual subsidies from the Government.

As seen from the Chapter X on plant and manufacturing costs, the total capital of investments and running-in costs, will amount to around 2,8 mill. Rs.

When using raw materials at high costs, the manufacturing cost will amount to 2,17 mill. Rupees.

The sales values are calculated to 2,22 mill. Rupees. However, if cheaper raw materials may be had, the economic results will be much better, estimated to around + 150,000 Rupees a year.

One may conclude that a plant for 2,500 tons glass is on the balancing point. It may operate fairly satisfactorily, but have to get the economic results warrenteed by the Government.

Economic considerations concerning a small glass factory with semi-automatic machines for bottles and pressed household glassware

I. **Capital investment**

		Rs.
1.	**Buildings**	
1.1	**Raw materials, store, drying, sieving, weighing, mixing:**	
	2,500 sq. ft. x 20 ft. x 20 Rs/sq. ft.	50,000
	+ 3,000 " " x 20 " x 25 " " "	75,000
1.2	**Factory**	
	7,500 sq. ft. x 20 ft. x 25 Rs/sq. ft.	190,000
1.3	**Store for finished wares, packing materials, expedition**	
	3,000 sq. ft. x 20 ft. x 20 Rs/sq. ft.	60,000
1.4	**Workshop, electric power intake, reserve power station**	
	1,500 sq. ft. x 12 ft. x 20 Rs/sq. ft.	30,000
1.5	**Laboratory**	
	600 sq. ft. x 10 ft. x 20 Rs/sq. ft.	12,000
1.6	**Office**	
	2,000 sq. ft. x 10 x 40 Rs/sq. ft.	80,000
1.7	**Canteen, rest rooms**	
	1,200 sq. ft. x 10 x 20 Rs/sq. ft.	24,000
1.8	**Garage**	
	1,000 sq. ft. x 10 x 15 Rs/sq. ft.	15,000
1.9	**Store for refractory materials**	
	600 sq. ft. x 10 ft. x 15 Rs/sq.ft.	9,000
	Total:	545,000
1.10	**Excavations, roadways, fences** (5%)	25,000
	Total:	570,000
1.11	**Architects, consultant engineers** (10%)	60,000
	Total:	630,000

		Rs.
2. General plant equipment		
2.1	Water tank, process water pipings, cooling of process water	18,000
2.2	Oil storage tanks (2 @ 15 m^3), oil pumping, piping, heating	20,000
2.3	Reserve diesel generator, 50 KW	30,000
	Total:	68,000
2.4	Foundations, drainage, inst. (6%)	4,000
	Total:	72,000
3. Transport equipment		
3.1	2 lorries @ 3.5 tons	36,000
3.2	1 private vehicle	12,000
3.3	Small motor truck	14,000
3.4	3 hand-driven trucks	2,000
		64,000
4. Furniture and fixtures		
4.1	Air conditioners in office	5,000
4.2	Kitchen equipment, chairs, tables in canteen	15,000
4.3	Desks and chairs (6)	3,600
4.4	Filing cabinets (4)	1,600
4.5	Typewriters (2)	4,000
4.6	Calculating machines	2,000
4.7	Copying machine	1,000
4.8	Drawing table (for mechanical engineer)	2,000
4.9	Partition walls in stores, cupboards in laboratory, shelves, chairs, fixtures, fittings in buildings not mentioned above.	50,000
	Total:	84,200

		Kgs.
5.	**Production tools and equipment**	
5.1	**Batch plant:**	
5.1.1	Conveyor, 10m l., 0.4m w., variable height, for raw materials piling	10,000
5.1.2	Roller conveyor, 4m l., for unloading lorries	3,000
5.1.3	Rotary dryer, oil-fired for drying silica and coral sand from 5% to 0.1% H_2O (oil consumption: 5 l/ton)	25,000
5.1.4	Ball mill for grinding coral sand	20,000
5.1.5	Vibrating screen for sieving raw materials	6,000
5.1.6	Elevators for ball mill and silo (ca 5m each)	5,000
5.1.7	Cullet crusher with magnetic separator (Putsch)	15,000
5.1.8	Conveyor on top silos (10 m. l.)	8,000
5.1.9	Scale with can for batch materials	10,000
5.1.10	Small scale	2,000
5.1.11	Batch mixer (Putsch)	20,000
5.1.12	Can for batch transport and vehicle	5,000
5.1.13	Silos for dry sand, coral sand, crushed cullet, white and coloured	20,000
5.1.14	Various small equipment	500
5.1.15	Installation costs (5% of 110,000)	5,500
	Total:	155,000
5.2	**Furnace plant equipment**	
5.2.1	2 recuperative oil-fired day-tanks (2-3 tons capacity each)	135,000
5.2.2	Batch feeding by hand-equipment	1,000
5.2.3	Waste gas system	20,000
5.2.4	Oil burners (Hanck Manuf.)	4,000
5.2.5	Air fans	10,000
5.2.6	Temperature indicating instrument with Pt/Pt Rh - thermocouples	4,000
5.2.6	Radiation control pyrometer	1,500
5.2.7	Combustion control	2,000
5.2.8	Cooling fan for tanks	3,000
5.2.9	Kiln for firing refractories	10,000
5.2.10	Carriage, Insurance, Freight	7,000
5.2.11	Installation	8,000
	Total:	205,500

		Rs.
5.3	**Glass machinery plant**	
5.3.1	Oil-fired lehr for up to 10 t/day	90,000
5.3.2	conveyor and stacker (omitted)	-
5.3.3	3 semi-automatic suction and blow bottle machines with cooling arrangements	29,000
5.3.4	Two 3/4 automatic hydraulic operated rotary 4 mould press	80,000
5.3.5	A spring cage 2 col. press with hydraulic operation	11,000
5.3.6	Kiln for heating moulds	5,000
5.3.7	3 sets of moulds for bottles and pressed ware (Coca Cola, Pepsi Cola, 1/1 and 1/2 beers, 1/1 and 1/2 rums, 6-10-20 oz tumblers, trays, jugs)	85,000
5.3.8	Neckring houlders, gathering iron	11,000
5.3.9	Print machine (2000 bottles/hour)	35,000
5.3.10	Kiln for burning print (continuous)	90,000
5.3.11	2 air compressors with tanks, after-coolers ($4\ m^3$/min., 7 atm. each)	50,000
5.3.12	Vacuum pump ($3\ m^3$/min)	10,000
5.3.13	2 handdriven trucks	1,000
5.3.14	Control equipment (Polariscope - weight control + Pressure tester)	4,000
5.3.15	Carriage, Insurance, Freight	5,000
5.3.16	Installation	18,000
	Total:	524,000
5.4	**Laboratory equipment**	
5.4.1	Glass, chemicals, platinum	2,500
5.4.2	Analyse balance	2,000
5.4.3	Diamond saw	4,000
5.4.4	Lab. furnace	1,500
5.4.5	Microscope	3,000
5.4.6	Hood with fan	3,000
5.4.7	Distilled water apparatus	3,000
	Total:	19,000

5.5	Workshop equipment	Rs.
5.5.1	Metal saw	3,000
5.5.2	Big lathe	25,000
5.5.3	Small lathe	15,000
5.5.4	Shaping	10,000
5.5.5	Drill. machine	15,000
5.5.6	Welding equipment	4,000
5.5.7	Various small machines for cleaning, cutting, grinding, drilling etc.	7,000
5.5.8	Hand tools for mechanics	1,000
5.5.9	Hand tools, instruments for electricians	3,000
5.5.10	Installations	3,000
	Total:	86,000

II. Starting Expenses

1.	Glass technologist: ½ year @ Rs 40,000 =	20,000
2.	2 trained operators: ½ year @ Rs 25,000 =	25,000
3.	Travel and stay expenses	50,000
4.	Manufacturing costs in 1½ months	115,000
	Total:	210,000

III. Annual manufacturing expenditures

1. Raw materials

				Rs.
1.1	Silica sand:	635 tons ● 185 Rs/t		118,000
1.2	Soda ash:	220 " " 350 "		77,000
1.3	Coral sand:	173 " " 18 "		3,000
1.4	Felspar:	47 " " 285 "		14,000
1.5	Minor materials:	25 " " 350 "		9,000
			Total:	221,000

2. Fuels

2.1	Oil to furnaces:	450,000 L ● 0.282 Rs/L	=	128,000
2.2	" " lehrs, etc.	108,000 " 0.342 "	=	37,000
2.3	" " dryer:	4,000 " 0.342 "	=	1,500
			Total:	166,500

3. Electric power

3.1	Batch plant:	100 KW
3.2	Furnace plant:	50 "
3.3	Glass plant:	100 "
3.4	Lehr, kilns:	50 "
3.5	Workshop:	25 "
3.6	Lighting, etc.:	50 "
		375 "

Corresponding to 225 KW effective costs:

225 KW ● 8.58 Rs/KW year		2,000
225 KW x 2,400 h x 0.0715 Rs/KWh		39,000
50 KW x 5,000 h x 0.715 "		18,000
	Total:	59,000

4. Water supply

Estimated
10,000 m^3/year @ 0.16 Rs/m^3 = Rs 1,600

5. Various articles of consumption

Lubricants - hand tools - office, workshop, transport supplies, minor renewals Rs 15,000

6. Renewals of moulds

Per year, 5 sets of moulds Rs 10,000

7. Maintenance of tank linings

Per year Rs 5,000

8. Maintenance of factory for the rest

2% of capital costs Rs 35,000

9. Packing materials

Estimated yearly: Rs 40,000

IV. Overhead costs

Audit	13,000
Insurance, workmen's compensation	3,000
Telephone, cable	3,000
Overalls	10,000
Insurance factory	18,000
Pension premium	4,000
Rates	12,000
Rent	3,000

Staff housing		7,000
Fees		3,000
Travels, meetings		3,000
Unforeseen		11,000
	Total:	90,000

V. Labour

1. Direct labour cost

1.1	Watchman		1
1.2	Raw materials handling:		
	Sand drying, milling, sieving:	1	
	Cullet transport, handling	1	
	Batch weighing, mixing (working foreman)	1	
	Transport raw materials and mixed batch	1	
			4
1.3	Furnace plant:		
	Furnace operators		4
1.4	Bottle plant:		
	Gatherers	6	
	Pressers	4	
	Press helpers	3	
	Transfer to lehr	4	
	Controllers, packers at lehr	3	
	Transport to print	1	
	Printer	1	
	Control and packing at print lehr	2	
	Transporters of packing material and packed ware	2	26

1.5	Warehouse, expedition		
	Working foreman	1	
	Workers	3	4
1.6	Transport		
	Lorry drivers	2	
	Lorry assistants	2	
	Motor-truck	1	5
1.7	Laboratory assistant		1
1.8	Masons		2
1.9	Workshop		
	Working foreman	1	
	Mechanics	2	
	Electricians	2	
	Welder (Blacksmith)	1	
	Carpenter	1	
	Mould cleaner	1	8
1.10	Yardmen, gardeners		2
1.11	Cleaners of rooms, canteen, office		4
		Total:	61 workers

Wages			Rs
4 boys (16-18 years)	@ 1,200	Rs/year	5,000
28 unskilled workers	@ 1,700	" "	48,000
27 skilled workers	@ 4,500	" "	120,000
2 working foremen	@ 6,000	" "	12,000
		Total:	185,000

2. Indirect labour costs

	Rs.
Plant manager	40,000
Secretary	7,200
Chemist	18,000
Mech. Engineer	18,000
General foreman (Supervisor)	7,200
Assistant foreman	6,000
Accountant	7,200
Pay clerk	6,000
3 clerks	8,500
Typist	4,200
Salesman	7,200
Messenger	1,700
Total:	131,200

VI. Depreciation fixed costs

			Value Rs	Life Years	Rs per year
I.	1.	Buildings	630,000	20	31,500
	2.	General plant equipment	72,000	15	4,800
	3.	Transport equipment	64,000	5	12,800
	4.	Furniture and fixtures	84,000	10	8,400
	5.	Production tools and equipment:			
		Batch plant	155,000	10	15,500
		Furnaces	135,000	6	22,700
		Furnace plant	70,000	10	7,000
		Glass machines	524,000	10	52,400
		Lab. equipment	19,000	10	1,900
		Workshop	86,000	10	8,600
II.		Starting expenditures	210,000	10	21,000
		Total:	2,049,000	Total :	186,600

VII.		Manufacturing Overheads		Rs.	Approx.
	VI.	Depreciation fixed costs		186,600	187,000
	IV.	Overhead costs			90,000
	V.2	Indirect labour costs		131,200	131,000
			Total	Approx.	408,000

VIII.		Manufacturing Costs			Rs.
	III.1	Direct raw materials			221,000
		Additions for sacking silica sand			8,500
	III.2	Fuels			166,500
	III.3	Electric power			59,000
	III.4	Water supply			1,600
	III.5	Articles of consumption			15,000
	III.6	Renewals of moulds			10,000
	III.7	Maintenance of tank linings			5,000
	III.8	Maintenance of the factory for the rest			35,000
	III.9	Packing materials			40,000
	V.1	Direct labour costs		Approx.	185,000
	VII.	Manufacturing overheads		Approx.	408,000
			Total	Approx.	1,154,600

IX.	Sales per year (620 t bottles, 215 t household ware)	Rs.
	Bottles	485,000
	Tumblers and household ware	255,000
	Total	740,000

X. Glass Plant for a yearly production of around 2,500 tons

Supposing the domestic consumption in Mauritius could be increased to 3 times as much as it is today, we could fancy a plant for around 2,500 tons per year, and the economic situation would be better. This will require some more investments, viz:

Monorail, batch bins and hoist	15,000
2 continuous oil-fired tanks of 5-6 tons each (instead of day tanks)	260,000

3 Roirant B-machines (instead of hand operated machines)	230,000
2 Batch Feeders	40,000
Conveyors from machines to lehr	10,000
Unforeseen	50,000

Investment and depreciation will be:

	Rs.	years	Rs/year
Buildings	630,000	20	31,500
General plant equipment	72,000	15	5,000
Transport equipment	64,000	5	13,000
Furniture and Fixtures	84,000	10	8,400
Batch plant	170,000	10	17,000
Furnaces	260,000	6	43,500
Furnace plant	110,000	10	11,000
Glass machinery	734,000	10	73,400
Lab. Equipment	19,000	10	1,900
Workshop	86,000	10	8,600
Starting expenditure	210,000	10	21,000
Unforeseen	50,000	10	5,000
Total:	2,489,000		239,300

Direct labour

	Unskilled	Skilled	Boys	Working persons
Watchmen	4			
Batch plant	6	1		
Furnace		4		
Roirant machines		3		
Gatherers		9		
Pressers		3		
Transport to lehr			12	
Control, lehr		3		
Packing	6			
Transport print	3			
Printing	3			
Control print		3		
Packing print	3			

Direct labour (continued)

	Unskilled	Skilled	Boys	Working Foremen
Transport packed ware	6			
Warehouse	6			1
Transport lorries	7			
Laboratory		1		
Masons	1	1		
Workshop	2	8		1
Gardeners	3			
Cleaners	4			
Total:	54	36	12	2
Wages	92,000	162,000	15,000	12,000

Total: Rs 281,000

Manufacturing costs	Rs.
Raw materials	686,100
Fuels	427,200
Power	76,300
Water	2,000
Articles of consumption	20,000
Renewals of moulds	35,000
Maintenance tank linings	10,000
" factory	35,000
Packing materials	120,000
Direct labour costs	281,000
Manufacturing overhead costs:	
Indirect labour 115,000	
Depreciation 239,000	
Overhead 90,000	444,000
Total:	2,136,600

Sales will be: 740 x 3 = Rs 2,220,000

At disposal for interests, discounts, allowances, profit etc., will be only neglibible amounts. However, the result is on the plus-side.

Instruments required

	Rs.
Fixed investments	2,279,000
Starting expenditures	210,000
Material supply for 2 months	216,000
Direct labour, 1 month	26,000
Manufacturing overhead, 1 month	35,000
Total:	2,766,000

Import Statistics concerning bottles and household glassware

Table 1: Bottles, flasks, containers, stoppers, closures, blown, pressed, moulded, not otherwise worked (CIF - prices)

COUNTRY	1964		1965		1966		1967	
	No.	Value Rps	No.	Value Rps	No.	Value Rps	No.	Value Rps
U.K.	77,000	27,500	93,078	33,078	154,394	61,705	142,572	39,054
Hong Kong	23,000	22,000	78,300	48,100	39,964	12,014	51,982	32,214
India	288	021	-	-	5,760	550	-	-
Kenya	-	-	431,136	155,360	150,090	57,127	291,152	96,006
Malaysia	275,700	45,300	327,816	35,676	-	-	-	-
Rep. S. Africa	1,363,819	332,577	2,071,596	557,867	655,764	188,212	919,248	266,595
Belgium	300,090	111,004	-	-	-	-	-	-
China	807	1,670	709	1,252	3,265	1,860	12,589	13,509
France	10,617	9,710	3,587	4,713	2,221	1,836	8,053	4,917
Germany (Fed.Rep.)	3,611	5,065	150	350	-	-	4,364	1,629
Holland	4	7	-	-	-	-	-	-
Italy	2	8	-	-	-	-	-	-
Japan	5,520	2,538	1,209	562	-	-	-	-
Thailand	-	-	100	082	-	-	-	-
Australia	-	-	-	-	268	554	4,688	1,500
Singapore	-	-	-	-	400,320	80,874	300,660	30,171
Tanzania	-	-	-	-	-	-	2,850	1,110
Czechoslovakia	-	-	-	-	1,800	1,527	23,216	21,592
Switzerland	-	-	-	-	48	37	-	-
U.S.A.	-	-	-	-	-	-	10	43
Other countries not specified	-	-	-	-	-	-	-	-
TOTAL	2,061,519	557,454	3,007,755	837,079	1,413,844	486,296	1,761,194	508,340

Table 2

Glass tableware and other articles of glass for household, hotel and restaurant use (except mirrors and looking glasses) (CIF -prices)

COUNTRY	1964	1965	1966	1967
	Value, Rps	Value, Rps	Value, Rps	Value, Rps
U.K.	168,548	110,703	109,630	76,817
Australia	10,810	4,276	7,377	14,277
Malaysia	117,673	195,660	-	-
China	47,658	128,697	116,289	126,185
Czechoslovakia	28,170	31,208	18,030	26,877
France	118,794	126,530	91,858	55,271
W. Germany	9,977	38,122	9,857	6,692
Italy	16,142	3,270	3,028	8,076
Japan	32,379	21,343	13,177	10,235
Norway	54	366	-	-
Poland	6,271	2,765	5,500	-
Sweden	45,260	5,355	4,735	3,514
Switzerland	974	2,003	1,484	82
U.S.A.	1,727	094	635	298
Eire	-	-	-	2,776
Hong Kong	-	-	867	725
India	-	-	75	-
Rep. S. Africa	-	-	13,263	115
Singapore	-	-	253,604	92,513
Austria	-	-	6,126	-
Belgium	-	-	2,536	8
Denmark	-	-	097	077
Finland	-	-	1,771	-
Holland	-	-	1,207	589
Israel	-	-	-	163
Madagascar	-	-	10	-
Spain	-	-	11	-
TOTAL	579,916	693,327	660,367	424,400

Table 3

Window Glass

Country	1964		1965		1966		1967	
	m^2	Values Rs	m^2	Values Rs	m^2	Values Rs	m^2	Values Rs
U.K.					9,435	44,079	4,769	43,928
Australia					-	-	2,931	31,945
South Africa					200	7,225	-	-
Belgium					3,353	47,149	3,612	38,843
Czechoslovakia					75 855	200,782	43,246	130,925
France					9,451	51,843	1,929	29,619
Germany W.					-	-	429	3,016
Holland					-	-	564	1,270
Japan					6,431	38,382	51,557	207,676
Spain					-	-	3,359	8,819
Switzerland					892	1,637	-	-
TOTAL	171 029	607 851	181 689	788,469	108,202	391,097	112,396	504,041

Table 4

Estimated yearly consumption of bottles in Mauritius according to conferences with larger consumers

Types of bottles	Colour	Weight per bottle grams	Cost (CIF) per bottle	Numbers per year	Total weight (kilos)	Conference with:
24-oz beer (print)	Amber	504	45 cts	250,000	135,000	P.A. Hugnin Manager of Mauritius Breweries
12-oz beer	"	337	21-22 cts	250,000	85,000	
26-oz Coca Cola (print)	White Flint	800	68 cts	86,000	69,000	
10-oz Coca Cola (print)	"	425	35 cts	200,000	85,000	
6½-oz Regular	"	385	33 cts	150,000	61,000	
8 oz Fanta	"	388	33 cts	72,000	28,000	
Sprite	Green	430	?	72,000	31,000	
Soda, Tonic, Ginger Ale	White Flint	400	?	20,000	8,000	
Pepsi Cola big size (print)	White Flint	425	28 cts	144,000	61,000	H.J. Currimjee General Manager of Pepsi Cola, etc.
Small soda	"	300	?	14,400	4,300	
Big soda	"	450	?	14,400	6,500	
Brandy (print)	"	550	65 cts	33,000	18,000	M.Merven Manager of New Goodwill Co. Ltd.
Pint	"	500	?	3,600	1,800	
Soda, Limonade	"	400	?	4,000	1,600	

Table 4 (cont.)

Wine, 24 cs	Amber	500	17 cts	20,000	10,000	N. Oxenham
Wine, 12 cs	"	335	?	40,000	13,500	tech. man of E. Oxenham wine
Totally per year:				1,381,400	618,700	

The consumption represents a cif-value of 485 000 Rps

(Conference is also had with tech. man of Lai Wan Chut Wine Company. They utilize only used bottles at 7 cts).

GLASS MANUFACTURE IN MAURITIUS

Summary and Conclusions

1. RAW MATERIALS

The only raw material found in Mauritius, usable for all kinds of glassware, is coral sand, particularly from Belle Mare on the east coast. It contains mainly $CaCO_3$ and some smaller amounts of $MgCO_3$. It costs around 20 Rs/ton, delivered factory site near Port Louis.

Bagasse Ash and some of the Trachytes may be usable for dark coloured glass, but only to a small extent. Prices will be around the same as for coral sand.

Silica Sand has to be imported from Kenya Glass Works Ltd., P.O. Box 180, Mombasa. Price not yet fixed. (May be - 100 Rs/ton CIF). Later on silica sand might be imported from Madagascar when deposits there are exploited. From Europe and W. Australia the sand will be too expensive.

Soda Ash might be imported from China National Chemicals, Tientsin, at a cost of - 325 Rs/ton CIF Port Louis. Quality: "Light, 98 per cent". Magadi soda ash from Kenya and European soda ash are more expensive.

Felspar might be imported from John Heffer (Mining) Ltd., P.O. Box 11944, Nairobi. Price not fixed, but it ought to be cheaper than from Europe.

Later on felspar might be had from Madagascar when the deposits are exploited.

Other chemicals, sulphate, saltpetre etc., must be imported via a local agency from Europe or China, but only in smaller amounts.

Mauritius is therefore in a bad situation due to shortage of main materials for glass manufacture.

2. FUELS AND POWER

These are somewhat expensive

3. GLASS MARKET

The glass market in Mauritius is very small, and it does not seem to increase either. Window glass production is not realisable. One Fourcault machine will produce the yearly domestic consumption within 3-4 months. Bottles and pressed

household ware might be realisable on semi-automatic machines. However, the estimated consumption of 835 tons/year is too small for an economic production.

A consumption of 2,500 tons/year would make the economy of a semi-automatic plant more balancing, particularly if cheapest raw materials are used. However, the economy of the plant must be warranted by the Government, eventually by subsidies.

4. A larger common market of Mauritius, Réunion and Madagascar has been fancied. However, negotiations will take time. Further, it has been brought to our mind that a bottle glass factory for 7,000 tons/year is being built at Tamatave and will start production in 1969. If this works satisfactorily, an export to Madagascar from Mauritius will be impossible. May be, this will also prevent a factory from being built in Mauritius.

5. It seems that the only possible way of having a glass production in Mauritius, will be to build a small handicraft shop, making glass souvenirs, ashtrays, vases, etc. with engravures. A private person, Mr. Marcel Lagesse, the owner of a mirror glass factory in Moka, is very much interested in this matter.

It will need the teaching of some skilled youth in gathering and glass blowing and they have to study this somewhere in Europe.

Some equipment will also be needed here: small pot furnace, pyrometer, cooling kiln, a press with moulds, gathering and blowing equipment and a small batch mixer. The investments will be small. The profit will depend upon the design and quality of the products.

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