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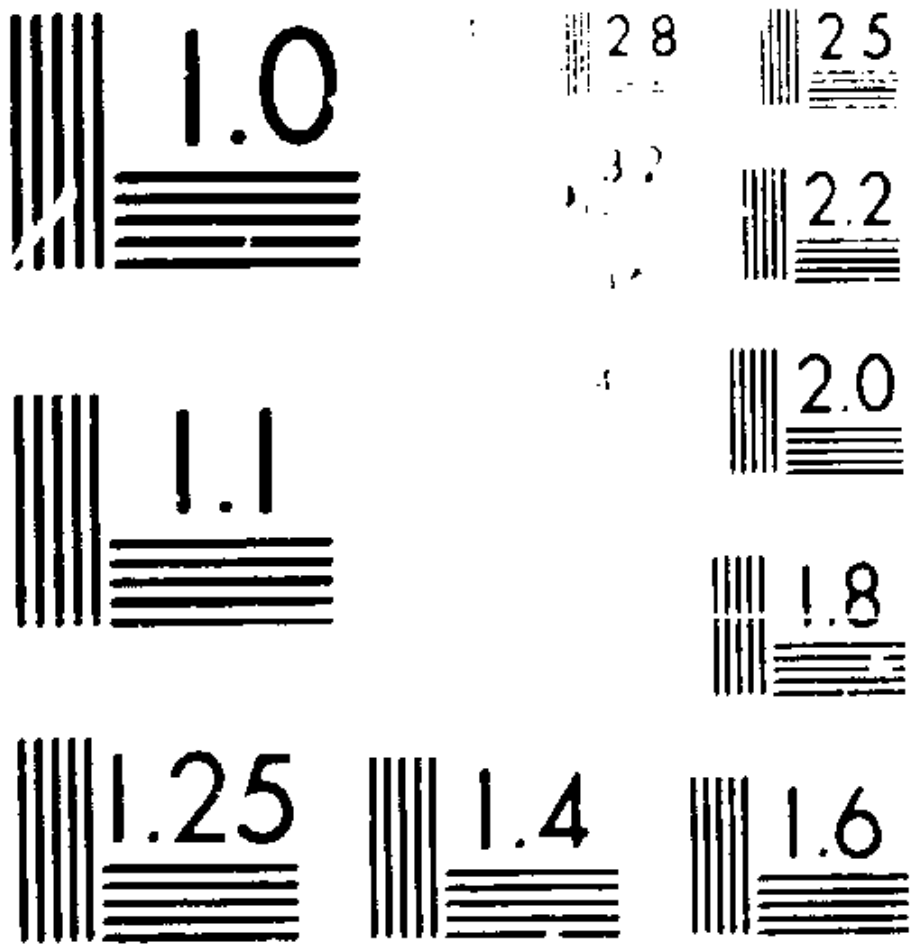
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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

10523

YEMEN ARAB REPUBLIC

FEASIBILITY STUDY FOR A HOLLOW GLASS MANUFACTURING PROJECT*

WORLD BANK/UNIDO
CO-OPERATIVE PROGRAMME

REPORT No. 15
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PREFACE

The attached study is one in a series on the construction industry in the Yemen Arab Republic carried out by the World Bank/ UNIDO Co-operative Programe beginning in 1979 with a general survey of construction materials. The basis for this study is a pre-feasibility report and market study prepared by consultant Lennart Königson following a field mission in July 1980. The original report was revised by the consultant in February 1981. After review within UNIDO, the document was further revised and edited by Mr. Edward Espenhahn in the offices of the World Bank/UNIDO Co-operative Programme.

The observations and opinions expressed in this report are those of the authors and do not necessarily reflect those of either UNIDO or the World Bank Group.

CURRENCY EQUIVALENTS

Currency Unit:	Yemeni Rial (YR) 1 YR = 100 Fils
Currency Equivalent[1/]:	1 YR = US$ 0.22 US$ 1= YR 4.5

ABBREVIATIONS

CP	- World Bank/UNIDO Co-operative Programme
IBY	- Industrial Bank of Yemen
LTL	- Long Term Loan
Tons	- Tonnes (metric)
YAR	- Yemen Arab Republic

1/ Official rate of exchange since February 1973.

SUMMARY

The rapid economic growth of the Yemen Arab Republic (YAR) during the past decade supported the introduction of a number of modern manufacturing plants producing consumer goods and building materials. Beverage production increased considerably and imports of bottles rose accordingly, creating a market for a small glass bottle plant. A World Bank/UNIDO Co-operative Programme (CP) survey of the building materials industry in the Yemen Arab Republic in 1979 revealed the presence of an extensive silica sand deposit on the outskirts of the capital, Sanaa. Samples of the sand were investigated by the Mining University, Leoben, Austria and found to have outstanding chemical and physical properties for container and sheet glass manufacture, and these findings were confirmed by glass making trials with the sand in Europe. The CP is commissioning a more detailed investigation of the deposit to determine the chemical and physical properties and quantity of the material over a wider area. Limestone already used by the cement industry, and feldspar are also available in the YAR.

A consultant, appointed by the CP to examine the feasibility of manufacturing hollow and other glass products, visited the YAR in July 1980, to investigate the local market for bottles, construction costs and the availability of manpower, materials and other inputs. A preliminary report prepared by the consultant in October 1980 and subsequently revised in February 1981 indicated that there was an opportunity for a glass container manufacturing facility mainly to supply bottles to the fast-growing soft drink industry in the YAR. There are also outlets for milk, vegetable oil and other bottles, and for domestic glassware which the factory could supply at a later date. The following report presents the plant, machinery, building and installation costs in some detail. The sales market data are more limited as national production and import statistics have only recently begun to record the data needed to supplement the information from the beverage producers. A prospective investor will need to conduct a more thorough survey of the beverage firms' past and future production plans and of bottle quantities, types, specifications and costs.

The present report is based on one size of bottle which is widely used by the beverage firms. It will eventually be necessary to make provision for a wider range of bottle sizes and types. The standard bottle weighing 0.43 kg with a content of only 0.25 litres has a relatively heavy net weight-to-contents ratio compared with the returnable bottles normally used by Coca Cola, Pepsi Cola and Canada Dry bottlers in other countries. The proposed market survey should investigate the possibility of introducing lighter bottles which would be cheaper to produce.

The proposed factory location near the sand deposit has access to a high tension power line on the Sanaa supply system. The installed load of 910 kW and average load of 550 kW represents an appreciable proportion of the city's present generating capacity, and adequate power may not be continuously available until the new thermal power station and connecting power line from the coast are completed. Power costs, which are high at present, may then be reduced because fuel oil is available at a relatively low price from friendly neighbouring countries. The glass melting operation, a major user of energy, would also benefit from the low price of fuel oil.

The project is equipped to produce 14,550 tons of containers a year, or 34 million standard-size bottles, with a work force of 164 employees. The investment cost is estimated at YR 75 million (US$ 16.7 million equivalent) in 1981, the base year for the financial projections. The cost per employee is approximately YR 457,000 (US$ 102,000 equivalent).

Customs duty on imported bottles is only 15 percent at present, and it is assumed in this study that Government will grant the project a rather larger, but still modest, degree of protection amounting to 25 per cent of the cif import value during the first five years of operation. This corresponds to an ex-works sales price of YR 1.20 per bottle (US$ 620 per ton) during the first five years, after which the sales price could revert to YR 1.10 per bottle which is the estimated cost of imported bottles in 1981.

The projected financial internal rate of return is 14.5 per cent with an economic rate of return of 10.8 per cent. Introduction of a lighter bottle would increase the rates of return, which at a bottle weight of 0.34kg would be 16.2 and 12.0 per cent respectively. These rates do not take into account the at-present unquantifiable savings which will be made in pre-payments and stocks due to the long import route and port delays, which will be obviated when the factory can deliver bottles direct to the trade. The pay back period is about 6.5 years to recover total capital expenditure on the project.

The project should provide a discounted rate of return of 15 percent after tax to the shareholders as shown in the suggested financing plan. The plan comprises share capital of YR 30 million (US$ 6.7 million equivalent) and suppliers credits and long-term loans of YR 45 million (US$ 10.0 million equivalent) at prevailing rates of interest.

Assuming the loans and 20 per cent of the equity were provided from external sources, the YAR would still need to provide an estimated YR 4.8 million is foreign exchange during the construction period. Net foreign exchange savings from project operations would average about YR 3.4 million per annum during the first five years, YR 6.1 million during years 6 to 10, and would thereafter increase to YR 12 million after completion of the loan repayments.

I. PROJECT CONCEPT

General

1. The project is for the production of glass containers to satisfy local demand primarily with respect to soft drink bottles and possibly milk bottles. A survey has identified the presence of potentially suitable silica sand at several locations in the Yemen Arab Republic. One such deposit is situated near the capital, Sanaa, and its location is such that a glass plant could be erected in its immediate vicinity and be serviced by roads, power, water and sewerage. The properties of the silica sand deposit were investigated at the Institute for Applied Mineralogy of the Mining University, Leoben, Austria, and this is the subject of a separate report.

2. The project has an annual capacity of 14,550 tons of bottles per year, which would be adequate for satisfying the YAR's estimated annual demand for soft drink and milk glass containers.

3. This study estimates the project to require total outlays of YR 75 million ($16.7 million equivalent) prior to start of commercial operations and is expected to yield a discounted internal rate of return of 14.5 per cent.

4. The Glass Forming process assumed to be applied is the so-called blow-blow method in which the molten glass (gob) is formed by two consecutive air insertion (blow) sequences in, firstly, a plunger mechanism which forms the container's neck and, secondly, a counterblow mechanism where the container's body and bottom plate are formed with a vacuum-assisted system. This method is versatile and well-suited for a large number of differently shaped hollow containers. The other processes are standard and traditional for the glass industry.

Raw Material

5. The plant would require the following raw materials:

Sand

Soda ash

Limestone

Feldspar

Sodium sulphate

Coloring and other additives

of which the sand would account for 57.7 percent of total raw material weight followed by soda ash, 18.5 percent, lime 15 percent and feldspar 8 percent. As sand, lime and feldspar exist locally, imported raw materials should amount by weight to only 19 percent of total requirements.

6. Limestone could be quarried at a cement plant near Hodeidah and may also exist at other locations. Feldspar exists at several deposits spread throughout the mountainous area but has hitherto not been exploited due to lack of demand.

7. The sodium sulphate and other components are additives needed to color the glass. It has, for this purpose, been assumed that primarily green bottles would be produced. Additionally the plant would need to import packaging material, molds, lubricants and spare parts.

Capacity and Volume of Production

8. The plant is assumed to have a continuous glass melting furnace with an inner melting area of 28 m^2 and a maximum daily melting capacity of 52 tons. Such furnaces are available from several manufacturers. The furnace could produce clear and colored glass in different batches. The glass making section would be equipped with an 8 section blow-blow machine with double gob feeder. It is assumed that the plant would operate continuously 24 hours per day (4 shifts and 7 days per week) and that the average number of working days per year would be 330 with the remaining period being used for maintenance. In addition, furnace relining would need to be done approximately every fifth year.

9. Calculation of annual production is based on the assumption that soft drink bottles with a content of 0.25 litres and a glass weight of 430 grams would be produced as this is the standard size container in the YAR.

10. The equipment would have a rated capacity of 82 bottles per minute corresponding to a gross daily production of 118,080 bottles or 50.8 tons. This would, on an annual basis, correspond to 39.0 million bottles weighing a total of 16,760 tons. It is assumed that 75 percent of rated capacity would be reached after two years of operation, at which time the plant would produce 12,850 tons of glass containers. Maximum attainable capacity utilization has been set at 85 percent of rated capacity to account for defective products, power failures, changes in product mix (colors of glass), etc.

Power and Utilities

11. The total rated electrical power consumption is estimated at 910 kW. With an average utilization rate of 60 percent in each shift, the power load during 330 working days would amount to 550 kW. During downtime, power consumption would decrease to approximately 275 kW, and the annual total consumption would amount to approximately 4,590,000 kWh. An 11 kV line passes the area of the proposed site. It has been assumed that power from this source could be used and that

the electric power company would install an 11 kV/600 V transformer station at the site of the plant.

12. Heating of the furnaces could be either by electricity or by oil. As Yemen's electrical power is generated by oil the latter alternative would likely prove most economical. This study therefore assumes that the furnaces would be oil fired.

13. A melting volume of 52 tons per day would, for the proposed regenerative U-flame unit melter with recuperators, require 1,584 kcal per 1 kg of glass. As heavy fuel oil contains 9,600 kcal/kg, the required volume of oil would be 0.165 kg per kg of glass, corresponding to approximately 3,100 tons of heavy fuel oil per year.

14. Light fuel oil would be used for the annealing system, forehearth and sand drying drum. The forehearth could also be gasfired, but this is likely to be less economical in the YAR. Annealing systems for this size plant are similarly produced for electric, oil or gas heating.

15. The estimated consumption of light fuel oil is approximately 300 tons per year calculated as follows:

Annealing system	18 l/hr =	146	ton/yr
Forehearth	15 l/hr =	120	ton/yr
Dryer	10 l/hr =	25	ton/yr (one shift)
Mold pre-heater	12 l/hr =	9	ton/yr (30 days)
Total		300	ton/yr

Additional fuel would be required for the gob feeder which should preferably be gas fired. An average volume of 30 kg propane would be needed per hour. This would correspond to some 263 tons per year.

16. Water requirements for washing and for sanitary purposes have been conservatively estimated at approximately 8 m^3 per ton of glass, or 12.5 m^3/hour, which would correspond to an annual water consumption of approximately 100,000 m^3. Water in the area of the glass sand is drawn from ground water acquifers which are also used for agricultural purposes on adjacent sites. As most of the water would be used for washing, recirculating systems would be possible. A more detailed survey of water availability and cost would be needed, however, in order to determine the feasibility of such installations. This study does not make provision for a recirculation system.

Staffing

17. The staff has been divided into three categories:

Administrative staff

Technical management and supervisory staff

Production personnel

18. As production would be carried out 24 hours per day and 7 days per week, it has been assumed that the production personnel would work in four shifts, the personnel for raw material preparation in two shifts, and others in one shift.

19. In summary, staff requirements would be as follows:

Administrative staff	15
Technical management and supervisory staff	11
Production personnel	138
Total	164

Allocation of production personnel by departments is at Annex 4.

II. THE MARKET

General

20. Available import statistics suggest that the YAR's glass container imports consist primarily of soft drink bottles, of which an estimated 17.5 million were imported in 1979. Another important category of imports in that year was tableware glass, the volume of which has been estimated at some 2,000 tons. In the future there may, in addition, develop a demand for milk and other foodstuff glass containers and, to a lesser extent, a demand for non-returnable bottles.

Soft Drink Bottles

21. The projected demand for soft drink bottles would be in the form of additions to stock as soft drink sales grow and in the form of replacements. The bottling industry in the YAR is not allowed to use non-returnable bottles. The survey of the soft drink industry in the YAR suggests that bottling capacity is likely to double within approximately one and one-half years if the industry can realize its present plans for expansion. In the estimate of future soft drink sales it was assumed that the rate of expansion would be slower than envisaged by industry representatives but that it would reach an average of 25 per cent in the coming years. On this basis, and with the application of normal industry ratios for glass bottle inventory and replacements, an average annual demand of approximately 10,000 tons is estimated for the period 1981-1988, as outlined in the Market Analysis at Annex 3.

Milk Bottles

22. Bottles for milk distribution are estimated to account for an annual demand of approximately 1,200 tons during the period 1982 to 1988. This assessment is based on the assumption that the existing dairy project as well as the new project will, contrary to present practice, use glass containers for distribution. If this switch from paper to glass containers takes place, and it is being advocated by the Government and by the Industrial Bank of Yemen, the above estimate of demand may prove to be conservative.

Other Returnable Bottles

23. Such bottles could be used by the mineral water bottling company and by cooking oil producers, both of which, at present, use plastic containers. The producers may well resist a switch to returnable glass bottles on account of higher costs, but environmental concerns with respect to disposal of plastic containers are considerable and would likely result in the Government exerting pressure on the producers when local glass production comes into being. The annual demand for such glass containers is estimated at approximately 2,000 tons in the latter part of the 1980's.

Non-returnable Containers

24. Although there is a ban on the use of non-returnable containers for the food industry in the YAR, demand may develop for certain potential export products. Fruit juices, and in particular grape juices for which there is a large market in neighboring Saudi Arabia, could be one such product. To account for this possibility, the demand projections include some 500 to 800 tons of non-returnable containers.

Tableware and Household Glass

25. This category is impossible to estimate with any measure of reliability. There is only data for one year's imports, and with this as a starting point consumption is projected to grow to approximately 2,500 tons in 1988. This corresponds to some 2kg glass consumption per family and year and would include, apart from tableware, also various kitchen glass utensils and containers.

Other Glass Products

26. This category covers vases, lamps, ornamental blown glass, ash trays etc., which on the basis of 1979 import data accounted for approximately 500 tons. This volume of demand is assumed to remain relatively unchanged for the projected period.

Projected Hollow Glass Demand

27. The table below shows the projected annual demand for glass for the period 1981-1988 by different users.

Summary of Potential Demand for Hollow Glass
(tons)

	1981	1982	1983	1984	1985	1986	1987	1988
Soft drink bottles	8,800	9,700	10,200	10,500	10,100	10,300	10,200	9,700
Milk bottles	-	2,600	900	1,000	1,100	1,200	1,300	1,500
Other returnable bottles	-	-	-	1,700	1,800	1,900	2,000	2,100
Other non-returnable containers	-	-	300	400	500	600	700	800
Tableware and household glass	2,000	2,100	2,200	2,300	2,400	2,500	2,500	2,500
Misc. other glass	400	450	500	500	500	500	500	500
	11,200	14,850	14,100	16,400	16,400	17,000	17,200	17,100

Projected Glass Bottle Price

28. The analysis of import statistics contained in the Appendix suggests that the cost of imported glass bottles is approximately YR 1,800 - 2,000/ton landed. Information obtained from bottlers indicates that the cost of bottles delivered Sanaa ranged between YR 0.98 and YR 1.03 per bottle.

29. As one ton of glass contains 2,325 bottles of 0.43 kg weight the average landed price in 1979-1980 per bottle would be YR 0.78 to which should be added customs duty of 15 percent and transport estimated at around YR 0.10 per bottle or YR 230 (approx. US $50 equivalent) per ton. The delivered cost in Sanaa would thus correspond to approximately YR 1.00 which compares well with the data provided by bottlers.

30. The projected cost of bottles in 1981, the base year of this study, is YR 1.10 an increase of ten percent over 1980. However, this price includes an import tariff of only 15 percent of the cif cost which is considered to be a very low level of protection on a new industry of this type in a develo-

ping country. It is assumed that a modest increase in protection will be granted by Government corresponding to an import duty of 25 percent and a price of YR 1.20 delivered Sanaa as follows:

Estimated Cost of Imports

	1981	At start of Operations
Cost per bottle YR		
Cif price	0.83	0.84
Import duty 15%	.12	
" " (assumed) 25%		.21
	.95	1.05
Port and clearing charges	.05	.05
Landed cost	1.00	1.10
Transport to Sanaa	.10	.10
Delivered Sanaa per bottle	1.10	1.20
YR per ton	2,558	2,790
US $ per ton (equivalent)	568	620

31. The project income and cash flow projections are based on the price of YR 1.20 per bottle during the first five years of operation when the project is building up production and bearing relatively high interest charges. From year six onwards the project is expected to yield a reasonable return at the lower existing import duty and level of protection, and the sales revenue and cash flow projections are based on the lower price of YR 1.10 per bottle.

Summary of Findings

32. The market survey concluded that total hollow glass demand in Yemen would approximate 15,000 tons per year in 1983-1984, which would be the earliest possible time that a glass bottle plant could be in production. Bottles would account for 80 per cent of the market or roughtly 12,000 tons/year. As this period would likely coincide with the start-up of several new bottling plants and be followed by some years with substantial or possibly oversupply of bottling facilities, growth of demand during the latter part of the 1980's could be expected to be modest but sustained. It is expected that demand for

glass bottles would have reached a level of some 14,000 tons/ year towards the end of the 1980's. The conclusion is thus that the market for glass bottles from 1983 onwards should be sufficient to support a plant with an annual capacity of 13,000 tons/year.

33. Other hollow glass products, which require a slightly different process for manufacturing, would account for some 3,000 to 4,000 tons of annual demand. The basis for estimating this level of demand is, however, highly uncertain. At this stage it therefore seems advisable to proceed only with a glass bottle plant and postpone any investment in other glass-forming equipment until such time as the market can be more accurately assessed.

III. PROJECT COST ESTIMATE

Buildings

34. Total covered area of the three buildings: factory, workshop and office would be approximately 5,800 m^2 to which should be added a basement area of 850 m^2. It has been assumed that the factory building and the workshop would be steel structures with light-weight beams and corrugated or similar steel walls and roofs. No provision has been made for insulation which is unlikely to be required given the climate in Sanaa. The office has been assumed to be a traditional stone masonry structure. Layout of the site and principal factory section drawings are attached as Annex 17.

35. Estimated costs of the buildings, including land preparation and fencing as detailed in Annex 5 are:

	YR'000	US$ '000 equivalent
Factory and workshop	8,960	1,990
Office	260	145
Services	280	65
Total building cost	9,900	2,200

Equipment

36. The equipment for which prices have been estimated includes equipment for raw material handling, furnace, glass making, treatment, inspection and packaging as well as miscellaneous auxiliary equipment.

37. The cost estimate is based on manufacturers' quoted ex-factory prices in mid-1980. Only a limited number of suppliers have been contacted and, although the estimated cost is likely to prove realistic, price information from a wider range of suppliers may suggest a need for revisions.

Equipment Cost Estimate

	YR'000	US$ '000 equivalent
Batch plant for receiving, storing, conveying, mixing and weighing of sand, soda ash, lime and crushed glass.	4,800	1,067
Heavy oil fired furnace 1x4 m for continuous batch melting including batch charger	2,000	444
Furnace recuperator including high temp. burners, piping, insulation, flues, etc.	1,000	222
Forehearth, gob feeder and bottle forming machine with 8 stations	5,100	1,133

	YR'000	US$ '000 equivalent
Annealing system	650	145
Inspection line including vibrating transfer plate, single liner, precision inspection conveyor, visual inspection station, pre-selector, bore and leak inspector and flow and jam detector	750	167
Shrink film packaging unit	300	67
Palletizer	200	44
Fork lift	50	11
Maintenance workshop equipment	1,300	289
Laboratory equipment	350	78
Sub-total production equipment	16,500	3,667
Compressed air, storage and distribution of gas and oil, distribution of water	5,000	1,111
Electrical installation including transformer station and reserve diesel electric power unit	2,400	533
Sub-total auxiliary equipment	7,400	1,644
Excavators	500	110
Dumptrucks	300	67
Delivery vans	125	28
Cars	125	28
Sub-total vehicles	1,050	233
Office equipment	125	28
Telephones and switchboard	25	6
Furniture and furnishings	100	22
Sub-total office and other equipment	250	56
Total estimated cost of equipment	25,200	5,600

Note: No provision is made for printing equipment, which can be added at a later stage when printed beverage bottles are required in the local market.

Other Costs

38. Other costs consist of packing and transport, erection and engineering services.

Other Cost Estimate

	YR '000	US$ '000 equivalent
Export packaging	400	90
Freight and insurance	1,950	435
Local handling and inland transport	675	150
Erection cost	2,150	475
Detailed engineering: process	2,700	600
Detailed engineering: civil	825	180
Total estimated other costs	8,700	1,930

39. The above estimated other costs are based on percentage rates and should be validated on the basis of weights and volumes of goods to be shipped in the case of transport and similar charges. The erection cost estimate is an assessment of manpower requirements which should be checked against eventual manufacturers' quotations for such services. The estimated cost for engineering services assumes that the sponsors would themselves arrange for project design and procurement. Should the plant be procured on a turnkey basis the engineering costs would decrease and instead be included in building and equipment costs.

Summary of Fixed Asset Cost Estimate

	YR '000	US$ '000 equivalent
Land[1/]	4,000	890
Construction	9,900	2,200
Equipment	25,200	5,600
Other costs	8,700	1,930
Contingencies	4,800	1,065
Escalation	7,150	1,590
Total fixed assets	59,750	13,275

1/ This cost is uncertain as land costs vary substantially around Sanaa and have tended to rise very rapidly in recent years.
It is based on the assumption that YR 100/m^2 would be a valid price for 40,000 m^2 in the area concerned.

40. To the above listed costs has been added a contingency factor corresponding to 10 per cent and escalation in the amount of 15 per cent which would correspond to price levels projected in 1981.

Other Assets

41. The costs shown in the balance sheet under the heading Other Assets cover the cost of additional feasibility studies, market analysis, legal and other company formation expenses, management during implementation, training, staff costs prior to commercial operation, plant commissioning and test runs, as shown below:

Other Assets Cost Estimate

		YR'000	US$ '000 equivalent
Project preparation and implementation		7,100	1,580
Feasibility studies	1,000		
Incorporation costs	500		
Implementation management	5,600		
Pre-operating expenses		2,525	560
Training (120 man months)	750		
Staff costs	1,775		
Interest during construction		3,375	750
Total		13,000	2,890

Working Capital

42. The working capital estimate makes provision for raw material stocks to be built up to four months supply, and for finished goods to be maintained at two and a half weeks production, after the start of plant operation. Appropriate stocks of packing and other materials, spare parts and molds are provided for. Sales will be made on a cash basis and no amount for debtors or receivables is included.

43. A small overdraft facility finances part of the current assets for a short time after the end of the construction period. Suppliers credits on part of the production materials and spare parts purchases are included. Estimated working capital at the start of operations comprises:

Working Capital Estimate
At end of construction period and start of operations

Current Assets		YR'000
Cash		100
Raw materials		600
Finished goods		-
Packing and other materials		200
Pallets	100	
Plastic film, etc.	50	
Other materials	50	
Molds		300
Spare parts		2,800
		4,000
Less: Current Liabilities		
Short-term debt		1,150
Suppliers credits		600
		1,750
Working Capital		2,250

Summary of Project Cost Estimate

44. The project cost at the end of the construction period amounts to YR 75 million (US$ 16.7 million equivalent) for which share capital and long term loans will be required:

Project Cost Estimate

	YR'000	US$'000 equivalent
Fixed assets	59,750	13,278
Project preparation, pre-operational and interest expenses	13,000	2,889
Working capital	2,250	500
	75,000	16,667

IV. OPERATING COST ESTIMATE

General

45. The cost data given below are tentative. Unit rates and prices have, in some cases, been calculated by adding escalation to cost information which is two to three years old. In other cases costs have been assessed on the basis of cost data from European plants almost all of which are substantially larger than the one under study for the YAR.

Raw Materials

46. Silica sand, the main raw material accounting for over 55 percent of the input weight, is available from a high quality deposit at Al Jiraf on the outskirts of Sanaa. A summary of the report by the Mining University, Leoben, Austria, commissioned by the World Bank/UNIDO Co-operative Programme in 1979, is attached at Annex 6. The quartz sand has very suitable chemical (under 0.03 percent Fe_2O_3 and only traces of mica and heavy minerals) and physical properties which were confirmed by glassmaking trials in Europe. The World Bank/UNIDO Co-operative Programme is at the present time commissioning a more detailed study which will plot the chemical and physical characteristics and determine the reserves of high quality sand over a wider area of the deposit. The resulting map and report should be ready for distribution by September 1981.

Raw Material Requirements Per Ton of Glass

	Quantity kg	Unit Price YR/ton	YR/ton of Glass
Sand	721.5	21	15
Soda ash	231	1,125	260
Lime	186.5	50	10
Feldspar	100.0	1,000	100
Sodium sulphate	5.5	1,500	8
Other	5.5	2,200	12
Total per ton of glass	1,250		405

47. The cost of sand is based on the assumption that the glass factory would do the quarrying with its own staff and equipment, the costs of which are included in the above shown fixed asset cost estimate. Labor and direct operating costs have been calculated at YR 21/ton of sand. The soda ash cost is based on export cost statistics for Kenya and the Federal Republic of Germany.

Other Materials and Repairs	YR '000p.a.
48. Lubricants, Sundry, etc.	400
Molds, 6 sets each with 340 parts at YR 170,000/set	1,020
Spareparts at approx 5% of fixed asset cost	1,400
Repair Cost at approx 2% of fixed asset cost	500

The item "Repair Cost" refers to cost of repairs, excluding spare parts, effected by persons outside the glass company. Total annual cost of repairs and maintenance including spare parts and internal labor would amount to about YR 2.5 million, corresponding to 10% of equipment cost.

Power, Fuel and Water

49. The electrical power rates used are those applied by the World Bank for a rural electrification project currently under consideration. The heavy fuel oil cost is of critical importance for the project's viability. Heavy fuel oil is not available commercially and would need to be imported by the company. The price used is projected by IBY to apply for the cement project, based on the favourable prices at which the YAR obtains its petroleum products from friendly supplier countries. Light fuel oil (diesel) is currently marketed at YR0.9/litre.

(1) Electrical power at YR 1/kWh corresponding to YR 4,590,000/year or YR 353/ton glass.

(2) Heavy fuel oil at YR 590/ton corresponding to YR 1,830,000/year or YR 140/ton glass.

(3) Light fuel oil and diesel at YR 900/ton corresponding to YR 270,000/year or YR 20/ton glass.

(4) Propane gas at YR 1,600/ton corresponding to YR 420,000/year or YR 32/ton glass.

50. Total power and fuel cost per ton would thus amount to YR 545. Water at an average cost of YR 2 per m^3 would cost annually YR 200,000 corresponding to YR 16 per ton of glass.

Salaries and Wages

51. Composition of staff and assumed monthly salaries and wages are shown below:

Administrative Staff

	No	Monthly Salary YR'000	Annual Cost YR'000
Gen. Manager	1	10	120
Asst. Gen. Man.	1	8	96
Accountant	1	4.4	53
Sales staff	2	4.5	108
Clerks	2	3.5	84
Personnel	1	3.5	42
Secretaries	2	3	72
Drivers	2	3	72
Guards	3	3	108
Total	15		755

Technical Management and Supervisory Staff

Expatriate technicians	3	12	432
Engineers	4	8	384
Shift supervisors	4	6	288
Total	11		1,104

Production Personnel

Foremen	11	3.5	462
Skilled workers	77	2.5	2,310
Unskilled workers	50	1.5	900
Total	138		3,672
Grand Total	164		5,531

52. Available data on industrial salaries and wages appear to be largely out of date. Although a substantial margin for escalation has been added to available statistical salary and wage data, local demand, which for the Sanaa area has been very high, may result in salary and wage scales above those assumed in this report:

	YR'000
Total annual salaries	2,141
Total annual wages	3,390
Total cost	5,531

Training

53. The capital cost estimate includes YR 750.000 for the training of personnel during the construction period prior to commissioning. Further sums are included in the fixed expenses to cover the cost of local staff training, including expatriate assistance during the first three years of operation:

YR 350,000 in year 1

YR 175,000 in year 2

YR 100,000 in year 3

Packaging materials

54. As each pallet would take some 1,400 bottles and on the assumption that each pallet could be used 5 times per year a total of 4,262 pallets would be required at full production. Pallets are likely to require continuous replacement on account of damage and disappearance in the distribution. A replacement rate of 25% has been assumed. The bottles would be placed on carton bottoms and the top layer should also be protected by kraft paper or carton. The annual carton board requirement would amount to 127,926 pieces per year. Each pallet load would be covered with shrink-wrap plastic, requiring 21,321 m^2 of film annually.

Packaging Material Cost Estimate

	No per year	Cost per unit	YR Annual Cost	Cost/ton of bottles
Pallets	1,066	50	53,300	4.2
Cartons	127,926	3.50	44,800	3.5
Shrink film	21,321	12.50	266,500	20.7
Total			364,600	28.4

Administrative Costs

55. Office, travel, insurance, etc. expenses of YR 100,000 per annum are included in fixed costs.

V. FINANCIAL EVALUATION

Capital Expenditure

56. Expenditure over a three year implementation period is projected as follows:

Y R '000	Year 1	Year 2	Year 3	Total
Current Assets			3,900	3,900
Raw materials			600	600
Packing and other materials			200	200
Molds and spare parts			3,100	3,100
Fixed Assets	5,000	26,000	28,750	59,750
Land	5,000			5,000
Construction and buildings		8,000	4,500	12,500
Equipment		18,000	24,250	42,250
Other Assets	2,000	3,000	8,000	13,000
Project preparation, etc.	2,000	2,000	3,100	7,100
Pre-operating expenses		150	2,375	2,525
Interest during construction		850	2,525	3,375
Total Assets	7,000	29,000	40,650	76,650
Total excluding interest	7,000	28,150	38,125	73,275

Revenue

57. The average cost of imported bottles in 1979-1980 was YR 1.00 per bottle including shipping, 15% customs duty and inland transport from Hodeidah to Sanaa. This has been increased by 10% to YR 1.10 to reflect the factory sales price at 1981 levels. As explained, a higher price of YR 1.20 per bottle, corresponding to a tariff protection of 25 rather than 15 per cent, has been assumed during the first five years of operation after which the sales projections revert to the import price level of YR 1.10 per bottle.

The revenue calculations provide for a build-up of finished goods inventory corresponding to 5% of annual production.

Assumptions

58. The principal assumptions underlying the financial evaluation are listed at Annex 7.

Financial Projections

59. The capital cost and operating projections are given at 1981 estimated prices. Annual operating income is shown after deducting variable and fixed direct costs from production value and before deducting overhead costs or capital charges of depreciation, amortization of other assets and interest payments. After examining the financial and the associated economic rates of return of the project, the report contains a further set of projections embodying a typical financing plan with an initial equity: loan ratio of 40:60

Financial Analysis

60. Annual production, revenue, variable and fixed direct costs, and the balance of operating income before depreciation and interest over fifteen years of operation are shown at Annex 8. Cash flow before interest charges is also shown, from which the financial and economic discounted rates of return of the project are derived.

61. Annex 9 discounts the annual capital expenditure and operating cash flow figures. The financial internal rate of return at constant prices is 14.5 per cent. Pay back period is about 6.5 years to recover total capital expenditure.

62. The sensitivity of the project to changes in capital cost, production level, and sales and input prices is shown in the sensitivity analysis at Annex 10. Examples of the change of rate of return from the basic 14.5 per cent rate are:

(1) 12.9% at capital expenditure overrun of 10%
8.2% at capital expenditure overrun of 50%

(2) 12.6% with a one year delay in operating cash flow

(3) 12.3% with production level 10% lower
7.1% with production level 30% lower

(4) 12.5% with sales price of YR 1.10 throughout
9.7% with sales price 10% lower
18.9% with sales price 10% higher

(5) 13.8% with wages and salaries 10% higher
13.0% with wages and salaries 20% higher

(6) 17.2% with electricity price 50% lower (YR0.50 per unit)
13.4% with fuel oil price 50% higher

(7) 16.2% with a 0.34kg bottle weighing 21% less.

Return on Investment

An appropriate financing plan is applied to the foregoing capital cost and operating cash flow projections. Capital expenditure is financed by:

	YR'000	US$ equivalent	%
Share capital	30,000	6,667	40
Long-term loan	45,000	10,000	60
	75,000	16,667	100

The long-term loan bears interest at 8.5 per cent per annum and is repayable over 10 years subsequent to a 1.5 year grace period from the start of operations. These terms are consistent with financing arrangements currently available to industry in the YAR.

64. Projected Balance Sheet, Annex 12, and Income Statement, Annex 11, show a discounted rate of return after tax of 15 per cent on the YR 30 million equity investment.

V. ECONOMIC EVALUATION

65 Introduction of the project to supply bottles to the local beverage and other industries will provide outlets for raw materials (sand and feldspar) which are available in the country but not yet exploited. The present long delivery times and port charges to which imported bottles are subject can be obviated.

Economic Analysis

66. With a strong Yemeni currency and the employment opportunities for Yemeni workers in neighbouring countries, only two adjustments are made to the financial analysis to determine the economic rate of return of the project. Annual sales values are reduced by the amount of customs duty, and an economic cost of electricity of YR 0.50 per unit is assumed. This is half the present tariff of YR 1.00 (equivalent to US 22 cents) per kWh, which is very high. The cost of imported petroleum products is, however, comparatively low, enabling heavy fuel oil to be sold to consumers at YR 0.59 per kg. Thus fuel, the major component in the cost of electricity at the new thermal power station, would account for about YR 0.15 to YR 0.20 per kWh. Including other generation and distribution expenses, the economic cost of electricity is, therefore, estimated to be no more than YR 0.50 per kWh.

67. With these adjustments to the financial analysis, the economic internal rate of return of the project is 10.8 per cent, as calculated at Annex 9.

Foreign Exchange Savings

68. Estimated foreign exchange savings are assessed at:

Annex 14, Capital Cost Estimate,
Annex 15, Projected Operating Income,
Annex 16, Estimated Foreign Exchange Savings,

which are based on assumed foreign exchange components of the capital and operating costs. Sales are valued at the cif cost of imports.

69. Making allowance for estimated indirect as well as direct foreign exchange costs of project inputs, there should be an appreciable foreign exchange saving, amounting to YR 9.1 million equivalent before capital charges in the first year of operation, rising to YR 13.3 million a year at full production. The resultant benefit to the YAR will depend on the method of financing and on the foreign exchange components of the share and loan capital. It is assumed at Annex 16 that twenty per cent of the share capital and the entire long term loan are provided and serviced in foreign exchange. On this basis the YAR would be required to devote about YR 5 million equivalent in foreign exchange to the capital cost of the project. After servicing the foreign equity and loan capital, the project should repay the initial foreign exchange contribution from within the country (est. YR 4.75 million) in the first year of operation. The annual foreign exchange benefit should average:

YR 3.4 million equivalent in years 1 to 5
YR 6.1 million equivalent in years 6 to 10

thereafter rising to YR 11.9 million a year when the loan has been repaid.

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT
COUNTRY DATA

AREA	POPULATION	DENSITY (1979)
195,000 sq. km.	5.8 million (end 1979) Rate of Growth: 2.9 percent	30 per sq. km.

POPULATION CHARACTERISTICS (1978)	
Crude birth rate (per 1,000)	48
Crude death rate (per 1,000)	25
ACCESS TO SAFE WATER (1977)	
Occupied dwellings without safe water (%)	96
NUTRITION (1977)	
Calorie intake as percent of requirements	91
Per capita protein intake (grams/day)	68

HEALTH (1978/79)	
Population per Physician	12,510
Population per hospital bed	2,065
ACCESS TO ELECTRICITY (1977)	
% of urban population	57
EDUCATION (1977)	
Adult literacy rate percent	13
Primary school enrollment percent	26

GNP PER CAPITA IN 1977/78 : $ 410 1/

NATIONAL ACCOUNTS (US$ Mln)
(1978/79 Prices)

	1978/79 2/	ANNUAL RATE OF GROWTH (Constant prices) FY73-79
GNP at Market Prices	3,810	13
GDP at Market Prices	2,800	10
Gross Domestic Investments	900	33
Gross National Savings	524	27
Exports of GNFS	107	10
Imports of GNFS	1,490	28

GOVERNMENT FINANCE (YRls Mln)

	1975/76	1976/77	1977/78	1978/79	% of GNP 1978/79
Current Revenue	605	1,293	1,985	2,188	13
Current Expenditure	617	841	1,250	1,840	11
Current Deficit/Surplus	-12	452	735	348	2
Capital Expenditure	361	603	1,167	2,670	16
External Assistance, Net	635	606	697	1,904	11
MONEY CREDIT AND PRICES	----------YRls Million Outstanding End Period----------				
Money Supply	2,509	4,370	6,205	7,583	
Bank Credit to Govt. Sector, net	-407	-939	-990	-609	
Bank Credit to Non-Govt. Sector	566	1,474	1,555	2,199	
	---------- Percentages ----------				
Annual Percentage Increase in:					
Money Supply	120	74	42	22	
Consumer Price Index	17	24	19	22	

1/ Calculated by the World Bank Atlas conversion technique.
All other conversions to dollars in this table are at the average exchange rate prevailing during the period covered.

2/ Tentative World Bank estimates

Source: IBRD Report No. 2856 - YAR, October 23, 1980.

BALANCE OF PAYMENTS (US$ Mln)

	1972/73	1975/76	1976/77	1977/78	1978/79
Exports of Goods, fob	7	12	19	7	3
Imports of Goods, cif	120	382	730	906	-1,405
Trade Balance	-113	-370	-711	-899	-1,402
Non Factor Services, Net	-11	21	-10	-21	19
Factor Income, Net	105	479	896	1,160	1,007
Workers' Remittances, Net	(102)	(457)	(842)	(1,090)	(898)
Investment Income, Net	(3)	(22)	(54)	(70)	(109)
Balance on Current Account	-19	130	175	240	-376
M & LT Capital, Net	22	153	146	165	435
Official Grants, Net	14	114	104	103	312
Official Loans, Net	8	39	42	62	123
Disbursements	(12)	(42)	(46)	(68)	(133)
Repayments	(-4)	(-3)	(-4)	(-6)	(-10)
Other Capital (including errors and omissions), Net	25	-11	133	-32	144
Increase in Reserves (-)	-28	-272	-454	-373	-203
Gross Reserves (end FY)	65	520	974	1,347	1,550

EXTERNAL PUBLIC DEBT, JUNE 30, 1979

	US$ Mln.
Total Commitments	1,075
Of which Disbursed	543

MERCHANDISE EXPORTS
(Average 1976/77-1978/79)

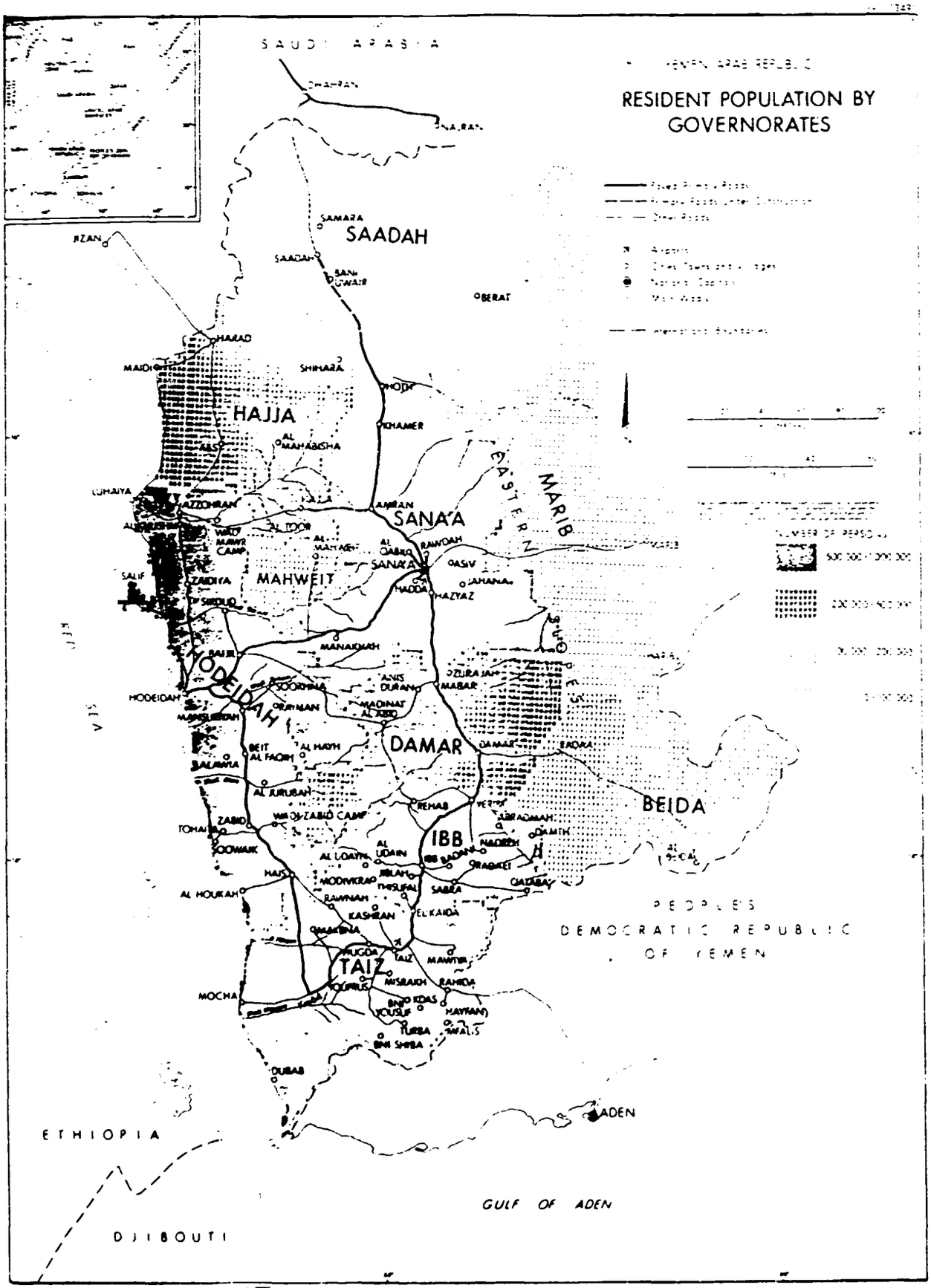
	%
Cotton & Cotton Products	2
Coffee	5
Hides & Skins	16
Biscuits & Confectionary	20
All other Commodities	57
	100

DEBT SERVICE RATIO FOR 1978/79: 1.7% 1/

1/ Includes workers' remittances.

Annex 2

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT



YEMEN ARAB REPUBLIC

A MARKET ANALYSIS FOR HOLLOW GLASS

by Lennart Königsson

Methodology

The methodology employed involved, firstly, identification of sources of demand, secondly, analysis of past consumption data for hollow glass in the YAR and, thirdly, a matching of future demand which could reasonably be expected to be generated by each source using growth rates extrapolated from past data.

The demand sources identified were the following:

(1) Food processing industries such as soft drink bottlers, dairies and juice producers and producers of cooking oil;

(2) households using glass for storage, as tableware and for decorative purposes.

Other industrial users of hollow glass were not identified. Obtaining data on past consumption from sources such as import statistics was fraught with a number of difficulties, the major ones being (a) that time series were not complete, (b) that only value had been recorded and not quantity and (c) that the definitions of various groups of products were changed between 1977/78 and 1979. Additionally, it is probable that different exchange rates have been applied with respect to values for different periods.

A gross approximation of observable import trends on the basis of import statistics is shown below:

Glassware; SITC No. 66500

(YR '000)

1976 12 months	11,418	
First 6 months of 1977	N.A.	
Last 6 months of 1977 and first 6 months of 1978	12,197	(reduced by 20 per cent on account of probable exchange rate error)
Last six months of 1978	N.A.	
1979 12 months	28,976	(See Table 8, SITC Nos. 66511, 66500 and 66589)

It has therefore been possible to use past consumption data, such as import statistics, only as a rudimentary check on the aggregate demand data developed as a result of analysis of use and of growth of demand.

Returnable Soft Drink Bottles

This category would be of two types, namely additions and replacement of returnable containers and supply of non-returnable containers. For returnable containers the consumers would consist primarily of bottling companies and dairies.

The table below shows existing and planned bottling industries in the YAR. Those industries shown as planned are under actual construction and are likely to be in operation within twelve to eighteen months.

Table 1

Existing and Planned Soft Drink Bottling Capacity in the YAR, 1980

Brand Existing Plants	Rated Capacity (cases/day)	Location
Pepsi	9,000	Sanaa
Pepsi Cola[1/]	2,500	Hodeidah
Canada Dry	17,500	Hodeidah
7-up	9,000	Sanaa
Coca Cola etc.	15,000	Taiz
Sub-total	53,000	
Planned new plants		
Pepsi Cola	17,500	Hodeidah
Canada Dry	17,500	Damar
RC Cola	10,000	Sanaa
Other	approx. 15,000	N.A.
Sub-total	60,000	-
Total (less plants to be closed)	110,000	-

1/ To be closed with opening of new plant.

Total soft drink bottling capacity in the YAR at present is thus 53,000 cases[1] per day which is expected to increase to approximately 110,000 cases/day in one to one and one-half years. The capacities shown above are generally based on operating two shifts per day during 300 days of the year. The bottlers in the YAR are presently operating at full capacity during nine months of the year and some 70 to 85 per cent of capacity during the three winter months. It is the expectation of the industry that the additional capacity, to be brought on stream in the near future, will be utilized in the same manner.

On a yearly basis present production amounts to 11.3 million cases, or 270 million bottles, whereas production in one to two years' time would increase to 23.5 million cases (560 million bottles) per year. On a per capita basis, consumption of locally bottled soft drinks would thus be 51 bottles per person and year, or approximately 1 bottle per person and week. With the expected increase in productive capacity, consumption would need to expand to 103 bottles per person and year or 2 bottles per person and week.

This consumption could be compared to known approximate rates per person in neighbouring countries:

Saudi Arabia	35 bottles/week
Egypt[2]	0.8 bottles/week
Kuwait	7 bottles/week
Bahrain	20 bottles/week

The market analysis also involved a comparison with projected soft drink consumption rates made by the Industrial Bank of Yemen for the purpose of assessing the viability of a new Canada Dry bottling plant. The data obtained through this study, conducted in 1979, is shown and compared with industry data in the table overleaf.

1/ Each case containes 24 bottles of 25 cl content.

2/ An average consumption rate in countries with similar gross national product and similar climate as Egypt was 1.4 bottles per week in 1977.

Table 2

Comparative Data on Estimates of
Soft Drink Bottling Capacity in the YAR

Plarts and Brands	Industry Estimates-1980	IBY Feasibility Study Estimates-1979
Pepsi Cola-Sanaa:		
cases/hr	-	-
cases/day	9,000	-
cases/year	2,025,000	2,331,000
Pepsi Cola-Hodeidah:		
cases/hr	-	-
cases/day	2,500	-
cases/year	565,000	-
Canada Dry-Hodeidah:		
cases/hr	-	500
cases/day	17,500	-
cases/year	3,307,500	1,440,000
7-up-Sanaa:		
cases/hr	-	-
cases/day	9,000	-
cases/year	2,025,000	-
Coca Cola-Taiz:		
cases/hr	-	650
cases/day	15,000	-
cases/year	3,375,000	1,872,000
Total (cases/year)	11,297,500	5,643,000

In addition to the capacities of some of the existing plants, the feasibility study also detailed the level of the YAR imports of "carbonated soft drinks" during recent years.

The statistics are not complete in that only value and not quantity is shown for some years.

Table 3

Imports of Carbonated Soft Drinks 1975-1979

Year	No. of Bottles	Value (YR)
1975	270,000	478,000
1976	126,000	83,000
1977	-	1,500,000
1978	-	9,600,000
1979	6,000,000 (est.)	8,158,000

Imports in recent years have thus reached a level of approximately YR 9 million corresponding to some 250,000 cases. It is probable that some proportion of these soft drinks were imported as cans although this has now been banned for environmental reasons, with the result that smuggling of canned soft drinks, according to industry sources, has taken on considerable proportions.

The above-mentioned IBY feasibility study reached the conclusion that demand for soft drinks in 1979 corresponded to 9.6 million cases, although the basis for the conclusion was not clear from the report. Rate of growth of demand was projected to be 2.5 per cent p.a. which IBY officials conceded was a highly conservative estimate.

Our conclusions with respect to the present status and future development is as follows:

- Current rate of consumption: Approx. 250 million bottles/year. (10.4 million cases).
- Estimated annual rate of growth in the immediate future: 20 per cent-30 per cent.
- Level of consumption in 1983-1984: Approx. 400 million bottles/year (16.5 million cases).

The latter estimate assumes that the industry's expansion rate will be slower than presently expected due to delays in implementation of new plants.

Volume of Soft Drink Bottle Replacement

Interviews with bottling industry representatives suggested that reliable statistics were kept with respect to losses and breakages of bottles. They were as follows:

- The average number of times in a year that a bottle is used is 16 to 19 which, incidentally, is a very high rate in comparison to that of other countries.
- Therefore, a bottle is returned after about 22 days.
- Bottle breakage in production amounts to 0.5 per cent of the number of bottles sold.
- Bottle rejection in production (during washing and subsequent inspection) amounts to 1 per cent of the number of bottles sold.
- Losses of bottles in the course of distribution amounts to 22 per cent of the number of bottles in stock.

As the stock of bottles would normally correspond to approximately 10 per cent of sales, annual purchases of glass bottles for the YAR's bottling industry should average 3.7 per cent of bottles sold.

A comparison with similar data for other Middle Eastern countries suggests that the bottle replacement rate in the YAR is high at present. It is important to note that statistics exist only for the last two years during which time the industry has expanded rapidly and during which time distribution has reached many areas previously not serviced.

Egypt, for example, in 1977 had the following data for soft drink bottle use and replacement:

Average number of times per year that a bottle was used: 10.

Bottle breakage in production: 0.5 per cent of sales.

Bottle rejection in production: 0.5 per cent of sales.

Bottle losses in distribution: 2 per cent of sales.

It is thus likely that the bottle replacement rate will decline in the YAR as the distribution improves and as the market's need for empty containers becomes satisfied.

In order to project future demand for glass containers, the following assumptions have been made:

Table 4.

Assumptions for Replacement of Bottles

(% of sales)

	1980	1981	1982	1983	1984	1985	1986	1987	1990
Breakage	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Rejections	1.00	0.95	0.90	0.85	0.80	0.75	0.70	0.60	0.50
Losses	2.2	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Total	3.70	3.55	3.40	3.35	3.30	3.25	3.20	3.10	3.00

The bottling industries would require glass bottles not only for replacing broken or lost containers but also for sustaining growth of sales. A normal ratio between stock of bottles and sales volume for the bottling industry is 1:10.

An assessment of demand for bottles resulting from increased sales volume would also necessitate assumptions with respect to growth of consumption more detailed than those made above.

As a hypothesis we have thus assumed a development as follows:

Table 5

Hypothetical Growth of Demand for Soft Drinks in the YAR, 1980-1988

	1980	1981	1982	1983	1984	1985	1986	1987	1988
No. of Plants	5	6	6	7	8	8	8	9	9
Total daily capacity (cases/day)	53,000	70,500	85,500	95,500	110,500	110,500	110,500	125,000	125,000
Total yearly capacity1/ (million bottles)	381.6	507.6	615.6	687.6	795.6	795.6	795.6	900.0	900.0
Capacity utilization (%)	70	70	70	72.5	70	75	80	75	76
Total output/year (million bottles)	270	350	430	500	560.0	600	640	670	690
Annual Increase (%)	-	30	23	16	12	7	6.5	4.5	3.0
Consumption per person per week (bottles)	1.00	1.25	1.50	1.70	1.85	1.90	2.00	2.05	2.10

1/ Assuming two shifts per day 300 days/year.

Projected demand for additions and replacement to and of soft drink bottles can thus be calculated as follows:

Table 6

Projected Demand for Soft Drink Bottles in the YAR, 1980-1988

(million bottles)

	1980	1981	1982	1983	1984	1985	1986	1987	1988
Additions to stock	-	8.0	8.0	7.0	6.0	4.0	4.0	3.0	2.0
Replacements	10.0	12.4	14.6	16.7	18.5	19.5	20.5	20.8	20.7
Total	10.0	20.4	22.6	23.7	24.5	23.5	24.0	23.8	22.7
Total weight (tons)1/		8,800	9,700	10,200	10,500	10,100	10,800	10,300	9,700

1/ One 25 centiliter bottle weighs 0.43 kg.

Other Returnable Bottles

The YAR's other major user of bottles is likely to be the dairy industry, which also mixes and distributes fruit juices. Data compiled by the Industrial Bank of Yemen suggests that this industry will expand considerably in the near future.

Planned daily production after completion of now initiated expansions is to be 72,000 litres of milk and 40,000 litres of juice. Both products can be expected to be distributed in glass containers each with a weight of 0.56 kg.

At present Yemen Dairy Products Ltd, which, apart from milk and juice, also produces ice-cream and yoghurt, packages all its products in either plastic or paper. As the issue of littering and environmental protection has become politically very important in the YAR, it is probable that this company and possibly other foodstuff producers would be required to switch to returnable bottles.

There is a large unsatisfied demand especially for milk in the YAR, and the Government could reasonably be expected to strongly promote its consumption as a measure to improve health. Given continued favourable prospects for growth and increased per capita income, a consumption growth rate of 10 per cent per annum for both of these products could well be achieved in the short term. It is worth noting that the presently planned production level would yield an annual per capita consumption of 4 kg which is one of the lowest in the world.

Annual milk and juice production is expected to reach 33.6 million litres per year when the new facilities are completed in one to two years time. The bottle additions and replacements would, using the same assumptions as for soft drink bottles develop as follows:

Table 7

Projected Demand for Milk Bottles, 1980-1988

(million bottles)

	1980	1981	1982	1983	1984	1985	1986	1987	1988
Additions to stock	-	-	3.4	0.3	0.4	0.4	0.5	0.5	0.5
Replacements	-	-	1.2	1.3	1.4	1.6	1.7	1.9	2.1
Total	-	-	4.6	1.6	1.8	2.0	2.2	2.4	2.6
Total weight (tons)	-	-	2,600	900	1,000	1,000	1,200	1,300	1,500

Two new dairy projects are planned, one at Dhamar supported by the British ODA and another at Mufrah. It is likely that both of these projects would use returnable hollow glass for distribution of products which, in due course, could more than double demand for milk bottles, as these two projects together were estimated by officials at the Industrial Bank of Yemen to reach an annual production in excess of 50 million litres. Both projects are, however, in the early planning stages and it would appear premature to take their eventual demand into consideration at this stage.

Other foodstuff producers which may in the future be required to change over from plastic to glass containers could be the mineral water bottling company and cooking oil manufacturers. Shamlan, the mineral water bottler, has a daily production capacity of 52,000 litres corresponding to 15 million litres per year. The commercially distributed volume of cooking oil, as opposed to smuggled oil, amounts to 36 million litres per year, and this may increase with the advent of a new project presently in the planning stage.

Using similar assumptions as for milk and juice containers, the consequences of these industries shifting to returnable glass containers would be an increase in demand for glass bottles of 1,700 tons per year which would gradually increase to approximately 2,000 tons. The demand for glass containers generated by the pharmaceutical industry is, judging by recent import statistics, nearly negligible and would likely be confined to a few hundred tons per year.

Household Hollow Glass

Hollow glass for household use is a potentially large source of demand albeit near impossible to estimate. A hypothetical discussion would, however, illustrate the possible upper and lower ranges for household demand for jars, bottles and similar food containers.

A 1975 census estimated the number of households in the YAR at 951,600. The population is estimated to have increased by some 10 per cent since that time, and it thus appears realistic to assume that the number of households may by now have increased by approximately 3 per cent to 980,000.

On the assumption that each household would annually buy only one glass container of approximately 1 litre content, annual demand for hollow glass would increase by 550 tons. An annual household consumption of four to five such containers would increase demand by over 2,000 tons per year, which would be sufficient to balance possible shortfall of demand from the mineral water and cooking oil industry.

Import statistics in the YAR were harmonized with the SITC nomenclature first in 1979, and they show imports of glass for that year as follows:

Table 8 Glass Imports, 1979

SITC No. for Glass	Value (YR '000)	Volume
66414 glass misc.	14	
66430 drawn or blown	12,671	
66450 cast or rolled	185	
66480 mirrors,etc.	3,011	
66511 bottles, etc.	16,624	(est. 17.5 million bottles)
66520 tableware glass	10,264	
66589 other glass	2,088	
66400-500 Total	44,857	

Volume is not recorded as shipping documents usually specify number of gross, pieces, sheets of certain sizes, etc. but not weights. From the above, however, it can be seen that tableware glass corresponded in value to some 60 per cent of glass bottles, the weight of which would roughly correspond to 7,500 tons.

The assumption that tableware costs two to three times as much per kg as do bottles on account of higher packing cost, shorter series of production and costlier raw material would indicate an import volume of around 2,000 tons.

Non-returnable Bottles

Yet another potentially large source of demand for a hollow glass manufacturing industry could be non-returnable bottles. The soft drink industry is likely to strongly support a development in that direction as it views the introduction of non-returnable bottles as highly favourable for increased soft drink consumption. In the case of the YAR this is probably due to the very sophisticated but also specialized transport system which has evolved with the rapid increase in consumption of qat. Qat is harvested in the early mornings and transported, often long distances, to the urban centres where it is consumed fresh the same afternoon. An ideal return cargo would be soft drinks, provided the empty bottles did not have to be transported back. This is believed to be one of the reasons for the popularity of canned soft drinks which can be found in very remote villages. Parallel with this, there are in the YAR very strong sentiments against non-returnable plastic containers such as those used by cooking oil and mineral water distributors as they have caused losses to cattle herds.

The adoption of non-returnable glass bottles may come as a compromise in the future for this and for other reasons, the main one being a desire to export processed agricultural products such as various juices and fruits. One possibility which struck the author during the visit to the YAR could be that of exporting grape juice.

Grape juice has found a large market in Saudi Arabia which today imports its entire consumption. The same may be the case in the Gulf countries. The YAR produces a good quality grape which with relatively simple means could be pressed and bottled. As no data is available for the rate of consumption in Saudi Arabia, an hypothetical discussion would give an indication of potentialities for the YAR.

On the assumption that per capita consumption of grape juice in Saudi Arabia would be 1 litre per year, total annual demand would be approximately 5,000 tons (compare Saudi Arabian soft drink consumption of $35 \times 52 \times 0.33 = 600$ litres per year per capita). If the YAR were to capture 10 per cent of the market, this would correspond to 500,000 litres per year, all of which would need to be shipped in non-returnable bottles each weighing 0.56 kg i.e. a total annual demand for glass of

280 tons. If the grape juice market in Saudi Arabia would correspond to 1 per cent of the soft drink market, demand for non-returnable glass bottles in the YAR would, assuming the same Yemeni market share, amount to 1,700 tons.

Grapes are, of course, only one of the many fruits grown in the YAR and for which outlets could be found both inside and outside of the YAR once suitable containers for transport were made available.

Other Glass

Table 8 above contains one item called "other glass". This covers a multitude of products such as lamp covers, various types of bottles and containers, for example, pharmaceutical products, demijohns, vases, ashtrays, etc. Import statistics suggest that some YR 2 million worth of such glass products were imported in 1979. On the assumption that such products would cost two to three times as much per kg as would bottles (bottles cost approximately YR 2.2/kg) the present annual volume of such imports would correspond to some 400 tons.

Summary

The table overleaf summarizes the above discussion of market potential. It should be emphasized again that the YAR's brief history of modern development in combination with the multitude of hindrances and bottlenecks which exist with respect to imports, shipping and distribution enables, at best, an educated guess with respect to future levels of consumption. To this should be added one general observation: Past experience in many developing countries suggests that demand for products not previously produced in the country and which are used by a large number of people is as a rule substantially underestimated. This has been the case for everything from domestic airline service to local production of Kleenex.

Table 9

Summary of Potential Demand for Hollow Glass by Different Users
(tons)

	1981	1982	1983	1984	1985	1986	1987	1988
Soft drink bottles	8,800	9,700	10,200	10,500	10,100	10,300	10,200	9,700
Milk bottles	-	2,600	900	1,000	1,100	1,200	1,300	1,500
Other returnable bottles	-	-	-	1,700	1,800	1,900	2,000	2,100
Other non-returnable containers	-	-	300	400	500	600	700	800
Table and household glass	2,000	2,100	2,200	2,300	2,400	2,500	2,500	2,500
Misc. other glass	400	450	500	500	500	500	500	500
Total	11,200	14,850	14,100	16,400	16,400	17,000	17,200	17,100

The above projections should be compared with available data for actual imports and for licenses for imports. The Ministry of Economy is, since the beginning of 1979, the authority which issues licenses for imports. Applications for import licenses must be supported by proforma invoices, and the Ministry of Economy on the basis of such invoices keeps statistics on the volume and value of issued import licenses. Unfortunately, such statistics have not yet changed to the same SITC nomenclature as have the import and export statistics kept by the Central Planning Board; therefore care must be taken in interpreting the data. The license and import data exist, however, only with respect to value. In order to determine the approximate value of imports the mission therefore reviewed a sample of import invoices kept with the Ministry of Economy. The main conclusions with respect to value per kg were as follows:

Soft drink bottles	YR 0.98-1.03/bottle or YR 2.03/kg (sample size 5, 1980 price level).
Tableware	YR 70 to 90 per set of 59.65 pieces weighing 14-18 kg or YR 4.00 to 6.50 per kg.
Other manufactured glass	YR 19-23 per dozen weighing 10-11 kg YR 130-160 per gross weighing 80-90 kg or between YR 1.60 to YR 2.10 per kg.

Aggregate data on values and volumes for which licenses had been granted were as follows:

	Manufactured Glass
Feb 1979 to Dec 1979	24,972, 160 items-YR 43,931,019
Jan 1980 to May 1980	10,737, 754 items-YR 22,533,763

A comparison with Table 8 suggests that demand for manufactured glass as expressed in the form of import licenses granted exceeded actual supply during 1979 by approximately 50 per cent (YR 28.9 million in imports versus YR 43.9 million for which licenses were granted).

The value of projected demand expressed in 1980 prices would be as follows using the above calculated costs per kg of glass.

Table 10

Demand for Hollow Glass in the YAR, 1981-1983

(YR millions)

	1981	1982	1983
Soft drink bottles	17.9	19.7	20.7
Milk bottles	-	5.2	1.8
Other non-returnable containers	-	-	0.6
Tableware	10.5	11.0	11.5
Misc other glass	0.7	0.8	0.9
Total	29.1	36.7	35.5

This would tend to support the contention that the projected level of demand for 1980 and the following years may be realistic if not conservative.

ANNEX 4

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT

PRODUCTION PERSONNEL

	Shifts	Foremen	Skilled workers	Unskilled workers
Raw material receiving station	1	1		6
Raw material storage and internal transport	2		3	8
Stores	4	1	4	
Raw material preparation	1	1		
a) sand washing			1	2
b) sand drying			1	2
c) lime calcining			1	2
d) glass crushing			1	3
Mixing plant	2	2		
a) raw material mixers			2	
b) chemical mixers			2	
c) transport				2
Production				
a) 8-station bottle blowing machine			8	
b) sorting & packing		4	16	
c) quality control			4	
d) finished goods transport			4	4
e) return glass handling				8
Furnace operations	4			
a) furnace monitoring			4	
b) mechanical support staff			2	2
c) electrical support staff			2	2
d) compressor operations			2	2
Laboratory	1		1	1
Finished goods storage and dispatch				5
Maintenance and repair	1	1		
a) mechanical			5	
b) welding and steel smiths			3	
c) electrical			2	
d) refractories			2	
e) carpentry			2	
f) mold making			2	1
g) other			2	
Total Production Personnel		11	77	50
		Grand total:		138

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT
BUILDING COST ESTIMATE

Building Dimensions

Factory sections 0-7	42.00 x 181.60 =	7,627.20 m^3
7-17	60.00 x 300.00 =	18,000.00
7-17	42.0x20.0x5.0 = 4,200	
(basement)	½(42.0x5.0x5.0= 525	
	4,725	4.725.00
17-21	24.00 x 140.00 =	3,360.00
	54.00 x 181.60 =	9,806.40
	Total factory	42,518.60
Workshop	48.00 x 15.00 x 4.00	2,880.00
Office	40.00 x 20.00 x 4.00	3,200.00
	Total building volume	49,600.00 m^3

Floor areas would be as follows:

Factory	4,290 m^2 (plus basement 850 m^2)
Workshop	720
Office	800
Total	5,810 m^2

Concrete works; factory	4.290x0.5 + 850x0.5 =	2,570 m^3
	(2x42 + 2x25)0.25 x 5 =	167
	Total factory	2,737
Workshop	720 x 0.35	252
	Total concrete	2,989 m^3

Wall and roof areas:

Outer walls; factory		3,733 m^2
workshop		630
roof: factory		4,622
workshop		800
Total sheet covered area		9,785 m^2

Steelcontent:

Steelstructure factory 33 x 4.290 =	142 tons
Steelstructure workshop 35 x 720 =	25 tons
Total	167 tons

BUILDING COST ESTIMATE	YR '000	US $ '000 equivalent
Land levelling and excavation 5.000 m^3 à 23.12	115	
Trenches and backfill 1.300 m^3 à 15.25	20	
Close timbering 4.125 m^3 à 32	130	
Hard standing areas 4.800 x 0.20 m^2 à 640	830	
Reinforced concrete slabs and walls 2.989.5 à 1.407	4,200	
Structural steel 167 à 9.702.5	1,625	
Steel doors 18 x 16 + 9x2.5 = 311.5 à 410	130	
Louvers 252 à 121	30	
Roofing 5.422.40 m^2 à 111	600	
Flooring 6660 m^2 à 58	385	
Walls 4.367.80-311-252=3.804.80 m^2 à 126	480	
Ventilators 70x2x2 = 280 m^2 130	35	
Plumbing 5 units 400 m pipe + lab inst.	175	
Electrical 1 main 100A, 4 main 30A, 2 main 15A, 22, 20A etc.	210	
Telephone 4 circuit à 766	5	
Sub-total;factory and workshop	8,960	1,991
Office floorslab 800 x 0.20 à 640	100	
Masonry walls 600 - 78 à 168 (hollow block)	90	
Plastering 600 - 78 à 70	35	
Roofing 900 à 111	100	
Ceiling 800 à 64	50	
Windows & doors 78 à 510	40	
Plumbing 30 units à 2600	80	
Partitioning 1300 à 108	140	
Painting 1300 à 18	25	
Sub-total office	660	147
Settling tank 16.70 m^3 à 1.407 + 32 + 23.12	25	
Gas storage	115	
Fencing 200 x 4 à 114	90	
Pumping station	50	
Sub-total other	280	62
TOTAL estimated cost of construction (see footnote)	280 9,900	2,200

Note: All unit prices have been taken from "Analysis and Escalation of Costs of Building Materials and Labor in Yemen Arab Republic" by Project Implementation Unit, IDA Education Project and from "Builder's Price Book, Sana'a" prepared by UNDP in Yemen Arab Republic.

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VORSTAND o. PROF. DR. PHIL. FELIX TROJER

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT

YAR: GLASS SAND AL JIRAF, SANA'A

prepared by Dr.Dipl.Ing.
A. Mayer and
Dipl.Ing.W. Pistora
Mining University Leoben

November 1979

Ref.: Glass Sand Sana'a, YAR

We recieved a sand sample "Sana'a" from Mr. Schüssler in October 1979 which was - as arranged - investigated for its common usability.

In consideration of the geographic and economic situation in YAR it was possible to find out two main fields for an economic use.

A - For the glass industry -for manufacture of glass wares of qualities "table ware" and "crystal glass",

B - For foundry industry -as high quality molding and core sand as used in the metal as well as the iron and steel foundry.

Note: An extract is also attached at page 10 of a report by VOEST-ALPINE, Austria of a further analysis and investigation of the sand sample.

The analysed sand is a very pure quartzsand with following chemical composition (fractions between 0.09 mm and 0.5 mm) :

more than 99% SiO_2

less than 0.03 % Fe_2O_3

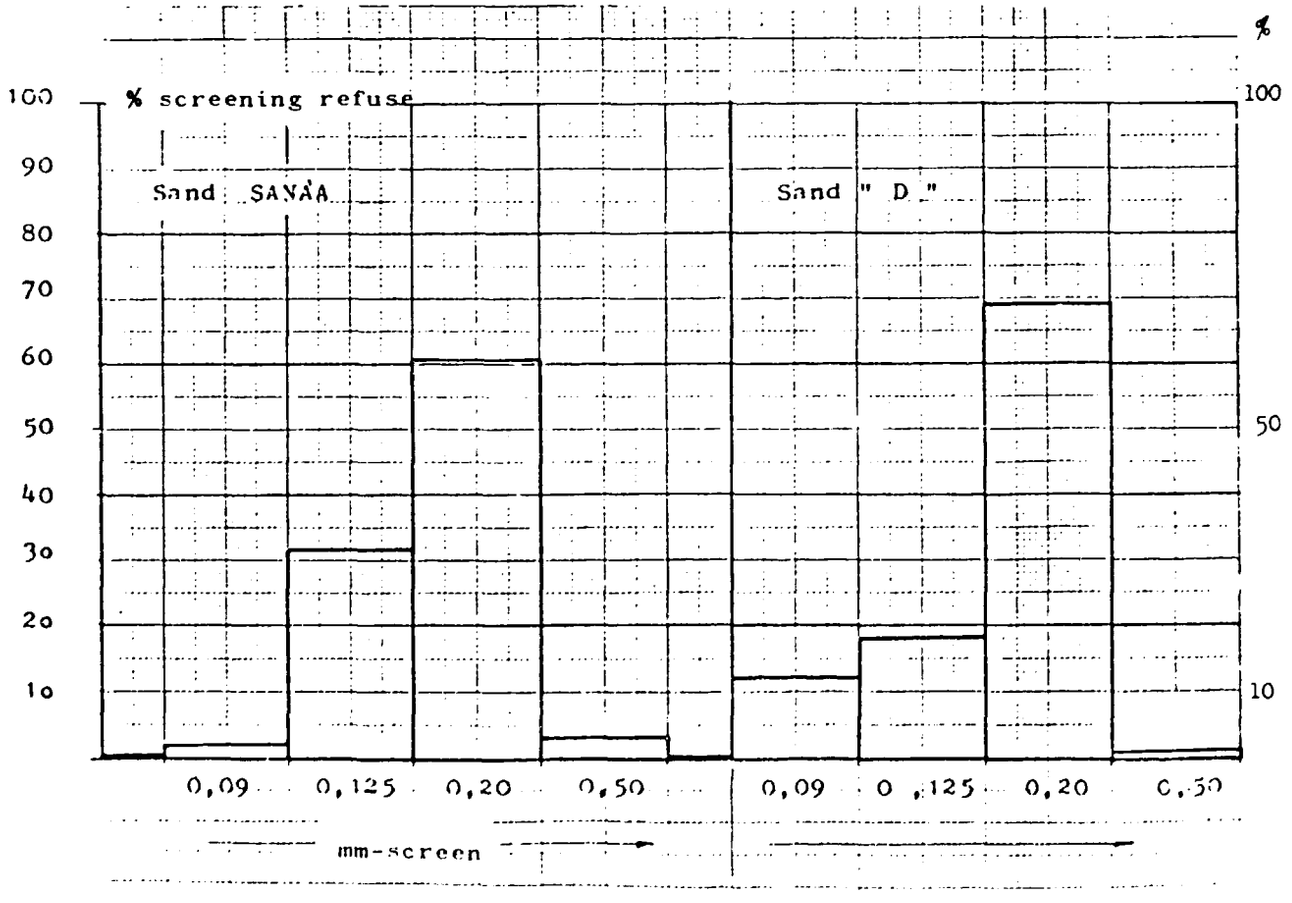
0.4 % Al_2O_3

0.1 % Alkalies

0.3 % loss on ignition

and other minerals such as feldspar, mica and heavy minerals such as rutile, anatas, garnets, disthene, chromite, magnetite, hematite and manganese which are only present in traces.
The analysed sample can be classified as first quality glass sand due to its excellent purity and very good grainsize distribution.

Diagram 1: Grain size distribution of the sand "Sana'a" in comparison to a I-A quality sand from the Federal Rep. of Germany



In the case of constant quality after dry cleaning (screening to 0.5 mm and if necessary dedusting) it is suitable as glass sand not only for a production of coloured glass (emarald-amber) but also for table ware and crystal glass.

As a result of screen analysis and elutriation between 94% and 98% of the raw material can be used depending on the projected quality of the final product without regard to the technically possible usability of the oversize and the slam matter.

Melting Tests

The time for melting and clearing was close to the corresponding values of spar-free, Westeuropean, first quality glass sands.

Blisters, seedes, streaks, cordes and other degasification effects reducing the quality could not be detected in laboratory tests.

The attached test glass melting samples'J'(sand Sana'a) and 'D' (sand Fed.Rep.of Germany) were melted under the same conditions and it must be added that the fractions more than 0.5 mm and less than 0.09 mm of the sample 'J' were separated.

Chemical Analysis of both Glass Samples

	Mass% Sand 'J'	Mass% Sand 'D'
SiO_2	59.30	59.20
Na_2O	25.40	25.40
Li_2O	0.90	0.90
CaO	12.30	12.30
MgO	1.90	1.90
Al_2O_3	traces	0.10
Fe_2O_3 and K_2O	traces	traces
	99.80	99.80

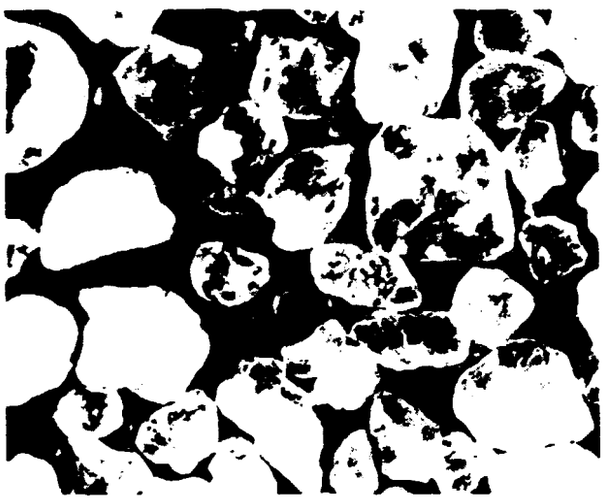
Sand Sana'a - Use as molding material in the metal iron and steel foundry

The investigation of the sand sample'Sana'a' for its usability as molding material showed following foundry-technical values:

	Sand Sana'a (crude)	typical comparative sands (BRD) (graded)	
screening portion	mass%	mass%	mass%
more than 1 mm	0.05	-	-
1.0 - 0.5 mm	3.05	2.5	2.0
0.5 - 0.2 mm	60.85	76.0	39.0
0.2 - 0.125 mm	32.65	18.0	54.0
0.125 - 0.09 mm	1.90	1.6	3.0
0.09 - 0.063 mm	0.30	1.0	1.0
less than 0.063	0.25	.0.5	0.4
slam matter %	0.60	0.3	0.4
real specific surface cm^2/g	147	135	160
number of permeability to gas	220	250	200
24 hours bending strength N/mm^2	260	290	250
AFS - value	58	51	61
Beginning of sintering	1500°C	1450°C	more than 1500°C

Quartz sand of the same composition as sand sample 'Sana'a' is even as raw material suitable for the metal as well as the iron and steel foundry.

It can be used as middle fine foundry sand with high refractoriness and high sintering point. It can be expected that even values not having been investigated which are of interest for clay or carbonate bond molds and cores will show similar positive results.



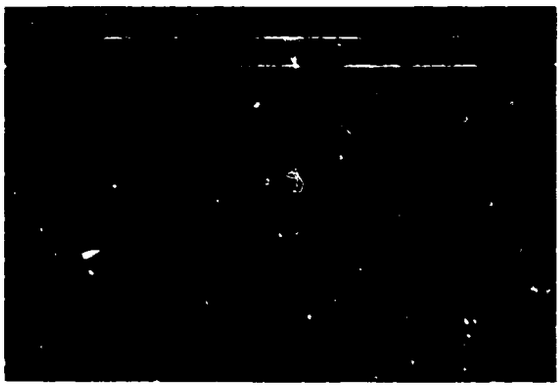
44 x

Photos 1 and 2 show edges curved grains with high degree of uniformity and among them by nature some splintery grains.

200 x

Photo 2

Photo 3 shows the surface quality of a grain from sample 'Sana'a'



1000 x

Examples for Typical Glass Batches

Window Glass - Sheet Glass (produced by Method of Fourcault)

typical analysis	wt.%	typical batch	(parts)
SiO_2	72.9	sand	1000
Al_2O_3	1.0	soda ash	370
Fe_2O_3	0.15	Na_2SO_4 (salt cake)	4
CaO	9.1	calcined dolomite	110
MgO	3.4	burned lime	60
Na_2O	13.2	feldspar	60
SO_3	0.3		

Container Glasses - Bottles - Cans etc.

Container Glasses Crystal Glass		Amber Bottles	
typical analysis	wt.%	typical analysis	wt.%
SiC_2	72.0	SiO_2	73.0
Al_2O_3	0.9	Al_2O_3	0.3
Fe_2O_3	0.1	Fe_2O_3	0.5
CaO	9.1	CaO	8.6
MgO	-	MgO	1.5
$Na_2O + K_2O$	16.9	$Na_2O + K_2O$	15.6
MnO	0.1	MnO	0.5

Laboratory Ware "p"

typical analysis	wt.%
SiO_2	80.5
Al_2O_3	2.0
CaO	0.3
Na_2O+K_2O	4.6
B_2O_3	11.8
As_2O_3	0.7

Typical Batch for Bottles, Laboratory ware and Lead Crystal

	amber bottles	lab ware	lead crystal
sand	1000.0	1000.0	1000.0
limestone	192.0	-	-
dolomite	144.0	-	-
soda ash	383.0	-	60.0
N-syenite	125.0	-	-
Na_2SO_4	16.0	-	-
Fe-oxide	3.0	-	-
coal	3.0	-	-
NaCl	-	42.0	-
B_2O_3	-	196.0	4.0
pyrobor	-	181.0	-
lepidolite	-	99.0	-
borax	-	30.0	-
PbO	-	-	510.0
K_2CO_3	-	-	237.0
As_2O_3	-	8.0	0.9

Cost of Raw Materials - Average Values 1979

for Middle - Europe

	US $/tonne*
lime powder 0.015% Fe_2O_3	18
soda ash	154
unburned dolomite powder	14
$BaCO_3$	231
Na_2SO_4	77
$NaNO_3$	246
Na-feldspar	38 - 92
B_2O_3	923-1231
borax calc.	654

Decolourizers	US $/kg*
zinc-selenite	28
cobaltoxide	11
As_2O_3	1

* original values were given in Austrian Shillings

1 US $ = 13 AS

AMOUNT AND COST OF ENERGY NEEDED

Today's maximum temperatures in modern tanks for glass with high flow rates are supposed to be approximately between 1550° and 1600°C.

The Feeder-temperature for today's produced sorts of hollow glass ware is indicated to be 1300°C on the average.

On the other hand soft lead crystal glass (crystal glass or TV bulbs) reaches the viscosity needed for processing at 1200°-1250°C.

The amount of energy needed for manufacture of saleable products will therefore extremely depend on the sort of glass, the raw materials, the recycling of heat, insulation, the type of the oven and many other factors. Therefore one can only assume average empirical values which partly exceed the theoretical values of energy consumption.

Amount of Energy Needed for	kcal/kg	KWh
hollow glass - saleable	5000-15000	6-20
plate glass (window panes produced by using Fourcault process)	4300-6000	5-7
plate glass (window panes produced with Float-method	5000-6000	6-7
raw glass- full electrically melted	690-2100	0.8-2.4
raw glass- oil and gas fired	3000-4000	3.5-4.7

(Dr.Dipl.Ing.A.Mayer)

(Dipl.Ing.W.Pistora)

Translation (not literal)

Glass Sand Al Jiraf Yemen

VÖEST-ALPINE
Research, Development, Quality and Raw Material Technology
RFR Leoben
Report Nr.86/79
Ref.DI Dr.H.Kolb
Leoben 1979 11 14

A sand sample, provided by Prof.Schmidt, MUL was investigated for suitability as raw material for glass production.
Sample material about 2 kg, fine grained, dry.

Granulometric Analysis:
The sieve analysis of the sample is contained in Tab.1, the graphic representation is given in Fig.1.

Chemical Analysis:

Fe_2O_3	0.03%
SiO_2	98.56%
Al_2O_3	0.47%
K_2O	0.108%
Na_2O	0.027%

According to these results the sand is very well suited for the glass industry (white glass products) without sorting.

Mineralogical Investigation:
From the sample a heavy minerals concentrate was obtained by means of floating and heavy liquids. In this concentrate the following minerals were found, in order of frequency:
Monazite
Zirkon
Hematite
Ilmenite
Rutil.

Conclusions for Dressing:
The iron content of the raw material is sufficiently low for the production of white glass. If the small content of feldspar remains constant, this constituent needs not to be removed.
If a lower iron content is desired in the final product, a simple dressing method, by floating or floatation can achieve this. With an Oxidfloatation the above mentioned minerals could be removed to a fair degree. Simpler and cheaper can this be achieved also by floating (hearth), as the content of heavy minerals is very low. In both cases a sorting of the material is necessary first. In Fig.2 a procedure proposal is presented. Before any further considerations, though, the intended final product has to be ascertained. When receiving sufficient data, as outlined in the investigation sheets for dressing installatiors by VÖEST-ALPINE AG, further proposals can be worked out.

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT

ASSUMPTIONS UNDERLYING FINANCIAL PROJECTIONS

A. Financial Cash Flow

1. Capital costs are based on 1980 price quotations for equipment and building plus escalation of 15% to arrive at mid-1981 estimated costs. A 10% contingency allowance is included. Planning, construction and commissioning cover three years.

2. Input prices of materials and spare parts are at estimated 1981 levels. Manpower costs comprising about 25% of direct expenses will need to be reviewed in the light of actual manpower availability and cost in 1981.

3. Customs duties on capital equipment and imported materials and spare parts are assumed to be exempt for the entire life of the project in as much as the project is likely to have approved investment status.

4. Sales income is based on a bottle price of YR 1.20 ex works during the first five years of operation. This corresponds to a 25% protective duty instead of the present 15%, to which the project reverts in year six onwards with a sales price of YR 1.10 per bottle, equivalent to US$ 620 and $ 568 per ton respectively.

5. Production of a standard-size 0.25 litre bottle weighing 0.43 kg as used by the beverage firms is assumed.

6. Capacity utilization in tons and numbers of standard bottles is 60% in year 4, the first year of operation, 75% in year 5, increasing by 2.5% per year to a maximum of 85%, when output amounts to 33.8 million bottles weighing 14,550 tons.

7. Furnace rebuilding will reduce production to 77.5% of capacity in the sixth year of operation and in each succeeding fifth year thereafter, resulting in reduced profitability and net cash flow in those years.

8. Maintenance. There is a generous provision for maintenance, including replacement, of fixed assets such as furnace refactories and vehicles, which are included in the operating rather than the capital account for the sale of simplicity.

9. Operating cash flow comprises sales revenue (after build-up of finished stocks), less variable and fixed direct costs which do not include capital charges (depreciation and loan interest and repayments). All prices are at constant, 1981 estimated prices.

10. The financial rate of return and sensitivity analysis are derived from the operating cash flow summarized at Annex 8.

B. Economic Rate of Return

11. In view of the strength of the Yemeni currency only two adjustments are made to the financial cash flow:

(1) Sales income is reduced by the amount of the customs duty on imported bottles.

(2) Power charge. The conomic cost of electricity is assessed at YR 0.50 per kWh, based on the comparatively low price of petroleum products from neighbouring supplier countries. As explained in paragraph 66 of the report, the cost of generating and distributing electricity from the new thermal should be of the above order using heavy fuel oil at the prevailing price of YR 0.59 per kg.

C. Balance Sheet and Profit and Loss Projections

12. Financing Plan. An appropriate financing plan is employed to give prospective investors an indication of the return expected on the share capital.

13. Equity: Loan Ratio of 40:60 is assumed at the end of the construction period:

	YR million	US$ million equivalent	%
Share capital	30	6.7	40
Long term loans	45	10.0	60
Total finance	75	16.7	100

14. Loan terms. The average principal terms and conditions for the loans are:

Interest: 8.5% p.a.
Grace period: 1.5 years from start of operations
Repayments: over 10 years subsequent to the grace period

The terms, with the possible exception of the grace period, are generally consistent with export credit financing conditions available for projects in the YAR.

15. Depreciation of fixed assets at YR 2.8m per annum averages 5% of the initial total fixed asset value.

16. Amortization of other assets (pre-production expenses including interest, etc.) is YR 1.3 million p.a. over ten years.

17. Corporate Tax. As an approved investment, complying with Law No. 12 of 1970, the project is assumed to be exempt from profits tax during the first five years of operation. Thereafter, tax of 35% is deducted from annual profits after depreciation and amortization. Actual tax allowances may be higher or lower than this.

18. Distribution of Profits. After-tax profits are mainly distributed as dividends. Retained profits are maintained at a low level on the assumption that a separate financing plan will be made for project expansion.

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT

Projected Operating Income and Cash Flow

(YR'000)

Year 1/	Operational Period 1	2	3	4	5	6	7	8 to 10 2/	11	12	13 to 15 2/
Production Data											
Capacity utilization (%)	60	70	75	77.5	80	77.5	85	85	77.5	85	85
No. of bottles (million)	23.9	27.8	29.8	30.8	31.8	30.8	33.8	33.8	30.8	33.8	33.8
Bottle production (tons)	10,277	11,975	12,835	13,265	13,695	13,265	14,550	14,550	13,265	14,550	14,550
Revenue											
Net sales revenue 3/	27,250	33,180	35,800	36,970	38,160	34,125	37,075	37,235	34,095	37,075	37,235
Increase in finished goods	1,430	240	130	50	40	- 190	160		- 160	160	
Production value	28,680	33,420	35,930	37,020	38,200	33,935	37,235	37,235	33,935	37,235	37,235
Variable Direct Costs											
Raw materials	4,400	4,970	5,200	5,265	5,340	5,265	5,890	5,890	5,265	5,890	
Power, fuel, water	6,040	6,870	7,195	7,440	7,685	7,440	8,160	8,160	7,440	8,160	
Molds	825	970	1,015	1,045	1,080	1,045	1,050	1,050	1,045	1,050	>18,925
Packing materials	305	360	385	400	410	400	435	435	400	435	
Wages	2,880	3,220	3,390	3,390	3,390	3,390	3,390	3,390	3,390	3,390	
Total	14,450	16,390	17,185	17,540	17,905	17,540	18,925	18,925	17,540	18,925	18,925
Fixed Direct Costs											
Salaries	2,140	2,140	2,140	2,140	2,140	2,140	2,140	2,140	2,140	2,140	
Lubricants, etc.	400	400	400	400	400	400	400	400	400	400	
Spare parts	350	700	1,400	1,400	1,400	2,400	1,400	1,400	2,400	1,400	> 4,540
Repairs	100	250	500	500	500	1,000	500	500	1,000	500	
Training, office, etc. costs	450	275	200	100	100	100	100	100	100	100	
Total	3,440	3,765	4,640	4,540	4,540	6,040	4,540	4,540	6,040	4,540	4,540
Total Direct Costs	17,890	20,155	21,825	22,080	22,445	23,580	23,465	23,465	23,580	23,465	23,465
Operating Income before interest and depreciation	10,790	13,265	14,105	14,940	15,755	10,355	13,770	13,770	10,355	13,770	13,770
Cash Flow before interest charges	9,360	13,025	13,975	14,890	15,715	10,545	13,610	13,770	10,515	13,610	13,770

1/ Furnace relining in sixth year of operation repeated in eleventh year of operation.

2/ Per annum in years 8-10 and 13-15.

3/ Sales price YR 1.20 in years 1 through 5 and YR 1.10 therafter.

ANNEX 9

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT

Financial and Economic Internal Rates of Return

(YR'000)

A. FINANCIAL RATE OF RETURN

Capital Expenditure

Year	1	7,000
	2	28,150
	3	38,125
Total:		73,275

Operating Cash Flow 1/

Year	1	9,360
	2	13,025
	3	13,975
	4	14,890
	5	15,715
	6	10,545
	7	13,610
	8	13,770
	9	13,770
	10	13,770
	11	10,515
	12	13,610
	13	13,770
	14	13,770
	15	13,770
		203,685
	16	16,135
Total:		214,000

B. ECONOMIC RATE OF RETURN

No adjustments to Financial Capital Expenditure

Adjustments to Financial Cash Flow:

	Deduction from Sales 3/	Expenses (Power) 4/	Net Deductions	Net Cash Flow
	4,992	1,764	3,228	
	6,080	2,007	4,073	
	6,562	2,098	4,464	
	6,778	2,169	4,609	
	6,988	2,239	4,749	
	3,844	2,169	1,675	
	4,041	2,379	1,662	
	4,059	2,379	1,680	
	4,059	2,379	1,680	
	4,059	2,379	1,680	
	3,716	2,169	1,547	
	4,041	2,379	1,662	
	4,059	2,379	1,690	
	4.059	2,379	1,680	
	4,059	2,379	1,680	
Total:	71,396	33,647	37,749	176,251

Present Value

Discounted at	Capital Expenditure	Operating Cost Flow	NPV
0%	73,275	214,000	+ 140,285
[illegible]	60,880	92,542	+ 31,662
10%	58,275	77,126	+ 18,851
13%	54,627	59,717	+ 5,090
15%	52,439	50,893	- 1,546

Present Value

Discounted at	Net Deductions	NPV
0%	- 37,749	102,536
8%	- 19,241	+12,421
10%	- 15,702	+ 3,149
13%	- 13,475	- 8,385
15%	- 11,135	-12,681

Internal Rate of Return: Financial 14.5%

Economic 10.8%

1/ Sales revenue less direct costs from Annex 8, Projected Operating Cash Flow.

2/ Operating years 1 to 15 represent years 4 to 15 subsequent to the planning and construction period.

3/ Protective tariff deducted; 25% in years 1 to 5 and 15% of cif value thereafter.

4/ Economic cost of electricity is estimated at 50% of the tariff (YR 1.00 or US cents 22 a unit), representing a deduction of approximately 28% of the fuel, power, and water charge.

5/ Pay back of the project capital expenditure is effected in the sixth year of operation. Cash flow at end of sixth year amounts to YR 77,510 million.

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT

Sensitivity Analysis

Discounted rate of return on expenditure of YR 73,275 million over fifteen years following three year planning and construction period (Annex 9)

1. Financial Internal Rate of Return

Base case		14.5%
Capital expenditure	plus 10%	12.9%
	plus 20%	11.6%
	plus 50%	8.2%
Operating cash flow delayed one year		12.6%
Sales price	plus 10%	18.9%
	minus 10%	9.7%
Sales price at YR 1.10 per bottle throughout		12.5%
Total direct costs	plus 10%	11.7%
	minus 10%	17.2%
Variable direct costs	plus 5%	13.4%
	plus 10%	12.3%
	minus 10%	16.7%
	minus 12.5%	17.2%
Wages and Salaries	plus 10%	13.8%
	plus 20%	13.0%
	plus 50%	10.9%
Electricity	minus 50%	17.2%
Fuel oil	plus 50%	13.4%
Production lower by	10%	12.3%
	20%	9.7%
	30%	7.1%
Bottle weight reduced to 0.34 kg		16.2%

2. Economic Internal Rate of Return

Base case	10.8%
Bottle weight reduced to 0.34kg	12.0%

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT

Projected Income Statement

(YR'000)

Year	Operational Period 1	2	3	4	5	6 1/	7	8	9	10	11 1/	12	13	14	15
Operating Income 2/	10,790	13,265	14,105	14,940	15,755	10,355	13,770	13,770	13,770	13,770	10,355	10,770	13,770	13,770	13,770
Less: Overhead Costs	7,925	7,830	7,450	7,070	6,690	6,310	5,930	5,550	5,170	4,790	3,110	2,800	2,800	2,800	2,800
Depreciation, Amortization 3/	4,100	4,100	4,100	4,100	4,100	4,100	4,100	4,100	4,100	4,100	2,800	2,800	2,800	2,800	2,800
Loan Interest	3,825	3,730	3,350	2,970	2,590	2,210	1.830	1,450	1,070	690	310				
Income before Tax	2,685	5,435	6,6,55	7,870	9,065	4,045	7,840	8,220	8,600	8,980	7,245	10,970	10,970	10,970	10,970
Tax Liability						1,415	2,745	2,875	3,010	3,190	2,535	3,840	3,840	3,840	3,840
Earnings After Tax	2,865	5,435	6,655	7,870	9,065	2,630	5,095	5,345	5,590	5,790	4,710	7,130	7,130	7,130	7,130
Retained Earnings											1,000	1,000			
Available for Dividends	2,865	5,435	6,655	7,870	9,065	2,630	5,095	5,345	5,590	5,790	3,710	8,130	7,130	7,130	7,130
Percentage Return on Share Capital															
Earnings	9.5	18.1	22.2	26.2	30.2	8.8	17.0	17.8	18.6	19.3	15.7	23.8	23.8	23.8	23.8
Dividends	9.5	18.1	22.2	26.2	30.2	8.8	17.0	17.8	18.6	19.3	12.7	17.1	23.8	23.8	23.8

1/ Furnace relining in sixth year of operation repeated in eleventh year of operation.

2/ Annex 8: Projected Operating Income

3/ Depreciation 2,800 p.a. and Amortization (in years 1 to 10) 1,300 p.a.

ANNEX 11

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT

Projected Balance Sheet

(YR'000)

	Construction Period			Operational Period														
Year	1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
ASSETS																		
Current Assets	1,000		4,000	7,150	9,000	8,200	8,400	8,000	9,015	9,945	9,675	9,410	9,190	7,835	8,690	11,490	14,290	17,090
Cash and bank deposits	1,000		100	450	1,860	1,380	930	240	1,445	2,215	1,945	1,680	1,460	265	960	3,760	6,560	9,360
Raw materials			600	1,400	1,600	1,750	1,750	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	7,730	7,730	7,730
Finished goods				1,430	1,670	1,800	1,850	1,890	1,700	1,860	1,860	1,860	1,860	1,700	1,860			
Packing and other materials			200	420	120	420	420	420	420	420	420	420	420	420	420			
Molds and spare parts			3,100	3,450	3,450	3,450	3,450	3,450	3,450	3,450	3,450	3,450	3,450	3,450	3,450			
Fixed Assets	5,000	31,000	59,750	56,950	54,150	51,350	48,550	45,750	42,950	40,150	37,350	34,550	31,750	28,950	26,150	23,350	20,550	17,750
At cost	5,000	31,000	59,750	59,750	59,750	59,750	59,750	59,750	59,750	59,750	59,750	59,750	59,750	59,750	59,750	59,750	59,750	59,750
Less: accumulated depreciation				2,800	5,600	8,400	11,200	14,000	16,800	19,600	22,400	25,200	28,000	30,800	33,600	36,400	39,200	42,000
Other Assets	2,000	5,000	13,000	11,700	10,400	9,100	7,800	6,500	5,200	3,900	2,600	1,300	—					
Project preparation, pre-op. interest and expenses	2,000	5,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000					
Less: Accumulated depreciation				1,300	2,600	3,900	5,200	6,500	7,800	9,100	10,400	11,700	13,000					
Total Assets	8,000	36,000	76,750	75,800	73,550	69,240	64,750	60,250	57,165	53,995	49,625	45,260	40,940	36,785	34,840	34,840	34,840	34,840
LIABILITIES																		
Current Liabilities			1,750	3,050	5,300	5,500	5,500	5,500	6,915	8,245	8,375	8,510	8,690	5,785	4,840	4,840	4,840	4,840
Short-term debt			1,150															
Accounts Payable			600	800	800	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Current maturities: L.T. debt				2,250	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	2,250				
Tax payable									1,415	2,745	2,875	3,010	3,190	2,535	3,840	3,840	3,840	3,840
Long-Term Debt		10,000	45,000	42,750	38,250	33,750	29,250	24,750	20,250	15,750	11,250	6,750	2,250	—				
Long-term loans		10,000	45,000	45,000	42,750	38,250	33,750	29,250	24,750	20,250	15,750	11,250	6,750	2,250				
Less: current maturities				2,250	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	2,250				
Share Capital and Reserves	8,000	26,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	31,000	30,000	30,000	30,000	30,000
Share capital	8,000	26,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Retained earnings														1,000				
Total Liabilities	8,000	36,000	76,750	75,800	73,550	69,240	64,750	60,250	57,165	53,995	49,625	45,260	40,940	36,785	34,840	34,840	34,840	34,840

ANNEX 12

[illegible] HOLLOW PLATE PROJECT

[illegible] Source and Application of Funds

([illegible])

erational Period											
4	5	6	7	8	9	10	11	12	13	14	15
7,877	9,065	2,630	5,095	5,345	5,590	5,790	4,710	7,130	7,130	7,130	7,130
4,100	4,100	4,100	4,100	4,100	4,100	4,100	2,800	2,800	2,800	2,800	2,800
11,977	13,165	6,730	9,195	9,445	9,690	9,890	7,510	9,930	9,930	9,930	9,930
11,977	13,165	6,730	9,195	9,445	9,690	9,890	7,510	9,930	9,930	9,930	9,930
4,500	4,500	4,500	4,500	4,500	4,500	4,500	4,500	2,250			
- 477	- 435	1,205	770	- 270	- 265	- 330	-1,195	695	2,800	2,800	2,800
	200	-1,105	100				- 100	100			
		400	-1,330	- 130	- 135	- 180	652	-1,409			
- 477	- 435	-1,505	- 430	- 400	- 400	- 510	- 450	2,800	2,800	2,800	
7,877	9,065	2,630	5,095	5,345	5,590	5,790	3,710	8,130	7,130	7,130	7,130
11,977	13,165	6,730	9,195	9,445	9,690	9,890	7,510	9,930	9,930	9,930	9,930

Year	Estimated Period					
	1	2	3	1	2	3
FUNDS PROVIDED						
Shareholders Equity	[illegible]	[illegible]	[illegible]			
Long-term Loans		[illegible]	[illegible]			
From Operations						
Net Income				[illegible]	[illegible]	[illegible]
Depreciation, Amortization				[illegible]	[illegible]	[illegible]
Total from Operations				[illegible]	[illegible]	[illegible]
TOTAL FUNDS PROVIDED	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FUNDS APPLIED						
Fixed Asset	[illegible]	[illegible]	[illegible]			
Other Assets	[illegible]	[illegible]	[illegible]			
Repayment of Long-term Debt					[illegible]	[illegible]
Working Capital						
Cash	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Inventories			[illegible]	[illegible]	[illegible]	[illegible]
Short-term Debt			[illegible]	[illegible]		
Acc ounts Payable			[illegible]	[illegible]		[illegible]
Tax Reserve						
Total Working Capital	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Cash Available for Dividends				[illegible]	[illegible]	[illegible]
TOTAL FUNDS APPLIED	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT

Capital Cost Estimate: Foreign Exchange and Local Currency Components

(YR million)

Capital Expenditure over three year implementation period:

	Total	Estimated In Foreign Currency	Estimated In Local Currency
Current Assets	3.90	3.58	.32
Raw materials	.50	.38	.12
Packing and other materials	.30	.25	.05
Molds and spare parts	3.10	2.95	.15
Fixed Assets	59.75	45.12	14.63
Land	5.00		5.00
Construction and buildings	12.50	5.00	7.50
Equipment	42.25	40.12	2.13
Other Assets	13.00	7.05	5.95
Project preparation, etc.	7.10	2.48	4.62
Pre-operating expenses	2.53	1.20	1.33
Interest during construction	3.37	3.37	
Total Capital Cost	76.65	55.75	20.90

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT

Estimated Foreign Exchange Component of Projected Operating Income

(YR million)

Year	1	2	3	4	5	6	7-10	11	12-15
Production Data									
Capacity Utilization (%)	60	70	75	77.5	80	77.5	85	77.5	85
No. of bottles (million)	23.9	27.8	29.8	30.8	31.8	30.8	33.8	30.8	33.8
Production Value[1/]	19.84	23.12	24.78	25.61	26.44	25.61	28.10	25.61	28.10
Variable Direct Costs	9.04	10.28	10.78	11.05	11.30	11.05	12.12	11.05	12.12
Raw materials	3.30	3.73	3.90	3.95	3.97	3.95	4.42	3.95	4.42
Power, fuel, water	4.71	5.35	5.60	5.79	5.97	5.79	6.35	5.79	6.35
Molds, packing materials	1.03	1.20	1.28	1.21	1.26	1.21	1.35	1.21	1.35
Fixed Direct Costs	1.70	1.99	2.77	2.70	2.70	2.70	2.70	2.70	2.70
Salaries	.60	.60	.60	.60	.60				
Lubricants, etc.	.35	.35	.35	.35	.35	2.70	2.70	2.70	2.70
Spare parts, repairs	.42	.85	1.70	1.70	1.70				
Training, office, etc.	.33	.19	.12	.05	.05				
Total Direct Costs	10.74	12.27	13.55	13.75	14.00	13.75	14.82	13.75	14.82
Estimated Foreign Exchange Income before Interest and Depreciation	9.10	10.85	11.23	11.86	12.44	11.86	13.28	11.86	13.28

1/ At CIF cost of imported bottles = YR 0.83 per bottle

ANNEX 15

YEMEN ARAB REPUBLIC: HOLLOW GLASS PROJECT

Estimated Foreign Exchange Savings

(YR million)

Construction Period

	Foreign Exchange Component in Capital Cost 1/	Less: Equity	Loans	NET F.E. Expenditure
Year 1	1.00	1.60		- .60
2	20.00	3.60	10.00	6.40
3	34.75	.80	35.00	- 1.05
Total	55.75	6.00	45.00	4.75

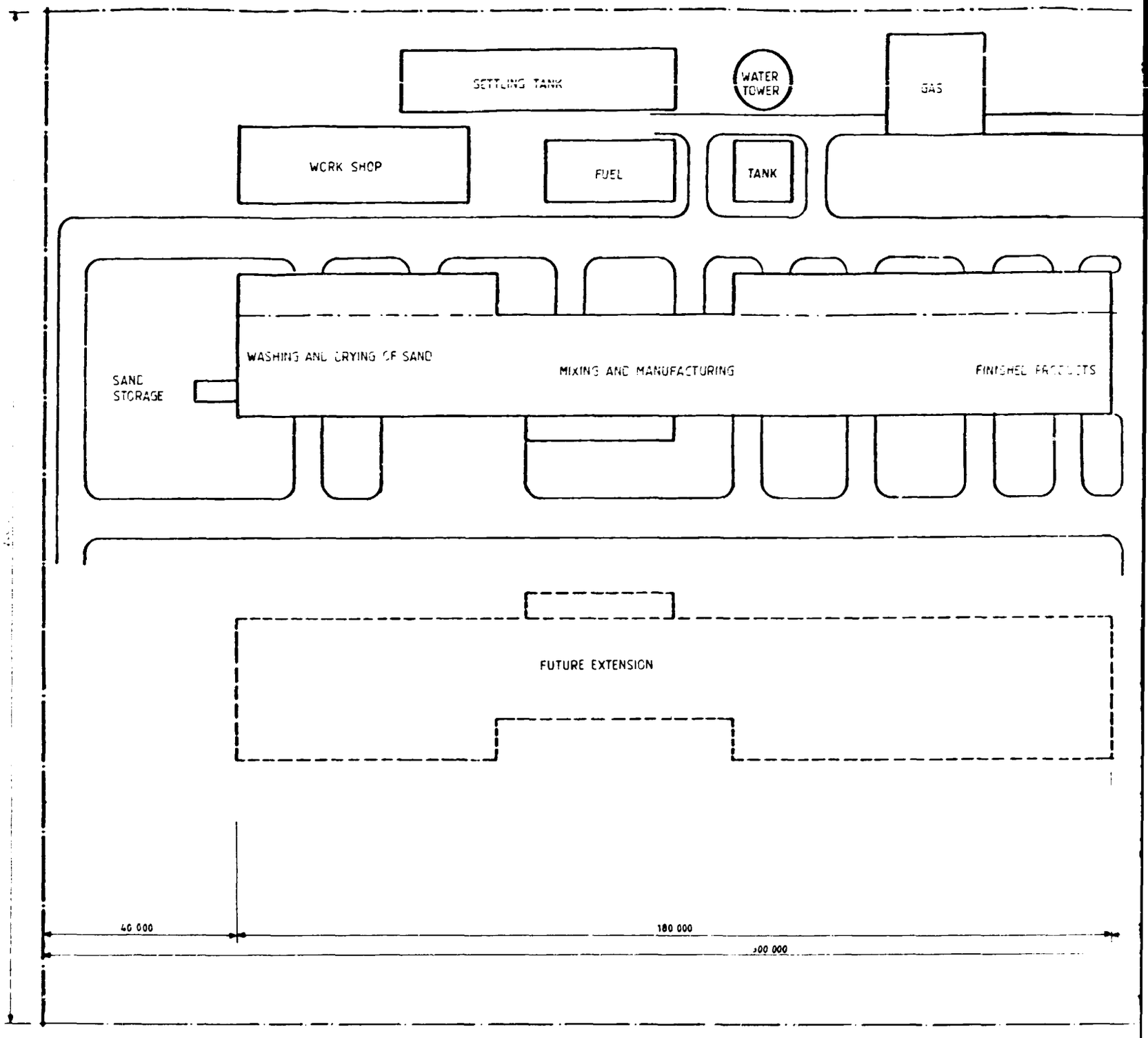
Operating Period

	Sales Value 2/	Less: Direct Expenses 3/	Operating Cash Flow	Less: Loan Servicing	Dividends	NET F.E. Savings
Year 1	19.84	10.74	9.10	3.82	.48	4.80
2	23.12	12.27	10.85	6.23	1.14	3.48
3	24.78	13.55	11.23	7.85	1.32	2.06
4	25.61	13.75	11.86	7.47	1.50	2.89
5	26.44	14.00	12.44	7.09	1.50	3.85
6	25.61	13.75	11.86	6.71	.90	4.25
7	28.10	14.82	13.28	6.33	.90	6.05
8	28.10	14.82	13.28	5.95	.90	6.43
9	28.10	14.82	13.28	5.57	.90	6.81
10	28.10	14.82	13.28	5.19	1.20	6.89
11	25.61	13.75	11.86	4.81	1.40	5.65
12	28.10	14.82	13.28	2.50	1.40	9.38
13	28.10					11.88
14	28.10	14.82	13.28	-	1.40	11.88
15	28.10					11.88

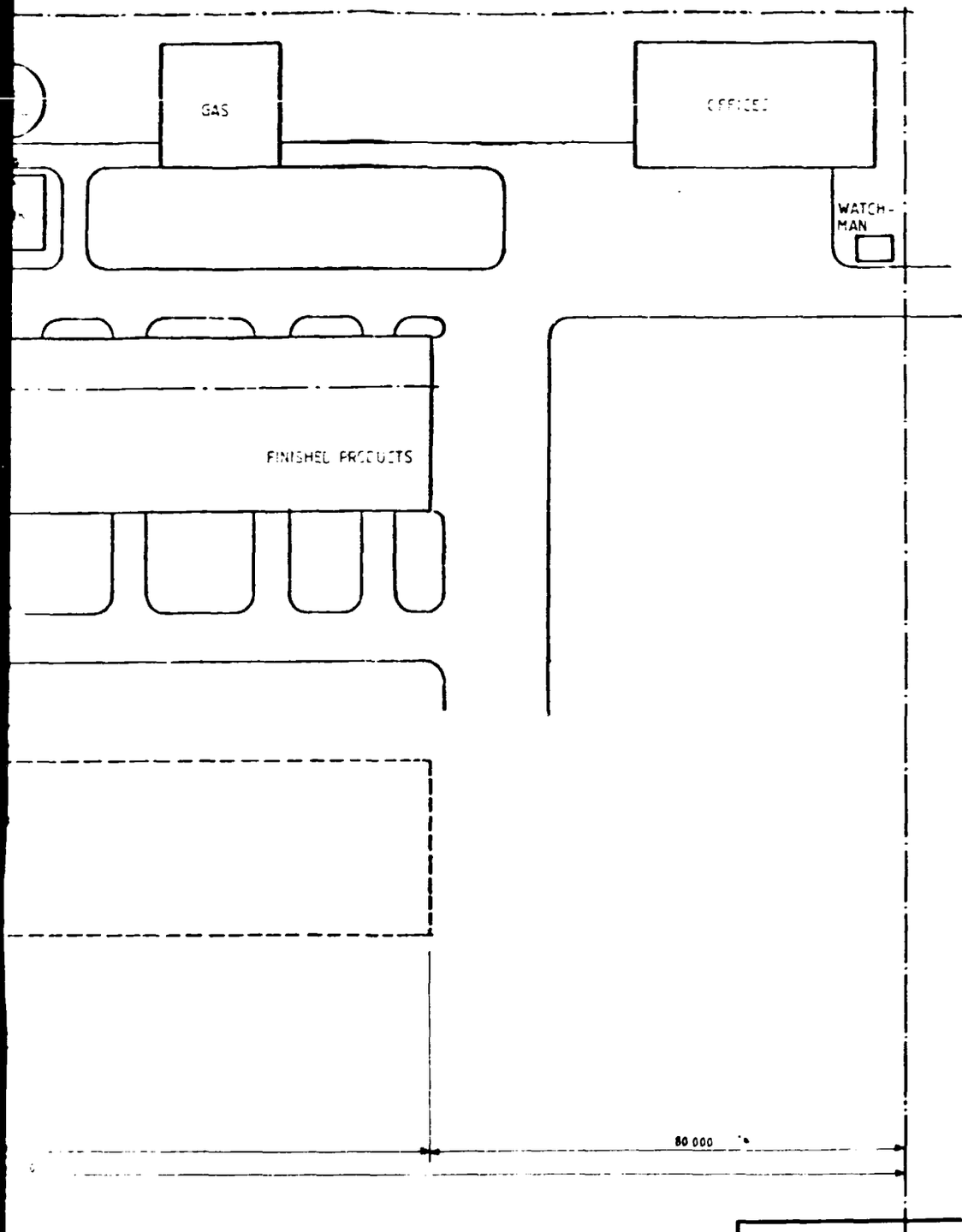
1/ Assumed foreign exchange components of capital expenditure from Annex 14.

2/ Sales at cif value of YR 0.83 per bottle.

3/ Foreign exchange content of direct expenses is shown in Annex 15.


SETTLING TANK
WATER TOWER
GAS
WORK SHOP
FUEL
TANK
SAND STORAGE
WASHING AND DRYING OF SAND
MIXING AND MANUFACTURING
FINISHED PRODUCTS
FUTURE EXTENSION
40 000
180 000
300 000

SECTION 1



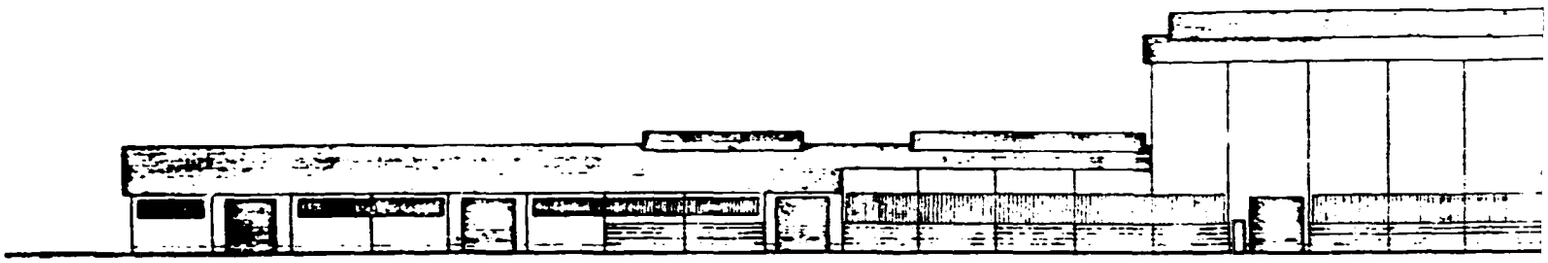
SWEDISH DEVELOPMENT CORPORATION AB **Stockholm, Sweden**	Drawn MK Checked Approved Date 25-9-80 Assignm no 20[illegible]

ANNEX 17 (1)

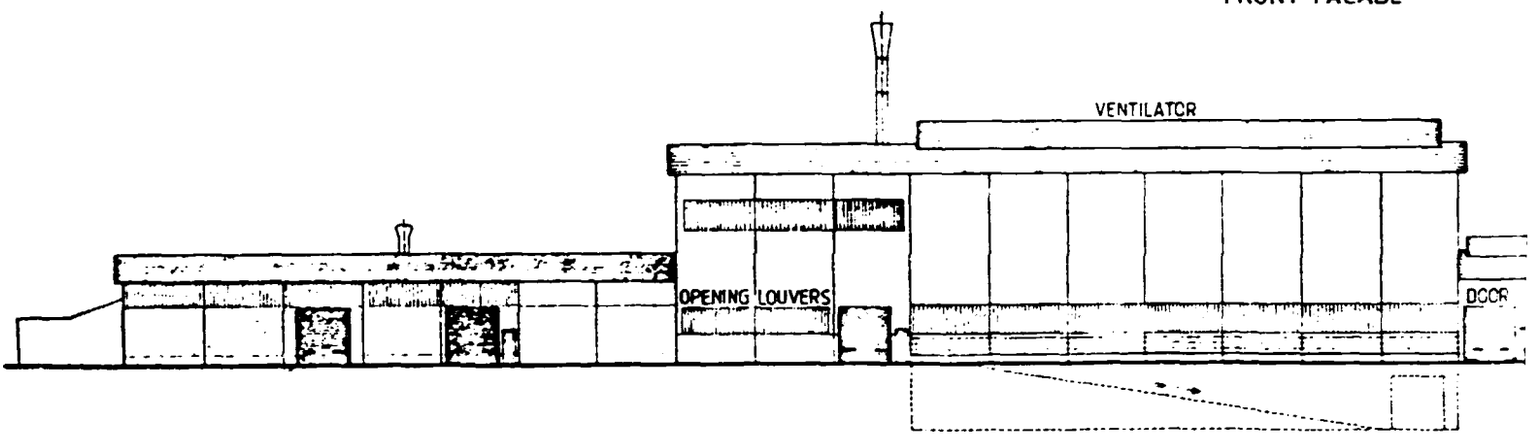
YEMEN ARAB REPUBLIC
SANA'A GLASS BOTTLE PROJECT
SITE PLAN

SECTION 2

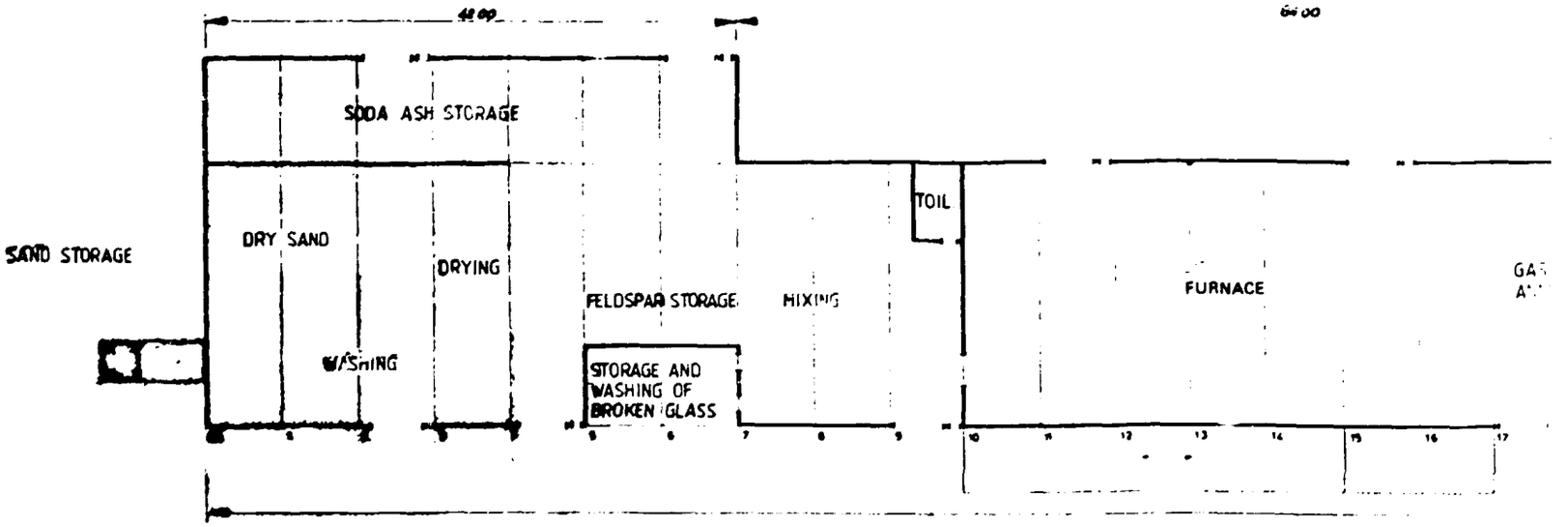
REAR FACADE



FRONT FACADE

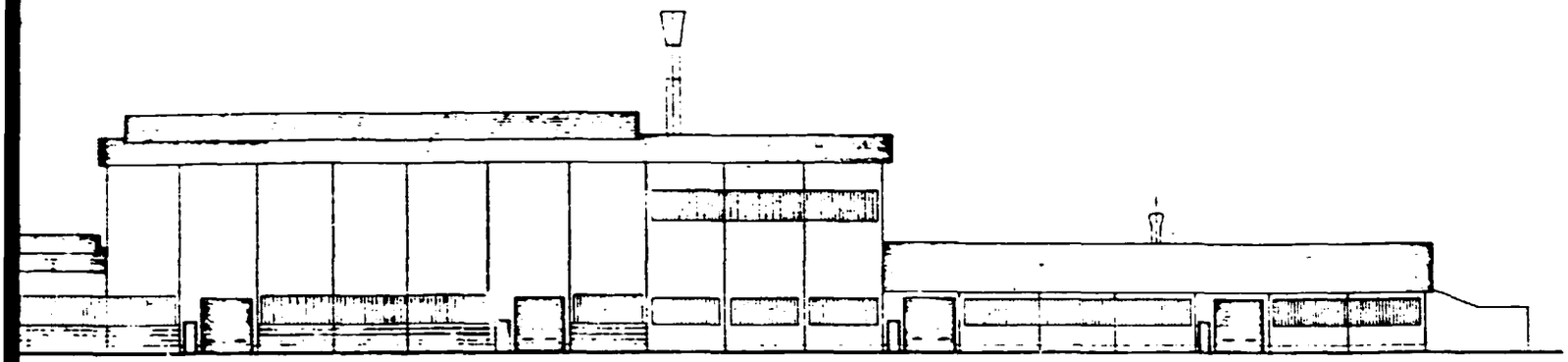


PLAN VIEW

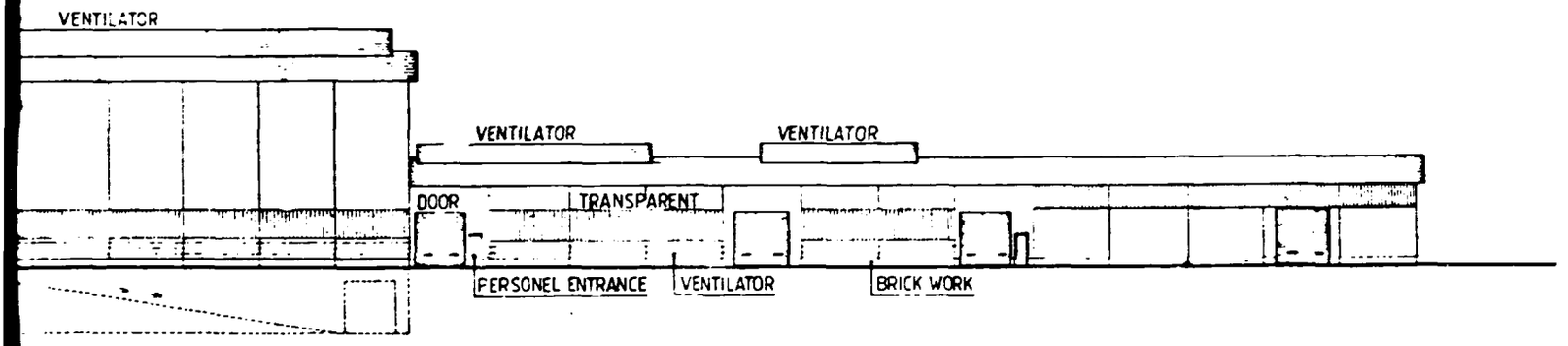


SECTION 1

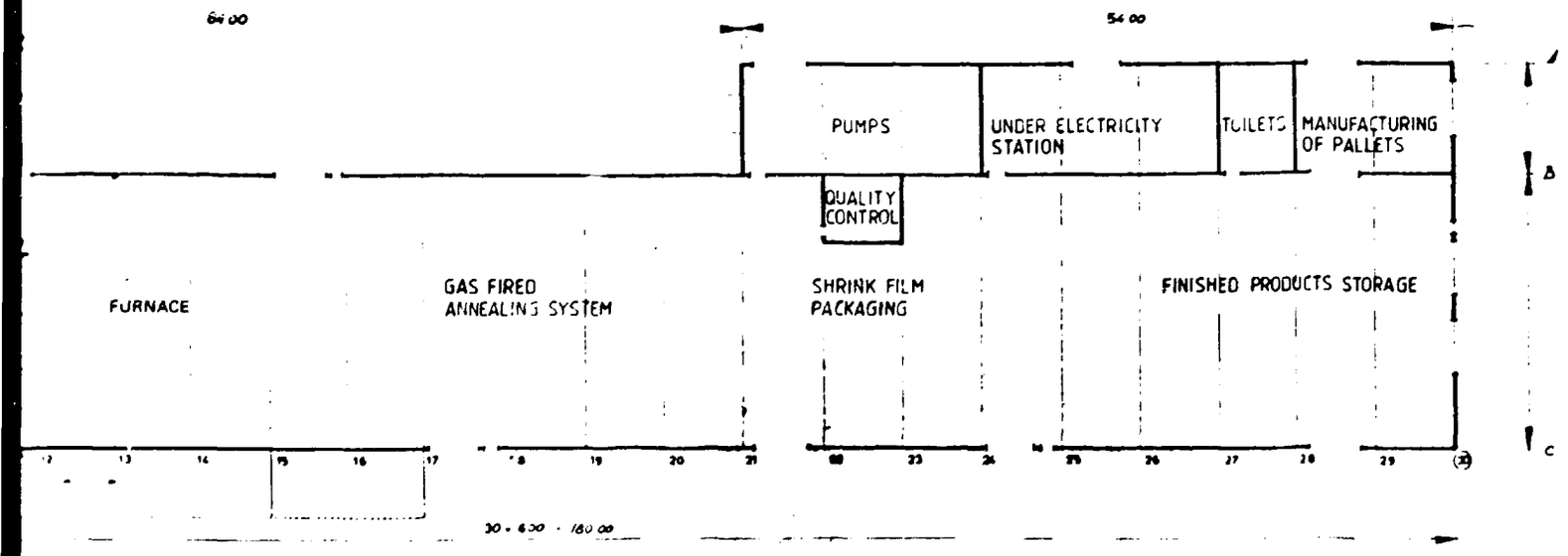
REAR FACADE



FRONT FACADE

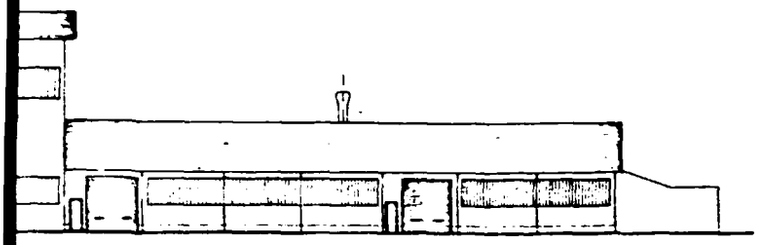


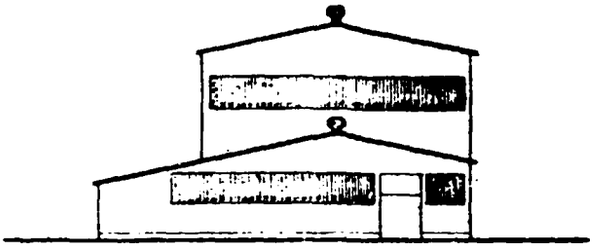
PLAN VIEW



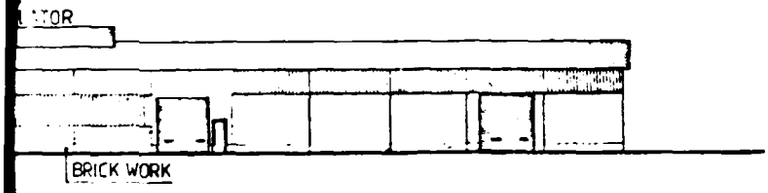
SECTION 2

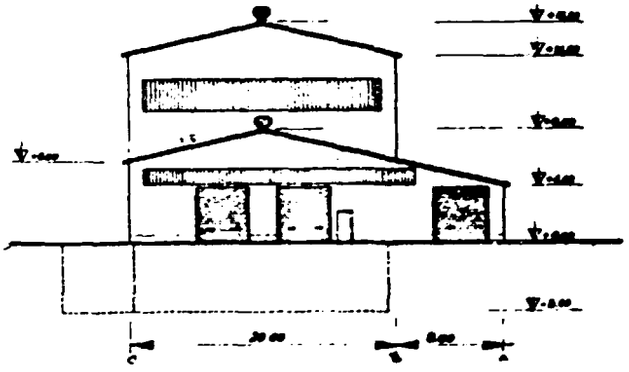
FRONT 0

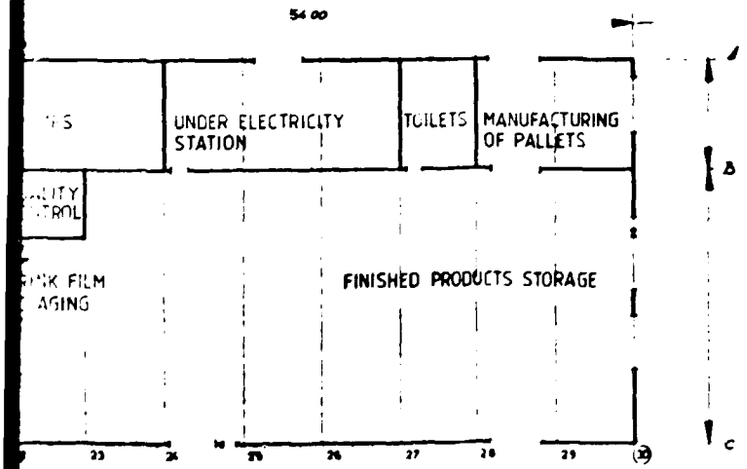




FRONT 30







SWEDISH DEVELOPMENT CORPORATION AB
Stockholm, Sweden

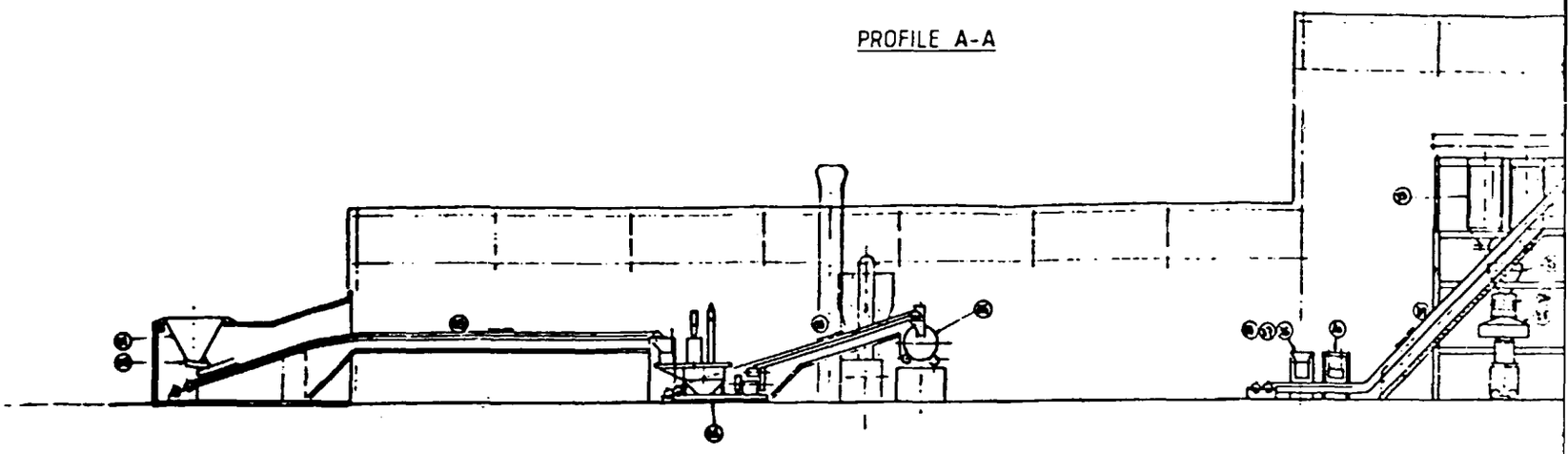
Drawn	MK
Checked	
Approved	LK
Date	26-9-80
Assignm. no.	8004012

ANNEX 17 (2)

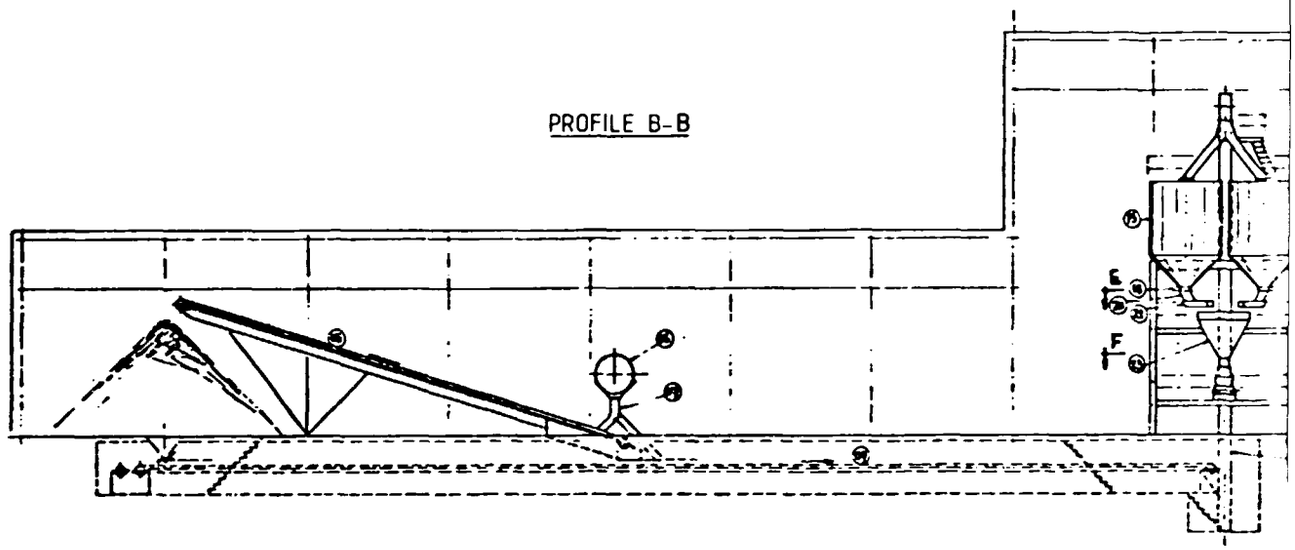
YEMEN ARAB REPUBLIC
SANA'A GLASS BOTTLE PROJECT
BUILDINGS

SECTION 3

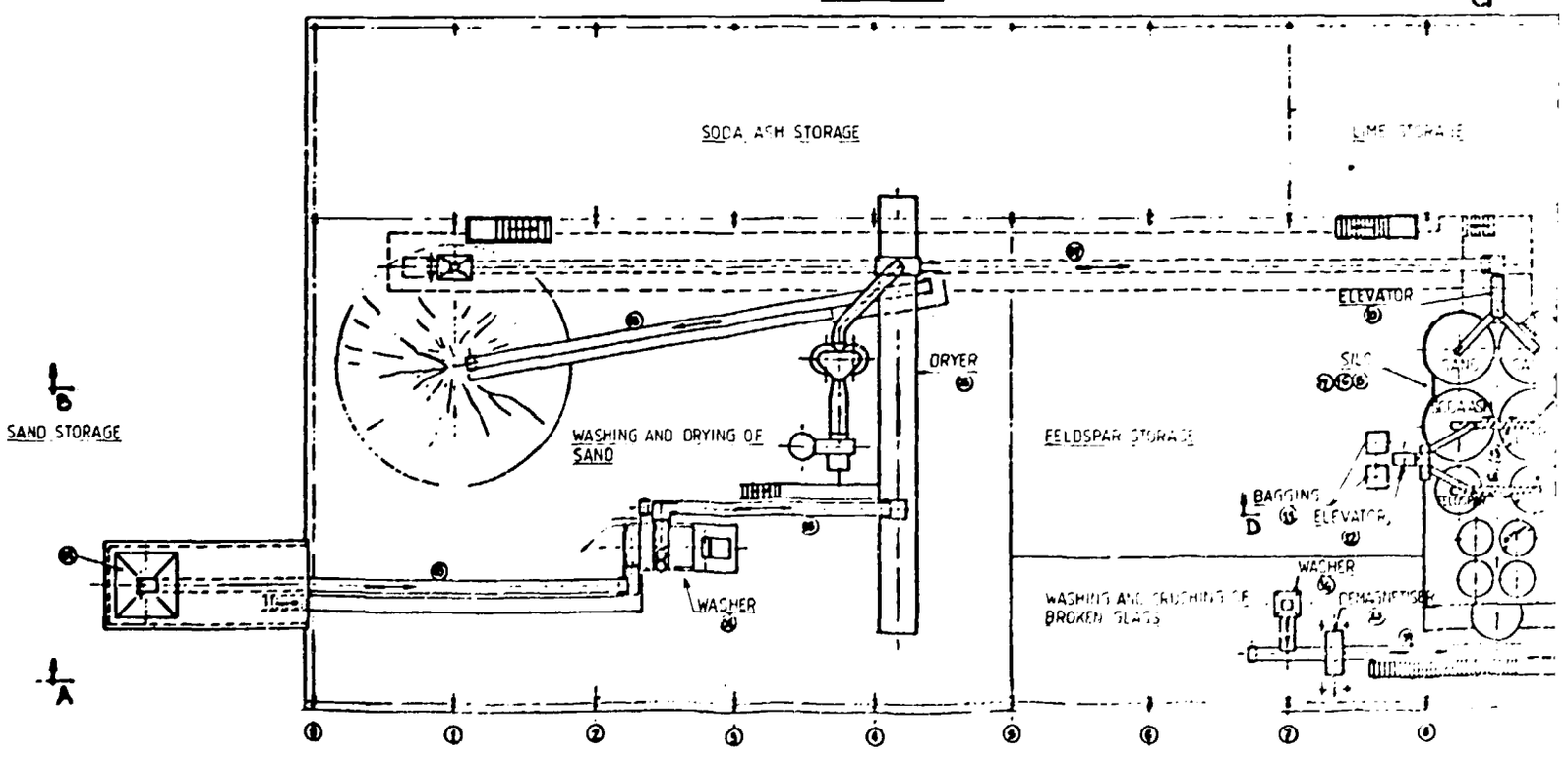
PROFILE A-A



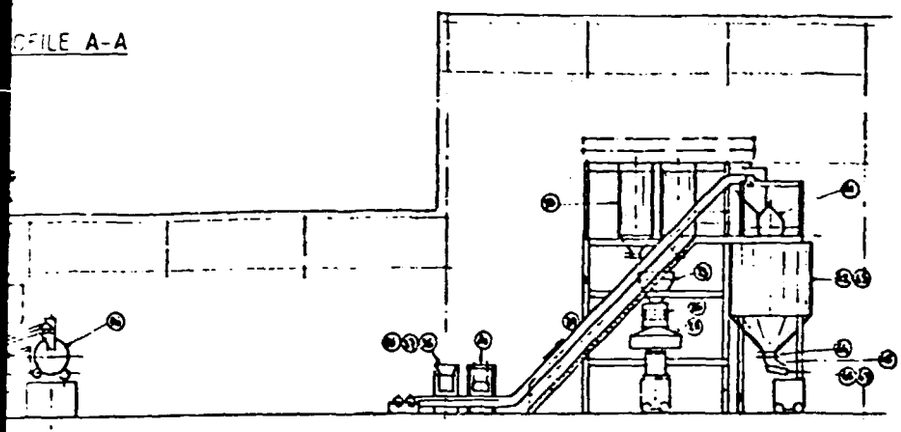
PROFILE B-B

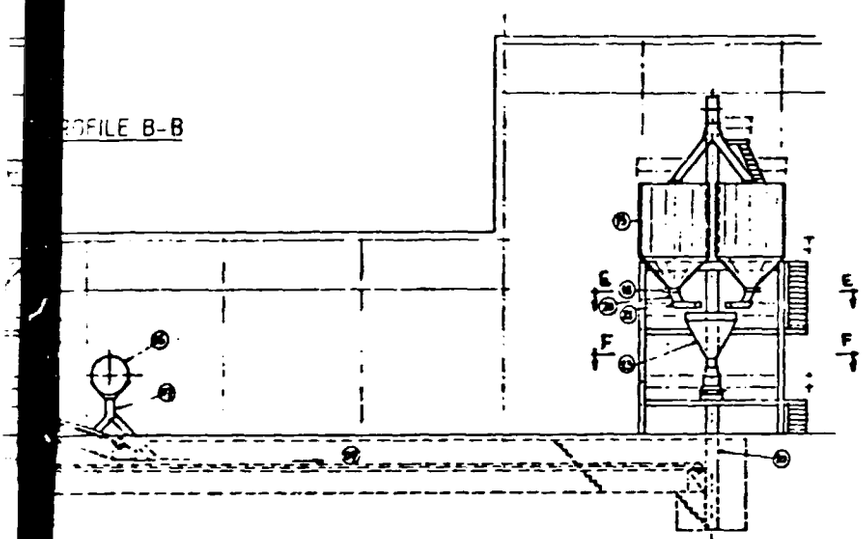


PLAN VIEW

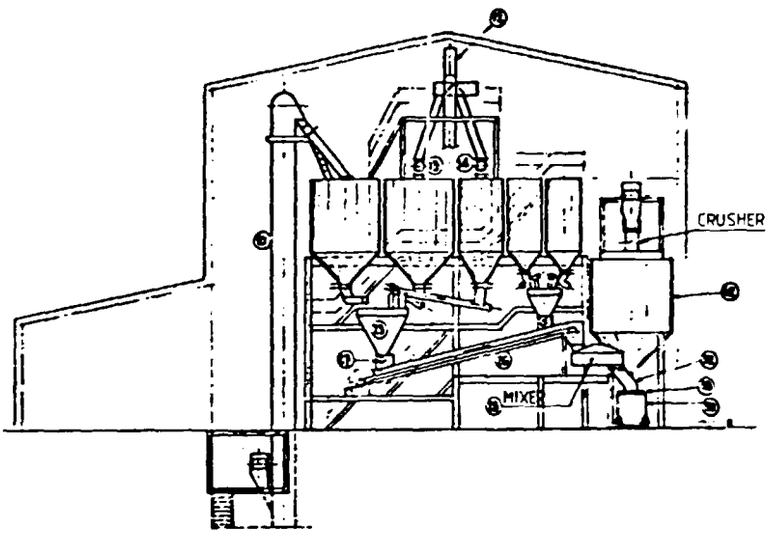


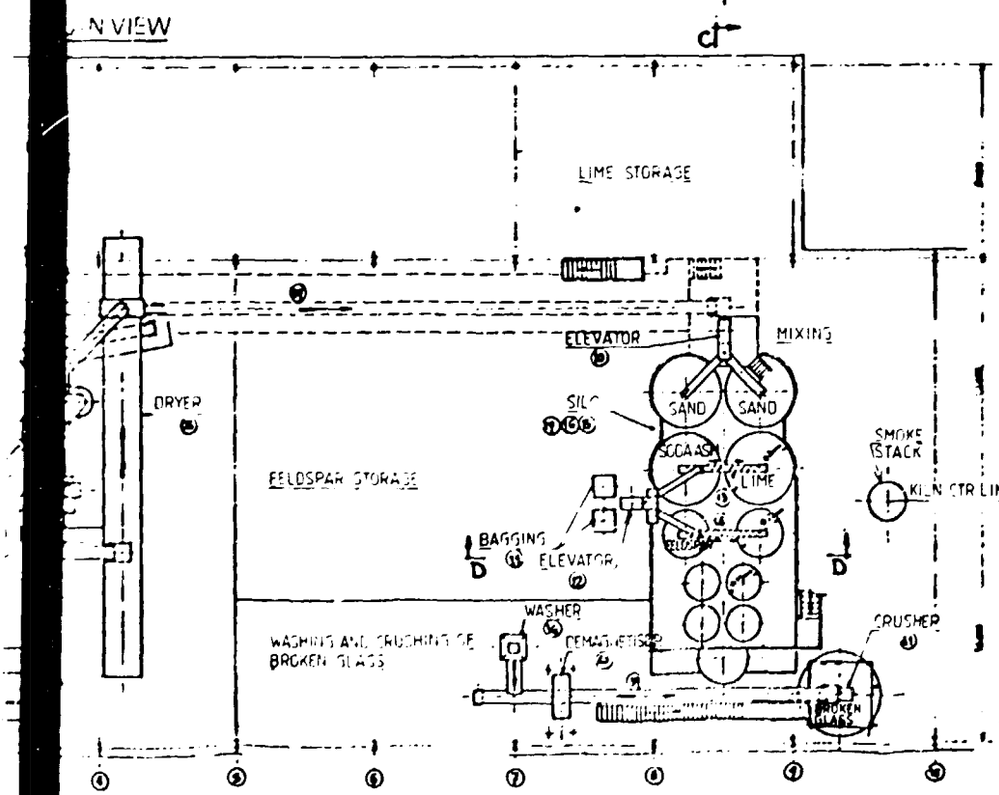
SECTION 1



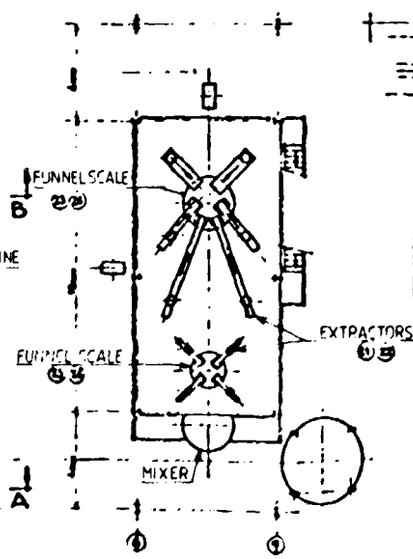


PROFILE C-C

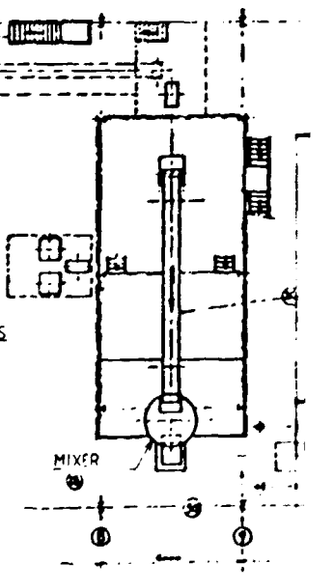




PROFILE E-E

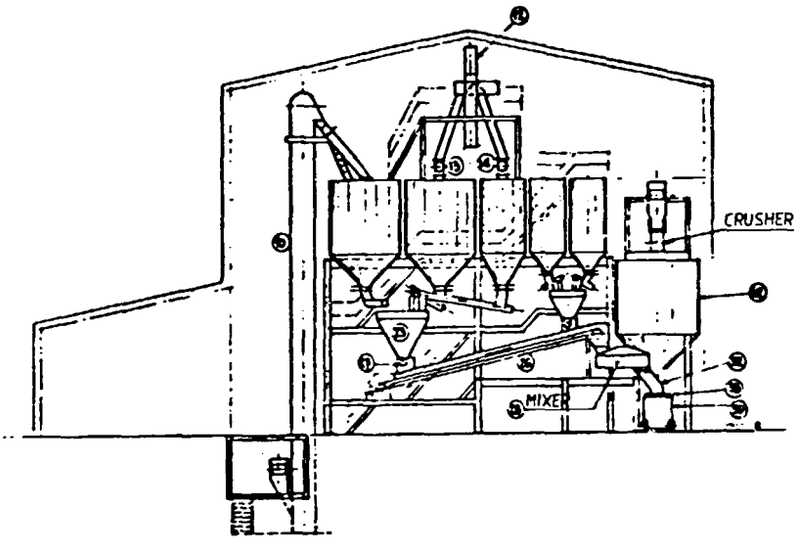


PROFILE F-F

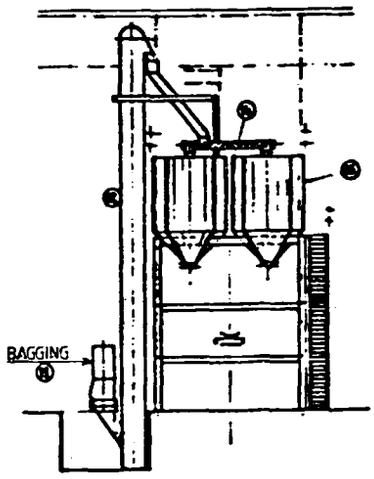


SECTION 2

PROFILE C-C

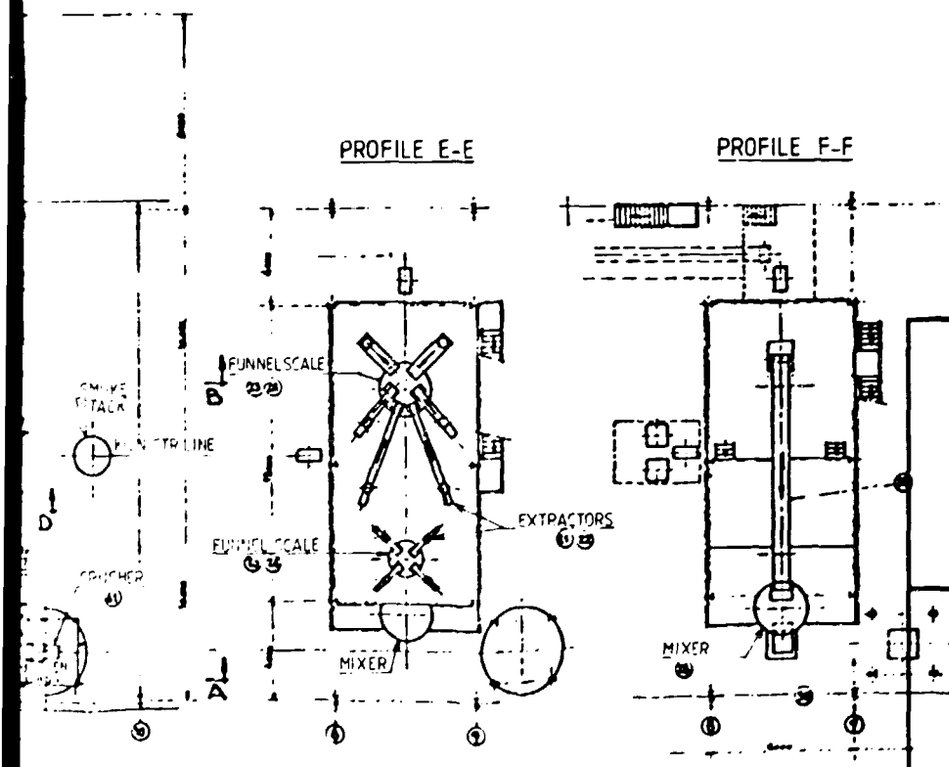


PROFILE D-D



PROFILE E-E

PROFILE F-F



SECTION 3

SWEDISH DEVELOPMENT CORPORATION AB
Stockholm, Sweden

Drawn
Checked
Approved
Date 26-7-80
Assignm no

ANNEX 17 (3)

YEMEN ARAB REPUBLIC
SANA'A GLASS BOTTLE PROJECT
RAW MATERIAL PREPARATION