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FINAL REPORT
UGANDA FEASIBILITY STUDY
GLASS CONTAINER PLANT

UNIDO REF XP/UGA/88/006

CONTRACT 88/97

ABAY S.A.
4, rue de Genève
1140 BRUSSELS
BELGIUM

Brussels, September 1989.

F E A S I B I L I T Y   S T U D Y
for the ESTABLISHMENT of a
G L A S S   C O N T A I N E R
and
T A B L E W A R E S   F A C T O R Y
in
U G A N D A

UNIDO (VIENNA)
CONTRACT No 88/97
REF. XP/UGA/88/006
ACTIVITY CODE J.14101

Practically, the feasibility study attempted to elucidate two main groups of objectives :

1. Assess the viability of the project on the basis of purely commercial criteria but also with a view on the impact on national economy and development targets.

2. Define the fundamental framework for the technical and practical conditions of the implementation and operation of the plant : process selection, equipment characterization, determination of production requirements, identification of operations, planning of activities.

Detailled scope of this feasibility study as defined by UNIDO and the Government of UGANDA is enclosed in <u>Annex 1</u>.

Main sources of data are enclosed in <u>Annex 2</u>.

It is understood that the final aim of the present feasibility study is to assist in a rational decision-making for :

- realizing the project or not ;
- serving as a reference basis during the various stages of the implementation process.

Acknowledgments

We like to thank each person of mark who advises us and contributes to this feasibility study. Unfortunately, we had not received always full coordinates or visit cards and we like to apologize if some names are missed in the list enclosed in Annex 3.

The responsibles of ABAY for this feasibility study are :

Mr. R. VROONEN, Project leader
Mr. J.-E. LANOTTE, Economist
Mr. M. PIERRET, Glass expert.

The responsible of UNIDO for this feasibility study (backstopping officer) is :

Mr. V. KLYKOV, Industrial Development Officer.

Mio = Million.

t/d (or y) = ton/day (or year).

l = litre, hl = hectolitre, ml = millilitre.

m/m = millimetre, cum = cubic metre.

p.a. = per annum.

U.Sh. = Uganda Shilling.

USD = American Dollar (or U.S. $).

U.K. (or G.B.) = United Kingdom - F = France - H = Holland - FRG = Federal Republic of Germany.

A.D.B. = African Development Bank (Abidjan - Ivory Coast).

U.D.C. = Uganda Development Corporation.

E.A.D.B. = East African Development Bank.

B.E.I. = Banque Européenne d'Investissement (Luxemburg).

C.E.E. (or E.E.C.) = Economic European Countries.

F.A.D. = Fonds Arabes de Développement.

F.E.D. = Fonds Européens de Développement.

O.P.E.C. = Organization of Petroleum Expert Countries.

S.A.C.E. = Italian Credit Insurance.

S.F.I. (or I.F.C.) = International Finance Corporation member of the World Bank (W.B.).

U.C.B. = Uganda Commercial Bank.

I.C.I. plant = Imperial Chemical Industry, soda ash plant in Kenya.

COMFAR COMPUTER Model Explanatory notes and reporting.

I.R.R. = Internal Rate of Return.

I.R.R.E. = Internal Rate of Return Economic.

B.L. = Battery Limit.

L.P.G. = Liquified Petroleum Gas.

G.N.P. = Gross National Product.

Forming machine (I.S. = Individual Section).

G.C. = General Contractor.

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SUBJECT : FEASIBILITY STUDY FOR A GLASS CONTAINER AND TABLEWARE FACTORY IN UGANDA.
CONTRACT UNIDO 88/97-XP/UGA/006-ACT. CODE J.14101.

ABSTRACT OF CONCLUSIONS

- Critical assessment of all available data shows that a glass containers and tablewares production plant in Uganda would be viable.

- The market study concludes to an increase in domestic demand of about 12 %/year (average) and in the demand of the neighbouring countries in such an extent that an annual production of 6,600 tons net of saleable glass can be absorbed in 1992 (when the plant is expected to start) to reach about 9,300 tons net of glass in 1995 when the plant will work at its target efficiency. In 1995, the quantities of saleable products manufactured by the two lines of production will be : 6,600 tons/year of glass containers and 2,700 tons/year of tablewares.
  . Glass containers production will cover the domestic consumption only. As the Ugandese Government has clearly indicated that measures will be taken to discourage the importation to protect local production. Reciprocally, it seems that exportation to surrounded countries will be very difficult and presently it has not been taken into consideration.
  . Tablewares production (about 25 %) will cover domestic market and 75 % of the production will be sold to surrounded countries mainly in Burundi and in Rwanda where no production plant exists.

- The raw materials survey established that, the main ones, sand and limestone/dolomite, are available in Uganda and that soda ash may be imported from Kenya (I.C.I. plant).

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- Plant location should be in Kampala industrial area. It requires 3.9 hectares.

- Study of production plant's engineering to suit Uganda's environment resulted in the choice of process avoiding unnecessary mechanization and automation. One furnace of 50 tons/day with 2 lines of production (glass containers - tablewares) will serve a production conform to European standards. Process and engineering proposed are suitable for a flexible (capacity) and polyvalent (size/shape/weight) production of finished products conform to the market.

- The equipment necessary, specified and described, is designed to be easily and cheaply adapted for a doubling of the capacity after 4 to 5 years of operation as we expect also an increase of the demand to absorb progressively the increase of production. This increase of the production level could be done when the plant has to stop (after 4 to 5 years of operation) for the refurbishment of the furnace.

- Project will employ : 182 people (including 92 on shift basis).

Use of the existing site of the old factory of the Madhvani group will allow a reduction of the investment of about 2.4 million $ and improve the internal rate of return from 15.1 % up to 16.4 %.

The impact on the profitability of the project of a reduction of 5 % of the selling price from the exported tablewares is insignificant. We should thus recommend this policy in order to facilitate the penetration to the foreign market.

Our recommendations are :
- start with the "double gob" production (furnace of 90 tons/day) when the market allow it (expected in 1995-96) ;
- obtain a tax holiday period from the Ugandese Authorities ;
- use the existing plant (Madhvani group) ;
- penetrate the export market of tablewares with a lower selling price

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- As there is not domestic production of glass products, the project will also contribute to the independance of Uganda from the importation and allow a quick development of the beverages national industries, as well as save foreign currencies. Today, beverages national industries suffer from a lack of bottles.

- Project implementation period is estimated to 2 years starting from the date of enforcement of the contract for execution of the plant.
  We will recommend to avoid the delay in its implementation as the cost data in this study becomes outdated and need to be reviewed, to minimize the time between the decision to implement the plant and the time when the contract is in force to commence the work.

  From now, four months to take decision of implementation and fourteen months to award the contract of execution should be the maximum target date for the basic alternative if the Government takes a positive decision.

November 1989.

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I. EXECUTIVE SUMMARY.

I.1. PROJECT BACKGROUND AND HISTORY

Glass has always been considered one of the important indicators of civilization and technical development. Even today the richest and most developed countries are the highest consumers of glass per capita.

Of course, we will explain why, and it is a fact, the important glass properties (chemically inert, impermeable, hygienic, washable, odourless, transparent, thermal/mechanical shock resistant, recoverable, etc ...) make that glass material for containers and tablewares are still prefered for many applications towards : plastic, polyethylene, steel (can), etc ...

Due to its then higher level of development, Uganda preceded most countries in the region by setting up a container glass industry already in the early seventies but stopped this factory for political reason in 1974.

With a population of over 16 million inhabitants (23 million projected by the year 2000), a big human resource, a potential mineral and agricultural wealth and the availability of the basic raw materials for glass manufacturing, it was normal for the Government of Uganda to give a priority to the re-establishment of a glass containers industry in the country.

Since 1974, when the existing plant called "East African Glass works Ltd (Madhvani Group) was stopped, several efforts have been made to reactivate this industry. But no progress seems to be forthcoming.

The main reasons according to us were that : due to the political/economical situation of the country, firstly the approach of the project was not enough well defined and mature, secondly the promotors were not enough confident to undertake such a huge project (± 25 million USD for a new plant at that time).

It should be also noted that no agreement between Uganda and Madhvani Group (the owner of the plant) has been reached up to now.

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Today, the situation in Uganda is much more clear and moving to a political and economical stability. The country is in reorganizing phase based on realistic, promising and financially supported programmes.

Industry will be rehabilitated and developed. This could push the Government to implement very soon the project of the glass containers production plant within a more strong environment with support of private promotors to be attracted through adequate incentives.

This project is among the priorities of Uganda mainly due to the fact that beverages industry's development particularly but also pharmacy, parapharmacy, chemical and agro industry packing development is today limited by the availability of glass containers. This project is urgently needed. A solution to reduce the delay of execution and the investment cost of the projet will be the recovery of the buildings and infrastructure of the existing glass factory providing that the Government finds a consensus with the owner. Concerning the recovery of the existing equipment, our inspection report concludes that nothing could be reused (destroyed, obsolete, old equipment without spare parts available, ...).

In December 1988, with their financing support, UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION (UNIDO) committed ABAY * for a contract to perform a feasibility study for a new glass containers and tablewares factory to be implemented in Uganda under the Authority of the Ministry of Industry and Technology.

* ABAY, a belgian consulting, engineering and contracting company, had already a long experience of Uganda as being involved in the project of rehabilitation of the sugar and glass industry and similarly in the neighbouring countries.

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In January 1989, as scheduled, the missions of economist, marketing, geologist and engineering experts started on site. The draft of the final report was sent to UNIDO in early July 1989 and the final report was edited in November 1989.

The feasibility study attempted to elucidate two main groups of objectives :

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Detailled scope of this feasibility study as defined by UNIDO and the Government of UGANDA is enclosed in Annex 1.

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- realizing the project or not ;
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I.2. MARKET AND PLANT CAPACITY

As conceived by UNIDO and the Government of Uganda, the main purposes of the market study were :

a. to estimate the present effective national demand of glass containers and tablewares ;

b. to forecast the future domestic consumption and the potential exportation of these two products if a production plant is implemented in Uganda in a very near future ;

c. to determine whether a sufficient effective demand will exist to absorb the proposed glass production sized as a minimum technical and economical capacity.

Demand for new bottles is due to :

- growth of beverages production (volume and new Trade Marks) and relevant stockage of bottles on plant site ;
- circulating bottles return (trippage) ;
- breakage at the manipulation of empty bottles, filling up in the bottlers plant ;
- distribution losses (transportation, household stock ...).

We analysed systematically all these items according the methodology explained in chapter III all these items and we concluded concerning :

A. GLASS CONTAINERS MARKET

BEER AND SOFT DRINKS CONSUMPTION in UGANDA

In 1988, the Ugandese consumption of beer and soft drinks consumption was 35,35 mio litres. This figure is very low (30 - 40 %) when compared with per capita consumption of surrounded countries. According to the bottlers interview, this consumption should grow up to 186,065 .o litres in 1995 (27 % growth rate p.a.).

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According to our experience, we have considered only a 12 % global average growth rate p.a. (from 1989) for beverages :

- 6.6 % p.a. increase of the urban population
- 5.4 % p.a. increase of the G.N.P. per capita.

In 1995 the total annual consumption will be 101,178 mio litres splitted as follows :

- 46,981 mio l beer (2,4 l per capita)
- 0,735 mio l alcohol
- 53,462 mio l soft drinks (2,7 l per capita).

In 1995, the 101,178 mio l beverage consumption will be only 41.1 % of the average beverages consumption of 8 African countries having a similar G.N.P. per capita.

QUANTITY OF BOTTLES TO COVER THE UGANDESE CONSUMPTION OF BEVERAGES

We have considered 10 returns per year per bottle and 20 returns per bottle's life.

- 1.5 % to 2.5 % breakages
- 2.5 % to 3.5 % no return.

It has to be produced in 1995, 16,247,600 bottles,

- 2,867,000 bottles due to the increase of production,
- 13,380,600 bottles due to the replacement for breakages and non return.

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As the Ugandese Government has clearly indicated its willing to protect its future glass containers production by firmly discouraging present importation. We assumed that, reciprocally, exportation to surrounded countries (mainly those producing bottles) will not be possible. For that reason, market of glass containers concerns presently only Uganda.

As it is done now, we expect that the selling of bottles will be done directly from the producer to the bottlers (direct channeling without intermediates).

B. GLASS TABLEWARES MARKET

LOCAL SURVEY OF THE TABLEWARES UGANDESE CONSUMPTION

The consumption of glass tablewares in Uganda is presently not sizable and very low.

It seems not within the habits of the major parts of the population to use glass tablewares.

These items are obviously used in the hotels, but after interviewing them, this particular consumption is neglictable.

The market does not exist officially. Practically all the glass tablewares we can find in Uganda are imported through non official channels from the Far East.

The common idea prevailing in Uganda is that the market will develop itself as soon as a national production comes into operation. This is absolutely true, but however it remains to determine the size of this expected market.

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<u>SIZE OF EXPECTED MARKET</u> (domestic and export)

We have to start with information from the neighbouring countries (Rwanda - Burundi - Tanzania) we can see that for G.N.P. comparable (230 - 290 USD) the market per capita ranges from 0,087 kg to 0,132 kg annually.

The figures applied for Uganda would correspond to a market of 1,583 to 2,420 tons of tablewares in 1992.

According to the feasibility study conducted in May 1979 by Mr. Pierre MONTAGNE consultant on behalf of UNIDO for the implementation of a glass factory in Burundi, the projected market for tablewares in Burundi, Rwanda and Kivu (Zaïre) was 1,780 tons in 1991.

According to our information, the press line to produce tablewares in Burundi was never materialized.

As a consequence, we believe that a part of the Rwanda and Burundi market could be covered by the present project.

As the demand is presently very low in Uganda compared with other african countries we assume a consumption of 0,027 kg/y per capita (corresponding 33 % of the average in Africa as for the beverages and the containers) we come to a figure of 485 t/y consumed in Uganda.

We propose to consider for this project a production of the new plant of about 2,000 t in 1992, assuming that 2,000 - 485 = 1,515 t/y could be easily sold in Burundi/Rwanda (and Kivu).

As for the bottles, we shall consider also an average growth rate of 12 % p.a. from 1992.

We have standardized the models, sizes and shapes according to the types of products consumed in the other countries.

This program can be changed according to the evolution of the market without bringing significative changes to the financial study.

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For tablewares, marketing study and sales promotion and organization have to be set up even for the domestic market and the exportation (to start with Rwanda - Burundi).

C. PLANT CAPACITY

Due to the complexity of the glass production and the fragility of the products, for this Industry the following assumptions are generally accepted.

a) For the first year of production only 60 % of the glass quantity pulled out the furnace is converted in saleable products.

b) When the plant is running smoothly at its nominal capacity, 80 % of the glass pulled out the furnace is converted in saleable products, this corresponds to the full efficiency. The balance (not saleable products) is recycled to the furnace wihtout problem.

We expected that the Ugandese plant will start in 1992 and the full efficiency will be reached after four years of continuous operation (in 1995).

The production needed to cover the Ugandese containers market is :

YEAR	EFFICIENCY (%)	BOTTLES PRODUCED (NET)	TONS OF GLASS (SALEABLE PRODUCTS)
1992	60	10,643,600	4,674.8
1993	70	12,953,000	5,236
1994	75	14,507,300	5,864.2
1995	80	16,247,600	6,567.6

./.

The production needed to cover the tablewares market is :

YEAR	EFFICIENCY (%)	TABLEWARE PRODUCED (NET)	TONS OF GLASS (SALEABLE PRODUCTS)
1992	60	9,075,000	1,924.8
1993	70	10,260,000	2,177.4
1994	75	11,495,000	2,444.6
1995	80	12,825,000	2,726.1

To reach, at the full efficiency in 1995, the hereabove productions we have selected 2 lines of production.

- For the containers production.
  One IS 6 forming machine single gob.

- For the tablewares production.
  One press machine single gob.

  Both machines are corresponding to the minimum size available on the present market of the main manufacturers.
  A small reserve a capacity is required to accept, in certain limits, modification of the production proposed program to satisfy the demand if type, shape or volume of bottles or tablewares are changing.

- One single furnace will feed both lines, its capacity will be 50 tons/day molten glass.

After 4 or 5 years of its initial operation, the furnace has to stop and be refurbished (replacement of all the main refractories).

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Furnace life

The life of the furnace is the quantity of time during which the furnace can melt glass continuously 24 hours per day before stopping for a complete overhauling involving the replacement of weaved refractories.

This life depends on several factors :

- the original quality and quantity of refractories ;
- the ability of the production and maintenance personnel ;
- the quantity of glass pulled out from the furnace.

In developing countries, 4 to 5 years must be considered as a maximum furnace life time.

At that time, a doubling of the capacity is scheduled by minor redesigning of the furnace and using the same two forming machines but with double gob (instead of single gob). This could be performed easily, quickly and cheaply. Graphic of production program answering constantly to the curve of demand is enclosed next page.

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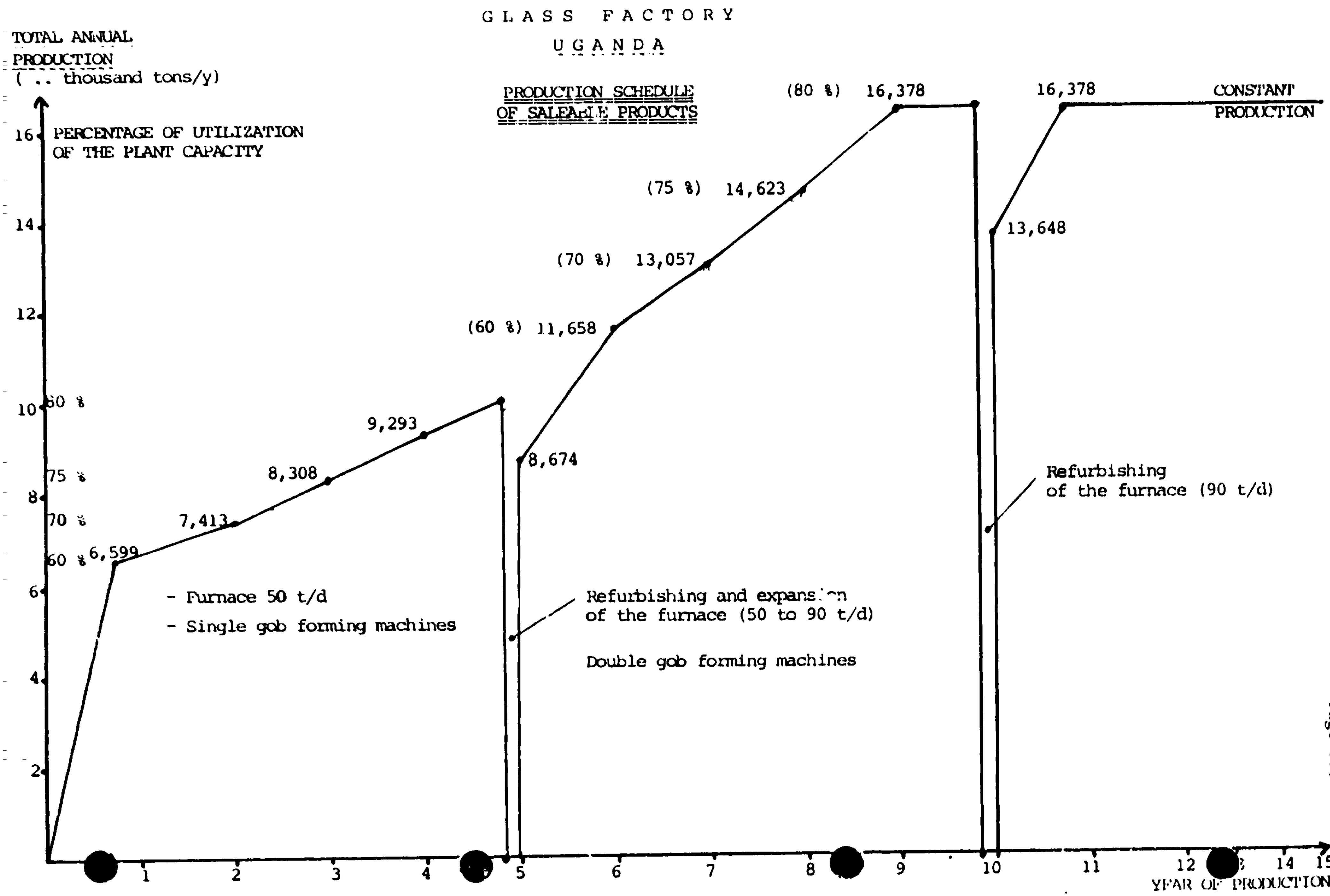
GLASS FACTORY
UGANDA
PRODUCTION SCHEDULE
OF SALEABLE PRODUCTS
TOTAL ANNUAL PRODUCTION
(.. thousand tons/y)
PERCENTAGE OF UTILIZATION
OF THE PLANT CAPACITY
16
14
12
10
8
6
4
2
80 %
75 %
70 %
60 %
6,599
7,413
8,308
9,293
8,674
(60 %) 11,658
(70 %) 13,057
(75 %) 14,623
(80 %) 16,378
16,378
13,648
CONSTANT
PRODUCTION
- Furnace 50 t/d
- Single gob forming machines
Refurbishing and expansion
of the furnace (50 to 90 t/d)
Double gob forming machines
Refurbishing
of the furnace (90 t/d)
1
2
3
4
5
6
7
8
9
10
11
12
14
15
YEAR OF PRODUCTION

D. TURNOVER

The turnover has been calculated with the following selling prices : Bottles : 0.8 U $/Kg

Tablewares : 1.6 U $/Kg.

The sold production during the four first years of production will be according to the production program tables enclosed in the Chapter III.1. : Demand and Market Study.

At the end of the fifth year of production, we consider that the factory has to be stopped for refurbishing the furnace. Using this opportunity the furnace can be extended up to 90 tons/day glass pulled out to satisfy the future doubling of the demand (see Market study).

From the sixth year of production, the rebuilded furnace will be able to feed the production lines working in double gob process allowing to follow the considered market increase of 12 % per annum. From that time the project becomes really profitable (refer to Sensitivity analysis).

At the end of the tenth year of production, the factory has to be stopped again to refurbish the furnace, the capacity of production will be unchanged at 90 tons/day.

The maximum yearly production will therefore be achieved during the ninth year and it will be kept unchanged after each furnace further refurbishing (refer to Production schedule).

This study being limited to the fifteen first years of production of the factory, we have not considered a third refurbishing of the furnace during the fifteen year.

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* TURNOVER *
****

amounts in thousand US $	1	2	3	4	5	6	7	8	9	10
Bottles	3739.8	4188.8	4691.4	5254.1	4903.8	6590.7	7381.6	8267.4	9259.5	7716.2
Tablewares	3079.7	3483.8	3911.4	4361.8	4071.0	5471.4	6128.0	6863.4	7686.9	6405.8
GROSS SALES REVENUE	6819.5	7672.6	8602.7	9615.8	8974.9	12062.1	13509.6	15130.7	16946.4	14122.0
TAXES	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
NET SALES REVENUE										
in local currency	5640.0	6338.3	7104.7	7945.3	7415.7	9966.5	11162.6	12502.1	14002.3	11668.6
in foreign currency	1179.5	1334.3	1498.1	1670.6	1559.2	2095.5	2347.0	2628.7	2944.1	2453.4
NET TOTAL	6819.5	7672.6	8602.7	9615.8	8974.9	12062.1	13509.6	15130.7	16946.4	14[illegible]
Bottles	3739.8	4188.8	4691.4	5254.1	4903.8	6590.7	7381.6	8267.4	9259.5	7716.2
Tablewares	3079.7	3483.8	3911.4	4361.8	4071.0	5471.4	6128.0	6863.4	7686.9	6405.9
Total main products	6819.5	7672.6	8602.7	9615.8	8974.9	12062.1	13509.6	15130.7	16946.4	14122.0
Total by-products	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

amounts in thousand US $	11	12	13	14	15
Bottles	9259.5	9259.5	9259.5	9259.5	9259.5
Tablewares	7686.9	7686.9	7686.9	7686.9	7686.9
GROSS SALES REVENUE	16946.4	16946.4	16946.4	16946.4	16946.4
TAXES	.0	.0	.0	.0	.0
NET SALES REVENUE					
in local currency	14002.3	14002.3	14002.3	14002.3	14002.3
in foreign currency	2944.1	2944.1	2944.1	2944.1	2944.1
NET TOTAL	16946.4	16946.4	16946.4	16946.4	16946.4
Bottles	9259.5	9259.5	9259.5	9259.5	9259.5
Tablewares	7686.9	7686.9	7686.9	7686.9	7686.9
Total main products	16946.4	16946.4	16946.4	16946.4	16946.4
Total by-products	.0	.0	.0	.0	.0

I.3. MATERIALS AND INPUT

RAW MATERIALS

Main raw materials needed for container glass production and tablewares are : sand, soda ash, limestone, dolomite, feldspar and a number of chemicals required in small quantities (baryum sulfate, sodium nitrate, borax, selenium, cobalt, ...).

The total quantity of raw materials required to produce 1,000 tons of container glass amounts to about 1,200 tons and to produce 1,000 tons of tablewares we need about 1,330 tons of raw material.
Batch plant feeding the furnace prepares a mixing with about : 55 - 58 % sand, 18 - 20 % soda ash, 15 % dolomite + limestone, 6 % feldspar plus small quantities of other chemicals..

Silica sand :
We have investigated different locations. We analysed many samples of sand. We selected our prefered location in DIIMU beach, 40 km south Masaka, on shore of Lake Victoria (this sand is already consumed in small quantity to produce porcelain tablewares). See hereto attached map.
Granulometry of the sand is acceptable.
Analysis indicates that the sand is suitable for glass making after simple washing in the glass factory.
A new quarry has to be equipped (about 5,000 t/y of sand for the first year of operation of the glass factory).
The quarry will be operated by a local enterprise and we take into consideration the same price of sand as sold now to the porcelain factory.
Of course, operation of the new quarry could also be included in the investment and the management of the new glass factory. This alternative is considered also in our study.

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Limestone/dolomite :
We investigated different sites and analysed samples to conclude that limestone/dolomite available (after treating in the cement factory) according to the analysis and granulometry used in the Ugandese cement industry in Hima is suitable and will be bought from the cement factory.

Soda ash : from Kenya (I.C.I. plant) for the present study (could also come from Europe).

Feldspar : from Kenya for the present study.

Other chemical : from Europe.

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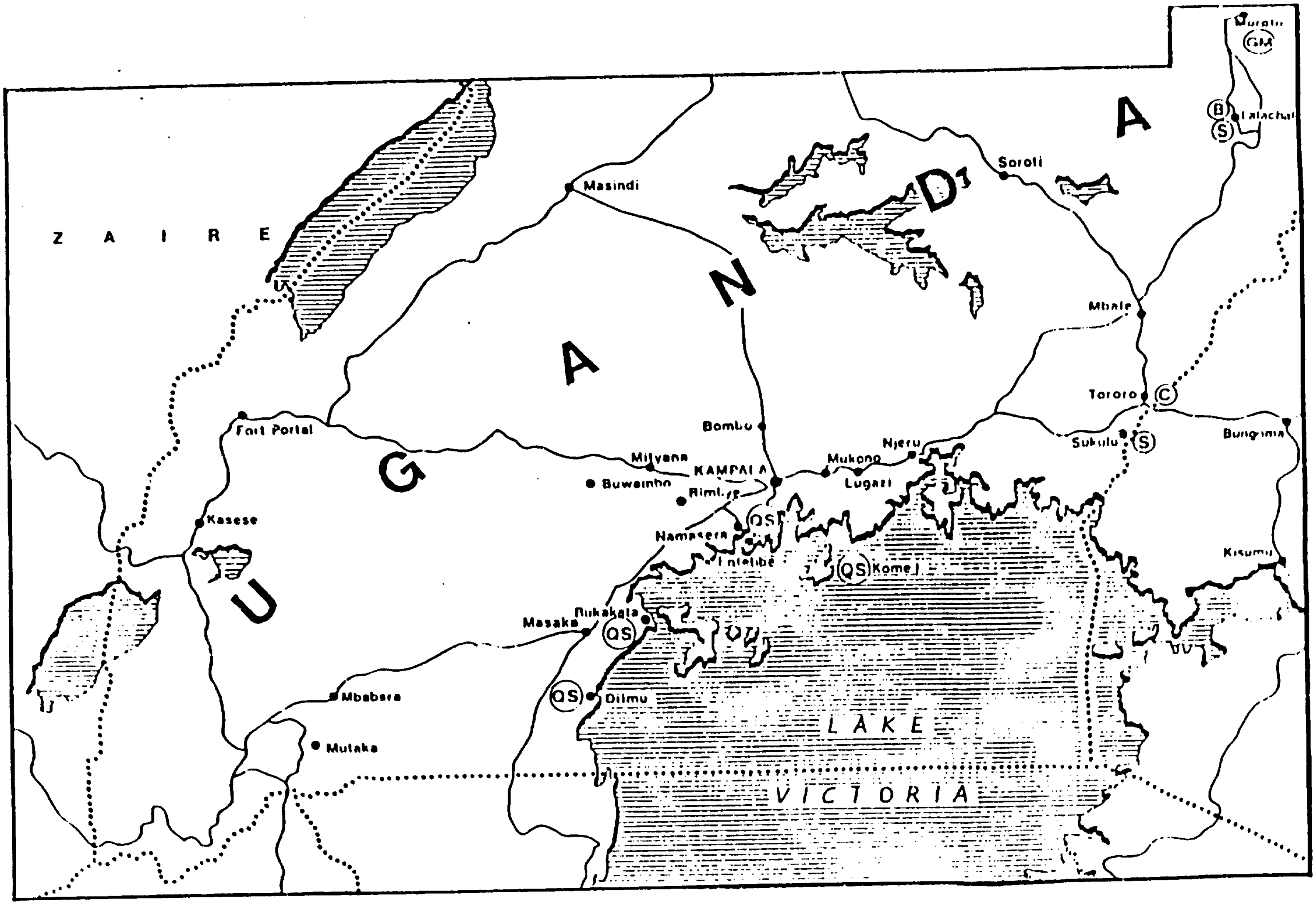

Kilometres
0 50 100 150 200

B Barytes
S Sulphate
C Cement
GM Graphite Marble
QS Quartz sand

MAP SHOWING LOCATION OF RAW MATERIAL DEPOSITS

UTILITIES

Electricity :

To heat the furnace, we suggested to use predominantly electricity mainly due to its cheap price compared with the heavy fuel to be imported from abroad through Kenya.

For the annealing and decorating lehr, forehearth.

For the equipment, lighting, etc ...

Of course, continuous correct availability has to be ensured by Ugandese electrical network.

We analysed, in this study, impact on production if short cuts of electricity amounts 10 % of the year.

As usual, we included an emergency power set to keep the plant on safe status but not to operate the plant, as it requires to much power and huge investment for sporadic operations.

Heavy fuel oil : to heat (partly) the furnace.

LPG : for the tablewares line glazer. To be imported.

Water :

For industrial water, cooling water and potable water from the network of the industrial area.

As indicative, we expected that for the first years of operation (production ± 6,600 t/y glass) the annual consumption is about :

Heavy fuel	=	700 - 750 tons.
LPG	=	30 - 35 tons.
Electricity	=	15 to 16,000 kwh.
Water	=	75 to 80,000 cum.

Moulds :

In the annual cost, sets of moulds necessary for the program of production is foreseen.

Consumables :

Lubricants, grease, colours, printing, screens, ...

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Spare parts :

For this type of industry to be kept on continuous operation (365 d/y) we advised to store spare parts for two years of the normal operation.

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I.4. LOCATION AND SITE

LOCATION

- Clearly, the final product i.e. the glass containers and tablewares is much more difficult to handle and transport than all of the raw materials separately and collectively.

- This entails that the orientation of the plant with respect to the market has a priority over the orientation with respect to the raw materials.

- Of course, as raw materials and finished products are brought from or to different directions, infrastructural facilities [road, rail, harbor (Lake Victoria), airport] and continuous feeding and large amount of utilities (electricity, water, fuel) should be economically available and easily accessible.

- Optimization of location on above items almost automatically results in the choice with the best socio-economic environment. The fact that the plant has to be located in priority near its market area, which is generally a well populated region, with good infrastructure (utilities) entails also the presence of good source of labour, especially in the unskilled to medium skilled categories.
  We, therefore, consider Kampala industrial area as being the best place to locate the factory.
  The old plant of the Madhvani Group in Port Bell is still existing. Although there is no more machinery recoverable, the buildings themselves can technically be used for this project. Nevertheless, a future expansion (over doubling the projected capacity) is very limited in that site.

  Of course, this alternative, as buildings and all the recommended infrastructure exist, will lead to a sizable reduction in costs and will speed the technical implementation of the plant.

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- But Ugandese Authorities have clearly indicated to us that we had not to take the reuse of Madhvani site as first option for this study.
  Their advise results from the fact that from 1974 all efforts to find a goodwill and an agreement to reintegrate Madhvani Group in it glass activity failled. This problem has been emphasized by the fact that some internal dispute arises recently in the family itself. But according to our interviews with the responsibles of the Group in Nairobi, they clearly indicate their willing to cooperate and find a solution to be involved in the rehabilitation of their plant in Kampala as they did for the sugar factory in Kakira (Uganda).

- Free industrial lands are presently available and suitable for a new glass factory in the industrial area near Port Bell in Luzira and Mutungo areas (set of maps is hereto attached).
  We considered this location in our study.

- Final precise location would be done after negociations with local authorities and Ministry of Environmental Protection.

SITE

Project layout is enclosed in this study. It could be slightly adapted with the shape of the land available, predominant wind, sewer water, electricity network connexion and economical access to the road, railway.

Please note that the chimney is designed to be conform to the pollution regulations imposed in European industrial area.

The surface area needed for the factory (including gate, administrative offices, production plant, storage of finished products and raw materials-utilities, internal roads and parking) is : 3,9 hectares (300 m x 130 m).

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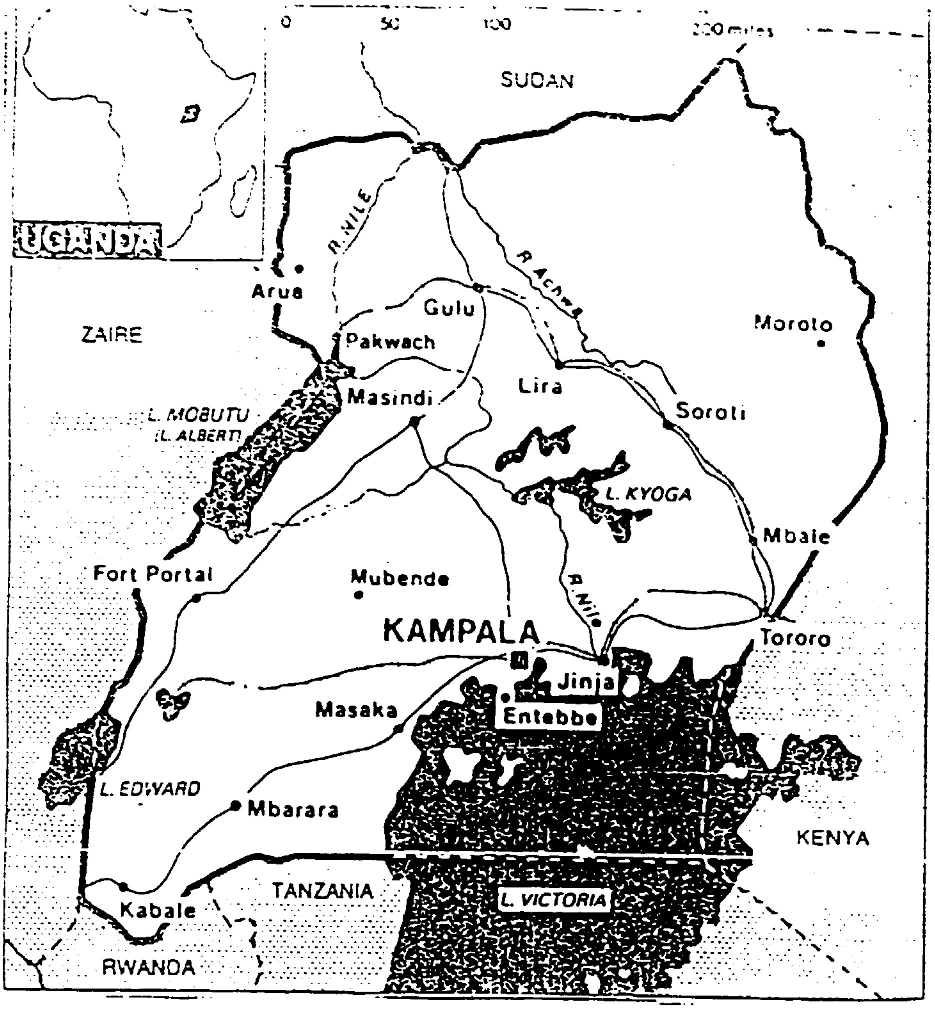
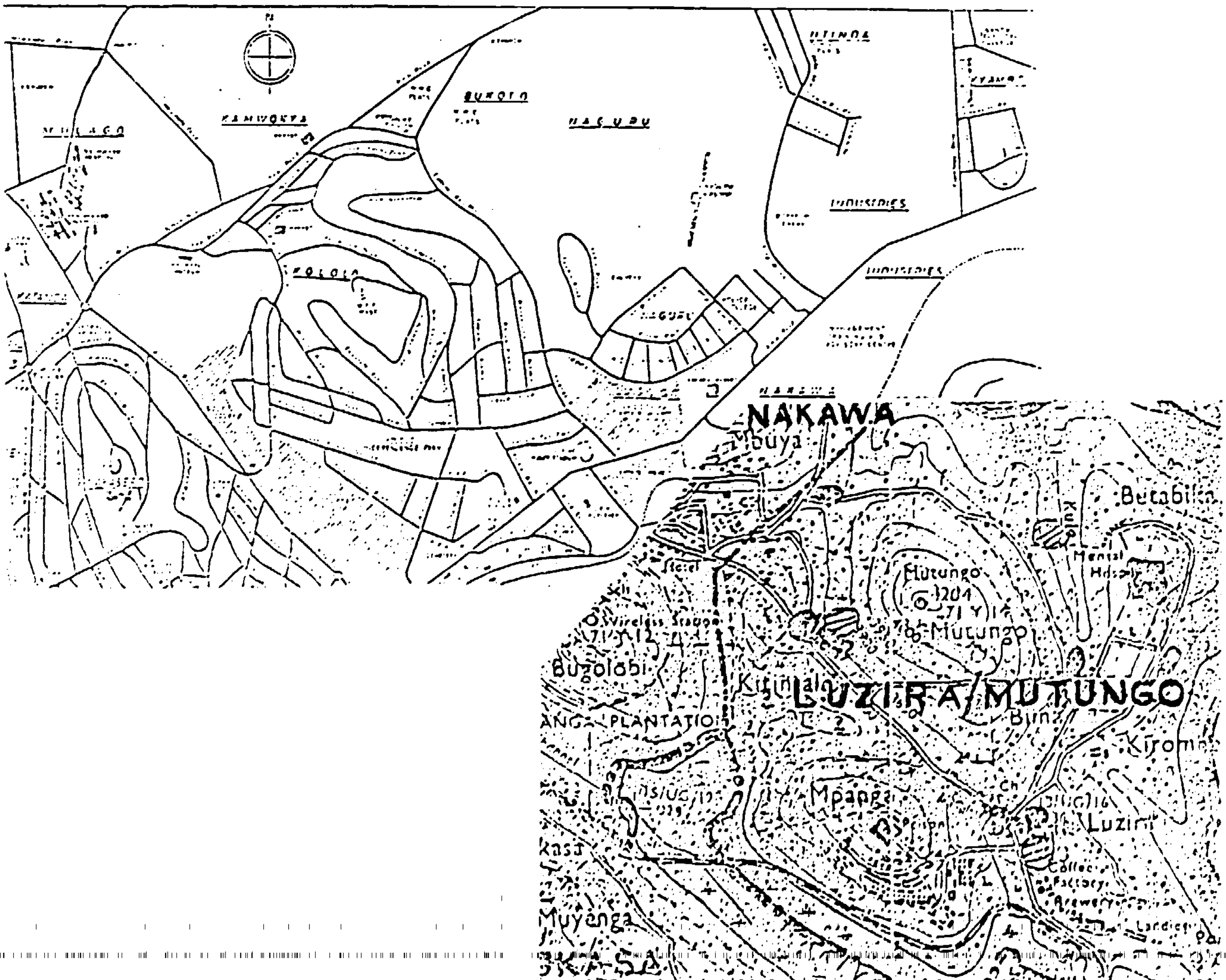


MAP OF KAMPALA CITY



I.5. PROJECT ENGINEERING

Care has been taken to adapt, as far as possible, plant requirements to the physical and socio-economic environmental conditions prevailing in Uganda. It is attempted to tailor the project to suit Uganda's environment, by avoiding unnecessary mechanization and automation and by reducing or cancelling cost centres which exert no bearing on the final output, or which can be avoided without technical consequences for the production.

This policy aims at two goals : first, to save on investment and second, to increase social benefits by offering more job opportunities and enhancing technical skill build-up.

We selected the size and the quality to be produced in conformity with the European standards to be able to compete mainly the imported products in Uganda but also to be export oriented.

According to our experience the production of non returnable bottles (light bottles) are not advisable for developing countries and Uganda for the following reasons :

- technology is more sophisticated and more difficult to apply ;
- bottles are more fragile to fill and transport ;
- if collection of empty bottles is not properly organized to recycle as cullet, the non returnable bottles are definitively much more expensive.

TECHNOLOGY

The production process by using one IS-6 single gob machine (later could operate a double gob) for glass container production and one press machine for glass tablewares is relatively simple, the skillness of operators required is not too high. Therefore, overseas training of factory personnel and the extent of technical assistance from abroad can be kept within reasonable limits.

A modern design of machinery and equipment is proposed to ensure efficient production of medium and high quality glass. On the other hand, the plant should not be oversophisticated in order to avoid dependance on expatriate experts for trouble-shooting.

Employment of automatization should be restricted to those stages of process where otherwise efficiency or quality could be affected.

A process diagram is hereto attached.

- Rated melting capacity
  The factory should have one furnace to feed the production lines with a rated total melting capacity of 50 tons/24 hours.
  Heating mainly by electricity and heavy fuel oil with necessary equipment for control and safety.

- Pulled glass quantity
  The amount of total glass pulled per annum depends on the size/weight of the glass articles produced.
  For the proposed production program the pull glass amount at full efficiency will be
  about 8,250 tons/y for containers
  about 3,375 tons/y for tablewares.
  Based on about 300 working days/y depending from the annual rate of production.
  Production's time losses are mainly due to the size/weight (change of moulds at the forming machine) and colors changing in the production program, the necessary maintenance and repair of machinery.

- When the normal refractory refurbishing of the furnace, after about 5 years of operation, will take place the furnace could be redesigned to satisfy a **doubling** of the saleable production capacity as per the market demand.

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Furnace life

The life of the furnace is the quantity of time during which the furnace can melt glass continuously 24 hours per day before stopping for a complete overhauling involving the replacement of weaved refractories.

This life depends on several factors :

- the original quality and quantity of refractories ;
- the ability of the production and maintenance personnel ;
- the quantity of glass pulled out from the furnace.

This latter factor can be explained when comparing to a car, the car's life depends obviously from the performed miling.

In developed countries, the trend is today to build very expansive furnaces to increase the life of the furnace. This life can today reach more than 6-7 years.

In developing countries, 4 to 5 years must be considered as a maximum time, the investment needed to build very expansive furnaces being very often lacking.

In this project, we have envisaged a 5 years life furnace in the investment, considering the quantity of glass produced during this period and considering also the training performed abroad and on site by expatriated specialists.

Batch plant is already designed to absorb the increase (doubling) of capacity. Equipment are designed to prepare the mixing of the raw materials and the recycled cullet to feed the furnace.

Forming machine (I.S.) and press machine, single gob. It could be equipped to work on double gob for doubling the production after the fifth year.

- Production line

Equipment is selected to produce articles as per European standards.

Selected machineries are flexible and polyvalent to produce a diversified (shape/size/weight) products in flint, green, amber, eventually decorated, as required by the market study.

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- Raw materials storage

  Have been sized according the local facilities of provisioning to feed continuously the plant.

- Civil engineering work

  We suggested to use steel frame building with walls in concrete panels.

  Roof : concrete, eternit or galvanized cladding.
  Internal walls : hollow concrete blocks.
  Natural ventilation for the industrial plant.
  Air conditioning in personnel buildings.

- Project of layout is enclosed in chapter VI.

  Plant area = 3,9 hectares
  including production factory, final products stores, administrative, workshop, cantine, utilities buildings, storages, roads, parking ...
  Remark : In principle, the site and buildings of the old glass factory (Madhvani Group) in Kampala could be reused for this project.

THE AUTOMATIC PRODUCTION OF GLASS CONTAINERS

1 Batch Plant
The raw materials (sand, soda ash, lime, etc.) which are stored in bulk are mixed and transported to the production plant.

2 Batch Charger
The batch charger feeds the batch (mixture of raw materials) continuously and automatically into the furnace.

3 Furnace
In the furnace the batch is melted into glass at temperatures up to 1600°C.

4 Forehearth
Here the glass is cooled or heated to become homogeneous and stable in temperature while being channelled to the forming machine.

5 Feeder
In the feeder the glass is formed into gobs of suitable shape and weight, which are then sheared off for delivery to the forming machine.

6 Glass Forming Machine (I.S. or H-28) or a press line (tablewares)
The forming machine forms the glass gobs into containers by a two stage blow/blow or press/blow process.

7 Stacker
The hot containers arriving from the forming machine via conveyor and transfer device are loaded by a stacker onto the belt of the annealing lehr.

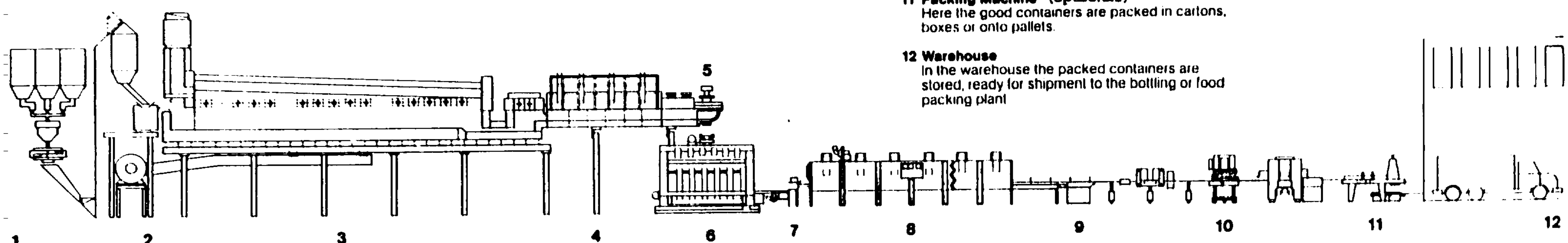
8 Annealing Lehr
In the annealing lehr the hot glassware is cooled at a controlled rate in order to avoid stresses being set-up in the glass, which would result in breakage.

9 Transport Equipment
On leaving the annealing lehr the cooled containers are transferred onto the transport belt of the single or dual liner, and then pass through the inspection department.

10 Inspection Equipment
Various automatic inspection devices check the containers for dimensions, strength, cracks, crizzles and other defects.

11 Packing Machine (optional)
Here the good containers are packed in cartons, boxes or onto pallets.

12 Warehouse
In the warehouse the packed containers are stored, ready for shipment to the bottling or food packing plant.



I.6. PLANT ORGANIZATION

According to our experience of the glass industry, we select the organization for this medium size factory avoiding overstructurization, multiplication of the cost centres, dissolution of responsabilities and finally the increasing of the operating costs.

- The whole structure is topped by a General Manager.

- The technical department is staffed by a technical manager to supervise plant production in quantity and in quality.

- The commercial department is staffed by a sales manager. As traditional channels (without intermediate) will be used for domestic sales and export will be limited to 3 or 4 countries, the staff is limited.

- The administration, accounting (planning, budgeting, costing, statistics, performance control, buying raw materials, spare parts and utilities, selling accounting), personnel management (wages, salaries, social, transport, training) section will be kept to a minimum in order to decrease non-productive costs.

- Operational organization chart is hereto attached.

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- BOARD OF DIRECTORS
  - GENERAL MANAGER — SECRETARY
    - TEMPORARY GENERALIST GLASS ENGINEER ADVISERS
    - TECHNICAL MANAGER
      - TYPISTS
      - ASSISTANT
      - LABORATORIES
      - MACHINE SHOP MANAGER
        - SHIFT FITTERS
        - ELECTRICIANS
        - PLANT MAINTENANCE
        - MOULD REPAIRS
      - WAREHOUSE MANAGERS
        - ASSISTANTS
        - FORKLIFT DRIVERS
        - GUARDS
      - SHIFT MANAGERS
        - BATCH HOUSE
        - FURNACE OPERATORS
        - CHIEF MACHINISTS
          - MACHINISTS
        - CHIEF INSPECTION
          - QUALITY CONTROL
          - GRADERS
        - DECORATING PLANT
    - SALES MANAGER
      - SECRETARY
        - ASSISTANTS
    - PERSONNEL MANAGER
      - FINANCIAL ACCOUNTANT
        - SECRETARY
          - ASSISTANTS
      - PAYROLL ACCOUNTANT
        - SECRETARY
          - ASSISTANTS
      - PRODUCTION ACCOUNTANT
        - SECRETARY
          - ASSISTANTS
      - DRIVERS
      - MESSENGERS
      - OFFICE CLEANING

N.B. : The following working posts are considered to be fulfilled by specialized expatriates :

- Advisers
- Technical manager
- Shift managers
- Furnace operators
- Chief machinists.

I.7. MANPOWER

GUIDING POLICY

- Knowing the situation of employment (and its costs) in Uganda, it should be stressed that without overstaffing the plant, maximum employment opportunities should be tought against automatic automation tendency normally developed by equipment suppliers.

- Kampala industrial area gives a labor force available enough in quantity but training requirements should be seriously managed as a money and time consumer.

- We took into consideration the present regulation for working time ; holidays and social benefits, etc ... excluding housing, meal, extra benefit, etc ... and wages and salaries for this type of industry operating 24 hours continuously per day.

- 365 days (24 h/d) working time for this continuously operated industry.

TOTAL MANPOWER FOR OPERATIONAL PHASE

182 men, when the plant will run smoothly at its projected capacities.

- 92 people will work on shift (8 hours/day) ;
- 90 will work on single shift basis.

Supervisory and managerial staff (the manager) should be suitably experienced or perfectly trained well in advance of the start up.

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PREPRODUCTION PHASE'S MANPOWER

Managerial staff, supervisors and foremen and specialized machine operators (f.i. forming machine IS + PRESS) have to be recruited in advance and attend to the installation of equipment that they will later be operating. Of course, required persons at this phase (depending also from their previous experience in the glass industry) should be kept to a minimum to maintain preproduction cost as low as possible.

- A cost's study should be done in due time to decide recruitement policy : extensive training programs for national labor versus recruitement of experienced foreign experts (or management contracts with foreign company).
  Taking into account : local facilities for training, credit for training, provision for continuous training after start up, etc ...

- In terms of growth of efficiency and productivity, continuous training after the start up may be organized in the plant itself by the expatriates and later one by the trained local people.

SUPERVISION OF THE CIVIL WORK, ERECTION AND COMMISSIONING OF THE PLANT ON SITE

Extent of services procured by the General Contractor (G.C.)

In order to realize the smooth construction of the contract plant, the G.C. shall be responsible for sending skilled, healthy and competent technical personnel (expatriates) to the owner's plant site for technical services.

Of course, the specialities, occupations, number of personnel and their duration in Uganda are depending from the type and scope of subcontracts (civil works, erection, ...) to the local specialized companies as indicative, a preoperational organization chart is hereto attached.

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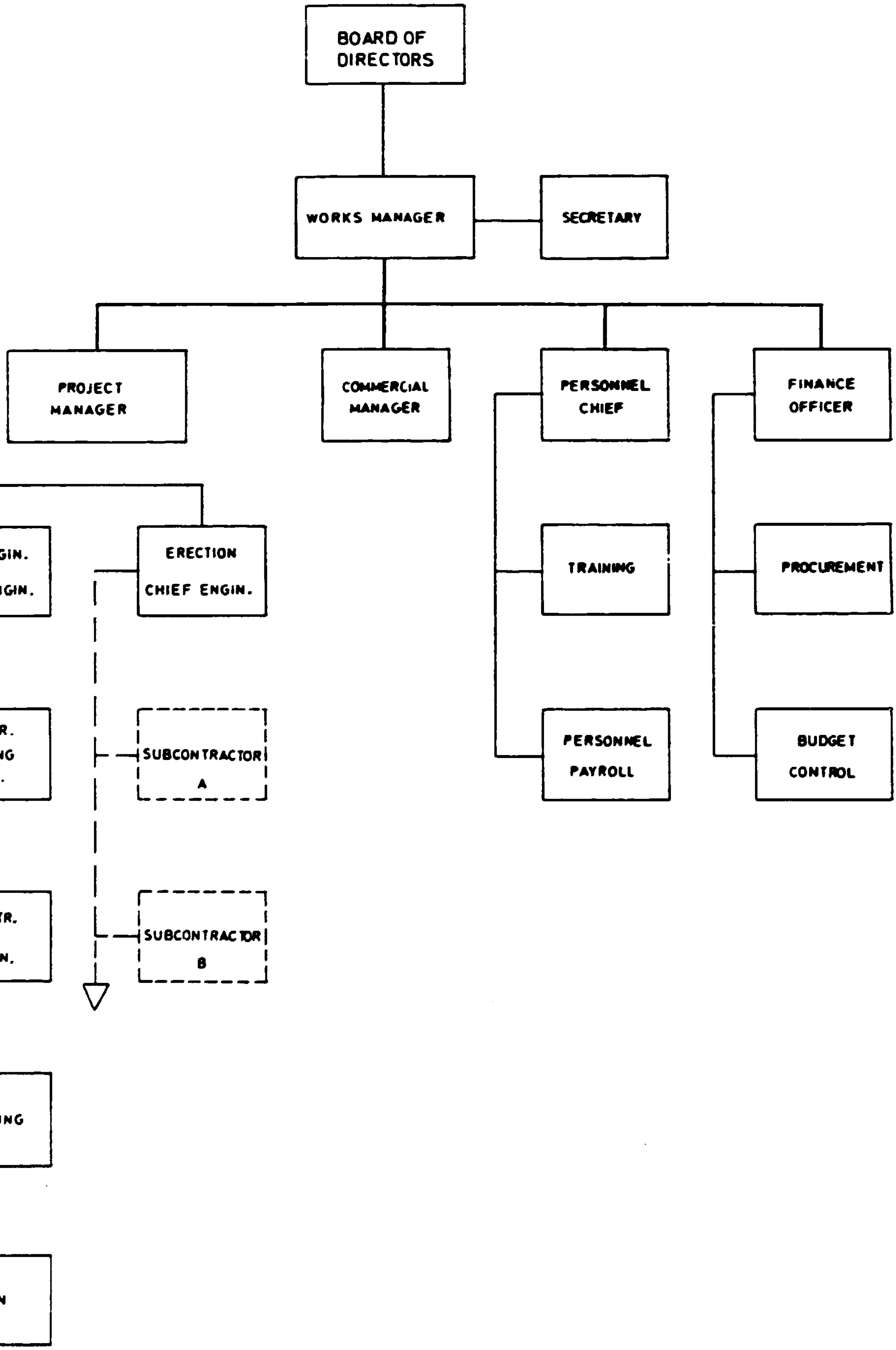
MANAGEMENT CHART DURING CONSTRUCTION



I.8. IMPLEMENTATION SCHEDULING

- The project implementation phase embraces the period from the decision to invest to the start of commercial production.

- Of course, a number of stages could not really be sized in time figure as Uganda has not tackle such an huge industrial new project from long time.

- Negotiations and contracting, overlaping of main activities period could not easily be estimated as depending from the approach set up to execute the project (consultant, experts, turnkey, ...)

- Consequently, we prefer to propose an optimum implementation program, grouping the main activities as hereafter mentioned.

ACTIVITIES (from decision to invest, month : 0)	To be finalized before :
A. - Select and finalize agreement with promotors and shareholders. Found a company to operate the plant. - Fix best suitable loans (local + international - short, + medium and long term), negociate and finalize.	month 2
B. - Set up implementation management team (select experts and a consultant). - State fundamental data for project implementation. - Elaborate implementation program and time schedule and responsibilities. - Elaborate preliminary costs figures and projection of expenses to implement the plant. - Obtain governmental approvals for the project and its proposed financial structure (local and foreign currencies) and approved enterprise certificate.	month 2 to 3

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C. - Select and finalize the site agreement for the plant (and quarries) (investigate the caracteristics of the soil).
- Prepare specifications for International tendering for process, equipment, material, civil works, erection works, general contractor.
- Fix program of recruitement and training.

<u>month 2</u>
<u>to 4</u>

D. - Issue tenders for the implementation of the plant.
- Prepare specifications for connections with water, electricity, road, railway sewer and finalize the contracts.
- Obtain building permits.
- Select operational personnel.
- Obtain import licences.
- Tender for raw materials and finalize.

<u>month 4</u>
<u>to 5</u>

E. - Bids collection and comparison for implementation of the plant.
- Negociations.

<u>month 6</u>
<u>to 8</u>

F. - Award the contract for the total implementation of the plant.

<u>months 8</u>
<u>to 10</u>

G. - Enforcement of the contract
. down payment
. opening of the L/C.
- Contract for raw materials.

<u>months 10</u>
<u>to 11</u>

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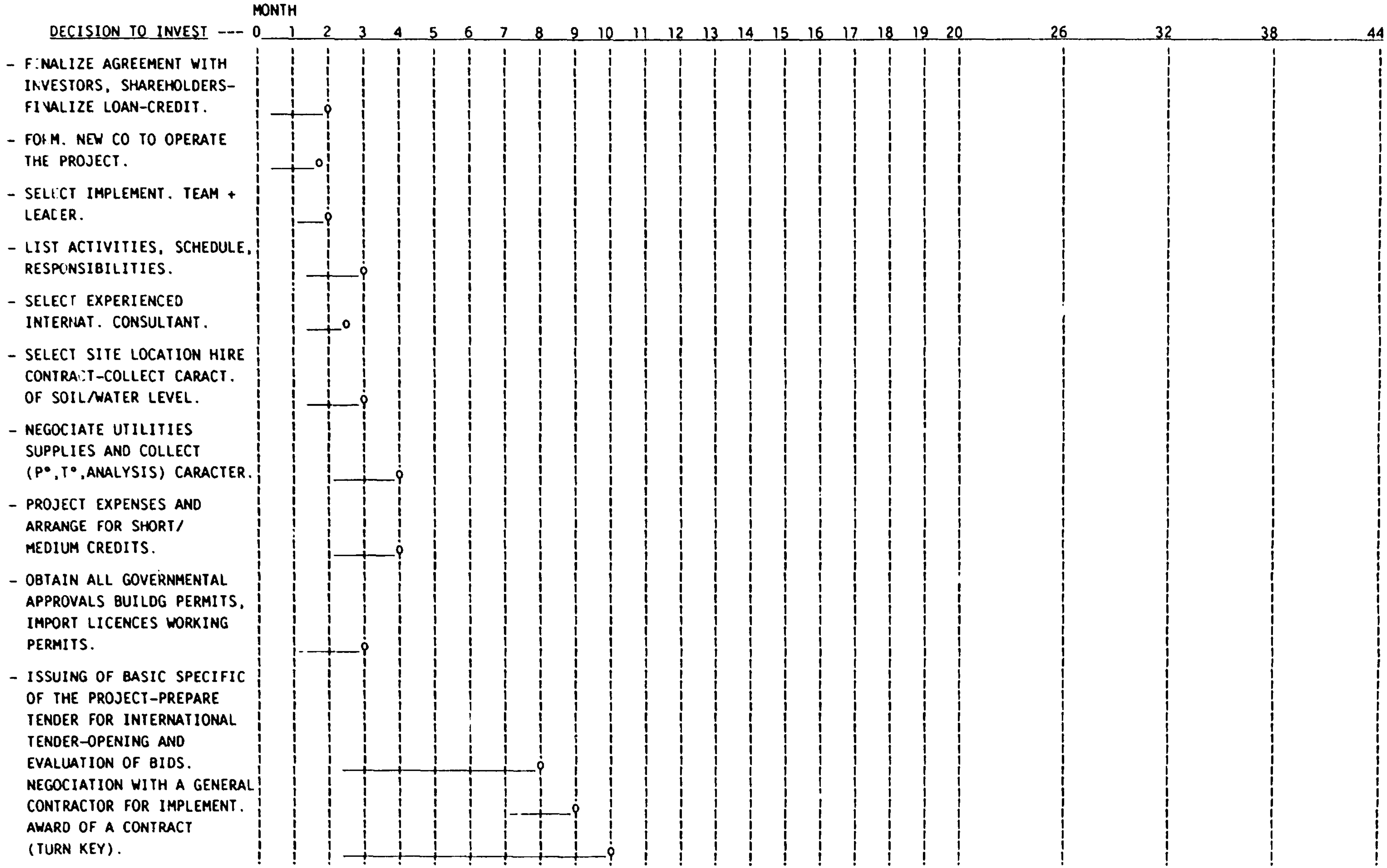
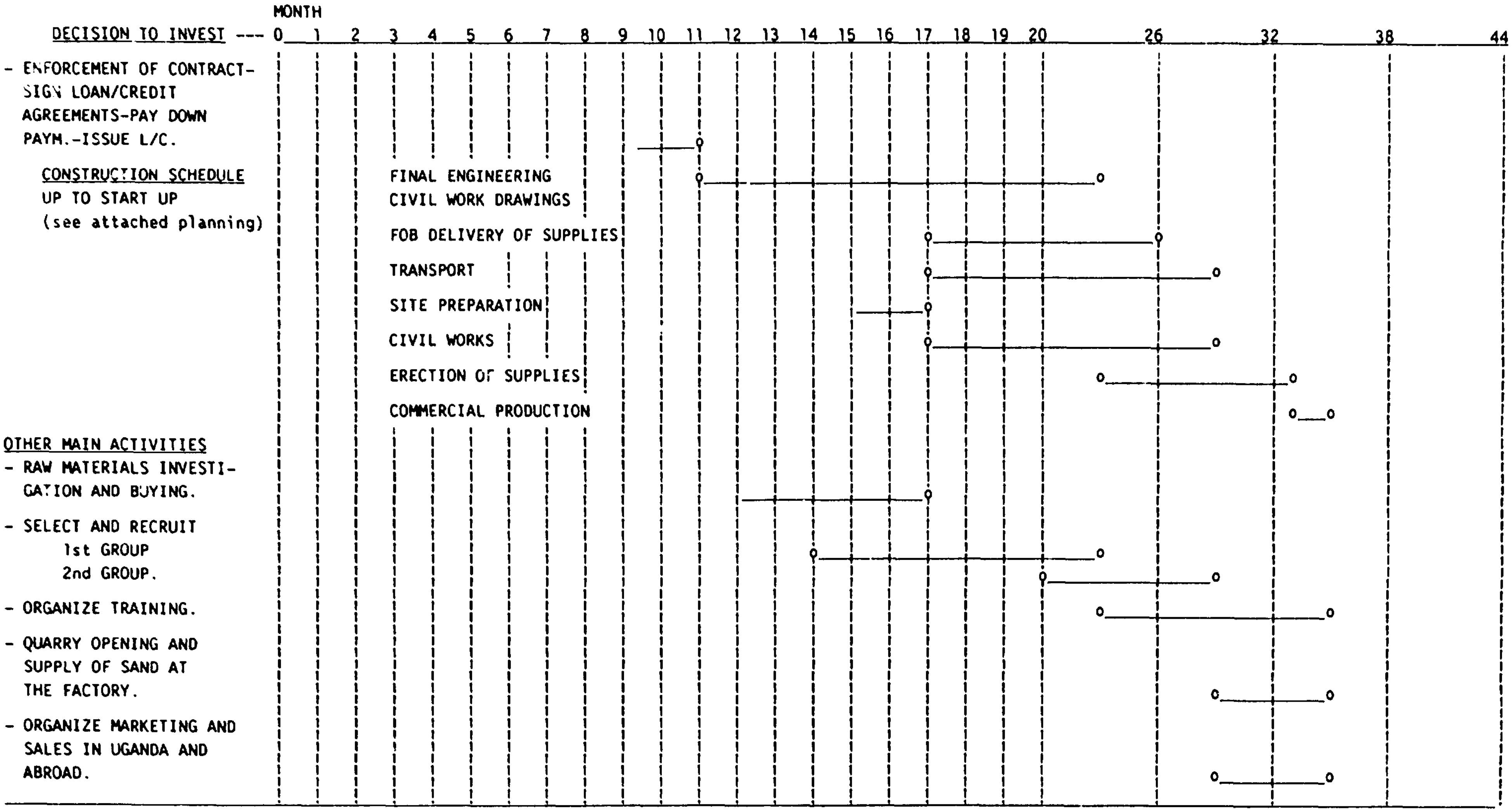
H. - Civil works and erection work, commission and start up of the saleable production. Detailled schedule page 36. — 24 months after G.

I. - General schedule of main activities is hereto attached.

SCHEDULING OF MAIN ACTIVITIES (LIST NON EXHAUSTIVE)





IMPLEMENTATION OF A GLASS CONTAINERS AND TABLEWARES PLANT IN UGANDA

CONSTRUCTION SCHEDULE

```
            6           12          18          24
X_!_!_!_!_!_!_!_!_!_!_!_!_!_!_!_!_!_!_!_!_!_!_!_!

X ENFORCEMENT OF CONTRACT WITH A GENERAL CONTRACTOR

X___! SITE STUDY (SOIL TESTING)

X___________! WORKING DRAWINGS

  !_____! FOUNDATION DESIGN

        !_______________! FINAL DRAWINGS

            !_______________________! KNOW HOW & TECHNICAL
                                      DOCUMENTATION

            !_________________! FOB DELIVERY OF SUPPLIES

                !_________________! TRANSPORT OF SUPPLIES
                                    ON SITE

            !_____________________! ERECTION OF BUILDINGS

       ERECTION OF SUPPLIES !_________________!

                                  STARTING UP !_!
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I.9. FINANCIAL AND ECONOMIC EVALUATION

A. TOTAL INVESTMENT COSTS.

All the figures are expressed in U \$. The conversion rates used are the average in force during April 89, i.e.
1 U \$ = 200 Uganda Shilling ((U.Sh.).

Total investment consists of total initial investment and total current investment.

1. Total initial investment during construction period is presented on the p. 38 and include.
   1.1. Initial fixed investment US\$ 24,305,700
   1.2. Preproduction costs, including :
      - Training of key personnel.
      - Salaries and wages before start-up.
      - Company constitution costs.
      - Fees + arrangement cost of the credit, loans, ...
      - Contingencies.

      Cost : 1,785,100 U \$.
   1.3. Financial charges before start-up on the following base : 12 months interest on the long term credits, i.e. : 1,433,400 U \$ in foreign currency.
   1.4. Working capital, on the following basis of calculation :
      - Accounts receivable : 30 days coverage of production costs.
      - Inventories : as per normal criteria for glass project.
      - Cash in hand : 1 month of wages and fixed costs.

   Total: US\$ 1,436,900

2. Current investment :
   Current investment of the project is replacement investment for :
   - Furnace extension at the end of the fifth year of production : 2,697,000 U \$
   - Furnace partial rebuilding at the end of the tenth year of production : 1,068,000 U \$
   - Replacement of the rolling stock at years 5 and 10 : 238,000 U \$.

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TOTAL INITIAL INVESTMENT

amounts in thousand US $	LOCAL CURRENCY	FOREIGN CURRENCY	TOTAL
Initial fixed investment	2697.7	21608.0	24305.7
Preproduction costs	181.9	1518.2	1700.1
Reserve	9.1	75.9	85.0
Financial charges before start up	.0	1433.4	1433.4
INVESTMENT TO BE DEPRECIATED	2888.7	24635.5	27524.3
Working capital 1st year	173.8	1263.2	1436.9
TOTAL INVESTMENT	3062.5	25898.7	28961.2

B. PROJECT FINANCING.

BASIC DATA CONSIDERED FOR THE FINANCIAL STRUCTURE.

- Basic principle :

  . 1/3 of the total financial needs (working capital excluded) would be covered by the equity.
  . 2/3 would be financed by loans.
  . 20 % of the equity would be brought in foreign currency by foreign technical partner (licensor and/or the General Contractor).

- Terms and conditions of the loans :

  . 18 months credits for working capital

  to cover the working capital at ist level of the 1st operating year.
  Rate : 14 %.

  The increase in the working capital for the years following the first year of operation would be assumed to be financed by self-financing.

  This credit will be reimbursed at the middle of the second operating year.

  . Long term loans :

  Buyer's credit in foreign currency to be secured by the general contractor who will get the construction contract.

  It has been supposed that this loan will cover ± 70 % of the financial needs not covered by the equity.

  Rest of the needs in foreign currency will have to be covered by other sources such as an A.D.B. loan.

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Terms and conditions of these loans are those presently in for Buyer's credits granted by european countries and for A.D.B. loans.

For Buyer's credits :

They are : - Interest rate of 8.3 %.
- Repayment holiday for the construction period + 6 months operation.
- Reimbursement in 10 half-yearly instalments, the first one maturing 6 months after start-up.

For A.D.B. loans :

They are = - Interest rate of 7.4 %.
- Repayment holiday for 5 years.
- Reimbursement in 30 half-yearly instalments, the first one maturing 5 years after the beginning of the construction period.

Cash flow schedule for financial planning.

See tables below.

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* F I N A N C I A L   S T R U C T U R E *

amounts in thousand US $	LOCAL CURRENCY	FOREIGN CURRENCY	T O T A L
EQUITY	7720.0	1930.0	9650.0
Buyers credit	.0	12500.0	12500.0
ADB loan	.0	5350.0	5350.0
Working capital local currency	200.0	.0	200.0
Working capital foreign curr.	.0	1300.0	1300.0
TOTAL LONG TERM LOANS	200.0	19150.0	19350.0
SHORT TERM CREDITS	.0	.0	.0
TOTAL FINANCIAL STRUCTURE	7920.0	21080.0	29000.0

C. FINANCIAL AND ECONOMIC ANALYSIS.

The basic study alternative considers a furnace of 50 t/day melted glass, which furnace is intended to be increased to a 90 t/day size during the 5th year of production in order to be able to increase at that time the production to follow the market projected increase.

The study covers a period of 17 years i.e. 2 years of construction and 15 years of operation.

FINANCIAL ANALYSIS.

a. Rate of return :
   a.1. simple rates of return,
   a.2. internal rates of return.

b. The pay-back period.

c. The break-even point.

ECONOMIC ANALYSIS.

a. The added value.

b. The impact of the project on the foreign currency balance of the country.

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FINANCIAL ANALYSIS.

a. Rate of return :

a.1. Simple rates of return :

The simple rates of return rely on the operational accounts.
They are ratios of the net profit to the net sales revenue, the original investment outlay and to the equity.

The results are :

	100 % capacity	200 % capacity
Return on equity	6.5 %	36.8 %
Return on investment	2.2 %	12.0 %

- 100 % correspond to the plant working with a furnace of 50 tons/day (5 first years of production).

- 200 % correspond to the plant working with a furnace of 90 tons/day (10 following years of production).

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a.2. Internal rate of return :

The rates which are needed to evaluate the project or to make comparisons between several alternatives or between different projects, are to be worked out.

These are :

. The economic for contractor I.R.R. after tax, obtained by discounting the net cash flow given in "Economic" table.
  It corresponds to the I.R.R. of the COMFAR.
. The economic for contractor I.R.R. before tax, obtained by discounting the gross cash flows given in "Economic" table.
. The financial I.R.R before tax, obtained by discounting the gross cash flows given in "Financial" table.
. The financial I.R.R. after tax, obtained by discounting the net cash flows given in "Financial" table.
  It corresponds to the I.R.R.E.2 of the COMFAR.

The economic rate, giving the rate of return of the total investment outlay, shows the highest rate of interest that could be borne without inducing losses for the proposed project provided that the loan repayments schedule falls in line with the cash inflows. It is the real rate of return of the total investment or of the equity which takes account of the entire length of a project's life from its moment of origin, of the staggering of cash flows and of the moment such flows take place.

We considered the economic rate of return to evaluate the profitability of the project.

1. As a function of the data taken into consideration for the basic hypothesis (furnace 50 tons/day) the profitability of the project is not very high but feasible.

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The project shows a loss of 1,014 Mios $ for the first working year but the results then become positive even if we have to wait until the third operating year before the cumulated results becomes positive which could be acceptable. From the STATE point of view it should be considered the other important advantages of the project savings of currencies, independance from the imports of bottles to develop beverages industry, creation of employments, technological development of the country.

2. The average annual rate of return for the 15 years of production is not high but acceptable on the economic point of view. It is generally considered that an economic rate of return (for an industrial project) above 12 % is acceptable.

<u>Results</u> :

Economic for contractor I.R.R. after tax	:	15.1 %.
Economic for contractor I.R.R. before tax	:	19.4 %.
Financial I.R.R. before tax	:	21.2 %.
Financial I.R.R. after tax	:	15.4 %.

3. From a strictly economic point of view, the total investment proposed is also acceptable if the investor thinks that a profitability rate of the investment of 19.4 % is not less than what he takes the cut off rate to be.

4. The economic rate I.R.R. is much higher than the interest rates considered for the loans. That makes also the project feasible.

5. The financial I.R.R. is used by the investor in capital to improve the advantage of placing his money in one project rather that in another type of placement.
A rate of 15.1 % is certainly attractive.

./.

b. Pay-back period :

It is the period required to recover the original investment outlay (without land and working capital) through the "profits" the project earns (gross production margin - tax on profits).

The pay-back period is 6 years and 3 months after start-up of the production, which is rather long.

c. Break-even point :

The break-even point of a project is the percentage of the production capacity to be reached before the project begins to make a profit.

We have calculated the figures for each year, the results appear on the last line of table showing the profitability schedule (pages 391-392).

Before increasing the furnace capacity, i.e. from the first to the fourth years of production, the break-even point ranges from 124.9 % to 80 % with an average of 89.7 %.

This is rather high, this figure shows that ± 90 % of the planned production must be produced and sold to avoid losses.

However the situation improves considerally with the increase of the furnace capacity, i.e. from the fifth year of production, the break-even point ranging then from 59.8 % to 18.7 % with an average of 26.8 %.

This means that approximately one quarter of the planned production must be produced and sold to avoid losses. Above this percentage, the project will make profit.

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ECONOMIC ANALYSIS.

a. Added value :

Each industrial investment brings some added value to the national economy of the country where the project is implemented.

It increases the G.N.P. of the country.

The added values are given in page 47.

The average value on 15 years is : 8,735,010.9 U $
what is 47,473 U $ per person employed
or 9.6 % of the total investment.

These values are fairly good.

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****
* ADDED VALUE *
****

% or US $		average 3 years	average 5 years	average 10 years	average 15 years
ADDED VALUE					
per year		4226813.9	4898095.6	7273519.7	8735010.9
per person employed		23224	26620	39530	47473
in % of annual net sales	%	55	59	64	66
in % of total investment	%	14.6	16.9	24.8	29.6
per t. of raw material		422.9	458.4	505.3	522.4
per t. of Bottles		310.4	332.1	362.4	373.8
per t. of Tablewares		257.7	275.7	300.9	310.3
per t. of total main products		568.1	607.9	663.3	684.0

****
* PAY-BACK PERIOD: * [illegible] years et 3 months
****

b. <u>The impact of the project on foreign currency balance</u>.

The foreign currency balance will be affected whether the project is implemented or not.

If the project is implemented, foreign currency will not be lost in importing glass containers, but currency will leave the country to pay for the project.

Table below shows the impact of this.

When drawing up this table, we have considered :

- foreign currency inflows :
  . the savings made on not importing bottles and tablewares which is valued at 560 $/T and 1,120 $/T for the quantities corresponding to the project's production,
  . the revenues from the equity and foreign credit,
  . the export sales.

- foreign currency outflows :
  . the investment (without working capital),
  . production costs,
  . debt service for the foreign credits.

<u>Conclusion</u> :

For an import CIF price for bottles of 560 $/T and for tablewares of 1,120 $/T, the project will save 6,3 million $ per year as an average. The total savings in foreign currency of the project during the 15 years of production is 95,359,300 U $.

It is only if the CIF price of glass should fall under 230 $/T that the project would not allow foreign currency savings.

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****
* IMPACT ON THE FOREIGN CURRENCY BALANCE *
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in US $	average 3 years	average 5 years	average 10 years	average 15 years
Averaged yearly saving	-1115067	-312339	4132573	6357284
Minimum cif price needed to reach foreign currency break-even point.	874.11	763.01	347.39	226.43

D. SENSITIVITY ANALYSIS.

This analysis examines the consequences which variations in some parameters may have on the investment, financial structure and the profitability of the project.

We have examined variations regarding :

F.1. Variation of the sales price :

Three alternatives.
Two where sales price of domestic sales is 10 % higher or lower, one where sales prices of exported tablewares is 5 % lower in order to make easier the entering in foreign markets.

Alternative A : sales price + 10 %.
Alternative B : sales price - 10 %.
Alternative C : sales price of exported tablewares - 5 %.

F.2. Variation of production costs :

Alternative D : production costs - 10 %.

F.3. Variation of interest rate :

Alternative E : interest rates - 1 %.

Buyer's credit	:	7.3 %	instead of	8.3 %.
A.D.B. loan	:	6.4 %	instead of	7.4 %.
Working capital credits	:	12 %	instead of	14 %.

F.4. What happen if the project receives a tax holiday of 5 years :

Alternative F.

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F.5. Variation of the investment costs :

Three alternatives.
Two in which each of the investment items, without working capital, would be 10 % lower or higher.
One alternative considering the utilization of the existing buildings and infrastructure of the old plant of the Madhvani Group.

Alternative G : investment costs + 10 %.
Alternative H : investment costs - 10 %.
Alternative I : existing site utilization.

F.6. Starting with higher capacity :

Alternative where the production start immediately with a furnace capacity of 90 T/day instead of 50 T/day.

Alternative J : is called "double gob" alternative.

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a. FINANCIAL ANALYSIS.

If we make the comparison of the various alternatives of the I.R.R. level we obtain :

	Alternative	I.R.R. %
	Basic	15.1
A	Selling price + 10 %	17.1
B	Selling price - 10 %	12.6
C	Export price - 5 %	14.8
D	Production costs - 10 %	16.1
E	Interest rates - 1 %	15.0
F	Tax holiday 5 years	15.6
G	Investment costs + 10 %	13.9
H	Investment costs - 10 %	16.5
I	Existing site	16.4
J	Double gob	19.9.

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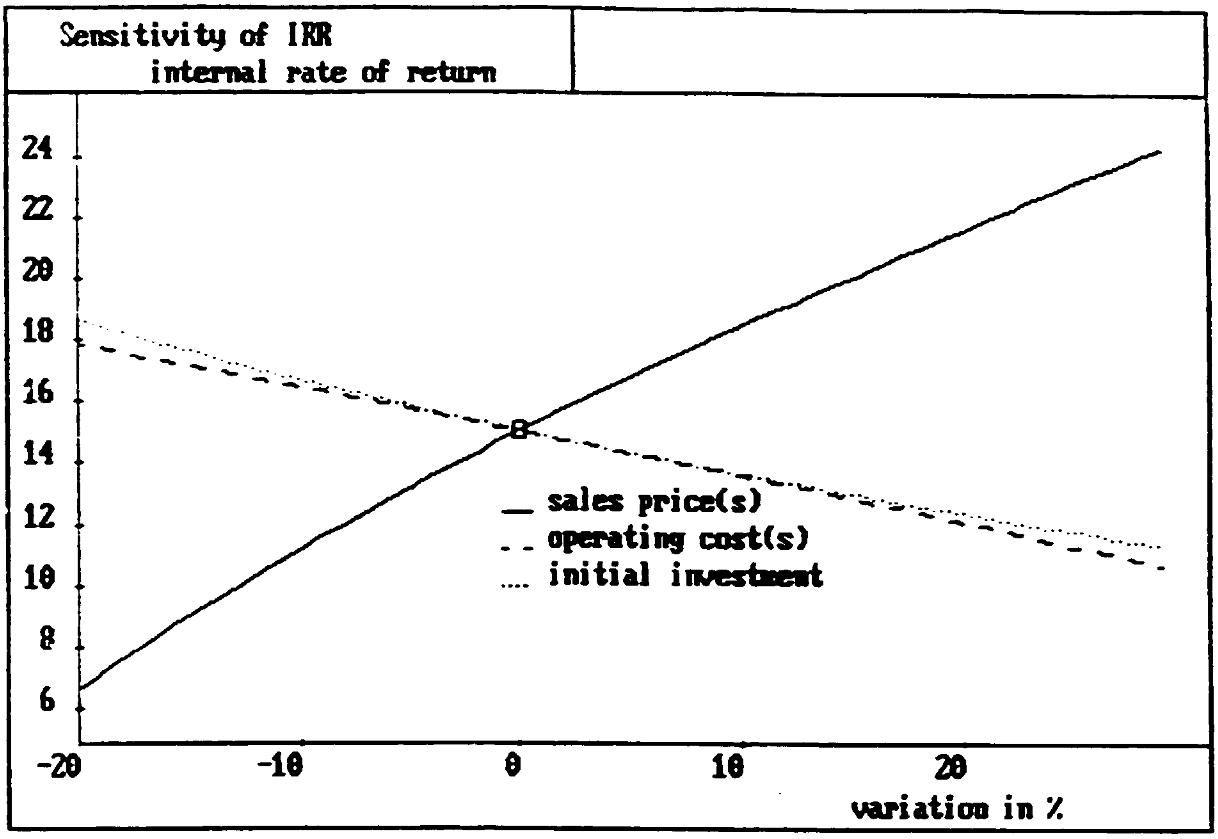
Sensitivity of IRR
internal rate of return
24
22
20
18
16
14
12
10
8
6
-20
-10
0
10
20
variation in %
sales price(s)
operating cost(s)
initial investment

Project is mainly sensitive to the selling prices. But if we decrease by 5 % the selling prices of the exported tablewares, the impact on the profitability is marginal. We thus recommend this price policy to penetrate the foreign markets.

Impact of operating cost and investment cost, as we can see on the chart below, is quite the same, impact of a variation of the operating costs is a little bit higher.

Using the existing facilities of the old plant of the Madhvani group will allow a reduction of the investment cost of 2.4 million $. The impact on the profitability is the same as a global reduction of the investment cost by 10 % (the I.R.R. would be 16.5 %).

Variation of 1 % interest rate has a negligible impact.

A tax holiday period of 5 years has an interesting impact and improves with 0.5 % the I.R.R.

Finally, the best improvement for the project would be significately obtained by starting immediately with a higher production capacity (the I.R.R. would be 19.9 %).

Obviously, the market must absorb this increase of the production.

b. ECONOMIC ANALYSIS.

Tables below compare the various alterations as far as the added value and the foreign currency balance impact are concerned.

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######################
* ECONOMIC ANALYSIS *
######################

amounts in thousand US $	BASIC	A Sel.prices + 10 %	B Sel.prices - 10 %	C Sel.prices export -5%	D Prod.costs - 10 %	E Inter.rate - 1 %	F 5 years tax holid.
YEARLY AVERAGE 15 YEARS							
ADDED VALUE							
per year	8735.0	10056.3	7413.6	8620.2	9182.8	8735.0	8735.0
per person employed	47.5	54.7	40.3	46.8	49.9	47.5	47.5
in % of annual net sales %	66.1	69.2	62.3	65.8	69.5	66.1	66.1
in % of total investment %	29.6	34.1	25.1	29.2	31.4	29.8	29.6
IMPACT ON THE FOREIGN CURRENCY BALANCE							
Average annual savings	6357.3	6586.8	6127.7	6242.5	6657.7	6435.0	6357.3
Minimum cif import price of main products from which savings are generated US $	226.4	208.5	244.4	235.4	202.9	220.3	226.4

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* ECONOMIC ANALYSIS *

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amounts in thousand US $	BASIC	G Investment + 10 %	H Investment - 10 %	I existing site	J double gob 90 t/day
YEARLY AVERAGE 15 YEARS					
ADDED VALUE					
per year	8735.0	8735.0	8735.0	8735.0	10475.3
per person employed	47.5	47.5	47.5	47.5	56.9
in % of annual net sales %	66.1	66.1	66.1	66.1	67.5
in % of total investment %	29.6	27.1	32.6	32.5	34.0
IMPACT ON THE FOREIGN CURRENCY BALANCE					
Average annual savings	6357.3	6138.9	6579.5	6498.1	8005.0
Minimum cif import price of main products from which savings are generated US $	226.4	243.5	209.0	215.4	190.5

I.10. CONCLUSIONS

A. ADVANTAGES OF THE PROJECT

a) This new glass containers and tablewares project should be and is considered by the Ugandese authorities as a priority project because.

1. Present shortage of bottles reduces the activity of the bottlers.

2. Import of bottle's is also depending from the availability of foreign exchange and the project will save foreign currencies.

If Uganda is producing glass mainly from its main resources : raw material, utilities, manpower, obviously its dependence from abroad will be reduced.

Of course, savings (and earnings by exportation of part of the production) has a national impact on the availability of foreign exchange for other purposes also reduction of risk on the exchange rate.

b) Uganda will produce bottles where the market exists.

- Demand will be satisfied more easily and quickly.
- Transport, handling costs will be reduced.
- Breakage during transport will be reduced.
- Production could be more easily and more quickly adapted to the demand.
- Direct buying ex glass factory by the bottlers will reduce the selling cost.

c) The design of the plant could allow a increase of production (doubling) if demand increases as we expected.

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d) Flexibility of the process and polyvalence make that the production program could be adapted to the types of containers needed (as soon as quantity is enough to sustain a profitable production).

e) Glass factory is a manpower consumer also quarries, workshops and all peripheric companies linked with the glass factory.

f) Project could lead to a valorization of an existing investment (the old East African Glass works plant).

g) After a few years of operation, exportation could be developed to other countries like : Zaïre, Soudan, Ethiopia, ... to generate foreign exchange in enough quantities to render the project self supporting progressively.

h) It is unanimously accepted that growth rate of domestic demand and consumption of glass containers (also tablewares) are linked with the local availability of containers.
We expected that beside the beverages industry other industries as : agro industry, pharmacy, parapharmacy, chemical industry, all industries needing packages will also be developed.

CONCLUSIONS AND RECOMMENDATIONS

1. BASIC ALTERNATIVE :

This basic alternative consider the use of a 50 t/day furnace feeding single gob process machines up to the fifth year of production. At that time the furnace will be increased to a 90 tons/day and it will feed double gob process machines.

This alternative is viable :
- The I.R.R. on 15 years = 15.1 %.
- The average return on equity becomes positive from the third year of production : 0.8 %, and the same average return on 15 years is 36.8 %.
- Past the fifth year of production, the break even point decreases below 50 % to reach 18.7 % at the 15th year.

An increase of the selling price by 10 % will give an I.R.R. of 17.1 %.

A reuse of the existing site of the old factory of the Madhvani Group will allow a reduction of the investment of about 2,4 million U $ and improve the I.R.R. up to 16.4 %.

The impact of a reduction of 5 % of the selling price from the exported tablewares is insignificant. We should thus recommend this policy in order to facilitate the penetration of the foreign market.

2. ALTERNATIVE J :

This alternative consider the use of a 90 t/day furnace feeding double gob process machines from the start up of the factory.

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This alternative is obviously more profitable than the basic one.

- The I.R.R. on 15 years = 19.9 %.
- The average return on equity is positive from the first year of production : 1.3 %, and the same average return on 15 years is 45.2 %.
- Past the second year of production, the bread even point decrease below 50 % to reach 18.7 % at the 15th year.

3. RECOMMENDATIONS :

The alternative J is more profitable.
However it must be noted that only the basic alternative of the project could start immediately as the present market demand is only sufficient to absorb the production of single gob machines, with a furnace of 90 t/day.

In any case, the market demand will only be sufficient in 1995-96 to absorb the production of double gob machines with a furnace of 90 t/day.

The only two options to be considered are :

- Either to start immediately the basic alternative with a furnace of 50 t/day.
- Or to wait 2-3 years before starting the alternative J with a furnace of 90 t/day.

Considering the Ugandese Government recommendations to start the project as soon as possible, our recommendations are :

. Start with the basic alternative immediately.
. Obtain a tax holiday period from the Ugandese Authorities.
. Use the existing plant (Madhvani group) if a suitable agreement can be found between both parties.
. Penetrate the tablewares export market of tablewares with a lower selling price.

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B. CHANCES OF IMPLEMENTING THE PROJECT

Basically, the criteria for the future implementation of the project seem to be satisfied.

We can resume the situation as follow.

OUTLOOK OF UGANDA IS IMPROVING EVERY DAY.

1. The economy is looking stronger, performance in 1987 and 1988 in term of percent growth in G.P.D. is continuing to be at least at 6 % and over with good prospect for the future price of coffee, the main export.

2. Political situation.

   - Substantial improvements are achieved in the internal security, situation oughting to bring a cut in the crippling level of military expenditure.

   - The Government seems today to have sufficient political support to put an end to the corruption and smuggling which are so damaging to the economy.

   - Relation with Kenya seems more quite.

   - The Government embarks on reconstruction in the North.

CONCEPT OF THE PROJECT INCREASES THE CHANCE OF IMPLEMENTATION.

It is clear that the development of the beverages industry, the food industry, the pharmacy, etc ... is limited by the lack of packing.

It is also clear that the market of these products in Uganda is underdeveloped.

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In particular, the national consumption of beverages is far below from the consumption per capita in the neighbouring countries having similar G.N.P.

The Government is decided to give a priority :

a. to the rehabilitation of the industrial sector,
b. to the privatization,
c. to help new profitable industrial investment initiated by the private promotors.

This could concern both alternatives of this glass container project through rehabilitation of the existing plant or through the implementation of a new factory. The Ugandese Authorities asked us to base our study on a complete new factory.

The concept of the glass factory project is based on criteria which should lead to a success.

1. The demand for bottles is existing for the present and the future production.

2. For the purpose of this study it has been assumed that the relevant price level lies below or at least equal to the imports prices which include more breakage, more handling charge.

   Consequently the home manufactured real price will be lower and profit should be higher than mentioned.
   Generally speaking all data for the study are on the conservative side.

3. The new issue of the document related to incentives for new investment is in preparation but not yet discussed in the Parliament and published.

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We have not taking into account eventual subsidies for utilities. But this could help again to the profitability of the project with other incentives : tax holiday, free of charge land, etc ...

4. Main raw material : sand, limestone, dolomite are available in Uganda suitable for glass production. Electricity is available at an attractive price.

5. Appropriateness of the engineering and the technical design of the plant take into account the environment of Uganda.

   - Easy extension (doubling) of the production.
   - Flexibility of the production at different level.
   - Polyvalence to produce different colours, shapes, sizes.
   - Simplitícy of the process.

6. Current financial situation and financial viability of the project are acceptable.

7. National economic benefits, particularly foreign exchange savings and earnings (export tablewares to Burundi-Rwanda) are resulting from this project.

PROMOTORS AND INVESTORS ARE INTERESTED, IN PRINCIPLE, IN THIS GLASS PROJECT.

As we contacted potential promotors and investors before having the conclusions of this study, the results of our meetings were only indicative.

In principle, the following entities are interested to cooperate to implement this project :

A.- public sector, f.i. Ministry of Industry [through Uganda Development Corporation or through bottlers (Nile Breweries)], eventually Ministry of Defence, and

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- private sector, f.i. bottlers (Uganda Breweries, Lake Victoria Bottlers) together with private investors like Spear Motor, Nile Glassworks Ltd.

B. Different international financing organizations have already marked interest for this project : A.D.B. (Abidjan), E.A.D.B. (Kampala), F.A.D., O.P.E.C., F.E.D.

C. Madhvani group involvement could be also analysed either through equity participation (bringing their site as share in the new company) or by selling their existing site of the old glass plant to the new shareholders.

Anyway further investigations will be done in due time and this list of potential cooperations is of course non exhaustive but very encouraging and promising for a quick implementation of this project.

FINANCING COULD BE RAISED.

Flow of investment aid is beginning to have a real impact on the economy which should encourage donors and International financing organization to have confidence and long term aid to Uganda and to viable projects.

We recorded summaries of the main contacts or interviews (but these are not limitative) concerning the potential financing of this project.

- Foreign currencies

  . A.D.B. (Abidjan) and E.A.D.B. are in principle very much interested in the financing of this project (refer to telex enclosed in annex 9.).
  . B.E.I. (C.E.E.) could allocated part of its : 30 Mios USD credit [allocated via U.D.C. (Uganda Development Corporation) for the 5 years plan (1985 - 1990)] but decision, priority and conditions remain under the Ugandese Authorities.

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. European credit Development Fund is not interested.
. Belgian Credit [through Agence de Coopération et Développement (A.G.D.C.)] could be available.
. Italian Credit (covered by SACE) could be available at interest rate of 8.2. %/y in USD (reimbursement during 7 to 8 years after start up of the plant).
. Swiss and German Credits are also available at similar conditions.
. Development Finance Co of Uganda Ltd.
. S.F.I. and World Bank seem not interested.

- Local currency

For local expenses (civil works and erection works), U.D.B. or U.C.B. are the main interlocutors interested to finance the local part.

Public sector share (probably through Uganda Development Corporation - U.D.C.) could amount 20 to 40 % of the total equity. If it is the case, a bank guarantee for the foreign loans could be obtained from the Ugandese State.

In short,

Uganda needs a glass container and tablewares factory, local (and foreign) promotors are willing to participate in this project principally the bottlers who know the excellent prospect of the market and the profit from this business.

But Uganda Authorities have to definite a clear policy to promote and allocate incentives for such a project in an attractive way and environment to allow and ensure a reasonable profit.

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II. PROJECT BACKGROUND AND HISTORY.

II. PROJECT BACKGROUND AND HISTORY

The industry of glass containers manufacture in East Africa dates back to over 30 years the first glass factory was established in Mombasa (Kenya) in late 1940.

This was followed later by the establishment of four other factories in Nairobi, Dar-es-Salam, Bujumbura and in 1969 in Kampala (Uganda).

Factories in Kenya, Tanzania and Uganda were initiated under the aegis of the Madhvani Group of Companies.

Whereas the other factory in Kenya (only one, Nairobi plant closed in 1988), Tanzania, Burundi continue production, the Ugandese factory closed in 1974 due to political decision.

The capacity of the Ugandese plant (formally called "East African Glass works Ltd") was 24 tons of saleable glass per day (8,500 t/y) (furnace : 30 t/d).

They were selling bottles to

Uganda Breweries Ltd
Nile Breweries Ltd
Lake Victoria Bottling Co Ltd
New Kampala Minerals
Jubilee Ice and Soda Co
East African Distillers.

They used to make provisions for pharmaceuticals and cosmetics. It used to produce glass tumbers as well and plastic crates. Exports were not developed. As the Ugandese plant stopped its production in 1974, all containers and glass wares for Uganda are presently imported.

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But since that time, as reported in the previous feasibility studies and confirmed by our interviews with the major glass consumers in Uganda, there is a serious shortage of glass containers forcing regularly the bottlers to limit their production.

During the last 10 years, several efforts have been made to reactivate Uganda's only glass factory (East African Glass works Ltd, in Kampala) but no significant progress has been made.

For instance, a Korean company was asked to study and participate in the rehabilitation of the existing plant but finally this project failed to come out.

Our company, ABAY, was also asked by the Madhvani Group to make different studies and offers for the rehabilitation of this factory.

The last offer we produced was in November 1984. No consensus was found between the Ugandese Government and the Madhvani Group to start the implementation of the project. The main reason was, according to our information, the lack of credit's insurance to cover the financing already and potentially found. This was due to the fact that Uganda was not in a sufficiently stabilized economical/political situation.

Also, several prefeasibility and feasibility studies have been performed during the last 7 years by foreign companies and local consultant offices for a new glass factory. But the implementation of the project was never decided for the same reasons as mentioned before. Even the situation of Uganda was much more improved and also as per our analysis, because the International Financing Organizations were not sufficiently confident in the recorded data of the studies collected during an erratic period of Ugandese Industrial Development stage and political searching of stability. The domestic market analysis of glass containers was not deeply evaluated.

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It is important to underline that the latest statistical yearbook include generally information ending on 1974 or insufficient to be taken into consideration.

Analysing these studies, it is confirmed that :

1. it is an interest, a need and a priority to revitalize the glass industry in Uganda ;
2. local and foreign promotors are interested in this glass project ;
3. demand for new bottles is growing by the fact that beverages demand is increasing (consumption being presently limited by the possibilities of importation) ;
4. Uganda per capita consumption of beverages (and bottles) is still much lower than in the neighbouring countries having similar G.N.P.;
5. raw materials (sand/dolomite/limestone) for glass manufacturing are existing in Uganda.
6. Previous projected plant capacities were too optimistic.

The projected capacities recorded in the different studies were different and too optimistic for that period. But now the situation of the potential market is considerably more attractive and we could propose today a capacity figure which is believed to be more realistic (much lower than recorded in previous studies) and conservative.

If experience of the new factory during the first five years of produccion shows that our assumptions were too pessimistic and that a corresponding excess demand will occur, an extension of capacity will be advisable and easily/cheaply obtained because, in that case, our initial design is allowing a doubling of the capacity.

In october 1986, ABAY was asked to quote for a complete feasibility study for a new glass containers production plant with a special emphasize to the market study on site.

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Today, the situation in Uganda is much more clear and moving to a political and economical stability. The country is in reorganizing phase based on realistic, promising and financially supported programmes.

Industry will be rehabilitated and developed. This could push the Government to implement very soon the project of the glass containers production plant within a more strong environment with support of private promotors to be attracted through adequate incentives.

This project is among the priorities of Uganda mainly due to the fact that beverages industry's development particularly but also pharmacy, parapharmacy, chemical and agro industry packing development is today limited by the availability of glass containers. This project is urgently needed. A solution to reduce the delay of execution and the investment cost of the project will be the recovery of the buildings and infrastructure of the existing glass factory providing that the Government finds a consensus with the owner. Concerning the recovery of the existing equipment, our inspection report concludes that nothing could be reused (destroyed, obsolete, old equipment without spare parts available, ...).

After UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION (UNIDO) acceptance to finance this study, ABAY signed a contract with UNIDO (VIENNA) in December 1st, 1988 to perform this feasibility study for the Ugandese Ministry of Industry and Technology.

We start to work in January 1989.

For their good information and as preliminary actions we gave, in April 1989, to the Ministry of Industry a list (non exhaustive) of basic obligations (document enclosed end of chapter IX.) to implement the project.

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The market survey, raw material analysis, site evaluation, plant design, evaluation of commercial profitability, economic costs and benefits are developed in our feasibility study, we also recorded our contacts concerning : promotors/investors and financing of the project.

In our study, practically, we were guided by the Ugandese Authorities to analyse a complete new glass factory.
Of course, we knew and we examine the alternative to use the existing glass factory of the Madhvani Group in the industrial area of Kampala. We are not officially informed firstly about the eventual negociation with the Government and this Group, secondly about the policy and the problems to be solved.
But we concluded definitively and surely that the rehabilitation of the existing Madhvani glass factory in Kampala with its infrastructure roads, connexions with water, electricity, sewers will speed the implementation of a glass container plant in Uganda.
Different approaches could be suggested either Madhvani Group brings in the new company its plant as a share or sell its plant to the new company which will invest and operate the glass factory.
But the Madhvani Plant rehabilitation is an alternative solution which cannot be totally ignored.

Informations about the promotors.

It is evident that during our missions on site, we had not yet the results of our study and consequently our discussions with the potential promotors were only informative.

A second reason for that was the the revised issue of the Government policy concerning foreign investment in Uganda and incentives for new industrial investment was not yet discussed in the Parliament.

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But it is clear that firstly the Government policy is to develop industrial projects in a short term (and Glass Industry is one of the priority), secondly that the incentives and policy versus foreign investment (document No 3 October 1977) will be very much improved.

Nevertheless, ou preliminary conclusions of our contacts are concerning :

- <u>Ugandese promotors</u>

  Public and private sector are definitively willing to work together to promote this project under certain conditions.

  . Public sector share [probably through Uganda Development Corporation (UDC) directly or through the bottlers] will be between 20 and 40 % of the total equity (± 35 % of the global investement).
  . Bank guarantees for the loan will be givnd by the State if above condition is respected.
  . Private sector seems to prefer to limit the participation to private industrials to one or two main shareholders : Spear motor, Private bottlers. We found also other potential partners (but it was not our duty to select them) for instance : Nile Glass Works Ltd and other personalities of the politic, finance or purely private sector.
  . Foreign participation in the sharecapital of 5 to 15 % minimum by the technology's licensor or the general contractor [in the previous DECREE (oct. 77) : 500,000 USD].
  . Involvement of a technical partner for management at least for 3 to 5 first years of operation.
  . Bottlers are interested to participate as shareholders as well.

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- <u>Foreign promotors</u>

. As a general remark, many foreigners are studying the possibility to participate in Ugandese industrial project.

. It should not be difficult to interest a foreign glass producer to invest in this project as soon as incentives (tax holiday, subsidies, board's participation, rapatriation of dividend, etc ...) are similar to these one he can obtain in neighbouring countries.

. S.F.I. (World Bank) indicates, as preliminary approach, no interest to invest if the project does not generate enough foreign currencies to covers the needs to operate the plant and to reimburse the loan.

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III. MARKET AND PLANT CAPACITY.

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III.1. DEMAND AND MARKET STUDY

PRELIMINARY REMARKS

- Demand and market considerations are closely linked in developing countries in which governmental policies and institutions are of particular importance as it is in Uganda. Consequently, for this study, no clear distinction has been maintained between the demand and the market.

- As it does not exist any local production of glass containers [the East African Glass Works in Kampala (Madhvani Group) stopped its production in 1974], "present market" of glass containers study is based on the volume of actual importation.

- It is also clear that imports are illusory indicators of aggregate demand as they are subject to severe restrictions of foreign currencies availability and exchange allocations/quotas. This fact is particularly recorded in each of our interviews with the Ugandese bottlers and glass containers consumers. Demand is obviously bigger than present consumption.

- As the importation of beer, soft and alcoholic drinks is forbidden, the demand has to be satisfied only by the local production of beverages which is also and definitively limited by the glass containers availability (as per our interviews).

- It should be noted that the beer (soft drinks) industry depends presently on imports for over 95 percent of its raw materials and spares for its specialised machinery and 100 percent for the glass containers.

  Conclusion, no competitive market current consumption, for beverages and/or for glass containers, can be equated with the current effective demand due to the restrictions of imports.

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- We had noted that no workable statistics from the last 10 years exist to cover the importation of glass containers in Uganda.

- Similarly, the import licences records for glass containers do not seem to cover all the importations (quantities and values seems also generally in discordance).

- Statistics, records and import licences records do not exist or do not mention any importation of tableware.
  Nevertheless, in the main big towns in Uganda shops are selling imported tablewares from different sources.

- Systematic and professional market/demand study was not possible. Demand has been evaluated in comparison with our experience and datas for surrounded similar countries.

- Due to the specific general present environment in Uganda we found that producers are not reluctant to divulge information on operational aspects of industry but consumers were more reluctant to reveal information on family budgets, personal incomes, habits, preferences and market responses.
  This reluctance plus frequent changes in socio-economic living patterns often render the available historical date irrelevant for an industrial programming. Basically, we collected information from our interviews with the glass containers Ugandese consumers (bottlers, ...). These information have been crosschecked with datas collected from surrounded countries and by calculations using general statistics and economic datas available for Uganda.

- Finally, it seems also very clear to us that many experts are working now hardly to elaborate very useful and diversified types of general records and statistics on the country. The possibility of crosschecking will obviously give more accurate information in a very near future. Consequently, it could be also advisable to envisage a complementary mission on site to control our assumptions and to complete our records when datas were insufficient to be taken presently into consideration.

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METHODOLOGY FOLLOWED

Present effective demand

1. We spent on site an extensive time to interview the main consumers of glass containers in Uganda.

2. We collected statistics and importation licences records but we had to conclude :

   a. figures are not consistent, erratic or inexistant for the last 10-15 years and finally not workable ;
   b. as a glass production plant started in 1969 in Uganda, we collected statistics of imports in the period preceding 1969. But we concluded that importation figures were rather small which seems not to reflect the market at that time.

3. We collected information from the main importers (Kenya - Burundi - C.E.E) of glass containers in Uganda where statistical information are available.

4. Since we know that a correlation exists between beverages consumption and glass containers we collected data of the present production of beverages in Uganda to deduct the glass containers demand.

Forecast the future domestic consumptions

1. We use information received through the interviews concerning the programs of extension of the production of beverages to calculate the needs of glass containers.

2. We compared these information with surrounded developing countries (Kenya, Zaïre, Burundi, Tanzania, Rwanda ...).

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3. Since we know that there is a correlation between the population and the income level of a given country and the amount of container glass that a population consumes per head and per year we draw conclusions with regard to the glass consumption in Uganda based on the following factors :
   - population ;
   - G.N.P. per capita ;
   - growth rate of population ;
   - growth rate of G.N.P.

   Of course, as it is or will be the case in Uganda, we observed that, in general, the higher "level of industrialization" and "affluence" per square kilometer, for a given population, corresponds to the higher "per capita consumption of bottles". It is observed that for those countries where the industry of container glass manufacture has a longer industrial activity, the actual growth rate is lower than for those whose glass industry is recent as it will be in Uganda.

Concerning export

For the bottles, we have not taking into consideration exportation. For tablewares, we use the results of a feasibility study realized for a production plant to be implemented in Burundi but for which the production never starts and leaving available this potential market.
(This study was ordered by UNIDO and executed in May 1979 by a consultant Mr. Pierre MONTAGNE.)

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A. GLASS CONTAINERS

A.1. EVALUATION OF THE PRESENT CONSUMPTION OF GLASS CONTAINERS

A.1.1. INTERVIEW OF THE UGANDESE BOTTLERS AND OTHER CONSUMERS OF GLASS CONTAINERS

Each interview has been conducted in the factory by two ABAY's experts (frequently, accompanied by one delegate of the Ministry of Industry).

As far as possible, we interviewed on the site, the General Manager, the Plant Manager and the Administrative and/or the Financial Manager. We paid a visit in the factory.

In the Ministries, we interviewed the Deputy Ministry and/or the Permanent Secretary and/or the Commissioner.

The information we were be concentrating to collect concern mainly

1. Status of the company.
2. Installed production capacity.
3. Present production.
4. Forecast production for 5 to 10 years and eventual constraints for the projected development.
5. Percent of breakages of the bottles.
6. Life of the bottle.
7. Bottles prices, structures of prices and sources of buying.

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Uganda breweries Ltd

- This Company is 100 % private. The shareholders are as follows :

  . East African Breweries / Kenya Breweries (Kenya)
  . Allied Breweries (U.K.)
  . City Breweries Investment Ltd (Kenya)
  . Private Ugandese (2 %)

- The installed capacity of the brew house is 300.000 hl/year.

- Their present average production is : 8,000 crates/day, working 3 shifts/day and 20 days/month. (one crate of beer bottles = 25 bottles of one half litre).

  This production may be considered as a maximum possibility for the present fermentor, but their bottling capacity is higher.

- They plan to extend in a very near future, provided that :

  . Government policy concerning taxation and pricing remains within closed limits as the present ones.
  . Decrease of electricity and water shortages.
  . Availability of foreign currencies to buy their imported raw materials, the spare parts, and the bottles.
  . Improvement of the road conditions.

- The expansion program is to obtain :

  12,500 crates/d by the end of 1989
  25,000 crates/d by the end of 1995.

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- They consider 1 to 2 % breakages as a global average.

- Their number of returns per bottle's life is 10 to 20.

- Nowadays, they have 8,000 crates of empty bottles in stock and they buy more or less 50,000 crates per year, to cover the breakages and the non-return.

- Presently, they buy their bottles from Central Glass (Kenya), Burundi, Belgium and B.D.R.

- The present price is 0.3 U $ CIF per bottle (500 ml). Import tax 30 % not to be added.

<u>Nile breweries Ltd</u>

- This Company is 100 % governmental, under the Ministry of Industry and Technology authority.

- The installed capacity of the brew house is 135,000 hl/year

  They produce different brand name beers in a similar bottle (Club, Crane, Nile higer, Nile special).

- Their last figures of production were :

  25,000 crates during December '88
  28,000 crates during January '89

  They expect to produce an average of 60,000 crates per month in 1989.

- They plan to extend by the end of 1989, provided that :

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. Government policy concerning the selling price of the beer remains within certain limits.
. Money availability for investment.
. Availability of foreign currencies to buy their raw materials and spare parts.
. Buying of a generator emergency set necessary to avoid electrical breakages problem.

- This expansion program consists of a rehabilitation of the brew house only, the bottling lines having a sufficient capacity (576,000 hl/year).

  When completed, this expansion program will allow to produce 1,200 hl/day.

  They also expect to introduce in the market a 300 ml - (185 gr) new bottle containing another type of beer with a higher percentage of alcohol.

  They already have the corresponding filling line. This introduction is not yet decided, but if a positive decision is taken,it will concern about 20 % of their production.

- They consider 1 to 1,5 % of breakages in the bottling hall, and a global average of 2 % including the breakages during transport.

- Their number of return per bottle per year is 10.

- Nowadays, they have 200,000 crates of empty bottles in stock.

- Presently, they buy their bottles from B.D.R., Belgium
  Emco Glass (Kenya) and Central Glass (Kenya).

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- The present price is 0.4295 DM (0.23 U $) CIF per bottle (500 ml).

  This price includes the transport cost for about 30 % and the insurance cost for about 10 %.

Chibuku Breweries Ltd

- They were packing local beer in polyethylene lined paper containers.
- They do not use glass containers.
- Anyway they are out of production or sporadically.

Lake Victoria Bottling Co Ltd

- This Company is 98 % governmental, under the Ministry of Industry and Technology authority, 2 % remains in private hands.

  The company produces soft drinks under the franchise of Pepsi Cola International, i.e. : Pepsi Cola, Mirinda and Teem in NAKAWA industrial area.

  They expect to produce in a next future : soda water, tonic water and club soda. Later on, they intend also to produce 7-Up and fruit juices.

  Their old plant ceases production, whilst a new one was commissioned in November 1987.

- The installed capacity is 4.5 mio. cases/year, working 2 shifts per day. (one case soft drink = 24 bottles of 300 ml).

- They plan to produce : 2.5 mio cases in 1989
  3 mio cases in 1990
  and 4 to 4.5 mio cases in 1991-1992.

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They intend for the end of 1992 to erect a new factory in the west of the country (Mbarara). This factory will have 75 % of the capacity of the present one.

Therefore, they will be able to produce 7 mio cases from 1993 with the two factories.

- They consider 1.5 % of breakages as an average.

- Their number of returns per year per bottle is 10.

- Nowadays they have 45,800 empty bottles available in stock and
  80,000 bottles in trade.

  Their needs for 1989 are :

  30,000 bottles in production
  28,000 bottles for 2 days stock
  37,100 bottles for breakages
  and 200,000 bottles in trade.

- Presently they buy their bottles from Burundi and Emco Glass (Kenya). They intend also to buy from Central Glass (Kenya) in the future.

- The present price is 0.23 U $ C&F per bottle ex Burundi (better quality), and 0.16 U $ C&F per bottle ex Emco Glass (Kenya) - capacity 300 ml.

  They told us to consider 45 U Sh C&F (1 U $ = 160 U Sh) per bottle as an average, including the 30 % import taxes.

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East African Distilleries Ltd

- This company has the following shareholders :

  51 % Uganda Development Co (Ministry of Industry).
  26 % Duncan Gilbey and Matheson Int Ltd (GB)
  23 % Development Finance Co (UDC-CDC-DEG-IFC).

  The company produces : Uganda Waragi, Mark Royal Whisky and Gilbeys Gin.

- The installed capacity is 4 mio litres per year.

  Their expected production for 1989 working one shift per day is :

  1,200,000 bottles per year of Waragi/whisky in 300 ml bottle
  800,000 bottles per year of Waragi/whisky in 750 ml bottle
  300,000 bottles per year of Gin in 750 ml bottle.

- They plan to increase their production provided that :

  . Availability of foreign currencies to buy their raw materials.
  . Money availability for local investment.
  . Possibility of export.
  . Possible law protection against alcohol imports.
  . Solution to the enguli (raw alcohol) shortages.

- The increase of production is expected to be of 30 % within 2 years, and 50 % within 4 years.

- They claimed that the empty bottles do not come back easily and that they have to consider their full production as being one way.

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- Presently they buy their bottles from Emco Glass (Kenya) and Verlipack (Belgium).

- Their present average prices per bottle, including 30 % import duties are :

Waragi/whisky 300 ml	:	20 U Sh CIF	(0.1 U $)
Waragi/whisky 750 ml	:	100 U Sh CIF	(0.5 U $)
Waragi(octogonal) 750 ml	:	115 U Sh CIF	(0.575 U $)
Gin (square) 750 ml	:	90 U Sh CIF	(0.45 U $)

Kampala bottlers Ltd

- This company is 100 % private Ugandese.

  They manufacture four products in similar bottles under the franchise of Schweppes Int., in 300 ml and 200 ml.
  Today they mainly fill up 300 ml bottles.

- They started to produce in March 1987.

- Their bottling capacity is 3 mio cases per year, working one shift.

  Their peak production was 60,000 cases per month. Their present average production of 40,000 cases per month is 30 % of the installed factory capacity.

- They expect to increase their production up to 50 % of the installed factory capacity, provided that :

  . Decrease of the water shortages
  . Decrease of the electricity shortages

  The increase of production would be 10 % per year.

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- They consider 1.2 - 1.3 % fo breakages during transport and 0.6 % of breakages in the factory, or a global average of 2 % breakages.

- Their number of returns per bottle's life is presently only 8, but they claim that it is not significant due to the youthness of the factory and that this figure will approach 15 to 20 in the future.

- They have bought :

  in 1987 : 20,000 cases of empty bottles,
  in July 1988 : 60,000 cases of empty bottles.

  Presently they still have 30,000 cases in stock.

- They have bought empty bottles from Greece, Emco Glass (Kenya) and Central Glass (Kenya).

- The present price is 0.17 U $ C&F per bottle ex Emco Glass
  and 0.26 U $ C&F per bottle ex Central Glass

  Their prices does not include the 30 % import taxes.

  They told us to consider the price of Central Glass to whom they intend to buy in the future because its better quality.

<u>Century Bottling Co.</u>

- This company is 100 % private Ugandese.

  They expect to start-up production in April 1989, to manufacture Coca Cola and Fanta under the franchise of Coca Cola Int.

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Later on, they hope to produce also Sprite, King size Coca (one litre), and Ginger Ale.

- The installed capacity is 1,8 mio. cases/year.

- They expect to produce at the start-up 5,000 cases/day and to increase in the future up to 8,000 cases/day.

- They bought for the start-up 1 mio. bottles from Central Glass (Kenya) at a price of 0.2 U $ C & F.

  This price does not include the 30 % import taxes.

Jubilee Ice & Soda Works Ltd

- This Company is 100 % government owned.

  They manufacture two type of soft drinks, Purple and Orange drinks, that they sell only in the neighbourhood of Jinja for the time being.

- Their bottling production installed capacity is 17,600 cases per month (300 ml bottle).

  Their average maximun production for the last years was 7,000 cases during December 1987 which is corresponding at 100 % of the total installed capacity.

  They expect to increase their production, provided that :

  . Money availability to buy a bottle-washing machine,
  . Availability of foreign currencies to buy bottles,
  . Money availability for local marketing (outside Jinja).

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This increase of production would reach 120,000 cases per year in 1989 and 180,000 cases per year in 1993-1994.

- They consider 8 % of total breakage.

  They claimed that 50 % of empty bottles do not come back.

- These last years, they have bought 8,000 cases of empty bottles per year, and they try to keep the same as permanent stock.

- They have bought recently from Emco Glass (Kenya) at unit price of : 2.43 K Shs FOB + 0.83 K Shs transport = 3.26 K Shs C&F (1 K Sh = 0.053 U $).

  This price does not include the 30 % import taxes.

<u>Nile Crystal Springs Ltd</u>

- This company is 100 % private Ugandese.

  They manufactured two types of soft drink, Ruwen-O-Zor and Vimto Blackcurrent.

- Their production capacity is 2,400 cases/month.

  In 1988, they have produced an average of 76 cases/ month and they are presently stopped due to a shortage of empty bottles.

- Their breakage was of 8 bottles per day.

- Their number of returns per year per bottle is 8.

  They have a quotation from Emco Glass (Kenya) dated November 11th, 87 in which one bottle costed : 0.15 U $ FOB + 0.05 U $ transport = 0.20 U $ C&F.

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Presently they are awaiting foreign currencies to enable them to buy empty bottles.

Their restarting seeming hazardeous and taking also in account their poor means of production and small past production, we decide not to take them in consideration for the expected future.

Kampala Mineral Water Ltd

- This company is 100 % private Ugandese.

  They manufactured 3 types of soft drinks on the trade name of MASABA (orange, cola, ventesa (Ginger).

- Their production capacity was 40,000 cases/year (1/3 in 33 cc and 2/3 in 20 cc).

  The plant has been stopped for years and now they received a new licence to start the plant again.

  But, the start-up has been delayed from 1988 and will probably be postponed again up to 1990 due to shortage of funds to rehabilitate the plant and the shortage of foreign currencies to buy spare parts and bottles.

  We have not taken them into consideration for the expected future.

Masaka Growers Co. Union

- This company is 100 % private Ugandese.

  They manufactured a pineapple juice called Creps and Squash (pineapple concentrates) and expect to produce also in a near future Ketchup, Chili sauce and Jam.

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- They started in December 1988 and are producing 30,000 bottles (300 ml) per day of Creps and 300 bottles (one litre) per day of Squash, working two shifts per day.

  When in production, Ketchup, Chili sauce and Jam will be bottled at a speed of 30,000 (200-300 ml) bottles per day.

- They expect to increase their production by increasing the working time. This one will increase from 12 up to 20 hours per day within 2 - 3 years time.

  Furthermore, such a factory, established with the help of the "Food and Agriculture Organisation of the United Nations" is likely to be multiplicated 5 or 6 times all around the country.

- Currently they broke 3.5 % in and out the factory, but they hope this figure will decrease in a near future.

- They consider the number of return per year per bottle to be 10.

  The bottles actually used were bought 5 years ago at an untraceable price.

<u>**Edible Oil and Soap Industry Ltd**</u>

- This group is 100 % private ugandese.

  They operate six similar plants in Uganda.

- Their total production is 80 to 100,000 l/year during the crops (cotton seeds) period October to February.

  They packaged in steel containers of 20 litres.

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They produced themselves the steel barrels.

Their plants are working at 25-30 % of the nominal capacity due to shortage (state limitation) of cotton seeds available for process.

- They do not intend to use in the future glass bottles (eventually, plastic bottle of one litre).

Dairy Corporation

- This company is 100 % governmental, under the Ministry of Animal Industries and Fisheries.

- They produce 200,000 hl/year (1 shift/day), of one litre polyethylen packages.

  The cost of one pack is only 3 U Sh, which is evidently beyond the cost of a glass bottle.
  On another hand, even if the plastic cost is low, it is imported from Italy, France, BRD. Therefore, they agree as once as a glass production unit starts up in Uganda, to study to impact of replacing plastic by glass. If the results of that study are positive, they shall need to buy new glass bottling lines.

  We have not taken them into consideration for the expected future.

Winits (Uganda) Ltd

- This company is Government owned.

- The information we obtained from the company was so unreliable that we could not put the use in this report.

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- Production and market are sporadic and not significant to be taken into consideration.
  Selling are based on returnable bottle. Other companies are trying to promote wine produced from Bananas (Banapo wine).

Ministry of Health

Public sector

The general policy for the next 5 years does not include for a packaging plant of medecines in Uganda according to the interview of the Deputy Minister and the Chief of Central Medical Store in Entebbe.

They import glass containers :

100,000/year plasma containers of one litre
Containers for syrup and containers for eye medecine are used for local packaging but in small quantities, sizes and diversified types which cannot be taken into consideration in our production program for the next 5 to 10 years. Information for future expansion program of packaging is unknown.

Private sector

B.1 - Medipharm in Kampala.
B.2 - UPL Pharmaceutical Ltd (parastatal Co.)
B.3 - UP 50 - Pharmacy.
B.4 - Packaging project in Jinja (Egyptian project in study stage).

The diversification in this sizes, types, colors of the 100 - 150 - 250 ml (amber) and the small quantities considered could not be taken into consideration in an economical industrial production program for the next 5 to 10 years at least.
Expansion of future packaging industries are unknown.

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Ministry of Animal Industries and Fisheries

Public sector

- According to the commissioner's interview this ministry has no project for the 5 coming years to package medecines in Uganda.

- They only project studied for the present time is a vaccine production unit (financed by FAO) at the Animal Health Research Center (Entebbe).
  Any way, these ampoules cannot be taken into consideration in our programme of production.

Private sector

The main importers : Bayer S.A. (BDR) - Wettrone (UK) Meytbaker are not interested presently to use glass containers to package medecines in Uganda.

Ministry of Agriculture

According to the commissioner's interview, this Ministry has no project for the 5 coming years to package industrially vegetables, fruits or other solid products of the agroindustry. It has been mentioned small scale private projects (honey, jam ...).

In general the actual consumptions of glass containers for such a purpose are extremely small because they are based on the use of returnable existing containers (for honey, they presently pack in plastic containers). No important realistic projects for the next 5 years has been detected. Same conclusion as for the Phyto pharmacy (pesticides, insecticides ...).

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Miscellaneous

Other companies are using glass containers, but the small quantity of articles that they need annualy cannot be envisaged in the present study. Once the new glass factory in Uganda will have started its production, these companies could always negociate with the glass factory one of the two following solutions :

. either to order in one time their needs for several years ;
. or to switch the design (and/or capacity) of their container to another design already produced by the glass factory.

The detected companies are :

. Homely Home Preserves (Jam and Chili Sauce)
. Banapo Wine
. Kabale Wine
. Sanya Distilleries project, 5,000 l/d gin (Mr Th. J. KATTO).

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S U M M A R I Z A T I O N

S U M M A R I Z A T I O N

BEER/SOFT DRINKS/ALCOHOL BOTTLER'S INTERVIEWS	STATUS	INSTALLED CAPACITY	PRESENT AVERAGE CAPACITY (1988 - BEGIN. 89)	EXPANSION PROGRAMME	BREAKAGE GLOBAL AVERAGE %	NUMBER OF RETURN PER BOTTLE'S LIFE	STOCK CRATES	BOTTLES BOUGHT PER YEAR	SOURCES	PRICE PER BOTTLE (U $)	CAPACITY OF BOTTLE (ml)
UGANDA BREWERIES Ltd	Private (100 %) Kenya	30 Mios l/y	8.000 crates/d (24 Mios l/y)	12.500 crates/d (90) (37.5 Mios l/y) 25.000 crates/d (95)	1 - 2	10 - 20	8.000	50.000	KENYA BURUNDI BELGIUM B.D.R.	0.3 (CIF) (excluding import tax)	500
NILE BREWERIES Ltd	Public (100 %)	13.5 Mios l/y	1.250 crates/d (12/88) 1.400 crates/d (01/89) 3.000 crates/d (end 89) (9.000 Mios l/y)	28.8 Mios l/y (90) 9.600 crates/d (90)	1 - 1.5	10	200.000 (!)	?	KENYA BELGIUM B.D.R.	0.23 (CIF) (including 30 % transport 10 % insurance)	500
LAKE VICTORIA BOTTL. Co Ltd	Public (98 %) Private (2 %)	32.4 Mios l/y 4.5 Mios cases/y	2.5 Mios cases/y (18 Mios l/y) 3.000 crates/d (end 89) (9.000 Mios l/y)	3 Mios cases/y (90) 4-4.5 Mios cases/y (90-92) 7 Mios cases/y (93) (in 2 factories)	1.5	10	45.800 crates + 80.000 (in trade)	300.000	KENYA	0.16 to 0.23 (C&F) (including 30 % import tax)	300
EAST AFRICAN DISTILLERIES Ltd	UDC (Ministry of Industry) (51 %) Go Bo (26 %) DFCO (23 %)	4.0 Mios l/y	1.2 Mios bottles/y Waragi/whisky (300 ml) 0.8 Mios bottles/y Waragi/whisky (750 ml) 0.3 Mios bottles/y gin (750 ml) (1.2 Mios l/y)	progress : 30 % in 1991 progress : 50 % in 1993	?	0	?	?	KENYA BELGIUM	0.1 U$ (CIF) 0.5 U$ 0.575 U$ 0.45 U$ (including 30 % import tax)	300 750 750 750
KAMPALA BOTTLERS Ltd	Private (100 %)	20 Mios l/y 3.0 Mios cases/y	2.000 cases/d 480.000 cases/y (3.460.000 l/y)	progress : 10 %/year	1.2 to 1.3	8	30.000	20.000 to 60.000	GREECE KENYA	0.17 to 0.26 (C&F) (excluding 30 % import tax)	300 (200)
CENTURY BOTTLING Co	Private (100 %)	13 Mios l/y 1.8 Mios cases/y	5.000 cases/d at start-up (1989)	8.000 cases/d full installed capacity	?	?	46.600 (1 Mio bottles)	?	KENYA	0.20 (C&F) (not including 30 % import tax)	300
JUBILEE ICE & SODA WORKS Ltd	Public (100 %)	1.5 Mios l/y 210.000 cases/y	350 cases/d (605.000 l/y)	120.000 cases/y (89) 180.000 cases/y (93-94)	8	2	?	8.000	KENYA	0.17 (C&F) (not including 30 % import tax)	300
NILE CRYSTAL SPRINGS Ltd	Private (100 %)	28.800 cases/y	Plant stopped	Start-up ?	8	8	?	?	KENYA	0.20 (C&F)	300
UGANDA MINERAL WATER Ltd	Private (100 %)	40.000 cases/y	Plant stopped	Start-up 1990 ?	?	?	?	?	?	?	300 200
MASAKA GROWERS Co UNION Ltd	Private (Ministry of Industry) (51 %)	300.000 cases/y	1.250 cases/d (2.160.000 l/y) Start-up Dec. 88	progress : 100 % in 91-92	3.5	10	?	?	?	?	300
WINITS Ltd	Public (100 %)										

GENERAL CONCLUSIONS OF THESE INTERVIEWS ON THE FACTORIES

1. Information received verbally (even not so accurate that we hoped) could not be very much improved presently.

2. Because such information could slighly deviate from the reality for personal and/or confidential and/or for prestige's reasons, we could assume that the bottle's consumption (breakage, ...) is probably higher than divulged.
   The figure announced are on the conservative side.

3. As production is generally erratic (electrical power interruption, non continuous supply of raw material, bottles and spare parts, etc ...) average bottles consumption could also much fluctuate in a range of 10 to 20 % (depending of the season) and consequently be bigger as per the same range if the plant was working continuously.

4. Bottles in stock in site is also highly variable and accurate records are difficult to obtain for a long period even an average quantities per annum, present or expected to be purchased for the future.

5. We could generally conclude that figures collected are far below the real consumption of bottlers per each bottler.

OUR ADVISE

As the whole situation in Uganda is definitively moving but still in critical phase in many aspects and if the decision to implement the glass containers production plant is slightly delayed (over one or two years) it seems highly advisable to schedule a supplementary short mission next year in Uganda to check if the market and the industrial production's facilities are improving, faster or not, as we expected today.

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A.1.2. SIZE AND COMPOSITION OF THE PRESENT DEMAND OF BEVERAGES

Preliminary remarks

- As it is clear that demand of glass containers is directly linked with the beer, soft and alcoholic drinks demand, consequently, this study has analysed firstly this sector of beverages.

- Generally due to the lack of specific informations it was not possible to enter in a detailled market study for instance by segmentation of consumer group or by geographical division of the market.
  Similarly, figures given hereafter are not broken dow to each brand produced because each brand is produced according to the availability of raw materials for it. This means, therefore, that there is no fixed production ratio for each brand.

- Even consumer habits, in one case, may change more rapidly than in another and, for instance, a high income segment may show greater response in accepting a higher priced product, we have analysed the market/demand as a whole in general.

- Due to the lack of informations on the North part of the country and the impossibility to pay a visit in this part, our study is based on informations extrapolated to the whole population of the Uganda assuming :

  . firstly that we expect the normalisation of the communications of this part of the country at the latest when the plant will start its full production ;
  . secondly that urban concentration is mostly located in the south part of Uganda ;
  . thirdly that consumer habits are basically standard all over the country.

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a. <u>Past and present production of beverages</u>.

We have summarized the past and present production of the Ugandese bottlers which is, as we concluded before, equivalent to the national consumption.

See table 1 next page.

References :

- Background of the Budget 1988-1989 - Ministry of Planning for the year 1982 up to 1987.
- For 1988, we used informations collected during our interviews with bottlers in 1988/89 in Uganda.

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TABLE 1. : PAST AND PRESENT PRODUCTION OF UGANDESE BOTTLERS

NAME OF BOTTLER	PRODUCTION (IN 1,000 LITRES) PER ANNUM						
	1982 *	1983 *	1984 *	1985 *	1986 *	1987 *	1988 +
UGANDA BREWERIES Ltd	5955	6477.1	6482.2	5373.5	5226.7	13191.6	17000
NILE BREWERIES Ltd	3832	7729	8334.4	2810.7	1376.7	3292.1	4252.5
LAKE VICTORIA BOTTLING Co Ltd	1682.6	3893.9	5601.8	4750.2	4460.3	5348.8	12996
EAST AFRICAN DISTILLERIES Ltd	19.5	27.7	31.8	153.3	116.2	158.6	332.4
KAMPALA BOTTLERS Ltd	-	-	-	-	-	359.1	600
CENTURY BOTTLING Co	-	-	-	-	-	-	-
JUBILEE ICE & SODA WORKS Ltd	-	-	-	21.6	28.7	100.3	165.2
NILE CRYSTAL SPRINGS Ltd	1.6	9.4	5.5	-	-	2.8	4.4
UGANDA MINERAL WATERS Ltd	80.5	20	155.5	230	560.3	-	-
MASAKA GROWERS Co UNION	-	-	-	-	-	-	-
TOTAL	11571.2	18157.1	20611.2	13339.3	11768.9	22453.3	35350.5

* Ref. - Background of the Budget 1988-1989.

+ Ref. - Our interviews on site.

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b. <u>Installed capacity and percentage of utilization of the plant to produce beverages</u>

We refer to the table 2. (hereto enclosed) installed capacities and percentage of utilization of the bottling plants in Uganda (these figures were crosschecked with the informations we received during our interviews.

Each existing plant could produce much more beverages using its present installed capacity providing that they received enough local fUnds and foreign currencies to reduce the bottlenecks.

The main reasons of the constraint are :

- local money availibility at reasonnable conditions for proper maintenance and investment
- availability of foreign currencies to buy bottles (or to implement a new glass containers plant in Uganda), raw material (concentrates, malt, ...), spare parts
- electricity and water constant feeding
- clear definition of the future policy for the taxation and selling prices of the beverages.

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TABLE 2. : INSTALLED CAPACITY (1.000 LITRES) AND % CAPACITY UTILIZATION OF BOTTLING PLANTS IN UGANDA

NAME OF BOTTLER	Installed capacity th.litres	% CAPACITY UTILIZATION						CAPACITY UTILIZATION CHANGE					
		1982	1983	1984	1985	1986	1987	82/83	83/84	84/85	85/86	86/87	87/88
UGANDA BREWERIES Ltd	31,250	19.1	20.7	20.7	17.2	16.7	42.2	1.7	0.0	3.5	0.5	25.5	34.6
NILE BREWERIES Ltd	16,000	24.0	48.3	52.1	17.6	8.6	20.6	24.4	3.8	34.5	9.0	12.0	58.5
LAKE VICTORIA BOTTLING Co Ltd	12,110	13.9	32.2	46.3	39.2	36.0	44.2	18.3	14.1	7.0	2.4	7.3	80.5
EAST AFRICAN DISTILLERS Ltd	2,000	1.0	1.4	1.6	7.7	5.8	7.9	0.4	0.2	6.1	1.9	2.1	8.7
KAMPALA BOTTLERS Ltd	1,800	-	-	-	-	-	20.0	-	-	-	-	20.0	13.4
CENTURY BOTTLING Co	-	-	-	-	-	-	-	-	-	-	-	-	-
JUBILEE ICE & SODA WORKS Ltd	528	-	-	-	4.1	5.4	19.0	-	-	-	1.3	13.6	19.0
NILE CRYSTAL SPRINGS Ltd	513	0.3	1.8	1.1	-	-	0.5	1.5	0.8	1.1	-	0.5	0.5
UGANDA MINERAL WATERS Ltd	587	13.7	3.4	26.5	39.2	95.5	-	10.3	23.1	12.7	56.3	95.5	-

Ref. Background of the Budget 1988-1989.

c. Comparison of the Ugandese present consumption of beverages with consumptions of the surrounded countries

Beer :

Burundi : 23,9 l/capita/y (1988)
Kenya : 10,8 l/capita/y (1986)
13,6 l/capita/y (1988)
Rwanda : 8 l/capita/y (1988)
Ref. : Statistical abstracts from the country.

Soft drinks :

Burundi : 19,7 l/capita/y (1986)
21,4 l/capita/y (1988)
Kenya : 8,0 l/capita/y (1986)
11,3 l/capita/y (1988)
Rwanda : 9 l/capita/y (1988)
Ref. : Statistical abstracts from the country.

Consumption's comparison (litre/capita/year)

	UGANDA present consumption in 1988/89	KENYA in 1988	BURUNDI in 1988	RWANDA in 1988
BEER	1,3	13,6	23,9	8
SOFT DRINKS	0,86	11,3	21,4	9

Remarks :

1. Burundi, Rwanda, Kenya are consuming almost their respective total production. Only 5 to 15 % is left for the exportation. Consequently, we concluded that each respective demand could be considered as satisfied and figures l/capita/y is the present consumption in the actual marketing conditions in these countries.

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2. It is clear that the present Ugandese consumptions of beverages are far lower that these recorded in these surrounded countries. This conclusion is the same if we compared Ugandese consumptions with the average African consumptions of countries for which ABAY performed a feasibility study on the same subject.

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CONCLUSIONS FOR THE GLASS CONTAINERS

1. Present consumption of beverages is equivalent and fluctuates according the national production.

2. Beverages production could rapidly increase (if foreign currencies are available) because the percentage of utilization of the existing plants is generally very low. Consequently, the glass containers consumption could fluctuate and increase rapidly as constraints are resolved.

3. Glass containers availability being limited by the quota of foreign currencies, the present demand is bigger than the present consumption.

4. Above point 3. confirmed by the very low consumption of beer and soft drinks in Uganda when compared with the surrounded countries (3 to 5 times bigger).
   Traditionally beer consumption in Africa is closely linked with the G.N.P. and welfare improvement of the population. For Uganda, beer is in a process of inexhaustible demand.
   A bigger availability of glass containers should allow the improvement of the consumption of beverages as the potential demand is existing in Uganda.

5. Local production and availability of glass containers seems one of the important factors to improve the national consumption of beverages.
   Additionally, Kenya and Burundi for instance produce their own glass containers which seems to stimulate also the national consumption through new initiatives of products to be packed in glass containers.

6. Conclusions of this paragraph (A.1.2.) are generally conform with the interviews and the conclusions of the preceding paragraph (A.1.1.).

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A.1.3. PRESENT QUANTITIES OF CONTAINERS BOUGHT PER YEAR

TABLE 3. : PRESENT QUANTITIES OF BOTTLES BOUGHT PER YEAR

(According to the interviews)

BEER		
- UGANDA BREWERIES Ltd	50,000 crates (25 bottles/500 ml)	1,250,000
- NILE BREWERIES Ltd	For breakages : 40,000 cr/m x 25 x 12 m x 2 %	240,000
	For non return : estimated	760,000
- CHIBUKU BREWERIES Ltd	Plant stopped.	
SOFT DRINKS		
- L.V.B.	(Stock) 28,000 cr/y x 24 (300 ml)	672,000
	(Breakages) 37,100 cr/y x 24	890,400
	(Non return) 2,500,000 x 24 x 1.5 %	900,000
		2,462,400
- CENTURY BOTTLING Ltd	5,000 cr/d x 20 d/m x 8 (april - dec) x 24 b/cr x 2 %	384,000
- KAMPALA BOTTLERS	60,000 cr/y x 24 (300 ml)	1,440,000
- JUBILEE ICE & SODA WORKS	8,000 cr/y x 24 (300 ml)	192,000
- KAMPALA MINERAL WATER Ltd	Plant stopped.	
- NILE CRYSTAL SPRINKS Ltd	Plant stopped.	
- MASAKA GROWERS Co	No figure available as the plant starts presently.	

Suite 1 of TABLE 3. : PRESENT QUANTITIES OF BOTTLES BOUGHT PER YEAR

(According to the interviews)

ALCOHOLIC BEVERAGES

- EAST AFRICAN DISTILLERIES	(300 ml)	1,200,000
	(750 ml)	800,000
	(750 ml)	600,000
- WINITS	Not significant.	

MEDICAL USE

- CENTRAL MEDICAL STORE	(1,000 ml)	100,000

IN RESUME

			Average weight/bottle (Kg)	Consumption Tons/year
Beer bottles	(500 ml)	2,250,000	0.400	900
Soft drinks	(300 ml)	4,478,000	0.425	1,900
Alcoholic drinks	(300 ml)	1,200,000	0.270	324
	(750 ml)	1,100,000	0.450	495
				3,622

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CONCLUSIONS

1. Informations received are subject to a certain confidentiality. The correct figures are difficult to obtain.

2. Existing stock of previous years can influence the quantities bought each year.

3. Some quantities are not officially declared and supported by import licences. Consequently, a margin of 10-20 % above the announced figure seems possible.

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A.2. FORECAST OF CONSUMPTION OF BEVERAGES UP TO 1995 REFERING TO

A.2.1. FORECASTED MAXIMUM ANNUAL PRODUCTION OF BEVERAGES IN UGANDA ACCORDING TO THE INTERVIEWS

In the following tables we have summarized the past production and the expected production of each Ugandese bottler according to our interviews on site.

When adding all the expected production in 1995, we observe an average growth rate of 27 % per annum from 1988.

Even if we consider that each bottler will obtain all necessary conditions for increasing its production (see the conditions stated in the interview of each bottler), we do not believe that such a progress could be obtained in such a short time.

Obviously, when planning for the future, each of them does not consider the expansion program of his competitors. Nevertheless, he considers to increase his own share of the market. An example of the evidence of this factor is that the expected production of both breweries will exceed, from 1991, the maximum beer consumption expected in Uganda. (See chapter A.2.2. entitled : Target maximum annual consumption of beverages compared with the consumptions of surrounded countries.)

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TABLE 4. : EXPECTED PRODUCTION OF UGANDESE BOTTLERS ACCORDING TO LOCAL INTERVIEW

PRODUCTION (IN 1,0 00 LITRES) PER ANNUM							
NAME OF BOTTLER	1989	1990	1991	1992	1993	1994	1995
UGANDA BREWERIES Ltd	24000	37500	45000	52500	60000	67500	75000
NILE BREWERIES Ltd	9000	9000	28800	28800	28800	28800	28800
LAKE VICTORIA BOTTLING Co Ltd	18000	21600	28800	32400	50400	50400	50400
EAST AFRICAN DISTILLERIES Ltd	2010	2310	2610	2810	3015	3015	3015
KAMPALA BOTTLERS Ltd	3456	3800	4150	4490	4840	5180	5530
CENTURY BOTTLING Co	6480	8640	10368	12096	13824	13824	13824
JUBILE ICE & SODA WORKS Ltd	835	920	1000	1086	1170	1252	1252
NILE CRYSTAL SPRINGS Ltd	-	-	-	-	-	-	-
UGANDA MINERAL WATERS Ltd	-	-	-	-	-	-	-
MASAKA GROWERS Co UNION	2664	5496	6045	6595	7145	7695	8244
TOTAL	66445	89266	126773	140777	169194	177666	186065

A.2.2. STATISTICAL CALCULATION

We have tried to check the future trend of beverages (beer and soft drinks) consumption, by using the following statistical methods :

- Straightforward projection :

  The last known consumption is 35,350,500 l in 1988 and the basic period consumption is 11,571,200 l in 1982.
  The extrapolated constant growth rate for the corresponding period is :

$$\frac{35,350,500}{11,571,200} = 3.06 \text{ over 6 years,}$$
$$\text{or : } \underline{20.5\ \%\ \text{per year}}$$

- Moving averages :

  The average consumption for the three last years of known consumption is 23,191,000 l for 1986 to 1988.

  The average consumption for the three first years of basic period consumption is 16,780,000 l for 1982 to 1984.

  The extrapolated constant growth rate for the corresponding period is :

$$\frac{23,191,000}{16,780,000} = 1.382 \text{ over 4 years,}$$
$$\text{or : } \underline{8.5\ \%\ \text{per year}}$$

- Regression model :

  With this method, the consumption is calculated with the following equation : $Q = a + bt$

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Where :

Q = Consumption the considered year in 1000 l

a }
b } = Coefficients determined by past consumption

t = Number of years, from the first year of the past consumption up to the considered year

a and b are calculated as follows :

$$b = \frac{n \sum Qt - \sum t \sum Q}{n \; t^2 - (t)^2}$$

$$a = \frac{\sum Q - b \sum t}{n}$$

Where n is the number of years of the past consumption.

t	Q	t^2	Q^2	Qt
1	11571.2	1	133892660	11571.2
2	18157.1	4	329680280	36314.2
3	20611.2	9	424821560	61833.6
4	13339.3	16	177936920	53357.2
5	11768.9	25	138507000	58844.5
6	22453.3	36	504150680	134719.8
7	35350.5	49	1249657800	247453.5
28	133251.5	140	2958646800	604094

$$b = \frac{7 \times 604094 - 28 \times 133251.5}{7 \times 140 - 784} = 2538.9$$

$$a = \frac{133251.5 - 2538.9 \times 28}{7} = 8880.3$$

Using the equation Q = a + bt from 1989, we find the following figures :

1989 : 29191500 l

1990 : 31730400 l

1991 : 34269300 l

1992 : 36808200 l

1993 : 39347100 l

1994 : 41886000 l

1995 : 44424900 l

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The average growth wn in 1995 from the start figure of 1988 is

$\frac{44424900}{35350500}$ = 1.257 over 7 years or <u>3.25 % per year</u>

After having tested these results, we have concluded that they were not significant :

- The coefficient of determination = 0.428, which means that 57.2 % of the variations remain unexplained.

- The standard error for a = 5875, which means $\frac{5875}{8880.3}$ = two thirds of the regression coefficient

- The standard error for b = 1314, which means $\frac{1314}{2538.9}$ = half of the regression coefficient

- <u>Conclusion of the statistical calculations</u> :

Due to the erratic figures of consumption obtained from 1982, these methods of analysis are not reliable.
These erratic figures obviously obtained as a consequence of the political economic and general instability of the country which only ceased recently.
These methods could only be perhaps considered whether this instability would pursue in the future, what is apparently not going on.

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A.2.3. TARGET MAXIMUM ANNUAL CONSUMPTION OF BEVERAGES IN UGANDA COMPARED WITH THE PRODUCTION OF SURROUNDED COUNTRIES

A. UGANDA

According to the studies respectively done by :

. Nile Breweries for the beer

. Pepsi Cola International for the soft drinks

the maximum annual consumption in Uganda for the coming years is :

. beer

4 l/capita/y or 4 x 16 Mio = 64 mio l in 1988
4 x 20 Mio = 80 mio l in 1995.

. soft drinks

5.4 l/capita/y or 5.4 x 16 Mio = 86.4 mio l in 1988
5.4 x 20 Mio = 108 mio l in 1995.

The present consumption in 1988 is :

beer	1,3 l/capital/y	or 21.3 mio litres
soft drinks	0,86 l/capital/y	or 13.8 mio litres

B. BEVERAGE PRODUCTION COMPARED WITH OTHER AFRICAN COUNTRIES

As a matter of fact, as far as this study is concerned, it doesn't matter that much to have a precise relationship between the beer and soft drinks production in Uganda.

What is really important to be sure about is the veracity of our projection in the future of the total beverage production.

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In this regard we shall compare the beverage production in sor:e others African countries, taken from the "Memento de l'Economie Africaine 1980" - Ediafric.

	GNP/Capita (1986)	Soft drinks production in mio l (1979)	Beer production in mio l (1979)	Population in mio (1979)	Soft drinks production per capita (l)	Beer production per capita (l)
Benin	270	9.5	22	3.5	2.7	6.3
Congo	342	3.3	23.9	1.6	2.1	14.9
Burkina Faso	150	20	38	6.8	2.9	5.6
Mali	180	2	-	6.5	0.3	-
Mauritania	420	1	-	1.5	0.7	-
Niger	260	3.5	5.3	5.4	0.6	1
Togo	250	10.7	28.1	2.5	4.3	11.2
Senegal	420	35	35	5.6	6.3	6.3
Ivory Coast	730	82.3	119.1	8	10.3	14.9
Cameroun	910	60.8	195.4	8.4	7.2	23.3
Burundi	240	8	60	4	2	15.1
Rwanda	290	5.6	33.3	4.9	1.1	6.7

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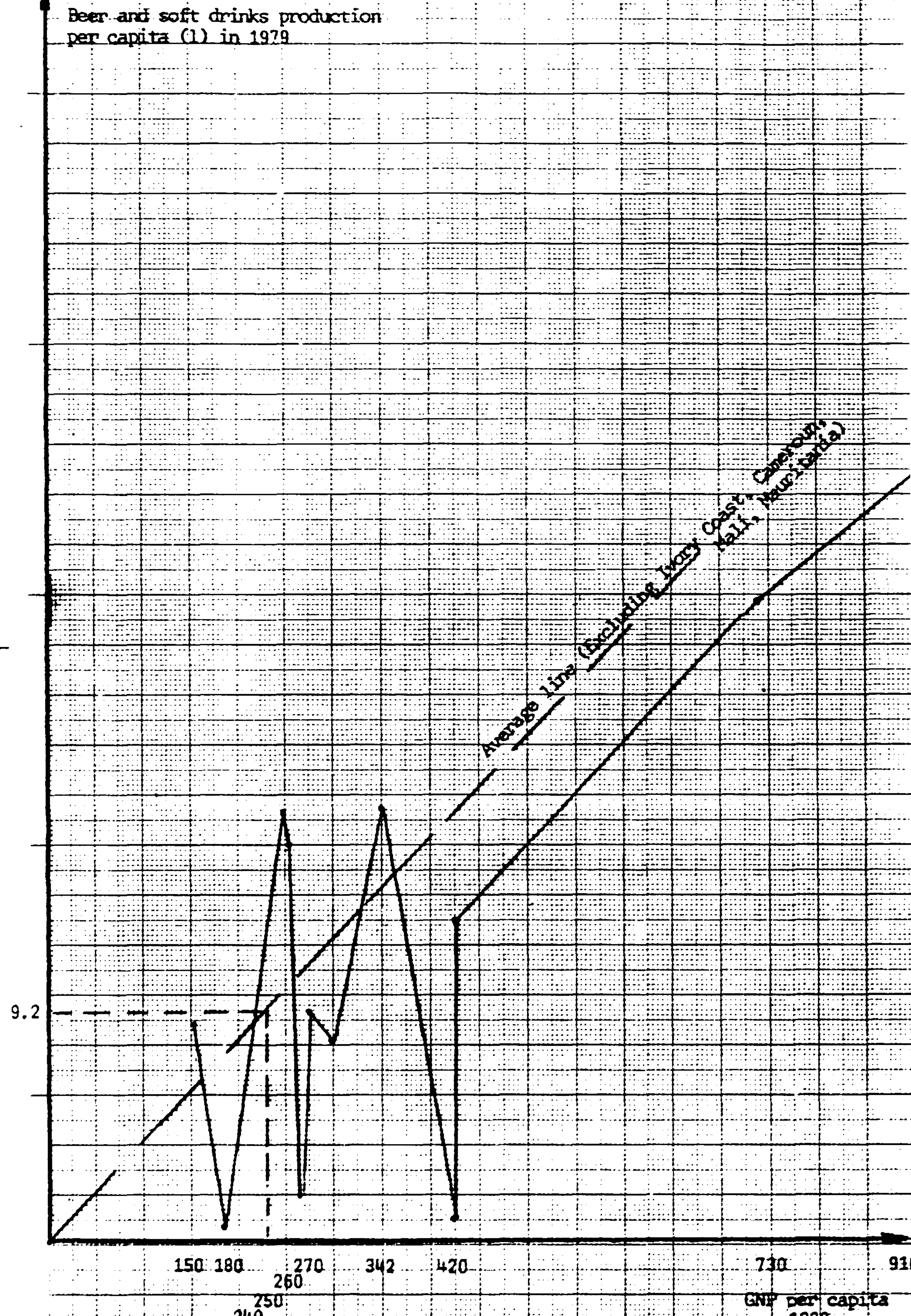
Beer and soft drinks production
per capita (1) in 1979
Average line (Excluding Ivory Coast, Cameroun,
Mali, Mauritania)
9.2
150 180 270 342 420 730 910
260
250
240
GNP per capita
1988

From the hereabove table, we shall not consider :

- Ivory Coast and Cameroun, whose GNP is not comparable with Uganda.
- Mali and Mauritania who have no beer production.

With the other figures, we have calculated an average line, giving for a country like Uganda (GNP per capita = 230 US $) an average production in 1979 of 9.2 l per capita.

According UNIDO/IPP/PAG (Unido statistical data base, estimates and forecasts) the average annual growth rate of beverages in developing countries was
4.4 % for the period 1975-1985
and 5.5 % for the period 1985-1989.

On another hand, commputing the population growth and projections for the considered countries given by the World Development Report 1987, we find the following average increase of population from 1979 :
8.7 % in 1982
30.2 % in 1988
and 63.8 % in 1995.

Considering the average growth rate of beverages, keeping the value of 5.5 % after 1989 and the increase of population, we can conclude that for a country having the same GNP per capita as Uganda in 1986, i.e. 230 US $, the average production of beer and soft drinks per capita should be
9.6 l in 1982
10.7 l in 1988
12.4 l in 1995.

We may now compare those averages with the past, present and expected future prevailing in Uganda.

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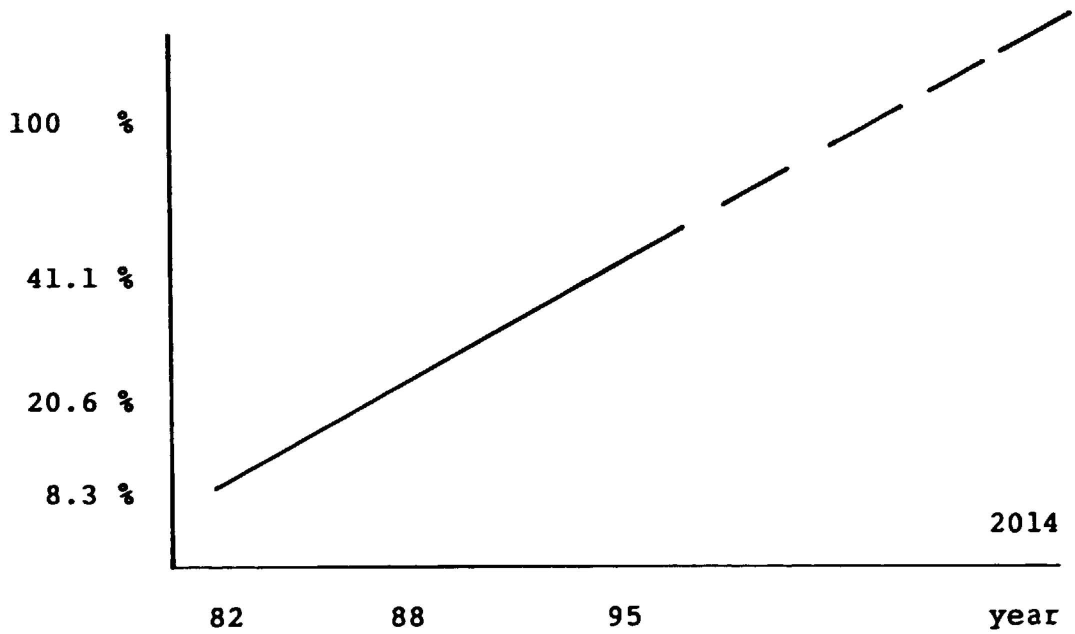
YEAR	Average production per capita (1)	Ugandese production per capita (1)	Ugandese production per capita (% of the average)
1982	9.6	0.8	8.3 %
1988	10.7	2.2	20.6 %
1995	12.4	5.1	41.1 %

Ugandese production per capita

(% of the average)



From the above curve, we may get the following conclusions :

- The expected production in Uganda we have considered for 1995 doesn't seem too high, the increase being only a little faster that the increase occured between, 82 and 88, justified by the present recovery of stability of the country and the consequential restart of the economy.

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- The hereabove statement is reinforced by the fact that the extrapolation of the increase of production will only catch up the calculated average in 2014.

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A.2.4. FORECASTED CONSUMPTION ACCORDING TO OUR CALCULATION (demographic and economic growth rate factors)

We have considered in our study an average growth rate of beverages production of 12 % per annum, for the following reasons :

4.1. The exceptional circumstances prevailing in the country until January 1986, and the subsequent economic decline shows at evidence that a strong straightening could be expected from the present political stability.

"Uganda's economic performance in 1985 must be seen against the background of civil war which raged in the country during much of 1985.
The resulting events made rational economic planning impossible, leading to neglect in the maintenance of existing facilities and infrastructure and preventing the execution of recurrent and development programmes. G.D.P. per capita, like other data for the period, reflects the exceptional circumstances prevailing in the country in 1985, with a fall of 2.7 per cent against 1984. It was in particular the informal sector, whose 40 per cent share of G.D.P. traditionally weighs heavily in the country's overall economic performance, that was affected.

Following the stabilization of the political situation since the new Government took over in January 1986 GDP is estimated to have recovered by 12 per cent in 1986 as against 1985. Again it was the informal sector whose revival was decisive for the improvement of the general economic situation."

From "The Least Developed Countries" 1987 Report.

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4.2. A 12 % p.a. growth rate is on line with the recent increase of production starting in 1986 (See the table entitled : Past and expected production of Ugandese bottlers).
Nevertheless, a precise extrapolation of the production figures for 1986-1987-1988 up to 1995 lead us to an average growth rate of 18.5 % based in 1988 level.

4.3. <u>Effect of the growth of general and rural population and G.D.P</u>.

4.3.1. According to the World Development Report 1988 from the World Bank, an average annual growth of the population between 1986 and 2000 is considered to be : <u>3.2</u> %.

According to the Ugandese Statistics Department, the percentage of urban population between 1985 and 1990 is expected to increase by 3.4 % per year (9.7 % urban in 1985 and 11.4 % urban in 1990).

Population in 1988 :
15,947,800 (Of which 10.7 % urban = 1,706,400)

Population in 1995 :
19,881,900 (Of which 13.5 % urban = 2,684,000)

Considering that surely for the next future it is mainly the urbanized population who consumed bottled beverages, we may consider that a 6.6 % (3.2. + 3.4.) p.a. increase will follows directly the increase of the urban population, at constant G.D.P. per capita.

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4.3.2. On another hand, from studying the evolution of the G.D.P. per capita (see the table entitled : Gross domestic product at factor cost by industry).

We can observe that :

. the G.D.P. per capita has decreased from 1971 to 1980 at an average of 5.25 % per year.

. the G.D.P. per capita has slightly increased from 1980 to 1983 to decrease again up to 1986 at an average of 5.5 % per year.

From the present period of stabilization of the economy of the country, we can resonably expect that the economy will recover its losses at the same speed it has got them. In this prospect, the G.N.P. per capita will reach around 1998-1999 the level of 775 which is the peak value obtained in 1971 before the troubles began.

According to the World Development Report 1988 (World Bank), the following results have been achieved as for average annual growth rate of the G.N.P. per capita for the period 1965-1986 :

. Low income economies countries (G.N.P. = 270 U $ 1986) = 3.1 %

. Uganda (G.N.P. = 230 U $ 1986) = - 2.6 %

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TABLE 5. : GROSS DOMESTIC PRODUCT AT FACTOR COST BY INDUSTRY 1980/1987 (millions of 1966 Uganda shillings)

INDUSTRY	Peak Between 1966-1987 YEAR	Peak Between 1966-1987 VALUE	1980	1981	1982	1983	1984	1985	1986	1987	% Change 1985/84	% Change 1986/85	% Change 1987/86
MONETARY ECONOMY													
Agriculture	1973	1,795	1,234	1,221	1,401	1,416	1,308	1,392	1,232	1,300	6.4	-11.5	5.5
Cotton Ginning, Coffee Curing and Sugar Manufacture	1970	114	43	31	43	41	41	41	42	42	-	2.4	-
Forestry, Fishing and Hunting	1984	128	100	101	104	106	128	102	125	102	-20.3	22.5	-18.4
Mining and Quarrying	1970	119	6	6	7	7	7	6	5	6	-14.3	-16.7	20.0
Manufactured Food Products	1972	63	9	10	16	17	18	20	14	17	11.1	-30.0	21.4
Miscellaneous Manufacturing	1971	482	209	206	223	232	241	206	183	228	-14.5	-11.2	24.6
Electricity	1987	131	78	96	90	81	93	78	107	131	-16.1	37.2	22.4
Construction	1969	109	25	25	28	32	34	39	43	49	14.7	10.3	14.0
Commerce	1971	940	508	491	543	575	533	573	543	576	7.5	-5.2	6.1
Transport and Communications	1974	346	168	182	200	211	212	215	275	248	1.4	27.9	-9.8
General Government	1987	950	882	890	900	909	923	932	941	950	1.0	1.0	1.0
Miscellaneous Services	1972	502	278	280	319	343	370	398	423	439	7.6	6.3	3.8
Rents	1987	364	282	283	295	308	321	335	349	364	4.4	4.2	4.3
Total Monetary Economy	1971	5,252	3,822	3,822	4,169	4,278	4,229	4,337	4,282	4,452	2.6	-1.3	4.0
NON-MONETARY ECONOMY													
Agriculture	1983	2,309	1,734	1,962	2,133	2,309	1,957	1,763	1,615	1,725	-9.9	-8.4	6.8
Forestry, Fishing and Hunting	1986	243	209	216	216	219	226	230	238	243	1.8	3.5	2.1
Construction	1979	42	12	13	15	15	16	16	17	17	-	6.3	-
Owner Occupied Dwellings	1986	380	330	338	340	350	359	369	380	390	2.0	3.0	2.6
Total Non-Monetary Economy	1983	2,893	2,293	2,529	2,704	2,893	2,558	2,378	2,250	2,375	-7.0	-5.4	5.6
GROSS DOMESTIC PRODUCT	1972	7,542	6,115	6,351	6,873	7,171	6,787	6,715	6,532	6,827	-1.1	-2.7	4.5
GROSS DOMESTIC PRODUCT PER CAPITA (SHS.)	1971	775	478	483	509	516	475	457	433	440	-3.8	-5.3	1.6

SOURCE: Statistics Department, Ministry of Planning and Economic Development.

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Uganda having during 1965-1986 period the worst result amongst the low income economies countries must therefore get an average growth rate of 5.7 % in the future only to joining the average level of these countries.

It is also interesting to observe that this percentage of 5.5 % is also the average annual growth rate for beverages production in developing countries that Unido considered for the period 1985-1989 (Unido statistical data base, estimates and forecast by Unido IPP/PAG).

For the same period, the same source considered 6.4 % average annual growth rate for glass and glass products in developing countries.

The combination of the two factors :

. increase of urban population of 6.6 % p.a.
. increase of G.D.P. per capita of 5.25 - 5.5 % p.a.

leads to an expected global increase of production of 12 % p.a.

4.4. Others reasons

- The part of G.N.P. coming from the manufactured food products has increased from 1986 to 1987 by 20 %.

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The extrapolation of this figure in the future will give for about 2003-2004 the level of 119 which is the peak value in 1970 for this sector when considering the past figures of G.N.P. at constant value. It is remarkable to see that this sector is the one which suffered a maximum from the troubled period. It should normally have in the future one of the best curve of recovery.

This increase of 20 % p.a. can be compared with the 18.5 % increase of beverage production as printed out hereabove.

- Studying a neighbouring country (Kenya) having a glass production unit, we can observe that :

  . The average annual growth rate of G.N.P. per capita between 1965 and 1986 was 1.9 %. (World Development Report 1988 - World Bank).

  . During the same period the annual growth rate of glass production at constant 1980 prices was 8.3 %.
  (Handbook of Industrial Statistics 1988 - Unido) (2 extracts enclosed).

CONCLUSION

We may therefore reasonably believe that for a restarting economy like these of Uganda, an average growth rate of beverage production (and glass production) of 12 % p.a. could be obtained, assuming also that beverages demand/market is always higher than the production's capacity.

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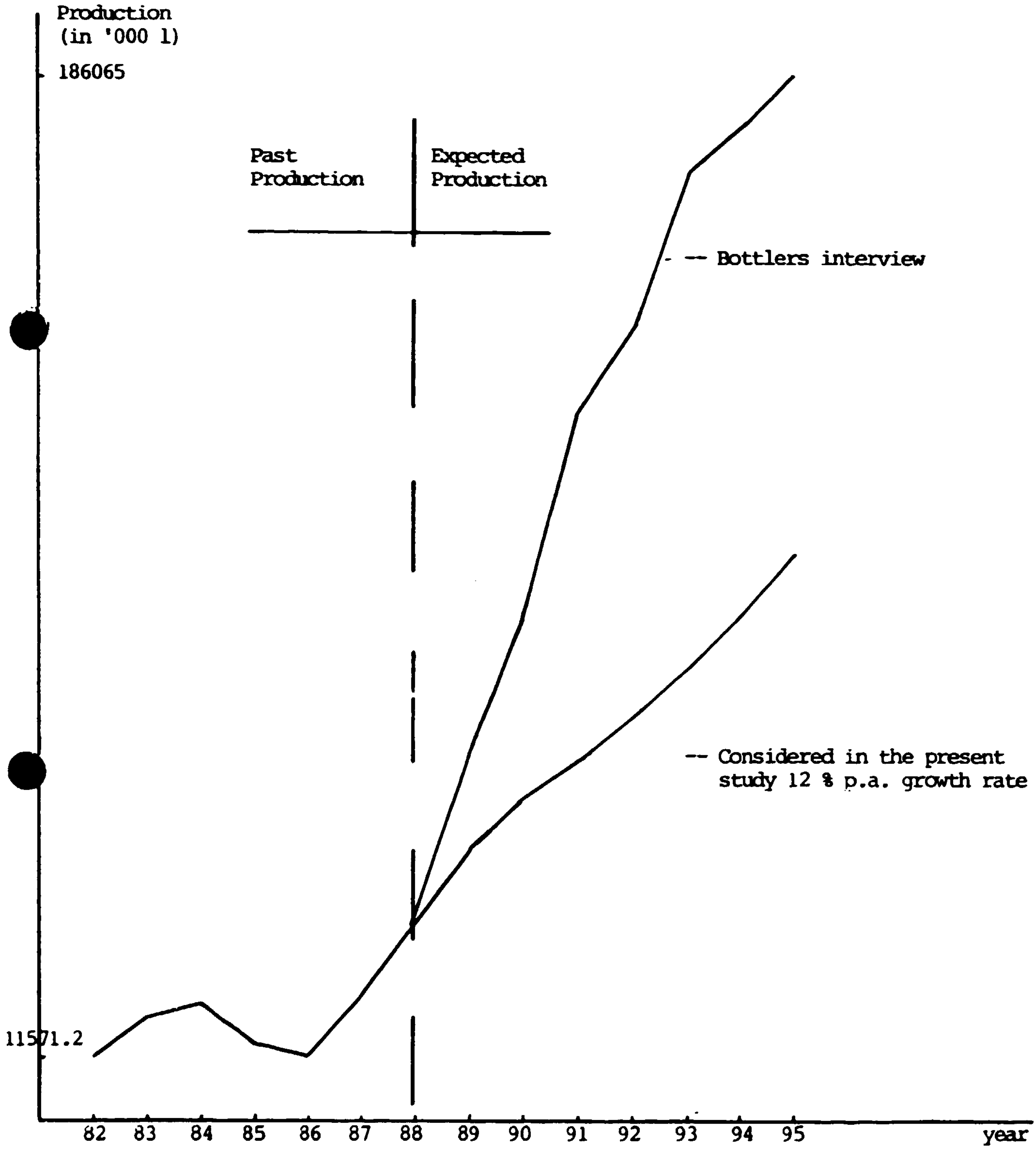
TABLE 6. : PAST AND EXPECTED PRODUCTION OF UGANDESE BOTTLERS



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A.2.5. COMPARISON OF FORECASTED PRODUCTIONS BASED ON INTERVIEWS INFORMATION AND FORECASTED CONSUMPTIONS BASED ON CALCULATIONS FROM DEMOGRAPHIC AND GROWTH RATES FACTORS

Herebelow are the projections of production per bottler indicating their past production, as well as their forecast production : - according to their hopes,
- according to a 12 % p.a. growth rate,

In each curve, the maximum present capacity of production is also indicated .

These curves are calling the following comments :

- Uganda Breweries Ltd, Nile Breweries Ltd :

An uniform 12 % p.a. growth rate as considered by us leads to a bigger nominal increase for Uganda Breweries due to their better production those last years. In 1995 they should reach the half of their expectancy whilst Nile Breweries would only reach one third.
Maybe the progress of Uganda Breweries will be slower at the advantage of Nile Breweries, but as far as this feasibility study is concerned it does not matter, both competitors using the same bottle.

- Century Bottling Co :

The application of the 12 % p.a. growth rate on the expected production figure of 1989 of Century Bottling Co. leads them to a bigger nominal increase vis-à-vis their competitors.

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In 1995, Century Bottling Co. should reach 92 % of their expectancy whilst :

Lake Victoria Bottling Co. should reach 58 %
Kampala Bottlers Co. should reach 24 %
Jubile Ice & Soda Works Ltd. should reach 29 %.

Most probably the production figures considered for Century Bottling Co. will not be achieved whilst their competitors could obtain better results than those considered.

Here again, it does not matter, each bottler in competition using practically bottles having same capacities and same weights. Therefore a transfer of production from a soft drink bottlers to one of its competitor will in no way change the production programme of the glass factory.

- Masaka Growers Co. Union

The same phenomena occurs for Masaka Growers Co. Union, where the 12 % p.a. growth rate in the expected production figure of 1989 even conducts to production figures higher than expected and higher than the maximum present capacity.

We have decided not to correct this curve for the following reasons :

. They claimed that 5 or 6 other similar factories will be built around the country in the next few years, under the coordination of the F.A.O. - U.N. Due to their recent success introducing their new taste on the market, we believe that other factories of this kind have great chances to be built soon.

One other similar factory will be enough to correct the curve to an acceptable level, each one producing in 1995 : 10,249 : 2 = 5,125 x 1,000 l, or 62 % of the maximum capacity.

. On another hand, they intend to bottle Ketchup, Chili Sauce and Jam. In this field they will have no competitor, and we strongly believe that an unexploited important market exist in this sector and that the competent authorities should support such idea.

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TABLE 7. : EXPECTED PRODUCTION OF UGANDESE BOTTLERS CONSIDERING A 12 % P.A. GROWTH RATE

PRODUCTION (IN 1,0 00 LITRES) PER ANNUM							
NAME OF BOTTLER	1989	1990	1991	1992	1993	1994	1995
UGANDA BREWERIES Ltd	19040	21324.8	23883.8	26749.8	29959.8	33555	37581.6
NILE BREWERIES Ltd	4762.8	5334.3	5974.5	6691.4	7494.4	8393.7	9400.9
LAKE VICTORIA BOTTLING Co Ltd	14555.5	16302.2	18258.4	20449.5	22903.4	25651.8	28730
EAST AFRICAN DISTILLERIES Ltd	372.3	417	467	523	585.8	656.1	734.8
KAMPALA BOTTLERS Ltd	672	752.6	843	944.1	1057.4	1184.3	1326.4
CENTURY BOTTLING Co	6480	7257.6	8128.6	9104	10196.4	11420	12790
JUBILE ICE & SODA WORKS Ltd	185	207.3	232.1	259.9	291.1	326.1	365.2
MASAKA GROWERS Co UNION	2664	5815.7	6513.5	7295.2	8170.7	9151.1	10249.3
TOTAL	48731.6	57411.5	64300.9	72016.9	80659	90338.1	101178.2

TABLE 8. : UGANDA BREWERIES Ltd PRODUCTION

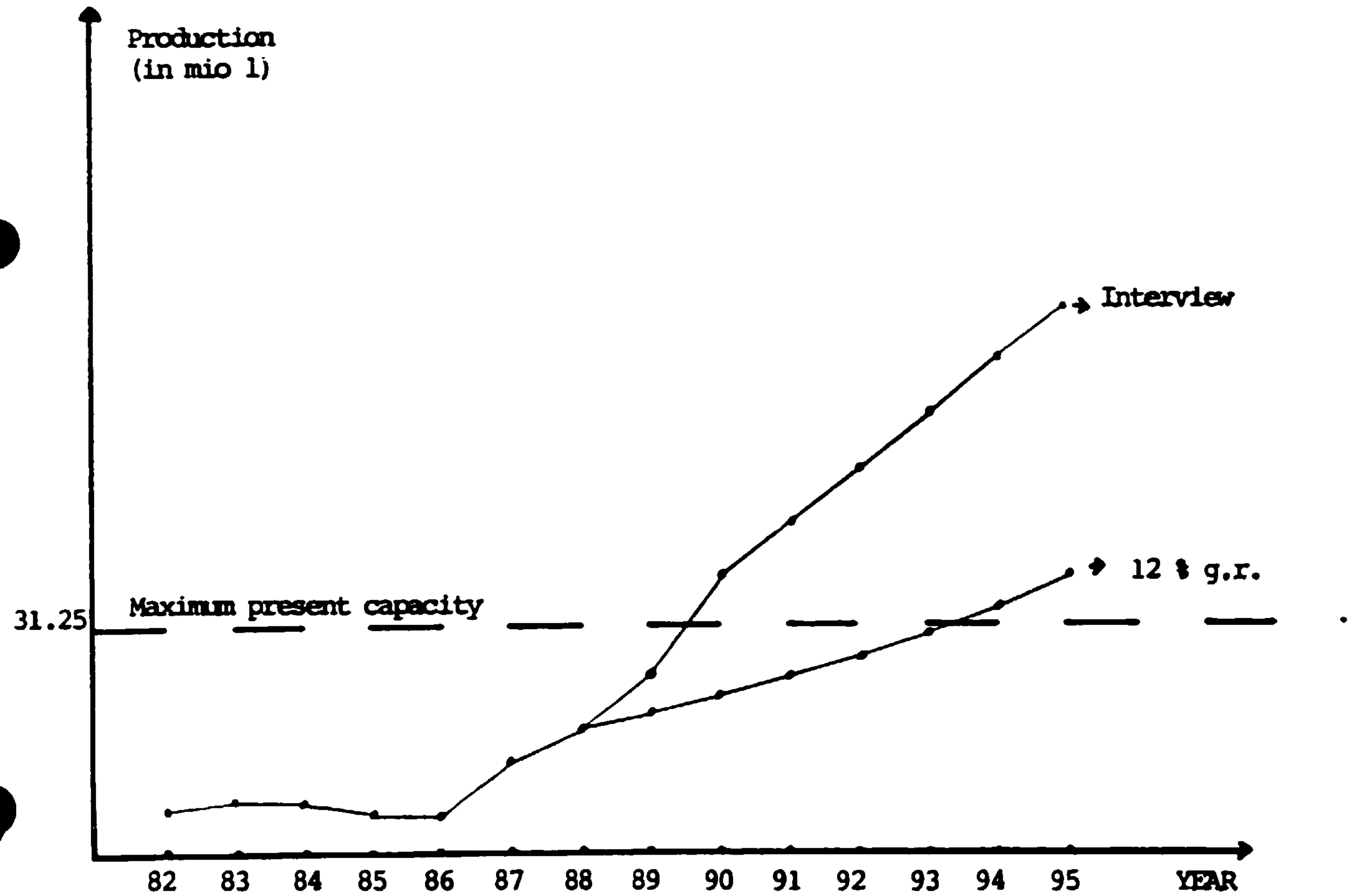

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TABLE 9. : NILE BREWERIES Ltd PRODUCTION

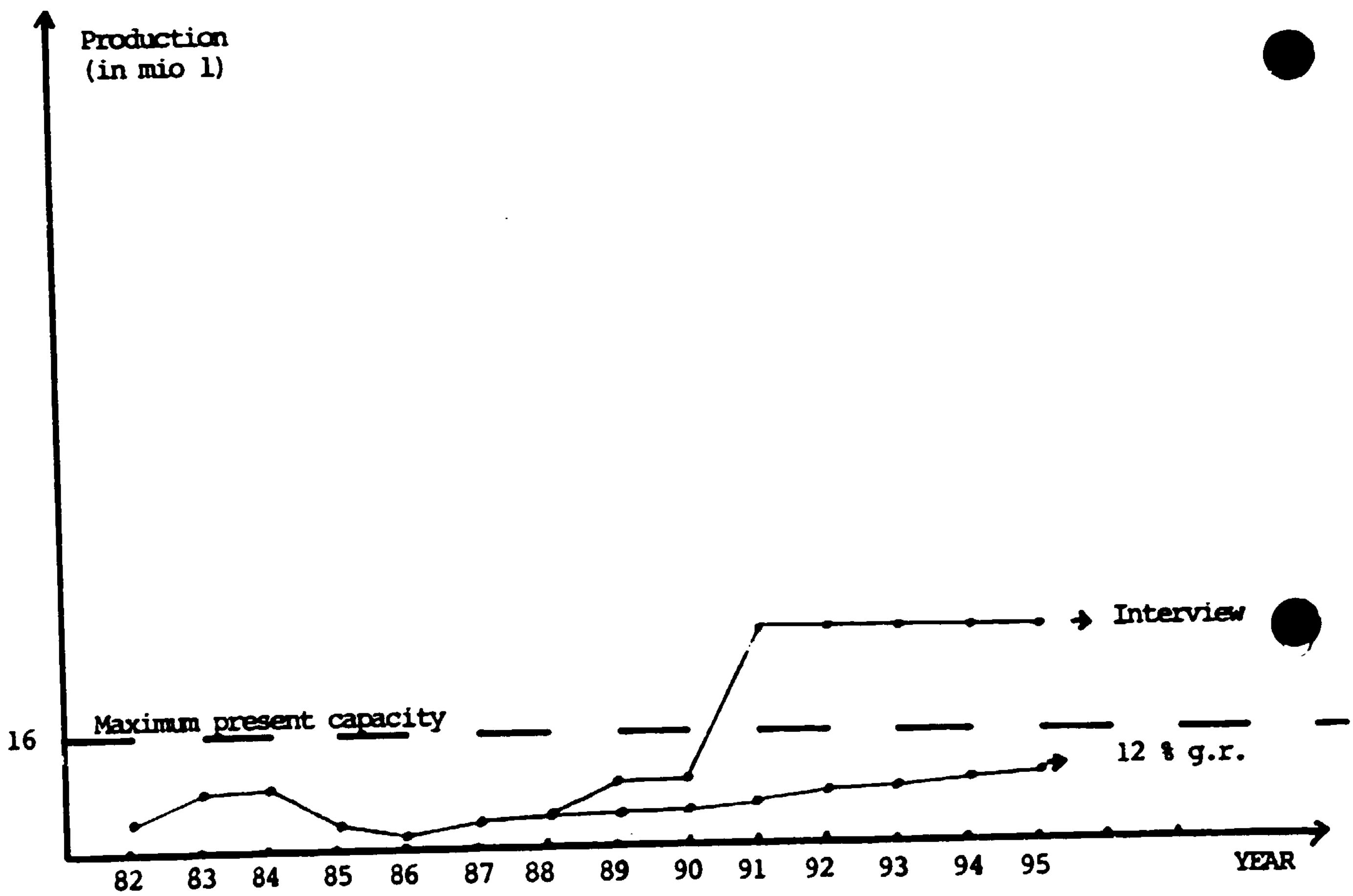

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TABLE 10. : LAKE VICTORIA BOTTLING Co PRODUCTION

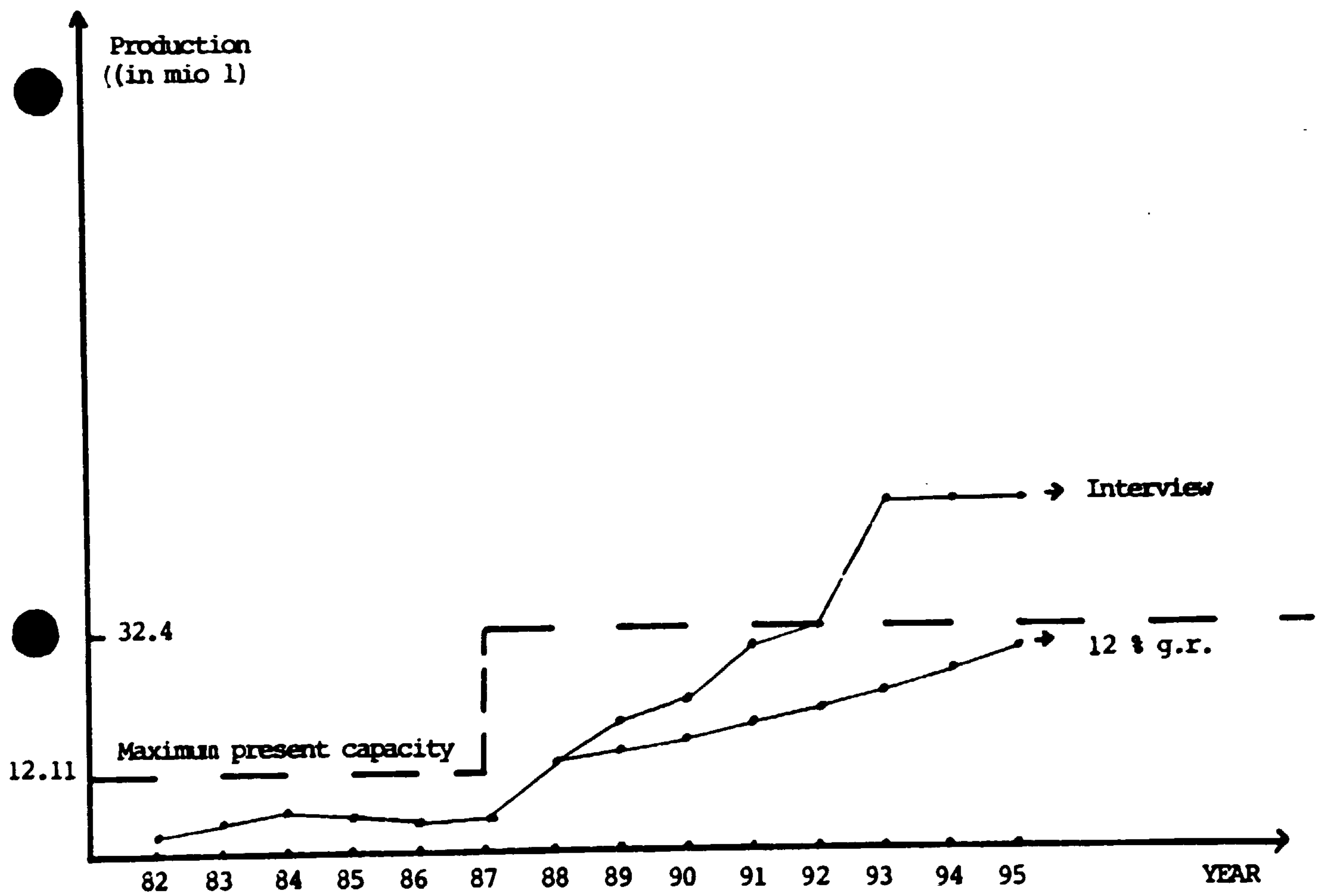

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TABLE 11. : EAST AFRICAN DISTILLERIES Ltd PRODUCTION

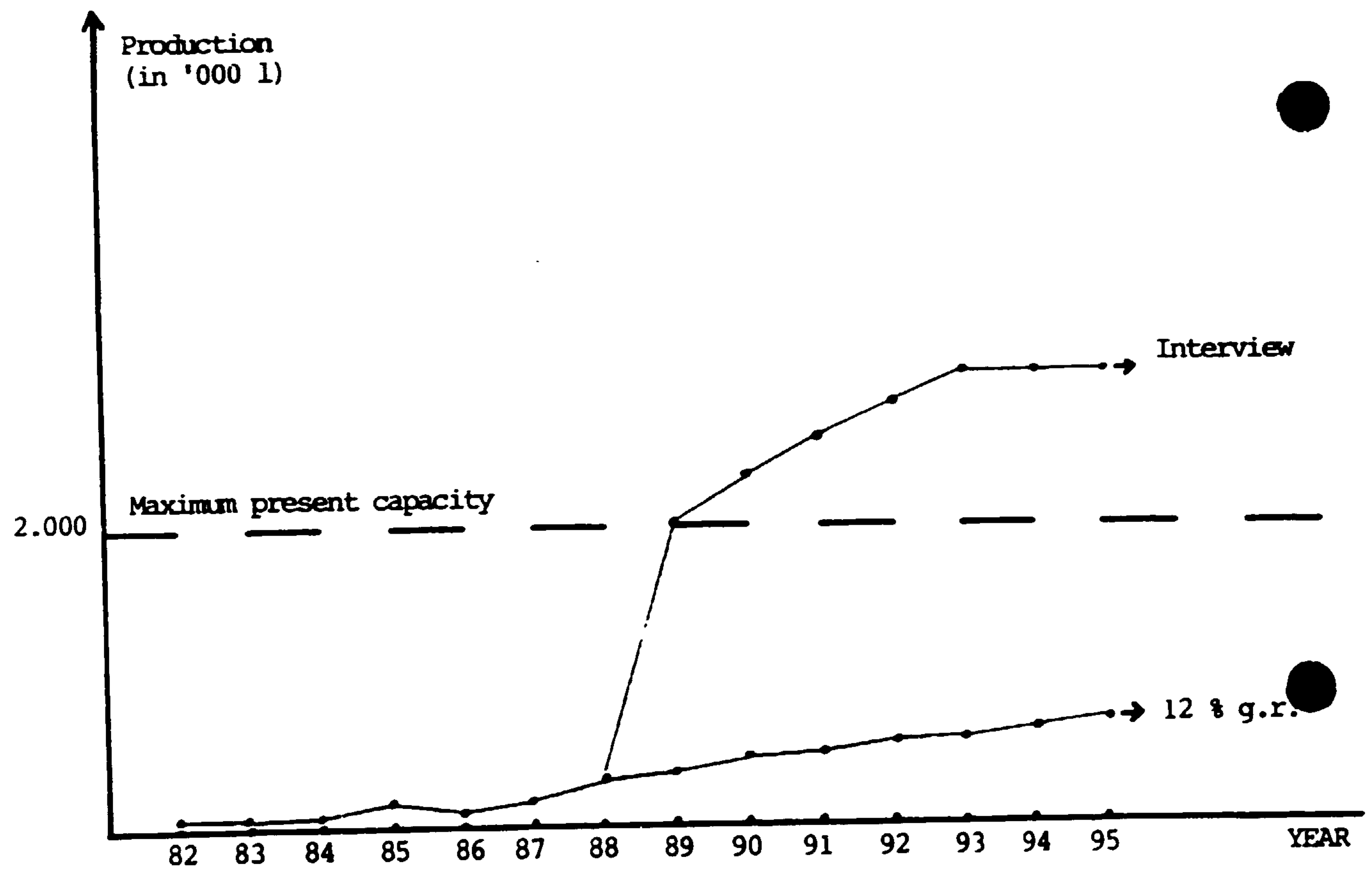

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TABLE 12. : KAMPALA BOTTLERS Ltd PRODUCTION

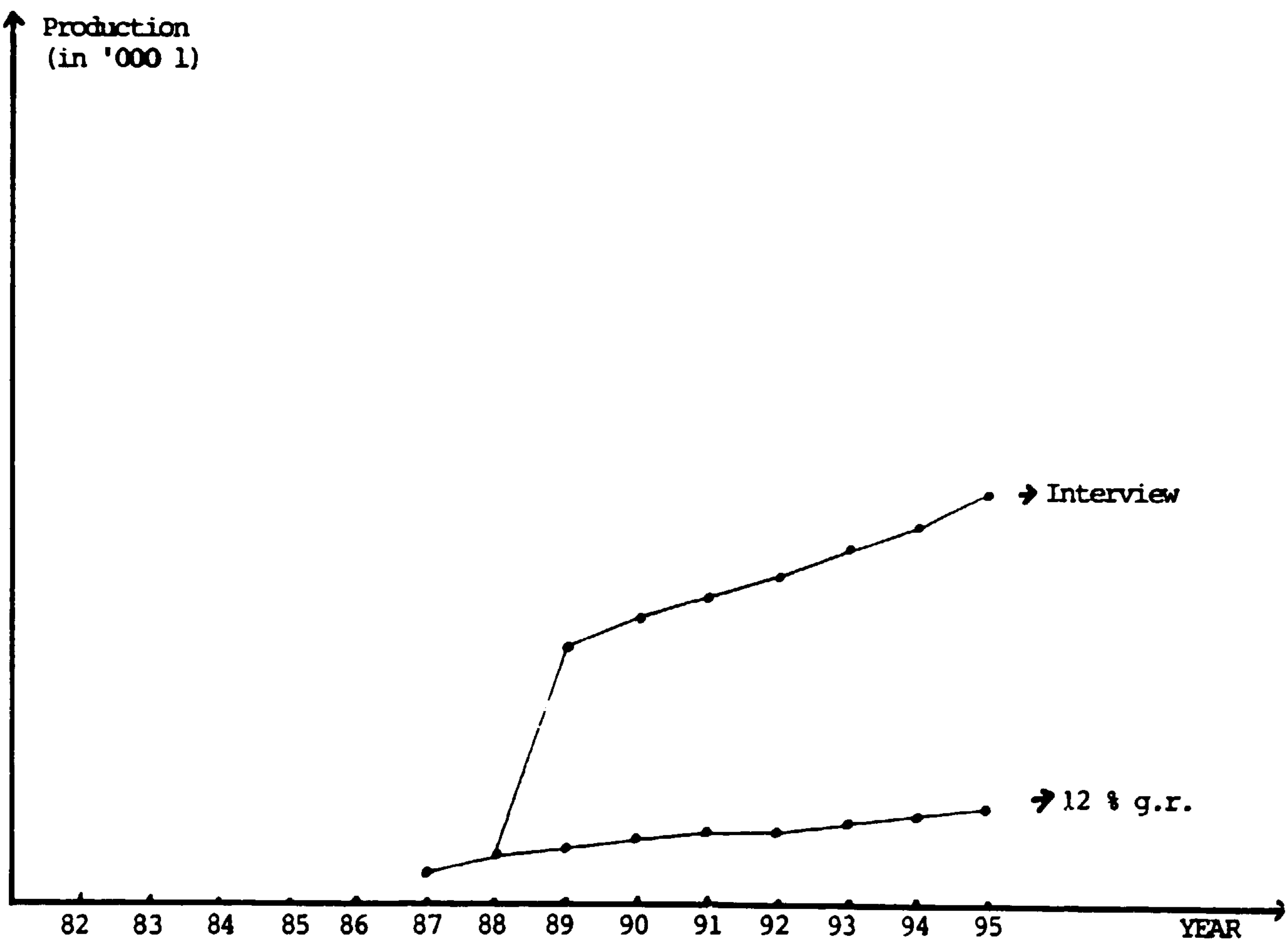

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TABLE 13. : CENTURY BOTTLING Co PRODUCTION

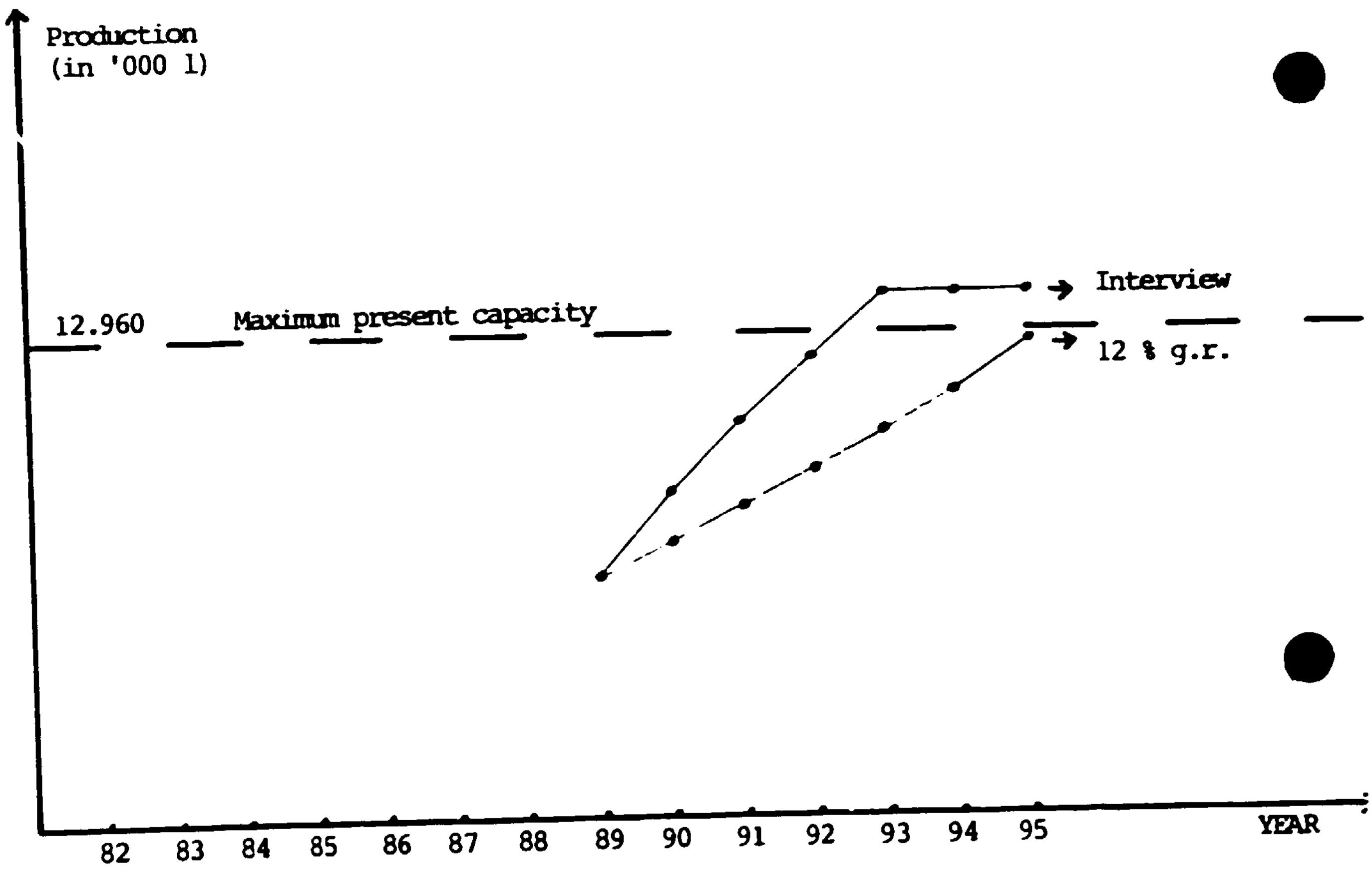

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TABLE 14. : JUBILEE ICE & SODA WORKS LTD PRODUCTION

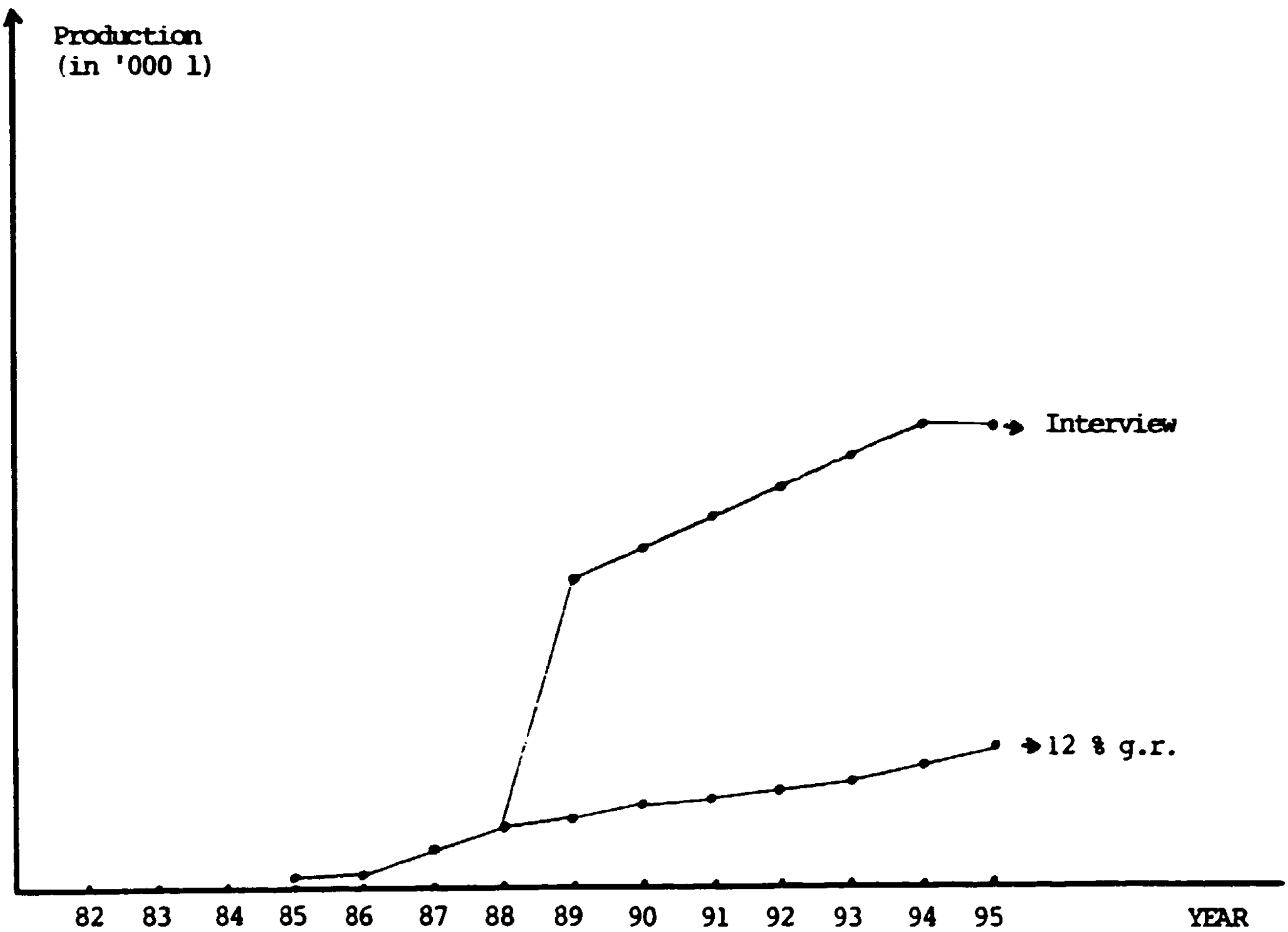

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TABLE 15. : MASAKA GROWERS Co UNION PRODUCTION

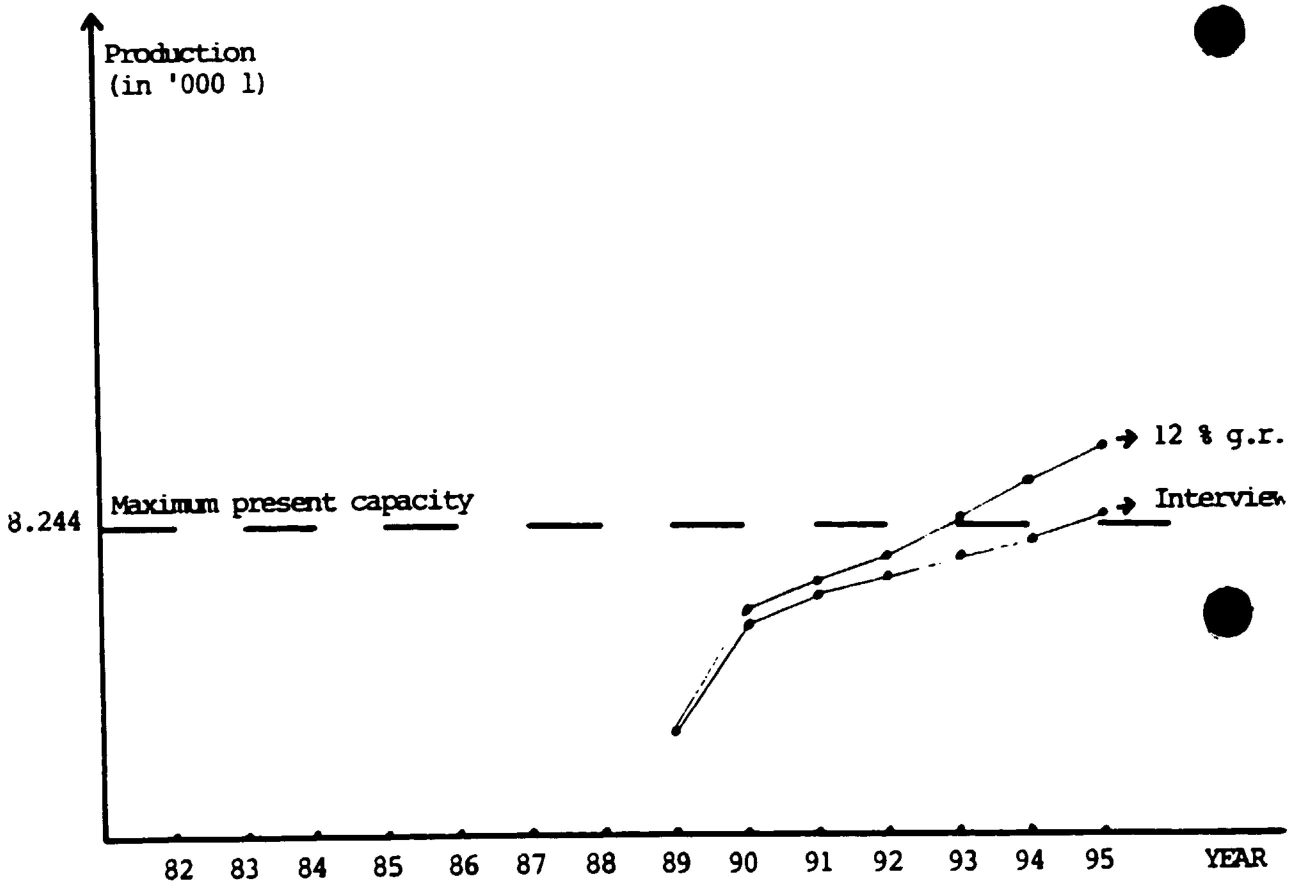

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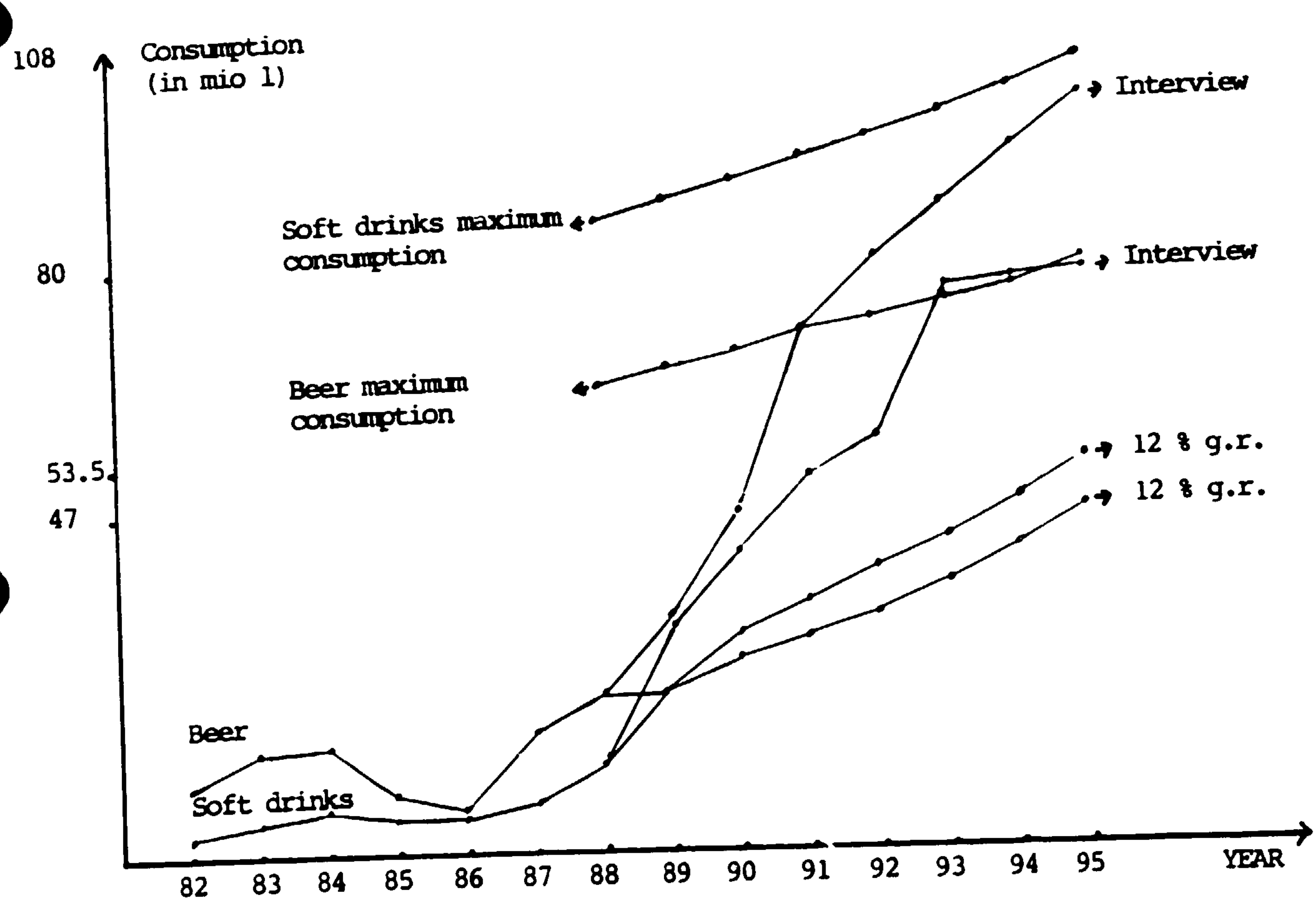
TABLE 16. : EXPECTED BEER AND SOFT DRINKS PRODUCTION (INTERVIEWS) VIS-A-VIS CALCULATED CONSUMPTION AND TARGET MAXIMUM ANNUAL CONSUMPTION



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CONCLUSIONS

When comparing the target maximum curve with the bottlers expectancy we note that :

- The beer bottlers are particularly optimistic, the expected production of both breweries is intended to reach the maximum consumption in 1991, and four years later their production should be 30 % above this maximum.

- The soft drink bottlers are proportionaly more realistic, they intend to reach 53 % of the maximum consumption in 1991 and 73 % in 1995.

Considering a growth rate of 12 % p.a. from 1988 leads to the following remarks :

- The beer production should reach in 1995, 59 % of the maximum consumption.

- The soft drinks production should reach in 1995, 50 % of the maximum consumption.

- The maximum consumption being likely higher for the soft drinks than for the beer and the past production showing the reverse trend, a remarkable fact is that due to the new soft drinks bottlers (Century Bottling Co. - Masaka Growers Co. Union) the change of tendency will take place already in 1989, the soft drinks production becoming slightly higher than the beer production.
  We may therefore understand that those new investments
  in the soft drink sector are on line with the estimated trend of maximum consumption in Uganda.

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A.3. TYPE OF CONTAINERS TO BE PRODUCED

In the herebelow table entitled "Description of the bottles used by the Ugandese bottlers" we have described the bottles considered in the production program of the glass factory.

This list has been obtained as follows :

- All considered bottles have received data according to the bottler's interview.

- The new 300 ml bottle for Nile Breweries Ltd. has not been considered, the decision to introduce this bottle having not been yet taken.

- The soda water, tonic water and club soda bottles for Lake Victoria Bottling Co. Ltd have not been considered, the weights and speed of production of these bottles being similar to those of Pepsi Cola, Mirinda and Teem.

- The 200 ml bottles for Kampala Bottlers Ltd have not been considered, because apparently the market becomes shorter and shorter for this capacity.
  The company claimed to have not bought any more bottles of this type since the start-up of the factory.

- The Sprite, King size Coca and Ginger Ale bottles for CENTURY Bottling Co. have not been considered, because the period of introduction of thoses bottles in the market is still very uncertain.

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TABLE 17. : DESCRIPTION OF THE BOTTLES USED BY THE UGANDESE BOTTLERS

NAME OF BOTTLER	TYPE OF BOTTLE	CAPACITY (CC)	WEIGHT (grs)	COLOUR	DECORATION
UGANDA BREWERIES Ltd	BEER	500	370	AMBER	-
NILE BREWERIES Ltd	BEER	500	370	AMBER	-
LAKE VICTORIA BOTTLING Co Ltd	PEPSI COLA	300	420	FLINT	3 COLOURS
	MIRINDA	300	420	FLINT	3 COLOURS
	TEEM	300	420	GREEN	3 COLOURS
EAST AFRICAN DISTILLERIES Ltd	WARAGI (round)	300	320	FLINT	-
	WARAGI (round)	750	565	FLINT	-
	WARAGI (octogonal)	750	609	FLINT	-
	GIN (square)	750	674	FLINT	-
KAMPALA BOTTLERS Ltd	SCHWEPPES	300	425	FLINT	-
CENTURY BOTTLING Co.	COCA COLA	300	425	FLINT	2 COLOURS
	FANTA	300	425	FLINT	2 COLOURS
JUBILEE ICE & SODA WORKS Ltd	PURPLE	290	450	FLINT	2 COLOURS
	ORANGE	290	450	FLINT	2 COLOURS
MASAKA GROWERS Co UNION	CREPS	300	425	FLINT	1 COLOUR
	SQUASH	700	600	FLINT	-
	KETCHUP	340	340	FLINT	-
	CHILI SAUCE	340	340	FLINT	-
	JAM	500	525	FLINT	-

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A.4. FUTURE NATIONAL CONSUMPTIONS OF GLASS CONTAINERS UP TO YEAR 1995

GENERAL CONCLUSIONS FROM THE PRECEDING PART OF THE STUDY

a. According the interviews, the present production figures of beverages, and consequently the present consumption figures of bottles, is following the national demand but the potential market could absorb much more if glass containers were available in Uganda in bigger quantities at the same price.

b. Existing production's capacities of beverages are capable to fulfil rapidly an increase of 30 to 50 % demand of beverages as soon as mainly financial and foreign currencies constraints are resolved. A production plant of glass containers in Uganda will help hardly to solve the problem.

c. Availability of glass containers will generate new projects creating new consumers.

d. According comparisons with surrounded countries, Uganda presents an inexhaustible potential demand for beverages and consequently a demand of glass containers.

e. A growth rate of 12 % per year of beverages consumption is quite conservative for the next 6 to 7 years and conform to our conclusions coming from different sources.

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f. Forecast of production of beverages as per the interviews and our calculation confirm the optimism in the beverages industry and the existing potential market in Uganda supposing a much bigger availability and flexibility to respond to the expansion of the demand of glass containers.

g. Exportation of glass containers for the 10 first years of operation has not been presently considered (but an additional mission could be considered as a follow up) in this study for 2 main reasons :

   1. It has been clearly told by the Ugandese officials that they intend to protect the local production by appropriated means to avoid importation and competition on the Ugandese market.
      Reciprocally, surrounded countries producing glass containers (Kenya, Burundi, Zaïre, ...) told us that Ugandese products will be, in that case, banished for importation.
   2. For the surrounded countries which are not producers (Rwanda, Soudan, ...) we do not expect that, during the first years of production in Uganda, a sufficient marketing strategy and effort will be developed to capture substancially these existing markets.

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Anyway, as per our design of the plant, the initial capacity can also be doubled easily and at a very reduced cost when refurbishing the furnace (after 4-5 yeas of operation) extra demand coming from exportation can be fulfilled easily.
We think that this policy is also reasonable to allow a certain period during which productive skills can be developed in order to be able to offer a product of international standard at a competitive price.

h. Market penetration has not to be considered as the new glass containers production plant in Uganda will be the sole supplyer of these products to satisfay the Ugandese demand.
Of course, substitution with presently imported containers is acceptable only if quality of domestic production is comparable.

i. Sales channels are very simple as the bottles are directly bought by the bottlers from the glass factory (as it is now).

j. Nevertheless, if other consumers appear in Uganda (for instance new companies developping the package, in Uganda, for pharmaceutical, parapharmaceutical or agro industrial products) the sales manager of the glass factory will have to introduce the containers produced locally.

k. If later one exportation seems possible and profitable, marketing and selling should be studied also by the sales manager.

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CALCULATION OF THE FUTURE NATIONAL CONSUMPTION OF BOTTLES UP TO 1995

- Two companies claimed to have a high percentage of non return, East African Distilleries Ltd (100 %) and Jubilee Ice & Soda Works Ltd (50%). Nevertheless we believe that this phenomena should be temporary and ought to decrease with the global increase of production of beverages in Uganda.

- Kampala Bottlers Ltd claimed to have a return on the bottle's life of only 8, but the introduction of this company on the market is too recent to be considered in this regard.

- The other bottlers are unanimous to consider their returns as follows : 10 per year
  20 per bottle's life.

  Even if the return per bottle's life seems not to be a very familiar figure for the interviewed bottlers, we consider that these figures are normal and on line with other studies we have done on the past from a conservative point of view. We shall therefore consider those figures to determine the consumption of bottles vis-à-vis the beverage production.

- Concerning the breakage percentage, the average figure stands between 1.5 and 2.5 %, with the exceptions of Jubilee Ice & Soda Works Ltd who claimed a very high figure of 8 % and Masaka Growers Co Union who claimed 3.5 % but they just started their factory.

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The considered percentage for bottles replacement (breakages + non return) being 1/20 = 5 %, we have concluded that the non return percentage stands between 2.5 and 3.5 %. Here again, we consider this figure as being normal.

- We shall calculate the bottles consumption according to the following formulas :

$$B = B\,1 + B\,2$$

$$B\,1 = \frac{\sum Q_N - \sum Q_{N-1}}{Ry \times C}$$

$$B\,2 = \frac{Q_N}{Rl \times C}$$

Whereas :

B	= Total bottles consumption in pieces for the year N.
B 1	= Bottles consumption in pieces for the year N due to the increase of production.
B 2	= Bottles consumption in pieces for the year N due to the replacement for breakages and non returns.
Q_n	= Beverage production in litres for the year N
Q_{N-1}	= Beverages production in litres for the year preceeding N.
Ry	= Number of returns per year.
Rl	= Number of returns per bottle's life.
C	= Capacity of the bottle in litres.

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TABLE 18. : CONSUMPTION OF BOTTLES IN 1989

NAME OF BOTTLER	TYPE OF BOTTLE	CAPACITY (CC)	'000 LITRES PRODUCEC IN 1988	'000 LITRES TO BE PRODUCED IN 1989	B1	B2	B
UGANDA BREWERIES Ltd	BEER	500	17000	19040	408	1904	2312
NILE BREWERIES Ltd	BEER	500	4252.5	4762.8	102.1	476.3	578.4
LAKE VICTORIA BOTTLING Co Ltd	PEPSI COLA	300	6498	7277.8	259.9	1213	1472.9
	MIRINDA	300	5198.4	5822.2	207.9	970.4	1178.3
	TEEM	300	1299.6	1455.6	52	242.6	294.6
EAST AFRICAN DISTILLERIES Ltd	WARAGI (round)	300	59.5	66.7	2.4	11.1	13.5
	WARAGI (round)	750	99.2	111.1	1.6	7.4	9
	WARAGI (octogonal)	750	99.2	111.1	1.6	7.4	9
	GIN (square)	750	74.5	83.4	1.2	5.6	6.8
KAMPALA BOTTLERS Ltd	SCHWEPPES	300	600	672	24	112	136
CENTURY BOTTLING Co.	COCA COLA	300	-	3240	1080	540	1620
	FANTA	300	-	3240	1080	540	1620
JUBILEE ICE & SODA WORKS Ltd	PURPLE	290	82.6	92.5	3.4	15.9	19.3
	ORANGE	290	82.6	92.5	3.4	15.9	19.3
MASAKA GROWERS Co UNION	CREPS	300	-	2160	720	360	1080
	SQUASH	700	-	504	72	36	108
	KETCHUP	340	-	-	-	-	-
	CHILI SAUCE	340	-	-	-	-	-
	JAM	500	-	-	-	-	-

TABLE 19. : CONSUMPTION OF BOTTLES IN 1990

NAME OF BOTTLER	TYPE OF BOTTLE	CAPACITY (CC)	'000 LITRES PRODUCED IN 1989	'000 LITRES TO BE PRODUCED IN 1990	B1	B2	B
UGANDA BREWERIES Ltd	BEER	500	19040	21324.8	457	2132.5	2589.5
NILE BREWERIES Ltd	BEER	500	4762.8	5334.3	114.3	533.4	647.7
LAKE VICTORIA BOTTLING Co Ltd	PEPSI COLA	300	7277.8	8151.1	291.1	1358.5	1649.6
	MIRINDA	300	5822.2	6520.9	232.9	1086.8	1319.7
	TEEM	300	1455.6	1630.2	58.2	271.7	329.9
EAST AFRICAN DISTILLERIES Ltd	WARAGI (round)	300	66.7	74.6	2.6	12.4	15
	WARAGI (round)	750	111.1	124.4	1.8	8.3	10.1
	WARAGI (octogonal)	750	111.1	124.4	1.8	8.3	10.1
	GIN (square)	750	83.4	93.5	1.4	6.2	7.6
KAMPALA BOTTLERS Ltd	SCHWEPPES	300	672	752.6	26.9	125.4	152.3
CENTURY BOTTLING Co.	COCA COLA	300	3240	3628.8	129.6	604.8	734.4
	FANTA	300	3240	3628.8	129.6	604.8	734.4
JUBILEE ICE & SODA WORKS Ltd	PURPLE	290	92.5	103.6	3.8	17.9	21.7
	ORANGE	290	92.5	103.6	3.8	17.9	21.7
MASAKA GROWERS Co UNION	CREPS	300	2160	2419.2	86.4	403.2	489.6
	SQUASH	700	504	564.5	8.6	40.3	48.9
	KETCHUP	340	-	816	240	120	360
	CHILI SAUCE	340	-	816	240	120	360
	JAM	500	-	1200	240	120	360

TABLE 20. : CONSUMPTION OF BOTTLES IN 1991

NAME OF BOTTLER	TYPE OF BOTTLE	CAPACITY (CC)	'000 LITRES PRODUCED IN 1990	'000 LITRES TO BE PRODUCED IN 1991	B1	B2	B
UGANDA BREWERIES Ltd	BEER	500	21324.8	23883.8	511.8	2388.4	2900.2
NILE BREWERIES Ltd	BEER	500	5334.3	5974.5	128	597.5	725.5
LAKE VICTORIA BOTTLING Co Ltd	PEPSI COLA	300	8151.1	9129.2	326	1521.5	1847.5
	MIRINDA	300	6520.9	7303.4	260.8	1217.2	1478
	TEEM	300	1630.2	1825.8	65.2	304.3	369.5
EAST AFRICAN DISTILLERIES Ltd	WARAGI (round)	300	74.6	83.6	3	13.9	16.9
	WARAGI (round)	750	124.4	139.4	2	9.3	11.3
	WARAGI (octogonal)	750	124.4	139.4	2	9.3	11.3
	GIN (square)	750	93.5	104.7	1.5	7	8.5
KAMPALA BOTTLERS Ltd	SCHWEPPES	300	752.6	843	30.1	140.5	170.6
CENTURY BOTTLING Co.	COCA COLA	300	3628.8	4064.3	145.2	677.4	822.6
	FANTA	300	3628.8	4064.3	145.2	677.4	822.6
JUBILEE ICE & SODA WORKS Ltd	PURPLE	290	103.6	116	4.3	20	24.3
	ORANGE	290	103.6	116	4.3	20	24.3
MASAKA GROWERS Co UNION	CREPS	300	2419.2	2709.5	96.8	451.6	548.4
	SQUASH	700	564.5	632.2	9.7	45.2	54.9
	KETCHUP	340	816	913.9	28.8	134.4	163.2
	CHILI SAUCE	340	816	913.9	28.8	134.4	163.2
	JAM	500	1200	1344	28.8	134.4	163.2

TABLE 21. : CONSUMPTION OF BOTTLES IN 1992

NAME OF BOTTLER	TYPE OF BOTTLE	CAPACITY (CC)	'000 LITRES PRODUCED IN 1991	'000 LITRES TO BE PRODUCED IN 1992	B1	B2	B
UGANDA BREWERIES Ltd	BEFR	500	23883.8	26749.8	573.2	2675	3248.2
NILE BREWERIES Ltd	BEER	500	5974.5	6691.4	143.4	669.1	812.5
LAKE VICTORIA BOTTLING Co Ltd	PEPSI COLA	300	9129.2	10224.7	365.2	1704.1	2069.3
	MIRINDA	300	7303.4	8179.8	292.1	1363.3	1655.4
	TEEM	300	1825.8	2044.9	73	340.8	413.8
EAST AFRICAN DISTILLERIES Ltd	WARAGI (round)	300	83.6	93.4	3.3	15.6	18.9
	WARAGI (round)	750	139.4	156.1	2.2	10.4	12.6
	WARAGI (octogonal)	750	139.4	156.1	2.2	10.4	12.6
	GIN (square)	750	104.7	117.2	1.7	7.8	9.5
KAMPALA BOTTLERS Ltd	SCHWEPPES	300	843	944.1	33.7	157.4	191.1
CENTURY BOTTLING Co.	COCA COLA	300	4064.3	4552	162.6	758.7	921.3
	FANTA	300	4064.3	4552	162.6	758.7	921.3
JUBILEE ICE & SODA WORKS Ltd	PURPLE	290	116	130	4.8	22.4	27.2
	ORANGE	290	116	130	4.8	22.4	27.2
MASAKA GROWERS Co UNION	CREPS	300	2709.5	3034.6	108.4	505.8	614.2
	SQUASH	700	632.2	708.1	10.8	50.6	61.4
	KETCHUP	340	913.9	1023.6	32.3	150.5	182.8
	CHILI SAUCE	340	913.9	1023.6	32.3	150.5	182.8
	JAM	500	1344	1505.3	32.3	150.5	182.8

TABLE 22. : CONSUMPTION OF BOTTLES IN 1993

NAME OF BOTTLER	TYPE OF BOTTLE	CAPACITY (CC)	'000 LITRES PRODUCED IN 1992	'000 LITRES TO BE PRODUCED IN 1993	B1	B2	B
UGANDA BREWERIES Ltd	BEER	500	26749.8	29959.8	642	2996	3638
NILE BREWERIES Ltd	BEER	500	6691.4	7494.4	160.6	749.4	910
LAKE VICTORIA BOTTLING Co Ltd	PEPSI COLA	300	10224.7	11451.7	409	1908.6	2317.6
	MIRINDA	300	8179.8	9161.4	327.2	1526.9	1854.1
	TEEM	300	2044.9	2290.3	81.8	381.7	463.5
EAST AFRICAN DISTILLERIES Ltd	WARAGI (round)	300	93.4	104.9	3.8	17.5	21.3
	WARAGI (round)	750	156.1	174.8	2.5	11.7	14.2
	WARAGI (octogonal)	750	156.1	174.8	2.5	11.7	14.2
	GIN (square)	750	117.2	131.3	1.9	8.8	10.7
KAMPALA BOTTLERS Ltd	SCHWEPPES	300	944.1	1057.4	37.8	176.2	214
CENTURY BOTTLING Co.	COCA COLA	300	4552	5098.2	182.1	849.7	1031.8
	FANTA	300	4552	5098.2	182.1	849.7	1031.8
JUBILEE ICE & SODA WORKS Ltd	PURPLE	290	130	145.6	5.4	25.1	30.5
	ORANGE	290	130	145.6	5.4	25.1	30.5
MASAKA GROWERS Co UNION	CREPS	300	3034.6	3398.8	121.4	566.5	687.9
	SQUASH	700	708.1	793.1	12.1	56.7	68.8
	KETCHUP	340	1023.6	1146.4	36.1	168.6	204.7
	CHILI SAUCE	340	1023.6	1146.4	36.1	168.6	204.7
	JAM	500	1505.3	1685.9	36.1	168.6	204.7

TABLE 23. : CONSUMPTION OF BOTTLES IN 1994

NAME OF BOTTLER	TYPE OF BOTTLE	CAPACITY (CC)	'000 LITRES PRODUCED IN 1993	'000 LITRES TO BE PRODUCED IN 1994	B1	B2	B
UGANDA BREWERIES Ltd	BEER	500	29959.8	33555	719	3355.5	4074.5
NILE BREWERIES Ltd	BEER	500	7494.4	8393.3	180	839.4	1019.4
LAKE VICTORIA BOTTLING Co Ltd	PEPSI COLA	300	11451.7	12825.9	458.1	2137.7	2595.8
	MIRINDA	300	9161.4	10260.7	366.4	1710.1	2076.5
	TEEM	300	2290.3	2565.2	91.5	427.5	519.1
EAST AFRICAN DISTILLERIES Ltd	WARAGI (round)	300	104.9	117.4	4.2	19.6	23.8
	WARAGI (round)	750	174.8	195.8	2.8	13.1	15.9
	WARAGI (octogonal)	750	174.8	195.8	2.8	13.1	15.9
	GIN (square)	750	131.3	147	2.1	9.8	11.9
KAMPALA BOTTLERS Ltd	SCHWEPPES	300	1057.4	1184.3	42.3	197.4	239.7
CENTURY BOTTLING Co.	COCA COLA	300	5098.2	5710	203.9	951.7	1155.6
	FANTA	300	5098.2	5710	203.9	951.7	1155.6
JUBILEE ICE & SODA WORKS Ltd	PURPLE	290	145.6	163	6	28.1	34.1
	ORANGE	290	145.6	163	6	28.1	34.1
MASAKA GROWERS Co UNION	CREPS	300	3398.8	3806.7	136	634.5	770.5
	SQUASH	700	793.1	888.2	13.6	63.4	77
	KETCHUP	340	1146.4	1284	40.5	188.8	229.3
	CHILI SAUCE	340	1146.4	1284	40.5	188.8	229.3
	JAM	500	1685.9	1888.2	40.5	188.8	229.3

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TABLE 24. : CONSUMPTION OF BOTTLES IN 1995

NAME OF BOTTLER	TYPE OF BOTTLE	CAPACITY (CC)	'000 LITRES PRODUCED IN 1994	'000 LITRES TO BE PRODUCED IN 1995	B1	B2	B
UGANDA BREWERIES Ltd	BEER	500	33555	37581.6	805.3	3758.2	4563.5
NILE BREWERIES Ltd	BEER	500	8393.3	9400.9	201.4	940.1	1141.5
LAKE VICTORIA BOTTLING Co Ltd	PEPSI COLA	300	12825.9	14365	513	2394.2	2907.2
	MIRINDA	300	10260.7	11492	410.4	1915.3	2325.7
	TEEM	300	2565.2	2873	102.6	478.8	581.4
EAST AFRICAN DISTILLERIES Ltd	WARAGI (round)	300	117.4	131.5	4.7	21.9	26.6
	WARAGI (round)	750	195.8	219.3	3.1	14.6	17.7
	WARAGI (octogonal)	750	195.8	219.3	3.1	14.6	17.7
	GIN (square)	750	147	164.7	2.4	11	13.4
KAMPALA BOTTLERS Ltd	SCHWEPPES	300	1184.3	1326.4	47.4	221.1	268.5
CENTURY BOTTLING Co.	COCA COLA	300	5710	6395	228.3	1065.8	1294.1
	FANTA	300	5710	6395	228.3	1065.8	1294.1
JUBILEE ICE & SODA WORKS Ltd	PURPLE	290	163	182.6	6.8	31.5	38.3
	ORANGE	290	163	182.6	6.8	31.5	38.3
MASAKA GROWERS Co UNION	CREPS	300	3806.7	4263.5	152.3	710.6	862.9
	SQUASH	700	888.2	994.8	15.2	71.1	86.3
	KETCHUP	340	1284.4	1438.1	45.3	211.5	256.8
	CHILI SAUCE	340	1284	1438.1	45.3	211.5	256.8
	JAM	500	1888.2	2114.8	45.3	211.5	256.8

A.5. GLASS CONTAINERS PRODUCTION PROGRAM UP TO 1995

a. Bottles

Beer and soft drinks and alcohol consumption

The beer and soft drink consumption was 35.35 mio l in 1988. According to the bottlers interviews, this consumption should grow up to 186.065 mio liters in 1995. (27 % growth rate p.a.).

In our study we have considered only a 12 % growth rate p.a. giving in 1995 a consumption of 101.178 mio litres :

- 6.6 % p.a. increase of the urban population
- 5.4 % p.a. increase of the G.N.P. per capita.

This 1995 total consumption is splitted as follows :

- 46.983 mio l beer
- 0.735 mio l alcohol
- 53.462 mio l soft drinks.

The 46.982 mio l beer consumption in 1995 is 2.4 l per capita or 60 % of the target maximum consumption of 4 l per capita.

The 53.462 mio l soft drinks consumption in 1995 is 2.7 l per capita or 50 % of the target maximum consumption of 5.4 l per capita.

The 101.178 mio l beverage consumption in 1995 is 41.1 % of the average consumption of 8 African countries having a similar G.N.P. per capita.

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Production of bottles to cover this consumption

We have considered 10 returns per year (trippage) per bottle and 20 returns per bottles life :

- 1.5 % to 2.5 % breakages
- 2.5 % to 3.5 % no return.

If the experience of the new factory during the first years of operation shows that trippage or breakages will be less than 10 and that a corresponding excess demand will occur, an extension capacity (doubling) will be possible to be realized during the first refurbishing of the furnace. But for the present study, we prefer to be on conservative side of the demand.

It has to be produced in 1995, 16,247,600 bottles :

- 2,867,000 bottles due to the increase of production,
- 13,380,600 bottles due to the replacement for breakages and non return.

Progress yield

In the following tables, we have calculated per article the production per day using one machine type I S, single gob process.

We have considered a net yield of saleable articles of

. 60 % of the grow production for the first year
. 70 % of the grow production for the second year
. 75 % of the grow production for the third year
. 80 % of the grow production for the fourth year.

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Actually, the factory will work at full capacity as from the first year. However, we must remember that it will take time for the staff to become acquainted with the machines and technology concerned. That is only we have considered a progressive yield in four years time to obtain a 80 % figure which is the average maximum to be considered.

This yield can vary according the precise design of the article and according to the quality of the production equipment involved in the process and to the skilness of the personnel.
In the developed countries this yield usually vary between a range from 80 % to 90 %.
In developing countries this range is wider, from 20-30 up to 80 %.
We have considered that the present project could reach progressively this yield of 80 %, only because of the magnitude of the assistance considered in the costing (training abroad and continuous training on site performed by the expatriated technical assistance).

Glass colour and saleable production time

From the production program, we can see that the glass colour are divided as follows :

3.7 % green
33 % amber
63.3 % flint.

Obviously it should be better to have only two colours, the ideal being to switch the amber bee bottles to the green. But we have no idea neither the brewering nor the market could accept this switch over.

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In this study we have kept the three colours but after possible implementation of the glass factory, if the bee bottles ought to be kempt amber, it shall be maybe interesting to cancel the Teem green bottles production. The profitability of this bottle being lower than those of the other bottles, due to the loss of production time for changing the colour in the furnace only for this bottle.

If the three colours production is eventually maintained, the ideal sequence should be as follows :

- flint campaign
- change from flint to green - 3 days's time
- change from green to amber - 3 days's time
- change from amber to flint - 4 days's time.

When changing from a colour to another, it is however necessary to take account of the glass oxidation level :

- from flint to green - no problem
- from green to amber - a small redex probelm (compatibility of exidation condition) is to be expected. A detailed programme which provides a slow and progressive development of the exidation level will have to be established and complied with
- from amber to flint - the situation is same as the preceeding one, but to a little higher degree.

The workability of each type of glass is affected during about one week after obtaining the desired tint.

In fact the factory will run 24 hours a day throughout the year, but the maximum days of saleable production should be kept around 315 per year when producing 3 colours, the difference of 50 days being lost for the following reasons :

- machine stoppages for maintenance

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- machine stoppages for repairs
- machine stoppages for mould changes
- machine stoppages for colour changes (see hereabove).

The production programme shown for 1995 considers 3/4 days of saleable production per year ; which means that from 1996 a double gob production process has to be installed on the IS machine to allow the expected increase of production.

At that time a possible increase of the furnace capacity and size could take place, as a fraction of the eventual production programme when producing.

Even if this furnace's increase would not be necessary, around 1996, and after each 4 years time production, the furnace must be stopped for partial reconstruction.

During these years, the reconstruction time will take about two months, which means a saleable production time of : $315 \times \frac{10}{12} = 262$ days.

Minimum time of production per article

The minimum time of production of a same article is about 1 day to keep the relative cost of this article within reasonable limits ; due to the loss of time for changing the moulds.

Looking at the production programme we can see that the articles for East African Distilleries Ltd and those for Jubilee Ice & Soda Works Ltd do not reach a production time of one day, although they have been rounded off to this figure.

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However we have kept them in the programme for the following reasons ;

- the established programme is a theoritical one, considering each year separately. After start up this programme must obviously be adapted as a function of negociations between the glass factory and the bottles. It can be therefore imagined to produce in one time the needs for two years of East African Distilleries Ltd and Jubilee Ice & Soda Works Ltd, in order to decrease the relative costs of these bottles.

- East African Distilleries Ltd claimed that their bottles should now be considered as one way, and Jubilee Ice & Soda Works Ltd claimed that the percentage of non return reachs 50 %. We have not taken this factor into consideration, thinking this phenomene is temporary. But we can imagine that these high non return percentage though decreasing in the future shall stay at a higher level than the 5 % uniformly used in this study.

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TABLE 25. : PRODUCTION PROGRAM IN 1992 (BOTTLES)

TYPE OF BOTTLES (of different shape, weight, capacity)	CAPACITY (CC)	WEIGHT (GRS)	COLOUR	PIECES/MIN (GROSS)	EFFICIENCY %	PIECES/D (NET)	'000 PIECES/Y (NET)	NBER OF DAYS	TONS/Y (NET)
BEER	500	370	AMBER	48	60	41472	4060.7	99	1502.4
PEPSI COLA	300	420	FLINT	45	60	38880	2069.3	54	869.1
MIRINDA	300	420	FLINT	45	60	38880	1655.4	43	695.3
TEEM	300	420	GREEN	45	60	38880	413.8	11	173.8
WARAGI (ROUND)	300	320	FLINT	52	60	44928	18.9	1	6
WARAGI (ROUND)	750	565	FLINT	37	60	31968	12.6	1	7.1
WARAGI (OCTOGONAL)	750	609	FLINT	36	60	31104	12.6	1	7.7
GIN (SQUARE)	750	674	FLINT	33	60	28512	9.5	1	6.4
SCHWEPPES	300	425	FLINT	45	60	38880	191.1	5	81.2
COCA COLA	300	425	FLINT	45	60	38880	921.3	24	391.6
FANTA	300	425	FLINT	45	60	38880	921.3	24	391.6
PURPLE	290	450	FLINT	43	60	37152	27.2	1	12.2
ORANGE	290	450	FLINT	43	60	37152	27.2	1	12.2
CREFS	300	425	FLINT	45	60	38880	614.2	16	261
SQUASH	700	600	FLINT	36	60	31104	61.4	2	36.8
KETCHUP	340	340	FLINT	50	60	43200	182.8	5	62.2
CHILI SAUCE	340	340	FLINT	50	60	43200	182.8	5	62.2
JAM	500	525	FLINT	39	60	33696	182.8	6	96
						TOTAL	10643.6	300	4674.8

TABLE 26. : PRODUCTION PROGRAM IN 1993 (BOTTLES)

TYPE OF BOTTLES	CAPACITY (CC)	WEIGHT (GRS)	COLOUR	PIECES/MIN (GROSS)	EFFICIENCY %	PIECES/D (NET)	'000 PIECES/Y (NET)	NBER OF DAYS	TONS/Y (NET)
BEER	500	370	AMBER	48	70	48384	4548	95	1682.8
PEPSI COLA	300	420	FLINT	45	70	45360	2317.6	51	973.4
MIRINDA	300	420	FLINT	45	70	45360	1854.1	41	778.7
TEEM	300	420	GREEN	45	70	45360	463.5	11	194.7
WARAGI (ROUND)	300	320	FLINT	52	70	52416	21.3	1	6.8
WARAGI (ROUND)	750	565	FLINT	37	70	37296	14.2	1	8
WARAGI (OCTOGONAL)	750	609	FLINT	36	70	36288	14.2	1	8.6
GIN (SQUARE)	750	674	FLINT	33	70	33264	10.7	1	7.2
SCHWEPPES	300	425	FLINT	45	70	45360	214	5	91
COCA COLA	300	425	FLINT	45	70	45360	1031.8	23	438.5
FANTA	300	425	FLINT	45	70	45360	1031.8	23	438.5
PURPLE	290	450	FLINT	43	70	43344	30.5	1	13.7
ORANGE	290	450	FLINT	43	70	43344	30.5	1	13.7
CREPS	300	425	FLINT	45	70	45360	687.9	16	292.4
SQUASH	700	600	FLINT	36	70	36288	68.8	2	41.3
KETCHUP	340	340	FLINT	50	70	50400	204.7	4	69.6
CHILI SAUCE	340	340	FLINT	50	70	54000	204.7	4	69.6
JAM	500	525	FLINT	39	70	39312	204.7	6	107.5
						TOTAL	12953	287	5236

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TABLE 27. : PRODUCTION PROGRAM IN 1994 (BOTTLES)

TYPE OF BOTTLES	CAPACITY (CC)	WEIGHT (GRS)	COLOUR	PIECES/MIN (GROSS)	EFFICIENCY %	PIECES/D (NET)	'000 PIECES/Y (NET)	NBER OF DAYS	TONS/Y (NET)
BEER	500	370	AMBER	48	75	51840	5093.9	99	1884.8
PEPSI COLA	300	420	FLINT	45	75	48600	2595.8	54	1090.2
MIRINDA	300	420	FLINT	45	75	48600	2076.5	43	872.1
TEEM	300	420	GREEN	45	75	48600	519.1	11	218
WARAGI (ROUND)	300	320	FLINT	52	75	56160	23.8	1	7.6
WARAGI (ROUND)	750	565	FLINT	37	75	39960	15.9	1	9
WARAGI (OCTOGONAL)	750	609	FLINT	36	75	38880	15.9	1	9.7
GIN (SQUARE)	750	674	FLINT	33	75	35640	11.9	1	8
SCHWEPPES	300	425	FLINT	45	75	48600	239.7	5	101.9
COCA COLA	300	425	FLINT	45	75	48600	1155.6	24	491.1
FANTA	300	425	FLINT	45	75	48600	1155.6	24	491.1
PURPLE	290	450	FLINT	43	75	46440	34.1	1	15.3
ORANGE	290	450	FLINT	43	75	46440	34.1	1	15.3
CREPS	300	425	FLINT	45	75	48600	770.5	16	327.5
SQUASH	700	600	FLINT	36	75	38800	77	2	46.2
KETCHUP	340	340	FLINT	50	75	54000	229.3	5	78
CHILI SAUCE	340	340	FLINT	50	75	54000	229.3	5	78
JAM	500	525	FLINT	39	75	42120	229.3	6	120.4
						TOTAL	14507.3	300	5864.2

TABLE 28. : PRODUCTION PROGRAM IN 1995 (BOTTLES)

TYPE OF BOTTLES	CAPACITY (CC)	WEIGHT (GRS)	COLOUR	PIECES/MIN (GROSS)	EFFICIENCY %	PIECES/D (NET)	'000 PIECES/Y (NET)	NBER OF DAYS	TONS/Y (NET)
BEER	500	370	AMBER	48	80	55296	5705.0	104	2110.9
PEPSI COLA	300	420	FLINT	45	80	51840	2907.2	56	1221
MIRINDA	300	420	FLINT	45	80	51840	2325.7	45	976.8
TEEM	300	420	GREEN	45	80	51840	581.4	12	244.2
WARAGI (ROUND)	300	320	FLINT	52	80	59904	26.6	1	8.5
WARAGI (ROUND)	750	565	FLINT	37	80	42624	17.7	1	10
WARAGI (OCTOGONAL)	750	609	FLINT	36	80	41472	17.7	1	10.8
GIN (SQUARE)	750	674	FLINT	3[illegible]	80	38016	13.4	1	9
SCHWEPPES	300	425	FLINT	45	80	51840	268.5	6	114.1
COCA COLA	300	425	FLINT	45	80	51840	1294.1	25	550
FANTA	300	425	FLINT	45	80	51840	1294.1	25	550
PURPLE	290	450	FLINT	43	80	49536	38.3	1	17.2
ORANGE	290	450	FLINT	43	80	49538	38.3	1	17.2
CREPS	300	425	FLINT	45	80	51840	862.9	17	366.7
SQUASH	700	600	FLINT	36	80	41472	86.3	2	51.8
KETCHUP	340	340	FLINT	50	80	57600	256.8	5	87.3
CHILI SAUCE	340	340	FLINT	50	80	57600	256.8	5	87.3
JAM	500	525	FLINT	39	80	44928	256.8	6	134.8
						TOTAL	16247.6	314	6567.6

b. Other containers

The demand for bottles others than for beer, soft drinks and alcohol is difficult to estimate since there are no data on future production for such sectors as the pharmaceutical, phytopharmaceutical, chemical, cosmetic industries and food industries.

Therefore, we can only try roughly estimate the demand for glass containers in these relation to the demand for glass containers consumed for beer, soft drinks and alcohol.

It can be assumed that this covers already 90 % of the country's total glass demand.

This supplementary consumption will affect the demand progressively but we suggest to keep this additional demand, firstly as a safety factor on our previous assumptions, secondly as a counterbalance of the effect of household stock of containers.

In fact, the need to return empty bottles to obtain filled products has created some stockpilling of empty containers at the household level.

The greater availability of glass containers however, would reduce the tendency for household stockpilling and release on to the market a number of bottles.

c. Types & sizes of bottles

Refer to annex 4.

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B. TABLEWARES

B.1. GLASS TABLEWARES MARKET

The market of glass tablewares in Uganda is presently not seizable.

This market, apparently very low, does not exist officially. Practically all the glass tablewares we can find in Uganda are coming from the Far East mainly and through no official channels.

However, the market will develop itself as soon as a national production comes into operation.

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B.2. TABLEWARES EXISTING PRODUCTION

According to the feasibility study conducted in may 1979 by Mr. Pierre MONTAGNE for UNIDO for the implementation of a container glass factory in Burundi, the projected market for tablewares in Burundi, Rwanda and Kivu (Zaïre) was 1.780 T in 1991, with the following hypotheses :

- Rwanda and Burundi having a similar market
- Kivu having half the Burundi market
- Annual increase of 7.5 %.

The contract signed by Tanzanian Saruji Co in 1980 for the implementation of a container glass factory considered the production in 1.980 of 2.280 T of tablewares, for the national demand.

From the following table, we can see that for GNP comparable countries, the market of tablewares per capita ranges from 0.087 kg to 0.132 kg. These figures applied for Uganda will give a range of 1.583 to 2.420 T of tablewares in 1992. We will consider an average of about 2.000 T/y.

Market of tablewares Rwanda-Burundi-Tanzania

	Rwanda	Burundi	Tanzania	Uganda
Tablewares market in 1992	776 T	766 T	2.280 T (in 1990)	2.000 T
Population in 1992	7.7 mio	5.8 mio	26.3 mio (in 1990)	18.2 mio
Tablewares market per capita in 1992	0.099 kg	0.132 kg	0.087 kg (in 1990)	0.11 kg
GNP per capita in 1986	290 US$	240 US$	250 US$	230 US$

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According to the latest information we have collected, the press line to produce tablewares which was expected in Burundi has never been materialized.

Verrundi, the Burundese glass factory, has only begon to produce tumblers by cutting bottles. They have stopped this production after 100,000 tumblers, because the quality was too low (external aspect). They expect to restart some production of this kind in the future, but such a kind of production (cutted bottles) will never allow a sufficient quality level.

As a consequence, we believe that a part of the Rwanda and Burundi market could be covered by the present project.

However, in order to stay on the conservative side, we shall keep the capacity of this project to around 2.000 T of tablewares in 1992. Indeed, the present market in Uganda for glass tablewares being so small, it is difficult to forecast the impact of the introduction in the market of locally produced items. The hereabove calculation consisting of intrapolation of Rwanda, Burundi and Tanzania consumptions could be too optimistic. We have made herebelow some assumptions, probably more realistic.

	Rwanda	Burundi	Uganda
<u>Assumption 1 ; Mean maxim</u> *			
Total market	766 T	766 T	1.583 T (0.087 kg/capita = Tanzania)
Market share of the glass factory	208 T	208 T	1.583 T
% Market share	27 %	27 %	100 %

* Mean maxim = Maximum course of the average figures.

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	Rwanda	Burundi	Uganda
Assumption 2 : Mean average *			
Total market	766 T	765 T	1.234 T (0.068 kg/capita)
Market share of the glass factory	383 T	383 T	1.234 T
% Market share	50 %	50 %	100 %
Assumption 3 : Mean mini *			
Total market	766 T	766 T	468 T (0.026 kg/capita)
Market share of the glass factory	766 T	766 T	468 T
% Market share	100 %	100 %	100 %

These assumptions show up clearly that in the worst case when the full market of Rwanda-Burundi will be necessary to cover the production of 2.000 T, the minimum necessary local market in Uganda is 468 T, or 0.026 kg/capita.

We may therefore be confident that the choosen capacity of 2.000 T could be absorbed in priority in Uganda, the Rwanda and Burundi markets serving to take the remaining part of the production.

* Mean average = Middle course of the average figures.
* Mean mini = Minimum course of the average figures.

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B.3. FORECAST OF TABLEWARES UGANDESE CONSUMPTION BY COMPARISON WITH OTHER AFRICAN COUNTRIES

The following consumptions in Africa are expected in 1992 :

- 0,099 kg per capita for Rwanda
- 0,132 kg per capita for Burundi
- 0,092 kg per capita for Tanzania
- 0,254 kg per capita for Sénégal
- 0,037 kg per capita for Niger
- 0,231 kg per capita for Ivory Coast
- 0,043 kg per capita for Burkina Faso
- 0,028 kg per capita for Mali
- 0,116 kg per capita for Kenya.

We will consider an Ugandese production of the new plant of about 2,000 t in 1992.

This production will be absorbed in priority in Uganda, the Rwanda and Burundi markets sewing to take the remaining part of the production.

The average of the nine other countries is : 0,084 kg per capita for a country having the same G.N.P. per capita as Uganda.
Excluding Rwanda and Burundi, the average is still : 0,081 kg per capita.

If we take 0,081 kg per capita in 1992 for Uganda, it is a local consumption of 1,470 t. In that case 530 t. remain to be exported to Rwanda and Burundi, it is 35 % of their market.
If we consider that the situation of the tableware will not succeed to be better that those of the beverages compared with average Africa, we will take this last percentage in 1992, or 33 %.

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Therefore 33 % of 1,470 t. = 485 T. is to be consumed within Uganda. It is 0,027 kg per capita what is lower than all the studied countries. The difference between 2,000 t. and 485 t., i.e. : 1,515 t. is to be exported in Rwanda and Burundi, it is almost 100 % of their market.

These conclusions are similar to the ones we obtain in preceding paragraf B.2.

We may therefore be confident that the choosen capacity of 2,000 tons could be absorbed in priority in Uganda, the Rwanda and Burundi markets to take the remaining part of the production.

As for the bottles, we shall consider an average growth rate of 12 % p.a. from 1992.

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B.4. TYPE OF TABLEWARES TO BE PRODUCED

This market, as explained above, is to be considered as a new one, to be generated mainly by the local production.

We shall consider a press line with block and split moulds allowing the production of :

- tumblers, ashtrays, vases
- tea cup and tankart (with handles)
- bowls, saucers, plates, etc ...

Almost all types of glass tablewares could be produced on this line, except the footglasses and the very big dimensioned articles.

In the production programme we have taken a distribution existing in another country. Obviously, after commissioning of the glass factory, this programme can be changed according to the evolution of the market (type of articles, designs, dimensions and weights).

The production capacity of the press line being limited by the tonnage of glass pulled out from the furnace, and the turnover considered in this study being expressed in US $ per kg of glass, the financial study would not change from a different type of production in this press line.

Refer to annex 5. to see the types of tablewares who could be produced in Uganda.

B.5. TABLEWARES PRODUCTION PROGRAM UP TO 1995

In the following tables, we have kept the same yield evolution considered for the bottles,

- 60 % the first year
- 70 % the second year
- 75 % the third year
- 80 % the fourth year.

The bottles line and the tablewares line being feeded by the same furnace, obviously the percentage of coloured production and the saleable production time ought to be identical for bottles and tablewares. (See the bottles production programme)

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CONCLUSION

PLANT CAPACITY FOR GLASS CONTAINERS AND TABLEWARES

The hereabove productions during the four first years of production will be realized with one IS machine single gob producing the bottles and one press single gob producing the tablewares.

One single furnace will feed both lines, its capacity will be 50 t. molten glass per day.

From the fifth year of production, double gob process will be needed in order to allow the increse of production to follow the market increase. At that time the furnace capacity will be expanded up to 90 t. molten glass per day.

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TABLE 29. : PRODUCTION PROGRAM IN 1992 (TABLEWARE)

TYPE OF ARTICLES	CAPACITY (CC)	WEIGHT (GRS)	PIECES/MIN (GROSS)	EFFICIENCY %	PIECES/D (NET)	'000 PIECES/Y (NET)	NBER OF DAYS	TONS/Y (NET)
TUMBLER	90	95	47	60	40608	2000	50	190
TUMBLER	160	150	43	60	37152	2000	54	300
TUMBLER	250	210	40	60	34560	2000	58	420
BOWL 11 CM DIA.	-	220	38	60	32832	1000	31	220
BOWL 22 CM DIA.	-	850	15	60	12960	150	12	127.5
ASHTRAY	-	250	30	60	25920	125	5	31.3
TEA CUP 28 CL	-	270	28	60	24192	300	13	81
SAUCER FOR DITO	-	220	32	60	27648	300	11	66
PLATE 23 CM DIA.	-	460	19	60	16416	500	31	230
DESSERT PLATE 19 CM DIA	-	330	22	60	19008	300	16	99
TANKART 23 CL	-	350	27	60	23328	200	9	70
TANKART 37 CL	-	450	23	60	19872	200	10	90
					TOTAL	9075	300	1924.8

TABLE 30. : PRODUCTION PROGRAM IN 1993 (TABLEWARE)

TYPE OF ARTICLES	CAPACITY (CC)	WEIGHT (GRS)	PIECES/MIN (GROSS)	EFFICIENCY %	PIECES/D (NET)	'000 PIECES/Y (NET)	NBER OF DAYS	TONS/Y (NET)
TUMBLER	90	95	47	70	47376	2275	48	216.1
TUMBLER	160	150	43	70	43344	2255	52	338.3
TUMBLER	250	210	40	70	40320	2220	55	466.2
BOWL 11 CM DIA.	-	220	38	70	38304	1150	30	253
BOWL 22 CM DIA.	-	850	15	70	15120	165	11	140.3
ASHTRAY	-	250	30	70	30240	150	5	37.5
TEA CUP 28 CL	-	270	28	70	28224	340	12	91.8
SAUCER FOR DITO	-	220	32	70	32256	325	10	71.5
PLATE 23 CM DIA.	-	460	19	70	19152	575	30	264.5
DESSERT PLATE 19 CM DIA	-	330	22	70	22176	330	15	108.9
TANKART 23 CL	-	350	27	70	27216	245	9	85.8
TANKART 37 CL	-	450	23	70	23184	230	10	103.5
					TOTAL	10260	287	2177.4

TABLE 31. : PRODUCTION PROGRAM IN 1994 (TABLEWARE)

TYPE OF ARTICLES	CAPACITY (CC)	WEIGHT (GRS)	PIECES/MIN (GROSS)	EFFICIENCY %	PIECES/D (NET)	'000 PIECES/Y (NET)	NBER OF DAYS	TONS/Y (NET)
TUMBLER	90	95	47	75	50760	2540	50	241.3
TUMBLER	160	150	43	75	46440	2510	54	376.5
TUMBLER	250	210	40	75	43200	2505	58	526.1
BOWL 11 CM DIA.	-	220	38	75	41040	1275	31	280.5
BOWL 22 CM DIA.	-	850	15	75	16200	195	12	165.8
ASHTRAY	-	250	30	75	32400	165	5	41.3
TEA CUP 28 CL	-	270	28	75	30240	395	13	106.7
SAUCER FOR DITO	-	220	32	75	34560	380	11	83.6
PLATE 23 CM DIA.	-	460	19	75	20520	635	31	292.1
DESSERT PLATE 19 CM DIA	-	330	22	75	23760	380	16	125.4
TANKART 23 CL	-	350	27	75	29160	265	9	92.8
TANKART 37 CL	-	450	23	75	24840	250	10	112.5
					TOTAL	11495	300	2444.6

3067S

TABLE 32. : PRODUCTION PROGRAM IN 1995 (TABLEWARE)

TYPE OF ARTICLES	CAPACITY (CC)	WEIGHT (GRS)	PIECES/MIN (GROSS)	EFFICIENCY %	PIECES/D (NET)	'000 PIECES/Y (NET)	NBER OF DAYS	TONS/Y (NET)
TUMBLER	90	95	47	80	54144	2815	52	267.4
TUMBLER	160	150	43	80	49536	2825	57	423.8
TUMBLER	250	210	40	80	46080	2815	61	591.2
BOWL 11 CM DIA.	-	220	38	80	43776	1400	32	308
BOWL 22 CM DIA.	-	850	15	80	17280	225	13	191.3
ASHTRAY	-	250	30	80	34560	175	5	43.8
TEA CUP 28 CL	-	270	28	80	32256	450	14	121.5
SAUCER FOR DITO	-	220	32	80	36864	445	12	97.9
PLATE 23 CM DIA.	-	460	19	80	21888	700	32	322
DESSERT PLATE 19 CM DIA	-	330	22	80	25344	430	17	141.9
TANKART 23 CL	-	350	27	80	31104	280	9	98
TANKART 37 CL	-	450	23	80	26496	265	10	119.3
					TOTAL	12825	314	2726.1

* PRODUCTION PROGRAMME *

Net quantities	1	2	3	4	5	6	7
Nominal capacity (tons/day)	90.0	90.0	90.0	90.0	90.0	90.0	90.0
Utilization (%)	60.0	70.0	75.0	80.0	80.0	80.0	80.0
Used capacity (tons/day)	54.0	63.0	67.5	72.0	72.0	72.0	72.0
Bottles (t.)	6178.8	8073.7	9688.4	11574.4	9645.3	11574.4	11574.4
Tablewares (t.)	2564.7	3351.2	4021.5	4804.3	4003.6	4804.3	4804.3
TOTAL	8743.5	11424.9	13709.9	16378.7	13648.9	16378.7	16378.7

	8	avg. 15 y.
Nominal capacity (tons/day)	90.0	90.0
% utilization (%)	80.0	77.7
Used capacity (tons/day)	72.0	69.9
Bottles (t.)	11574.4	10598.4
Tablewares (t.)	4804.3	4399.2
TOTAL	16378.7	14997.5

PRODUCTION PROGRAMME
LOCAL MARKET

Net quantities		1	2	3	4	5	6	7
Bottles	(t.)	6178.8	8073.7	9688.4	11574.4	9645.3	11574.4	11574.4
Tablewares	(t.)	1582.4	2067.7	2481.2	2964.3	2470.2	2964.3	2964.3
TOTAL		7761.3	10141.4	12169.7	14538.7	12115.5	14538.7	14538.7

		8	avg. 15 y.
Bottles	(t.)	11574.4	10598.4
Tablewares	(t.)	2964.3	2714.3
TOTAL		14538.7	13312.7

PRODUCTION PROGRAMME
EXPORT MARKET

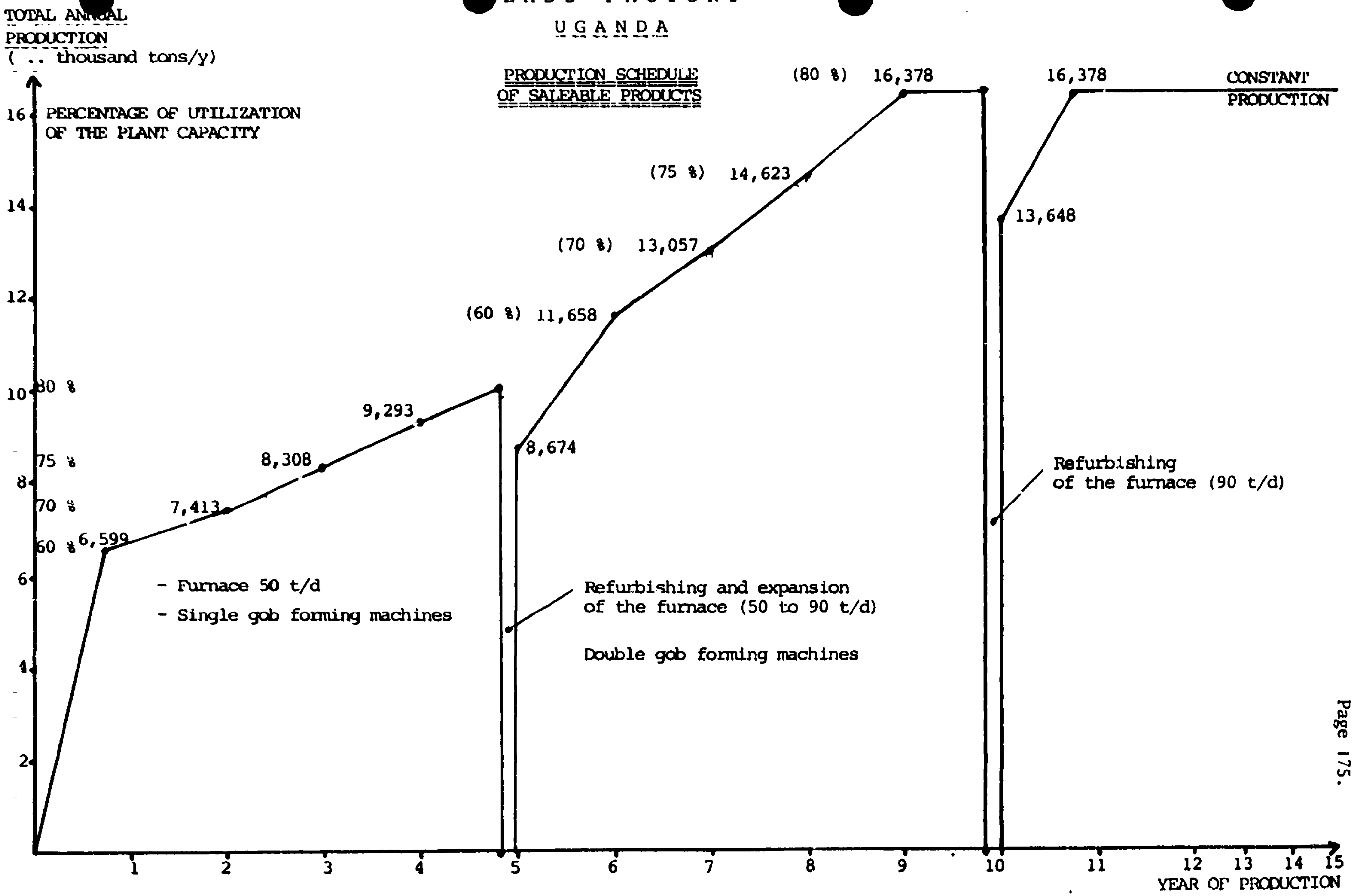
Net quantities		1	2	3	4	5	6	7
Bottles	(t.)	.0	.0	.0	.0	.0	.0	.0
Tablewares	(t.)	982.3	1283.5	1540.2	1840.0	1533.4	1840.0	18[illegible]
TOTAL		982.3	1283.5	1540.2	1840.0	1533.4	1840.0	1840.0

		8	avg. 15 y.
Bottles	(t.)	.0	.0
Tablewares	(t.)	1840.0	1684.9
TOTAL		1840.0	1684.9

GLASS FACTORY

UGANDA

PRODUCTION SCHEDULE OF SALEABLE PRODUCTS



III.2. SALES FORECAST AND PLANT CAPACITY

A. BOTTLES - JARS

The weighed average cost per kg of glass amounts to : 0.8 U $.

This cost has been calculated with the figures given by each bottlers, taking into account that the interviews have taken place in February 1989 when the rate of exchange was 1 U $ = 165 U Sh whilst the rate considered in this study is the rate prevailing in April 1989 : 1 U $ = 200 U Sh.

We have also included in this cost the 30 % import taxes which are presently added for the soft drink bottles.
For the beer bottles these taxes are not applicable today but this could change in June 1989.

However we have considered them for all the bottles, because it would have been nonsense from the point of view of a glass factory to consider producing bottles with 2 types of selling prices and with different profitabilities per bottle. Agreement should be made between the Government and the breweries from another side.

Domestic sales

It is clear that today, in Uganda, there is a serious shortage of glass containers availability. This has been also widely confirmed by the figures we recorded previously from our studies of glass industry in Africa and by the present data specially when we compared the consumption per capita of beverages linked with bottles consumption.

./.

By lowering the observed per capita consumption and the prediction of the bottlers for their expension of production growth noted for the purpose of forecasting the future, we want to reach three objectives.

a. to prevent a too optimistic growth rate of the economic development of Uganda and its impact on the life index growth rate ;
b. to make the study more reliable ;
c. to ease the sales forecast according the production rate.

Consequently, at least for the first 10 years of operation of the new plant, the penetrability of the Ugandese market will not be a problem as soon as the quality and the prices of the glass containers produced in Uganda will be equivalent to the present products imported.

1. We have proposed a technology and a design of the new plant to match the European standards of quality.
   We have suggested and prices in the investment enough training, technical and management assistance to reach these objectives.

2. Incentives and policy of taxation on beverages and on bottles produced in Uganda should be allocated in such a way that the selling prices should be equal or preferably lower than these imported products which include import duties, handling/packaging and long travel transportation charge.

3. The global growth rate (12 %) we selected could be reached easily by the bottlers with their existing plant capacities considering the present percentage of utilization. Again, we are on the conservative side.

./.

4. The design of the new plant is very flexible and conservative to follow the demand. If after 4 or 5 years of operation our assumptions on trippage, breakage or beverages consumption are to pessimist the glass containers plant could easily, with a limited investment (2 to 3 Mios USD), double its production capacity. Consequently, production will follow the sales/demand.

5. We do not consider in this study a fixed production ratio for each "Brand" of beverages (they are presently produced according the availability of raw materials for it). Nevertheless, the global penetration of the market for the soft drinks should be as forecasted as the global demand will be slightly behind the growth rate adopted in the study.

6. The consumption of beverages and bottles should be eased by the present policy to avoid dependance of importation and need of foreign currency by the cultivating Barley and producing malt in Uganda.

For pharmaceutical, chemical and cosmetic products, agro-industry and food products packaging, it was not possible to obtain a clear policy and predict future sales of containers. Promotion will be done item by item. We can ensure that the new plant could integrate for instance : jars production as soon as the tonnage required will justify economically a change in the production programme. Our experts could help to design other production programme in due time when figures of demand will be more precise.

Exportation of bottles - Jars sales

We understood that appropriate mesures will be taken to protect the domestic production. Reciprocally, exportation will be also difficult in the neighbouring countries. For the time being, we strongly suggest for the 5 first years of production to concentrate on the domestic market.

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If an increase of production will be necessary after 5 years due to the demand of domestic market, at that time, the possibility of exportation should also be studied and eventually integrated in the new production programme.

B. TABLEWARES

The tablewares presently found on the market are mainly made of poor quality China-ware. The C.I.F. prices are as follows :

- China-ware mug : 410 U Sh
- China-ware tea cup and saucer : 465 U Sh
- China-ware dessert plate : 250 U Sh
- Chine-ware flat plate : 565 U Sh
- China-ware deep plate : 565 U Sh
- Plastic mug : 305 U Sh
- Decorated plastic flat plate : 665 U Sh
- Decorated glass tumbler : 885 U Sh

The three glass articles found on the market and which are comparable to those included in the new factory production program are :

Article	Origin	C.I.F. price (U Sh)	Weight (gr)	Capacity (cc)	Price (U $/kg)
Tumbler	Kenya	250	240	272	5.2
Tankart	China	500	350	230	7.1
Tankart	China	665	450	370	7.4

The average price of these articles is 6,6 U $/kg.
This is 8,25 times more expensive than the bottles.

Usually a glass tablewares is 1,5 to 5 times more expensive per kilo than a glass bottle.

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This high difference is mainly due to the present shortage of this kind of article in the market.

In order to stay on the conservative side and to allow to the glass factory to sell its production by creating actually a new kind of market and habits, we shall consider a selling price equivalent to twice the bottles prices only, or 1,6 U $/kg.

This price is less than the quarter of the today existing cost of these glass articles and well below the cost of the plastic and China-ware articles.

Per article, the selling price would be approximately in U Sh :

Tumbler 90 cc	:	30 U Sh	
Tumbler 160 cc	:	48 U Sh	
Tumbler 250 cc	:	67 U Sh	(Presently 250 U Sh)
Boul 11 cm dia	:	70 U Sh	
Boul 22 cm dia	:	272 U Sh	
Ashtray	:	80 U Sh	
Tea cup 28 cl	:	86 U Sh	
Saucer for dito	:	70 U Sh	
Plate 23 cm dia	:	147 U Sh	
Dessert plate 19 cm dia	:	147 U Sh	
Tankart 23 cl	:	112 U Sh	(Presently 500 U Sh)
Tankart 37 cl	:	144 U Sh	(Presently 665 U Sh)

Domestic sales

We determined by comparison with statistics and our record the consumption per capita of the neighbouring countries as it was not possible to evaluate the present Ugandese importation which does not follow the official channel.
We fixed the Ugandese domestic market.
Of course, penetration of the market should be organized and developed. Again, our present figures of consumptions and growth rate are very conservative.

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Export sales

We based our figures enclosed in this study on a feasibility and market study for the glass factory in Burundi.
As the tablewares production line in Burundi was never erected, we assume that the Ugandese tablewares production line could fulfil this potential market (Burundi - Rwanda - Kivu).
We designed the Ugandese plant to produce the same articles at the same quality than in Burundi.
Of course, the assessement of the penetrability of this market of the surrounding countries [Burundi - Rwanda - Kivu (Zaïre)] is depending from the concordance of the policy, the marketing and selling task force, the necessary investment and efforts to be deployed on professional scale with necessities to obtain expected results.

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* SALES REVENUE IN LOCAL CURRENCY *
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amounts in thousand US $	1	2	3	4	5	6	7	8	9	10
Bottles	3739.8	4188.8	4691.4	5254.1	4903.8	6590.7	7381.6	8267.4	9259.5	7716.2
Tablewares	1900.2	2149.5	2413.3	2691.2	2511.8	3375.8	3781.0	4234.7	4742.8	3952.4
GROSS SALES REVENUE	5640.0	6338.3	7104.7	7945.3	7415.7	9966.5	11162.6	12502.1	14002.3	11668.6
TAXES	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
NET TOTAL	5640.0	6338.3	7104.7	7945.3	7415.7	9966.5	11162.6	12502.1	14002.3	11668.6
Bottles	3739.8	4188.8	4691.4	5254.1	4903.8	6590.7	7381.6	8267.4	9259.5	7716.2
Tablewares	1900.2	2149.5	2413.3	2691.2	2511.8	3375.8	3781.0	4234.7	4742.8	3952.4
Total main products	5640.0	6338.3	7104.7	7945.3	7415.7	9966.5	11162.6	12502.1	14002.3	11668.6
Total by-products	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

amounts in thousand US $	11	12	13	14	15
Bottles	9259.5	9259.5	9259.5	9259.5	9259.5
Tablewares	4742.8	4742.8	4742.8	4742.8	4742.8
GROSS SALES REVENUE	14002.3	14002.3	14002.3	14002.3	14002.3
TAXES	.0	.0	.0	.0	.0
NET TOTAL	14002.3	14002.3	14002.3	14002.3	14002.3
Bottles	9259.5	9259.5	9259.5	9259.5	9259.5
Tablewares	4742.8	4742.8	4742.8	4742.8	4742.8
Total main products	14002.3	14002.3	14002.3	14002.3	14002.3
Total by-products	.0	.0	.0	.0	.0

****
* SALES REVENUE IN FOREIGN CURRENCY *
****

amounts in thousand US $	1	2	3	4	5	6	7	8	9	10
Bottles	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Tablewares	1179.5	1334.3	1498.1	1670.6	1559.2	2095.5	2347.0	2628.7	2944.1	2453.4
GROSS SALES REVENUE	1179.5	1334.3	1498.1	1670.6	1559.2	2095.5	2347.0	2628.7	2944.1	2453.4
T A X E S	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
N E T T O T A L	1179.5	1334.3	1498.1	1670.6	1559.2	2095.5	2347.0	2628.7	2944.1	2453.4
Bottles	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Tablewares	1179.5	1334.3	1498.1	1670.6	1559.2	2095.5	2347.0	2628.7	2944.1	[illegible]
Total main products	1179.5	1334.3	1498.1	1670.6	1559.2	2095.5	2347.0	2628.7	2944.1	2453.4
Total by-products	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

amounts in thousand US $	11	12	13	14	15
Bottles	.0	.0	.0	.0	.0
Tablewares	2944.1	2944.1	2944.1	2944.1	2944.1
GROSS SALES REVENUE	2944.1	2944.1	2944.1	2944.1	2944.1
T A X E S	.0	.0	.0	.0	.0
N E T T O T A L	2944.1	2944.1	2944.1	2944.1	2944.1
Bottles	.0	.0	.0	.0	.0
Tablewares	2944.1	2944.1	2944.1	2944.1	2944.1
Total main products	2944.1	2944.1	2944.1	2944.1	2944.1
Total by-products	.0	.0	.0	.0	.0

C. PLANT CAPACITY

PLANT CAPACITY FOR GLASS CONTAINERS AND TABLEWARES

The hereabove productions recorded in paragraph A.5. and B.5. will be realized with one IS6 machine single gob producing the bottles and one press single gob producing the tableware.

One single furnace will feed both lines, its pulled glass capacity will be 50 t. molten glass per day.

Pulled glass quantity

The amount of total glass pulled per annum depends on the size/weight of the glass articles produced.
For the proposed production program the pull glass amount at nominal efficiency (80 %) will be :

about 8,250 tons/y for containers
about 3,375 tons/y for tablewares.

Based on about 300 working days/y depending from the annual rate of production.
Production's time losses are mainly due to the size/weight (change of moulds at the forming machine) and colors changing in the producting program, the necessary maintenance and repair of machinery.

As explained before only a part of the pulled glass out of the furnace is transformed in saleable products. The efficiency is increasing year by year.
The difference of quantities of glass pulled out the furnace and the glass products saleable is recycled to the furnace (it is called cullet).

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Actually, the factory will work at full capacity as from the first year. However, we must remember that it will take time for the staff to become acquainted with the machines and technology concerned. That is why we have considered from 60 % a progressive yield in four years time to obtain a 80 % efficiency which is the average maximum to be considered.

This yield can vary according the precise design of the article and according to the quality of the production equipment involved in the process and to the skilness of the personnel.
In the developed countries this yield usually vary between a range from 80 % to 90 %.
In developing countries this range is wider, from 20-30 up to 80 %.
We have considered that the present project could reach progressively this yield of 80 % after 4 years of continuous smooth operation, only because of the magnitude of the assistance considered in the costing (training abroad and continuous training on site performed by the expatriated technical assistance).

III.3. TURNOVER

The turnover has been calculated with the following selling prices : Bottles : 0.8 U $/Kg
Tablewares : 1.6 U $/Kg.

The sold production during the four first years of production will be according the production program tables enclosed in the Chapter III.1. : Demand and Market Study.

At the end of the fifth year of production, we consider that the factory has to be stopped for refurbishing the furnace. Using this opportunity the furnace can be extended up to 90 T/day pull out to satisfy the doubling of the demand (see Market study).

From the sixth year of production, the rebuilded furnace will be able to feed the production lines working in double gob process allowing to follow the considered market increase of 12 % per annum. From that time the project becomes really profitable (refer to Sensitivity analysis).

At the end of the tenth year of production, the factory has to be stopped again to refurbish the furnace, the capacity of production will be unchanged at 90 T/day.

The maximum yearly production will therefore be achieved during the ninth year and it will be kept unchanged after each furnace further refurbishing (refer to Production schedule page).

This study being limited to the fifteen first years of production of the factory, we have not considered a third refurbishing of the furnace during the fifteen year.

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* TURNOVER *

amounts in thousand US $	1	2	3	4	5	6	7	8	9	10
Bottles	4943.1	6458.9	7750.7	9259.5	7716.2	9259.5	9259.5	9259.5	9259.5	7716.2
Tablewares	4103.5	5362.0	6434.4	7686.9	6405.8	7686.9	7686.9	7686.9	7686.9	6405.8
GROSS SALES REVENUE	9046.6	11820.9	14185.1	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4	14122.0
TAXES	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
NET SALES REVENUE										
in local currency	7474.9	9767.3	11720.7	14002.3	11668.6	14002.3	14002.3	14002.3	14002.3	11668.6
in foreign currency	1571.7	2053.6	2464.4	2944.1	2453.4	2944.1	2944.1	2944.1	2944.1	2453.4
NET TOTAL	9046.6	11820.9	14185.1	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4	14122.0
Bottles	4943.1	6458.9	7750.7	9259.5	7716.2	9259.5	9259.5	9259.5	9259.5	7716.2
Tablewares	4103.5	5362.0	6434.4	7686.9	6405.8	7686.9	7686.9	7686.9	7686.9	6405.8
Total main products	9046.6	11820.9	14185.1	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4	14122.0
Total by-products	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

amounts in thousand US $	11	12	13	14	15
Bottles	9259.5	9259.5	9259.5	9259.5	9259.5
Tablewares	7686.9	7686.9	7686.9	7686.9	7686.9
GROSS SALES REVENUE	16946.4	16946.4	16946.4	16946.4	16946.4
TAXES	.0	.0	.0	.0	.0
NET SALES REVENUE					
in local currency	14002.3	14002.3	14002.3	14002.3	14002.3
in foreign currency	2944.1	2944.1	2944.1	2944.1	2944.1
NET TOTAL	16946.4	16946.4	16946.4	16946.4	16946.4
Bottles	9259.5	9259.5	9259.5	9259.5	9259.5
Tablewares	7686.9	7686.9	7686.9	7686.9	7686.9
Total main products	16946.4	16946.4	16946.4	16946.4	16946.4
Total by-products	.0	.0	.0	.0	.0

IV. MATERIALS AND INPUT.

IV.1. RAW MATERIALS ANALYSES

1. RAW MATERIALS STANDARD SPECIFICATION

The specifications have been drawn up in order to meet the requirements of hollow glass manufacture (bottles and tablewares).

1.1. SAND

Chemical		(%)
SiO_2		99.5 min.
Al_2O_3		< 0.5 ± 0.1
Na_2		
K_2O		< 0.5 ± 0.1
CaO		
MgO		
Cr_2O_3		< 0.001
Fe_2O_3	(white)	0.022 ± 0.008
	(coloured)	0.200 ± 0.020
TiO_2		< 0.05
ZnO_2		< 0.01

Physical

The corresponding apertures for US mesh number and other systems are given in enclosed table.

Oversize on US 20	:		0	%
Oversize on US 30	:	max.	4	%
Oversize on US 40	:	max.	25	%
Undersize through US 140	:	max.	5	%

Heavy minerals

Those of refractory nature such as Cr_2O_3, ZnO_2, Al_2O_3, TiO_2 : smaller than 200 microns.

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COMPARISON OF STANDARD SERIES OF MESH SIEVES

The table below gives apertures, expressed in m/m for those larger than 1 m/m and in microns for those less than 1 m/m

U.S.A. and CANADA						GREAT BRITAIN					HOLLAND	GERMANY			FRANCE	
ASTM : B11-61 CANADA : 3-GR-1b			TAYLOR			I.M.M.		BS-410-62			N480-1952	DIN 1171		DIN 4188	AFNOR : NFX-11-501	
Mesh N°	Aperture in m/m	Aperture in m/m	Mesh N°	Aperture in m/m	Aperture in In.	Mesh N°	Aperture in m/m	Mesh N°	Aperture in m/m	Aperture in In.	Aperture in m/m	N°	Aperture in m/m	Aperture in m/m	N° module	Aperture in m/m
	8,00		2 1/2	8,00	0,312				9,53	3/8				8,00		
	6,35		3	6,73	0,263				6,35	1/4				6,30		
3 1/2	5,66	0,223	3 1/2	5,613	0,221								6,00			
4	4,76	0,187	4	4,699	0,185				4,76	3/16			5,00	5,00	38	5,000
5	4,00	0,157	5	3,962	0,156								4,00	4,00	37	4,000
6	3,36	0,132	6	3,327	0,131			5	3,35	0,132			3,00	3,15	36	3,150
7	2,83	0,111	7	2,794	0,110			6	2,80	0,1107					35	2,500
8	2,39	0,094	8	2,362	0,093	5	2,54	7	2,40	0,0949			2,50	2,50	34	2,000
10	2,00	0,079	9	1,991	0,078			8	2,00	0,0810				2,00	33	1,600
12	1,68	0,066	10	1,651	0,065			10	1,68	0,0660			2,00	1,60		
14	1,41	0,055	12	1,397	0,055	8	1,574	12	1,40	0,0553		4	1,50	1,25	32	1,250
16	1,19	0,047	14	1,168	0,046	10	1,270	14	1,20	0,0474		5	1,20			
18	1,00	0,039	16	0,991	0,039	12	1,056	16	1,00	0,0395		6	1,00	1,00	31	1,000
20	841	0,0331	20	833	0,0328			18	850	0,0336	850			800	30	800
25	707	0,0280	24	701	0,0276	16	792	22	710	0,0275	710	8	750	630	29	630
30	595	0,0232	28	589	0,0232	20	635	25	600	0,0236	600	10	600	500	28	500
35	500	0,0197	32	495	0,0195			30	500	0,0197	500	12	500	400	27	400
40	420	0,0165	35	417	0,0164	30	421	36	420	0,0166	420	14	430	315	26	315

COMPARISON OF STANDARD SERIES OF MESH SIEVES

The table below gives apertures, expressed in m/m for those larger than 1 m/m and in microns for those less than 1 m/m

U.S.A. and CANADA						GREAT BRITAIN					HOLLAND	GERMANY			FRANCE	
ASTM : B11-61 CANADA : 3-GR-1b			TAYLOR			I.M.M.		BS-410-62			N480-1952	DIN 1171		DIN 4188	AFNOR : NFX-11-501	
Mesh N°	Aperture in m/m	Aperture in m/m	Mesh N°	Aperture in m/m	Aperture in In.	Mesh N°	Aperture in m/m	Mesh N°	Aperture in m/m	Aperture in In.	Aperture in m/m	N°	Aperture in m/m	Aperture in m/m	N° module	Aperture in m/m
45	354	0,0138	42	351	0,0138	40	347	44	355	0,0139	350	16	400	250	25	250
50	297	0,0117	48	295	0,0116			52	300	0,0116	300	20	300	200	24	200
60	250	0,0098	60	246	0,0097	50	254	60	250	0,0099	250	24	250	160	23	100
70	210	0,0083	65	208	0,0082	60	211	72	210	0,0083	210	30	200	125	22	125
80	177	0,0070	80	175	0,0069	70	180	85	180	0,0070	175			100	21	100
100	149	0,0059	100	147	0,0058	80	157	100	150	0,0060	150	40	150	90		
						90	139	120	125	0,0049	125			80	20	80
120	125	0,0049	115	124	0,0049	100	127	150	105	0,0041	105	50	120	71		
140	105	0,0041	150	104	0,0041	120	107	170	90	0,0035	90	60	100	63	19	63
170	88	0,0035	170	89	0,0035	150	84	200	75	0,0030	75	70	90	56		
200	74	0,0029	200	74	0,0029							80	75			
230	63	0,0024	250	61	0,0024	200	63	240	63	0,0026	60	100	60	50	18	50
270	53	0,0021	270	53	0,0021			300	53	0,0021	50			45		
325	44	0,0017	325	43	0,0017			350	45					40	17	40
400	37							400	37							

1.2. SODA ASH

Chemical

Na_2O	: min.	58	%
NaCl	: max.	0.3	%
Na_2SO_4	: max.	0.03	%

Physical

Oversize on US 20	:	0	%
Oversize on US 30	: max.	5	%
Undersize through US 170	: max.	5	%

1.3. LIMESTONE AND DOLOMITE

Chemical

For white glass

$SiO_2 - Al_2O_3$	: stable at ±	0.5	%
CaO - MgO	: stable at ±	0.3	%
Fe_2O_3	: max.	0.1	%
Cr_2O_3	: max.	0.001	%

For coloured glass

Same specifications as those for white glass except for Fe_2O_3 which may reach max. 0.25 % provided that the stability of the Fe_2O_3 content is guaranteed at ± 0.05 %.

Physical

Oversize on US 8	:	0	%
Oversize on US 20	: max.	20	%
Undersize through US 170	: max.	10	%

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1.4. FELDSPAR

Chemical

For white glass

SiO_2	:	max.	67	%
Al_2O_3	:	min.	16	%
$Na_2O + K_2O$	:	min.	9	%
$CaO + MgO$	:	max.	2	%
TiO_2	:	max.	0.3	%
$SiO_2 - Al_2O_3 - CaO - Na_2O - K_2O$	:	stable at ±	0.5	%
Fe_2O_3	:	max.	0.15	%
Cr_2O_3	:	max.	0.001	%

For coloured_glass

Same specifications as those for white glass except for Fe_2O_3 which may reach max. 0.35 % on condition that it is stable at ± 0.05 %.

Physical

Oversize on US 20	:		0	%
Oversize on US 30	:	max.	0.1	%
Undersize through US 200	:	max.	15	%

1.5. BARIUM SULPHATE

Chemical

$BaSO_4$	:	min.	95	%
Fe_2O_3	:	max.	0.2	%
SiO_2, Al_2O_3	:	max.	5	%
CaO, MgO	:	max.	5	%

Physical

Oversize on US 35	:		0	%
Undersize through US 400	:	max.	80	%

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1.6. SODIUM NITRATE

Chemical

$NaNO_3$	: min.	99.5	%
$NaNO_2$	: max.	0.05	%
Fe_2O_3	: max.	0.003	%
NaCl	: max.	0.20	%

Physical

Oversize on US 30	: min.	90	%
Undersize through US 6	:	100	%

1.7. ANHYDROUS BORAX (Trade home PYROBOR or DEHYBOR)

Chemical

$Na_2B_4O_7$	: min.	99.5	%
SO_3	: max.	0.05	%

Physical

Undersize through US 200	: max.	10	%

1.8. ANTIMONIOUS OR ARSENIOUS ANHYDRIDE

Chemical

Sb_2O_3, $A_{s2}O_3$	: min.	99	%

Physical

These products are generally supplied in the form of powder. Various grain sizes can be obtained on the market ; the main thing is to keep grain size constant.

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1.9. SELENIUM

Chemical

Selenium	:	min.	99 %

Physical

These products are generally supplied in the form of powder. Various grain sizes can be obtained on the market ; the main thing is to keep grain size constant.

1.10. COBALT OXIDE

Chemical

Cobalt oxide	:		71 %

Physical

These products are generally supplied in the form of powder. Various grain sizes can be obtained on the market ; the main thing is to keep grain size constant.

1.11. PYRITE

Chemical

FeS_2	:	min.	90 %
	but stable at ± 1.5 % of the average		
Fe_2O_3	:	min.	60 %
	but stable at ± 1 % of the average		

Physical

Oversize on US 20	:		0 %
Oversize on US 30	:	max.	1 %
Undersize through US 200	:	max.	4 %.

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2. SAND

2.1. ENTEBBE DEPOSITS

One sample has been analyzed by Geoconsult in their feasibility study for a flat glass plant in 1982. This sample was collected from Kigungu Beach, which was reported to have the best sand in that region.

L.O.I. 1000 ° C	:	0.14
SiO_2	:	99.6
Al_2O_3	:	0.03
Fe_2O_3	:	0.09
TiO_2	:	0.01
MgO	:	0.01
CaO	:	0.06
K_2O	:	0.00
Na_2O	:	0.00
MnO	:	0.00
P_2O_5	:	0.01
SO_3	:	0.00
ZnO	:	0.00
Bao	:	0.00
Cr_2O_3	:	0.00

The granulometry stands within a range of 0.27 - 0.81 mm, with a mean grain size of 0.55 mm.
Other deposits have been studied by J.W. Barnes in 1961.

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Physical analyses

In %	+ 16 mesh	- 16+ 25 mesh	- 25+ 36 mesh	- 36+160 mesh	-100+120 mesh	- 120 mesh
Aerodrome Beach	0.3	2.6	21.8	72.5	1.2	1.4
Beach near swimming pool	2	16.7	21.7	58.8	0.4	0.2
Hydrological Beach	0.6	0.7	2.8	90.4	2.5	3
Bendigere Beach	0.2	1.7	23.4	73.7	0.5	0.2

Chemical analyses

In %	SiO_2	Fe_2O_3	Al_2O_3	TiO_2	CaO	MgO	L.O.I.
Aerodrome Beach	99.5	0.13	0.05	0.11	trace	trace	0.14
Aerodrome Beach	99.91	0.02	-	-	trace	-	0.06
Bendigere Beach	97.94	0.3	0.86	0.01	0.09	0.03	0.38
Near Bugongo Point	98.24	0.51	0.75	0.10	0.10	0.03	0.16

Although a high percentage of Fe_2O_3, the Entebbe deposits could be treated and used for a glass industry.
However, we have been told that these beaches being close to the airport, it is not allowed to quarry in this area.

2.2. BUKAKATA DEPOSITS

This deposit was previously used by East African Glassworks (Kampala) who gave the following analyses :

Chemical analyses

Loss on ignition	0.17 %
SiO_2	99.20
Al_2O_3	0.16
Fe_2O_3	0.29
CaO	-
MgO	-
K_2O	0.04

Physical analyses

Fraction in mm Ø		weight %
	+ 0.80	-
- 0.80	+ 0.60	1.0
- 0.60	+ 0.50	0.8
- 0.50	+ 0.40	3.4
- 0.40	+ 0.33	19.0
- 0.33	+ 0.28	46.8
- 0.28	+ 0.15	26.4
- 0.15	+ 0.10	2.4
- 0.10		0.2

Other analyses have been realized by the Economic Technical Department, T.N.O., Netherlands in 1971 ("Investigation on feasibility of establishing a plant for production of sheet glass within E.A.C.").

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Physical analyses

Retained by sieve opening (after passing the preeceeding one)		Sample Serial Numbers				
		27003 B	27007 A	27007 B	27007 C	27007 D
2.0 mm	(10 mesh)	-	-	-	-	-
1.0 mm	(18 mesh)	0.24 %	0.03 %	-	0.48 %	0.10 %
0.841 mm	(20 mesh)	0.15 %	0.15 %	0.03 %	1.61 %	0.10 %
0.5 mm	(35 mesh)	0.94 %	7.86 %	1.17 %	33.28 %	10.76 %
0.315 mm	(48 mesh)	22.31 %	33.34 %	18.95 %	53.35 %	77.51 %
0.25 mm	(60 mesh)	30.16 %	27.55 %	26.22 %	8.83 %	9.84 %
0.2 mm	(73 mesh)	27.25 %	21.85 %	31.31 %	2.10 %	1.50 %
0.125 mm	(120 mesh)	18.766%	9.16 %	21.96 %	0.32 %	0.19 %
0.10 mm	(140 mesh)	0.15 %	0.05 %	0.21 %	0.03 %	-
0.09 mm	(170 mesh)	0.04 %	0.01 %	0.03 %	-	-
0.071 mm	(200 mesh)	-	-	0.03 %	-	-
Sample Size		53 g	87 g	33 g	31 g	30 g

Chemical analyses

Oxide	Sample Serial Numbers				
	27003 B	27007 A	27007 B	27007 C	27007 D
SiO_2	98.9 %	99.2 %	99.0 %	99.3 %	99.2 %
Fe_2O_3	0.101% (0.10)	0.035% (0.03)	0.027% (0.04)	0.030% (0.04)	0.086% (0.14)
Al_2O_3	0.21 %	0.11 %	0.07 %	0.09 %	0.07 %
Na_2O	trace	trace	trace	trace	trace
K_2O	0.01 %	0.01 %	0.01 %	0.01 %	0.01 %
TiO_2	0.030%	0.011%	0.011%	0.009%	0.009%
PbO	(0.01)	(0.01)	(0.02)	(0.01)	(0.05)
MgO	(0.01)	(0.013)	(0.017)	(0.05)	(0.05)
Cu_2O_3	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
CaO	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
L.O.I. 1000 ° C	0.20	0.19	0.29	0.16	0.22

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At last one sample has been analyzed by Geoconsult in 1982 ("Feasibility study for a flat glass plant").

L.O.I. 1000 ° C	:	0.19
SiO_2	:	99.2
Al_2O_3	:	0.15
Fe_2O_3	:	0.2
TiO_2	:	0.04
MgO	:	0
CaO	:	0.02
K_2O	:	0.01
Na_2O	:	0
MnO	:	0
P_2O_5	:	0
SO_3	:	0.02
ZnO	:	0
BaO	:	0
Cr_2O_3	:	0.

The granulometry stands within a range of 0.2 - 0.56 mm, with a mean grain size of 0.4 mm.

This deposit was promising for the glass industry.

However, the report ASBD/20 of the Geological Survey and Mines Department written by M. BAZAALE-DOLO A.S. in December 1988 stated as follows :

"The sand which used to form a peninsula is now an island. The murrum road from Masaka having been washed away. A concrete causeway is reported to be in a state of disrepair with the last 30 yards of the causeway to the island having been submerged about 3 feet which means access to the island will require reconstruction of the causeway."

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2.3. KOME ISLANDS DEPOSITS

This deposit was previously used by East African Glasswcrk (Kampala) who gave the following analyses :

Chemical analyses

		Normal %
SiO_2	:	99.56
Al_2O_3	:	0.05
Fe_2O_3	:	0.056
Cao	:	-
Mgo	:	-
K_2O	:	0.03
p.c.	:	0.23
Organic matter	:	Same trace.

Physical analyses

Fraction in mm			Weight %
0.80			0
0.6	-	0.8	0
0.5	-	0.6	0
0.4	-	0.5	3.0
0.3	-	0.4	50.80
0.2	-	0.3	40.40
0.15	-	0.28	5.40
0.10	-	0.15	0.40
0.10			0.0

The Federal Institute for Technical Assistance - Yugoslavia, 1978 ("Feasibility study for manufacturing of sheet glass in Uganda") gave the following analyses :

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Chemical analyses

		Normal %
SiO_2	:	99.56
Al_2O_3	:	0.05
Fe_2O_3	:	0.056
Cao	:	-
Mgo	:	-
K_2O	:	0.03
L.O.I.	:	0.23

Physical analyses

Fraction in mm		Weight %
	+ 0.50	-
- 0.50	+ 0.40	3.0
- 0.40	+ 0.30	40.40
- 0.30	+ 0.20	50.80
- 0.20	+ 0.15	5.40
- 0.15	+ 0.10	0.40
- 0.10		0.00

Geoconsult - 1982 (Feasibility study for a flat glass plant") gave the following analyses :

L.O.I. 1000 ° C	:	0.15
SiO_2	:	99.4
Al_2O_3	:	0.06
Fe_2O_3	:	0.04
TiO_2	:	0.01
MgO	:	0.00
CaO	:	0.02
K_2O	:	0.01
Na_2O	:	0.03
MnO	:	0.00
P_2O_5	:	0.00

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SO_3	:	0.03
ZnO	:	0.00
BaO	:	0.00
Cr_2O_3	:	0.00

The granulometry stands within a range of 0.25 - 0.9 mm, with a mean grain size of 0.46 mm.

As a conclusion, this deposit was also quite promising, like the Bukakata deposit, but the Geological Survey and Mines Department (Report ASBD/20 - M. BAZAALE-DOLO - December 1988) stated as follows : "The former beach on which East African Glassworks were depending for supplies is under water. A new storm beach has been built up higher than the former beach. The storm beach is largely made up of quartzite cobbles but there is a section in the centre made of sand. This sand contains appreciable quantities of iron (about 1 - 5 %). Above tne water level, sand is of insufficient quantity or quality for exploitation."

2.4. NYIMU BAY DEPOSIT

This deposit has been studied by J.W. BARNES in 1961.

Physical analyses

+ 16 mesh	nil
- 16 + 25 mesh	0.2 %
- 25 + 36 mesh	0.9 %
- 36 + 100 mesh	90.3 %
- 100 + 120 mesh	5.8 %
- 120 mesh	2.5 %

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Chemical analyses

SiO_2	99.17 %
Fe_2O_3	0.05 %
Al_2O_3	0.06 %
TiO_2	0.02 %
CaO	0.11 %
MgO	0.01 %
L.O.I.	0.4 %

The Geological Survey and Mines Department (Report ASBD/20 - M. BAZAALE-DOLO - December 1988) reported however, that the reserves of this deposit is only 5,000 tons which is far too low to start quarrying for the glass industry.

2.5. NALUMULI BAY DEPOSIT

The access to Nalumuli Bay from either Nkokonjeru or Ngogwe is by following the southern track up to Gaba. Then, taking a rough track South East from Gaba to Nalumuli Bay. The total distance from Kampala is 36 miles.

This deposit has been studied by J.W. Barnes in 1961.

Physical analyses

+ 16 mesh	trace
- 16 + 25 mesh	0.2 %
- 25 + 36 mesh	7.7 %
- 36 + 100 mesh	91.6 %
- 100 + 120 mesh	0.4 %
- 120 mesh	0.1 %

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Chemical analyses

SiO_2	99 %
Fe_2O_3	0.29 %
Al_2O_3	0.26 %
TiO_2	0.03 %
CaO	0.14 %
MgO	-
L.O.I.	0.13 %

The Geological Survey and Mines Department (Report ASBD/20 - M. BAZAALE-DOLO - December 1988) reported that the reserves of this deposit is only 200,000 tons. The Fe_2O_3 content of this sand is far too high to produce flint or even half flint glass. However, we believe it could be suitable for producing coloured glass. For an annual requirement of such a sand of about 2,500 tons per year, the deposit quantity should be far sufficient for the glass factory's life.

Our own analyses on this sand are as follows :

Physical analyses

	Sample Serial Numbers			
	1		2	
	Analyse 1 1	Analyse 1 2	Analyse 2 1	Analyse 2 2
+ 2 mm	0	0.1 %	0	0
- 2 mm + 1 mm	0.1 %	0.1 %	0	0.1 %
- 1 mm + 0.5 mm	0.5 %	0.4 %	0.4 %	0.4 %
- 0.5 mm + 0.25 mm	54.7 %	51.5 %	56.1 %	54.8 %
- 0.25 mm + 0.125 mm	44.2 %	47.2 %	42.9 %	44.2 %
- 0.125 mm + 0.063 mm	0.5 %	0.5 %	0.5 %	0.4 %
- 0.063 mm + 0.04 mm	0	0.1 %	0	0
- 0.04 mm	0	0	0	0

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<u>Chemical analyses</u> (Datas in weight - %)

	Sample Serial Numbers	
	1	2
SiO_2	98.36	98.23
Al_2O_3	0.231	0.221
Fe_2O_3	0.346	0.341
Cr_2O_3	0.003	0.004
CaO	0.014	0.011
MgO	0.016	0.014
TiO	0.09	0.11
Na_2O	0.007	0.019
K_2O	0.037	0.038
Carbon	0.203	0.421
Glowing loss	0.69	0.59
Remaindered Moisture	2.79	3.11

Although the granulometry curve is ideal for the glass industry, the Fe_2O_3 content of this sand is too high, even for a coloured glass production. A simple washing of this sand will most probably allow to reduce this Fe_2O_3 content up to a level acceptable for an amber and green glass production.

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2.6. DIIMU DEPOSIT

Diimu is located about 40 km South of Masaka on the shore of Lake Victoria. The beach deposit has a length of approximately 8 km, a width of 35 m and a thickness of 1 m. The first 2.5 km only of this deposit contains 100,000 T of sand.

A second, known as "Old Deposit", is located 90 m from the lake and has a length of 2 1/2 km and a width of 90 m. Both glass sand areas, with the exception of the beach, are covered with short grass and forest.

In the "Old Deposit" the fine sands are found at 3 ft. depth. From the surface down to 3 ft., the sand is coarse and mixed with black soil.

2.6.1. Geological survey analyses

The 6.5 first km of this deposit have been studied by the Geological Survey and Mines Department by their reports written by M.E. MUKINDA in October 1972 (Report EM/1) and in May 1973 (Report EM/2).

Extracts of these reports are resumed herebelow :

2.6.1.1. Physical analyses

(Samples A = New deposit , 5 m from the lake)
(Samples B = New deposit , 30 m from the lake)
(Samples C = Old deposit).

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SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1187

Sample Nos	1 A	2 A	3 A	4 A	5 A	6 A	7 A	8 A	9 A	10 A	11 A	12 A	13 A
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	0.02	0.02	Nil	0.02	Nil	Nil	0.02	Nil	Trace	Trace	0.22	Nil	Trace
- 16 + 25 mesh	0.04	0.24	0.02	0.08	0.24	0.02	0.40	0.02	0.04	0.18	1.40	0.02	0.02
- 25 + 36 mesh	0.52	1.20	0.42	0.92	0.24	0.22	1.48	0.18	0.48	1.70	3.36	0.22	0.16
- 36 + 100 mesh	95.24	97.10	98.46	98.18	97.70	98.82	97.18	98.36	98.48	96.96	94.66	98.70	98.58
- 100 + 120 mesh	3.06	1.20	0.80	0.60	0.62	0.92	0.76	1.04	0.80	0.80	0.28	1.68	1.10
- 120 mesh	1.12	0.24	0.30	0.20	0.20	0.02	0.16	0.40	0.20	0.36	0.08	0.38	0.14
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	14 A	15 A	16 A	17 A	18 A	19 A	20 A	21 A	22 A	23 A	24 A	25 A	26 A
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	0.04	0.08	Nil	0.04	0.02	Nil	0.18	Nil	Nil	0.02	Trace	0.02	0.02
- 16 + 25 mesh	0.10	0.76	0.32	0.36	0.12	0.02	1.24	0.02	0.02	0.46	0.02	0.06	0.06
- 25 + 36 mesh	0.84	1.10	3.76	2.38	0.80	0.40	4.50	0.24	0.20	6.16	0.40	1.00	0.64
- 36 + 100 mesh	98.28	97.58	95.60	97.12	96.66	99.02	93.60	99.18	99.00	93.28	98.88	98.88	99.12
- 100 + 120 mesh	0.66	0.40	0.28	0.06	1.78	0.48	0.42	0.48	0.66	0.06	0.60	0.02	0.14
- 120 mesh	0.08	0.08	0.06	0.04	0.62	0.08	0.06	0.08	0.12	0.02	0.10	0.02	0.02
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

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<u>SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1187</u>

Sample Nos	27 A	28 A	29 A	30 A	31 A	32 A	33 A	34 A	35 A	36 A	37 A	38 A	39 A
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	1.26	0.02	0.22	Trace	0.02	0.14	2.04	1.14	2.20	11.62	0.48	0.26	0.20
- 16 + 25 mesh	5.56	0.08	0.92	0.08	0.16	1.52	6.30	8.86	5.80	19.36	2.52	0.92	0.84
- 25 + 36 mesh	15.60	1.08	3.60	1.18	1.96	18.00	20.48	30.20	28.20	31.70	16.16	19.88	10.48
- 36 + 100 mesh	77.52	98.54	95.20	98.60	97.74	80.30	71.10	59.78	63.74	37.30	80.78	78.88	88.42
- 100 + 120 mesh	0.04	0.24	0.04	0.12	0.08	0.02	Trace	Trace	Trace	Trace	0.02	0.02	0.04
- 120 mesh	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02	0.06	0.02	0.04	0.04	0.02
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	40 A	41 A	42 A	43 A	44 A	45 A	46 A	47 A	48 A	49 A	50 A	51 A	52 A
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	0.02	0.08	0.10	0.28	0.34	0.12	0.08	0.02	0.34	0.98	0.30	1.44	13.48
- 16 + 25 mesh	0.26	1.24	0.26	0.08	0.92	0.74	1.00	0.50	0.82	3.04	1.06	2.25	16.48
- 25 + 36 mesh	7.04	41.80	3.84	14.20	17.40	34.28	28.78	51.44	27.92	35.76	27.24	40.30	45.16
- 36 + 100 mesh	92.59	56.82	95.72	84.66	81.28	64.82	70.08	47.98	70.88	60.16	71.36	55.70	24.42
- 100 + 120 mesh	9.06	0.04	0.06	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.02
- 120 mesh	0.04	0.02	0.02	0.02	0.04	0.04	0.02	0.02	0.04	0.02	0.04	0.02	0.04
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1187

Sample Nos	1 B	2 B	3 B	4 B	5 B	6 B	7 B	8 B	9 B	10 B	11 B	12 B	13 B
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	0.12	0.02	Trace	0.02	Nil	0.02	0.02	Nil	0.14	0.32	0.06	0.12	0.04
- 16 + 25 mesh	0.82	0.16	0.28	0.08	0.06	0.26	0.30	0.20	1.00	2.68	1.44	0.60	0.46
- 25 + 36 mesh	3.84	0.58	1.62	0.42	0.30	1.30	3.82	0.80	3.06	4.26	8.16	2.86	2.96
- 36 + 100 mesh	94.66	97.96	96.94	98.76	98.76	97.52	94.58	98.12	95.42	92.36	90.14	96.02	96.02
- 100 + 120 mesh	0.44	1.04	0.92	0.62	0.76	0.74	1.02	0.50	0.34	0.32	0.14	0.32	0.36
- 120 mesh	0.12	0.24	0.24	0.10	0.12	0.16	0.26	0.38	0.04	0.06	0.04	0.08	0.08
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	14 B	15 B	16 B	17 B	18 B	19 B	20 B	21 B	22 B	23 B	24 B	25 B	26 B
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	0.02	2.54	0.48	0.46	Nil	2.48	0.64	0.22	2.44	10.22	0.80	0.12	0.50
- 16 + 25 mesh	0.38	9.92	2.54	1.80	0.64	6.86	4.98	2.32	7.44	30.42	3.56	0.76	3.42
- 25 + 36 mesh	1.70	24.14	9.08	4.92	2.94	24.68	20.80	9.62	14.90	23.60	21.22	4.08	16.92
- 36 + 100 mesh	96.94	63.14	87.76	92.44	95.96	65.66	73.40	87.16	74.68	35.64	73.72	94.74	78.96
- 100 + 120 mesh	0.76	0.18	0.08	0.30	0.38	0.24	0.14	0.54	0.42	0.06	0.62	0.24	0.16
- 120 mesh	0.20	0.08	0.06	0.08	0.08	0.08	0.04	0.14	0.12	0.06	0.08	0.06	0.04
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

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SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1187

Sample Nos	27 B	28 B	29 B	30 B	1 C	2 C	3 C	4 C	5 C	6 C	7 C	8 C	9 C
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	2.40	8.86	3.84	4.74	3.34	6.04	13.16	18.00	1.10	3.90	44.62	47.64	23.20
- 16 + 25 mesh	13.34	18.72	19.32	22.44	1.08	1.30	3.46	3.84	1.32	3.28	17.30	6.60	3.83
- 25 + 36 mesh	25.00	23.76	41.42	38.08	1.20	0.94	2.54	3.32	2.70	6.02	14.38	7.90	4.60
- 36 + 100 mesh	58.86	48.30	35.26	34.58	88.32	90.02	79.76	74.10	94.08	86.02	22.86	36.76	62.92
- 100 + 120 mesh	0.28	0.28	0.10	0.12	3.86	1.26	0.72	0.40	0.54	0.40	0.32	0.32	3.30
- 120 mesh	0.12	0.08	0.06	0.04	2.20	0.44	0.36	0.34	0.26	0.38	0.32	0.78	2.02
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	1 D	40 D
Weight reporting	%	%
Size fraction		
+ 16 mesh	0.42	7.00
- 16 + 25 mesh	0.76	5.08
- 25 + 36 mesh	1.32	19.66
- 36 + 100 mesh	95.18	67.26
- 100 + 120 mesh	1.66	0.56
- 120 mesh	0.66	0.44
Total products	100.00	100.00

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SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1204

Sample Nos	53 A	54 A	55 A	56 A	57 A	58 A	59 A	60 A	61 A	62 A	31 B	32 B
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction												
+ 16 mesh	2.06	0.76	0.60	0.58	0.42	0.48	0.26	1.14	0.20	0.54	3.48	1.14
- 16 + 25 mesh	5.28	4.32	2.42	2.60	2.14	1.24	1.92	3.34	0.94	4.60	13.96	3.46
- 25 + 36 mesh	32.98	43.82	47.04	41.92	47.84	35.22	48.42	36.96	14.30	56.50	31.20	20.08
- 36 + 100 mesh	59.60	51.00	49.86	54.80	49.54	62.86	49.24	58.42	84.36	38.26	50.68	75.16
- 100 + 120 mesh	0.04	0.04	0.02	0.02	0.02	0.12	0.08	0.06	0.12	0.04	0.60	0.12
- 120 mesh	0.04	0.06	0.06	0.08	0.04	0.08	0.08	0.08	0.08	0.06	0.08	0.04
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	33 B	34 B	35 B	36 B	37 B	38 B	39 B	40 B	41 B	42 B	43 B	44 B	45 B
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	0.06	0.64	4.94	0.80	0.56	0.84	1.00	0.42	1.82	1.96	1.14	1.04	0.48
- 16 + 25 mesh	1.86	3.60	19.66	2.02	1.52	3.78	2.30	0.96	5.94	7.64	3.74	4.40	1.76
- 25 + 36 mesh	15.72	20.58	37.72	18.16	16.80	21.80	23.70	24.38	42.18	36.42	34.06	29.62	20.80
- 36 + 100 mesh	81.54	74.10	37.20	78.68	80.88	73.12	72.78	74.08	49.90	53.88	60.88	64.68	76.74
- 100 + 120 mesh	0.24	0.98	0.38	0.30	0.20	0.42	0.20	0.14	0.14	0.06	0.12	0.22	0.20
- 120 mesh	0.04	0.10	0.10	0.04	0.04	0.04	0.02	0.02	0.02	0.04	0.06	0.04	0.02
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1204

Sample Nos	46 B	47 B	48 B	49 B	50 B	51 B	52 B	xxxxxxxx	10 C	11 C	12 C	13 C	14 C
Weight reporting	%	%	%	%	%	%	%	xxxxxxxx	%	%	%	%	%
Size fraction								xxxxxxxx					
+ 16 mesh	7.16	0.36	0.32	0.58	2.32	4.88	0.08	xxxxxxxx	4.70	12.60	59.16	2.60	13.62
- 16 + 25 mesh	13.74	3.56	1.76	3.18	6.06	12.48	3.06	xxxxxxxx	0.76	1.78	16.82	0.90	1.44
- 25 + 36 mesh	29.74	25.88	19.30	20.38	24.70	30.00	31.14	xxxxxxxx	0.88	1.18	13.10	1.04	1.26
- 36 + 100 mesh	48.98	69.78	78.36	75.66	66.74	52.48	64.80	xxxxxxxx	86.80	76.88	10.52	88.96	79.12
- 100 + 120 mesh	0.32	0.36	0.18	0.12	0.14	0.12	0.16	xxxxxxxx	5.30	5.32	0.28	5.08	3.34
- 120 mesh	0.06	0.06	0.08	0.08	0.04	0.04	0.04	xxxxxxxx	1.56	2.24	0.12	1.42	1.22
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	xxxxxxxx	100.00	100.00	100.00	100.00	100.00

Sample Nos	15 C	16 C	17 C	18 C	19 C	20 C	21 C	22 C	23 C	24 C	25 C	26 C	27 C
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	21.02	1.82	3.46	30.18	1.40	1.68	15.18	0.52	3.70	30.66	2.26	8.38	33.02
- 16 + 25 mesh	6.44	0.58	0.64	4.40	0.54	0.50	3.98	0.48	0.64	4.24	0.64	0.54	2.94
- 25 + 36 mesh	5.84	0.60	0.70	5.18	0.74	0.68	5.12	0.72	0.76	5.00	0.90	0.50	2.94
- 36 + 100 mesh	61.04	91.36	91.32	54.38	90.74	93.22	70.14	93.38	90.44	56.24	92.04	83.92	57.90
- 100 + 120 mesh	5.54	4.74	3.14	4.12	5.34	3.12	3.92	4.02	3.66	2.78	3.66	5.50	2.12
- 120 mesh	0.12	0.90	0.74	1.74	1.24	0.80	1.66	0.88	0.80	1.08	0.50	1.16	1.08
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

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SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1204

Sample Nos	28 C	29 C	30 C	31 C	32 C	33 C	34 C	35 C	36 C	37 C	38 C	39 C	40 C
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	1.28	7.04	18.80	2.04	6.30	17.38	1.80	3.58	14.38	1.34	6.04	28.86	2.50
- 16 + 25 mesh	0.66	0.90	3.50	0.90	0.80	6.36	1.02	0.72	8.64	0.48	0.74	9.30	1.16
- 25 + 36 mesh	0.76	0.70	6.46	1.24	0.76	7.88	1.44	0.80	10.06	0.76	0.72	9.22	1.88
- 36 + 100 mesh	90.94	87.74	68.08	90.70	90.24	64.10	91.18	91.90	63.06	93.04	89.02	50.00	89.74
- 100 + 120 mesh	5.24	2.94	2.52	4.42	1.56	2.80	3.72	2.42	2.52	3.66	2.82	1.44	3.98
- 120 mesh	1.12	0.68	0.64	0.70	0.34	1.48	0.84	0.58	1.34	0.72	0.66	0.18	0.74
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	41 C	42 C	43 C	44 C	45 C	46 C	47 C	48 C	49 C	50 C	51 C	52 C	53 C
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	10.68	26.72	2.34	8.28	37.06	0.82	10.10	40.50	0.86	15.08	29.98	23.24	10.22
- 16 + 25 mesh	0.94	7.74	1.78	1.02	6.56	0.54	1.46	9.10	0.42	1.36	10.14	2.74	1.18
- 25 + 36 mesh	1.06	9.98	3.60	0.92	6.86	0.84	1.42	10.12	0.68	1.24	15.74	3.38	1.24
- 36 + 100 mesh	85.20	53.10	88.02	87.56	47.86	94.44	85.34	38.16	94.72	80.20	41.50	87.10	85.86
- 100 + 120 mesh	1.72	1.28	2.96	1.84	0.78	2.86	1.26	0.98	2.80	1.72	1.02	2.98	1.24
- 120 mesh	0.40	1.18	0.40	0.38	0.88	0.50	0.42	1.14	0.52	0.40	1.62	0.56	0.26
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1204

Sample Nos	54 C	55 C	56 C	57 C	58 C	59 C	60 C	61 C	62 C	63 C	64 C	65 C	66 C
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	43.24	1.30	11.62	25.64	1.50	11.00	27.10	3.96	17.98	30.56	1.22	7.66	26.26
- 16 + 25 mesh	8.30	0.84	1.58	11.08	1.00	2.12	10.52	1.14	3.10	15.90	0.60	2.50	15.28
- 25 + 36 mesh	11.42	1.04	1.56	16.46	1.54	2.06	16.88	2.20	3.30	21.70	0.98	2.60	16.80
- 36 + 100 mesh	34.94	93.68	83.60	44.76	92.28	83.38	41.32	84.00	70.52	29.82	92.92	85.84	36.66
- 100 + 120 mesh	0.90	2.70	1.30	0.90	3.18	1.18	2.16	8.34	4.98	1.40	3.72	1.18	2.72
- 120 mesh	1.20	0.44	0.34	1.16	0.50	0.26	1.42	0.36	0.12	0.62	0.56	0.22	2.28
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	67 C	68 C	69 C	70 C	71 C	72 C	73 C	74 C	75 C	76 C	77 C	78 C	79 C
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	0.72	8.66	30.24	1.88	8.50	29.22	2.56	15.74	26.96	1.44	13.66	32.92	1.66
- 16 + 25 mesh	0.52	2.02	18.74	1.04	2.30	16.28	1.80	2.40	15.86	0.58	2.70	14.68	0.72
- 25 + 36 mesh	0.84	2.02	21.02	1.42	2.46	17.70	2.88	2.24	18.96	0.78	2.12	17.22	1.26
- 36 + 100 mesh	93.66	85.94	27.26	91.84	85.44	32.84	88.42	78.80	33.64	92.62	79.86	30.50	92.94
- 100 + 120 mesh	3.64	1.10	1.42	3.28	1.02	2.06	3.60	0.70	2.34	3.94	1.28	2.72	2.94
- 120 mesh	0.62	0.26	1.32	0.54	0.28	1.90	0.74	0.12	2.24	0.64	0.38	1.96	0.48
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

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SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1204

Sample Nos	80 A	81 A	82 A	83 A	84 A	85 A	86 C	87 C	88 C	89 C	90 C	91 C	92 C
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	9.54	25.94	1.84	12.32	44.94	2.10	12.06	46.16	2.20	22.88	2.40	15.54	6.92
- 16 + 25 mesh	2.26	15.96	1.56	2.82	9.28	1.32	3.44	11.80	1.46	13.86	1.34	9.14	3.40
- 25 + 36 mesh	1.88	19.44	2.26	2.42	8.62	1.90	2.92	11.06	2.18	16.44	1.42	15.16	3.68
- 36 + 100 mesh	84.14	33.66	90.58	81.34	33.80	89.76	80.42	29.12	91.06	44.18	90.52	58.88	83.78
- 100 + 120 mesh	1.78	3.08	3.20	0.84	1.26	4.32	0.90	1.30	2.72	1.80	3.90	0.78	1.84
- 120 mesh	0.40	1.92	0.56	0.26	2.10	0.60	0.26	0.56	0.38	0.84	0.42	0.50	0.38
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	119 C	120 C	121 C	122 C	123 C	124 C	125 C	126 C	127 C	128 C	129 C	130 C	131 C
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	11.96	2.18	13.04	1.54	12.06	1.54	31.46	0.80	7.70	3.98	3.62	1.46	2.76
- 16 + 25 mesh	16.32	3.46	8.00	2.40	7.74	1.92	6.04	1.14	4.20	2.14	2.80	1.68	2.02
- 25 + 36 mesh	22.72	7.60	7.20	5.58	5.58	4.06	4.48	2.96	3.78	3.48	3.32	3.60	2.84
- 36 + 100 mesh	43.20	82.44	64.74	86.28	69.48	86.30	49.70	89.04	77.32	84.00	80.16	86.82	85.60
- 100 + 120 mesh	4.56	3.72	5.26	3.48	3.28	5.58	7.22	5.60	5.28	5.76	9.52	5.80	6.08
- 120 mesh	1.24	0.60	1.76	0.72	1.86	0.60	1.10	0.46	1.72	0.64	0.58	0.64	0.70
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1204

Sample Nos	93 C	94 C	95 C	96 C	97 C	98 C	99 C	100 C	101 C	102 C	103 C	104 C	105 C
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	10.90	6.48	13.72	2.52	31.54	3.02	17.40	1.38	18.40	6.56	16.56	1.18	14.70
- 16 + 25 mesh	5.54	4.00	11.66	1.80	15.26	2.18	10.50	1.24	11.48	3.90	18.02	1.18	13.08
- 25 + 36 mesh	5.46	3.84	13.32	1.86	18.92	2.52	10.62	1.30	11.76	3.34	19.66	2.22	14.26
- 36 + 100 mesh	75.96	81.54	58.66	90.76	32.26	89.88	59.50	92.24	55.72	84.10	41.90	88.30	54.44
- 100 + 120 mesh	1.56	3.84	1.88	2.66	1.54	2.02	1.38	3.32	2.00	1.74	2.48	6.68	2.16
- 120 mesh	0.58	0.30	0.76	0.40	0.48	0.38	0.60	0.52	0.64	0.36	1.38	0.44	1.36
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	106 C	107 C	108 C	109 C	110 C	111 C	112 C	113 C	114 C	115 C	116 C	117 C	118 C
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction													
+ 16 mesh	4.34	26.14	7.92	22.08	3.36	18.36	1.42	14.48	1.16	14.10	1.36	20.10	1.46
- 16 + 25 mesh	3.00	20.04	4.80	26.02	2.54	18.24	1.44	13.82	1.26	11.08	1.32	18.32	1.44
- 25 + 36 mesh	3.24	21.56	4.04	26.02	2.72	22.92	1.92	14.96	1.60	12.16	1.76	23.90	2.18
- 36 + 100 mesh	87.26	30.30	80.86	24.16	87.10	37.36	91.30	51.32	90.38	58.30	90.96	33.80	90.66
- 100 + 120 mesh	1.84	1.00	1.84	0.86	3.82	1.86	3.42	3.72	4.88	3.36	4.00	2.82	3.62
- 120 mesh	0.32	0.96	0.54	0.86	0.46	1.26	0.50	1.70	0.72	1.00	0.60	1.06	0.64
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1204

Sample Nos	63 A	64 A	65 A	66 A	67 A	68 A	69 A	70 A	71 A	72 A	73 A	74 A	75 A	76 A
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction														
+ 16 mesh	0.22	1.30	0.16	0.32	0.40	0.86	0.74	1.38	0.12	0.24	1.22	1.74	0.42	0.32
- 16 + 25 mesh	2.44	3.42	2.40	1.94	2.66	2.54	3.26	2.68	2.86	1.84	5.32	5.02	2.20	2.46
- 25 + 36 mesh	42.04	37.74	47.70	37.00	43.72	39.00	48.90	47.52	61.44	38.24	66.80	48.96	56.28	57.10
- 36 + 100 mesh	55.26	57.50	49.72	60.70	53.16	57.48	47.04	48.38	35.54	59.62	26.62	44.24	41.06	40.06
- 100 + 120 mesh	0.02	0.02	Trace	0.02	0.02	0.04	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.02
- 120 mesh	0.02	0.02	0.02	0.02	0.04	0.08	0.04	0.06	0.02	0.02	0.02	0.02	0.02	0.04
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1212

Sample Nos	77 A	78 A	79 A	80 A	81 A	82 A	83 A	84 A	85 A	86 A	87 A	88 A	89 A	90 A
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction														
+ 16 mesh	0.66	0.36	1.34	0.32	0.08	0.24	0.22	0.32	0.72	Not	0.40	0.06	0.70	1.42
- 16 + 25 mesh	3.82	3.38	5.74	2.54	2.78	2.00	2.08	3.26	3.92	received	2.56	3.32	5.28	4.42
- 25 + 36 mesh	60.80	60.64	61.46	56.12	76.98	74.16	71.46	72.18	72.42	Not	60.84	64.16	74.80	62.80
- 36 + 100 mesh	34.62	35.58	31.42	40.96	20.12	23.58	26.16	24.18	22.86	received	36.14	31.88	21.20	31.34
- 100 + 120 mesh	0.06	0.02	0.02	0.04	0.02	Trace	0.02	0.04	0.02	Not	0.04	0.02	0.02	0.02
- 120 mesh	0.04	0.02	0.02	0.02	0.02	0.02	0.06	0.02	0.06	received	0.02	0.02	Nil	Nil
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00		100.00	100.00	100.00	100.00

SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1212

Sample Nos	91 A	92 A	93 A	94 A	95 A	96 A	97 A	98 A	99 A	100 A	101 A	102 A	103 A	104 A
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction														
+ 16 mesh	0.32	1.76	0.10	0.12	1.10	0.52	0.16	0.34	0.64	0.14	0.24	0.36	0.38	0.10
- 16 + 25 mesh	1.46	8.34	1.76	1.44	7.18	3.08	1.34	1.76	3.54	1.02	1.54	1.62	1.90	1.08
- 25 + 36 mesh	62.50	63.56	58.56	49.20	64.10	55.10	26.34	36.88	37.80	18.76	37.14	30.78	15.72	24.12
- 36 + 100 mesh	35.62	26.16	39.52	49.18	27.56	41.24	72.06	60.94	57.94	79.92	60.96	67.12	81.66	74.42
- 100 + 120 mesh	0.02	0.10	0.02	0.04	0.04	0.02	0.06	0.02	0.06	0.14	0.10	0.08	0.30	0.26
- 120 mesh	0.08	0.06	0.04	0.02	0.02	0.04	0.04	0.06	0.02	0.02	0.02	0.04	0.04	0.02
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	105 A	106 A	107 A	108 A	109 A	110 A	111 A	112 A	113 A	114 A	115 A	116 A	117 A	118 A
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction														
+ 16 mesh	0.10	0.40	0.24	0.34	0.08	0.84	0.18	0.08	0.09	0.22	0.10	0.12	0.08	0.24
- 16 + 25 mesh	0.94	2.54	1.10	2.08	0.74	3.66	1.04	0.82	0.88	1.24	1.34	1.52	0.98	1.64
- 25 + 36 mesh	13.52	26.48	10.14	18.34	8.64	37.24	7.56	8.98	7.66	1.78	14.78	14.90	10.22	26.30
- 36 + 100 mesh	85.02	70.36	87.62	78.96	90.00	57.94	90.80	89.36	90.34	95.38	83.16	82.92	88.16	71.74
- 100 + 120 mesh	0.34	0.18	0.74	0.26	0.50	0.26	0.38	0.74	0.64	1.30	0.54	0.46	0.50	0.06
- 120 mesh	0.08	0.04	0.16	0.02	0.04	0.06	0.04	0.02	0.04	0.08	0.08	0.08	0.06	0.02
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00		100.00	100.00	100.00	100.00

SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1212

Sample Nos	119 A	120 A	121 A	122 A	123 A	124 A	125 A	126 A	127 A	128 A	129 A
Weight reporting	%	%	%	%	%	%	%	%	%	%	%
Size fraction											
+ 16 mesh	0.26	0.02	0.10	0.18	0.16	0.02	0.56	0.08	0.02	0.26	0.18
- 16 + 25 mesh	1.22	1.44	0.52	0.76	0.98	0.28	0.60	1.22	0.18	1.36	1.08
- 25 + 36 mesh	19.44	27.52	8.54	5.20	4.82	3.30	5.16	9.56	1.86	6.36	4.10
- 36 + 100 mesh	78.86	70.60	90.58	92.58	92.98	94.38	92.52	88.54	97.34	91.48	94.04
- 100 + 120 mesh	0.14	0.40	0.20	1.16	0.96	1.60	0.86	0.36	0.48	0.46	0.46
- 120 mesh	0.08	0.02	0.06	0.12	0.10	0.42	0.30	0.24	0.12	0.08	0.14
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	53 B	54 B	55 B	56 B	57 B	58 B	59 B	60 B	61 B	62 B	63 B	64 B	65 B	66 B
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction														
+ 16 mesh	0.36	1.28	2.24	2.14	2.02	1.72	6.92	4.90	5.86	16.46	4.66	4.80	1.42	3.58
- 16 + 25 mesh	2.58	7.50	5.98	11.34	7.06	3.72	17.54	20.16	16.48	20.00	33.76	16.94	9.80	22.16
- 25 + 36 mesh	30.18	46.88	35.62	42.40	30.60	20.76	42.08	50.24	42.68	24.50	36.52	43.24	61.88	53.32
- 36 + 100 mesh	66.78	44.28	56.02	44.02	60.26	73.76	33.38	24.64	34.86	38.94	25.00	34.96	26.80	20.88
- 100 + 120 mesh	0.04	0.02	0.06	0.04	0.02	0.02	0.02	0.02	0.04	0.02	0.02	0.02	0.02	0.02
- 120 mesh	0.06	0.04	0.08	0.06	0.04	0.02	0.06	0.04	0.08	0.08	0.04	0.04	0.08	0.04
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1212

Sample Nos	67 B	68 B	69 B	70 B	71 B	72 B	73 B	74 B	75 B	76 B	77 B	78 B	79 B	80 B
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction														
+ 16 mesh	2.96	2.46	1.56	5.28	1.10	3.56	7.10	3.58	3.40	0.60	8.22	3.96	0.86	4.76
- 16 + 25 mesh	12.28	27.82	10.82	28.80	9.70	23.14	16.00	10.38	13.40	10.12	31.56	17.94	10.48	14.84
- 25 + 36 mesh	53.52	46.48	63.06	24.16	65.00	56.76	30.24	39.62	56.84	70.66	45.48	46.12	74.84	56.28
- 36 + 100 mesh	31.16	23.16	24.50	41.54	24.08	16.46	46.28	46.34	26.30	18.32	14.62	31.80	13.62	24.04
- 100 + 120 mesh	0.02	0.02	0.02	0.08	0.02	0.02	0.08	0.02	0.02	0.04	0.02	0.06	0.02	0.02
- 120 mesh	0.06	0.06	0.04	0.10	0.10	0.06	0.26	0.06	0.04	0.26	0.10	0.12	0.18	0.06
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	81 B	82 B	83 B	84 B	85 B	86 B	87 B	88 B	89 B	90 B	91 B	92 B	93 B	94 B
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction														
+ 16 mesh	3.32	Not	1.88	2.40	5.34	2.18	1.96	7.28	2.40	2.82	1.58	34.78	0.08	3.06
- 16 + 25 mesh	15.02	received	11.86	12.66	31.68	13.22	10.60	11.08	5.84	16.72	12.64	35.84	2.04	21.44
- 25 + 36 mesh	59.02	Not	61.98	59.44	50.10	57.58	51.42	50.82	56.00	66.78	63.46	26.32	63.90	63.66
- 36 + 100 mesh	22.56	received	24.22	25.38	12.82	26.92	35.92	30.68	35.70	13.46	22.26	3.00	33.92	11.64
- 100 + 120 mesh	0.02	Not	0.02	0.02	0.02	0.04	0.04	0.04	0.02	0.06	0.02	0.02	0.02	0.02
- 120 mesh	0.06	received	0.04	0.10	0.04	0.06	0.06	0.10	0.04	0.16	0.04	0.04	0.04	0.18
Total products	100.00		100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

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SCREEN ANALYSES OF DIIMU GLASS SAND SAMPLES MDL 1212

Sample Nos	95 B	96 B	97 B	98 B	99 B	100 B	101 B	102 B	103 B	104 B	105 B	106 B	107 B	108 B
Weight reporting	%	%	%	%	%	%	%	%	%	%	%	%	%	%
Size fraction														
+ 16 mesh	0.82	1.90	2.40	1.52	0.82	1.08	0.98	0.26	0.62	0.94	2.86	2.68	4.46	2.50
- 16 + 25 mesh	12.64	11.66	10.14	7.16	19.44	6.82	5.58	3.26	9.86	15.94	9.62	14.40	16.42	13.48
- 25 + 36 mesh	69.66	65.38	62.48	64.12	69.12	66.56	61.94	63.94	68.44	69.24	60.42	56.06	62.60	61.74
- 36 + 100 mesh	16.60	20.82	24.90	27.06	10.46	25.42	31.36	32.44	20.86	13.74	26.98	26.66	16.40	22.02
- 100 + 120 mesh	0.06	0.04	0.02	0.04	0.04	0.04	0.06	0.02	0.04	0.02	0.02	0.06	0.02	0.06
- 120 mesh	0.22	0.20	0.06	0.10	0.12	0.08	0.08	0.08	0.18	0.12	0.10	0.14	0.10	0.20
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sample Nos	109 B	110 B	111 B	112 B	113 B	114 B	115 B
Weight reporting	%	%	%	%	%	%	%
Size fraction							
+ 16 mesh	1.32	0.82	0.42	0.74	1.84	1.18	2.72
- 16 + 25 mesh	10.76	5.82	5.82	5.78	11.48	6.22	6.44
- 25 + 36 mesh	63.62	71.40	60.64	48.82	59.16	49.04	51.64
- 36 + 100 mesh	24.08	21.86	33.00	44.46	27.28	43.14	39.02
- 100 + 120 mesh	0.06	0.02	0.02	0.08	0.06	0.12	0.06
- 120 mesh	0.16	0.08	0.10	0.12	0.18	0.30	0.12
Total products	100.00	100.00	100.00	100.00	100.00	100.00	100.00

From the size analysis it can be seen that :

The percentage retained on 36 mesh is greater than acceptable grade, of 10 % max including material retained on 25 mesh sieve. Samples Nos 109 A and 111 A - 114 A, 121 A - 129 A are near the specification.

2.6.1.2. Chemical analyses

Sample No	Head Samples		Non Magn.		Sample No	Head Samples		Non Magn.	
	SiO_2%	Fe_2O_3%	SiO_2%	Fe_2O_3%		SiO_2%	Fe_2O_3%	SiO_2%	Fe_2O_3%
1 A	99.41	0.079	99.55	0.048	1 B	99.60	0.042	99.69	0.038
3 A	99.41	0.064	99.57	0.068	3 B	99.57	0.068	99.52	0.054
5 A	99.57	0.052	99.60	0.044	5 B	99.46	0.055	99.62	0.043
7 A	99.32	0.084	99.64	0.047	7 B	99.54	0.053	99.63	0.042
9 A	99.35	0.103	99.57	0.047	9 B	99.55	0.017	99.68	0.038
11 A	99.20	0.022	99.54	0.086	11 B	99.54	0.027	99.96	0.041
13 A	99.28	0.120	99.59	0.058	13 B	99.64	0.012	99.67	0.037
15 A	99.59	0.079	99.62	0.002	15 B	99.71	0.010	99.69	0.030
17 A	99.78	0.054	99.72	0.050	17 B	99.25	0.088	99.57	0.048
19 A	98.99	0.017	99.61	0.049	19 B	99.76	0.065	99.70	0.035
21 A	99.30	0.130	99.57	0.052	21 B	99.42	0.078	99.70	0.040
23 A	99.58	0.033	99.68	0.038	23 B	99.72	0.030	99.74	0.027
25 A	99.56	0.039	99.67	0.036	25 B	99.17	0.096	99.55	0.027
27 A	99.68	0.028	99.73	0.047	27 B	99.64	0.041	99.71	0.037
29 A	99.57	0.009	99.65	0.049	29 B	99.79	0.028	99.77	0.039
31 A	99.68	0.006	99.68	0.049	1 C	99.09	0.060	99.62	0.056
33 A	99.78	0.050	99.71	0.041	2 C	99.35	0.030	99.63	0.076
35 A	99.66	0.055	99.75	0.040	3 C	99.09	0.099	99.60	0.060
37 A	99.69	0.060	99.64	0.045	4 C	99.31	0.017	99.65	0.066
39 A	99.21	0.017	99.57	0.055	5 C	99.31	0.100	99.58	0.080
41 A	99.60	0.060	99.71	0.051	6 C	99.87	0.301	99.60	0.071
43 A	99.45	0.084	99.51	0.054	7 C	99.47	0.086	99.78	0.037
45 A	99.41	0.086	99.48	0.065	8 C	99.31	0.045	99.59	0.070
47 A	99.75	0.051	99.72	0.055	9 C	99.36	0.115	99.59	0.059
49 A	99.65	0.066	99.65	0.052	1 D	99.25	0.025	99.61	0.045
51 A	99.61	0.069	99.71	0.056	40 D	99.50	0.073	99.56	0.052

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2.6.2. Geoconsult analyses

Four samples are analyzed in the Geoconsult's Feasibility Study for Sheet Glass Plant (January 1982).

2.6.2.1. Chemical Analysis

Sample No		4	5	6	7
L.O.I. 1000 ° C	:	0.18	0.18	0.13	0.09
SiO_2	:	99.6	99.4	99.3	99.3
Al_2O_3	:	0.17	0.18	0.16	0.21
Fe_2O_3	:	0.10	0.09	0.09	0.10
TiO_2	:	0.13	0.18	0.09	0.15
MgO	:	0.01	0.00	0.02	0.01
CaO	:	0.02	0.01	0.01	0.01
K_2O	:	0.03	0.05	0.02	0.01
Na_2O	:	0.00	0.00	0.00	0.02
MnO	:	0.00	0.00	0.00	0.00
P_2O_5	:	0.00	0.00	0.00	0.00
SO_3	:	0.01	0.01	0.01	0.01
ZnO	:	0.00	0.00	0.00	0.00
BaO	:	0.00	0.00	0.00	0.00
Cr_2O_3	:	0.00	0.00	0.00	0.00

2.6.2.1. Chemical Analysis

Sample No	4	5	6	7
Maxi size (mm)	0.54	0.56	0.59	0.47
Mini size (mm)	0.18	0.18	0.23	0.23
Average size (mm)	0.33	0.40	0.38	0.36

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2.6.3. ABAY analyses

Physical analyses

	Sample Serial Numbers							
	1		2		3		4	
	Analyse 1 1	Analyse 1 2	Analyse 2 1	Analyse 2 2	Analyse 3 1	Analyse 3 2	Analyse 4 1	Analyse 4 2
+ 2 mm	0.1 %	0	0	0	0	0	0.1 %	0
- 2 mm + 1 mm	0	0	0	0	0.1 %	0.1 %	0	0
- 1 mm + 0.5 mm	0.2 %	0.1 %	0.5 %	0.5 %	2.2 %	2.3 %	0.3 %	0.3 %
- 0.5 mm + 0.25 mm	66.5 %	64 %	59.2 %	61.7 %	71.3 %	74.7 %	63.5 %	65.4 %
- 0.25 mm + 0.125 mm	33.1 %	35.7 %	40.1 %	37.6 %	26.3 %	22.9 %	35.9 %	34 %
- 0.125 mm + 0.063 mm	0.1 %	0.1 %	0.1 %	0.1 %	0	0	0.2 %	0.2 %
- 0.063 mm + 0.04 mm	0	0	0	0	0	0	0	0
- 0.04 mm	0	0	0	0	0	0	0	0

Chemical analyses (Datas in weight - %)

	Sample serial number			
	1	2	3	4
SiO_2	99.51	99.34	99.42	99.46
Al_2O_3	0.124	0.137	0.131	0.144
Fe_2O_3	0.065	0.101	0.064	0.050
Cr_2O_3	0.003	0.003	0.003	0.003
CaO	0.013	0.015	0.010	0.014
MgO	0.015	0.019	0.014	0.014
TiO	0.14	0.26	0.19	0.13
Na_2O	0.014	0.014	0.014	0.020
K_2O	0.031	0.032	0.047	0.055
Carbon	0.024	0.020	0.009	0.014
Glowing loss	0.06	0.06	0.10	0.10
Remaindered Moisture	0.20	3.24	3.31	4.31

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2.6.4. Conclusion in DIIMU deposit

The granulometry curve is ideal for the glass industry.

The SiO_2 content, the Al_2O_3 content and constancy, the Na_2O + K_2O content and the CaO + MgO content are also ideal for the glass industry.

The Fe_2O_3 content is a little bit too high for producing flint glass with an upmost colour quality. However a simple washing should be sufficient to reduce this content to an acceptable level.

The Cr_2O_3 and TiO contents are also a little bit too high, but here also the washing should reduce these contents to an acceptable level.

We consider this sand as being definitely suitable for the glass industry.

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2.7. OTHER DEPOSITS

Several deposits are mentioned in the report ASBD/20 from the Geological Survey and Mines Department (Note in major occurences of glass sand and iron ore in Uganda by M. BAZAALE-DOLO A.S.).

These include : Lugazi, Muyenga near Kampala, Wera Bay, Katonga, Kabukero and Namalima. Most survey work have been concentrated in Lake Victoria, the other lake shores remaining unstudied.

3. SODA ASH

This product is either produced by the Solvay process or it is find as natural resource, mainly in the U.S.A. and in Kenya.

For evident economic reasons, it is advisable to use Kenyan soda ash for this project.

The analyse of this soda ash (Lake Magadi) is as follows :

Na_2CO_3	:	97.4 %
$NaHCO_3$	:	0.4 %
NaCl	:	0.43 %
NaF	:	0.9 %
Na_2SO_4	:	3.35 %
H_2O	:	0.3 %
Unmelted	:	0.25 %
Fe_2O_3	:	0.02 %

The analyse shows that the quality of this soda ash is lower than those of a processed one, on which we have based our standard specification. Nevertheless, as this product has been used for years in several glass factories, at the full satisfaction of their owners, we shall consider it for this project.

N.B. : Dense soda ash should be supplied, because light soda ash gives too much dust, which have a negative impact on the furnace and regeneration chambers refractories.

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4. LIMESTONE-DOLOMITE

As a preliminary we shall take an extract from the geological survey edited from "Mineral Resources of Uganda" Bulletin No 4 in 1982 by J.W. Barnes on behalf of Industrial Development Unit, Commonwealth Fund for Technical Cooperation. Limestone resources depend almost entirely upon the carbonatites of Eastern and Northern Provinces and on secondary limestones in the Lake Georges depression.

Carbonatites

These rocks of volcanic origin occur at Sukulu and Tororo in Eastern Province and at Napak and Toror in Karamoja. They are variable in composition and may be high in phosporus from associated apatite and they may also contain a high proportion of magnetite. Magnesia is generally low but rises to over 8 per cent at Napak.

Lake George limestones

Secondary limestones derived from lime leached from calcareous volcanic tuffs and from carbonate springs, occur around an ancient shore line approximately 100 feet above the present level of Lake George. These limestones vary in type from calcretes, tufas and sinters at Muhokya and Dura, to a true lake limestone at Hima.

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The calcretes were formed by capillary action drawing carbonates to the surface to form a siliceous limestone with moderate magnesia content. At Muhokya, re-solution has deposited purer sinters below the calcretes and abundant plant impressions suggest that photosynthesis played an active part in precipitation. Although the re-precipitated limestone is of high quality, the quantity is comparatively small. The deposit has, however, produced small tonnages of building lime over many years.

4.1. MOYO DEPOSIT

The Department of Geological Survey and Mines (Entebbe) by its report FAkk/6 written by MM Kabagambe and Kaliisa in 1978 has studied this deposit.

We resume herebelow the 57 analyses included in this report.

Sample	% CaO	% MgO	% Fe_2O_3	% SiO_2	% P_2O_5	% MnO
MDL 1322/ 2	29.45	20.18	1.10	0.15	0.03	0.16
4	30.97	19.13	1.01	0.06	0.04	0.24
8	30.12	19.72	0.78	0.09	0.04	0.17
11	28.32	20.03	0.55	0.19	0.07	0.05
13	34.62	15.21	0.45	0.12	0.06	0.05
13A	28.56	18.67	0.66	0.20	0.01	0.04
15	28.54	21.84	0.48	0.23	0.04	0.08
33	28.55	19.43	0.78	0.22	0.03	0.12
58A	37.77	12.05	2.34	0.07	0.80	0.33
15A	32.27	5.09	0.27	8.20	0.14	0.05
15B	37.77	4.94	0.60	12.61	0.15	0.05
17	11.45	7.49	0.96	49.00	0.38	0.08

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Sample	% CaO	% MgO	% Fe_2O_3	% SiO_2	% P_2O_5	% MnO
MDL 1322/19	39.13	6.44	0.36	11.60	0.14	0.06
22	29.75	18.87	0.18	2.21	0.94	0.06
23	49.16	3.03	0.60	4.11	0.15	0.07
24	28.72	15.45	0.61	6.41	0.07	0.06
26	30.33	20.30	0.71	0.52	0.03	0.05
26A	32.85	14.70	0.85	5.67	0.18	0.04
71	29.63	18.93	0.90	3.00	0.03	0.06
48	29.77	21.69	0.93	1.10	0.03	0.22
50	24.94	15.66	0.99	11.74	0.09	0.09
53	29.54	21.53	0.54	1.12	0.01	0.06
55	19.32	10.24	0.33	21.40	0.03	0.12
56	30.68	21.08	1.14	0.44	0.03	0.25
57	38.63	6.17	0.55	10.80	0.01	0.14
57A	25.45	16.67	2.40	11.01	0.08	0.37
58	21.82	7.53	0.63	21.39	0.06	0.12
61	30.68	21.38	0.48	1.51	0.01	0.07
64	30.90	21.84	0.64	0.42	0.06	0.14
32	27.50	18.33	0.51	6.59	0.01	0.08
34	35.24	15.25	1.00	2.30	0.04	0.30
35	33.41	16.69	1.02	2.96	0.03	0.66
39	29.54	21.36	0.59	0.66	0.03	0.11
39A	42.49	5.32	2.96	6.74	0.15	0.92
41	29.43	20.45	0.48	2.15	0.05	0.08
42	23.32	10.91	0.55	15.10	0.02	0.15
42A	26.95	20.15	0.75	0.79	0.03	0.08
45	29.88	20.15	2.91	1.23	0.04	0.09
70	29.43	21.36	0.83	1.35	0.03	0.11
65	28.64	16.69	0.41	3.67	0.14	0.16
67	28.37	15.06	0.91	7.58	0.17	0.14
68	32.04	9.94	0.94	6.19	0.11	0.08
75	35.50	20.78	0.83	5.80	0.06	0.15

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Sample	% CaO	% MgO	% Fe_2O_3	% SiO_2	% P_2O_5	% MnO
MDL 1322/78	25.23	14.16	0.48	14.56	0.07	0.41
79	30.23	20.47	1.16	0.65	0.04	0.13
81	29.09	21.53	1.11	0.99	0.02	0.17
82	30.47	20.78	0.85	0.87	0.04	0.17
85	29.77	20.78	0.52	1.53	0.08	0.07
87A	29.77	19.28	0.73	2.52	0.02	0.09
MDL 1325/89	30.23	19.88	0.49	2.04	0.04	0.15
91	30.23	20.15	0.57	0.61	0.06	0.07
98	30.80	19.13	0.87	1.10	0.05	0.03
99	30.37	20.45	0.72	2.46	0.07	0.12
101	29.77	20.15	0.39	4.16	0.03	0.16
103	20.08	8.97	0.90	21.08	0.05	0.08
107	30.23	19.43	0.72	1.02	0.04	0.10
108	27.73	15.66	0.99	11.34	0.15	0.11

A standard limestone would have a content of about 55 % CaO and 0.5 % MgO and a standard dolomite would have a content of about 30.5 % CaO and 20.5 % MgO.

The hereabove analyses show that the Moyo deposit has the following content :

CaO : 11.45 to 49.16 % with an average of 30.1 %

MgO : 3.03 to 21.84 % with on average of 16.47 %.

Consequently, we can see that this deposit is very heterogeneous, varying from limestone to dolomite, with a average closer to a low magnesium content dolomite.

It is not so important to have a product closer to the specification of the limestone or to the dolomite, usually it is possible to calculate a batch formula in accordance as far as the content variations remain within certain limits.

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In this case, the CaO varies from 1 to 4 and practically none of the samples remain within the standard limit of deviation which is ± 0.3 %.
The MgO varies from 1 to 7 and here again none of the samples remain within the standard limit of deviation which is ± 0.3 %.
On another hand, the Fe_2O_3 ranges from 0.18 to 2.96 %, whilst the standard is 0.1 % maximum.
For all the reasons, we should conclude that the Moyo deposit is not suitable for the glass industry. However we have to point out that this deposit is reported to have a total tonnage of 4,794,678 tons. Ths glass factory will need around 2,000 T per year of limestone/dolomite. Then it should not be unrealistic to imagine that deeper geological studies will find within this area smaller but more homogeneous quantity of product which could be used to produce glass, after decreasing its iron content.

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4.2. HIMA DEPOSIT

The Department of Geological Survey and Mines (Entebbe), by its report SSB/04 written by M. BYAMUGISHA S.S. in 1984 has studied this deposit.
We resume herebelow the summary of tonnages by grades found out during this survey :

SUMMARY OF TONNAGES BY GRADES

	DRILLED AREA		PITTED AREA
	Main Block	Lower Block	
	Tons	Tons	Tons
By Lime Content :			
CaO %			
+ 50.0	2,741,680	83.330	
48.0 - 49.9	3,461,690	125,000	503,230
45.0 - 47.9	2,758,340		374,320
40.0 - 44.9	2,850,000	250,000	241,420
35.0 - 39.9	1,959,980	140,170	1,024,640
30.0 - 34.9	379,160	225,010	
25.0 - 29.9	245,380		
	14,396,680	787,510	2,143,610
By Magnesia Content :			
MgO %			
1.0 - 1.9	4,259,150	537,510	1,020,980
2.0 - 2.9	5,799,190		227,230
3.0 - 3.9	2,733,340	250,000	139,170
4.0 - 4.9	908,340		
5.0 - 5.9	133,330		120,000
6.0 - 6.9	550,000		196,660
7.0 - 7.9			56,330
8.0 - 8.9	13,330		98,580
9.0 - 9.9			
10.0 - 10.9			284,660
	14,396,680	787,510	2,143,610

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	DRILLED AREA		PITTED AREA
	Main Block	Lower Block	
	Tons	Tons	Tons
By Phosphorus Content :			
P_2O_5 %			
- 1.0	14,271,680	787,510	1,814,290
1.0 - 1.9	125,000		329,320
	14,396,680	787,510	2,143,610
By Iron Content :			
Fe_2O_3 %			
- 1.0	9,334,220		1,206,630
1.0 - 1.9	3,874,980	333,330	936,980
2.0 - 2.9	970,820		
3.0 - 3.9	116,660	454,180	
4.0 - 4.9	100,000		
	14,396,680	787,510	2,143,610
By Manganese Content :			
MnO %			
- 0.05	1,863,330		
0.05 - 0.09	6,279,220	83,330	
0.10 - 0.49	5,828,300	704,180	
0.50 - 0.99	62,500		
Not essayed	363,330		
	14,396,680	787,510	

TOTALS - all grades :

	Long tons	Long tons
Proved by drilling and pitting :		
Main body - graded limestone	14,396,680	
- ungraded (- 25 % CaO)	691,660	
Main body - pitted area, graded	2,143,610	
Lower body - graded limestone	787,510	
TOTAL PROVED	18,019,460	18,019,460
Estimated - Main body	2,410,000	
- Lower body	2,500,000	
TOTAL ESTIMATED	4,910,000	4,910,000
TOTAL PROVED and ESTIMATED		22,929,469

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Although the quality is only moderate, it can be exploited easily with little preliminary work as it is close to both the main road and railway, the stone and its products can be transported at minimum cost.
Since variation in quality follows a regular pattern, different grades can be quarried as required and fortunately the better qualities are in the thickest past of the deposit.
This Hima deposit is presently exploited by the Uganda Cement Corporation. Following analyses have been given by them in the feasibility study for a flat glass plant conducted by Geoconsult in January 1982.

Sample	G7	G7	G6	G6	G6	G6
Depth ft.	0-19	19-39	0-10	10-14	14-27	31-37
AAT %	90.33	88.25	88.43	89.46	94.58	88.20
SiO_2 %	4.01	3.34	7.66	6.32	3.40	5.86
Al_2O_3 %	3.02	3.43	1.67	1.38	1.41	1.40
Fe_2O_3 %	0.88	1.55	0.53	0.32	0.29	0.48
CaO %	46.10	45.69	45.76	48.35	49.95	47.35
MgO %	3.16	3.07	2.57	2.10	2.39	2.39
R_2O_3	3.90	4.98	2.20	1.70	1.70	1.88

The same remarks expressed for the Moyo deposit occur for the Hima deposit.
- high deviations of CaO and MgO content.
- high percentage of Fe_2O_3.

The same conclusion also occur, i.e. : this deposit is reported to have a total tonnage of 22,929,469 tons ; which means that an homogeneous part of this deposit having only 1/10000 of the total size would be sufficient to feed the glass factory during one year. This is quite possible to find, considering that the variation in quality follow a regular pattern.

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Additional geological study should be carried out in order to find a consequent volume of product having a more or less constant percentage of CaO and MgO and a Fe_2O_3 percentage as low as possible.

4.3. DURA DEPOSITS :

The Department of Geological Survey and Mines (Entebbe) by its report SSB/08 written by M. S.S. BYAMUGISHA, in 1986 has studied this deposit.
We resume herebelow the chemical analyses and the tonnage available of these deposits (West and East deposits) and of the satin-spar which constitutes 10 - 20 % of the whole deposit.

	West deposit	East deposit	Average of West and East deposits	Satin-spar
CaO (%)	49	50	50	54
MgO (%)	0.4	0.4	0.4	0.3
P_2O_5 (%)	0.39	0.09	0.26	0.02
Fe_2O_3 (%)	0.8	1	0.9	0.14
Available tonnage (T)	500,000	1,000,000	1,500,000 (total)	150,000 to 300,000

The Dura deposits have also been studied by the Uganda Cement Corporation, who gave the following analyses in the feasibility study for a flat glass plant conducted by Geoconsult in January 1982.

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MgO	SiO_2	Insol. Resid.	R_2O_2	Fe_2O_3	MnO	P_2O_5	CaO
1.70	2.24	0.40	1.70	0.90	0.21	0.28	49.39
0.89	3.58	0.35	1.83	0.82	0.07	0.21	48.76
1.53	1.91	0.32	1.90	0.63	0.24	0.13	47.28
1.50	7.48	0.84	1.68	1.19	0.07	0.13	44.06
1.04	1.47	0.51	2.07	1.40	0.40	0.06	40.74
2.62	4.63	0.73	2.44	0.49	0.03	0.14	46.91
2.62	2.93	0.61	2.50	0.51	0.02	0.13	47.46
1.07	1.48	0.28	3.56	1.92	0.24	0.06	51.12
3.04	3.26	0.54	3.75	2.02	0.40	0.03	47.15
1.79	4.89	1.06	4.08	2.38	0.48	0.33	47.03
1.25	8.91	2.50	5.70	2.00	0.11	0.28	42.82

The same Geoconsult feasibility study spoke about a sample n° 3 provided by Emco Glassworks (Nairobi) alleged to come from the Dura river and which has been analyzed by Geoconsult as follows :

L.O.I. 1000 ° C	:	44.50 %
SiO_2	:	0.14 %
Al_2O_3	:	0.00 %
Fe_2O_3	:	0.06 %
TiO_2	:	0.00 %
MgO	:	0.12 %
CaO	:	53.90 %
K_2O	:	0.02 %
Na_2O	:	0.20 %
MnO	:	0.01 %
P_2O_5	:	0.00 %
SO_3	:	0.45 %
Cr_2O_3	:	0.00 %
ZnO	:	0.00 %
Bao	:	0.01 %

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Generally speaking, these deposits seem to have a higher percentage of CaO and a lower percentage of MgO than those of Moyo and Hima, closer to the definition of limestone. However, the average percentage of 0.9 % Fe_2O_3 is far too high for a glass industry.
The satin-spar portion of the deposit can be used, the Fe_2O_3 content being 0.14 % to compare with the 0.1 % standard specification, and the available tonnage is far sufficient for the whole life of the glass factory.
The sample brought by EMCO GLASSWORKS (Nairobi) is obviously practically ideal for glass.
Further geological studies should be carried out specifically for the glass, in order to assess the possibility of quarring satin-spar with homogeneous components.

4.4. CONCLUSIONS

By its report HGP/26 written in February 1972 by H.G. PLUMMER, the Geological Survey and Mines Department (Entebbe) has made a review of limestone occurences in Uganda.
This report shows evidently that apurt of Moyo, Hima and Dura deposits, other sites are promissing and needed to be further investigated.
In this study, due to the few quantity annually needed for the glass factory, we would advise to use a limestone/dolomite from a site already quarried for the cement industry.
Another reason to buy to the cement industry is that the installation already exists to deliver a product having the suitable granulometry.
Geological studies should be carried out in Moyo, Hima and/or Dura, specifically for the glass industry, all the existing studies being done for the cement industry.

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The main differences between the two industries, as far as the limestone is concerned are as follows :

- For the cement, the CaO content should be minimum 40 % and preferally 50 %. For the glass, a mixed limestone/ dolomite could have between 45 and 50 % CaO content.
- For the cement, the MgO content should be less than 2.7 %. For the glass, a mixed limestone/dolomite could have between 6.5 and 7.5 % MgO content.
- For the cement, the Fe_2O_3 content should be below 2 %. For the glass, it should be below 0.1 %.

If the glass factory buy limestone/dolomite from Uganda Cement Corporation, it could take a product having higher MgO content than allowed for the cement. The glass, as customer, could therefore be complementary to the cement for the quarry.

Generally, precise CaO and MgO percentage are not fixed for the glass industry, the batch formula can be calculated in accordance with the content of the raw materials. But it is highly important to have a constancy of these percentages through the time. If not, the glass production efficiency and the stability of the quality level would decrease.

The main point will remain the percentage of Fe_2O_3. A too high percentage will not impeach to produce glass, but it will affect the colour of the flint glass. We don't know at which level a half flint glass could be accepted today by the market, but we think that once the glass factory will be in production, the market will absorb its production, if its quality is correct, without taking care of the colour purity. In this regard the only sample with a very good level of Fe_2O_3 (0.06 %) is the one provided by Emco Glasswork Ltd (Nairobi) to Geoconsult. A passage through a permanent magnet has to be considered in any case, in order to remove the free particles of Fe_2O_3.

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5. FELDSPAR

Two deposits have been analyzed by the Department of Geological Survey and Mines (Entebbe).
The first deposit is near Rwemiriro, it has been used for the glass production in the past by the East African Glass Work Ltd (Kampala). E.K. Rugamako has made the analyses of samples coming from this deposit in May 26, 1976.
The second deposit is near Lunya, it was analyzed by J.B. Pollack in December 7, 1964.

	Rwemiriro Deposit (Ankole)	The Lunya Deposit green feldspar	The Lunya Deposit white feldspar
SiO_2	63.82 %	63.71 %	63.73 %
Al_2O_3	17.68 %	19.51 %	19.37 %
Fe_2O_3	0.30 %	0.14 %	0.48 %
CaO	1.93 %	0.32 %	0.22 %
MgO	0.60 %	0.80 %	0.13 %
K_2O	15.61 %	15.00 %	15.00 %
Na_2O	0.01 %	1.75 %	1.75 %
	99.95 %	100.43 %	100.68 %.

No detailed geological investigations have been made on these deposits.
Although the Fe_2O_3 content of two analyses is too high for a flint glass production, we may say that most probably that content can be lowered by the use of a permanent magnet which will remove the free particles of Fe_2O_3.
In this condition, we consider the local feldspar as being suitable for glass production, but only for the future.
For the present study we shall envisage to buy feldspar from Kenya, dut to the fact that the Ugandese existing deposits are not presently quarried and that only about 700 T per year of feldspar will be needed for the glass factory.

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6. OTHER PRODUCTS

Other necessary products, like baryum sulfate, sodium nitrate, anhydrous borax, arsenium, selenium, cobalt oxide and pyrite have to be imported from Europe, in accordance with the standard specification stated hereabove.

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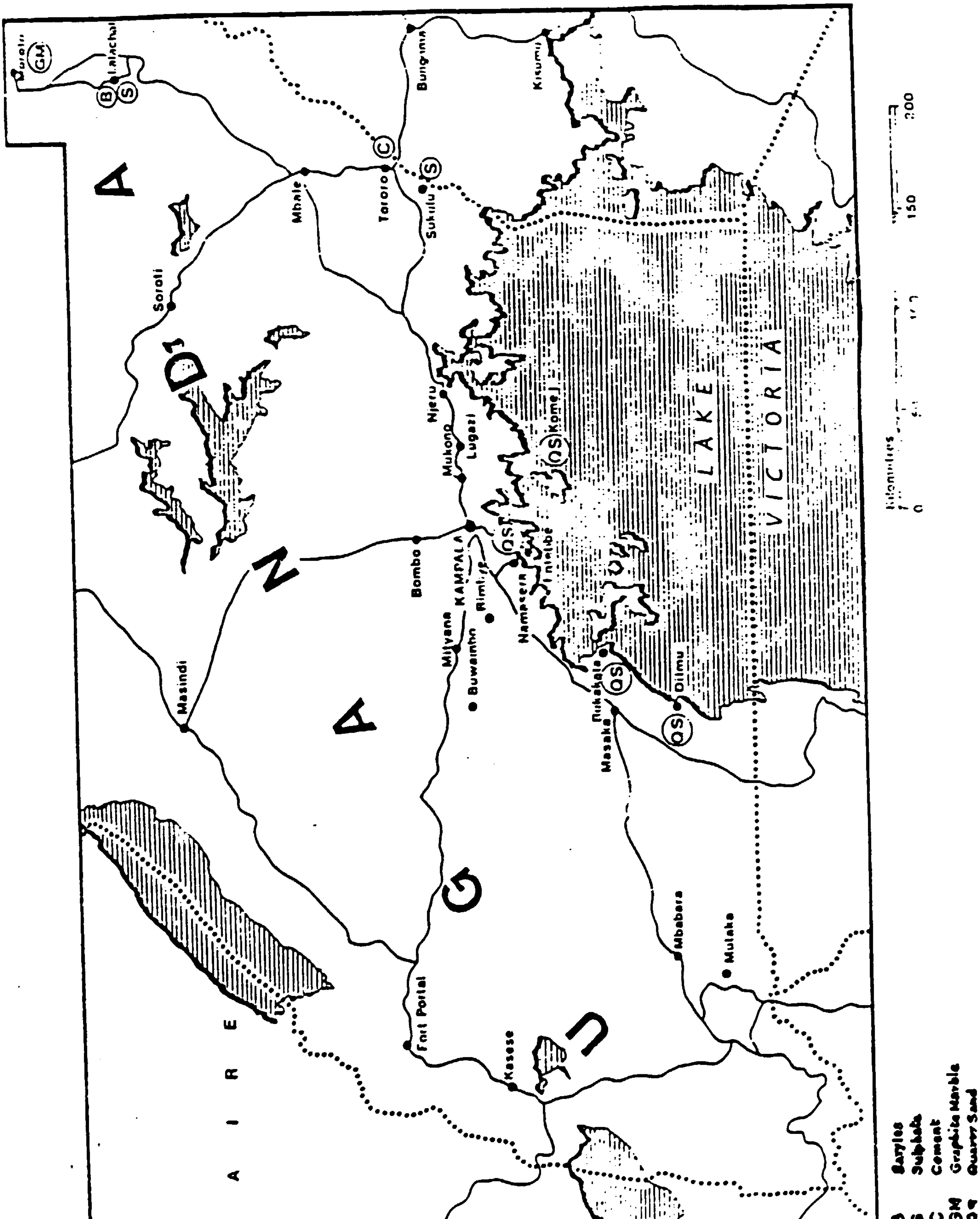
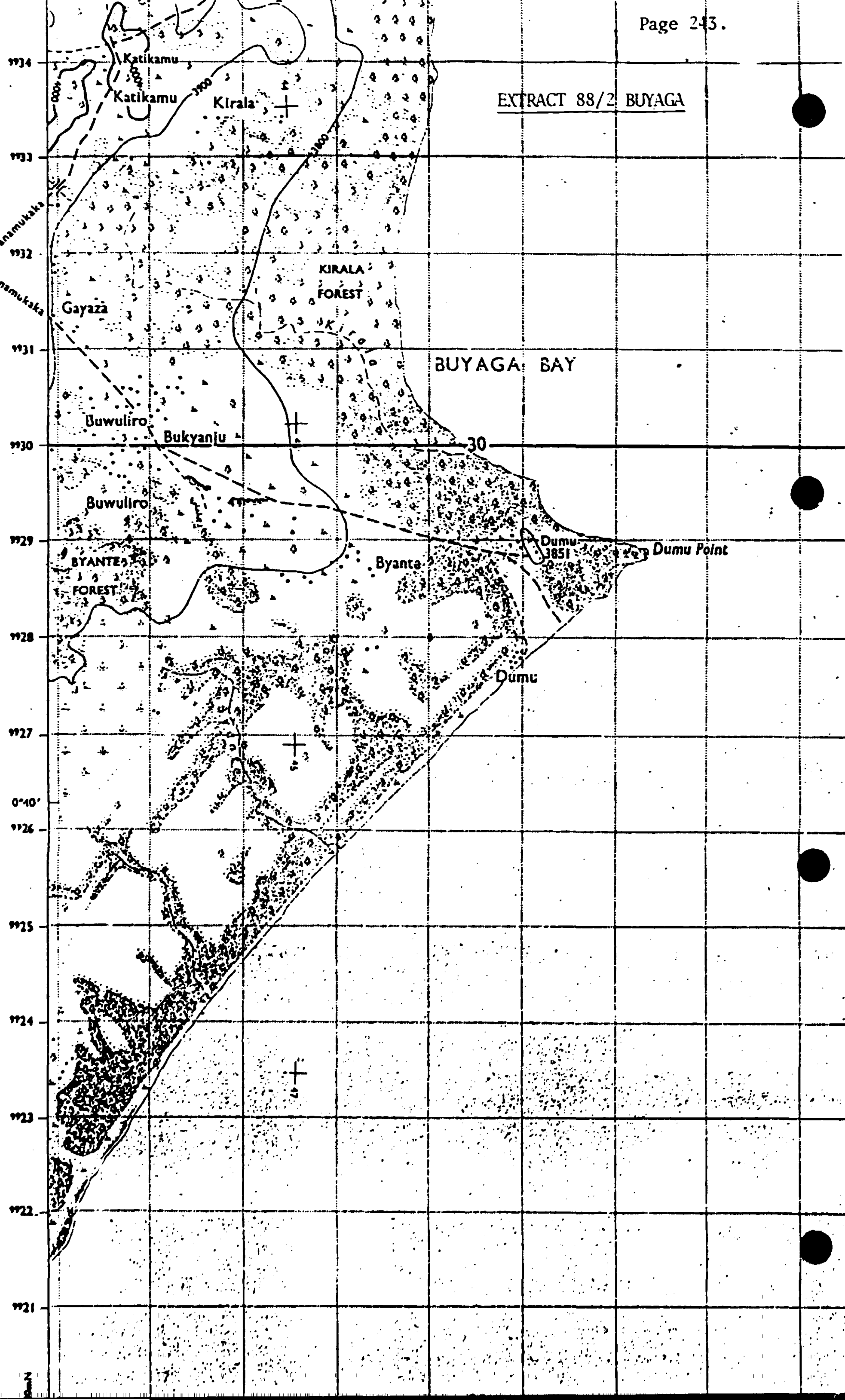
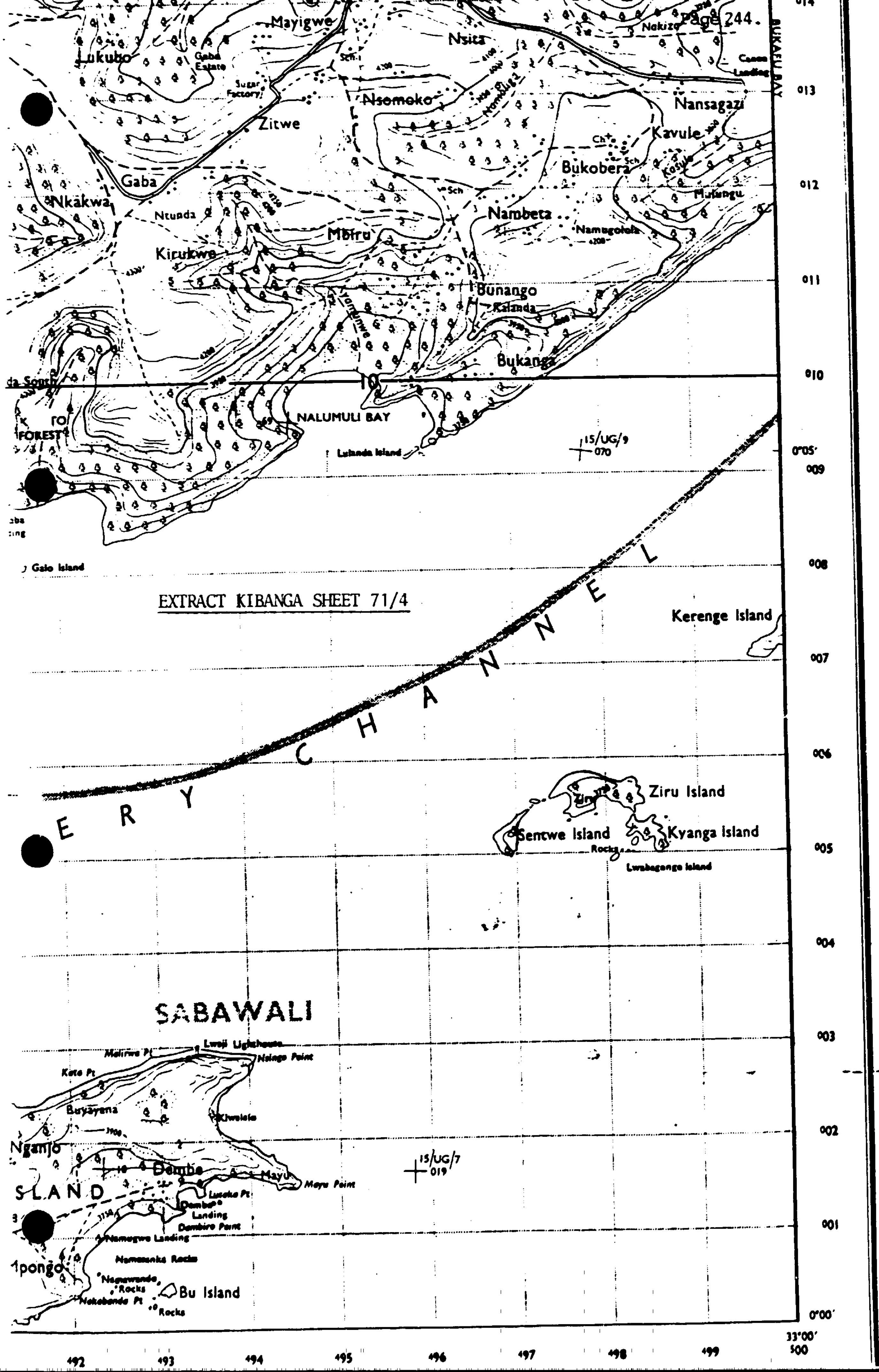
MAP SHOWING LOCATION OF RAW MATERIAL DEPOSITS



EXTRACT 88/2 BUYAGA





EXTRACT KIBANGA SHEET 71/4

IV.2. RAW MATERIALS COST

1. SAND

We envisage in this study to quarry the Diimu sand deposit. This area, according information received from the Ministry of Lands and Surveys, is a part of a Forest Reserve. This means that the Uganda Land Commission cannot lease it without the consent of the Ministry of Environment Protection.

Mr. G.W.C. SERWADDA, Under Secretary of this Ministry has confirmed that in principle it is forbidden to touch to the few Forests Reserves still existing in Uganda. However quarrying Diimu beach should be possible, considering the following factors :

- The best sand for the glass industry is definitely in this area.
- The quarry will not affect the forest itself, but only the beach between the forest and the lake, on which no trees are growing.
- The beach is presently free of buildings and the quarry will not necessitate erection of special buildings because the relatively low quantity of sand to be quarry daily can be done mainly manually.

The cost of quarrying this deposit has been given by Uganda Development Corporation which presently utilizes this sand for producing China wares in small quantities. This cost is 1.000 U Sh/T = 5 U $/T FOB Diimu, including the land leasing, the extraction cost and the loading cost.

We consider this actual market price in our study. If the new glass works company would operate itself the quarry, we evaluate (1 supervisor + 12 labourers + local transport facilities) that the price of the sand will be approximatively the same. But operation and supervision of the quarry by Kampala glass factory's management will be not so easy compared with a management by a local enterprise. For that reason we do not advise to put the quarry in the umbrella of the glass factory.

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The road between Masaka and Diimu is very rough, a road transport of this sand can only be envisaged whether a road improvement program is established in this area.
We envisage in this project to utilize a barge transport from Diimu beach up to Port Bell near Kampala where the glass factory should be erected. Such a barge transport system is currently managed by the Uganda Railways Corporation. This Corporation has quoted the cost of this transport from FOB Diimu up to CIF Port Bell, which is 500,000 U Sh = 2,500 U $ per barge of 200 T.

The total cost of sand will therefore be :

5 + 12.5 = 17.5 U $/T.

2. <u>SODA ASH</u>

The cost of soda ash received from the Magadi Soda Co Ltd (Kenya) is 250 U $/T C & F Kampala.

3. <u>LIMESTONE-DOLOMITE</u>

We envisage in this study to buy the limestone/dolomite from the Uganda Cement Corporation. The cost ex works of this product corresponding to our chemical specification and to our granulometric curve (crushed product) has been given by Uganda Development Corporation, owner of Uganda Cement Corporation.
This cost is 3,480 U Sh/T = 17.4 U $/T.
The road transport cost from Hima to Kampala has been given by Transami Ltd for 45 U $/T.

The total cost of limestone/dolomite will therefore be :

17.4 + 45 = 62.4 U $/T.

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4. **FELDSPAR**

We envisage, at least for the first years of production to import feldspar from Kenya. An average price from Machakos, Kajiado and South Kitui is 80 U $/T FOB Nairobi.
The road transport from Nairobi to Kampala is 70 U $/T.

The total cost of feldspar will therefore be :

80 + 70 = 150 U $/T.

5. **OTHER PRODUCTS**

The costing of the small products has been received from European suppliers.

Product	Cost CIF Mombasa (U $/T)	Cost of transport to Kampala (U $/T)	Cost CIF Kampala (U $/T)
Baryum sulfate	349	90	439
Sodium nitrate	510	90	600
Anhydrous borax	1,072	90	1,162
Arsenium	829	90	919
Selenium	72,360	90	72,450
Cobalt oxide	22,600	90	22,690
Pyrite	829	90	919

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* RAW MATERIAL *
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Quantities (in t.)	Unit price US $	1	2	3	4	5	6	7
Sand	17.50	5047.0	5699.0	6259.0	6879.0	6420.0	8629.0	9664.0
Soda ash	250.00	1677.0	1894.0	2080.0	2286.0	2134.0	2868.0	3212.0
Dolomite & limestone	62.40	1351.0	1526.0	1676.0	1842.0	1719.0	2311.0	2588.0
Feldspar	150.00	537.0	607.0	666.0	732.0	683.0	918.0	1028.0
Baryum sulfate	439.00	108.9	123.0	135.1	148.3	138.4	186.0	208.4
Sodium nitrate	600.00	95.7	108.0	118.6	130.3	121.6	163.4	[illegible].1
Anhydrous borax	1162.00	63.1	71.2	78.1	85.9	80.2	107.8	[illegible].7
Arsenium	919.00	7.5	8.5	9.3	10.3	9.6	12.9	14.5
Selenium	72450.00	.1	.1	.1	.1	.1	.1	.1
Cobalt oxide	22690.00	.0	.0	.0	.0	.0	.0	.0
Pyrite	919.00	10.4	11.7	12.9	14.2	13.3	17.8	19.9
TOTAL	97.96	8899.7	10048.5	11035.1	12128.1	11319.2	15214.0	17038.7

	8	9	10	11	12	13
Sand	10824.0	12123.0	10102.0	12123.0	12123.0	12123.0
Soda ash	3597.0	4029.0	3357.0	4029.0	4029.0	4029.0
Dolomite & limestone	2898.0	3246.0	2705.0	3246.0	3246.0	3246.0
Feldspar	1152.0	1290.0	1075.0	1290.0	1290.0	1290.0
Baryum sulfate	233.4	261.4	217.8	261.4	261.4	261.4
Sodium nitrate	205.0	229.6	191.3	229.6	229.6	229.6
Anhydrous borax	135.2	151.4	126.2	151.4	151.4	151.4
Arsenium	16.2	18.2	15.2	18.2	18.2	18.2
Selenium	.1	.1	.1	.1	.1	.1
Cobalt oxide	.0	.0	.0	.0	.0	.0
Pyrite	22.3	25.0	20.8	25.0	25.0	25.0
TOTAL	19083.2	21373.8	17810.4	21373.8	21373.8	21373.8

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* R A W   M A T E R I A L *
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amounts in thousand US $	1	2	3	4	5	6	7
Sand	88.4	99.7	109.5	120.4	112.3	151.0	169.1
Soda ash	419.3	473.5	520.0	571.5	533.5	717.0	803.0
Dolomite & limestone	84.3	95.2	104.6	114.9	107.3	144.2	161.5
Feldspar	80.5	91.0	99.9	109.8	102.4	137.7	154.2
Baryum sulfate	47.8	54.0	59.3	65.1	60.8	81.7	91.5
Sodium nitrate	57.4	64.8	71.2	78.2	73.0	98.0	109.9
Anhydrous borax	73.3	82.7	90.8	99.8	93.2	125.3	140.3
Arsenium	6.9	7.8	8.5	9.5	8.8	11.9	13.3
Selenium	4.1	4.6	5.1	5.7	5.3	7.1	8.0
Cobalt oxide	.1	.1	.2	.2	.2	.2	.2
Pyrite	9.6	10.8	11.9	13.0	12.2	16.4	18.3
in local currency	172.7	195.0	214.1	235.3	219.6	295.2	330.6
in foreign currency	699.1	789.4	866.8	952.7	889.4	1195.2	1338.6
T O T A L	871.7	984.4	1080.9	1188.1	1109.0	1490.4	1669.2

	8	9	10	11	12	13
Sand	189.4	212.2	176.8	212.2	212.2	212.2
Soda ash	899.3	1007.3	839.3	1007.3	1007.3	1007.3
Dolomite & limestone	180.8	202.6	168.8	202.6	202.6	202.6
Feldspar	172.8	193.5	161.2	193.5	193.5	193.5
Baryum sulfate	102.5	114.8	95.6	114.8	114.8	114.8
Sodium nitrate	123.0	137.8	114.8	137.8	137.8	137.8
Anhydrous borax	157.1	175.9	146.6	175.9	175.9	175.9
Arsenium	14.9	16.7	14.0	16.7	16.7	16.7
Selenium	8.9	9.9	8.3	9.9	9.9	9.9
Cobalt oxide	.3	.3	.3	.3	.3	.3
Pyrite	20.5	23.0	19.1	23.0	23.0	23.0
in local currency	370.3	414.7	345.6	414.7	414.7	414.7
in foreign currency	1499.2	1679.1	1399.1	1679.1	1679.1	1679.1
T O T A L	1869.4	2093.8	1744.7	2093.8	2093.8	2093.8

IV.3. UTILITIES COST

The cost of the calory produced by electricity is cheaper in Uganda than the cost of any other type of calory. The ideal should be therefore to heat electrically the furnace. However 32 % of the production must be in amber colour (beer bottles) and an all electric furnace will give greatest problem in that case, due to cold roof phenomenas. As we have no idea about the possibility of producing the beer bottles in green instead of amber, we have taken the option to keep the three colours production (flint-amber-green). Consequently, the best solution is to consider a mixed heating type furnace, using both heavy fuel oil and electricity.

- The fuel oil will be used only to partly heat the furnace.

- The L.P.G. will only be used for the tablewares line glazer.

- The electricity will be used for all other purposes, i.e. :
  . Partly the heating of the furnace.
  . The heating of the forehearth.
  . The heating of the annealing lehrs.
  . The heating of the decorating lehr.
  . The tracing of the fuel pipes.

- The water will be used as
  . Industrial water - Mixer
    - Gob chutes
    - Sand washing.
  . Potable and sanitary water.
  . Cooling water - Level detectors
    - Batch charger
    - Press plunger
    - IS machine
    - Air compressors

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* U T I L I T I E S *
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Quantities	(Unit)	Unit price US $	1	2	3	4	5	6
Electricity	(th.kwh)	23.53	15347.0	17020.0	17917.0	18855.0	17409.0	22510.0
Heavy fuel oil	(t.)	325.00	723.0	881.0	966.0	1054.0	918.0	1399.0
L.P.G.	(t.)	1070.00	35.0	35.0	35.0	35.0	30.0	35.0
Water	(cu.m.)	.25	77750.0	81200.0	84200.0	87500.0	85100.0	96850.0

		7	8	9	10	11	12	13
Electricity	(th.kwh)	24575.0	26028.0	27628.0	24293.0	24293.0	25968.0	26795.0
Heavy fuel oil	(t.)	1594.0	1731.0	1882.0	1567.0	1567.0	1725.0	1803.0
L.P.G.	(t.)	35.0	35.0	35.0	30.0	35.0	35.0	[illegible]
Water	(cu.m.)	102400.0	108500.0	115500.0	104700.0	115500.0	115500.0	115[illegible]

amounts in thousand US $	1	2	3	4	5	6
Electricity	361.1	400.5	421.6	443.7	409.6	529.7
Heavy fuel oil	235.0	286.3	313.9	342.5	298.3	454.7
L.P.G.	37.4	37.4	37.4	37.4	32.1	37.4
Water	19.4	20.3	21.0	21.9	21.3	24.2
in local currency	653.0	744.6	794.0	845.5	761.4	1046.0
in foreign currency	.0	.0	.0	.0	.0	.0
TOTAL	653.0	744.6	794.0	845.5	761.4	1046.0

	7	8	9	10	11	12
Electricity	578.2	612.4	650.1	571.6	571.6	6[illegible]
Heavy fuel oil	518.0	562.6	611.6	509.3	509.3	560.6
L.P.G.	37.4	37.4	37.4	32.1	37.4	37.4
Water	25.6	27.1	28.9	26.2	28.9	28.9
in local currency	1159.3	1239.6	1328.1	1139.2	1147.2	1238.0
in foreign currency	.0	.0	.0	.0	.0	.0
TOTAL	1159.3	1239.6	1328.1	1139.2	1147.2	1238.0

	13
Electricity	630.5
Heavy fuel oil	586.0
L.P.G.	37.4
Water	28.9
in local currency	1282.8
in foreign currency	.0
TOTAL	1282.8

IV.4. PERSONNEL COST

The salaries and living allowances paid in Uganda in the private sector are fairly higher than these paid in the public sector.

Considering that an industry such as the glass industry needs qualified and motivated manpower, we have taken the salaries amongst the highest received levels as a safety measure.

The total cost of labour, including salaries, taxes and living allowances (housing - transport - electricity - lunches - medical expenses) will be as follows :

Qualification	Number	Unit salary (U $/Year)	Unit allowance (U $/Year)	Total cost (U $/Year)
Administration				
General manager	1	5,000	5,000	10,000
Personnel manager	1	1,750	2,800	4,550
Sales manager	1	1,750	2,800	4,550
Accountants	3	1,350	2,350	11,100
Employees	12	450	1,050	18,000
Secretaries	5	700	1,450	10,750
Drivers-Messengers	8	400	1,050	11,600
Sub-total	31	-	-	70 550

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A. For the first 5 years of operation.

Qualification	Number	Unit salary (U $/Year)	Unit allowance (U $/Year)	Total cost (U $/Year)
Production personnel				
Technical manager *	1	20,000	-	20,000
Shift managers *	4	15,000	-	60,000
Machine shop manager	1	1,350	2,350	3,700
Warehouse manager	1	1,350	2,350	3,700
Laboratory specialist	1	1,350	2,350	3,700
Furnace operators *	4	10,000	-	40,000
Chief machinists *	2	10,000	-	20,000
Engineers	8	1,050	1,750	22,400
Skilled workers	39	750	1,450	85,800
Semi-skilled workers	17	550	1,450	34,000
Unskilled workers	73	400	1,050	105,850
Sub-total	151	-	-	399,150
Grand-total	182	-	-	469,700

The four working posts marked with an asterix are considered to be executed by specialized expatriates. We have not based their costing on an european level of cost but on a chinese or indian level.

For the fifth year of operation this expatriate assistance will be cancelled partially.

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B. From the fifth year of operation, the following production personnel will be :

Qualification	Number	Unit salary (U $/Year)	Unit allowance (U $/Year)	Total cost (U $/Year)
<u>Production personnel</u>				
Technical manager	1	2,500	2,350	4,850
1 local				
Shift managers	4			
1 expatriate		15,000	-	15,000
3 local		2,000	2,350	13,350
Furnace operators	6			
2 expatriates		10,000	-	20,000
4 local		1,300	2,000	13,200
Chief machinists	2			
1 expatriate		10,000	-	10,000
1 local		1,300	2,000	3,300
Others unchanged	140	-	-	259,150
Sub-total	153	-	-	338,550
Grand-total	184	-	-	409,100

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* MANPOWER: MONTHLY COSTS *
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Quantities	Quantities year 1	Quantities year 2	Quantities year 3	Quantities year 4	Quantities year 5	Months to pay before start up	Monthly cost US $ year 1	Monthly cost US $ year 2	Monthly cost US $ year 3
Administration									
General manager	1	1	1	1	1	0	833	833	833
Personnel manager	1	1	1	1	1	0	379	379	379
Sales manager	1	1	1	1	1	0	379	379	379
Accountant	3	3	3	3	3	0	308	308	308
Employee	12	12	12	12	12	0	125	125	125
Secretary	5	5	5	5	5	0	179	179	[illegible]
Driver - messenger	8	8	8	8	8	0	121	121	[illegible]
Sub-total	31	31	31	31	31	0	190	190	163
Production									
Technical manager *	1	1	1	1	0	0	1667	1667	1667
Technical manager	0	0	0	0	1	0	0	0	0
Shift manager *	4	4	4	4	1	0	1250	1250	1250
Shift manager	0	0	0	0	3	0	363	363	363
Machine shop manager	1	1	1	1	1	0	308	308	308
Warehouse manager	1	1	1	1	1	0	308	308	308
Laboratory specialist	1	1	1	1	1	0	308	308	308
Furnace operator *	4	4	4	4	2	0	833	833	833
Furnace operator	0	0	0	0	4	0	275	275	275
Chief machinist *	2	2	2	2	1	0	833	833	833
Chief machinist	0	0	0	0	1	0	275	275	275
Engineer	8	8	8	8	8	0	233	233	[illegible]
Skilled worker	39	39	39	39	39	0	183	183	[illegible]
Semi-skilled worker	17	17	17	17	17	0	167	167	167
Unskilled worker	73	73	73	73	73	0	121	121	121
Sub-total	151	151	151	151	153	0	220	220	220
Total variables costs	151	151	151	151	153	0	143	143	143
Total fixed costs	31	31	31	31	31	0	190	190	163
TOTAL	182	182	182	182	184	0	215	215	211

Quantities		Monthly cost US $ year 4	Monthly cost US $ year 5
Administration			
General manager		833	833
Personnel manager		379	379
Sales manager		379	379
Accountant		308	308
Employee		125	125
Secretary		179	179
Driver - messenger		121	121
Sub-total		190	190
Production			
Technical manager	*	1667	1667
Technical manager		0	404
Shift manager	*	1250	1250
Shift manager		36	363
Machine shop manager		308	308
Warehouse manager		308	308
Laboratory specialist		308	308
Furnace operator	*	833	833
Furnace operator		275	275
Chief machinist	*	833	833
Chief machinist		275	275
Engineer		233	233
Skilled worker		183	183
Semi-skilled worker		167	167
Unskilled worker		121	121
Sub-total		220	184
Total variables costs		143	160
Total fixed costs		190	190
TOTAL		215	185

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* MANPOWER *
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amounts in thousand US $	1	2	3	4	5
Administration					
General manager	10.0	10.0	10.0	10.0	10.0
Personnel manager	4.5	4.5	4.5	4.5	4.5
Sales manager	4.5	4.5	4.5	4.5	4.5
Accountant	11.1	11.1	11.1	11.1	11.1
Employee	18.0	18.0	18.0	18.0	18.0
Secretary	10.7	10.7	1.0	10.7	10.7
Driver - messenger	11.6	11.6	11.6	11.6	11.6
Sub-total	70.5	70.5	60.8	70.5	70.5
Production					
Technical manager *	20.0	20.0	20.0	20.0	.0
Technical manager	.0	.0	.0	.0	4.8
Shift manager *	60.0	60.0	60.0	60.0	15.0
Shift manager	.0	.0	.0	.0	13.0
Machine shop manager	3.7	3.7	3.7	3.7	3.7
Warehouse manager	3.7	3.7	3.7	3.7	3.7
Laboratory specialist	3.7	3.7	3.7	3.7	3.7
Furnace operator *	40.0	40.0	40.0	40.0	20.0
Furnace operator	.0	.0	.0	.0	13.2
Chief machinist *	20.0	20.0	20.0	20.0	10.0
Chief machinist	.0	.0	.0	.0	3.3
Engineer	22.4	22.4	22.4	22.4	22.4
Skilled worker	85.8	85.8	85.8	85.8	85.8
Semi-skilled worker	34.0	34.0	34.0	34.0	34.0
Unskilled worker	105.8	105.8	105.8	105.8	105.8
Sub-total	399.1	399.1	399.1	399.1	338.5
Total variables costs	399.1	399.1	399.1	399.1	338.5
Total fixed costs	70.5	70.5	60.8	70.5	70.5
TOTAL	469.7	469.7	460.0	469.7	409.1
in local currency	329.7	329.7	320.0	329.7	364.1
in foreign currency	140.0	140.0	140.0	140.0	45.0

IV.5. OTHER PRODUCTION COSTS

1. SPARE PARTS

As per the normal practice to operate a glass factory 24 h/d continuously a permanent stock of 2 years consumption is needed. It will be included in the working capital. The yearly consumption, from the first year of production, is estimated at 316,100 U $.

2. CONSUMABLE PARTS

These items include the moulds, the decoration enamels, the packing and miscellaneous (small tools, pallets, lubricants, etc ...)

Their cost is estimated as follows (in U $/Year).

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* CONSUMABLES *
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Quantities	(Unit)	Unit price US $	1	2	3	4	5	6
Moulds	(US $)	1.00	264700.0	267100.0	279200.0	292100.0	272600.0	366400.0
Enamels	(US $)	1.00	172400.0	193300.0	216800.0	242900.0	226800.0	304700.0
Packing	(US $)	1.00	50300.0	56900.0	63900.0	71300.0	66500.0	89400.0
Miscellaneous	(US $)	1.00	332700.0	332700.0	332700.0	332700.0	332700.0	332700.0

		7	8	9	10	11	12	13
Moulds	(US $)	410400.0	459600.0	514800.0	429000.0	514800.0	514800.0	514800.0
Enamels	(US $)	341300.0	382200.0	428100.0	356700.0	428100.0	428100.0	428100.0
Packing	(US $)	100200.0	112200.0	125700.0	104700.0	125700.0	125700.0	12[illegible].0
Miscellaneous	(US $)	332700.0	332700.0	332700.0	332700.0	332700.0	332700.0	3[illegible].0

amounts in thousand US $	1	2	3	4	5	6
Moulds	264.7	267.1	279.2	292.1	272.6	366.4
Enamels	172.4	193.3	216.8	242.9	226.8	304.7
Packing	50.3	56.9	63.9	71.3	66.5	89.4
Miscellaneous	332.7	332.7	332.7	332.7	332.7	332.7
in local currency	33.3	33.3	33.3	33.3	33.3	33.3
in foreign currency	786.8	816.7	859.3	905.7	865.3	1059.9
TOTAL	820.1	850.0	892.6	939.0	898.6	1093.2

	7	8	9	10	11	12
Moulds	410.4	459.6	514.8	429.0	514.8	[illegible]8
Enamels	341.3	382.2	428.1	356.7	428.1	[illegible]28.1
Packing	100.2	112.2	125.7	104.7	125.7	125.7
Miscellaneous	332.7	332.7	332.7	332.7	332.7	332.7
in local currency	33.3	33.3	33.3	33.3	33.3	33.3
in foreign currency	1151.3	1253.4	1368.0	1189.8	1368.0	1368.0
TOTAL	1184.6	1286.7	1401.3	1223.1	1401.3	1401.3

	13
Moulds	514.8
Enamels	428.1
Packing	125.7
Miscellaneous	332.7
in local currency	33.3
in foreign currency	1368.0
TOTAL	1401.3

3. **INSURANCE AND OVERHEADS**

These are estimated at 3 % of the production costs (raw materials, consumables, spare parts, utilities, manpower costs, technical assistance).

4. **TECHNICAL ASSISTANCE**

Notwithstanding the quality of the local personnel training performed abroad, the experience shows that this training is always insufficient to allow to reach developed countries personnel skilness.
In order to reach an optimized level of experience, several years of training should be necessary, what is practically impossible to obtain for evident planning and costing reasons. The only alternative to obtain a good efficiency in the production (in this project a 80 % yield is computed after 4 years of production) is the presence of expatriate technicians on site during several years. These experts should come from an european glass manufactoring company. The mission of these polyvalent experts should be double. Firstly they should be able to help the technical management for any kind of problem which could occur during their presence. Secondly, and this is the main purpose of their presence they should give a permanent follow up and extension of training to the local personnel, teaching them how to react facing all kinds of problems which cannot be always foreseen.

We consider in this study the assistance of three specialists the first year of production, of two specialists the second year and of one specialist the third year.

The relative cost is as follows :

1st year	:	510,000 U $
2nd year	:	340,000 U $
3rd year	:	170,000 U $.

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5. LAND

The surface area needed for the factory is 300 m x 130 m or 3.9 hectares.

The factory should be situated in the Kampala zone area, preferally close to Port Bell where the sand will be discharged or in the Kampala industrial zone (Nakawa - Kiswa).

According to the Ministry of Lands and Surveys, there is no unleased land in the Kampala Industrial Area, nor in Port Bell.

The Ministry of Housing and Urban Development has declared that free lands are available in the Luzira and Mutungo areas. These areas being situated between the Kampala Industrial Zone and Port Bell, close to the Victoria Lake, we consider them suitable.

The investment cost of land for this project will amount to 9,750 US $.

Production costs will also inclue a lease of 975 US $ per year.

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EXPLANATORY NOTE ON COMPUTER PROGRAMS

Two different programs have been used, the first one being an ABAY program and the second one the UNIDO program called COMFAR. The latter is easily recognizable by the "COMFAR-UNIDO" logo at the right upper part of the page.

The two programs give obviously the same final results. However some differences of concept can be observed when comparing tables coming from both programs.

As an example, the following production costs tables :

"The COMFAR program consider that depreciation and financial costs are included in the production costs, whilst the ABAY program excludes these items from the production costs to add them separately at a later stage. The indirect manpower, the insurance and overhead, and the land renting are presented separately in the ABAY program whilst they are grouped in the COMFAR under the name "Administrative overheads"."

Once again, the final computerized results are absolutely similar, but we believe it is useful to present the two programs in parallel. Some readers being more acquainted to one or the other type of program.

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* PRODUCTION COSTS SCHEDULE *
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amounts in thousand US $	1	2	3	4	5	6	7
VARIABLE COSTS							
Raw materials	871.7	984.4	1080.9	1188.1	1109.0	1490.4	1669.2
Consumables	820.1	850.0	892.6	939.0	898.6	1093.2	1184.6
Utilities	653.0	744.6	794.0	845.5	761.4	1046.0	1159.3
Spare parts	.0	.0	.0	.0	.0	.0	.0
Manpower (direct)	399.1	399.1	399.1	399.1	338.5	338.5	338.5
TOTAL VARIABLE COSTS	2743.9	2978.1	3166.7	3371.7	3107.5	3968.2	4351.7
FIXED COSTS							
Manpower (indirect)	70.5	70.5	60.8	70.5	70.5	70.5	70.5
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	316.1	316.1	316.1	316.1	316.1	316.1	316.1
Insurance and overhead	109.2	111.1	111.6	112.8	107.2	132.5	144.0
Technical assistance	510.0	340.0	170.0	.0	.0	.0	.0
Land renting	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TOTAL FIXED COSTS	1006.8	838.7	659.5	500.4	494.8	520.1	531.6
T O T A L	3750.8	3816.8	3826.2	3872.2	3602.3	4488.3	4883.4

	8	9	10	11	12	13	avg. 15 y.
VARIABLE COSTS							
Raw materials	1869.4	2093.8	1744.7	2093.8	2093.8	2093.8	1638.1
Consumables	1286.7	1401.3	1223.1	1401.3	1401.3	1401.3	1173.0
Utilities	1239.6	1328.1	1139.2	1147.2	1238.0	1282.8	1069.0
Spare parts	.0	.0	.0	.0	.0	.0	.0
Manpower (direct)	338.5	338.5	338.5	338.5	338.5	338.5	354.7
TOTAL VARIABLE COSTS	4734.3	5161.7	4445.5	4980.9	5071.7	5116.5	4234.8
FIXED COSTS							
Manpower (indirect)	70.5	70.5	70.5	70.5	70.5	70.5	69.9
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	316.1	316.1	316.1	316.1	316.1	316.1	316.1
Insurance and overhead	155.4	168.3	146.8	162.8	165.6	166.9	142.1
Technical assistance	.0	.0	.0	.0	.0	.0	68.0
Land renting	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TOTAL FIXED COSTS	543.0	555.9	534.4	550.4	553.2	554.5	597.0
T O T A L	5277.3	5717.7	4980.0	5531.3	5624.9	5671.0	4831.8

*** PRODUCTION COSTS SCHEDULE (IN LOCAL CURRENCY) ***

amounts in thousand US $	1	2	3	4	5	6	7
VARIABLE COSTS							
Raw materials	172.7	195.0	214.1	235.3	217.6	295.2	330.6
Consumables	33.3	33.3	33.3	33.3	33.3	33.3	33.3
Utilities	653.0	744.6	794.0	845.5	761.4	1046.0	1159.3
Spare parts	.0	.0	.0	.0	.0	.0	.0
Manpower (direct)	259.1	259.1	259.1	259.1	293.5	293.5	293.5
TOTAL VARIABLE COSTS	1118.1	1231.9	1300.6	1373.3	1307.8	1668.0	1816.8
FIXED COSTS							
Manpower (indirect)	70.5	70.5	60.8	70.5	70.[illegible]	70.5	70.5
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	.0	.0	.0	.0	.0	.0	[illegible]
Insurance and overhead	54.6	55.6	55.8	56.4	53.6	66.3	[illegible]
Technical assistance	.0	.0	.0	.0	.0	.0	.0
Land renting	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TOTAL FIXED COSTS	126.1	127.1	117.6	127.9	125.1	137.8	143.5
T O T A L	1244.2	1359.0	1418.2	1501.2	1432.9	1805.8	1960.3

	8	9	10	11	12	13	avg. 15 y.
VARIABLE COSTS							
Raw materials	370.3	414.7	345.6	414.7	414.7	414.7	324.4
Consumables	33.3	33.3	33.3	33.3	33.3	33.3	33.3
Utilities	1239.6	1328.1	1139.2	1147.2	1238.0	1282.8	1069.0
Spare parts	.0	.0	.0	.0	.0	.0	.0
Manpower (direct)	293.5	293.5	293.5	293.5	293.5	293.5	284.4
TOTAL VARIABLE COSTS	1936.7	2069.6	1811.6	1888.7	1979.5	2024.3	17[illegible]
FIXED COSTS							
Manpower (indirect)	70.5	70.5	70.5	70.5	70.5	70.5	69.9
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	.0	.0	.0	.0	.0	.0	.0
Insurance and overhead	77.7	84.2	73.4	81.4	82.8	83.5	71.0
Technical assistance	.0	.0	.0	.0	.0	.0	.0
Land renting	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TOTAL FIXED COSTS	149.2	155.7	144.9	152.9	154.3	155.0	141.9
T O T A L	2085.9	2225.3	1956.5	2041.7	2133.8	2179.3	1853.0

****
* PRODUCTION COSTS SCHEDULE (IN FOREIGN CURRENCY) *
****

amounts in thousand US $	1	2	3	4	5	6	7
VARIABLE COSTS							
Raw materials	699.1	789.4	866.8	952.7	889.4	1195.2	1338.6
Consumables	786.8	816.7	859.3	905.7	865.3	1059.9	1151.3
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	.0	.0	.0	.0	.0	.0	.0
Manpower (direct)	140.0	140.0	140.0	140.0	45.0	45.0	45.0
TOTAL VARIABLE COSTS	1625.9	1746.2	1866.2	1998.5	1799.7	2300.1	2535.0
FIXED COSTS							
Manpower (indirect)	.0	.0	.0	.0	.0	.0	.0
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	316.1	316.1	316.1	316.1	316.1	316.1	316.1
Insurance and overhead	54.6	55.6	55.8	56.4	53.6	66.3	72.0
Technical assistance	510.0	340.0	170.0	.0	.0	.0	.0
Land renting	.0	.0	.0	.0	.0	.0	.0
TOTAL FIXED COSTS	880.7	711.6	541.9	372.5	369.7	382.3	388.1
T O T A L	2506.6	2457.8	2408.1	2371.0	2169.4	2682.5	2923.1

	8	9	10	11	12	13	avg. 15 y.
VARIABLE COSTS							
Raw materials	1499.2	1679.1	1399.1	1679.1	1679.1	1679.1	1313.6
Consumables	1253.4	1368.0	1189.8	1368.0	1368.0	1368.0	1139.8
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	.0	.0	.0	.0	.0	.0	.0
Manpower (direct)	45.0	45.0	45.0	45.0	45.0	45.0	70.3
TOTAL VARIABLE COSTS	2797.6	3092.2	2634.0	3092.2	3092.2	3092.2	2523.7
FIXED COSTS							
Manpower (indirect)	.0	.0	.0	.0	.0	.0	.0
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	316.1	316.1	316.1	316.1	316.1	316.1	316.1
Insurance and overhead	77.7	84.2	73.4	81.4	82.8	83.5	71.0
Technical assistance	.0	.0	.0	.0	.0	.0	68.0
Land renting	.0	.0	.0	.0	.0	.0	.0
TOTAL FIXED COSTS	393.8	400.2	389.5	397.5	398.9	399.5	455.1
T O T A L	3191.4	3492.4	3023.5	3489.7	3491.1	3491.7	2978.9

Total Production Costs in thousand US $

Year	1992	1993	1994	1995	1996
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	871.722	984.382	1080.943	1188.095	1108.901
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	820.097	850.002	892.600	939.000	898.600
Energy	652.978	744.556	794.037	845.533	761.359
Labour, direct	399.100	399.100	399.100	399.100	338.500
Repair, maintenance	0.000	0.000	0.000	0.000	0.000
Spares	316.100	316.100	316.100	316.100	316.100
Factory overheads	510.000	340.000	170.000	0.000	0.000
Factory costs	3569.997	3634.139	3652.780	3687.828	3423.460
Administrative overheads	180.700	182.700	183.100	184.300	178.700
Indir. costs, sales and distributio	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	2491.513	2491.513	2491.513	2491.513	2491.513
Financial costs	1591.525	1279.025	966.525	752.427	518.533
Total production costs	7833.734	7587.377	7293.918	7116.067	6612.206
Costs per unit (single product) .	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	82.144	80.230	78.696	77.146	76.436
Of it variable,%	26.822	31.157	36.339	41.634	41.820
Total labour	469.600	469.600	469.600	469.600	409.000

Total Production Costs in thousand US $

Year	1997	1998	1999	2000	2001
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	1490.343	1669.193	1869.492	2093.830	1744.858
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	1093.200	1184.599	1286.700	1401.300	1223.100
Energy	1045.998	1159.350	1239.589	1328.060	1139.164
Labour, direct	338.500	338.500	338.500	338.500	338.500
Repair, maintenance	0.000	0.000	0.000	0.000	0.000
Spares	316.100	316.100	316.100	316.100	316.100
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	4284.142	4667.742	5050.381	5477.790	4761.722
Administrative overheads	204.100	215.500	226.900	239.900	218.300
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	1872.613	1872.613	1872.613	1872.613	1872.613
Financial costs	336.515	310.122	283.728	257.335	230.942
Total production costs	6697.370	7065.976	7433.623	7847.638	7083.577
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	71.739	71.028	70.772	70.533	71.154
Of it variable,%	55.490	58.908	62.713	66.533	61.425
Total labour	409.000	409.000	409.000	409.000	409.000

Total Production Costs in thousand US $

Year	2002	2003	2004	2005	2006
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	2093.830	2093.830	2093.830	2093.830	2093.830
Other raw materials	0.000	0.000	0.000	0.000	0.000
Utilities	1401.300	1401.300	1401.300	1401.300	1401.300
Energy	1147.214	1237.977	1282.786	1328.060	1328.060
Labour, direct	338.500	338.500	338.500	338.500	338.500
Repair, maintenance	0.000	0.000	0.000	0.000	0.000
Spares	316.100	316.100	316.100	316.100	316.100
Factory overheads	0.000	0.000	0.000	0.000	0.000
Factory costs	5296.944	5387.707	5432.516	5477.790	5477.790
Administrative overheads	234.300	237.100	238.500	239.900	239.900
Indir. costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Direct costs, sales and distribution	0.000	0.000	0.000	0.000	0.000
Depreciation	1546.813	1546.813	1546.813	1546.813	1546.021
Financial costs	204.548	178.155	151.762	125.368	98.975
Total production costs	7282.605	7349.775	7369.591	7389.871	7362.686
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	70.769	69.782	69.246	68.708	68.593
Of it variable,%	71.695	71.040	70.849	70.655	70.916
Total labour	409.000	409.000	409.000	409.000	409.000

V. LOCATION AND SITE.

V. LOCATION AND SITE

The four main factors to locate an industry are as follows :

- Existing infrastructure [roads, railway, access to the Victoria Lake (Harbor), water, electricity, sewage connections].
- Labor availability in quality and quantity.
- Proximity of the raw materials sources.
- Proximity of the customers.

In the particular field of the container glass industry, this last factor is by far the more important.
Indeed the transport cost of the containers is far more expensive than the transport cost of the raw materials due to the fact that the empty containers have a specific weight far below 1 kg/l whilst the bulk raw materials have a specific weight above 1 kg/l. In average we can say that for each cum (m^3)available on a truck, the tonnage of transported raw materials is at least 3 times higher than the possible tonnage of containers .

We shall therefore examine first of all the proximity of the customers.

1. Bottles :

From the table of consumption of bottles in 1992, we can see that the consumption per bottler's origin is as follows :

Kampala	:	57,770,100 l
Masaka	:	7,295,200 l
Jinja	:	6,951,400 l
Total	:	72,016,700 l

Kampala being situated roughly at half distance between Jinja and Masaka is obviously the ideal situation as far as the bottler's location is concerned (see attached map).

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2. Tablewares :

From the tablewares production chapter, we can see that as a mean average, the tablewares production will be sold for 61.7 % in Uganda and far 38.3 % in Rwanda-Burundi.

For the local market, Kampala will be the center of distribution, whilst for export, Masaka is closer to the Rwandese border.

3. Total production :

Adding the bottles and tablewares production, we can say roughly that the bast location is as follows :

Kampala	:	76 %
Masaka	:	19 %
Jinja	:	5 %.

As far as the raw materials are concerned, the soda ash and feldspar will come from Kenya and european imported small products will also come through Mombasa and Jinja. On another hand the limestone/dolomite will come from Hima through Masaka, whilst the barge transport of sand will come from Diimu which is closer to Masaka than Kampala.

Computing the transport costs for both containers and raw materials we arrive at the following conclusion :

Kampala	:	52.5 %
Masaka	:	35 %
Jinja	:	12.5 %.

If the glass factory is located in Kampala, the cost of transport (containers + raw materials) will be less than 60 % of the same cost for a factory located in Masaka.

It is without saying that infrastructure and labour availability are also ideal in Kampala compared with other Ugandese location.

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We therefore definitely consider Kampala as being the best place to locate the factory.

The old plant of the Madhvani's family, East African Glass Works Ltd is still existing in the Industrial Area of Kampala, although there is no more machinery recoverable, the buildings themselves can technically be used for this project although future expansion possibilities are very limited.

Of course, this alternative would lead to a sizeable reduction in needs for contruction and land preparation costs and delay.

However due on ownership problem this site cannot be considered for the time being. This fact was certified by both the Ugandese Ministry of Industry and the Madhvani Group itself (Mr. O.G. Kapoor - General Manager).

Another site would therefore be found in the vicinity of Kampala, close to the Industrial Area and Port Bell, where the sand is intended to be discharged from the barges coming from DIIMU. Free industrial lands being available in the Luzira and Mutungo areas, between the Industrial Area and Port Bell, we consider that the glass factory would be situated there. But final selection would be done in due time (see attached map).

Environmental considerations

The main problem is the sulphur content of the fuels and of the chemical in-puts in the batch. This sulphur escapes as SO_2 and SO_3. There are several possibilities of dealing with this.

1. The use of electricity as an added heating element would greatly decrease the SO_2 in the exhaust gases and would render the following solutions much more effective. Also for reasons of heat efficiency, the partial heating by electricity should be taken into consideration as we did.

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2. The exhaust gases are released in places where there is no damage to Uganda to be expected.
   Either the exhaust gases are released by a chimney high in the air, to let the SO_2 spread out and dilute below obnoxious concentations before returning to land as acid rain, or the gases are released to a body of water. In the present case, a release to Lake Victoria would appear to be a desirable solution. But since rain is frequent and heavy in the area of Kampala - Entebbe - Jinja, sulphur release in the air will be naturally cleaned by rain and drained without detremental consequences on the environment.
   We designed the chimney in the plant according the European regulations versus the pollution in industrial area.

Socio-economic preference for location

We do not detect special desire from the Government to give preference to certain area for industrial implementation considering the socio-economic impact.

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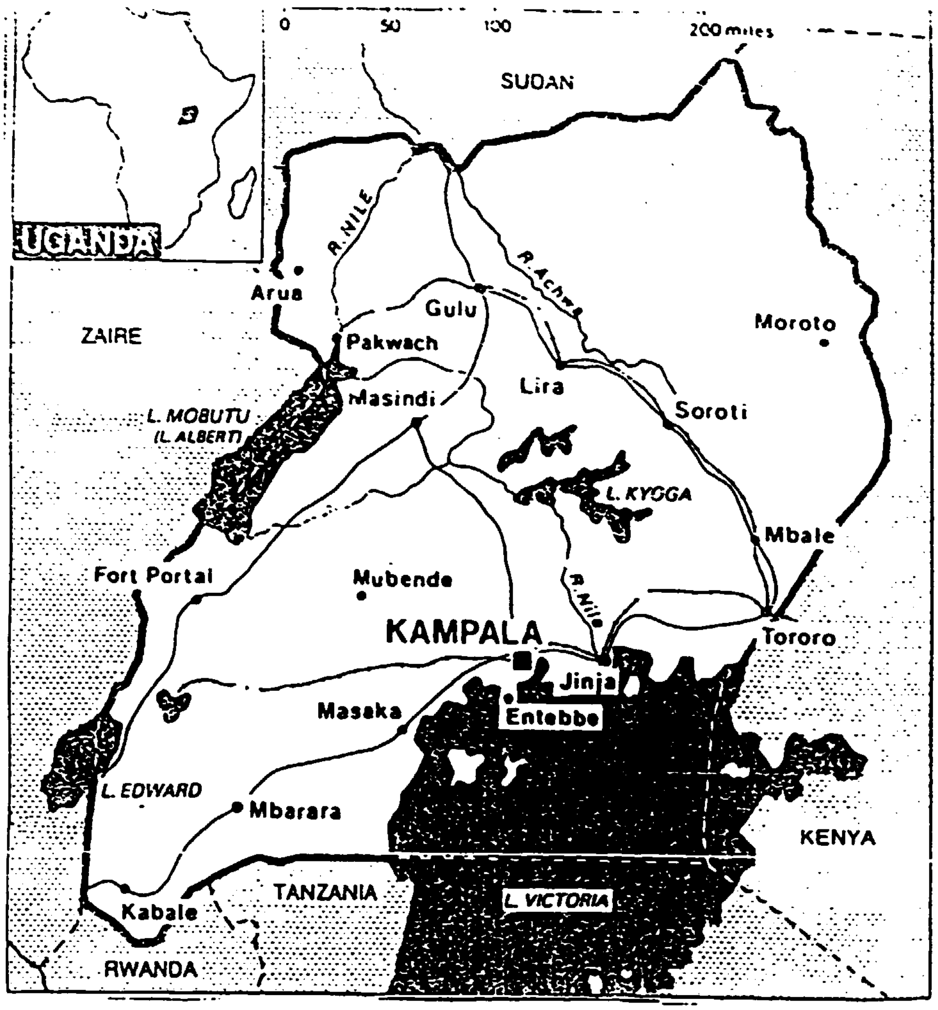
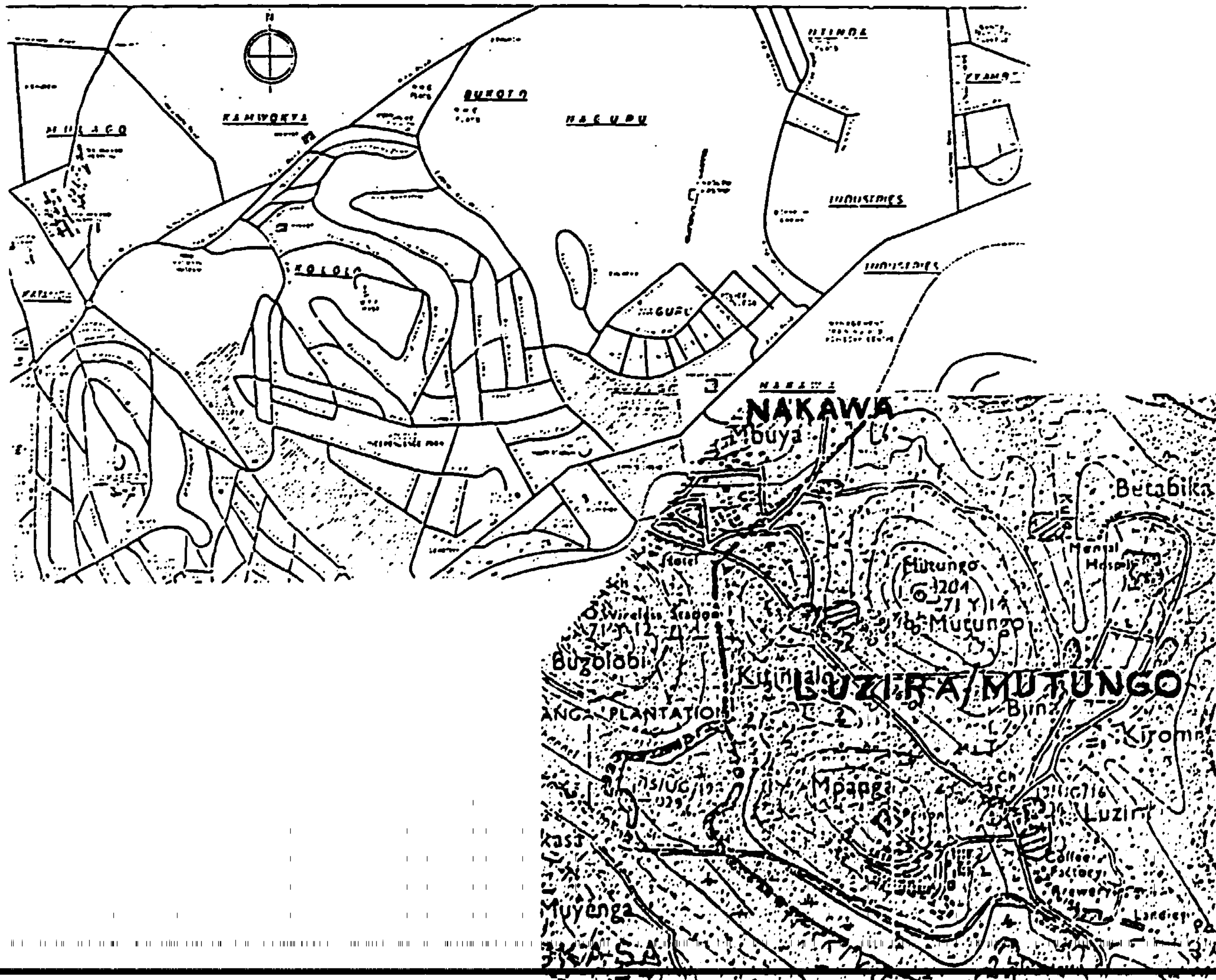


MAP OF KAMPALA CITY



VI. PROJECT ENGINEERING.

VI.1. PROJECT LAYOUT

A container glass factory will mainly include the following sections :

- Discharging and primary storage of the raw materials.
- Treatment of raw materials.
- Silo storage of raw materials.
- Weighing and mixing of raw materials.
- Transport of batch to the furnace.
- Melting of the batch.
- Container production machines.
- Annealing of the containers.
- Quality inspection of the containers.
- Manual packaging of the non decorated containers.
- Decoration of the containers.
- Annealing of the decorated containers.
- Manual packaging of the decorated containers.
- Cullet recycling.
- Finished products storage department.
- Utilities departments
    - . Compressors station.
    - . Electrical main station.
    - . Water cooling tower.
    - . Water settling pond.
    - . Water station.
    - . Water basin.
    - . LPG station.
    - . Fuel oil storage.
- Offsites departments
    - . Workshope.
    - . General store.
    - . Technical office.
    - . Laboratory.

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. General administration.
. Packing.
. Weighing plant.
. Gates house.

An example of project layout is attached, combining the different sections.

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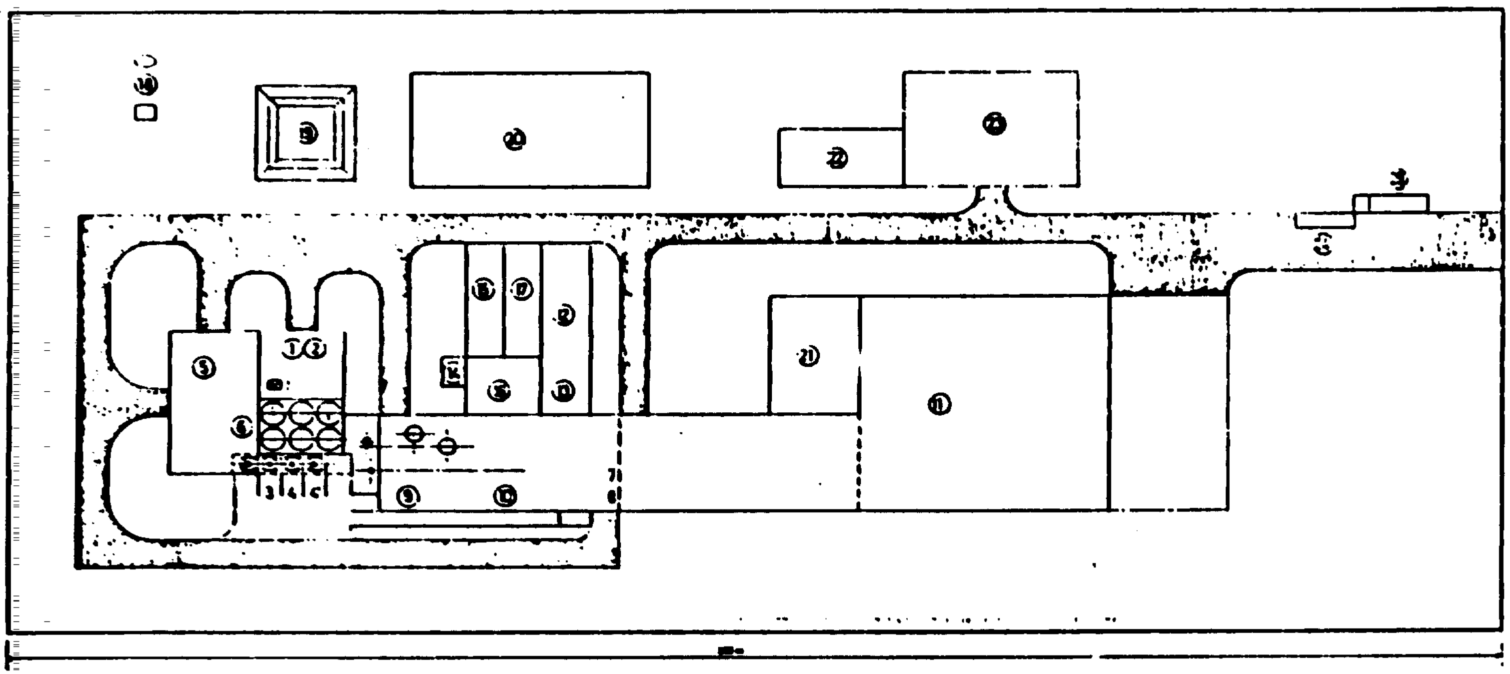

BUILDINGS IDENTIFICATION		IDENTIFICATION DES OUVRAGES
SAND DISCHARGING	1	DECHARGEMENT SABLE
SAND STORAGE	2	STOCK SABLE
LIMESTONE DOLOMITE STORAGE	3	STOCK CALCAIRE DOLOMIE
DOLOMITE LIMESTONE STORAGE	4	STOCK CALCAIRE DOLOMIE
FELDSPAR STORAGE	4	STOCK FELDSPATH
SODA ASH STORAGE	5	STOCK SOUDE
BATCH PLANT	6	UNITE DE COMPOSITION
EXTERNAL CULLET TREATMENT	7	TRAITEMENT DU CALCIN
CULLET STORAGE	8	STOCKAGE CALCIN
FURNACE HALL	9	HALL DU FOUR
FABRICATION HALL	10	HALL DE FABRICATION
WAREHOUSE FOR MOULDED GLASS	11	MAGASIN DES PRODUITS FINIS
COMPRESSORS STATION	12	SALLE DES COMPRESSEURS
ELECTRICAL MAIN STATION	13	DISTRIBUTION ELECTRIQUE
COOLING TOWER	14	TOUR DE REFROIDISSEMENT
SETTLING POND	15	BASSIN DE DECANTATION
WATER STATION	16	STATION D'EAU
WATER BASIN	17	BASSIN D'EAU
L.P.G. STATION	18	STOCK GAZ L.P.G
FUEL OIL STORAGE	19	STOCK FUEL
WORKSHOP-GENERAL STORE	20	ATELIERS-MAGASIN
TECHNICAL OFFICES-LABO	21	BUREAUX TECHNIQUES-LABO
GENERAL ADMINISTRATION BUILDING	22	ADMINISTRATION CENTRALE
PARKING	23	PARKING
WEIGHING PLANT	24	PONT A PESER
GATES HOUSE	25	CONCIERGERIE

UGANDA
GLASS CONTAINER PROJECT
GENERAL LAY-OUT

Engineering

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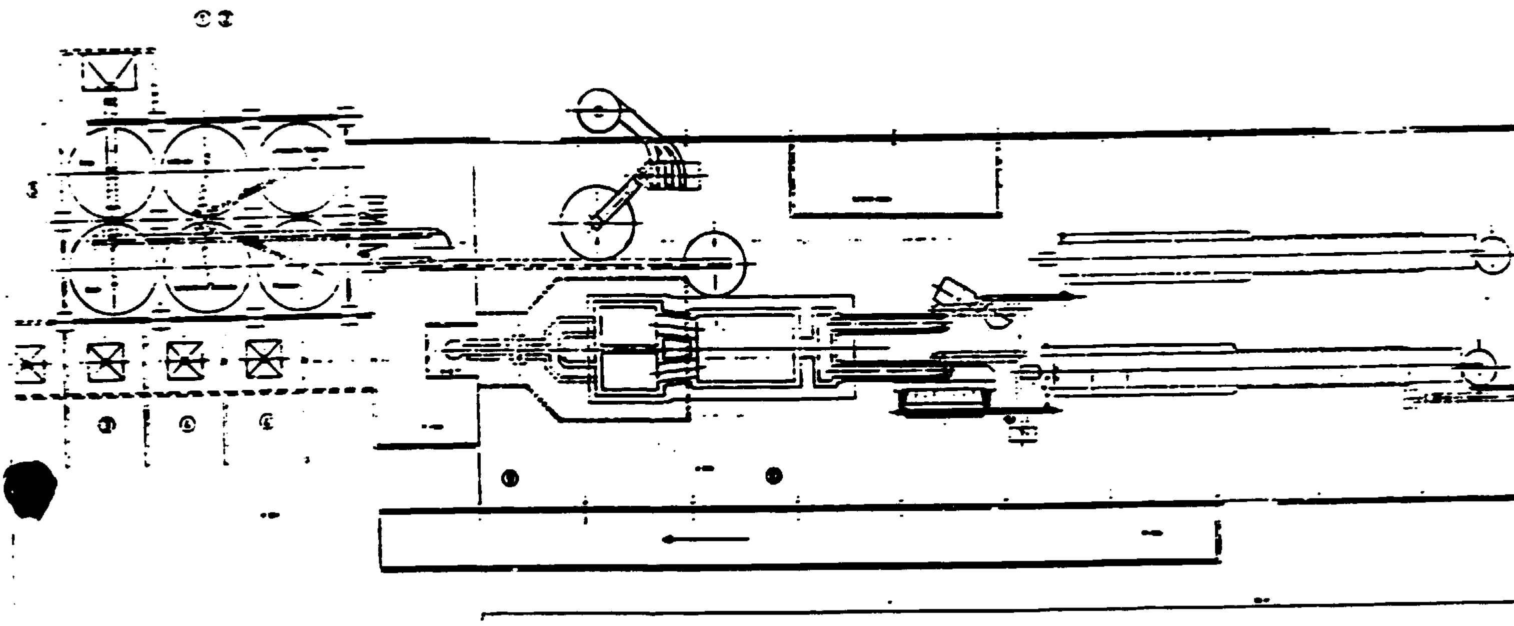
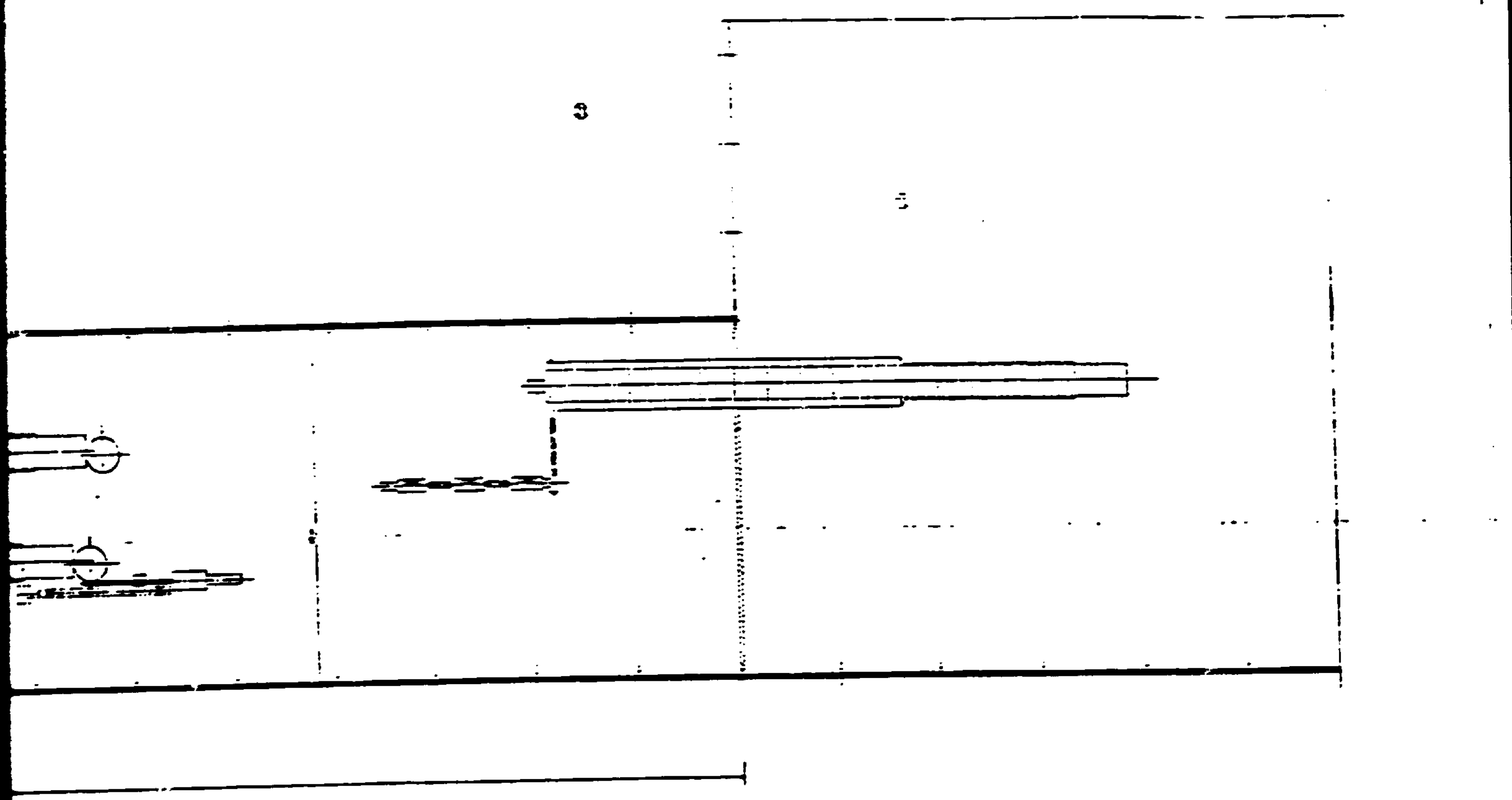


SECTION 1



SECTION .2

UGANDA
GLASS CONTAINER PROJECT
FURNACE AND FABRICATION HALL

A

VI.2. SCOPE OF PROJECT

1. BATCH PLANT

1.1. DISCHARGING AND PRIMARY STORAGE OF THE RAW MATERIALS

All the raw materials would be supplied to the factory
in lorries, in bulk : sand, limestone/dolomite, feldspar
in bags or drums : soda ash, baryum sulfate, sodium nitrate, anhydrous borax, arsenium, selenium, cobalt oxide, pyrite.

A weighbridge will weigh the lorries containing bulk materials at the entrance of the factory.

The sand will be discharged by tip-up trucks into a primary storage cell and distributed by an overhead travelling crane, also used to remove the sand from the cell.

The limestone/dolomite and the feldspar will be discharges by tip-up trucks into an underground hopper from which they will be extracted by an elevator transporter.

The other materials in bags or in drums will be transported by flat lorries with tarpaulin covers and palletized in a covered store.

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1.2. TREATMENT OF RAW MATERIALS

All the products, except the sand and the limestone/ dolomite are presumed to be supplied ready for immediate use without any previous treatment.

The raw sand extracted from the primary storage cell will be conveyed to a sieving group working in moist mode. This group preceded by a pulping unit is equipped with a static sieving device. Grains of sand below 0,8 mm will be sent to cyclone-drier unit equipped with a steam adding device. The washed and dried sand will be conveyed towards the daily silo by means of a circuit of conveyor belts.

The feldspar extracted from the underground hopper will goes through a permanent grate magnet and then conveyed to the daily silo by means of a circuit of conveyor belts.

1.3. SILO STORAGE OF RAW MATERIALS

The daily storage silos will include six silos for sand (2 x), sodium carbonate, limestone/dolomite (2 x) and feldspar, each with a capacity of 100 cum.

The daily storage capacity per material will therefore evoluate as follows according to the projected increase of production.

	1st year	9th year
Sand	14 days	6 days
Sodium carbonate	21 days	9 days
Limestone/dolomite	54 days	22 days
Feldspar	68 days	28 days

Smaller silos will be used for the other raw materials.

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1.4. WEIGHING AND MIXING OF RAW MATERIALS

The mixer will have a capacity of 500 l or 650 kg. Based on a 6 minutes cycle for the preparation of a batch, these would be 10 cycles per hour.

Until the end of the fifth year of production, a maximum of 50 tons of raw materials have to oe weighed and mixed per day.

During the five first years of production, the maximum effective working time will therefore be :

$$\frac{50,000}{650 \times 10} = 7.7 \text{ hours per day.}$$

After expansion, a maximum of 90 tons of raw materials have to be weighed and mixed per day.
At that moment, the maximum effective working time will be :

$$\frac{90,000}{650 \times 10} = 13.8 \text{ hours per day.}$$

The sand will be extracted from its daily silo by vibrating extractors, the other products will be extracted by Archimedean screws.

One cumulative weighing lime will be used for the sand, limestone/dolomite, feldspar and soda ash, comprising one weighing hopper of 700 kg capacity.

Another cumulative weighing line will be used for baryum sulfate, sodium nitrate, anhydrous borax comprising one weighing hopper of 20 kg capacity.

The other raw materials, arsenium, selenium, cobalt oxide and pyrite will be bagged and weighed by hand on a precision electronic balance. The weighed bags being deposited into the buckets ′f an automatic bag distributor, feeding directly the mixer.

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1.5. TRANSPORT OF BATCH TO THE FURNACE

One elevator transporter will convey the batch from an hopper underneath the mixer to the batch charging silo besides the furnace.

1.6. MELTING OF THE BATCH

A batch charger will extract the batch from the charging silo in order to feed the furnace.

The furnace will be of the mixed heating type, combining electricity and heavy fuel oil.

The preheating of the combustion air will be performed by twin vertical chamber regenerators.

The melting area will be 20 sqm for a capacity of 50 T/day of molten glass.

All parts of the furnace in contact with glass must be constituted of electrocast refractories, and namely :

- Wall of the melting tank.
- Bottom of the melting tank.
- Day-house angles.
- Throat.
- Electrode blocks.
- Day-house vault.
- End wells.
- Burner holes.
- Wall of the working tank.
- Bottom of the working tank.

All other refractories for both furnace and regenerators will be of higher qualities, in order to improve the life time of the furnace : silica, siloco-aluminous, basic refractories, mullite, sillimanite, zircon, insulating parts.

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The fuel oil heating will be performed by two burner ports placed in the rear wall of the melting tank, fitted with fuel oil injectors. As a result of the regenerative principle the flames change in intervals of 20 to 30 minutes from one burner port to the other. The inversion of combustion air and waste gas will be directed by two twinned driven dampers.

The electric heating will be realized with molybdenium electrodes located in the bottom of the melting tank and in the side walls of the working tank.

The electrodes will be electric feeded through a device including single phase transformer and induction regulators authorizing a control of the feeding voltage. Different devices are to be provided to ensure the security of the electric boosting.

In order to extend the life time of the furnace, air cooling on the flux line and on the throat have to be provided.

The control and pyrometry of the furnace will include namely :

- Measurement of temperature, with Pt and Ni thermocouples.
- Automatic reversal device to adjust and to set the different tempos of the reversal operations in regard one to the other (closing and opening of arrivals of fuel, air, waste gas).
- Furnace pressure control with pressure gauge and electronic transmitter.
- Heat flow control at present value and constant ratio between the air and combustion air flow.
- Glass level control controlling the speed of the batch charges with a frequency controller.

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- Electric boosting control with measurement of intensity and voltage for electrodes and induction controllers.
- Temperature control with radiation pyrometers located in the crown.

1.7. CONTAINERS PRODUCTION MACHINES

Two forehearth assemblies will bring the molten glass from the working tank of the furnace up to the production machines.

Each forehearth will include namely
- Refractories for channel block, superstructure and insulation.
- Electrical heating with molybdene electrodes put horizontally through the channel block in the middle of the glass depth.
- Temperature regulating system controlled from the control room.

Two feeders placed at the end of the forehearths will feed the production machines with cutted gobs having the desired weight in shape in accordance with the container to be produced.

Each feeder will include namely :
- Standard spout with tube equipment.
- Revolving tube drive mechanism.
- Electrical drive.
- Air spring for shears.
- Automatic shear retraction device.
- Basic accessories as shear cams, plunger cams.
- Single gob accessories including refractories in accordance with the production, to be used mainly during the five first years of production.

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- Double gob accessories including refractories in accordance with the production, but to be used only from the 6th year of production.

The production machines will include for the two lines of production :

- One 6 sections IS machine for the bottles production.
- One 12 stations press machine for the tablewares production.

The 6 sections IS machine line will include namely :

- Mechanism for mold operating, mold holder supporting, funnel, baffle, constant cushion invert, neck-ring, blowhead, take-out.
- Single gob delivery system assembled to the machine.
- Double job delivery system as loose parts.
- Single and double gob blow and blow plunger mechanisms with quick change cartridges for production of narrow neck ware.
- Electrical drive.
- Bottom mold cooling wind supply for individual sections.
- Automatic lubrication.
- Mechanical timing.
- Single and double gob accessories in accordance with the production.
- Single dead plate conveyor with extension, pushers, cooling control.
- Curved track ware transfer wheel.

The 12 stations press machine line will include namely :

- Clutch brake mechanism, pneumatically driven.
- Synchronisation with feeder and glazer.
- Rotating table and support mechanism.
- Pneumatic pressing system.
- Mechanical take-out.
- Vertical extractors for take-out and air cleaning.

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- Mechanical timing.
- Automatic lubrication.
- Glazer for fire finishing with burners, air-gas mixers, synchronous motor, air combustion fan.
- Ware transfer equipment.

1.8. ANNEALING OF THE CONTAINERS

From the ware transfers of the production machines, the containers will be pushed on stackers conveyors in order to feed the annealing lehrs.

The two stackers will be of the push bar type and will be equipped with conveyors and synchronisation.

The two annealing lehrs will be in accordance with the production schedule and they will include namely :
- Entry zone.
- Regulated zone.
- Junction.
- Cooling zone.
- Discharging table.
- Regulators pyrometric probes.

The first sections of each lehr will be entirely in stainless steel, the other sections partly.

The belts will be made of special steel for a temperature of 630 ° C.

The heating will be electrical.

The whole regulation system will be grouped in a control panel, which assumes the control and regulation of all heating and cooling devices.

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1.9. QUALITY INSPECTION OF THE CONTAINERS

The automatic inspection will be done only on bottles, the tablewares being inspected manually during their packing.

The inspection line will include :
- One single liner.
- One inspection conveyor.
- One visual inspection panel.
- One dual head gager.
- One optical detector.

The single liner will transfer automatically the bottles from the lehr's discharge table on to the inspection conveyor.

The inspection conveyor will transport the bottles under each inspection machine.

The visual inspection panel will allow to remove articles which run the risk of causing stoppage and damage to the other inspection machines.

The dual head gager permits obtaining at the same time the choke testing and dip-saddle testing. The choke testing includes the play ring and height gaging. The dip-saddle testing includes the unfilled and way testing, as well as the ring finish flatness.

The optical detector detects the reflection of a light way on a defect surface by an automatic optical process.

The inspection reliability is ensured by a receiver with very effective focalization.

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1.10. MANUAL PACKAGING OF THE NON DECORATED CONTAINERS

Due to the very low cost of the non skilled labours, it would not be profitable to consider automatic packing machines for this project.

Therefore, the packing for both bottles and tablewares will be manual.

The tablewares should be packed in cardboard boxes bought precutted, the only operations on site being to unfold the cardboard sheets, to place the interlayers, to filled up the articles and to close the boxes with glued tapes. The boxes will be manually palletized for transport. The bottles being presently bought by all major bottlers in Uganda in plastic crates, it is preferable to keep the same system. The manually filled crates will have to be palletized for transport.

1.11. DECORATION OF THE CONTAINERS

The bottles to be decorated will be taken from the store, or directly from the inspection line's end to be brought to the decorating machines.

We have envisaged three decorating machines using the principle of the thermofusible screen printing.

Only one machine will be used if only one colour is needed. If a two colour decoration is required, a liaison conveyor will bring the articles from the first machine to the second one. For a third colour, as needed for the production of Lake Victoria Bottling Co, a second conveyor will bring the articles to the third machine.

Equipment for laboratory have to be supplied in order to allow the preparation of the screens.

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1.12. ANNEALING OF THE DECORATED CONTAINERS

A lehr conveyor will bring the articles from the last machine to the stacker feeding the decorating lehr.

The decorating lehr will be in accordance with the production schedule and it will include namely :

- Entry zone.
- Regulated zone.
- Convection zone.
- Regulated and cooling zone.
- Junction.
- Cooling section with mobile blades.
- Discharging tables.
- Regulators, lehr pyrometric probes.

The first sections of each lehr will be entirely in stainless steel, the other sections partly.

The belts will be made of special steel for a temperature of 630 ° C.

The heating will be electrical.

The whole regulation system will be grouped in a control panel, which assumes the control and regulation of all heating and cooling devices.

1.13. MANUAL PACKAGING OF THE DECORATED CONTAINERS

The manually filled plastic crates will have to be palletized for transport.

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1.14. CULLET RECYCLING

Cullet (broken glass and non saleable production) will be recovered at the level of the production (hot cullet) through two gob recovery chutes under the feeders and through two waste recovery chutes under the production machines.

Cullet will be recovered at the level of the inspection (cold cullet) in containers and tablewares production's lines.

Both types of cullet (hot and cold cullet) will be brought to the cullet treatment plant, where they will be discharged in a receiving hopper under which an extractor will feed a cullet crusher. From the crusher a conveyor will bring the cullet on to a conveyor elevator to the daily storage silo. An iron tramp separator with permanent magnet will be installed above the conveyor.

From the daily storage silo, the cullet will be extracted by a vibrating extractor feeding the batch conveyor elevator to the batch charging silo besides the furnace.

1.15. FINISHED PRODUCTS STORAGE DEPARTMENT

The pallets of packed containers will be taken
- from the tablewares annealing lehr
- from the bottles inspection conveyor's end
- from the decorating lehr,

and brought by lifttruck to the storage department.

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1.16. UTILITIES DEPARTMENTS

Compressors station :

Three low pressure compressors, one of which as standby, delivering the air necessary for the forming machines and for the fuel atomization in the furnace.

Eff. output	:	28 cum/min.
Eff. pressure	:	3.5 bars.

Two medium pressure compressors, one of which as standby, delivering the air necessary for the control of the furnace, smoke reversing system, cold end, etc ...

Eff. output	:	7 cum/min.
Eff. pressure	:	7 bars.

Five vertical air tanks, for
- the low pressure circuit
- the medium pressure circuit
- the press machine
- the IS machine (2 x).

Electrical main station :

A 11 kV supply and distribution board should be located near the compressor building, including
- One input cell.
- One metering cell.
- Three output cells.
- One spare cell.

This distribution board would feed one transformer substation of 3 x 1.6 MVA, including
- Three 1.6 MVA transformers.
- Three high voltage boxes for the feeding cables.

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- One low voltage board.

The low voltage sub-distribution boards will be distributed all over the factory, including namely
- Motor starters.
- Local control boxes.

The wiring of all electrical equipment downstream the 11 kV station, including earthing.

One or more radioactive lightning-arrestors.

The lighting will have the following general lighting level :
- 300 lux for laboratories offices
- 100 lux for manufacturing halls
- 100 lux for stores
- 60 lux for raw materials storage
- 10 lux for outdoor lighting.

The emergency generating set with Diesel motor, alternator, etc ... will have an output of 625 kVA.

Water circuit :

A concrete water tower located in the factory would distribute water under pressure in the factory.

The industrial water will be mainly used for the following purposes :
- Cooling of gobs chutes in the cellar.
- Batch mixer.
- Cleaning.
- Sand washing.

Pumping station will be used to bring water
- from the cellar to the settling pond
- from the sand washing plant to the settling pond

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- from the settling pond to the water tower.

The cooling water will be mainly used for the following purposes :
- Compressors.
- Manufacturing machines.
- Emergency set.
- Charging machine.
- Furnace's burners.

The cooling water circuit working as a closed circuit will include
- Pumps to supply cold water.
- Atmospheric cooler.
- Hot water collecting tank.
- Hot water pumps.
- Water softener.

The fire-fighting water circuit and the drinking water circuit will be fully self-contained.

LPG station :

A storage of 2 T has to be provided, corresponding to about 20 days of production.

The necessary pumps, vaporisers and fittings will complete the station.

Fuel oil storage :

A storage tank of 110 cum has to be provided, corresponding to about 3 weeks of production.

The necessary pumps, preheating, tracing pipes and fittings will complete the station.

1.17. OFFSITES DEPARTMENTS

Workshops :

A general maintenance and mould maintenance workshop has to be provided.

The small production of the factory does not allow the implementation of a profitable mould production workshop.

On another hand, considering that the factory will be located in the vicinity of Kampala Industrial area, we consider that several jobs can be executed outside the factory and will therefore not require specific equipment in fields such as :
- Garage.
- Joiner's workshop.
- Forge and welding shop.
- Electrical maintenance shop.

Laboratory :

The laboratory will include equipment for quality control and for chemical analyses.

The quality control will be used for
- Determination of the tolerance margins with during production inspection.
- Checking efficiency of automatic inspection.
- Checking compliance with other quality criteria which cannot be detected by automatic inspection such as glass distribution, annealing level, etc ...

The chemical laboratory will be used to make physico chemical tests on raw materials, mixtures, glasses, exhaust gases.

THE AUTOMATIC PRODUCTION OF GLASS CONTAINERS

1 Batch Plant
The raw materials (sand, soda ash, lime, etc.) which are stored in bulk are mixed and transported to the production plant.

2 Batch Charger
The batch charger feeds the batch (mixture of raw materials) continuously and automatically into the furnace.

3 Furnace
In the furnace the batch is melted into glass at temperatures up to 1600°C.

4 Forehearth
Here the glass is cooled or heated to become homogeneous and stable in temperature while being channelled to the forming machine.

5 Feeder
In the feeder the glass is formed into gobs of suitable shape and weight, which are then sheared off for delivery to the forming machine.

6 Glass Forming Machine (I.S. or H-28) or a press line (tablewares)
The forming machine forms the glass gobs into containers by a two stage blow/blow or press/blow process.

7 Stacker
The hot containers arriving from the forming machine via conveyor and transfer device are loaded by a stacker onto the belt of the annealing lehr.

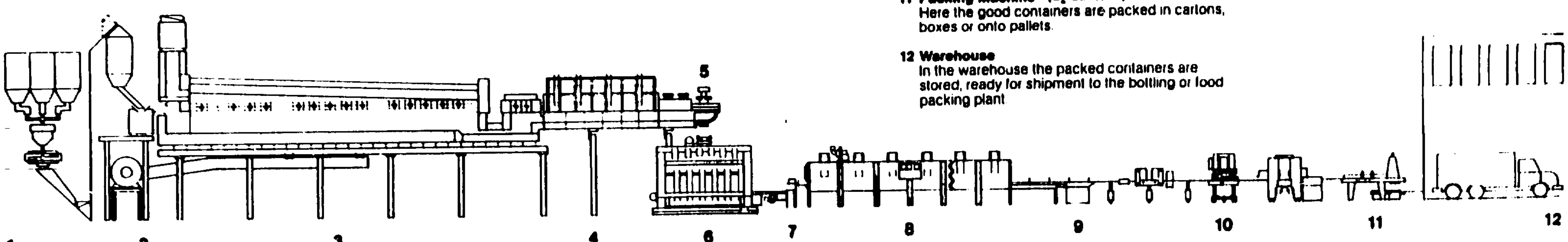
8 Annealing Lehr
In the annealing lehr the hot glassware is cooled at a controlled rate in order to avoid stresses being set-up in the glass, which would result in breakage.

9 Transport Equipment
On leaving the annealing lehr the cooled containers are transferred onto the transport belt of the single or dual liner, and then pass through the inspection department.

10 Inspection Equipment
Various automatic inspection devices check the containers for dimensions, strength, cracks, crizzles and other defects.

11 Packing Machine (optional)
Here the good containers are packed in cartons, boxes or onto pallets.

12 Warehouse
In the warehouse the packed containers are stored, ready for shipment to the bottling or food packing plant.



VI.3. TECHNOLOGY

1. BASIC IDEAS

Although the container production technology is actually standardized and very well known over the world, some technical improvements have recently came on the market. Considering the very small size of the projected factory, the lack of glass experienced specialists in the country and the predetermination to keep the investment as low as possible, we have not advice to consider those new sophisticated improvements in the scope of this project.

However, the process has been kept as automatized as possible and the origin of the equipment has been choosen amongst the top existing suppliers in order to assure for this project the three following key ideas :

- Ability of producing high quality containers, according the international standards in force for the bottlers and the consumers.
- Ability of producing such containers with less possible glass experiented specialists.
- Ability of producing such containers, with greater possible financial profitability.

Technology

As for all the other industries the glass technology improves continuously. The today trend is to obtain light weight articles to reduce the production cost. A new technology has been developed in this regard, consisting of improvement in the production machinery components up to new type of machinery (A IS machine from Emhart).
Automatic centralized control of melting process, production process and cold end process has also been developed giving feed back informations to the furnace and the production machinery from the cold end.
However, these new technologies are very expansive and sometimes difficult to manage. We do not advice to envisage them presently in developing countries.

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2. BATCH PLANT

The system considered for the batch preparation is based on the most successful technology General Contractors have applied for many glass batching system.

The full electronic and static weighing equipment considered offers as advantages :
. High accuracy.
. Repeatability.
. Dust proof operation.
. Practically no maintenance.

The handling equipment is of such a design that the system is absolutely dust-tight, working silently without loss of material and very easy to operate in automatic, semi-automatic and manual mode.

The weighing equipment will consist of :
. Three load cells, from which is suspended the hopper through a shock-absorber system, the hopper being stabilized by link in order to avoid lateral motion.
. The load cells are connected to a junction box, from which the signals are transmitted to a digital scale calibrated according to the nominal value of the maximum weight.
. The digital electronic scale is calibrated to display the nominal weight from 2 to 4,000 graduations in order to increase the feed accuracy.
The best weighing equipment, according to us, is from Toledo (Belgium) or Zippe (F.R.G.).
The mixer should be subcontracted from Eirich (F.R.G.) or Teka (F.R.G.).

2. FURNACE

The end fired tank furnace will be designed for a continuous melting operation of the batch at a temperature of 1,500 - 1,600 ° C.

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The furnace will be of a mixed heating type, using both electricity and heavy fuel oil.

The preheating of the combustion air should be done in order to respect the fuel consumption considered in the production costs table. This preheating could be obtaining by two different systems, with a metallic recuperator or with refractories regenerative chambers. The regenerative chambers, although more expensive gives a better fuel saving coefficient. This system has been considered in the investment cost.

We have however to point out that due to the small size of the furnace and to the fact that the heating is mixed, a recuperator system should not be rejected at first sight. The costing difference could may be compensate the higher fuel consumption.

The design of the furnace must allow the capacity increase (50 T/d to 90 T/d) envisaged at the first refurbishing, the major items of the furnace must be calculated at the first begin of this extension (except the refractories and part of the steel structures).

Furnace life

The life of the furnace is the quantity of time during which the furnace can melt glass continuously 24 hours per day before stopping for a complete overhauling involving the replacement of weaved refractories.

This life depends on several factors :
- the original quality and quantity of refractories ;
- the ability of the production and maintenance personnel ;
- the quantity of glass pulled out from the furnace.

This latter factor can be explained when comparing to a car, the car's life depends obviously from the performed miling.

In developed countries, the trend is today to build very expansive furnaces to increase the life of the furnace. This life can today reach more than 6-7 years.
In developing countries, 4 to 5 years must be considered as a maximum time, the investment needed to build very expansive furnaces being very often lacking.
In this project, we have envisaged a 5 years life furnace in the investment, considering the quantity of glass produced during this period and considering also the training performed abroad and on site by expatriated specialists.

The best furnaces, according to us, are from Fourment & Ladurée (F), A. Horn Sohne (F.R.G.), Nikolaus Sorg (F.R.G.), Toledo Engineering (U.S.A.) and K.T.G. (G.B.).

4. PRODUCTION MACHINERY

4.1. FOREHEARTHS AND FEEDERS

The purpose of the forehearth is to condition and homogenize the molten glass in the furnace thermally by means of an automatic heating system.

The purpose of the feeder mechanism is to synchronise the action of the plunger and glass cutter with the forming machine to ensure a supply of gobs of glass of suitable size, weight and temperature into the forming machine.

The best forehearths and feeders, according to us, are from Emhart (S), Maul Technology (G.B.), Bottero (I), B.H.F. (G.B.).

4.2. IS MACHINE (BOTTLES PRODUCTION)

The purpose of the IS machine is to form an article of the desired shap. from the gobs of glass supplied by the feeder and distributed to the moulds in each section by a system of chutes.

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This article is then evacuated in bulk to allow the next article to be formed.

The IS machine contains two sets of moulds, blank and blow moulds, one of each per section. The gob given by the feeder falls into the blank mould in order to form a parison fo the bottle by an air blowing process. The parison is then transfered automatically to the blow mould where the bottle is blown to its final shape. The bottle is afterwards taken out automatically and placed on a cooling plate for further transport into the annealing lehr.

Basically all the IS machines existing on the market are similar, the choice has to be made according to
- the accuracy of tolerances of the machines parts
- the origin compatible with the expected loan.

As far as the accuracy of tolerances are concerned, the best machines existing in the world are build by Emhart (S), this accuracy leading to less trouble shortings and greater machine parts life. Although Emhart (S) is usually more expensive than its competitors, we have considered their prices in the investment cost.

Other possible suppliers are Maul Technology (G.B.), Bottero (I), Fabricucion de Maquinas (Mex), B.D.F. (I).

4.3. PRESS MACHINE (TABLEWARES PRODUCTION)

The purpose of the press machine is to form an article of the desired shape from the gobs of glass supplied by the feeder and distributed to each mould successively, by step rotation of the press.

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At each station during the rotation, the mould feeded with glass will receive a succesive treatment in order to form the final shape of the article by pneumatic pressing to cool down the formed article and to take it out from the press. The article if afterwards transfered automatically on the glazer, from where it is conducted towards the annealing lehr.

The best press machines, according to us, are from I.M.I. (I), Lynch (U.S.A.), Guilhon & Barthelemy (F), Pöting (F.R.G.) and Walter (F.R.G.).

5. PRODUCTION TREATMENT

The purpose of the stacker is to put into the lehr in an automatic and orderly manner the glass containers coming from the corresponding forming machines.

The best stackers, according to us, are from Powers (U.S.A.), Sheppee Engineering (G.B.), I.M.I. (I).

The glass articles manufactured by the forming machine which come to the lehr have an important thermal heterogeneity between internal and external walls.

After natural cooling, this creates internal stresses so that the articles may spontaneously break.

The purpose of the annealing lehr is to reduce this disadvantage by treating the articles in such a manner as to homogenize the temperatures of the internal and external walls to a higher temperature than the annealing temperature and to cool them down according to a temperature curve as a function of the time called annealing curve.

The annealing temperature and curve are pre-determined and depend upon the type of glass, wall thickness of articles, annealing type which is desired, etc ...

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Practically, it is accepted that the residual stress level is less than 25 kg/sq cm.

The best annealing lehrs, according to us, are from CNUD (B), S.A.S. (G.B.), Pennekamp (F.R.G.), Smit Ovens (H).

6. COLD END

With a view to supplying the customers with articles which meet the quality specification generally accepted in the sector, we have considered an assembly of devices and machines which automatically check on the inspection line the various characteristics, the acceptability margins of which may be more reduced than those made by the forming machines.

The different existing suppliers in that field producing equipment with different functions and combination of function, it was necessary to select one of them to allowing the description of the equipment envisaged in the investment cost.

The choosen supplier is Powers (U.S.A.).

Other possibilities of choice being INEX (U.S.A.), Saint Gobain Cinématique et Contrôle (F).

The dual head gager is designed and made to check the main sizes of rings (unclogging-opening).

The optical detector detects the reflection of light ray on a defect surface. Inspection reliability being ensured by a receiver with very selective focalization.

Both dual head gager and optical detector will reject automatically defect bottles.

The visual inspection panel allow to check each bottle and to reject manually all bottles having visible defects.

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7. DECORATION PLANT

The type of decoration requested by the market consists of a ceramic ink to be applied on the bottle by a screen printing process. One, two and three colours are needed per decoration according to the type of the bottle. Full automatic machines do exist allowing to print a three colours decoration in one passage only. However, this type of machine, for which W. Kammann (F.R.G.) and Rosario (H) are the main manufacturers are very expensive and needed a speed of production of 80 - 100 bottles per minute to be profitable.

In the investment cost we have opted for three semi-automatic machines, allowing to decorate in three colours when adding. These machines are mainly manufactured by Dubuit (F).

When applied on the bottle, the decoration must be thermofused in order to be firmly adhered to the bottle. This is done by passing the bottle into a decorating lehr, where the decoration is heated around 600 ° C and then cooled down to the room temperature.

These decorating lehrs are similar to the annealing lehrs and are manufactured by the same suppliers, only the temperature curve being different.

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3 Furnace
In the furnace the batch is melted into glass at temperatures up to 1600°C.

4 Forehearth
Here the glass is cooled or heated to become homogeneous and stable in temperature while being channelled to the forming machine.

5 Feeder
In the feeder the glass is formed into gobs of suitable shape and weight, which are then sheared off for delivery to the forming machine.

6 Glass Forming Machine (I.S. or H-28) or a press line (tablewares)
The forming machine forms the glass gobs into containers by a two stage blow/blow or press/blow process.

7 Stacker
The hot containers arriving from the forming machine via conveyor and transfer device are loaded by a stacker onto the belt of the annealing lehr.

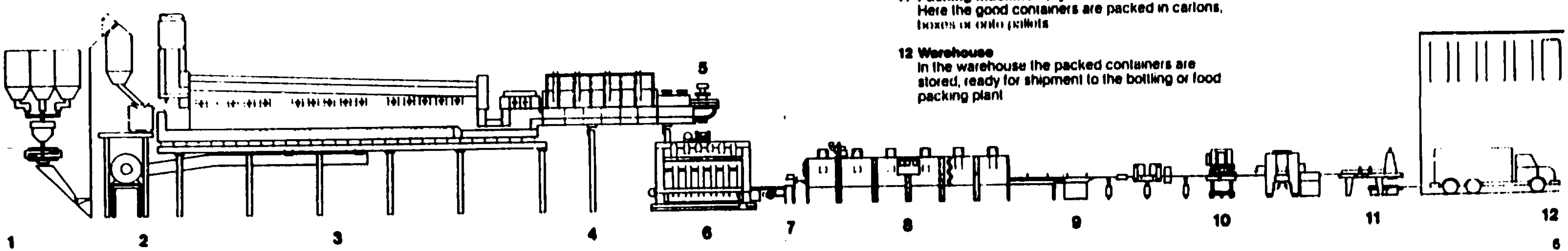
8 Annealing Lehr
In the annealing lehr the hot glassware is cooled at a controlled rate in order to avoid stresses being set-up in the glass, which would result in breakage.

9 Transport Equipment
On leaving the annealing lehr the cooled containers are transferred onto the transport belt of the single or dual liner, and then pass through the inspection department

10 Inspection Equipment
Various automatic inspection devices check the containers for dimensions, strength, cracks, crizzles and other defects.

11 Packing Machine (optional)
Here the good containers are packed in cartons, boxes or onto pallets

12 Warehouse
In the warehouse the packed containers are stored, ready for shipment to the bottling or food packing plant



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VI.4. EQUIPMENT

1. BATCH PLANT

1.1. One electronic weighbridge for trucks.

1.2. One electro-hydraulically operated grab overhead travelling crane.

1.3. One hopper for truck unloading of limestone/dolomite and feldspar.

1.4. One vibrating extractor under the hopper.

1.5. One conveyor elevator.

1.6. One permanent magnet.

1.7. One conveyor-elevator.

1.8. One hopper to remove sand.

1.9. One vibrating extractor under the hopper.

1.10. One smooth belt conveyor.

1.11. One pulping chute.

1.12. One static sieving device.

1.13. Waste chute.

1.14. Chutes for grains below 0.8mm.

1.15. Cyclone separating group.

1.16. Drying machine with filtering drier.

1.17. Steam production unit.

1.18. One belt collecting conveyor.

1.19. One conveyor-elevator to the daily silos.

1.20. Three chutes.

1.21. Two bag emptying devices.

1.22. Electrical tackle.

1.23. One dust catching plant with individual filters.

1.24. Six steel cones for big products dialy silos.

1.25. Three steel silos for small products.

1.26. Equipment for silos.

1.27. Extractors under silos.

1.28. Weighing equipment.

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1.29. Rotary spont under big products weighing hopper.
1.30. Connecting chute under small product weighing hopper.
1.31. Scales for manual weighing of micro-ingredients.
1.32. Automatic small bags distribution.
1.33. One mixer.
1.34. One receiving hopper under the mixer.
1.35. One vibrating distributor under the hopper.
1.36. One connection belt conveyor.
1.37. One conveyor elevator to the charging silo.
1.38. One tramp iron separator.
1.39. One loading silo.
1.40. Equipment of the loading silo.
1.41. One dust section system.
1.42. Electrical equipment.
1.43. Four hot cullet recovery chutes.
1.44. Ten waste recovery containers.
1.45. One receiving hopper.
1.46. One vibrating extractor.
1.47. One cullet crusher.
1.48. One belt conveyor under the crusher.
1.49. One tramp iron separator.
1.50. One conveyor-elevator to daily storage silo.
1.51. One storage silo.
1.52. Equipment for silo.
1.53. Vibrating extractor under silo.

2. <u>FURNACE</u>

2.1. Refractory materials.
2.2. Steel structures.
2.3. Fuel oil heating.
2.4. Automatic smoke reversal system.
2.5. Electric boosting.
2.6. Cooling system.
2.7. Batch charger.
2.8. Instrumentation-Control.

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3. PRODUCTION MACHINERY

3.1. Two forehearths.
3.2. Two feeders.
3.3. One IS 6 machine.
3.4. One conveyor.
3.5. One ware transfer.
3.6. Fixtures for feeders and IS machine.
3.7. One set of mould gauges.
3.8. One 12 stations press.
3.9. One glazer.
3.10. One ware transfer.
3.11. Two cooling fans.
3.12. Two preheating kilns.
3.13. Two control desks.

4. PRODUCTION TREATMENT

4.1. Two stackers.
4.2. Two annealing lehrs.

5. COLD END

5.1. One single liner.
5.2. One inspection conveyor.
5.3. One visual inspection panel.
5.4. One dual head gager.
5.5. One optical detector.

6. QUALITY CONTROL LABORATORY

6.1. Two tables.
6.2. Metrology tools.
6.3. Polariscope.
6.4. Ramp pressure tester.
6.5. Vertical load tester.
6.6. Hacksaw.

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6.7. Thermal shock tester.

6.8. Height control device.

6.9. Two scales.

7. CHEMICAL LABORATORY

7.1. Polarizing microscope.

7.2. Measuring instruments.

7.3. Densimeter.

7.4. pi H meter.

7.5. Furnace.

7.6. Drying oven.

7.7. Screen shaker.

7.8. Water generator.

7.9. Thermostatic bath.

7.10. Sample divider.

7.11. Two chronometers.

7.12. Set of crucibles.

7.13. Two scales.

7.14. Two air extractors.

7.15. Set of laboratory equipment.

7.16. Set of chemicals.

7.17. Pyropto.

7.18. Gas analyzer.

7.19. Moisture tester.

8. DECORATION PLANT

8.1. Three decorating machines.

8.2. Two liaison conveyors.

8.3. One lehr conveyor.

8.4. One stacker.

8.5. One decorating lehr.

8.6. One polycop with vacuum pump.

8.7. One metal helide copying lamp with cooling fan.

8.8. One fast contact copier with vacuum pump.

8.9. One mounting table with luminous lamp.

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8.10. One brillant developing equipment.
8.11. One pneumatic stretcher with air compressor.
8.12. 30 screen printing frames.
8.13. One screen developing device.
8.14. 50 m. stainless steel screens.
8.15. 50 m. polyester screens.

9. COMPRESSED AIR

9.1. Three low pressure compressors.
9.2. One vertical tank.
9.3. Two medium pressure compressors.
9.4. One vertical tank.
9.5. Three vertical tanks.

10. FUEL OIL

10.1. One fuel storage tank.
10.2. Two pumps for fuel oil storage.
10.3. Two pumps for fuel oil distribution.
10.4. Fuel oil preheating.
10.5. The tracing pipes.

11. L.P.G.

11.1. One L.P.G. storage tank.
11.2. One pumping station.
11.3. One vaporization installation.
11.4. One expansion station.

12. WATER

12.1. Two pumps for reclaiming the process water from the cellar.
12.2. One pump for reclaiming the process water from the sand washing plant.
12.3. Two pumps for drawing up the water out of the settling pond.

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12.4. Two pumps for supplying water to the cooling circuit.
12.5. One atmospheric cooler.
12.6. One hot water collecting tank.
12.7. Two hot water pumps.
12.8. One water softener.

13. FIRE FIGHTING EQUIPMENT

13.1. One fire fighting pump.
13.2. Outdoor equipment.
13.3. Indoor equipment.
13.4. Portable powder extinguishers.
13.5. Fire tender.

14. PIPINGS, FITTINGS AND SUPPORTS

14.1. Piping network for compressed air.
14.2. Piping network for fuel oil.
14.3. Piping network for L.P.G.
14.4. Piping network for water.
14.5. Piping networ' ofr fire-fighting.
14.6. Steel aerial pipe-rack.

15. GENERAL MAINTENANCE AND MOULD MAINTENANCE WORKSHOP

15.1. One standard lathe with copying system.
15.2. One universal milling machine.
15.3. One drilling machine on a column.
15.4. One double ended grinding machine.
15.5. One welding transformer.
15.6. One blowpipe welding set.
15.7. One sandblasting machine.
15.8. One jobsite cutting machine.
15.9. One set of tools for mechanician.
15.10. One set of tools for joiner.
15.11. One set of tools for electrician.
15.12. One set of measuring instruments for mechanician.
15.13. One set of measuring instruments for electrician.

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15.14. Metal spray coating.

15.15. Polishing station.

16. ELECTRICITY

16.1. 11 kV supply and distribution board.

16.2. One 110 V battery for the various control signals, protection and metering of the HV section.

16.3. One transformer substation of 3 X 1.6 MVA.

16.4. Condenser batteries.

16.5. Low voltage equipment.

16.6. Electric motors.

16.7. Wiving.

16.8. Lightning-arrestors.

16.9. Lighting.

16.10. Emergency generating set.

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VI.5. CIVIL ENGINEERING WORK

The work will comprise all elements of a civil engineering nature within the factory limits in order to provide a complete and operational project in accordance with the contract documents.

The civil work includes but is not limited to :
- Site installation and site clearance.
- Supply, delivery, installation and maintenance of all materials of a civil engineering nature to be incorporated in the work up to the end of the commissioning period.
- Setting out the work.
- Watching, lighting and temporary fencing as necessary.
- All labour necessary to complete the work.
- Supply or hire of all construction plant and equipment (including consumables) and subsequent removal from site in completion.
- All site close out procedures in order to leave the site in a clean and tiny condition.

The civil work can be detailed as follows.

1. SITE INSTALLATION AND SITE CLEARANCE

Supply, installation, maintenance and consumption costs of
- all temporary site offices, stores and workshops
- temporary power, water, compressed air
- temporary roads, drainage, fencing
- Site safety procedures, first aid facilities.

Clearance of the site from all obstacles, trees and existing structures.

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2. GENERAL LEVELLING

The general levelling will include the forming of embankments.

3. ROADS AND PARKING

Parking area of 35 m x 24 m.
The roads will include a concrete area of 24 m x 45 m for truck turning in front of the finished products warehouse.

4. FENCING

Galvanized chain-link 2 m high and 860 m length with metallic posts and three rows of barled wire over.

5. DRAINAGE AND WASTE WATER EVACUATION SYSTEM

Rain water will be evacuated to the site limit.
Industrial waste water will be evacuated to a settling pond.
Sewage effluent from toilets will be evacuated to a septic tank.

6. EXTERNAL TRANCHES AND CHANNELS

Roads crossing will have to be reinforced by appropriate means.

7. EXTERNAL FOUNDATIONS

For conveyors, lightpoles, piperack, etc ...

8. SAND PRIMARY STORAGE AREA

Concrete area of 17 m x 14 m with reinforced concrete retaining walls.

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9. LIMESTONE/DOLOMITE AND FELDSPAR PRIMARY STORAGE AREA

Concrete area of 14 m x 9 m with reinforced concrete retaining walls and partition walls.

10. SODA ASH PRIMARY STORAGE BUILDING

Steel building of 30 m x 18 m x 6 m height under caves, laid on reinforced concrete foundations.

11. BATCH PLANT

Steel building of 21 m x 15 m x 17 m height under caves. Walls and ground slab on reinforced concrete.

12. FURNACE HALL

Steel building of 30 m x 20 m x 17 m height under caves. Walls and ground slab on reinforced concrete.

13. FABRICATION HALL

Steel building of 30 m x 20 m x 10 m height
and 30 m x 20 m x 7 m height under caves.
Walls and ground slab on reinforced concrete.

14. WAREHOUSE FOR MOULDED GLASS

Steel building of 50 m x 45 m x 7 m height under caves, laid on reinforced concrete foundations.
Perimeter walls 2.2 m high laid on reinforced concrete foundations are made of hollow concrete blocks.

15. COMPRESSORS STATIONS AND ELECTRICAL SUB-STATION

Steel building of 36 m x 10 m x 9 m height under caves, laid on reinforced concrete foundations with galvanized roof cladding. External walls and internal partition are made of hollow concrete blocks.

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16. COOLING TOWER

Reinforced concrete basement of 6 m x 5 m x 2.4 m deep.

17. SETTLING POND

Reinforced concrete basin of 24 m x 8 m x 3 m deep divided over its length into three sections by reinforced concrete walls each 3 m wide, the center section being covered.

18. WATER STATION

Reinforced concrete frame building of 15 m x 12 m x 3.25 m height with walls on hollow concrete blocks.

19. WATER BASIN

Reinforced concrete basin of 24 m x 8 m x 3 m deep.

20. L.P.G. STATION

Reinforced concrete foundation raft for L.P.G. tank.
Pumping station of 4 m x 3 m x 3 m high consisting of a reinforced concrete frame laid on concrete foundations with walls of hollow concrete blocks.

21. FUEL OIL STORAGE

Reinforced concrete foundation raft for fuel oil tank.

22. WORKSHOP-GENERAL STORE

Steel building of 48 m x 24 m x 5.2 m height under caves, laid on reinforced concrete foundations.

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23. TECHNICAL OFFICES-LABORATORIES

Reinforced concrete frame building of 25 m x 18 m x 3.3 m heigh, laid on concrete foundations. External walls and internal partition are made of hollow concrete blocks.

24. GENERAL ADMINISTRATION BUILDING

Reinforced concrete frame building of 25 m x 12 m x 3.3 m heigh, laid on concrete foundations. External walls and internal partitions are made of hollow concrete blocks.

25. WEIGHING PLANT

Reinforced concrete pit of 12 m x 3 m x 2 m with concrete foundations. Walls in hollow concrete blocks.

26. GATES HOUSE

Reinforced concrete frame building of 12 m x 4 m x 3.2 m, laid on concrete foundations. External walls and internal partitions are made of hollow concrete blocks.

27. FURNITURES

Desks, chairs, cabinets, pharmacy, medical bed, medical cabinet and lockers.

28. VENTILATION AND AIR CONDITIONING

Will be ventilated :
- the soda ash storage building
- the fabrication hall
- the warehouse for moulded glass
- the workshop-general store.

Will be air conditioned :

- the compressors and electrical sub-station
- the offices, control rooms, sanitary, shower-lockers and refectory.

29. GENERAL DESCRIPTION OF CIVIL CONSTRUCTIONS (work)

29.1. Buildings - General

The factory, completely surrounded by a fence, will have two main groups of buildings (see layout drawing).

The first group includes the various fabrication halls, the warehouses and some raw material handling building, the second group includes the utility buildings and some raw material handling buildings.

As a rule, the architectural appearance of the fabrication halls and the warehouses will be kept uniform except where process requirements impose derogation from this general rule. The halls and warehouses will be steel structures, portals on reinforced concrete foundations, with a wall up to 3 m. high and above it corrugated sheet siding.

. The roof will be covered with the same corrugated sheets.

. Natural lighting will be provided by translucent corrugated sheets laid in strips along sides and on the roofs.

. Natural ventilation will be provided by louvres in the wall and by roof ventilators.

The second group (mainly utility buildings) will be made of reinforced concrete. It means that the upper structure is composed of a concrete frame (columns and beams) filled up with hollow concrete blocks.

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Inside the factory fence a road network serves all buildings and includes parking areas and enlargements for truck manoeuvring.

. The buildings will be surrounded by a walkway.

. The road system is completed by a sewerage network and a lighting network.

29.2. Structural steel

The upper structure for fabrication halls, warehouses and some buildings of the raw material handling section will be composed of steel frames.
This steel framework is composed of the main portals and the stabilising portals.
The long pans and gables are designed to receive the walls with louvres and the aluminium corrugated sheeting above.

The roofs are designed to be covered with aluminium corrugated sheets. The slope of the trusses is 20 °.
On the roofridge a roof ventilator will be placed for natural ventilation purposes where appropriate.
Upper floors will be of reinforced concrete supported by steel girders.
Gangways are covered with chequered plate or with grating.
Fabrication halls will be provided with gutters and water downpipes. Workshop buildings and warehouses not in line with fabrication halls will have a roof in overhang and no gutters.

VII. PLANT ORGANIZATION.

VII. PLANT ORGANIZATION

Organization of a factory should be adapted to the intrinsic factors of production and to the economic and social conditions of the environment.
Often, an overstructurization of the departments leads to the dissolution of responsibilities and to the creation of unavoidable, although sometimes hidden, conflicts and sensitivities.

Multiplication of the cost centres naturally results in an increase of costs and spending as well.

For a small- to medium-size factory, like the proposed glass plant in Uganda, it is definitily advisable to set up the simplest organization practically possible. As a matter of fact, centralized family-managed factories are often the most efficient in the present context.

The proposed glass plant would generally gain in efficiency if all personnel is organized and trained to work as a coherent team and not as competing departments and position-holders.

Knowing by experience that a feasibility study is normally used as a reference source during the implementation stages, we deliberately adopted the simplest scheme for the presentation of the plant organization.

We consider that a permanent staff of 182 peoples will be necessary to operate the factory.

This figure is kept unchanged until the fifteenth year of production, because the number of production lines will not change, the increase of production being realized by using the production machines in double gob process instead of single gob.

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The only difference following the increase of production could be at the level of packing, decorating and stocking the articles, but we consider that after 4-5 years of work we can expect a sufficient increase of productivity to absorb the extra work.

It is shown below the operational organization chart of the factory. Key personnel qualifications and job's descriptions are given in annex 6.

Out of the operational staff, we have also included 3 expatriates for a limited time to advise the General Manager from the start up of the plant and optimization of the performances of the factory. These 3 glass industry experienced engineers are considered as generalists to help the General Manager to solve economical and technical problems up to a smooth operation of the plant.
They should be involved and advised in the organization of the staff, in its continuous training, in the selection of people, in economical study of the operation of the plant, production price, selling price of the products, buying of proper raw material (advise on quality of different sources of raw material), optimization of production and programmes, solving problems of operation, advise in technical improvement of machineries, etc ...
As soon as the General Manager and the Plant Manager are enough experienced this type of support could be dropped.

Project could also integrated under the same umbrella of management and responsibilities the operation of sand quarry (in DIIMU). But in this study we do not suggest this solution as we estimated that local entrepreneur in Masaka area, where the quarry is located, could handled more cheaply the supply of sand from this quarry. Extraction and loading the barges (on the Victoria Lake) could be manually performed (one supervisor and about 12 unskilled workers) or with a payloader and belt conveyor which could be also utilized for other jobs in the surrouding area as they will be in service only part time. That is also a reason to leave the quarry operation and sand transportation to separated entity.

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OPERATIONAL ORGANIZATION CHART

- BOARD OF DIRECTORS
  - GENERAL MANAGER — SECRETARY — TEMPORARY GENERALIST GLASS ENGINEER ADVISERS
    - TECHNICAL MANAGER — TYPISTS — ASSISTANT — LABORATORIES
      - MACHINE SHOP MANAGER
        - SHIFT FITTERS
        - ELECTRICIANS
        - PLANT MAINTENANCE
        - MOULD REPAIRS
      - WAREHOUSE MANAGERS
        - ASSISTANTS
        - FORKLIFT DRIVERS
        - GUARDS
      - SHIFT MANAGERS
        - BATCH HOUSE
        - FURNACE OPERATORS
        - CHIEF MACHINISTS — MACHINISTS
        - CHIEF INSPECTION
          - QUALITY CONTROL
          - GRADERS
        - DECORATING PLANT
    - SALES MANAGER
      - SECRETARY
        - ASSISTANTS
    - PERSONNEL MANAGER
      - FINANCIAL ACCOUNTANT
        - SECRETARY
          - ASSISTANTS
      - PAYROLL ACCOUNTANT
        - SECRETARY
          - ASSISTANTS
      - PRODUCTION ACCOUNTANT
        - SECRETARY
          - ASSISTANTS
      - DRIVERS
      - MESSENGERS
      - OFFICE CLEANING

N.B. : The following working posts are considered to be fulfilled by specialized expatriates :

- Advisers
- Technical manager
- Shift managers
- Furnace operators
- Chief machinists.

VIII. MANPOWER.

VIII. MANPOWER

A. MANPOWER TO OPERATE THE PLANT

GUIDING POLICY

Whatever the status of the project is, a new glass containers plant is Uganda should be considered as an economical and social development project.

Knowing the situation of employment in Uganda, it should be stressed that, without overstaffing the plant, maximum employment opportunities should be sought against the automatic automation tendency normally developed by equipment suppliers.

Wherever possible, use of local human resources is preferred to imported automatic equipment which drives up investment costs and reduces possibilities of job opportunities for Ugandans. Moreover, it has to be kept in mind that automatic equipment, apart from being expensive to purchase, is also expensive to repair and maintain and that it has a higher probability to be rendered defect.
The subsequent operations in the plant as quarrying and transport, batchmaking, melting and forming treating, inspection, packing and storage are scrutinized in turn in the following section for manpower needs.

The East African Glass Works being closed since 1974 it is likely that glass specialized people in Uganda cannot be found easily.

In this respect we consider it wise to select the technical key people from outside the country. These specialists could come from India, Pakistan, China, Korea, Philippines, etc ... Their costing have been calculated on this base, the european and american level of wages being too high.

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Nevertheless, when selecting the personnel, it is advisable to try to find as much as possible local people having worked in the past for East African Glass Works and having therefore an experience in the glass field.

The total manpower for this project is as below :

1	General manager
1	Personnel manager
1	Sales manager
3	Accountants
12	Employees
5	Secretaries
8	Drivers-Messengers
1	Technical manager (expatriate)
4	Shift managers (expatriates)
1	Machine shop manager
1	Warehouse manager
1	Laboratory specialist
4	Furnace operators (expatriates)
2	Chief machinists (expatriates)
8	Engineers
39	Skilled workers
17	Semi skilled workers
73	Unskilled workers
182	Total.

From this list a part of the personnel will work per shift, we have considered four shifts, three shifts of 8 hours per day, the fourth one covering the week end and others holidays. This personnel working per shift may be detailed as follows :

4	Shift managers
8	Unskilled workers (Batch house)
4	Furnace operators
12	Machinists
4	Chief inspection

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4 Quality control
40 Graders
4 Shift fitters
4 Electricians
4 Fork lift drivers
4 Guards
92 Total.

Key personnel qualifications are given in annex 6.

The 90 other people will work on a single shift basis.

Out of the staff of the plant three engineers (generalists) expatriates experienced in the glass production will assist the General Manager.

There duties will be mainly :

1. Advise the General Manager in the general operation and production programme of this factory.

2. Help to solve the technical problem of production, raw material and utilities;

3. Organize permanent training.

B. EXPATRIATE ENGINEERS AND TRAINING

Training of Ugandans will be necessary. This should take place both abroad and on the site itself. Technical training abroad should be provided for and is best effectuated by the technology supplier ; after suitable training, the returning trainee still has to be schooled to solve practical problems on the site itself. Three expatriate engineers are foreseen in this study for technical supervision and for training during and after commission. In addition, training visits from the technology supplier should be negotiated in advance.

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C. SUPERVISION OF THE CIVIL WORK, ERECTION AND COMMISSIONING OF THE PLANT ON SITE

1. Extent of services procured by the General Contractor (G.C.)

In order to realize the smooth construction of the contract plant, the G.C. shall be responsible for sending skilled, healthy and competent technical personnel (expatriates) to the owner's plant site for technical services.

Of course, the specialities, occupations, number of personnel and their duration in Uganda are depending from the type and scope of subcontracts (civil works, erection, ...) to the local specialized companies.

1.1. The G.C. shall appoint one of the G.C.'s technical personnel to be the general representative of the G.C. at the contract plant site. He shall give general technical services withing the scope of the contract and fully cooperate and consult with the owner's general representative on the contract site to solve the technical and working problems relating to the contract. But the site representative of both parties, without the authorization of both parties, shall have no right to alter and amend the contract.

1.2. The G.C.'s technical personnel, on behalf of the G.C., shall give technical guidance to the owner whenever requested to do so during erection, mechanical test runs, commissioning, performance tests, operation, production process and maintenance, etc ... and also give advice on the necessary revisions of the civil works.

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1.3. The G.C. technical personnel shall, when requested, explain the technical documentation, drawings, process flowsheets, operation manuals, G.C.'s equipment performance, analysis method and precautions, etc ..., as well as answer and solve technical problems raised by the owner within the scope of the contract.

1.4. The G.C.'s technical personnel shall give the owner correct technical services and necesary demonstrations within the scope of the contract in order to enable the owner to ensure the correct execution of the above-mentioned works mentioned in clauses 1.2. and 1.3. of this paragraph.

1.5. The G.C.'s technical personnel shall assist the owner to train at the contract plant the owner's erection, adjustment, production, equipment maintenance and inspection personnel in an effort to raise their technical level.

2. Pre-operation organization chart as a guide

We attached a chart with the main activities to be fulfiled by the investor(s) responsibles consultant's people and Ugandese experts (eventually experts from the investor's existing staff) shall be appointed to fulfil these tasks.

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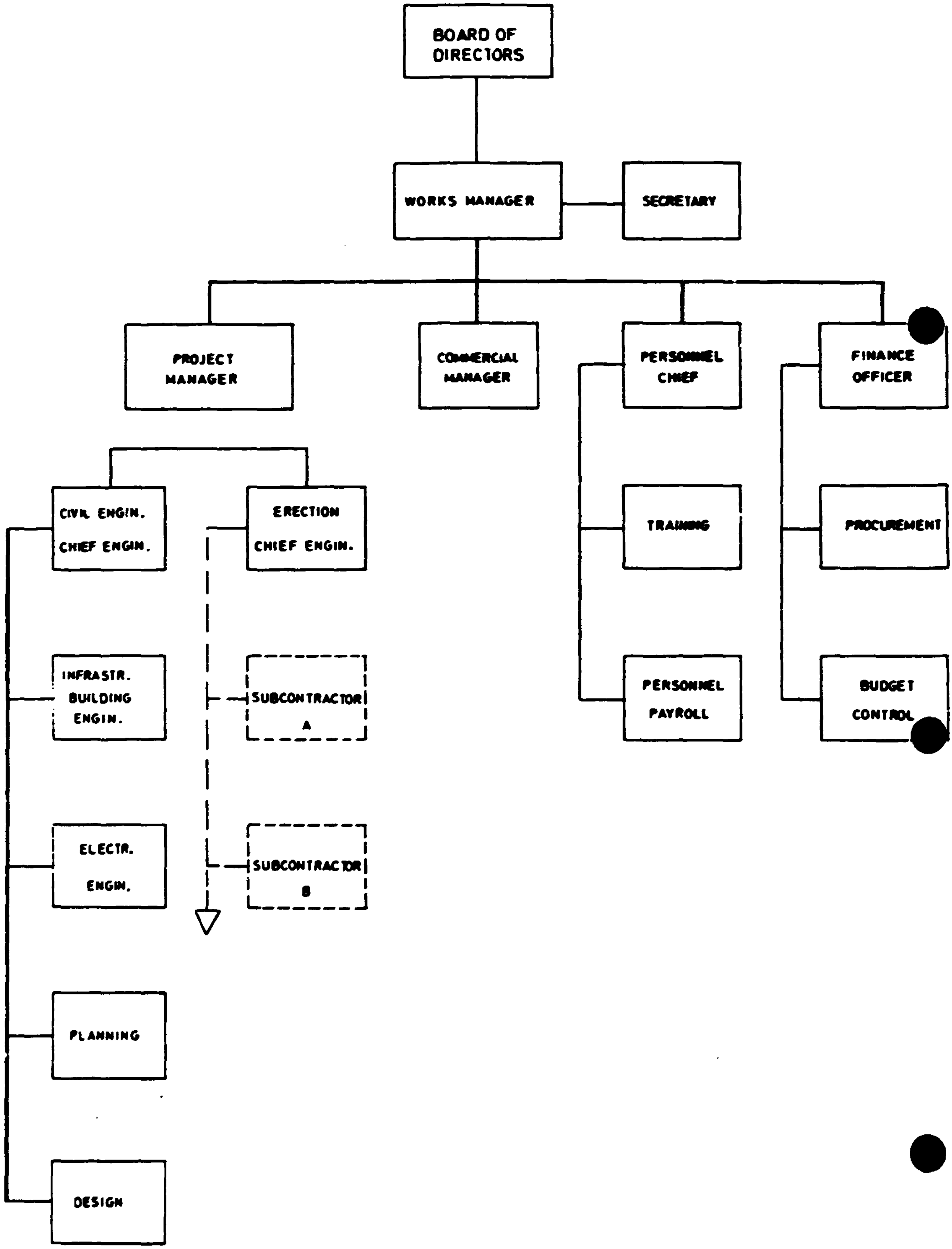
MANAGEMENT CHART DURING CONSTRUCTION



IX. IMPLEMENTATION SCHEDULING.

INTRODUCTION

Varying periods of time are required for various stages of implementation in different projects. These depend on the circumstances prevailing in a country and the specific nature and requirements of a particular project.

As it is long time that Uganda undertakes to implement, in the industrial sector, such a huge new project, it is extremely difficult to foreseen a time for each stage.

Emphasis is, however, put on the fact that a considerable amount of time may elapse between the moment when the decision is taken and the actual start of construction.

For instance, we know that in similar countries as Uganda, a period up to 8 months may be scheduled from the basic specification issuing, the tendering, opening of bids, evaluation of bids, final negociations, and to award a contract for the global construction of the plant.

But is should be kept seriously in mind that a proper organization of the tasks and schedule should be set up to minimize the period between the decision of implementation of the project and the start up of production to avoid that the cost data given in the feasibility study become outdated and need to be reviewed.

A period of one year to one and half year should be considered as a maximum between the date of the feasibility study and the award of a implementation contract.

That means that the decision to invest should be taken at the latest 4 to 5 months after the date of the feasibility study.

In the situation of Uganda, it seems very advisable to select early after the decision to invest is taken a consultant highly qualified on international projects for the follow up of the pre-implementation and implementation process.

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Also, we advise to proceed with a "turn key" basis approach for the implementation of this glass containers plant principally to insure proper coordination, great deal for overlaping of activities and cost control of all the activities to save time and money mainly by the early detection of implementation delays or overcosts and their financial impacts.

In the implementation schedule described hereafter, several assumptions have been made ; all of these stem from the special status of the project and are in line with the recommendations on plant location and the type of contract to issue for the implementation of the plant.

In principle we have not assumed a plant location at the old Madhvani glassworks, Kampala ; but near this industrial area (Luzira) should thus old site be selected, however, then still the implementation schedule is valid, requiring only some minor alterations.

We have not reserved a time span for prospecting for capital investment.

Furthermore, the plant site at the Madhvani glassworks would not involve any time for purchasing of land ; however, this is balanced by the fact that extensive negotiations with the Madhvani concern will need to take place.

In short, we elaborated a list of the main steps to be taken but it is rather difficult to allocate for each stage a target period.

In global, we foreseen as a maximum period of completion :

- Feasibility study date - decision to invest : 4 to 5 months.
- Arrangement for the project financing and list of main steps hereafter mentioned before signing a contract for the implementation : 10 to 11 months.
- Implementation of the contract up to start the saleable production : 24 months.

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SCHEDULING DESCRIPTION FOR THE IMPLEMENTATION

It is difficult to list and schedule the main steps and additional work to be done before the decision to invest is taken.

In resumé, they contributes and get finalization to

- Obtain Governmental approvals (particularly on foreign investment deal).

- Define and finalize the incentives applicable to this glass project.

- Select and join the potential promotors and shareholders, let them sign an agreement for equity capital sharing and issuing the equity capital.

- Clear the Madhvani Group eventual participation and finalize eventual integration.

- Find the best suitable loans to finance the project, locally and internationaly (export credit loans ...), short, medium and long term credit.

- Get the Government Guarantee for the total loan.

After decision to invest is effective, we can envisage the implementation and its schedule.

We perceived four phases :

1. Pre-implementation activities

   To be done by the investor(s) or their representative(s).
   The targets of these activities are to collected data for the tendering of the implementation of the plant.

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The main activities involved but not limited to are :

- Elect implementation management team [representative(s) of investor(s)].

- Fix a detailled list of activities, schedule and responsibles for the following activities involved but not limited to :

  . Select a consultant for the follow-up of the pre-implementation and implementation activities.

  . Fix total investment costs and their scheduling of disbursement.

  . Register the Glass Factory as an Ugandese Company, elaborate the statutes.

  . If old Madhvani glass plant is not available, select a 3.9 ha site in the Luzira or Mutungo area, sign a leasing agreement with the Uganda Land Commission, after having checked the environment regulations in this area.
  Soil (strength, porosity, permeability, ...) and water level testing should be made on the selected site.

  . Obtain import licences, building authorization and all other necessary permits, licences and local regulations should be collected and negociated for application at the glass factory.

  . Make the necessary arrangements to assure the road and possibly the railway connections.

  . Make the necessary arrangements to assure the utilities connections (industrial water, potable water, electricity) and obtain caracteristics/location of the supply (t°, p°, analysis) and caracteristics/location of sewage system.

  . Assure the approval of the Ministry of Environment Protection to use the Diimu beach sand.

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. Check with the Uganda Railways Corporation the availability of their barges to transport the sand from Diimu up to Port Bell [or envisage other types of transport (road, railway ...)].

. Check the possibility for the Geological Survey & Mines Dpt (Entebbe) to make a geological survey of the limestone/ dolomite quarry of Hima.

2. Tendering and contracting with a general contractor

2.1. Engineering preliminary design of constructions and machines

Detailed and comprehensive drawings of all parts of construction, foundations, utilities and machinery should be prepared by the consultant.
Specifications and quantities of construction materials should be delivered, and location of equipment should be specified.
Operation drawings of machinery should be submitted.

2.2. Tendering

Complete tender documents should be prepared, with quantities specifications and engineering drawings, and quotations should be invited from interested contractors. These are classified and evaluated according to scope of delivery, delivery time, quality and price.
The best offers are selected and discussed.
We strongly advise to tender on a "turn key" basis for the complete implementation of the plant.

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2.3. Negotiations with contractors

The selected contractors might be invited for extensive discussions on technical points in their delivery and operations. The situation should be fully clarified and, legally valid contracts should be drawn up and signed by both parties.

2.4. Enforcement of the contract with the general contractor

Usually from the signature of a contract with a General Contractor, one or two months are needed to implement the contract. This delay is due to the following happenings.

- Signature of loans and/or credit agreements.
- Receipt of the down payment.
- Opening of the letters of credit.
- Consent of the relevant authorities of both contractor and investor(s) countries.

3. Construction schedule

3.1. List of the main activities and sheduling

From the date of implementation of the contract, 24 months are needed to start the saleable production. Main activities of this 24 months schedule is shown in attached construction schedule.

3.2. Site preparation

If the new factory is not located in the Madhvani site, the new site will have to be cleared from vegetation, debris and existing structures, and it should be cleared. These activities could be included in the contract of the general contractor or subcontracted directly by the investor(s) or by the general contractor to a local builder.

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3.3. Constructions of utilities and buildings and erection works

The contractor should work to established specifications and quantities, and supervision should be provided to ensure quality control and correct timing. Special care is needed when connecting the new utilities to the existing network.
Civil work could be executed by the general contractor or subcontracted under its supervision to a civil work local company.

3.3.1. Civil works (refer also annex 7.)

Generally, the civil works comprise :

- . the site installation i.e. temporary offices and warehouses, temporary fencing, benchmark network ;
- . the general levelling, excavation, backfilling, concreting and finishing works for foundations of structural steel buildings and for equipment, for basements, pits, dykes, towers, for ground-floor and upper floors, for concrete buildings ;
- . the execution of the sewerage and road system ; the execution of trenches, channels, culverts ; the execution of various foundations, eg. for piperacks, for electrical poles, for conveyors ;
- . the placing of siding and roofing sheets ;
- . the painting of steel structures and equipment of wall, etc ...

The use of a competent staff, of skilled workers and labourers, the use of suitable equipment for execution of the works and the purchase, supply and delivery of all materials required for proper execution of the works form part of the civil works.

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3.3.2. Erection works (refer also annex 8.)

Generally, the erection works include :

. the reception, offloading, checking, handling and storage of the machinerey, equipment, structural steel and materials supplied from abroad ;

. the execution, installation, alignment, levelling mechanical connection of the same ;

. the piping, lagging, electricity and instrumentation works including piperacks, cableways, supports and connections ;

. the tests for completion of the factory including blank tests to check if the factory is ready to receive the raw material.

The use of a competent staff, of skilled workers and labourers, the use of suitable equipment for execution of the works and the purchase, supply and delivery of all consumable goods required for proper execution of the works form part of the erection works.

The supply of basic raw materials for the manufacture of the product and of the materials that are required for the proper operation of the processing machinery e.g. oils, greases (including the first filling), chemicals, fuel oil, propane and butane gas, etc ... is not included in the scope of the erection works. They are included in the scope of the erection of the equipment.

3.4. Quarry opening and quarrying

The quarry site should be cleared of vegetation and debris. In the sand quarry, a pit should be dug, from where the sand may be quarried in lateral directions.

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Quarry is staffed with labourers (12 men) to load manually the trucks contract with local transport company seems the cheaper solution. According our enquiry, it seems not necessary that the owner of the glass factory manages himself the sand quarry, leaving this simple operation to local contractor.

At the quarry site, temporary lodgings may be set up. These would predominantly consist of cheap local material like wood, and as such, are negligible to the overall project cost.

Quarrying should start two months before start up, in order to ensure a sufficient supply of the raw materials on the factory.

3.5. List of other important activities (list non exhaustive)

- Check the possibility with the bottlers in Uganda to use green bottles instead of amber ones (possibly by making marketing tests).

- Determine the marketing policy of the products of the plant, mainly for the tablewares sector, for both national and export markets. Organization of the sales is to be set up.

- Obtain the working permits for the long term foreign technical assistance specialists as well as for supervision of civil work and erection and commissioning foreign specialists.

- Tender and buy raw materials.

- Contract th utilities supply.

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3.6. Staff recruited before start up :

The key personnel should be recruited before the start up of the factory, in order to enable them to get some acquaintance with the machinery and to take advantage of foreign training in the General Contractor's country and/or in Uganda during the erection phase.

Should be recruited at least one year before start up :

- The General manager.
- The Personnel manager.
- The Sales manager.
- Two accountants.
- Four employees.
- Two secretaries.
- The Technical manager.
- One Shift manager.
- The Machine Shop manager.
- One engineer.
- The laboratory specialist.
- Four furnace operators.
- Two chief machinists.
- One skilled worker.

Should be recruited six months before start up :

- One accountant.
- Eight employees.
- Three secretaries.
- Two messengers.
- The Warehouse manager.
- Three Shift managers.
- Five engineers.
- One skilled worker.

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3.7. Training in the General Contractor's country :

In addition to the on site training that the staff recruited before start up should receive during the erection phase, a specific training program in the General Contractor's country must be done. This training program is intended to be realized for some specific technical working posts only in a glass factory giving the know how to the General Contractor (refer annex 6. General note for selection of the personnel and training).

This training program will be as follows :
- The Technical manager for a 3 months period.
- The Technical manager assistant for a 3 months period.
- Four Shift manager for a 2 months period.
- One engineer (electrician) for a 2 month period.
- The laboratory specialist for a 2 months period.
- Four furnace operators for a 2 months period each.
- Two chief machinists for a 3 months period each.
- One skilled worker (mould repair) for a 2 months period.
- Eight machinists for 2 months.

Extent of training of the owner's technical personnel.

a. The G.C. (General Contractor) shall designate his skilled and qualified technical personnel to give technical instructions and training to the owner's technical personnel and explain all the technical problems within the scope of the contract.

b. The G.C. shall ensure that the owner's technical personnel will operate and be trained at each relevant posts in the above mentioned plant to enable them to understand and to master the technology, operation, inspection and repairing as well as maintenance of the equipment, etc ...

c. The G.C. shall submit the preliminary training program to the owner three months before the training starts for owner's study. One month before the start of the training, the owner shall inform the G.C. of name, sex, birth date, nationality, occupation, specialty of his personnel to be trained. The final training program shall be fixed by both parties through consultation according to the stipulations of the contract and the actual requirements of the owner's technical personnel.

d. Before the training starts, the G.C. shall explain in detail to the owner's technical personnel the operating regulations and other precautions.

e. Refer to annexe 6. General note for "Selection and training".

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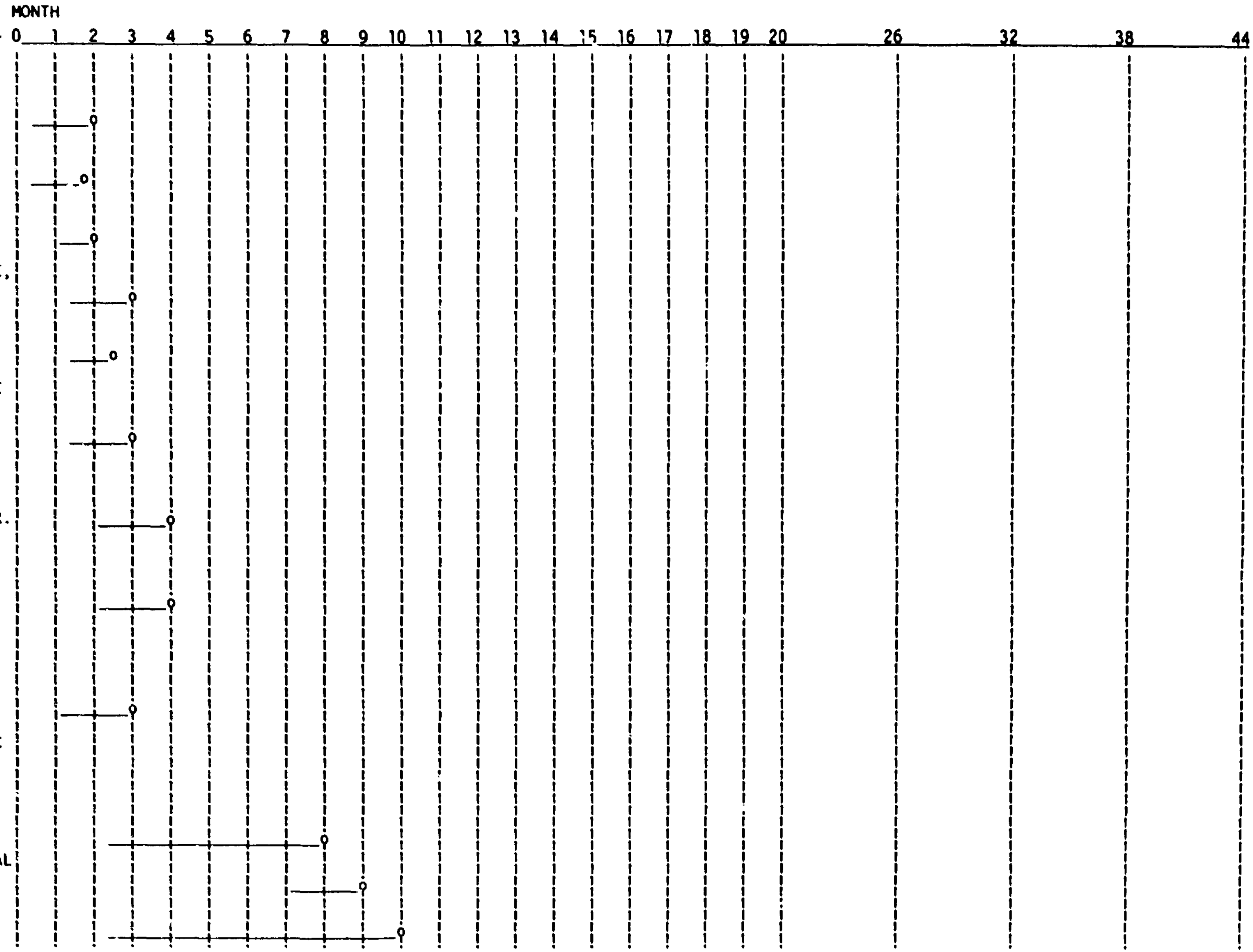
SCHEDULING OF MAIN ACTIVITIES (LIST NON EXHAUSTIVE)

DECISION TO INVEST ---



- FINALIZE AGREEMENT WITH INVESTORS, SHAREHOLDERS- FINALIZE LOAN-CREDIT.
- FORM. NEW CO TO OPERATE THE PROJECT.
- SELECT IMPLEMENT. TEAM + LEADER.
- LIST ACTIVITIES, SCHEDULE, RESPONSIBILITIES.
- SELECT EXPERIENCED INTERNAT. CONSULTANT.
- SELECT SITE LOCATION HIRE CONTRACT-COLLECT CARACT. OF SOIL/WATER LEVEL.
- NEGOCIATE UTILITIES SUPPLIES AND COLLECT (P°,T°,ANALYSIS) CARACTER.
- PROJECT EXPENSES AND ARRANGE FOR SHORT/ MEDIUM CREDITS.
- OBTAIN ALL GOVERNMENTAL APPROVALS BUILDG PERMITS, IMPORT LICENCES WORKING PERMITS.
- ISSUING OF BASIC SPECIFIC OF THE PROJECT-PREPARE TENDER FOR INTERNATIONAL TENDER-OPENING AND EVALUATION OF BIDS. NEGOCIATION WITH A GENERAL CONTRACTOR FOR IMPLEMENT. AWARD OF A CONTRACT (TURN KEY).

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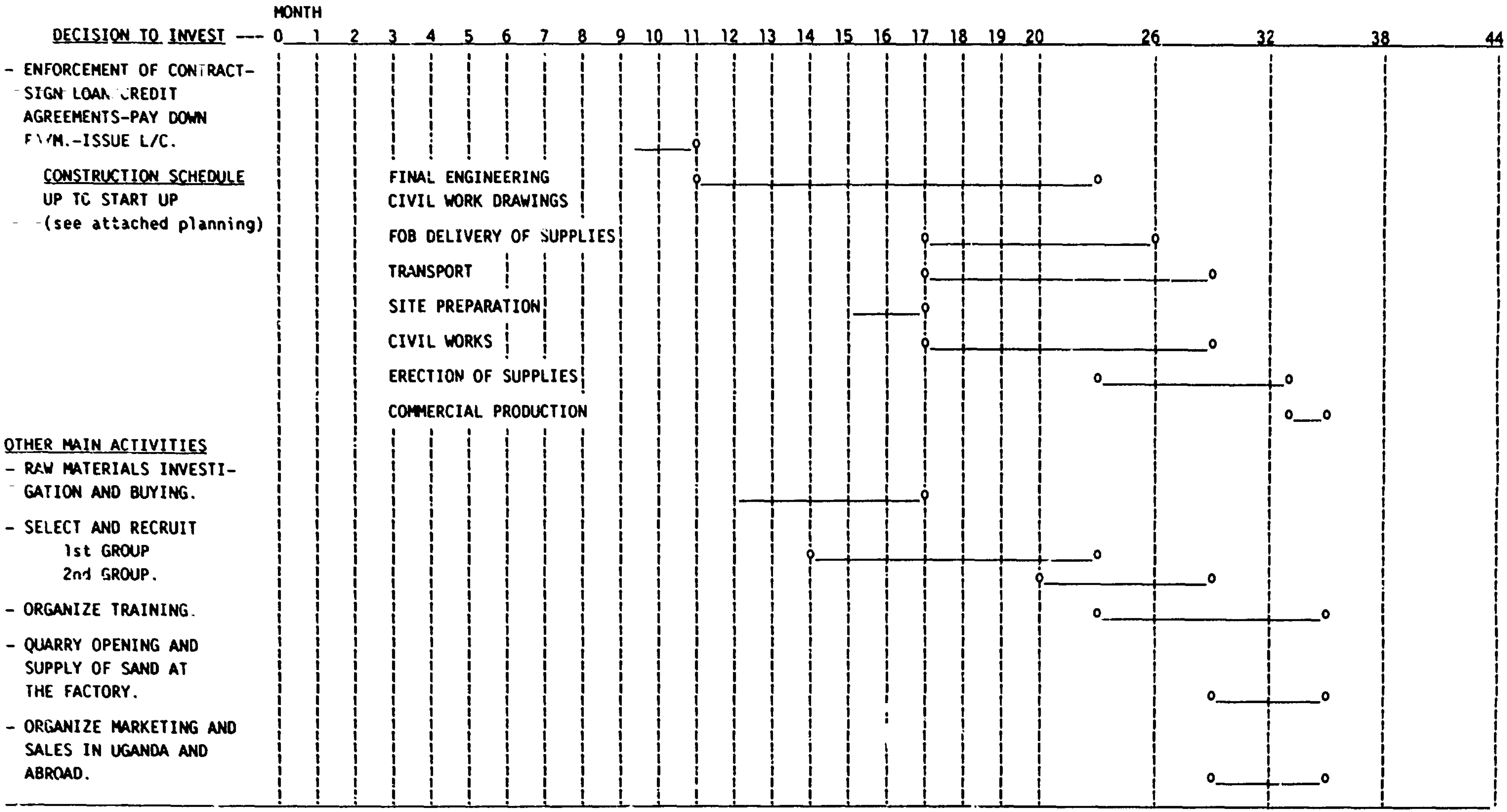

IMPLEMENTATION OF A GLASS CONTAINERS AND TABLEWARES PLANT IN UGANDA

CONSTRUCTION SCHEDULE

6 12 18 24

X_!

X ENFORCEMENT OF CONTRACT WITH A GENERAL CONTRACTOR

X____! SITE STUDY (SOIL TESTING)

X______________! WORKING DRAWINGS

!_______! FOUNDATION DESIGN

!___________________! FINAL DRAWINGS

!______________________________! KNOW HOW & TECHNICAL DOCUMENTATION

!______________________! FOB DELIVERY OF SUPPLIES

!______________________! TRANSPORT OF SUPPLIES ON SITE

!__________________________! ERECTION OF BUILDINGS

ERECTION OF SUPPLIES !_______________________!

STARTING UP !__!

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Conc: Implementation of A Glass Containers/ Tableware Production Plant in Uganda - List of Obligations

The Ministries concerned have to manage for the following (list non Exhaustive)-

1. Find promotors

2. Find and Finalize Equity (7-10 Mios $ (+30% of Global investment)

3. Find and finalize Loan(s) (Grant(s) for (+) 13-15 Mios $

4. Give sufficient Bank Guarantees for the Loan(s) (First Class Bank) Take the exchange risk.

5. Found and Register a company to operate the plant

6. Allocate a site (+ 3 Hectares Minimum) in Kampala Industrial Area

7. Give Building Permit + fuel Liquid gas storages

8. Issue Specific Liquid - Gazeous Effluents Pollution Regulations.

9. Issue adequate import licensed for Equipment/Material necessary to build the plant + raw material to operate

10. Provide the site with:

    9-1 Connection with Railway
    9-2 Connection with Large Type Tarmac Road (6-8 Meters)
    9-3 Connection with sewer network at B.L.
    9-4 Connection Potable water at B.L. (250 workers)
    9-5 Connection Electrical network at B.L. (11 KV - 7,5 Mioskua/year) 50HZ - Constant Feeding
    9-6 Connection water network at B.L. (35.000 M3/year - 3 kg/cm2) constant PO and feeding

11. Provide for Adequate labor force and training

    For + 250 workers including:

    - Plant Manager
    - Technical Manager
    - Marketing Manager
    - Financing Manager
    - Administrative + Personnel Manager
    - Maintenance Manager + Elect/Mecan Specialists
    - 5 Shift Supervisors
    - Skilled Operators for:
      - Batch Plant - Furnace - Forming
      - Machines - Processing Lines
      - Packaging - Utilities

......../2

12. Working Permits for (a) Plant Expatriates
Erection Fustars-up
Supervisors

(b) Medium Term for Management (General + Techn + Marketing) Expatriates
(3 to 4)

13. Organise for working capital + Insurances

14. Provide for sand and Dolomite continuously
(7-8000T/Y) (1-2000T/Y)

15. Define and organise Marketing.

X. FINANCIAL AND ECONOMIC EVALUATION.

X. FINANCIAL AND ECONOMIC EVALUATION.

PRELIMINARY NOTE

1. All the figures are expressed in U $.

   Investment costs and production costs were quoted by potential supplies in various currencies.
   Conversion rates used to transform these figures in their countervalue in US $ are those in force during april 89, i.e.

1 U $	=	1.81 DEM
1 U $	=	6.15 FEF
1 U $	=	1,314 LIT
1 U $	=	200 U.Sh.
1 U $	=	38 BEF

2. The study has been done using 2 computers models which are complementary.

   - The own ABAY model.
   - The COMFAR.

   Both of them are based on the UNIDO method for the preparation of industrial feasibility studies.

   Both of them given the same results. ABAY's program shows a I.R.R. on the total investment of 15.11 % and COMFAR's model 15.06 %.

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A. FINANCIAL ANALYSIS.

X.1. TOTAL INVESTMENT COST

The total investment can be subdivided into 4 parts :

- the initial fixed investment
- the preproduction costs representing non industrial costs prior to the factory start up excluding financing costs
- the financial charges before start up
- the working capital.

Table below summarizes the total investment. Details are given in the following pages.

At the end of the chapter you will find the investment cost schedule.

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TOTAL INITIAL INVESTMENT

amounts in thousand US $	LOCAL CURRENCY	FOREIGN CURRENCY	TOTAL
Initial fixed investment	2697.7	21608.0	24305.7
Preproduction costs	181.9	1518.2	1700.1
Reserve	9.1	75.9	85.0
Financial charges before start up	.0	1433.4	1433.4
INVESTMENT TO BE DEPRECIATED	2888.7	24635.6	27524.3
Working capital 1st year	173.8	1263.1	1436.9
TOTAL INVESTMENT	3062.5	25898.7	28961.2

1. INITIAL FIXED INVESTMENT

Table below summarizes the initial fixed investment. Details are given in the following pages.

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* INITIAL FIXED INVESTMENT *

amounts in thousand US $	LOCAL CURRENCY	FOREIGN CURRENCY	TOTAL
Land	9.8	.0	9.8
Civil works	2201.6	3302.4	5504.0
Equipment cif + engineering	.0	13085.0	13085.0
Furnace	.0	2573.0	2573.0
Erection and commissioning	486.4	2409.6	2896.0
Rolling stock	.0	238.0	238.0
SUB-TOTAL	2697.7	21608.0	24305.7
RESERVE	.0	.0	.0
TOTAL	2697.7	21608.0	24305.7

1.1. LAND

The surface area needed for the factory is 300 m x 130 m or 3.9 hectares.

The factory should be situated in the Kampala zone area, preferably close to Port Bell where the sand will be discharged, or in the Kampala industrial zone (Nakawa-Kiswa).

According to the Ministry of Lands and Surveys, there is no unleased land in the Kampala Industrial Area, nor in Port Bell.

The Ministry of Housing and Urban Development has declared that free lands are available in the Luzira and Mutungo areas. These areas being situated between the Kampala Industrial Zone and Port Bell, close to Victoria Lake, we consider them suitable.

These areas can be leased at the following cost :

500,000 U Sh flat
\+ 50,000 U Sh per year.

The investment cost of land for this project will amount to 9,750 US $.

Production costs will also include a lease of 975 US $ per year.

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1.2. CIVIL WORKS

These costs have been checked with local potential contractors capable to realize the civil works under the supervision of the General Contractor.

. Site installation	U $	569,900
. Earthworks		412,300
. Concrete formwork, reinforcement		2,528,700
. Subbases		136,500
. Brickwork and blockwork		282,800
. Tiling and rendering		145,300
. Ordinary and special coatings		144,900
. Painting and decorating		46,100
. Joinery and metal fittings		116,700
. Anchorages		8,900
. Metallic accessories		140,400
. Sanitary and plumbing works		58,100
. Rain and sewage water pipes		44,600
. Miscellaneous		31,500
. Furniture and equipment		4,000
. Steel structures		520,000
. Roof cladding, wall cladding, translucent sheet		183,300
. Ventilation and air conditioning		130,000
TOTAL	U $	5,504,000

1.3. ENGINEERING AND EQUIPMENT

The equipment transported to site and the total engineering of the plant have been costed as follows.

These costs have been calculated considering that the supply of all the equipment will be performed by a General Contractor specialized in the glass industry, what we consider to be the only way to avoid unexpected increases of prices and delays.

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. Batch plant	U $	1,907,400
. Furnace		2,573,000
. Production machinery		3,873,400
. Production treatment		572,200
. Cold end		157,200
. Laboratories		214,200
. Decoration		789,600
. Compressed air circuit		491,600
. Fuel oil circuit		36,800
. L.P.G. circuit		10,000
. Water circuit		59,000
. Fire fighting equipment		60,300
. Pipes-fittings-pipe racks		311,800
. Workshops		356,800
. Electricity		1,276,700
TOTAL EQUIPMENT FOB EUROPEAN PORT	U $	12,690,000
SEA FREIGHT AND INSURANCE	U $	395,000
ROAD TRANSPORT AND INSURANCE	U $	501,000
TOTAL EQUIPMENT CIF KAMPALA	U $	13,586,000
TOTAL ENGINEERING	U $	2,072,000
TOTAL EQUIPMENT CIF KAMPALA + ENGINEERING	U $	15,658,000

1.4. <u>ERECTION AND COMMISSIONING</u> :

These costs have been estimated as follows :

- Technical assistance given by the General Contractor for the supervision of the civil works and the erection and commissioning works :

  U $ 1,680,000.

- Details of this supervision and duties given in Chapter VIII.

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- Erection works :

These costs have been checked with local potential contractors capable to realize the erection works.

They are subdivided into fixed costs and variable costs :

Fixed costs :

- site equipment	U $	640,000
- consumables	U $	240,000
	U $	880,000

Variable costs :

Local manpower costs on a basis of 2,300 hours/year.

5 % engineers (expatriates) at 10,000 U $/year
15 % foremen-engineers at 2,800 U $/year
25 % skilled workers at 2,200 U $/year
25 % skilled workers at 2,000 U $/year
30 % unskilled workers at 1,450 U $/year.

That means :

(10,000 x 0.05 + 2,800 x 0.15 + 2,200 x 0.25 + 2,000 x 0.25 + 1,450 x 0.3)
= 2,405 U $ for 2,300 hours or 1.05 U $/hour.

Rate : 100 hours per ton erected or 105 U $/T.
To be erected : 2,000 T.
Thus the cost price for the contractor would be :

2,000 x 105	:	U $	210,000
+ 10 % overheads	:	U $	21,000
+ 30 % contingencies	:	U $	63,000
+ 20 % margin	:	U $	42,000
Sub-total	:	U $	336,000

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Total erection works costs (without technical supervision assistance) :

880,000 + 336,000 = 1,216,000 U $.

Total erection work costs including technical assistance in erection and commissioning :

1,680,000 (technical assistance page)
+ 1,216,000 (erection cost page)
= 2,896,000 U $.

1.5. ROLLING STOCK :

The rolling stock will include :

- Six manual forklifts
- Two diesel forklifts
- One wheel loader
- One dumper
- Twenty five cullet carts.

Their cost is : U $ 238,000

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2. PREPRODUCTION COSTS :

The following items have been added to the investment as preliminary miscellaneous expenses prior to start up :

. Training in Europe of 23 key personnel of the Buyer for a global pericd of 50 months	:	U $	490,000
. Salaries and wages of recruited staff before start up (40 % of the yearly manpower)	:	U $	187,900
. Constitution costs	:	U $	50,000
. Fees & arrangement cost of credits (4 % of initial fixed investment costs for commitment fees, insurance premium of credit, guarantees, opening of letters of credit, management fees). This percentage is evaluated according our experience for international contracts taking into account the politico/economical situation of the Uganda. This last related to the granting buyers credit is to be paid at the signature of the credit agreement.	:	U $	972,200
SU3 TOTAL	:	U $	1,700,100
. Reserve for contingencies (5 %)	:	U $	85,000
TOTAL	:	U $	1,785,100

Table below summarizes the preproduction costs.

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****
* PREPRODUCTION COSTS *
****

amounts in thousand US $	LOCAL CURRENCY	FOREIGN CURRENCY	TOTAL
Salaries before start up	131.9	56.0	187.9
Credit arrangement cost	.0	972.2	972.2
Training	.0	490.0	490.0
Constitution costs	50.0	.0	50.0
SUB-TOTAL	181.9	1518.2	1700.1
RESERVE	9.1	75.9	85.0
TOTAL	191.0	1594.1	1785.1

3. FINANCIAL CHARGES BEFORE START UP :

We have taken 12 months interest on the long term credits, i.e. 1,433,400 $ in foreign currency.

For more details, please refer to the chapter devoted to the financial structure.

4. WORKING CAPITAL REQUIREMENTS :

Theoretically, working capital represents the difference between current assets and current liabilities.
In fact, this item is the amount of cash required by a business to carry on its operation without interruption.
The nature of the glass manufacturing industry suggests a quick turn-over of inventory. The working capital requirements would be estimated on the following basis :

4.1. ACCOUNTS RECEIVABLE :

. 30 days coverage of production costs.

4.2. INVENTORIES :

. 90 days coverage of raw materials and consumables.
. 2 years coverage of the spare parts.
. 30 days coverage of fuel and LPG.
. 2 days coverage of production costs for work in progress.
. 3 weeks coverage of production costs for finished goods.

4.3. CASH IN HAND :

1 month of wages and fixed costs.

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4.4. The total of 4.1., 4.2. and 4.3. represents the current assets.

4.5. To determine the working capital, the current liabilities, that is the credit granted by the suppliers which is estimated at 30 days cover i.e. 1/4 of the variable costs (manpower excluded) + overhead, have been subtracted from the current assets.

4.6. The detail of the calculation of the working capital for the first fifteen operating years is stated in table below.

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****
* WORKING CAPITAL *
****

amounts in thousand US $	1	2	3	4	5	6	7
Accounts receivable	312.6	318.1	318.9	322.7	300.2	374.0	406.9
Raw materials	203.5	229.8	252.4	277.4	258.9	348.0	389.8
Consumables	205.0	212.5	223.1	234.7	224.6	273.3	296.1
Spare parts	632.2	632.2	632.2	632.2	632.2	632.2	632.2
Fuel and l.p.g.	25.4	29.0	30.9	32.9	29.6	40.7	45.1
Work in progress	20.8	21.2	21.3	21.5	20.0	24.9	27.1
Finished products	218.8	222.6	223.2	225.9	210.1	261.8	284.9
Cash in hand	116.2	102.2	88.0	74.0	73.5	75.5	76.4
CURRENT ASSETS	1734.5	1767.6	1790.0	1821.3	1749.2	2030.5	2158[illegible]
Accounts payable	297.6	302.9	304.5	307.3	290.3	362.2	394.1
WORKING CAPITAL	1436.9	1464.6	1485.5	1513.9	1458.9	1668.3	1764.4
VARIATION	1436.9	27.7	20.8	28.5	-55.1	209.4	96.1

	8	9	10	11	12	13
Accounts receivable	439.8	476.5	415.0	460.9	468.7	472.6
Raw materials	436.5	488.9	407.4	488.9	488.9	488.9
Consumables	321.7	350.3	305.8	350.3	350.3	350.3
Spare parts	632.2	632.2	632.2	632.2	632.2	632.2
Fuel and l.p.g.	48.2	51.6	44.3	44.6	48.1	49.9
Work in progress	29.3	31.8	27.7	30.7	31.2	31.5
Finished products	307.8	333.5	290.5	322.7	328.1	330.8
Cash in hand	77.2	78.3	76.5	77.8	78.0	116.2
CURRENT ASSETS	2292.7	2443.1	2199.3	2408.2	2425.7	2472.4
Accounts payable	425.8	461.6	401.7	446.5	454.0	495.7
WORKING CAPITAL	1866.9	1981.5	1797.6	1961.7	1971.7	1976.6
VARIATION	102.6	114.6	-183.9	164.1	10.0	5.0

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* WORKING CAPITAL (IN LOCAL CURRENCY) *
****

amounts in thousand US $	1	2	3	4	5	6	7
Accounts receivable	103.7	113.3	118.2	125.1	119.4	150.5	163.4
Raw materials	28.8	32.5	35.7	39.2	36.6	49.2	55.1
Consumables	8.3	8.3	8.3	8.3	8.3	8.3	8.3
Spare parts	.0	.0	.0	.0	.0	.0	.0
Fuel and l.p.g.	25.4	29.0	30.9	32.9	29.6	40.7	45.1
Work in progress	6.9	7.6	7.9	8.3	8.0	10.0	10.9
Finished products	72.6	79.3	82.7	87.6	83.6	105.3	114.4
Cash in hand	33.0	33.0	33.0	33.0	33.0	33.0	33.0
CURRENT ASSETS	278.7	302.8	316.7	334.4	318.5	397.1	430.1
Accounts payable	104.9	114.2	120.2	126.4	118.2	147.4	159.3
WORKING CAPITAL	173.8	188.6	196.5	208.0	200.2	249.7	270.8
VARIATION	173.8	14.8	7.9	11.5	-7.8	49.4	21.1

	8	9	10	11	12	13
Accounts receivable	173.8	185.4	163.0	170.1	177.8	181.6
Raw materials	61.7	69.1	57.6	69.1	69.1	69.1
Consumables	8.3	8.3	8.3	8.3	8.3	8.3
Spare parts	.0	.0	.0	.0	.0	.0
Fuel and l.p.g.	48.2	51.6	44.3	44.6	48.1	49.9
Work in progress	11.6	12.4	10.9	11.3	11.9	12.1
Finished products	121.7	129.8	114.1	119.1	124.5	127.1
Cash in hand	33.0	33.0	33.0	33.0	33.0	33.0
CURRENT ASSETS	458.3	489.7	431.3	455.6	472.7	481.2
Accounts payable	168.8	179.4	158.7	164.5	171.9	175.6
WORKING CAPITAL	289.5	310.3	272.5	291.1	300.8	305.5
VARIATION	18.7	20.7	-37.8	18.6	9.7	4.7

****
* WORKING CAPITAL (IN FOREIGN CURRENCY) *
****

amounts in thousand US $	1	2	3	4	5	6	7
Accounts receivable	208.9	204.8	200.7	197.6	180.8	223.5	243.6
Raw materials	174.8	197.4	216.7	238.2	222.3	298.8	334.7
Consumables	196.7	204.2	214.8	226.4	216.3	265.0	287.8
Spare parts	632.2	632.2	632.2	632.2	632.2	632.2	632.2
Fuel and l.p.g.	.0	.0	.0	.0	.0	.0	.0
Work in progress	13.9	13.7	13.4	13.2	12.1	14.9	16.2
Finished products	146.2	143.4	140.5	138.3	126.5	156.5	170.5
Cash in hand	83.2	69.2	55.0	41.0	40.5	42.5	43.4
CURRENT ASSETS	1455.9	1464.7	1473.3	1486.8	1430.7	1633.4	172[illegible]
Accounts payable	192.7	188.7	184.3	180.9	172.1	214.8	234.8
WORKING CAPITAL	1263.2	1276.0	1289.0	1305.9	1258.6	1419.6	1493.6
VARIATION	1263.2	12.9	12.9	17.0	-47.3	160.0	75.0

	8	9	10	11	12	13
Accounts receivable	266.0	291.0	252.0	290.8	290.9	291.0
Raw materials	374.8	419.8	349.8	419.8	419.8	419.8
Consumables	313.4	342.0	297.5	342.0	342.0	342.0
Spare parts	632.2	632.2	632.2	632.2	632.2	632.2
Fuel and l.p.g.	.0	.0	.0	.0	.0	.0
Work in progress	17.7	19.4	16.8	19.4	19.4	19.4
Finished products	186.2	203.7	176.4	203.6	203.6	203.7
Cash in hand	44.2	45.3	43.5	44.8	45.0	83.2
CURRENT ASSETS	1834.4	1953.4	1768.1	1952.6	1953.0	1991.2
Accounts payable	257.0	282.2	243.0	282.0	282.1	320.1
WORKING CAPITAL	1577.4	1671.2	1525.1	1670.6	1670.9	1671.1
VARIATION	83.8	93.8	-146.2	145.5	.3	.3

Net Working Capital in thousand US $

Year	mdc	coto	1992	1993	1994	1995	1996
Coverage	mdc	coto					
Current assets &							
Accounts receivable	30	12.0	312.558	318.070	319.657	322.677	300.180
Inventory and materials	87	4.2	408.448	442.200	475.471	512.164	483.573
Energy	14	25.7	25.394	28.955	30.879	32.882	29.608
Spares	720	0.5	632.200	632.200	632.200	632.200	632.200
Work in progress	2	180.0	19.833	20.190	20.293	20.488	19.019
Finished products	21	17.1	218.791	222.649	223.760	225.874	210.126
Cash in hand	30	12.0	117.158	103.158	89.025	74.958	69.442
Total current assets			1734.382	1767.422	1791.285	1821.244	1744.148
Current liabilities and							
Accounts payable	30	12.0	297.500	302.845	304.398	307.319	285.288
Net working capital			1436.883	1464.577	1486.887	1513.925	1458.860
Increase in working capital			1436.883	27.695	22.310	27.038	-55.065
Net working capital, local			173.744	188.604	197.934	208.048	200.217
Net working capital, foreign			1263.139	1275.974	1288.953	1305.877	1258.643

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Net Working Capital in thousand US $

Year	mdc	coto	1997	1998	1999	2000	2001
Coverage	mdc	coto					
Current assets &							
Accounts receivable	30	12.0	374.020	406.937	439.773	476.474	415.002
Inventory and materials	87	4.2	621.288	685.898	758.192	839.224	713.191
Energy	14	25.7	40.678	45.086	48.206	51.647	44.301
Spares	720	0.5	632.200	632.200	632.200	632.200	632.200
Work in progress	2	180.0	23.801	25.932	28.058	30.432	26.454
Finished products	21	17.1	261.814	284.856	307.841	333.532	290.501
Cash in hand	30	12.0	71.558	72.508	73.458	74.542	72.742
Total current assets			2025.359	2153.417	2287.729	2438.051	2194.391
Current liabilities and							
Accounts payable	30	12.0	357.012	388.978	420.865	456.482	396.810
Net working capital			1668.347	1764.438	1866.864	1981.569	1797.580
Increase in working capital			209.487	96.091	102.426	114.704	-183.988
Net working capital, local			249.737	270.832	289.503	310.349	272.526
Net working capital, foreign			1418.610	1493.605	1577.361	1671.220	1525.054

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Net Working Capital in thousand US $

Year			2002	2003	2004	2005	2006
Coverage	mdc	coto					
Current assets &							
Accounts receivable . . .	30	12.0	460.937	468.734	472.585	476.474	476.474
Inventory and materials .	87	4.2	839.224	839.224	839.224	839.224	839.224
Energy	14	25.7	44.614	48.144	49.886	51.647	51.647
Spares	720	0.5	632.200	632.200	632.200	632.200	632.200
Work in progress	2	180.0	29.427	29.932	30.181	30.432	30.432
Finished products . . .	21	17.1	322.656	328.114	330.809	333.532	333.532
Cash in hand	30	12.0	74.075	74.308	74.425	74.542	74.542
Total current assets			2403.134	2420.656	2429.310	2438.051	2438.051
Current liabilities and							
Accounts payable	30	12.0	441.412	448.976	452.710	456.482	456.482
Net working capital			1961.722	1971.680	1976.600	1981.569	1981.569
Increase in working capital			164.141	9.958	4.920	4.968	0.000
Net working capital, local			291.132	300.775	305.538	310.349	310.349
Net working capital, foreign			1670.590	1670.905	1671.062	1671.220	1671.220

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

5. REPLACEMENT INVESTMENTS :

They relate to :

- the furnace extension up to 90 T/day at the end of the fifth year of production

- the furnace partial rebuilding at the end of the tenth year of production

- the replacement of the rolling stock at years 5 and 10.

These investments are expressed, as follows, in thousand U $:

YEAR	5	10
Replacement investment furnace	2,697	1,068
Replacement rolling stock	238	238

6. TOTAL INVESTMENT SCHEDULE :

According to the various types of investment, the schedule has considered the spreading out of payments as follows, for a construction period of two years.

YEAR	00	0
Land	100 %	-
Civil works	58 %	42 %
Equipment and engineering	24 %	76 %
Erection and commissioning	15 %	85 %
Rolling stock	-	100 %
Training	15 %	85 %
Salaries and wages	-	100 %
Other preproduction costs	100 %	-
Financial charges before start-up	25 %	75 %

Table below shows this investment schedule.

./.

****
* INVESTMENT SCHEDULE *
****

amounts in thousand US $	-2	-1	1	2	3	4	5	6
L O C A L C U R R E N C Y								
Initial fixed investment	1359.6	1338.1	.0	.0	.0	.0	.0	.0
Replacement	.0	.0	.0	.0	.0	.0	.0	.0
Preproduction costs	50.0	131.9	.0	.0	.0	.0	.0	.0
Reserve	2.7	6.4	.0	.0	.0	.0	.0	.0
Financial charges before start up	.0	.0	.0	.0	.0	.0	.0	.0
Working capital	.0	.0	173.8	14.8	7.9	11.5	-7.8	49.4
TOTAL IN LOCAL CURRENCY	1412.4	1476.4	173.8	14.8	7.9	11.5	-7.8	49.4
F O R E I G N C U R R E N C Y								
Initial fixed investment	6034.8	15573.2	.0	.0	.0	.0	.0	.0
Replacement	.0	.0	.0	.0	.0	.0	2935.0	.0
Preproduction costs	1045.7	472.5	.0	.0	.0	.0	.0	.0
Reserve	22.8	53.1	.0	.0	.0	.0	.0	.0
Financial charges before start up	356.2	1077.2	.0	.0	.0	.0	.0	.0
Working capital	.0	.0	1263.2	12.9	12.9	17.0	-47.3	160.0
TOTAL IN FOREIGN CURRENCY	7459.5	17176.1	1263.2	12.9	12.9	17.0	2887.7	160.0
T O T A L								
Initial fixed investment	7394.4	16911.4	.0	.0	.0	.0	.0	.0
Replacement	.0	.0	.0	.0	.0	.0	2935.0	.0
Preproduction costs	1095.7	604.4	.0	.0	.0	.0	.0	.0
Reserve	25.5	59.5	.0	.0	.0	.0	.0	.0
Financial charges before start up	356.2	1077.2	.0	.0	.0	.0	.0	.0
Working capital	.0	.0	1436.9	27.7	20.8	28.5	-55.1	209.4
TOTAL INVESTMENT SCHEDULE	8871.8	18652.4	1436.9	27.7	20.8	28.5	2879.9	209.4
Accumulated in local currency	1412.4	2888.7	3062.5	3077.3	3085.2	3096.7	3089.0	3138.4
Accumulated in foreign currency	7459.5	24635.5	25898.7	25911.6	25924.5	25941.5	28829.2	28989.2
A C C U M U L A T E D T O T A L	8871.8	27524.3	28961.2	28988.9	29009.7	29038.2	31918.2	32127.6

Amounts in thousand US $	7	8	9	10	11	12	13	14
LOCAL CURRENCY								
Initial fixed investment	.0	.0	.0	.0	.0	.0	.0	.0
Replacement	.0	.0	.0	.0	.0	.0	.0	.0
Preproduction costs	.0	.0	.0	.0	.0	.0	.0	.0
Reserve	.0	.0	.0	.0	.0	.0	.0	.0
Financial charges before start up	.0	.0	.0	.0	.0	.0	.0	.0
Working capital	21.1	18.7	20.7	-37.8	18.6	9.7	4.7	4.7
TOTAL IN LOCAL CURRENCY	21.1	18.7	20.7	-37.8	18.6	9.7	4.7	4.7
FOREIGN CURRENCY								
Initial fixed investment	.0	.0	.0	.0	.0	.0	.0	.0
Replacement	.0	.0	.0	1306.0	.0	.0	.0	.0
Preproduction costs	.0	.0	.0	.0	.0	.0	.0	.0
Reserve	.0	.0	.0	.0	.0	.0	.0	.0
Financial charges before start up	.0	.0	.0	.0	.0	.0	.0	.0
Working capital	75.0	83.8	93.8	-146.2	145.5	.3	.3	.1
TOTAL IN FOREIGN CURRENCY	75.0	83.8	93.8	1159.8	145.5	.3	.3	.1
TOTAL								
Initial fixed investment	.0	.0	.0	.0	.0	.0	.0	.0
Replacement	.0	.0	.0	1306.0	.0	.0	.0	.0
Preproduction costs	.0	.0	.0	.0	.0	.0	.0	.0
Reserve	.0	.0	.0	.0	.0	.0	.0	.0
Financial charges before start up	.0	.0	.0	.0	.0	.0	.0	.0
Working capital	96.1	102.6	114.6	-183.9	164.1	10.0	5.0	4.9
TOTAL INVESTMENT SCHEDULE	96.1	102.6	114.6	1122.1	164.1	10.0	5.0	4.9
Accumulated in local currency	3159.5	3178.2	3199.0	3161.2	3179.8	3189.5	3194.3	3199.0
Accumulated in foreign currency	29064.1	29148.0	29241.8	30401.6	30547.1	30547.4	30547.6	30547.5
ACCUMULATED TOTAL	32223.6	32326.2	32440.8	33562.8	33726.9	33736.9	33741.9	33746.8

amounts in thousand US $	15	TOTAL
L O C A L C U R R E N C Y		
Initial fixed investment	.0	2697.7
Replacement	.0	.0
Preproduction costs	.0	181.9
Reserve	.0	9.1
Financial charges before start up	.0	.0
Working capital	.0	310.3
TOTAL IN LOCAL CURRENCY	.0	3199.0
F O R E I G N C U R R E N C Y		
Initial fixed investment	.0	21608.0
Replacement	.0	4241.0
Preproduction costs	.0	1518.2
Reserve	.0	75.9
Financial charges before start up	.0	1433.4
Working capital	.0	1671.2
TOTAL IN FOREIGN CURRENCY	.0	30547.8
T O T A L		
Initial fixed investment	.0	24305.7
Replacement	.0	4241.0
Preproduction costs	.0	1700.1
Reserve	.0	85.0
Financial charges before start up	.0	1433.4
Working capital	.0	1981.5
TOTAL INVESTMENT SCHEDULE	.0	33746.8
Accumulated in local currency	3199.0	3199.0
Accumulated in foreign currency	30547.8	30547.8
A C C U M U L A T E D T O T A L	33746.8	33746.8

Total Initial Investment in thousand US $

Year	1990	1991
Fixed investment costs		
Land, site preparation, development	9.750	0.000
Buildings and civil works	3192.320	2311.680
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	434.400	2699.600
Plant machinery and equipment	3757.920	11900.080
Total fixed investment costs	7394.390	16911.360
Pre-production capital expenditures.	1477.450	1741.050
Net working capital	0.000	0.000
Total initial investment costs	8871.840	18652.410
Of it foreign, in %	84.081	92.085

Total Current Investment in thousand US $

Year	1992	1993	1994	1995	1996
Fixed investment costs					
Land, site preparation, development	0.000	0.000	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000	0.000	238.000
Plant, machinery and equipment	0.000	0.000	0.000	0.000	2697.000
Total fixed investment costs	0.000	0.000	0.000	0.000	2935.000
Preproduction capitals expenditures.	0.000	0.000	0.000	0.000	0.000
Working capital	1436.883	27.695	22.310	27.038	-55.065
Total current investment costs	1436.883	27.695	22.310	27.038	2879.935
Of it foreign, %	87.908	46.344	58.180	62.592	100.000

Total Current Investment in thousand US $

Year	1997	1998	1999	2000	2001
Fixed investment costs					
Land, site preparation, development	0.000	0.000	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000	0.000	238.000
Plant, machinery and equipment	0.000	0.000	0.000	0.000	1068.000
Total fixed investment costs	0.000	0.000	0.000	0.000	1306.000
Preproduction capitals expenditures.	0.000	0.000	0.000	0.000	0.000
Working capital	209.487	96.091	102.426	114.704	-183.988
Total current investment costs	209.487	96.091	102.426	114.704	1122.012
Of it foreign, %	76.361	78.047	81.771	81.827	100.000

Total Current Investment in thousand US $

Year	2002	2003	2004	2005
Fixed investment costs				
Land, site preparation, development	0.000	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000	0.000
Working capital	164.141	9.958	4.920	4.968
[illegible] current investment costs	164.141	9.958	4.920	4.968
Of it foreign, %	88.665	3.164	3.200	3.170

X.2. DEPRECIATION

Depreciation schedule is shown in table below.

The depreciation rates used are as follows ;

- Land	:	NIL
- Engineering and equipment (including erection and commissioning costs)	:	15 years
- Furnace	:	5 years
- Civil works	:	25 years
- Rolling stock	:	5 years
- Preproduction costs	:	5 years
- Financial charges before start up	:	5 years.

The salvage value of the investment after 15 years of production will be :

- Land	:	9,750 U $
- Civil work	:	2,201,600 U $
- Working capital	:	1,981,500 U $
Salvage value	:	4,192,850 U $.

This value will be used for the calculation of the internal rates of return.

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****
* DEPRECIATION SCHEDULE *
****

amounts in thousand US $	1	2	3	4	5	6	7	8	9
Land	.0	.0	.0	.0	.0	.0	.0	.0	.0
Civil works	220.2	220.2	220.2	220.2	220.2	220.2	220.2	220.2	220.2
Equipment cif + engineering	872.3	872.3	872.3	872.3	872.3	872.3	872.3	872.3	872.3
Furnace	514.6	514.6	514.6	514.6	514.6	.0	.0	.0	.0
Erection and commissioning	193.1	193.1	193.1	193.1	193.1	193.1	193.1	193.1	193.1
Rolling stock	47.6	47.6	47.6	47.6	47.6	.0	.0	.0	[illegible]
Replacement	.0	.0	.0	.0	.0	587.0	587.0	587.0	[illegible]
Preproduction costs	357.0	357.0	357.0	357.0	357.0	.0	.0	.0	.0
Financial charges before start up	286.7	286.7	286.7	286.7	286.7	.0	.0	.0	.0
TOTAL	2491.5	2491.5	2491.5	2491.5	2491.5	1872.6	1872.6	1872.6	1872.6
ACCUMULATED	2491.5	4982.9	7474.4	9965.9	12457.3	14329.9	16202.4	18075.0	19947.6

	10	11	12	13	14	15
Land	.0	.0	.0	.0	.0	.0
Civil works	220.2	220.2	220.2	220.2	220.2	220.2
Equipment cif + engineering	872.3	872.3	872.3	872.3	872.3	872.3
Furnace	.0	.0	.0	.0	.0	.0
Erection and commissioning	193.1	193.1	193.1	193.1	193.1	193.1
Rolling stock	.0	.0	.0	.0	.0	.0
Replacement	587.0	261.2	261.2	261.2	261.2	261.2
Preproduction costs	.0	.0	.0	.0	.0	.0
Financial charges before start up	.0	.0	.0	.0	.0	.0
TOTAL	1872.6	1546.8	1546.8	1546.8	1546.8	1546.8
ACCUMULATED	21820.1	23366.9	24913.6	26460.4	28007.2	29553.9

****
* SALVAGE VALUE AFTER 15 YEARS *
****

amounts in thousand US $	
Land	9.8
Civil works	2201.6
Equipment cif + engineering	.0
Furnace	.0
Erection and commissioning	.0
Rolling stock	.0
Replacement	.0
Preproduction costs	.0
Financial charges before start up	.0
SUB-TOTAL	2211.4
Working capital	1981.5
SALVAGE VALUE	4192.8

X.3. FINANCIAL STRUCTURATION

1. INTRODUCTION.

The object of this chapter is to determine the financial arrangements for the project and to check whether the cash flow is adequate.

Using the investment schedule and operating costs as a basis, we have drawn up a cash flow forecast table for financial planning.

Using this table we can determine the financial structure required.

The table has been drawn up according to an iterative process by which we can work out the financial arrangement needed for the project while making sure that the project will at all time have the funds needed to continue its activities.

Using the investment diary, a financial arrangement and a diary of financial resources have been defined which are found to be adequate by checking the synchronization of cash flows (inflow and outflow) to avoid bottlenecks.

The resulting cash balance should always be positive - this is why the financial arrangement and its diary are adjusted by an iterative process to arrive at the table as it is given.

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2. BASIC DATA CONSIDERED FOR THE FINANCIAL STRUCTURE.

- BASIC PRINCIPLE :

  . 1/3 of the total financial needs (working capital excluded) would be covered by the equity.

  . 2/3 would be financed by loans.

  . 20 % of the equity will be brought in foreign currency.

- TERMS AND CONDITIONS OF THE LOANS :

  . 18 months credits for working capital

  tc cover the working capital at its level of the 1st operating year.
  Rate : 14 %.

  The increase in the working capital for the years following the fist year of operation would be assumed to be financed by self-financing.

  This credit will be reimbursed at the middle of the second operating year.

  . Long term loans :

  Buyer's credit in foreign currency to be secured by the general contractor who will get the construction contract.

  It has been supposed that this loan will cover ± 70 % of the financial needs not covered by the equity.

  Rest of the needs in foreign currency will have to be covered by other sources such as an A.D.B. loan.

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Terms and conditions of these loans are those presently in force for Buyer's credits granted by european countries according to the Consensus Agreement and for A.D.B. loan. A.D.B. has been approached for this project and is ready to grant a loan.

For Buyer's credits :

They are : - Interest rate of 8,3 %.
- Repayment holiday for the construction period + 6 months operation.
- Reimbursement in 10 half-yearly instalments, the first one maturing 6 months after start-up. [These are the conditions generally prevailing on the international market for such a project (applicable in Uganda).]

For A.D.B. loans :

They are : - Interest rate of 7,4 %.
- Repayment holiday for 5 years.
- Reimbursement in 30 half-yearly instalments, the first one maturing 5 years after the beginning of the construction period.
These conditions have been suggested (as preliminar) by A.D.B. financing department (refer telexes enclosed Annex 9.).

3. CASH FLOW SCHEDULE FOR FINANCIAL PLANNING.

See tables below.

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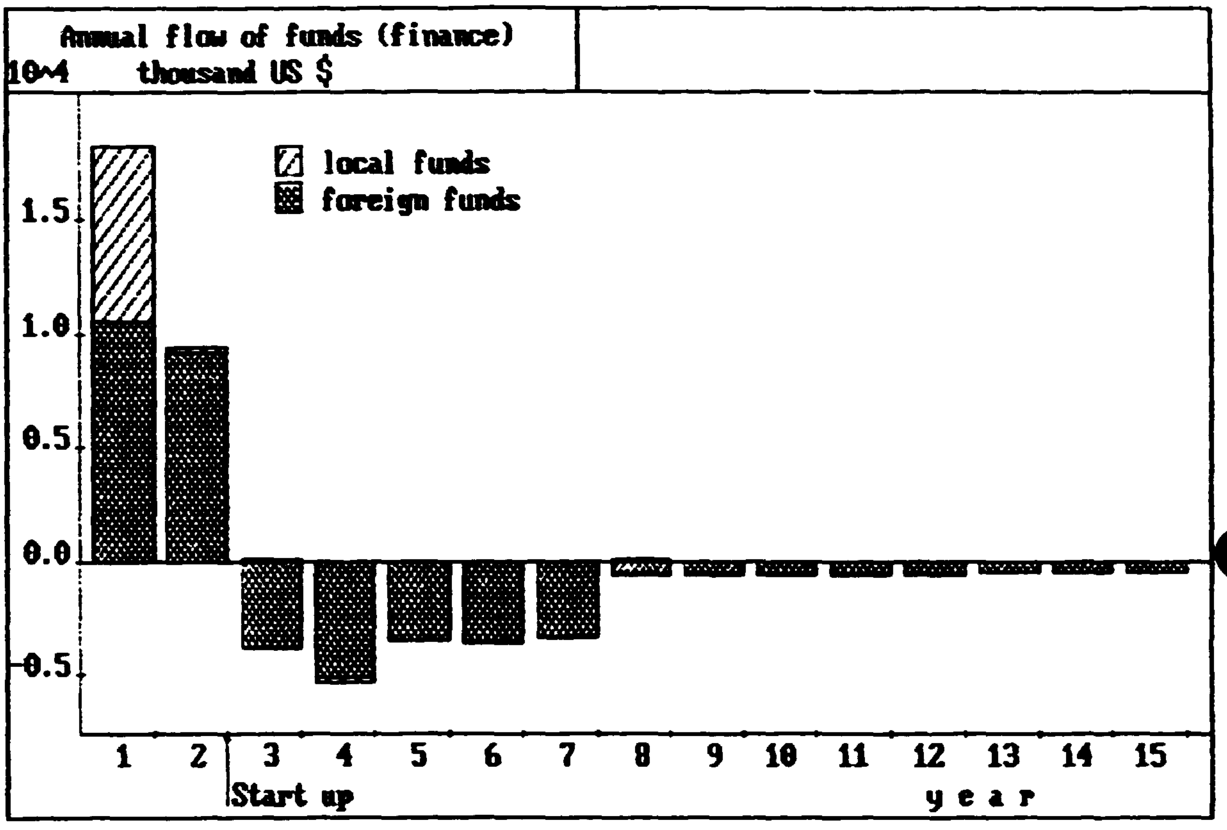
Annual flow of funds (finance)
10^4 thousand US $
local funds
foreign funds
1.5
1.0
0.5
0.0
-0.5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Start up
y e a r

****
* CASH FLOW SCHEDULE FOR FINANCIAL PLANNING *
****

amounts in thousand US $	-2	-1	1	2	3	4	5	6	7	8
INFLOWS										
Net sales revenue	.0	.0	6819.5	7672.6	8602.7	9615.8	8974.9	12062.1	13509.6	15130.7
Production costs	.0	.0	3750.8	3816.8	3826.2	3872.2	3602.3	4488.3	4883.4	5277.3
GROSS PRODUCTION MARGIN	.0	.0	3068.7	3855.8	4776.5	5743.7	5372.6	7573.8	8626.2	9853.4
Equity	9650.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Long term loans	8925.0	10425.0	.0	.0	.0	.0	.0	.0	.0	.0
Short term credits	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Lack of cash flow credit	.0	.0	984.1	1451.0	.0	.0	1827.6	.0	.0	.0
TOTAL INFLOWS	18575.0	10425.0	4052.9	5306.8	4776.5	5743.7	7200.2	7573.8	8626.2	9853.4
OUTFLOWS										
Investment	8871.8	18652.4	1436.9	27.7	20.8	28.5	2879.9	209.4	96.1	102.6
Long term debt service	.0	.0	4091.7	5279.1	3466.7	3609.1	3375.3	693.2	666.8	640.4
Interest on short term credit	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Interest on lack of cash flow	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Repayment short term credit	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Repayment lack of cash flow	.0	.0	.0	.0	1133.3	1106.2	.0	2023.3	.0	.0
Tax on profit	.0	.0	.0	.0	155.7	999.9	945.0	2145.9	2577.4	3078.8
TOTAL OUTFLOWS	8871.8	18652.4	5528.6	5306.8	4776.5	5743.7	7200.2	5071.7	3340.3	3821.8
CASH BALANCE	9703.2	-8227.4	-1475.7	.0	.0	.0	.0	2502.1	5286.0	6031.6
ACCUMULATED CASH BALANCE	9703.2	1475.7	.0	.0	.0	.0	.0	2502.1	7788.1	13819.7

amounts in thousand US $	9	10	11	12	13	14	15
INFLOWS							
Net sales revenue	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4	16946.4
Production costs	5717.7	4980.0	5531.3	5624.9	5671.0	5717.7	5717.7
GROSS PRODUCTION MARGIN	11228.7	9142.0	11415.1	11321.5	11275.4	11228.7	11228.7
Equity	.0	.0	.0	.0	.0	.0	.0
Long term loans	.0	.0	.0	.0	.0	.0	.0
Short term credits	.0	.0	.0	.0	.0	.0	.0
Lack of cash flow credit	.0	.0	.0	.0	.0	.0	.0
TOTAL INFLOWS	11228.7	9142.0	11415.1	11321.5	11275.4	11228.7	11228.7
OUTFLOWS							
Investment	114.6	1122.1	164.1	10.0	5.0	4.9	.0
Long term debt service	614.0	587.6	561.2	534.8	508.4	482.0	455.6
Interest on short term credit	.0	.0	.0	.0	.0	.0	.0
Interest on lack of cash flow	.0	.0	.0	.0	.0	.0	.0
Repayment short term credit	.0	.0	.0	.0	.0	.0	.0
Repayment lack of cash flow	.0	.0	.0	.0	.0	.0	.0
Tax on profit	3639.5	2815.4	3865.5	3838.6	3830.7	3822.6	3833.2
TOTAL OUTFLOWS	4368.1	4525.1	4590.8	4383.4	4344.1	4309.5	4288.8
CASH BALANCE	6860.6	4617.0	6824.3	6938.1	6931.3	6919.2	6939.9
ACCUMULATED CASH BALANCE	20680.3	25297.3	32121.6	39059.7	45991.0	52910.2	59850.2

****
* CASH FLOW SCHEDULE IN LOCAL CURRENCY *
****

amounts in thousand US $	-2	-1	1	2	3	4	5	6	7	8
INFLOWS										
Net sales revenue	.0	.0	5640.0	6338.3	7104.7	7945.3	7415.7	9966.5	11162.6	12502.1
Production costs	.0	.0	1244.2	1359.0	1418.2	1501.2	1432.9	1805.8	1960.3	2085.9
GROSS PRODUCTION MARGIN	.0	.0	4395.8	4979.3	5686.5	6444.1	5982.8	8160.7	9202.3	10416.2
Equity	7720.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Long term loans	.0	200.0	.0	.0	.0	.0	.0	.0	.0	.0
Short term credits	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Lack of cash flow credit	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL INFLOWS	7720.0	200.0	4395.8	4979.3	5686.5	6444.1	5982.8	8160.7	9202.3	10416.2
OUTFLOWS										
Investment	1412.4	1476.4	173.8	14.8	7.9	11.5	-7.8	49.4	21.1	18.7
Long term debt service	.0	.0	28.0	214.0	.0	.0	.0	.0	.0	.0
Interest on short term credit	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Interest on lack of cash flow	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Repayment short term credit	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Repayment lack of cash flow	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Tax on profit	.0	.0	.0	.0	155.7	999.9	945.0	2145.9	2577.4	3078.8
TOTAL OUTFLOWS	1412.4	1476.4	201.8	228.8	163.5	1011.4	937.2	2195.3	2598.5	3097.6
CASH BALANCE	6307.6	-1276.4	4194.1	4750.5	5523.0	5432.7	5045.6	5965.4	6603.8	7318.6
ACCUMULATED CASH BALANCE	6307.6	5031.3	9225.3	13975.9	19498.8	24931.4	29977.0	35942.4	42546.2	49864.3
Convert in foreign currency	.0	3555.5	5669.8	4750.5	5523.0	5432.7	5045.6	3463.4	1317.8	1287.0
BALANCE	6307.6	-4831.9	-1475.7	.0	.0	.0	.0	2502.1	5286.0	6031.6
ACCUMULATED BALANCE	6307.6	1475.7	.0	.0	.0	.0	.0	2502.1	7788.1	13819.7

amounts in thousand US $	9	10	11	12	13	14	15
INFLOWS							
Net sales revenue	14002.3	11668.6	14002.3	14002.3	14002.3	14002.3	14002.3
Production costs	2225.3	1956.5	2041.7	2133.8	2179.3	2225.3	2225.3
GROSS PRODUCTION MARGIN	11777.1	9712.1	11960.7	11868.5	11823.0	11777.1	11777.1
Equity	.0	.0	.0	.0	.0	.0	.0
Long term loans	.0	.0	.0	.0	.0	.0	.0
Short term credits	.0	.0	.0	.0	.0	.0	.0
Lack of cash flow credit	.0	.0	.0	.0	.0	.0	.0
TOTAL INFLOWS	11777.1	9712.1	11960.7	11868.5	11823.0	11777.1	11777.1
OUTFLOWS							
Investment	20.7	-37.8	18.6	9.7	4.7	4.7	.0
Long term debt service	.0	.0	.0	.0	.0	.0	.0
Interest on short term credit	.0	.0	.0	.0	.0	.0	.0
Interest on lack of cash flow	.0	.0	.0	.0	.0	.0	.0
Repayment short term credit	.0	.0	.0	.0	.0	.0	.0
Repayment lack of cash flow	.0	.0	.0	.0	.0	.0	.0
Tax on profit	3639.5	2815.4	3865.5	3838.6	3830.7	3822.6	3833.2
TOTAL OUTFLOWS	3660.3	2777.6	3884.1	3848.3	3835.4	3827.4	3833.2
CASH BALANCE	8116.8	6934.5	8076.6	8020.2	7987.6	7949.7	7943.9
ACCUMULATED CASH BALANCE	57981.7	64916.1	72992.7	81012.9	89000.4	96950.2	104894.0
To convert in foreign currency	1256.2	2317.5	1252.3	1082.1	1056.3	1030.5	1003.9
BALANCE	6860.6	4617.0	6824.3	6938.1	6931.3	6919.2	6939.9
ACCUMULATED BALANCE	20680.3	25297.3	32121.6	39059.7	45991.0	52910.2	59850.2

CASH FLOW SCHEDULE IN FOREIGN CURRENCY

amounts in thousand US $	-2	-1	1	2	3	4	5	6	7
INFLOWS									
Net sales revenue	.0	.0	1179.5	1334.3	1498.1	1670.6	1559.2	2095.5	2347.0
Production costs	.0	.0	2506.6	2457.8	2408.1	2371.0	2169.4	2682.5	2923.1
GROSS PRODUCTION MARGIN	.0	.0	-1327.1	-1123.5	-910.0	-700.4	-610.2	-586.9	-576.0
Equity	1930.0	.0	.0	.0	.0	.0	.0	.0	.0
Long term loans	8925.0	10225.0	.0	.0	.0	.0	.0	.0	.0
Short term credits	.0	.0	.0	.0	.0	.0	.0	.0	.0
Lack of cash flow credit	.0	.0	984.1	1451.0	.0	.0	1827.6	.0	.0
TOTAL INFLOWS	10855.0	10225.0	-342.9	327.5	-910.0	-700.4	1217.5	-586.9	-576.0
OUTFLOWS									
Investment	7459.5	17176.1	1263.2	12.9	12.9	17.0	2887.7	160.0	75.0
Long term debt service	.0	.0	4063.7	5065.1	3466.7	3609.1	3375.3	693.2	666.8
Interest on short term credit	.0	.0	.0	.0	.0	.0	.0	.0	.0
Interest on lack of cash flow	.0	.0	.0	.0	.0	.0	.0	.0	.0
Repayment short term credit	.0	.0	.0	.0	.0	.0	.0	.0	.0
Repayment lack of cash flow	.0	.0	.0	.0	1133.3	1106.2	.0	2023.3	.0
TOTAL OUTFLOWS	7459.5	17176.1	5326.9	5078.0	4612.9	4732.2	6263.0	2876.4	741.8
CASH BALANCE	3395.5	-6951.1	-5669.8	-4750.5	-5523.0	-5432.7	-5045.6	-3463.4	-1317.8
ACCUMULATED CASH BALANCE	3395.5	-3555.5	-9225.3	-13975.8	-19498.8	-24931.4	-29977.0	-33440.4	-34758.2
should be converted loc.curr.	.0	3555.5	5669.8	4750.5	5523.0	5432.7	5045.6	3463.4	1317.8
BALANCE	3395.5	-3395.5	.0	.0	.0	.0	.0	.0	.0
ACCUMULATED BALANCE	3395.5	.0	.0	.0	.0	.0	.0	.0	.0

amounts in thousand US $	8	9	10	11	12	13	14	15
INFLOWS								
Net sales revenue	2628.7	2944.1	2453.4	2944.1	2944.1	2944.1	2944.1	2944.1
Production costs	3191.4	3492.4	3023.5	3489.7	3491.1	3491.7	3492.4	3492.4
GROSS PRODUCTION MARGIN	-562.8	-548.3	-570.1	-545.6	-547.0	-547.6	-548.3	-548.3
Equity	.0	.0	.0	.0	.0	.0	.0	.0
Long term loans	.0	.0	.0	.0	.0	.0	.0	.0
Short term credits	.0	.0	.0	.0	.0	.0	.0	.0
Lack of cash flow credit	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL INFLOWS	-562.8	-548.3	-570.1	-545.6	-547.0	-547.6	-548.3	-548.3
OUTFLOWS								
Investment	83.8	93.8	1159.8	145.5	.3	.3	.1	.0
Long term debt service	640.4	614.0	587.6	561.2	534.8	508.4	482.0	455.6
Interest on short term credit	.0	.0	.0	.0	.0	.0	.0	.0
Interest on lack of cash flow	.0	.0	.0	.0	.0	.0	.0	.0
Repayment short term credit	.0	.0	.0	.0	.0	.0	.0	.0
Repayment lack of cash flow	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL OUTFLOWS	724.2	707.8	1747.4	706.7	535.1	508.7	482.1	455.6
CASH BALANCE	-1287.0	-1256.2	-2317.5	-1252.3	-1082.1	-1056.3	-1030.5	-1003.9
ACCUMULATED CASH BALANCE	-36045.2	-37301.3	-39618.8	-40871.1	-41953.2	-43009.5	-44039.9	-45043.9
should be converted loc.curr.	1287.0	1256.2	2317.5	1252.3	1082.1	1056.3	1030.5	1003.9
BALANCE	.0	.0	.0	.0	.0	.0	.0	.0
ACCUMULATED BALANCE	.0	.0	.0	.0	.0	.0	.0	.0

4. FINANCIAL STRUCTURE.

By drawing up cash flow tables for financial planning, we have been able to work out the financial structure and the debt service using the basic data given in item 2. Basic data considered for the financial structure.

The figures are shown on tables below.

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* FINANCIAL STRUCTURE *

amounts in thousand US $	LOCAL CURRENCY	FOREIGN CURRENCY	TOTAL
EQUITY	7720.0	1930.0	9650.0
Buyers credit	.0	12500.0	12500.0
ADB loan	.0	5350.0	5350.0
Working capital local currency	200.0	.0	200.0
Working capital foreign curr.	.0	1300.0	1300.0
TOTAL LONG TERM LOANS	200.0	19150.0	19350.0
SHORT TERM CREDITS	.0	.0	.0
TOTAL FINANCIAL STRUCTURE	7920.0	21080.0	29000.0

Source of Finance, production in thousand US $

Year	2004	2005	2006
Equity, ordinary ..	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000
Loan A, foreign .	0.000	0.000	0.000
Loan B, foreign..	-356.667	-356.667	-356.667
Loan C, foreign .	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000
Loan B, local....	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000
Total loan	-356.667	-356.667	-356.667
Current liabilities	3.734	3.773	0.000
Bank overdraft	0.000	0.000	0.000
Total funds	-352.933	-352.894	-356.667

Source of Finance, production in thousand US $

Year	1992	1993	1994	1995	1996	1997
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	-2500.000	-2500.000	-2500.000	-2500.000	-2500.000	0.000
Loan B, foreign..	0.000	0.000	0.000	-356.667	-356.667	-356.667
Loan C, foreign .	0.000	-1300.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000	0.000
Loan B, local....	0.000	0.000	0.000	0.000	0.000	0.000
Loan C, local....	0.000	-200.000	0.000	0.000	0.000	0.000
Total loan	-2500.000	-4000.000	-2500.000	-2856.667	-2856.667	-356.667
Current liabilities	297.500	5.345	1.553	2.921	-22.031	71.723
Bank overdraft	983.836	1450.918	-1126.063	-1107.670	1827.482	-2028.504
Total funds	-1218.664	-2543.737	-3624.509	-3961.416	-1051.215	-2313.447

Source of Finance, production in thousand US $

Year	1998	1999	2000	2001	2002	2003
Equity, ordinary ..	0.000	0.000	0.000	0.000	0.000	0.000
Equity, preference.	0.000	0.000	0.000	0.000	0.000	0.000
Subsidies, grants .	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, foreign .	0.000	0.000	0.000	0.000	0.000	0.000
Loan B, foreign..	-356.667	-356.667	-356.667	-356.667	-356.667	-356.667
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	0.000	0.000	0.000	0.000	0.000
Loan B, local....	0.000	0.000	0.000	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000	0.000	0.000	0.000
Total loan	-356.667	-356.667	-356.667	-356.667	-356.667	-356.667
Current liabilities	31.967	31.887	35.617	-59.672	44.602	7.564
Bank overdraft	0.000	0.000	0.000	0.000	0.000	0.000
Total funds	-324.700	-324.780	-321.049	-416.339	-312.065	-349.103

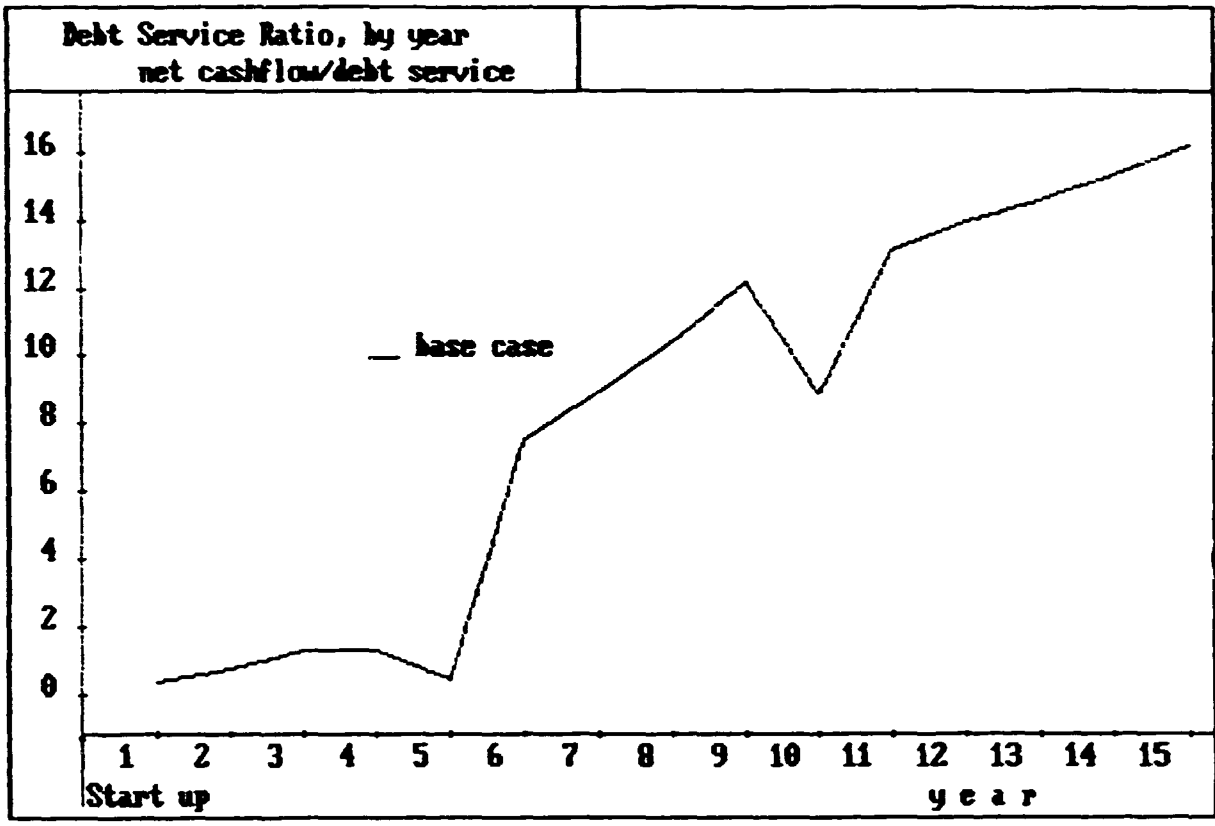
Source of Finance, construction in thousand US $

Year	1990	1991
Equity, ordinary ..	9650.000	0.000
Equity, preference.	0.000	0.000
Subsidies, grants .	0.000	0.000
Loan A, foreign .	6250.000	6250.000
Loan B, foreign..	2675.000	2675.000
Loan C, foreign .	0.000	1300.000
Loan A, local....	0.000	0.000
Loan B, local....	0.000	0.000
Loan C, local....	0.000	200.000
Total loan	8925.000	10425.000
Current liabilities	0.000	0.000
Bank overdraft	0.000	0.000
Total funds	18575.000	10425.000

* DEBT SERVICE : L O N G T E R M + S H O R T T E R M *

amounts in thousand US $	1	2	3	4	5	6	7	8	9	10
LOCAL CURRENCY										
INTERESTS										
Long term loans	28.0	14.0	.0	.0	.0	.0	.0	.0	.0	.0
Short term credits	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL I N T E R E S T S	28.0	14.0	.0	.0	.0	.0	.0	.0	.0	.0
REPAYMENT										
Long term loans	.0	200.0	.0	.0	.0	.0	.0	.0	.0	.0
Short term credits	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL R E P A Y M E N T	.0	200.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL IN LOCAL CURRENCY	28.0	214.0	.0	.0	.0	.0	.0	.0	.0	.0
FOREIGN CURRENCY										
INTERESTS										
Long term loans	1563.7	1265.1	966.7	752.5	518.7	336.6	310.2	283.8	257.4	231.0
Short term credits	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL I N T E R E S T S	1563.7	1265.1	966.7	752.5	518.7	336.6	310.2	283.8	257.4	231.0
REPAYMENT										
Long term loans	2500.0	3800.0	2500.0	2856.6	2856.6	356.6	356.6	356.6	356.6	356.6
Short term credits	.0	.0	1133.3	1106.2	.0	2023.3	.0	.0	.0	.0
TOTAL R E P A Y M E N T	2500.0	3800.0	3633.3	3962.8	2856.6	2379.9	356.6	356.6	356.6	356.6
TOTAL IN FOREIGN CURRENCY	4063.7	5065.1	4600.0	4715.3	3375.3	2716.5	666.8	640.4	614.0	587.6
T O T A L										
T O T A L INTERESTS	1591.7	1279.1	966.7	752.5	518.7	336.6	310.2	283.8	257.4	231.0
T O T A L REPAYMENT	2500.0	4000.0	3633.3	3962.8	2856.6	2379.9	356.6	356.6	356.6	356.6
G R A N D T O T A L	4091.7	5279.1	4600.0	4715.3	3375.3	2716.5	666.8	640.4	614.0	587.6

amounts in thousand US $	11	12	13	14	15	TOTAL
LOCAL CURRENCY						
INTERESTS						
Long term loans	.0	.0	.0	.0	.0	42.0
Short term credits	.0	.0	.0	.0	.0	.0
TOTAL INTERESTS	.0	.0	.0	.0	.0	42.0
REPAYMENT						
Long term loans	.0	.0	.0	.0	.0	200.0
Short term credits	.0	.0	.0	.0	.0	.0
TOTAL REPAYMENT	.0	.0	.0	.0	.0	200.0
TOTAL IN LOCAL CURRENCY	.0	.0	.0	.0	.0	242.0
FOREIGN CURRENCY						
INTERESTS						
Long term loans	204.6	178.2	151.8	125.4	99.0	7244.7
Short term credits	.0	.0	.0	.0	.0	.0
TOTAL INTERESTS	204.6	178.2	151.8	125.4	99.0	7244.7
REPAYMENT						
Long term loans	356.6	356.6	356.6	356.6	356.6	18079.2
Short term credits	.0	.0	.0	.0	.0	4262.8
TOTAL REPAYMENT	356.6	356.6	356.6	356.6	356.6	22342.0
TOTAL IN FOREIGN CURRENCY	561.2	534.8	508.4	482.0	455.6	29586.7
TOTAL						
TOTAL INTERESTS	204.6	178.2	151.8	125.4	99.0	7286.7
TOTAL REPAYMENT	356.6	356.6	356.6	356.6	356.6	22542.0
GRAND TOTAL	561.2	534.8	508.4	482.0	455.6	29828.7


Debt Service Ratio, by year
net cashflow/debt service
16
14
12
10
8
6
4
2
0
base case
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Start up
y e a r

X.4. PROFITABILITY.

The profitability study covers a period of 17 years i.e. 2 years of construction and 15 years of operation. In this chapter we shall examine in turn :

1) The profit and loss statement schedule.
2) The running costs structure and the cost price of 1 kg of glass.
3) The break-even point.
4) The pay-back period.
5) The economic and financial profitability :
   . simple rates of return,
   . internal rates of return.
6) The projected balance sheets.

1. PROFIT AND LOSS STATEMENT.

Tables below show the schedule of the results for each year of production.

These tables also show the evolution of the simple rates of return and of the break-even point.

In the first table the term "cash flow" means "profit before depreciation".

The bar chart after the table shows the annual sales, foreign as well as local, and the corresponding annual production costs, also foreign and local, for each year.

The graph chart after shows the evaluation of the net profit/total sales ratio.

We can see from these tables and charts that the profitability is every tiny the first three production years.

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##
* P R O F I T A B I L I T Y   S C H E D U L E *
##

amounts in thousand US $		1	2	3	4	5	6	7	8	9	10
Gross sales revenue		6819.5	7672.6	8602.7	9615.8	8974.9	12062.1	13509.6	15130.7	16946.4	14122.0
Taxes and duties		.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
NET SALES REVENUE		6819.5	7672.6	8602.7	9615.8	8974.9	12062.1	13509.6	15130.7	16946.4	14122.0
Production costs		3750.8	3816.8	3826.2	3872.2	3602.3	4488.3	4883.4	5277.3	5717.7	4980.0
GROSS PRODUCTION MARGIN		3068.7	3855.8	4776.5	5743.7	5372.6	7573.8	8626.2	9853.4	11228.7	9142.0
Financial charges		1591.7	1279.1	966.7	752.5	518.7	336.6	310.2	283.8	257.4	231.0
CASH FLOW		1477.0	2576.7	3809.8	4991.2	4853.9	7237.2	8316.0	9569.6	10971.3	8911.0
Depreciation		2491.5	2491.5	2491.5	2491.5	2491.5	1872.6	1872.6	1872.6	1872.6	1872.6
GROSS PROFIT		-1014.4	85.3	1318.3	2499.7	2362.4	5364.6	6443.5	7697.1	9098.8	[illegible]
Tax on profit		.0	.0	155.7	999.9	945.0	2145.9	2577.4	3078.8	3639.5	[illegible]
NET PROFIT		-1014.4	85.3	1162.7	1499.8	1417.4	3218.8	3866.1	4618.2	5459.3	4223.1
ACCUMULATED GROSS PROFIT		-1014.4	-929.1	389.2	2888.9	5251.3	10615.9	17059.4	24756.5	33855.2	40893.7
ACCUMULATED NET PROFIT		-1014.4	-929.1	233.5	1733.3	3150.8	6369.6	10235.6	14853.9	20313.1	24536.2
Return on sales (gross)	%	-14.9	1.1	15.3	26.0	26.3	44.5	47.7	50.9	53.7	49.8
Return on sales (net)	%	-14.9	1.1	13.5	15.6	15.8	26.7	28.6	30.5	32.2	29.9
Return on equity	%	-10.5	.9	12.0	15.5	14.7	33.4	40.1	47.9	56.6	43.8
Return on investment	%	-3.5	.3	4.0	5.2	4.9	11.0	13.2	15.7	18.5	14.4
R.O.S (gross) - average	%	-14.9	-6.4	1.7	8.8	12.6	19.8	25.4	30.0	34.1	36.0
R.O.S (net) - average	%	-14.9	-6.4	1.0	5.3	7.6	11.9	15.2	18.0	20.4	21.6
Ret. on equity - average	%	-10.5	-4.8	.8	4.5	6.5	11.0	15.2	19.2	23.4	25.4
Ret. on invest.- average	%	-3.5	-1.6	.3	1.5	2.2	3.6	5.0	6.3	7.6	8.4
Break-even point	%	124.9	93.2	75.8	60.0	59.8	33.8	29.7	26.0	22.8	27.3

amounts in thousand US $	11	12	13	14	15
Gross sales revenue	16946.4	16946.4	16946.4	16946.4	16946.4
Taxes and duties	.0	.0	.0	.0	.0
NET SALES REVENUE	16946.4	16946.4	16946.4	16946.4	16946.4
Production costs	5531.3	5624.9	5671.0	5717.7	5717.7
GROSS PRODUCTION MARGIN	11415.1	11321.5	11275.4	11228.7	11228.7
Financial charges	204.6	178.2	151.8	125.4	99.0
CASH FLOW	11210.5	11143.3	11123.6	11103.3	11129.7
Depreciation	1546.8	1546.8	1546.8	1546.8	1546.8
GROSS PROFIT	9663.7	9596.6	9576.8	9556.6	9583.0
Tax on profit	3865.5	3838.6	3830.7	3822.6	3833.2
NET PROFIT	5798.2	5757.9	5746.1	5733.9	5749.8
ACCUMULATED GROSS PROFIT	50557.4	60154.0	69730.8	79287.4	88870.4
ACCUMULATED NET PROFIT	30334.5	36092.4	41838.5	47572.4	53322.2
Return on sales (gross) %	57.0	56.6	56.5	56.4	56.5
Return on sales (net) %	34.2	34.0	33.9	33.8	33.9
Return on equity %	60.1	59.7	59.5	59.4	59.6
Return on investment %	19.7	19.5	19.5	19.4	19.5
R.O.S (gross) - average %	38.8	40.8	42.4	43.7	44.8
R.O.S (net) - average %	23.3	24.5	25.5	26.2	26.9
Ret. on equity - average %	28.6	31.2	33.4	35.2	36.8
Ret. on invest.- average %	9.4	10.2	10.9	11.5	12.0
Break-even point %	19.3	19.2	19.1	19.0	18.7

Net Income Statement in thousand US $

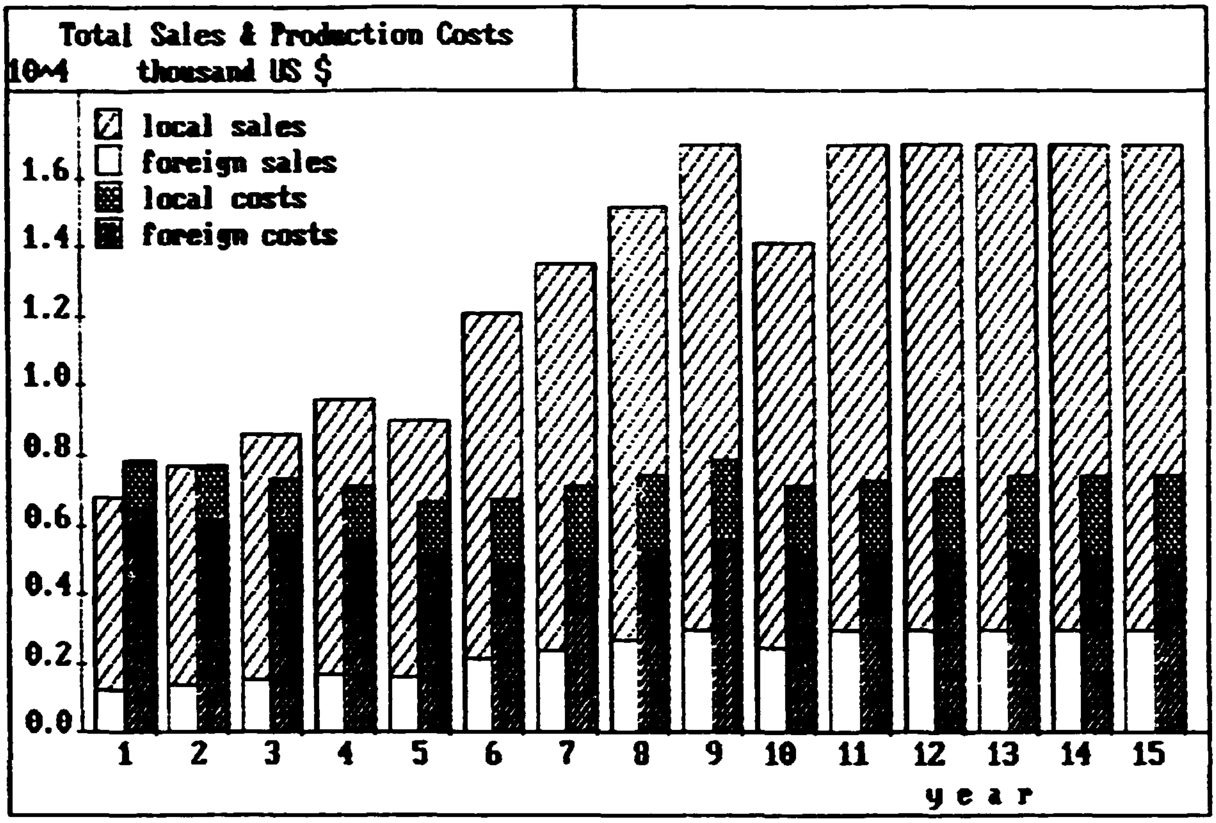
Year	1992	1993	1994	1995	1996
Total sales, incl. sales tax	6819.520	7672.641	8602.721	9615.840	8974.880
Less: variable costs, incl. sales tax.	2101.130	2363.989	2650.555	2962.700	2765.216
Variable margin	4718.391	5308.651	5952.166	6653.140	6209.664
As % of total sales	69.189	69.189	69.189	69.189	69.189
Non-variable costs, incl. depreciation	4141.080	3944.363	3676.833	3400.941	3328.457
Operational margin	577.311	1364.289	2275.333	3252.199	2881.207
As % of total sales	8.466	17.781	26.449	33.821	32.103
Cost of finance	1591.525	1279.025	966.525	752.427	518.533
Gross profit	-1014.214	85.264	1308.803	2499.772	2362.674
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	0.000	379.852	2499.772	2362.674
Tax	0.000	0.000	151.941	999.909	945.070
Net profit	-1014.214	85.264	1156.862	1499.864	1417.604
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-1014.214	85.264	1156.862	1499.864	1417.604
Accumulated undistributed profit	-1014.214	-928.951	227.911	1727.775	3145.379
Gross profit, % of total sales	-14.872	1.111	15.214	25.996	26.325
Net profit, % of total sales	-14.872	1.111	13.448	15.598	15.795
ROE, Net profit, % of equity	-10.510	0.884	11.988	15.543	14.690
ROI, Net profit+interest, % of invest.	2.097	4.951	7.700	8.159	6.351

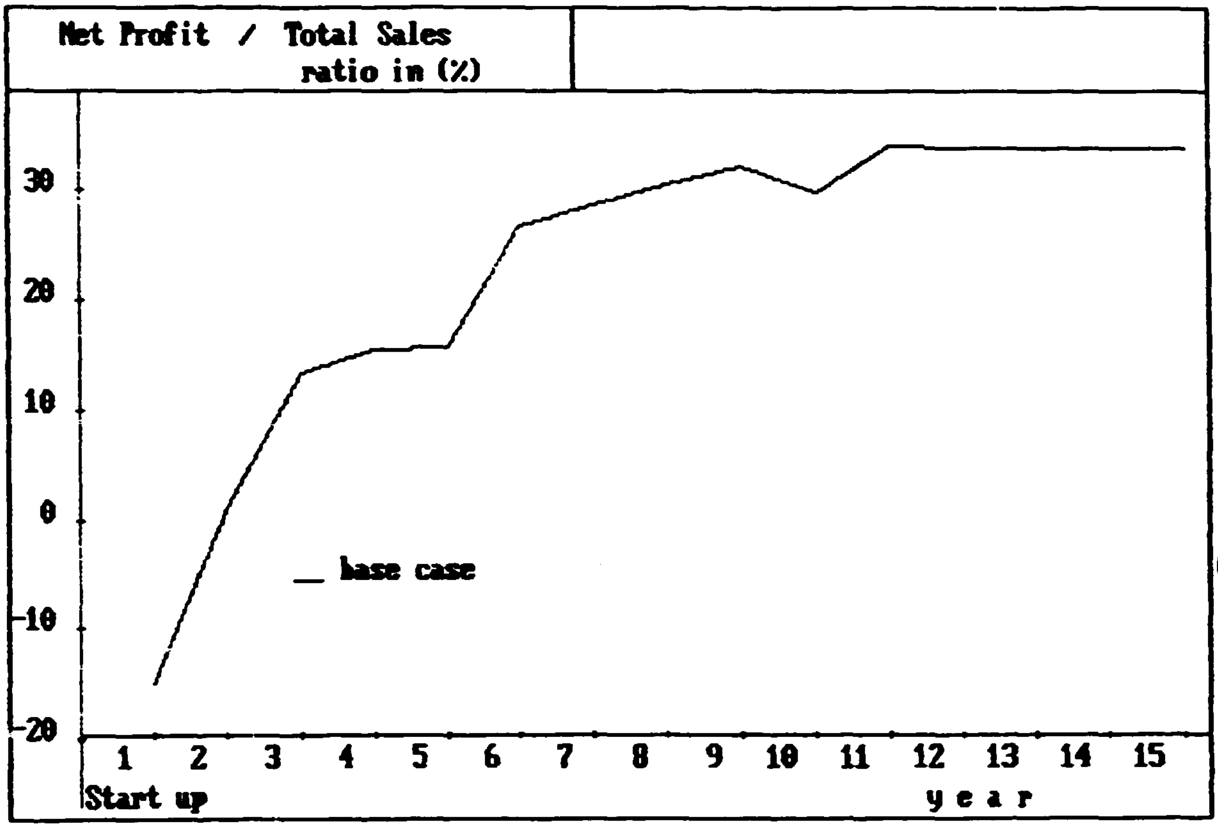
Net Income Statement in thousand US $

Year	1997	1998	1999	2000	2001
Total sales, incl. sales tax	12062.080	13509.600	15130.720	16946.400	14122.000
Less: variable costs, incl. sales tax.	3716.401	4162.391	4661.868	5221.290	4351.075
Variable margin	8345.679	9347.210	10468.850	11725.110	9770.925
As % of total sales	69.189	69.189	69.189	69.189	69.189
Non-variable costs, incl. depreciation	2644.453	2593.464	2488.027	2369.013	2501.560
Operational margin	5701.226	6753.746	7980.826	9356.098	7269.364
As % of total sales	47.266	49.992	52.746	55.210	51.475
Cost of finance	336.515	310.122	283.728	257.335	230.942
Gross profit	5364.711	6443.625	7697.098	9098.763	7038.423
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	5364.711	6443.625	7697.098	9098.763	7038.423
Tax	2145.884	2577.450	3078.839	3639.505	2815.369
Net profit	3218.827	3866.175	4618.259	5459.258	4223.054
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	3218.827	3866.175	4618.259	5459.258	4223.054
Accumulated undistributed profit	6364.206	10230.380	14848.640	20307.900	24530.950
Gross profit, % of total sales	44.476	47.697	50.871	53.691	49.840
Net profit, % of total sales	26.686	28.618	30.522	32.215	29.904
ROE, Net profit, % of equity	33.356	40.064	47.858	56.573	43.762
ROI, Net profit+interest, % of invest.	11.583	13.564	15.868	18.436	13.863

Net Income Statement in thousand US $

Year	2002	2003	2004	2005	2006
Total sales, incl. sales tax	16946.400	16946.400	16946.400	16946.400	16946.400
Less: variable costs, incl. sales tax.	5221.290	5221.290	5221.290	5221.290	5221.290
Variable margin	11725.110	11725.110	11725.110	11725.110	11725.110
As % of total sales	69.189	69.189	69.189	69.189	69.189
Non-variable costs, incl. depreciation	1856.767	1950.329	1996.539	2043.213	2042.422
Operational margin	9868.344	9774.781	9728.571	9681.897	9682.688
As % of total sales	58.233	57.681	57.408	57.132	57.137
Cost of finance	204.548	178.155	151.762	125.368	98.975
Gross profit	9663.795	9596.626	9576.810	9556.529	9583.714
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	9663.795	9596.626	9576.810	9556.529	9583.714
Tax	3865.518	3838.650	3830.724	3822.612	3833.486
Net profit	5798.277	5757.976	5746.086	5733.917	5750.229
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	5798.277	5757.976	5746.086	5733.917	5750.229
Accumulated undistributed profit	30329.230	36087.200	41833.290	47567.210	53317.440
Gross profit, % of total sales	57.026	56.629	56.512	56.393	56.553
Net profit, % of total sales	34.215	33.978	33.907	33.836	33.932
ROE, Net profit, % of equity	60.086	59.668	59.545	59.419	59.588
ROI, Net profit+interest, % of invest.	18.588	18.376	18.255	18.133	18.101


Total Sales & Production Costs
10^4 thousand US $
local sales
foreign sales
local costs
foreign costs
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
year


Net Profit / Total Sales
ratio in (%)
30
20
10
0
-10
-20
_ base case
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Start up
year

2. RUNNING COST STRUCTURE AND COST PRICE OF THE FINISHED GOODS.

Tables below shows the structure of :

. The annual running costs.
. The cost price of 1 kg of glass.
. The structure of the productions costs for the 4th years (50 T/day capacity) and for the 6th year (90 T/day capacity).

The table after gives the evolution of the cost price through the 15 years period.

Note the very high impact of the raw material and of the depreciation on the running costs and thus on the profitability of the project.

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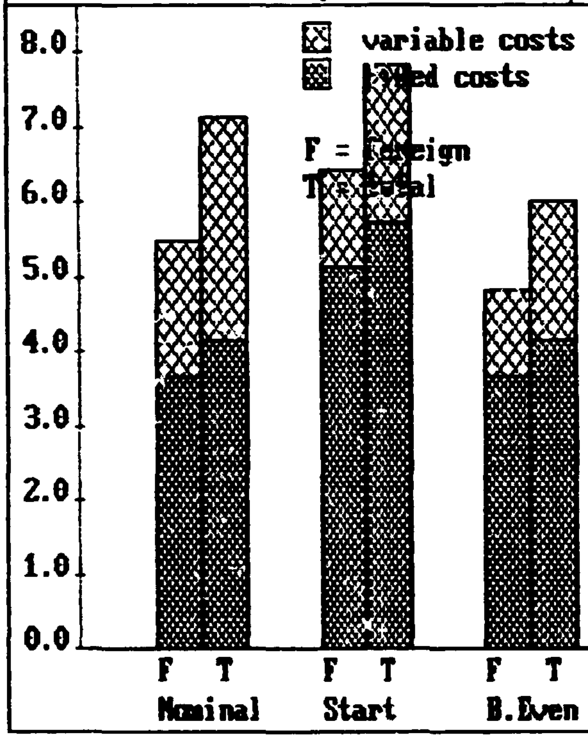
* PRODUCTION COSTS AND COST PRICE STRUCTURE *
* AVERAGE 15 PRODUCTION YEARS *
****

	.000 US $ per year	%	%	US $ per t. of raw mater. 16721 t.	US $ per t. of MAIN PROD. 12770 t.	US $ per t. of Bottles 9024 t.	US $ per t. of Tablewares 3746 t.
Raw materials	1638.1	22.5	33.9	98.0	128.3	99.2	198.4
Consumables	1173.0	16.1	24.3	70.2	91.9	71.0	142.1
Utilities	1069.0	14.7	22.1	63.9	83.7	64.7	129.5
Spare parts	.0	.0	.0	.0	.0	.0	.0
Manpower (direct)	354.7	4.9	7.3	21.[illegible]	27.8	21.5	43.0
VARIABLE COSTS	4234.8	58.1	87.6	253.3	331.6	256.4	512.8
Manpower (indirect)	69.9	1.0	1.4	4.2	5.5	4.2	8.5
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	316.1	4.3	6.5	18.9	24.8	19.1	38.3
Insurance and overhead	142.1	1.9	2.9	8.5	11.1	8.6	17.2
Technical assistance	68.0	.9	1.4	4.1	5.3	4.1	8.2
Land renting	1.0	.0	.0	.1	.1	.1	.1
PRODUCTION FIXED COSTS	597.0	[illegible]	12.4	35.7	46.8	36.1	72.3
TOTAL PRODUCTION COSTS	4831.8	66.3	100.0	289.0	378.4	292.6	585.1
Financial charges	485.8	6.7	10.1	29.1	38.0	29.4	58.8
Depreciation	1970.3	27.0	40.8	117.8	154.3	119.3	238.6
TOTAL FIXED COSTS	3053.1	41.9	63.2	182.6	239.1	184.9	369.7
GROSS OPERATING COSTS	7287.9	100.0	150.8	435.8	570.7	441.3	882.5
Sales by-products	.0	.0	.0	.0	.0	.0	.0
NET OPERATING COSTS	7287.9	100.0	150.8	435.8	570.7	441.3	882.5
Selling price	13212.6	181.3	273.4	790.2	1034.7	800.0	1600.0
Margin	5924.7	81.3	122.6	354.3	464.0	358.7	717.5
Margin in % selling price %	44.8	44.8	44.8	44.8	44.8	44.8	44.8

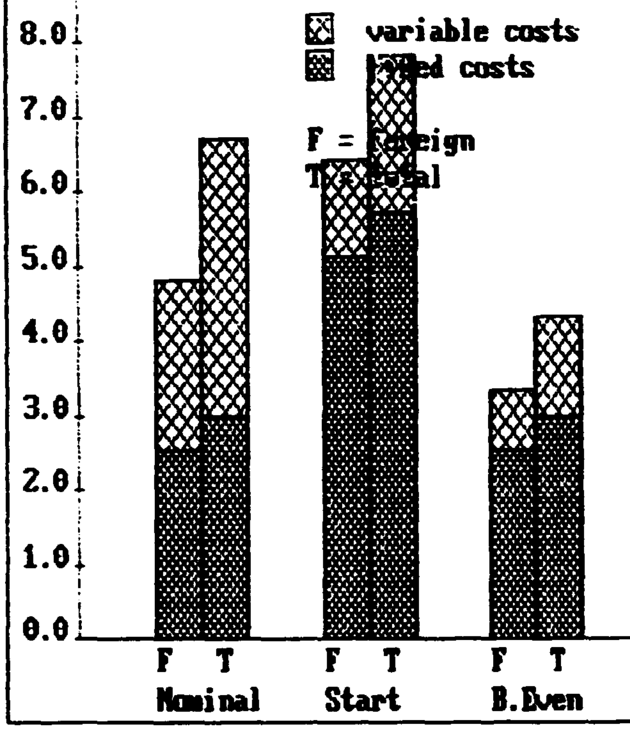
Structure of Production Costs
10^3 thousand US $ for 4th production year



Nominal	Start up	
16.70	11.13	raw material
0.00	0.00	other RM
13.20	10.47	utilities
11.88	8.34	energy
5.61	5.09	labour
0.00	0.00	maintenance
4.44	4.04	spares
2.59	8.82	overheads
35.01	31.80	depreciation
10.57	20.32	interest
100.00	100.00	Total Prod C.

Structure of Production Costs
10^3 thousand US $

for 6th production year



Nominal	Start up	
22.25	11.13	raw material
0.00	0.00	other RM
16.32	10.47	utilities
15.62	8.34	energy
5.05	5.09	labour
0.00	0.00	maintenance
4.72	4.04	spares
3.05	8.82	overheads
27.96	31.80	depreciation
5.02	20.32	interest
100.00	100.00	Total Prod C.

production level

****
* COST PRICE EVOLUTION *
****

US $	1	2	3	4	5	6	7	8	9	10
YEARLY EVOLUTION										
cost price per										
t. of Sand										
without depreciation	600.3	507.1	434.3	381.3	364.1	317.1	304.8	291.4	279.6	292.6
with depreciation	880.3	755.1	660.1	586.7	584.2	440.2	414.7	389.5	367.2	397.7
cost price per										
t. of main product										
without depreciation	809.5	687.4	576.8	497.6	475.1	413.9	397.8	380.3	364.8	381.8
with depreciation	1187.0	1023.5	876.7	765.7	762.3	574.5	541.2	508.3	479.1	519.0
AVERAGE EVOLUTION										
price per										
of Sand										
without depreciation	600.3	550.9	508.0	471.5	448.8	419.6	396.8	377.6	361.0	352.5
without depreciation	880.3	813.9	757.3	708.2	681.9	628.3	585.9	550.1	519.1	504.1
cost price per										
t. of main product										
without depreciation	809.5	744.9	682.4	628.0	595.1	554.4	523.0	496.8	474.3	462.7
without depreciation	1187.0	1100.5	1017.2	943.3	904.3	830.3	772.2	723.8	682.0	661.7

US $	11	12	13	14	15
YEARLY EVOLUTION					
cost price per					
t. of Sand					
without depreciation	268.4	271.5	272.4	273.4	272.1
with depreciation	340.7	343.9	344.8	345.7	344.5
price per					
of main product					
without depreciation	350.2	354.3	355.5	356.7	355.1
with depreciation	444.6	448.7	449.9	451.2	449.6
AVERAGE EVOLUTION					
cost price per					
t. of Sand					
without depreciation	341.6	333.6	327.3	322.3	318.0
without depreciation	483.0	467.0	454.5	444.4	435.8
cost price per					
t. of main product					
without depreciation	448.1	437.3	428.9	422.1	416.4
without depreciation	633.5	612.3	595.5	582.0	570.7

3. BREAK-EVEN POINT.

The break-even point of a project is the percentage of the production capacity to be reached before the project begins to make a profit.

It can be calculated either by using a graph or by applying the following formula :

$$\frac{\text{Fixed costs + Financial charges + Depreciation}}{\text{Net sales revenue - variable costs}}$$

We have calculated the figures for each year, the results appear on the last line of table showing the profitability schedule.

100 % capacity (50 T/d)	:	80.1 %
200 % capacity (90 T/d)	:	34.0 %
4th production year	:	60.0 %
6th production year	:	33.8 %.

We have again the confirmation that the project only becomes significantly profitable when the nominal capacity is increased up to 90 T/day.

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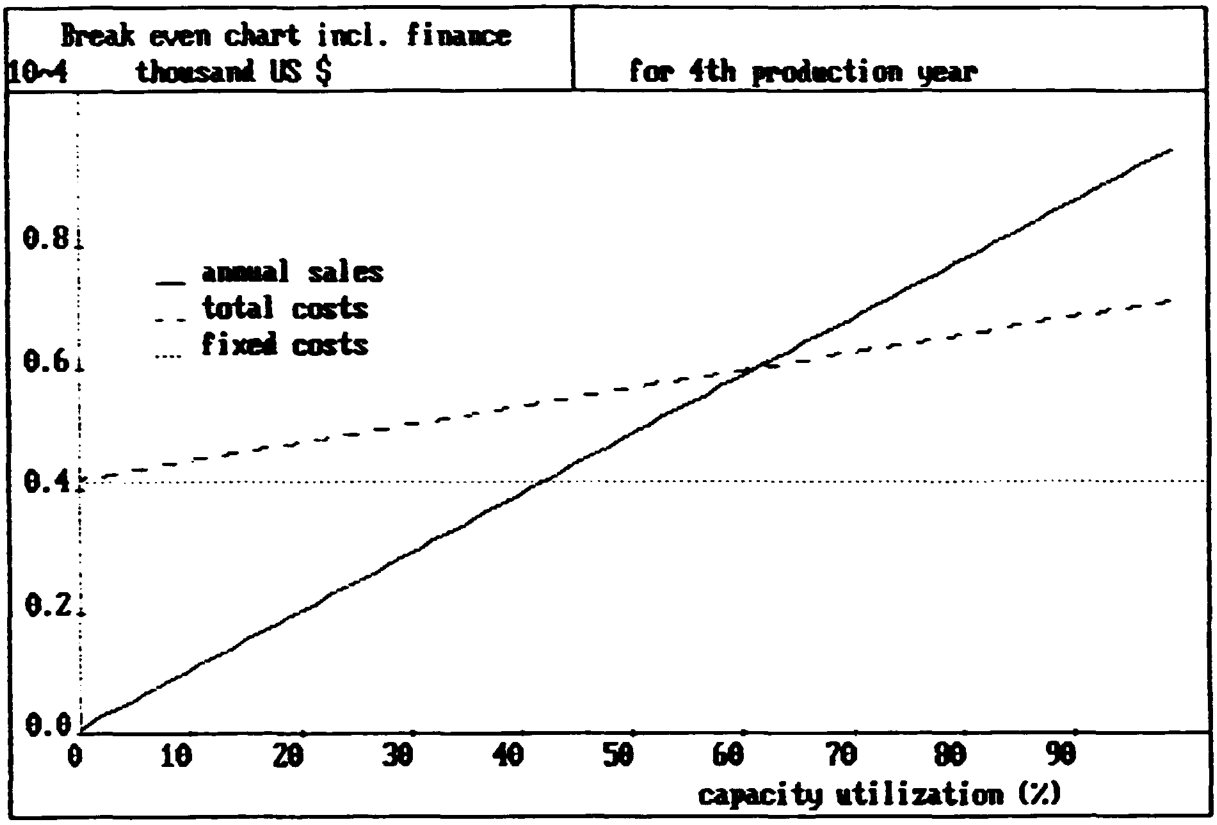
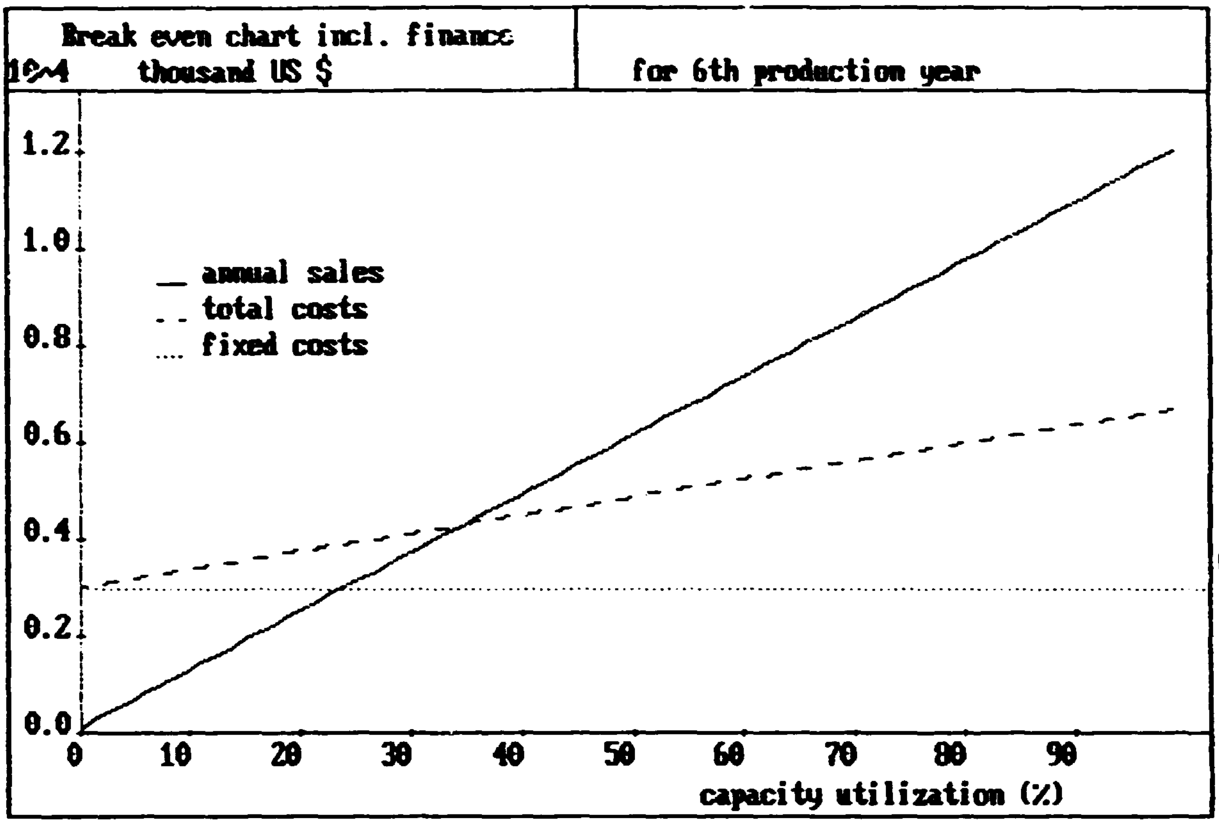

Break even chart incl. finance
10^4 thousand US $
for 4th production year
0.8
0.6
0.4
0.2
0.0
annual sales
total costs
fixed costs
0
10
20
30
40
50
60
70
80
90
capacity utilization (%)


Break even chart incl. finance
10^4 thousand US $
for 6th production year
1.2
1.0
0.8
0.6
0.4
0.2
0.0
— annual sales
- - total costs
.... fixed costs
0
10
20
30
40
50
60
70
80
90
capacity utilization (%)

4. PAY-BACK PERIOD.

It is the period required to recover the original investment outlay (without land and working capital) through the "profits" the project earns (gross production margin - tax on profits).

The pay-back period is 6 years and 3 months after start-up of the production, which is rather long.

5. PROFITABILITY.

5.1. SIMPLE RATES OF RETURN :

The simple rates of return rely on the operational accounts.
They are ratios of the net profit to the net sales revenue, the original investment outlay and to the equity.

As it is difficult to choose which is the most representative year to take as a basis, we have calculated the ratios for each production year separately and the evolution of the average ratios. The results appear on table showing the profitability schedule.

These figures do not take the construction period into consideration.

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The results are :

	100 % capacity (50 T/day)	200 % capacity (90 T/day)
Return on equity	6.5 %	36.8 %
Return on investment	2.2 %	12.0 %

5.2. INTERNAL RATES OF RETURN :

One of the great disadvantages of simple rates of return is that they do not take account of all of a project's useful life.
They are based on annual figures which are at their nominal value and not at their present value. And of course, one $ today does not have the same value as one $ tomorrow, without even considering inflation.

Thus a method must be found which remedies these disadvantages.

For the promoter of a project, his uppermost concern is what is the financial yield going to be on the sums he is going to invest, i.e. what profit is he going to make.
This is why the profitability analysis mainly involves determining a ratio between the profit and sums invested. Clearly a ratio must be found which is feasible, so that the promoter can choose which project it is best to invest in.

As a general rule, a promoter finances a project by contributing equity and loans. He needs to have a relevant instrument to evaluate the profitability of the invested equity.

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The promoter may often have to choose between several projects each presenting a different financial structure.

So he also needs to be able to analyse the project's intrinsic profitability, independent of its financial structure, by determining the profitability of all the investment.

This twofold analysis, also called research into the internal rates of return, is based on the cash flows recorded during each year of the period in question.

To do this, two tables are drawn up called : cash flow schedule for profitability analysis (economic or financial).

. "economic for entrepreneur" : examines the project's intrinsic financial value, should it not have outside financing.
. "financial" : examines the financial value of the equity should the project have outside financing.

From these tables, we shall get the figures need to calculate the internal rate of return-economic for entrepreneur, in the first case and the internal rate of return-financial in the second.

5.2.1. <u>Cash flow schedule for profitability analysis</u> :

To draw up these tables, we work out, for each year of the project's life (including the period of construction), the cash inflows and the cash outflows. The difference between the cash inflows and outflows will give the cash balance, the cash flow.

These cash flows are used to work out the internal rates of return.

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These tables will be different from the cash flow schedule for financial planning table because :

- they also take account of the salvage value of the investment at the end of the period in question,
- we are in the position where all of the financing requirements are covered by capital, without needing to resort to loans, in the case of the economic analysis,
- we are in the position of the investor of capital, in the case of the financial analysis.

a) For the economic for entrepreneur analysis, we determine each year the cash flow corresponding to :

Net turnover
- Total investment (1)
- Running costs (2)

= Gross cash flow
- Tax on the profit

= Net cash flow.

(1) Excluding financing costs prior to start-up but including working capital and funds for replacements.

(2) Excluding financing costs and depreciation.

<u>Notes</u> :

- Financing costs prior to start-up are not take into account because the situation is one in which there is no financing by loan.
- Depreciation which does not represent a cash outflow is not taken into consideration.

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- The gross cash flow will be used to evaluate the project's intrinsic profitability and to compare the economic and financial rates.

b) For the financial analysis, the following are considered :

Net turnover
- Equity
- Funds for replacements
- Debt service (excluding financing costs prior to start-up)
- Production costs

= Gross cash flow
- Tax on the profit

= Net cash flow.

Notes :

- Financing costs prior to start-up are not taken into consideration because they are financed either by the capital of by the loans.
- We are placing ourselves in the shareholder's position. He must lay down equity, pay back the loans take out to pay the investment (i.e. financing costs prior to start-up), funds for replacements, etc ...
- The gross cash flow offers, a priori, little interest, because, from the shareholder's point of view, it is what he is going to get after tax that counts.

  Nevertheless, it is useful because it means that, by comparing the economic and financial internal rates of return, we can find out whether the financing structure and the terms and conditions of the loans are good or not.

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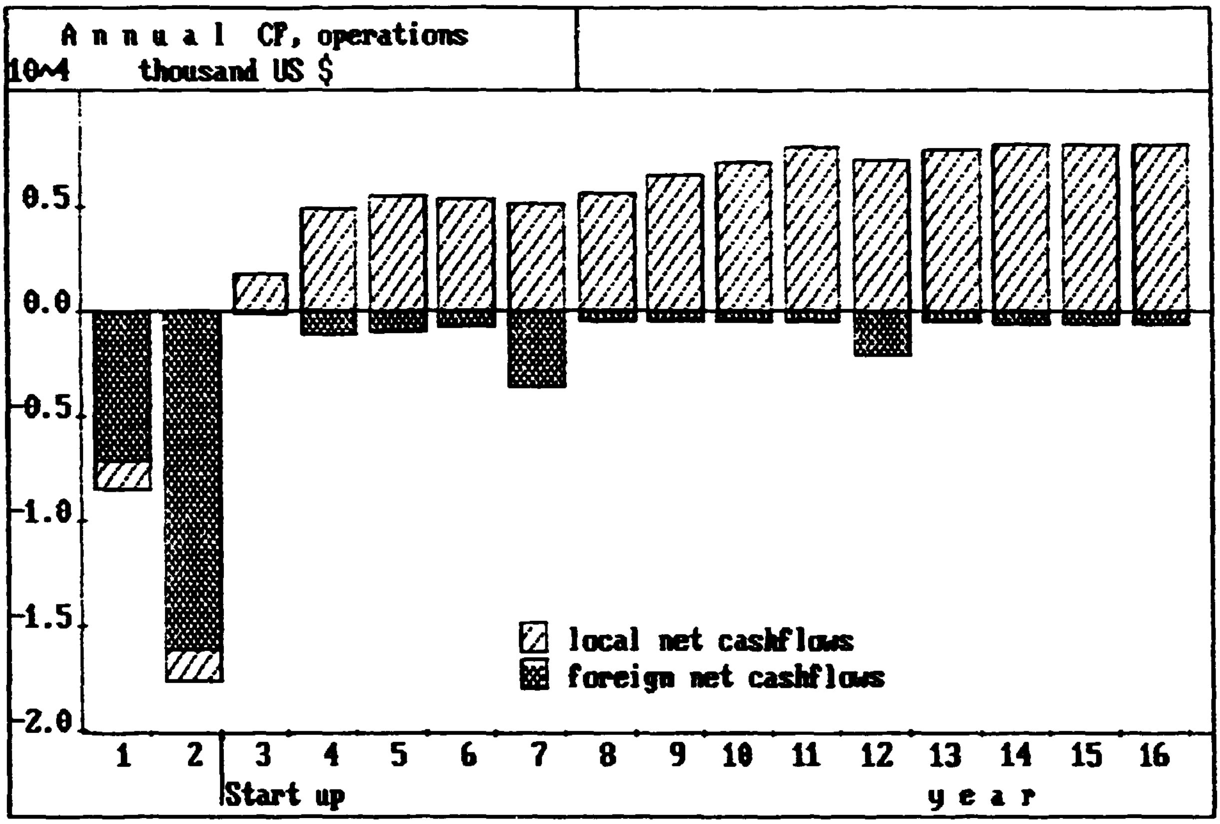
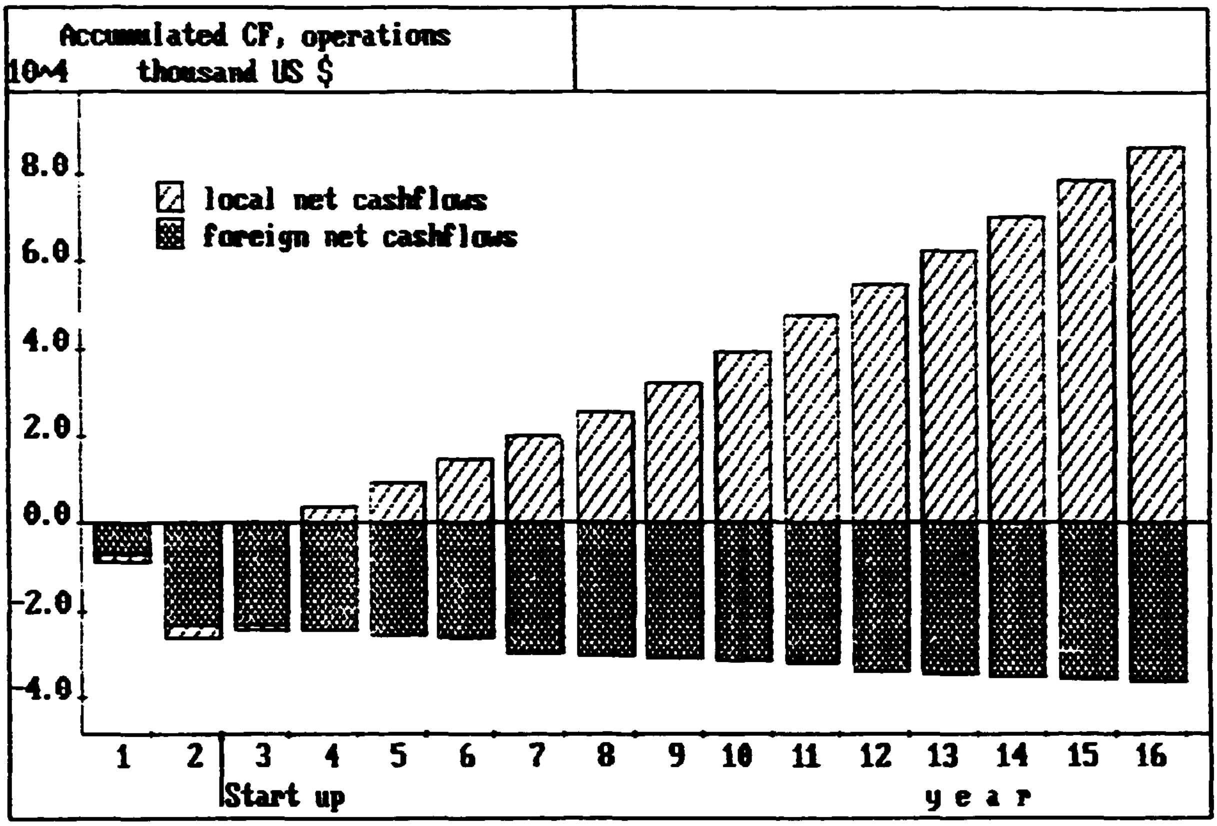
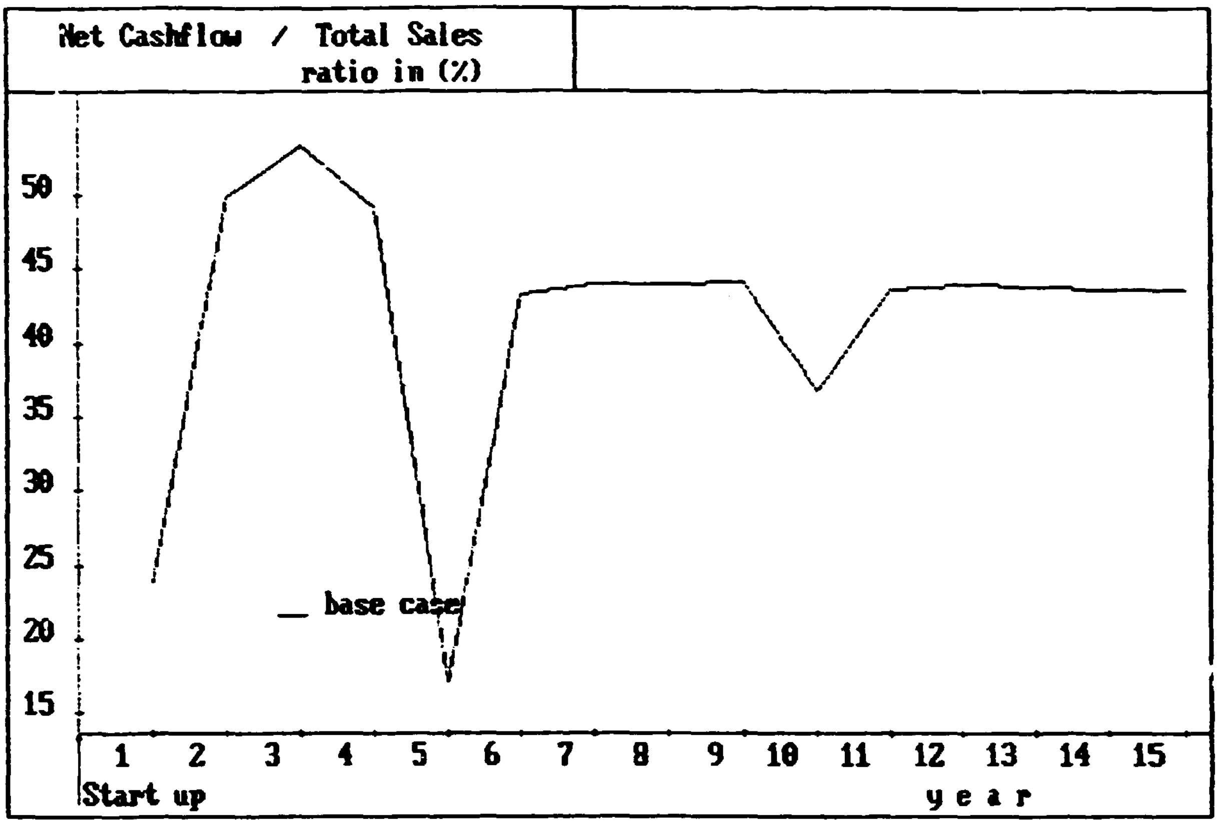
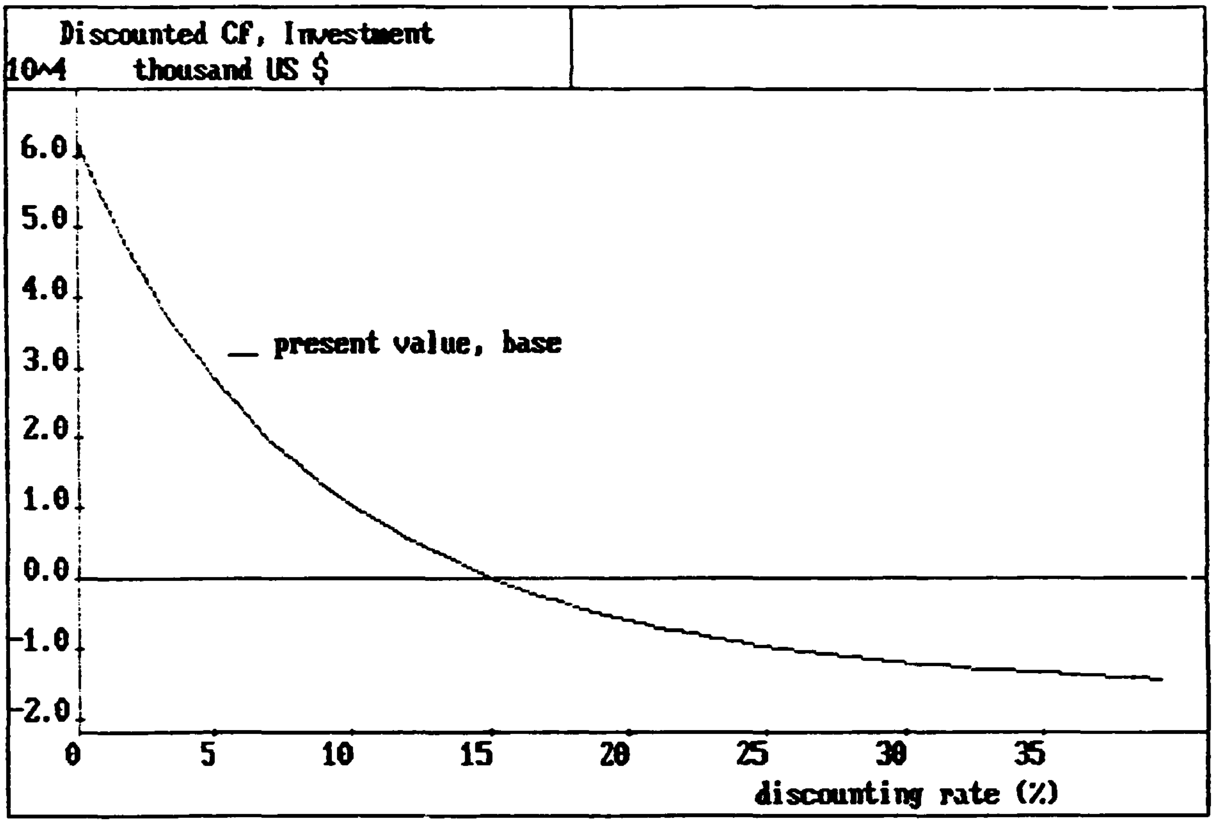

Annual CF, operations
10^4 thousand US $
0.5
0.0
-0.5
-1.0
-1.5
-2.0
local net cashflows
foreign net cashflows
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
Start up
year


Accumulated CF, operations
10^4 thousand US $
local net cashflows
foreign net cashflows
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Start up
year


Net Cashflow / Total Sales
ratio in (%)
50
45
40
35
30
25
20
15
base case
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Start up
year


Discounted CF, Investment
10^4 thousand US $
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
0
5
10
15
20
25
30
35
present value, base
discounting rate (%)

c) In both cases, a) and b), we add to the cumulative total of the cash flows, at the end of the period, the salvage value of the investment, i.e. the theoritical salvage value of the assets if they were sold at that time.

Thus we get a figure which represents the profit generated by the project at the end of the period of operation, increased by the salvage value of the investment.

Charts hereafter show :

- the annual cash flow evolution year by year and accumulated ;
- the evolution of the net cash flow/total sales ratio ;
- the discounted cash flow variation according to the discounting rate used.

We have a negative annual net cash flow during the construction period whereby the foreign component is dominating.
During the production phase, the annual cash flow is positive for each year.
Accumulated the net cash flow becomes positive in the 7th production year i.e. when the project run at 90 T/day capacity.

We also see a sharp fall in the cash flow in the 5th and 10th year after start up due to decrease of the production with rebuilding of the furnace and investment cost resulting from this.

Discounted cash flow curve shows positive present value with discounting rate of less than 15 %.

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5.2.2 <u>Net present value</u> :

We now use the concept of net present value to take account of the entire length of the project's working life and the staggering of the cash flows.

The net present value of the project can be defined as being the value obtained by discounting, separately for each year, the cash flows defined above, at a predetermined fixed rate of interest. The action of discounting begins at the moment when the project is supposed to commence, i.e. the second year after the moment when the contract for the project enters into force.

Thus the shortcomings of the net present value are :

- the difficulty in selecting the appropriate discount rate,
- it does not show the project's exact profitability rate.

For these reasons, we prefer to use the internal rates of return.

In fact, as a criterion it has the advantage :

- of being expressed as a percentage of the capital invested,
- that it takes account of how revenues and expenditure are distributed over time,
- it enables a comparison to be made with any other investment.

5.2.3. Internal rate of return :

a) Definitions :

- The I.R.R. is the discount rate at which the cumulative total of the cash flows, increased by the salvage value at the end of the period, is cancelled out.

- It is the discount rate at which the discounted value of the cash inflows equals that of the cash outflows.

- The economic for entrepreneur rate, giving the rate of return of the total investment outlay, shows the highest rate of interest that could be borne without inducing losses for the proposed project provided that the loan repayments schedule falls in line with the cash inflows.

- It is the real rate of return of the total investment or of the equity which takes account of the entire length of a project's life from its moment of origin, of the staggering of cash flows and of the moment such flows take place.

b) What are the rates to be worked out ?

The rates which are needed to evaluate the project or to make comparisons between several alternatives or between different projects, are to be worked out.

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These are :

. The economic for entrepreneur I.R.R. after tax, obtained by discounting the net cash flow given in "Economic" for entrepreneur table.

It corresponds to the I.R.R. of the COMFAR.

. The economic for entrepreneur I.R.R. before tax, obtained by discounting the gross cash flows given in "Economic" for entrepreneur table.

. The financial I.R.R before tax, obtained by discounting the gross cash flows given in "Financial" table.

. The financial I.R.R. after tax, obtained by discounting the net cash flows given in "Financial" table.

It corresponds to the I.R.R.E. 2 of the COMFAR.

. The I.R.R.E. 1 of the COMFAR is obtained by discounting the total equity paid in each year and the annual net profit after tax ; equity as an outflow and profit as an inflow.

"Financial" rates must be higher than their corresponding "Economic for entrepreneur" rates, in order to justify that it is better to finance the project by loans than by own capital.

c) Results :

ABAY_model

Economic for entrepreneur I.R.R. after tax	: 15.1 %.
Economic for entrepreneur I.R.R. before tax	: 19.4 %.
Financial I.R.R. before tax	: 21.2 %.
Financial I.R.R. after tax	: 15.4 %.

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COMFAR model

I.R.R. on investment : 15.06 %.

I.R.R. on equity

I.R.R. 1 : 16,97 %

I.R.R. 2 : 15.84 %.

d) Comments :

- Economic for entrepreneur rate :

19.5 % prior to tax

15.1 % after tax (I.R.R. on investment).

. The rate before tax gives the intrinsic profitability of the project ; i.e. the real efficiency of the total investment, such as the schedule of expenditure and revenue is worked out.

. It also represent the maximum rate of interest that can be borne by the project without inducing losses for the project if the investment were financed by loans. This is, of course, providing that the loan repayment schedule falls in line with the revenue so that the project always has sufficient funds available to meet these repayments.

The rate after tax does not represent this intrinsic profitability because this rate take tax into consideration which are influenced by the financial structure through the financial costs.

- Financial rate after tax : 15.4 % (I.R.R.E. 2 = 15.84 %).

. This gives the real profitability of the equity invested in the project.

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. The financial internal rate before tax (21.3 %) is higher than the economic for entrepreneur rate before tax (19.5 %) which means that the financial structure proposed is a good one and that if recourse is made to outside financing, the profitability of the equity is improved.

- I.R.R.E. 1 : 16.97 %.

This rate allows the potential for paying dividends to be evaluated for the shareholder considering the time-value if dividends and future risk components, respectively.

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UGANDA GLASS CONTAINERS PROJECT
September 1989
UNIDO project N° XP/UGA/88/006

2 year(s) of construction, 15 years of production
currency conversion rates:
foreign currency 1 unit = 1.0000 units accounting currency
local currency 1 unit = 1.0000 units accounting currency
accounting currency: thousand US $

Total initial investment during construction phase

fixed assets:	27524.25	89.505 % foreign
current assets:	0.00	0.000 % foreign
total assets:	27524.25	89.505 % foreign

Source of funds during construction phase

equity & grants:	9650.00	20.000 % foreign
foreign loans :	19150.00	
local loans :	200.00	
total funds :	29000.00	72.690 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	3750.70	3816.84	3835.88
depreciation :	2491.51	2491.51	2491.51
interest :	1591.53	1279.03	966.53
production costs	7833.73	7587.38	7293.92
thereof foreign	82.14 %	80.23 %	78.70 %
total sales :	6819.52	7672.64	8602.72
gross income :	-1014.21	85.26	1308.80
net income :	-1014.21	85.26	1156.86
cash balance :	-2459.58	-1450.92	1126.06
net cashflow :	1631.94	3828.11	4592.59

Net Present Value at: 10.00 % = 10349.36
Internal Rate of Return: 15.06 %
Return on equity1: 16.97 %
Return on equity2: 15.84 %

Index of Schedules produced by COMFAR

Total initial investment
Total investment during production
Total production costs
Working Capital requirements
Cashflow Tables
Projected Balance
Net income statement
Source of finance

* CASH FLOW SCHEDULE FOR PROFITABILITY ANALYSIS: ECONOMIC FOR ENTREPRENEUR *

amounts in thousand US $	-2	-1	1	2	3	4	5	6
INFLOWS								
Net sales revenue	.0	.0	6819.5	7672.6	8602.7	9615.8	8974.9	12062.1
OUTFLOWS								
Investment outlay (1)	8515.6	17575.2	1436.9	27.7	20.8	28.5	2879.9	209.4
Production costs	.0	.0	3750.8	3816.8	3826.2	3872.2	3602.3	4488.3
TOTAL OUTFLOWS	8515.6	17575.2	5187.7	3844.5	3847.0	3900.7	6482.3	4697.7
GROSS CASH FLOW	-8515.6	-17575.2	1631.8	3828.1	4755.7	5715.2	2492.6	7364.4
Tax on profit	.0	.0	.0	.0	155.7	999.9	945.0	2145.9
NET CASH FLOW	-8515.6	-17575.2	1631.8	3828.1	4600.0	4715.3	1547.7	5218.5
Gross present value at i.r.r.	-8515.6	-14718.7	1144.5	2248.5	2339.3	2354.3	859.9	2127.7
Net present value at i.r.r.	-8515.6	-15269.0	1231.7	2510.2	2620.6	2333.7	665.5	1949.4
ACCUMULATED GROSS CASH FLOW	-8515.6	-26090.9	-24459.0	-20630.9	-15875.2	-10160.1	-7667.4	-303.1
ACCUMULATED NET CASH FLOW	-8515.6	-26090.9	-24459.0	-20630.9	-16030.9	-11315.6	-9768.0	-4549.4

amounts in thousand US $	7	8	9	10	11	12	13	14
INFLOWS								
Net sales revenue	13509.6	15130.7	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4
OUTFLOWS								
Investment outlay (1)	96.1	102.6	114.6	1122.1	164.1	10.0	5.0	4.9
Production costs	4883.4	5277.3	5717.7	4980.0	5531.3	5624.9	5671.0	5717.7
TOTAL OUTFLOWS	4979.4	5379.9	5832.2	6102.0	5695.4	5634.9	5676.0	5722.5
GROSS CASH FLOW	8530.2	9750.9	11114.2	8020.0	11251.0	11311.5	11270.4	11223.9
Tax on profit	2577.4	3078.8	3639.5	2815.4	3865.5	3838.6	3830.7	3822.6
NET CASH FLOW	5952.8	6672.0	7474.6	5204.6	7385.5	7472.9	7439.7	7401.2
Gross present value at i.r.r.	2063.9	1975.8	1886.0	1139.8	1339.0	1127.4	940.8	784.6
Net present value at i.r.r.	1931.9	1881.2	1831.0	1107.6	1365.5	1200.3	1038.2	897.3
ACCUMULATED GROSS CASH FLOW	8227.1	17978.0	29092.1	37112.1	48363.1	59674.6	70945.0	82168.9
ACCUMULATED NET CASH FLOW	1403.4	8075.4	15550.0	20754.6	28140.1	35613.0	43052.7	50453.9

amounts in thousand US $	15	Salv.val.	T O T A L
I N F L O W S			
Net sales revenue	16946.4	.0	198188.4
O U T F L O W S			
Investment outlay (1)	.0	-4192.8	28120.5
Production costs	5717.7	.0	72477.4
TOTAL OUTFLOWS	5717.7	-4192.8	100597.9
GROSS CASH FLOW	11228.7	4192.8	97590.5
Tax on profit	3833.2	.0	35548.2
NET CASH FLOW	7395.5	4192.8	62042.3
Gross present value at i.r.r.	657.4	245.5	.0
Net present value at i.r.r.	778.9	441.6	.0
ACCUMULATED GROSS CASH FLOW	93397.6	97590.5	97590.5
ACCUMULATED NET CASH FLOW	57849.5	62042.3	62042.3

(1) without financial charges before start up.

INTERNAL RATE OF RETURN - ECONOMIC FOR ENTREPRENEUR PRIOR TO TAX : 19.41 %

INTERNAL RATE OF RETURN - ECONOMIC FOR ENTREPRENEUR AFTER TAX : 15.11 %

* CASH FLOW SCHEDULE FOR PROFITABILITY ANALYSIS: F I N A N C I A L *

amounts in thousand US $	-2	-1	1	2	3	4	5	6
I N F L O W S								
Net sales revenue	.0	.0	6819.5	7672.6	8602.7	9615.8	8974.9	12062.1
O U T F L O W S								
Salvage value	.0	.0	.0	.0	.0	.0	.0	.0
Equity	9650.0	.0	.0	.0	.0	.0	.0	.0
Replacement	.0	.0	.0	.0	.0	.0	2935.0	.0
Debt service (1)	.0	.0	4091.7	5279.1	4600.0	4715.3	3375.3	2716.5
Production costs	.0	.0	3750.8	3816.8	3826.2	3872.2	3602.3	4488.3
TOTAL OUTFLOWS	9650.0	.0	7842.5	9095.9	8426.2	8587.5	9912.6	7204.7
GROSS CASH FLOW	-9650.0	.0	-1023.0	-1423.3	176.5	1028.4	-937.7	4857.3
Tax on profit	.0	.0	.0	.0	155.7	999.9	945.0	2145.9
NET CASH FLOW	-9650.0	.0	-1023.0	-1423.3	20.8	28.5	-1882.7	2711.5
Gross present value at i.r.r.	-9650.0	.0	-696.3	-799.4	81.8	393.2	-295.8	1264.1
Net present value at i.r.r.	-9650.0	.0	-768.7	-927.2	11.8	13.9	-798.9	997.5
ACCUMULATED GROSS CASH FLOW	-9650.0	-9650.0	-10673.0	-12096.2	-11919.7	-10891.4	-11829.1	-6971.8
ACCUMULATED NET CASH FLOW	-9650.0	-9650.0	-10673.0	-12096.2	-12075.4	-12046.9	-13929.6	-11218.1

amounts in thousand US $	7	8	9	10	11	12	13	14
I N F L O W S								
Net sales revenue	13509.6	15130.7	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4
O U T F L O W S								
Salvage value	.0	.0	.0	.0	.0	.0	.0	.0
Equity	.0	.0	.0	.0	.0	.0	.0	.0
Replacement	.0	.0	.0	1306.0	.0	.0	.0	.0
Debt service (1)	666.8	640.4	614.0	587.6	561.2	534.8	508.4	482.0
Production costs	4883.4	5277.3	5717.7	4980.0	5531.3	5624.9	5671.0	5717.7
TOTAL OUTFLOWS	5550.2	5917.7	6331.7	6873.6	6092.5	6159.7	6179.4	6199.7
GROSS CASH FLOW	7959.4	9213.0	10614.7	7248.4	10853.9	10786.7	10767.0	10746.7
Tax on profit	2577.4	3078.8	3639.5	2815.4	3865.5	3838.6	3830.7	3822.6
NET CASH FLOW	5382.0	6134.2	6975.2	4433.0	6988.4	6948.1	6936.3	6924.1
Gross present value at i.r.r.	1709.0	1632.1	1551.5	874.1	1079.9	885.5	729.2	600.5
Net present value at i.r.r.	1716.3	1695.7	1671.5	920.9	1258.5	1084.6	938.6	812.3
ACCUMULATED GROSS CASH FLOW	987.7	10200.7	20815.4	28063.9	38917.7	49704.5	60471.5	71218.2
ACCUMULATED NET CASH FLOW	-5836.1	298.1	7273.3	11706.4	18694.8	25642.9	32579.1	39503.2

amounts in thousand US $	15	Salv.val.	T O T A L
I N F L O W S			
Net sales revenue	16946.4	.0	198188.4
O U T F L O W S			
Salvage value	.0	-4192.8	-4192.8
Equity	.0	.0	9650.0
Replacement	.0	.0	4241.0
Debt service (1)	455.6	.0	29828.7
Production costs	5717.7	.0	72477.4
TOTAL OUTFLOWS	6173.3	-4192.8	112004.2
GROSS CASH FLOW	10773.1	4192.8	86184.2
Tax on profit	3833.2	.0	35548.2
NET CASH FLOW	6939.9	4192.8	50636.0
Gross present value at i.r.r.	496.7	143.9	.0
Net present value at i.r.r.	705.7	317.5	.0
ACCUMULATED GROSS CASH FLOW	81991.3	86184.2	86184.2
ACCUMULATED NET CASH FLOW	46443.2	50636.0	50636.0

(1) without financial charges before start up.

I N T E R N A L R A T E O F R E T U R N - FINANCIAL PRIOR TO TAX : 21.21 %

I N T E R N A L R A T E O F R E T U R N - FINANCIAL AFTER TAX : 15.36 %

Cashflow Tables, construction in thousand US $

Year	1990	1991
Total cash inflow	18575.000	10425.000
Financial resources	18575.000	10425.000
Sales, net of tax	0.000	0.000
Total cash outflow	8871.840	18652.410
Total assets	8513.490	17577.360
Operating costs	0.000	0.000
Cost of finance	358.350	1075.050
Repayment	0.000	0.000
Corporate tax	0.000	0.000
Dividends paid	0.000	0.000
Surplus (deficit)	9703.160	-8227.410
Cumulated cash balance	9703.160	1475.750
Inflow, local	7720.000	200.000
Outflow, local	1412.338	1476.412
Surplus (deficit)	6307.662	-1276.412
Inflow, foreign	10855.000	10225.000
Outflow, foreign	7459.502	17176.000
Surplus (deficit)	3395.498	-6950.998
Net cashflow	-8513.490	-17577.360
Cumulated net cashflow	-8513.490	-26090.850

Cashflow tables, production in thousand US $

Year	1992	1993	1994	1995	1996	1997
Total cash inflow . .	7117.020	7682.159	8608.361	9621.824	8974.880	12133.800
Financial resources .	297.500	9.519	5.641	5.985	0.000	71.723
Sales, net of tax . .	6819.520	7672.641	8602.721	9615.840	8974.880	12062.080
Total cash outflow . .	9576.604	9133.078	7482.296	9514.152	10802.360	7608.519
Total assets	1734.382	33.040	23.863	29.959	2857.904	281.211
Operating costs . . .	3750.697	3816.840	3835.880	3872.127	3602.160	4488.242
Cost of finance . . .	1591.525	1279.025	966.525	752.427	518.533	336.515
Repayment	2500.000	4004.173	2504.087	2359.731	2878.698	356.667
Corporate tax . . .	0.000	0.000	151.941	999.909	945.070	2145.864
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-2459.585	-1450.919	1126.065	107.672	-1827.483	4525.285
Cumulated cash balance	-983.835	-2434.754	-1308.689	-201.017	-2028.500	2496.785
Inflow, local	5730.501	6347.919	7110.281	7951.265	7415.680	9996.570
Outflow, local	1504.364	1565.720	1562.140	2483.654	2336.639	3997.639
Surplus (deficit) .	4226.138	4782.199	5548.142	5467.611	5079.041	5998.932
Inflow, foreign . . .	1386.518	1334.240	1498.080	1670.560	1559.200	2137.233
Outflow, foreign . . .	8072.241	7567.358	5920.157	6030.499	8465.726	3610.880
Surplus (deficit) .	-6685.723	-6233.118	-4422.077	-4359.939	-6906.525	-1473.647
Net cashflow	1631.940	3828.106	4592.589	4716.765	1547.716	5218.466
Cumulated net cashflow	-24458.910	-20630.800	-16038.210	-11321.450	-9773.733	-4555.267

Cashflow tables, production in thousand US $

Year	1998	1999	2000	2001	2002	2003
Total cash inflow . .	13541.570	15162.610	16982.020	14122.000	16991.000	16953.960
Financial resources .	31.967	31.887	35.617	0.000	44.602	7.564
Sales, net of tax . .	13509.600	15130.720	16946.400	14122.000	16946.400	16946.400
Total cash outflow . .	8255.539	9130.828	10121.520	9505.012	10166.720	10015.800
Total assets	128.058	134.313	150.322	1062.340	208.743	17.522
Operating costs . . .	4883.243	5277.282	5717.689	4980.022	5531.244	5624.807
Cost of finance . . .	310.122	283.728	257.335	230.942	204.548	178.155
Repayment	356.667	356.667	356.667	416.339	356.667	356.667
Corporate tax . . .	2577.450	3078.839	3639.505	2815.369	3865.518	3838.650
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	5286.028	6031.779	6860.501	4616.988	6824.282	6938.164
Cumulated cash balance	7782.813	13814.590	20675.090	25292.080	32116.360	39054.530
Inflow, local	11174.960	12512.070	14013.500	11668.560	14008.860	14009.960
Outflow, local	4537.608	5159.744	5863.411	4700.401	5898.893	5956.334
Surplus (deficit) .	6637.348	7352.326	8150.091	6968.159	8109.962	8053.630
Inflow, foreign . . .	2366.611	2650.537	2968.516	2453.440	2982.147	2944.000
Outflow, foreign . . .	3717.931	3971.085	4258.106	4804.611	4267.827	4059.467
Surplus (deficit) .	-1351.319	-1320.548	-1289.590	-2351.171	-1285.680	-1115.467
Net cashflow	5952.817	6672.175	7474.501	5204.596	7385.498	7472.985
Cumulated net cashflow	1397.550	8069.725	15544.230	20748.820	28134.320	35607.300

Cashflow tables, production in thousand US $

Year	2004	2005	2006
Total cash inflow . .	16950.130	16950.170	16946.400
Financial resources .	3.734	3.773	0.000
Sales, net of tax . .	16946.400	16946.400	16946.400
Total cash outflow . .	10018.820	10031.080	10006.820
Total assets	8.654	8.741	0.000
Operating costs . . .	5671.016	5717.689	571[illegible]89
Cost of finance . . .	151.762	125.368	98.[illegible]75
Repayment	356.667	356.667	356.667
Corporate tax . . .	3830.724	3822.612	3833.486
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	6931.313	6919.098	6939.584
Cumulated cash balance	45985.840	52904.940	59844.520
Inflow, local	14006.130	14006.170	14002.400
Outflow, local	5985.206	6023.154	6025.444
Surplus (deficit) .	8020.929	7983.019	7976.956
Inflow, foreign . . .	2944.000	2944.000	2944.000
Outflow, foreign . . .	4033.616	4007.923	3981.372
Surplus (deficit) .	-1089.616	-1063.923	-1037.372
Net cashflow	7439.741	7401.132	7395.226
Cumulated net cashflow	43047.050	50448.180	57843.410

■shflow Discounting:

a) Equity paid versus Net income flow:
    Net present value .... 9748.99 at 10.00 %
    Internal Rate of Return (IRRE1) .. 16.97 %
b) Net Worth versus Net cash return:
    Net present value .... 8844.17 at 10.00 %
    Internal Rate of Return (IRRE2) .. 15.84 %
c) Internal Rate of Return on total investment:
    Net present value .... 10349.36 at 10.00 %
    Internal Rate of Return (IRR) .. 15.06 %
Net Worth = Equity paid plus reserves

6. PROJECTED BALANCE SHEETS AND DEBT EQUITY RATIO.

Table below displays the evolution of the balance sheet.

3 charts after shown that during the 5 first years of the project (construction period included) the debt portion exceeds the debt.

With the repayment of the loan,n the debt proportion diminishes.

Simultaneously, reserves are increasing due to positive income results but become only higher than equity from the 7th production year.

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Projected Balance Sheets, construction in thousand US $

Year	1990	1991
Total assets	18575.000	29000.000
Fixed assets, net of depreciation	0.000	8871.840
Construction in progress	8871.840	18652.410
Current assets	0.000	0.000
Cash, bank	0.000	0.000
Cash surplus, finance available	9703.160	1475.750
Loss carried forward	0.000	0.000
Loss	0.000	0.000
Total liabilities	18575.000	29000.000
Equity capital	9650.000	9650.000
Reserves, retained profit	0.000	0.000
Profit	0.000	0.000
Long and medium term debt	8925.000	19350.000
Current liabilities	0.000	0.000
Bank overdraft, finance required.	0.000	0.000
Total debt	8925.000	19350.000
Equity, % of liabilities	51.952	33.276

Projected Balance Sheets, Production in thousand US $

Year	1992	1993	1994	1995	1996
Total assets	27781.340	25322.860	22769.950	19379.450	19745.840
Fixed assets, net of depreciation	25032.740	22541.230	20049.710	17558.200	15066.690
Construction in progress	0.000	0.000	0.000	0.000	2935.000
Current assets	1617.224	1664.264	1702.260	1746.286	1674.706
Cash, bank	117.158	103.158	89.025	74.958	69.442
Cash surplus, finance available	0.000	0.000	0.000	0.000	0.000
Loss carried forward	0.000	1014.214	928.951	0.000	0.000
Loss	1014.214	0.000	0.000	0.000	0.000
Total liabilities	27781.340	25322.860	22769.950	19379.450	19745.840
Equity capital	9650.000	9650.000	9650.000	9650.000	9650.000
Reserves, retained profit	0.000	0.000	0.000	227.911	1727.775
Profit	0.000	85.264	1156.862	1499.864	1417.604
Long and medium term debt	16850.000	12850.000	10350.000	7493.333	4636.667
Current liabilities	297.500	302.845	304.399	307.319	285.288
Bank overdraft, finance required	983.836	2434.754	1308.689	201.021	2028.504
Total debt	18131.340	15587.600	11963.090	8001.674	6950.459
Equity, % of liabilities	34.736	38.108	42.380	49.795	48.871

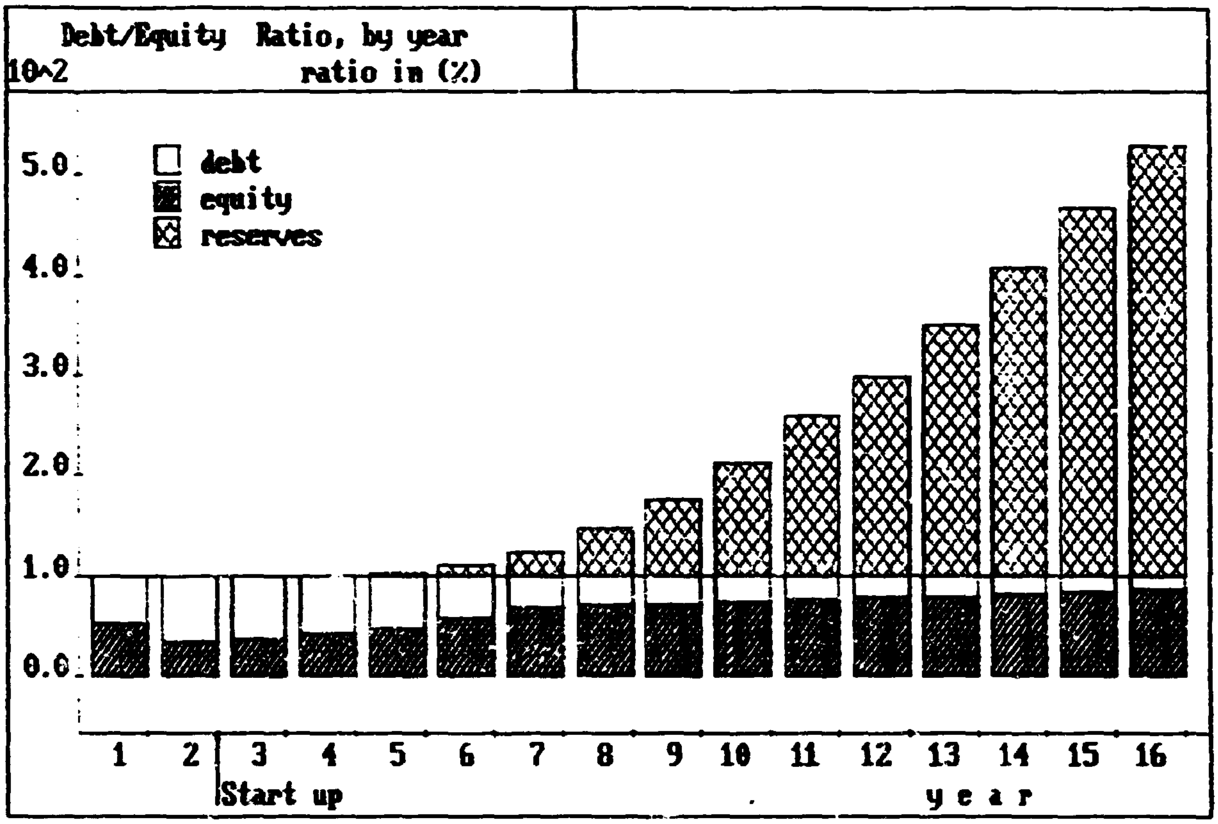
COMFAR 2.1 - ABAY S.A., BRUSSELS, BELGIUM

Projected Balance Sheets, Production in thousand US $

Year	1997	1998	1999	2000	2001
Total assets	20651.220	24192.690	28486.170	33624.380	37431.090
Fixed assets, net of depreciation	16129.080	14256.460	12383.850	10511.240	8638.624
Construction in progress	0.000	0.000	0.000	0.000	1306.000
Current assets	1953.600	2080.908	2214.271	2363.509	2121.649
Cash, bank	71.558	72.508	73.458	74.542	72.742
Cash surplus, finance available	2496.781	7782.811	13814.590	20675.090	25292.070
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	20651.220	24192.690	28486.170	33624.380	37431.090
Equity capital	9650.000	9650.000	9650.000	9650.000	9650.000
Reserves, retained profit	3145.379	6364.206	10230.380	14848.640	20307.900
Profit	3218.627	3866.175	4618.259	5459.258	4223.054
Long and medium term debt	4280.000	3923.334	3566.667	3210.000	2853.333
Current liabilities	357.012	388.978	420.865	456.482	396.810
Bank overdraft, finance required	0.000	0.000	0.000	0.000	0.000
Total debt	4637.012	4312.312	3987.532	3666.483	3250.144
Equity, % of liabilities	46.728	39.888	33.876	28.699	25.781

Projected Balance Sheets, Production in thousand US $

Year	2002	2003	2004	2005	2006
Total assets	42917.300	48326.180	53719.330	59100.360	64493.920
Fixed assets, net of depreciation	8397.811	6850.998	5304.185	3757.372	2211.351
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	2329.059	2346.347	2354.885	2363.509	2363.509
Cash, bank	74.075	74.308	74.425	74.542	74.542
Cash surplus, finance available .	32116.300	39054.530	45985.840	52904.940	59844.520
Loss carried forward	0.000	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	42917.300	48326.180	53719.330	59100.360	64493.920
Equity capital	9650.000	9650.000	9650.000	9650.000	9650.000
Reserves, retained profit	24530.950	30329.230	36087.200	41833.290	47567.210
Profit	5798.277	5757.976	5746.086	5733.917	5750.229
Long and medium term debt	2496.667	2140.000	1783.333	1426.667	1070.000
Current liabilities	441.412	448.976	452.710	456.482	456.482
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	2938.079	2588.976	2236.045	1883.149	1526.483
Equity, % of liabilities	22.485	19.968	17.964	16.328	14.963


Debt/Equity Ratio, by year
10^2
ratio in (%)
5.0
4.0
3.0
2.0
1.0
0.0
debt
equity
reserves
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Start up
year

B. ECONOMIC ANALYSIS.

1. ADDED VALUE.

Each industrial investment brings some added value to the national economy of the country where the project is implemented.
It increases the G.N.P. of the country.

The calculation of this added value can be worked out as follows :

Sales revenues
- Production costs
Gross production margin
+ Manpower costs
Added value

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****
* ADDED VALUE *
****

% or US $		average 3 years	average 5 years	average 10 years	average 15 years
ADDED VALUE					
per year		4226813.9	4898095.6	7273519.7	8735010.9
per person employed		23224	26620	39530	47473
in % of annual net sales	%	55	59	64	66
in % of total investment	%	14.6	16.9	24.8	29.6
per t. of raw material		422.9	458.4	505.3	522.4
per t. of Bottles		310.4	332.1	362.4	373.8
per t. of Tablewares		257.7	275.7	300.9	310.3
per t. of total main products		568.1	607.9	663.3	684.0

****
* PAY-BACK PERIOD: * 6 years et 3 months
****

2. THE IMPACT OF THE PROJECT ON FOREIGN CURRENCY BALANCE.

The foreign currency balance will be affected whether the project is implemented or not.

If the project is implemented, foreign currency will not be lost in importing glass containers, bu currency will leave the country to pay for the project.

Table below shows the impact of this.

When drawing up this table, we have considered :

- foreign currency inflows :
  . the savings made on not importing bottles and tablewares which is valued at 560 $/T and 1,120 $/T for the quantities corresponding to the project's production,
  . the revenues from the equity and foreign credit,
  . the export sales.

- foreign currency outflows :
  . the investment (without working capital),
  . production costs,
  . debt service for the foreign credits.

Conclusion :

For an import CIF price for bottles of 560 $/T and for tablewares of 1,120 $/T, the project will save 6,36 million $ per year as an average.

It is only if the CIF price of glass should fall under 226.4 $/T that the project would not allow foreign currency savings.

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****
* IMPACT ON THE FOREIGN CURRENCY BALANCE *
****

amounts in thousand US $	-2	-1	1	2	3	4	5	6
INFLOWS								
Net sales revenue	.0	.0	1179.5	1334.3	1498.1	1670.6	1559.2	2095.5
Export duties	.0	.0	.0	.0	.0	.0	.0	.0
Gross sales revenue	.0	.0	1179.5	1334.3	1498.1	1670.6	1559.2	2095.5
Production costs	.0	.0	2506.6	2457.8	2408.1	2371.0	2169.4	2682.5
OPERATING CASH FLOW	.0	.0	-1327.1	-1123.5	-910.0	-700.4	-610.2	-586.9
Equity	1930.0	.0	.0	.0	.0	.0	.0	.0
Long term loans	8925.0	10225.0	.0	.0	.0	.0	.0	.0
TOTAL INFLOWS	10855.0	10225.0	-1327.1	-1123.5	-910.0	-700.4	-610.2	-5[illegible]
OUTFLOWS								
Investment	7459.5	17176.1	.0	.0	.0	.0	2935.0	.0
Long term debt service	.0	.0	4063.7	5065.1	3466.7	3609.1	3375.3	693.2
Interests on short term credits	.0	.0	.0	.0	.0	.0	.0	.0
Interests on lack of cash flow credit	.0	.0	.0	.0	.0	.0	.0	.0
Dividends	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL OUTFLOWS	7459.5	17176.1	4063.7	5065.1	3466.7	3609.1	6310.3	693.2
FOREIGN CURRENCY BALANCE	3395.5	-6951.1	-5390.8	-6188.6	-4376.7	-4309.5	-6920.5	-1280.1
Import savings (cif value)								
Bottles	.0	.0	2617.9	2932.2	3284.0	3677.9	3432.7	4613.5
Tablewares	.0	.0	2155.8	2438.7	2738.0	3053.2	2849.7	3830.0
TOTAL IMPORT SAVINGS	.0	.0	4773.7	5370.8	6021.9	6731.1	6282.4	84[illegible]
IMPACT ON FOREIGN CURRENCY BALANCE	3395.5	-6951.1	-617.1	-817.7	1645.2	2421.6	-638.1	7163.3
ACCUMULATED	3395.5	-3555.5	-4172.6	-4990.4	-3345.2	-923.6	-1561.7	5601.6

Amounts in thousand US $	7	8	9	10	11	12	13	14
INFLOWS								
Net sales revenue	2347.0	2628.7	2944.1	2453.4	2944.1	2944.1	2944.1	2944.1
Export duties	.0	.0	.0	.0	.0	.0	.0	.0
Gross sales revenue	2347.0	2628.7	2944.1	2453.4	2944.1	2944.1	2944.1	2944.1
Production costs	2923.1	3191.4	3492.4	3023.5	3489.7	3491.1	3491.7	3492.4
OPERATING CASH FLOW	-576.0	-562.8	-548.3	-570.1	-545.6	-547.0	-547.6	-548.3
Equity	.0	.0	.0	.0	.0	.0	.0	.0
Long term loans	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL INFLOWS	-576.0	-562.8	-548.3	-570.1	-545.6	-547.0	-547.6	-548.3
OUTFLOWS								
Investment	.0	.0	.0	1306.0	.0	.0	.0	.0
Long term debt service	666.8	640.4	614.0	587.6	561.2	534.8	508.4	482.0
Interests on short term credits	.0	.0	.0	.0	.0	.0	.0	.0
Interests on lack of cash flow credit	.0	.0	.0	.0	.0	.0	.0	.0
Dividends	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL OUTFLOWS	666.8	640.4	614.0	1893.6	561.2	534.8	508.4	482.0
FOREIGN CURRENCY BALANCE	-1242.8	-1203.2	-1162.3	-2463.7	-1106.8	-1081.8	-1056.0	-1030.3
Import savings (cif value)								
Bottles	5167.1	5787.2	6481.7	5401.4	6481.7	6481.7	6481.7	6481.7
Tablewares	4289.6	4804.4	5380.8	4484.0	5380.8	5380.8	5380.8	5380.8
TOTAL IMPORT SAVINGS	9456.7	10591.5	11862.5	9885.4	11862.5	11862.5	11862.5	11862.5
IMPACT ON FOREIGN CURRENCY BALANCE	8213.9	9388.4	10700.1	7421.7	10755.7	10780.7	10806.4	10832.1
ACCUMULATED	13815.5	23203.9	33904.0	41325.7	52081.4	62862.1	73668.6	84500.7

amounts in thousand US $	15
INFLOWS	
Net sales revenue	2944.1
Export duties	.0
Gross sales revenue	2944.1
Production costs	3492.4
OPERATING CASH FLOW	-548.3
Equity	.0
Long term loans	.0
TOTAL INFLOWS	-548.3
OUTFLOWS	
Investment	.0
Long term debt service	455.6
Interests on short term credits	.0
Interests on lack of cash flow credit	.0
Dividends	.0
TOTAL OUTFLOWS	455.6
FOREIGN CURRENCY BALANCE	-1003.9
Import savings (cif value)	
Bottles	6481.7
Tablewares	5380.8
TOTAL IMPORT SAVINGS	11862.5
IMPACT ON FOREIGN CURRENCY BALANCE	10858.5
ACCUMULATED	95359.3

****
* IMPACT ON THE FOREIGN CURRENCY BALANCE *
****

in US $	average 3 years	average 5 years	average 10 years	average 15 years
Averaged yearly saving	-1115067	-312339	4132573	6357284
Minimum cif price needed to reach foreign currency break-even point.	874.11	763.01	347.39	226.43

C. SENSITIVITY ANALYSIS.

This analysis examines the consequences which variations in some parameters may have on the investment, financial structure and the profitability of the project.

We shall examine variations regarding :

1. VARIATION OF THE SELLING PRICE.

Three alternatives; two where selling price is 10 % higher or lower and a third one where selling price of exported tablewares is 5 % lower in order to make easier the entering in foreign markets.

Alternative A : selling price + 10 %.
Alternative B : selling price - 10 %.
Alternative C : export selling price - 5 %.

2. VARIATION OF PRODUCTION COSTS.

Alternative D : production costs - 10 %.

3. VARIATION OF INTEREST RATE.

Alternative E : interest rates - 1 %.

Buyer's credit	: 7.3 %	instead of 8.3 %.
A.D.B. loan	: 6.4 %	instead of 7.4 %.
Working capital credits	: 13 %	instead of 14 %.

4. What happen if the project receives a tax holiday of 5 years :

Alternative F.

5. VARIATION OF THE INVESTMENT COSTS.

Three alternatives.
Two in which each of the investment items, without working capital, would be 10 % lower or higher.
One additional alternative considering the utilization of the existing buildings and infrastructure of the old plant of the Madvhani group.

Alternative G : investment costs + 10 %.
Alternative H : investment costs - 10 %.
Alternative I : existing site.

6. STARTING WITH HIGHER CAPACITY.

Alternative where the production start immediatly with a furnace capacity of 90 T/day instead of 50 T/day.

Alternative J : "Double gob".

Detailed figures of this alternative is in Appendix II.

In appendix I you will find tables comparing all the alternatives according to the various criteria taken into consideration in the basic case.

We have also added some charts relating tc sensitivity of the selling price, production costs, interest rate and investment costs.

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A. FINANCIAL ANALYSIS.

If we make the comparison of the various alternatives of the I.R.R. level we obtain :

Alternative		I.R.R. %
	Basic	15.1
A	Selling price + 10 %	17.1
B	Selling price - 10 %	12.6
C	Export price - 5 %	14.8
D	Production costs - 10 %	16.1
E	Interest rates - 1 %	15.0
F	Tax holiday 5 years	15.6
G	Investment costs + 10 %	13.9
H	Investment costs - 10 %	16.5
I	Existing site	16.4
J	Double gob	19.9.

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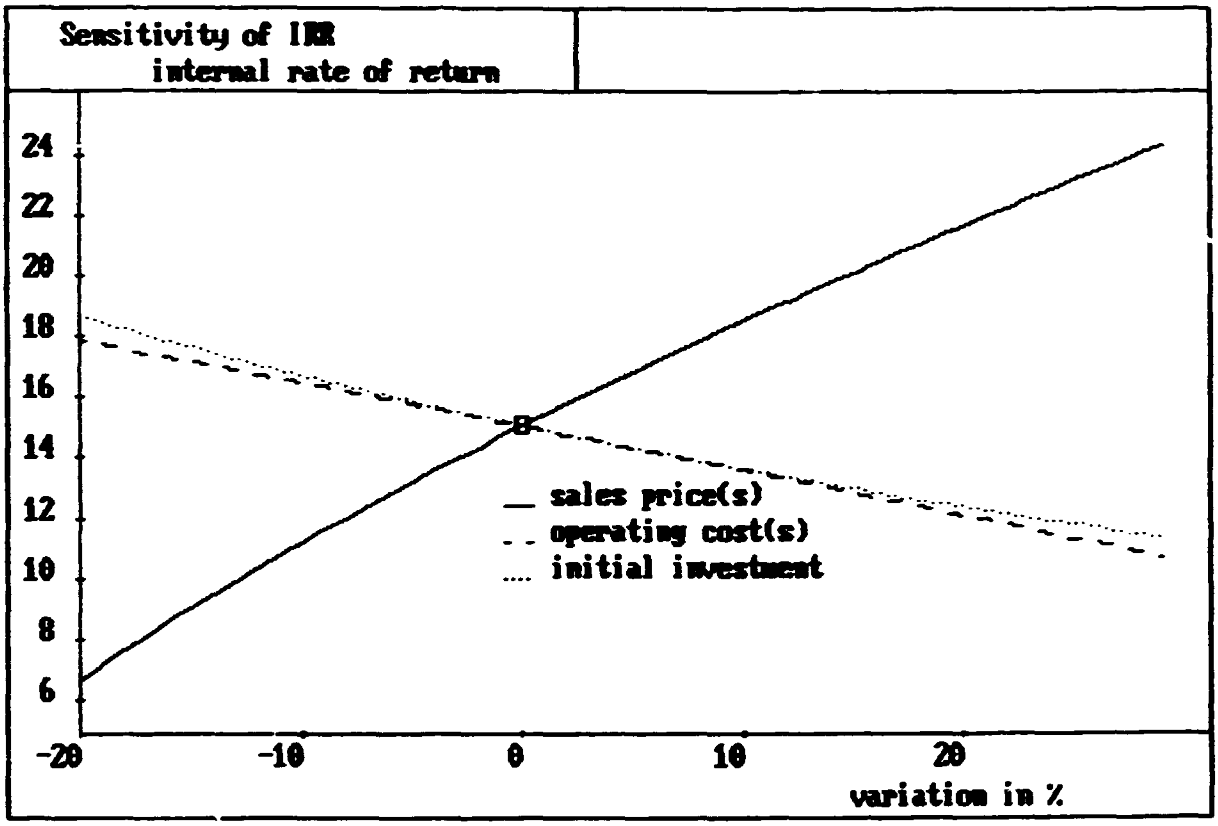

Sensitivity of IRR
internal rate of return
24
22
20
18
16
14
12
10
8
6
-20
-10
0
10
20
variation in %
sales price(s)
operating cost(s)
initial investment

Project is mainly sensitive to the selling prices. But if we decrease by 5 % the selling prices of the exported tablewares, the impact on the profitability is marginal. We thus recommend a price policy to penetrate the foreign markets.

Impact of operating cost and investment cost, as we can see on the chart below, is quite the same, impact of a variation of the operating costs is a little bit higher.

Using the existing facilities of the old plant of the Madhvani group will allow a reduction of the investment cost of 2.4 million $. The impact on the profitability is the same as a global reduction of the investment cost by 10 %.

Variation of 1 % interest rate has a negligible impact.

A tax holiday period of 5 years has an interesting impact and improves with 0.5 % the I.R.R.

Finally, the best improvement for the project would be significately obtained by starting immediately with a higher production capacity.

Obviously, the market must absorb this increase of the production.

B. ECONOMIC ANALYSIS.

Tables below compare the various alterations as far as the added value and the foreign currency balance impact are concerned.

****
* ECONOMIC ANALYSIS *
****

amounts in thousand US $	BASIC	A Sel.prices + 10 %	B Sel.prices - 10 %	C Sel.prices export -5%	D Prod.costs - 10 %	E Inter.rate - 1 %	F 5 years tax holid.
YEARLY AVERAGE 15 YEARS							
ADDED VALUE							
per year	8735.0	10056.3	7413.8	8620.2	9182.8	8735.0	8735.0
per person employed	47.5	54.7	40.3	46.8	49.9	47.5	47.5
in % of annual net sales %	66.1	69.2	62.3	65.8	69.5	66.1	66.1
in % of total investment %	29.6	34.1	25.1	29.2	31.4	29.8	29.6
IMPACT ON THE FOREIGN CURRENCY BALANCE							
Average annual savings	6357.3	6586.8	6127.7	6242.5	6657.7	6435.0	6357.3
Minimum cif import price of main products from which savings are generated US $	226.4	206.5	244.4	235.4	202.9	220.3	226.4

######################
ECONOMIC ANALYSIS
######################

amounts in thousand US $	BASIC	G Investment + 10 %	H Investment - 10 %	I existing site	J double gob 90 t/day
YEARLY AVERAGE 15 YEARS					
ADDED VALUE					
per year	8735.0	8735.0	8735.0	8735.0	10475.3
per person employed	47.5	47.5	47.5	47.5	56.9
in % of annual net sales %	66.1	66.1	66.1	66.1	67.5
in % of total investment %	29.6	27.1	32.6	32.5	34.0
IMPACT ON THE FOREIGN CURRENCY BALANCE					
Average annual savings	6357.3	6138.9	6579.5	6498.1	8005.0
Minimum cif import price of main products from which savings are generated US $	226.4	243.5	209.0	215.4	190.5

APPENDIX I.

SENSITIVITY ANALYSIS

SUMMARY TABLES and CHARTS

****
* INVESTMENT AND FINANCIAL STRUCTURE *
****

amounts in thousand US $	BASIC	A Sel.prices + 10 %	B Sel.prices - 10 %	C Sel.prices export -5%	D Prod.costs - 10 %	E Inter.rate - 1 %	F 5 years tax holid.
INVESTMENT							
Initial fixed investment	24305.8	24305.8	24305.8	24305.8	24305.8	24305.8	24305.8
Preproduction costs	1785.1	1785.1	1785.1	1785.1	1765.4	1785.1	1785.1
Financial charges before start up	1433.4	1433.4	1433.4	1433.4	1433.4	1240.8	1433.4
Working capital 1st year	1436.9	1436.9	1436.9	1436.9	1293.2	1436.9	1436.9
T O T A L I N V E S T M E N T	28961.2	28961.2	28961.2	28961.2	28797.7	28768.5	28961.2
Lack of cash flow during the first production years	4262.8	1193.9	6093.7	4435.2	2192.7	3567.3	2435.1
T O T A L	33223.9	30155.1	35054.9	33396.4	30990.4	32335.9	31396.3
FINANCIAL STRUCTURE							
Equity	9650.0	9650.0	9650.0	9650.0	9650.0	9650.0	9650.0
Long term loans	19350.0	19350.0	19350.0	19350.0	19200.0	19150.0	19350.0
Short term credit for working capital	.0	.0	.0	.0	.0	.0	.0
Short term credit for lack of cash flow	4262.8	1193.9	6093.7	4435.2	2192.7	3567.3	2435.1
T O T A L F I N A N C I N G	33262.8	30193.9	35093.7	33435.2	31042.7	32367.3	31435.1

#######################################
* INVESTMENT AND FINANCIAL STRUCTURE *
#######################################

amounts in thousand US $	BASIC	G Investment + 10 %	H Investment - 10 %	I existing site	J double gob 90 t/day
INVESTMENT					
Initial fixed investment	24305.8	26734.3	21875.2	21909.5	25505.8
Preproduction costs	1785.1	1943.8	1626.3	1684.5	1835.5
Financial charges before start up	1433.4	1573.7	1280.7	1289.0	1501.7
Working capital 1st year	1436.9	1436.9	1436.9	1436.9	1607.9
TOTAL INVESTMENT	28961.2	31688.8	26219.1	26319.9	30450.9
Lack of cash flow during the first production years	4262.8	5504.6	2240.5	2399.0	.0
TOTAL	33223.9	37193.4	28459.5	28718.9	30450.9
FINANCIAL STRUCTURE					
Equity	9650.0	10620.0	8750.0	8800.0	10160.0
Long term loans	19350.0	21100.0	17450.0	17550.0	20300.0
Short term credit for working capital	.0	.0	.0	.0	.0
Short term credit for lack of cash flow	4262.8	5504.6	2240.5	2399.0	.0
TOTAL FINANCING	33262.8	37224.6	28440.5	28749.0	30460.0

* PROFITABILITY ANALYSIS *

amounts in thousand US $	BASIC	A Sel.prices + 10 %	B Sel.prices - 10 %	C Sel.prices export -5%	D Prod.costs - 10 %	E Inter.rate - 1 %	F 5 years tax holid.
YEARLY AVERAGE 15 YEARS							
PRODUCTION							
Raw material processed (t.)	16721.3	16721.3	16721.3	16721.3	16721.3	16721.3	16721.3
MAIN PRODUCTS							
Bottles (t.)	9024.2	9024.2	9024.2	9024.2	9024.2	9024.2	9024.2
Tablewares (t.)	3745.7	3745.7	3745.7	3745.7	3745.7	3745.7	3745.7
BY-PRODUCTS							
Variable costs	4234.8	4234.8	4234.8	4234.8	3811.3	4234.8	4234.8
Fixed costs	597.7	597.7	597.7	597.7	537.9	597.7	597.7
PRODUCTION COSTS	4832.5	4832.5	4832.5	4832.5	4349.2	4832.5	4832.5
Financial charges	485.8	485.8	485.8	485.8	483.7	419.9	485.8
Depreciation	1970.3	1970.3	1970.3	1970.3	1968.9	1957.4	1970.3
GROSS OPERATING COSTS	7288.5	7288.5	7288.5	7288.5	6801.8	7209.8	7288.5
Sales by-products	.0	.0	.0	.0	.0	.0	.0
NET OPERATING COSTS	7288.5	7288.5	7288.5	7288.5	6801.8	7209.8	7288.5
Sales Bottles	7219.4	7941.3	6497.5	7219.4	7219.4	7219.4	7219.4
Sales Tablewares	5993.2	6592.5	5393.8	5878.4	5993.2	5993.2	5993.2
SALES MAIN PRODUCTS	13212.6	14533.8	11891.3	13097.8	13212.6	13212.6	13212.6
GROSS PROFIT	5924.0	7245.3	4602.8	5809.3	6410.8	6002.7	5924.0
Tax on profit	2369.6	2898.1	1841.1	2323.7	2564.3	2401.1	2229.8
NET PROFIT	3554.4	4347.2	2761.7	3485.6	3846.5	3601.6	3694.2

****
* PROFITABILITY ANALYSIS *
****

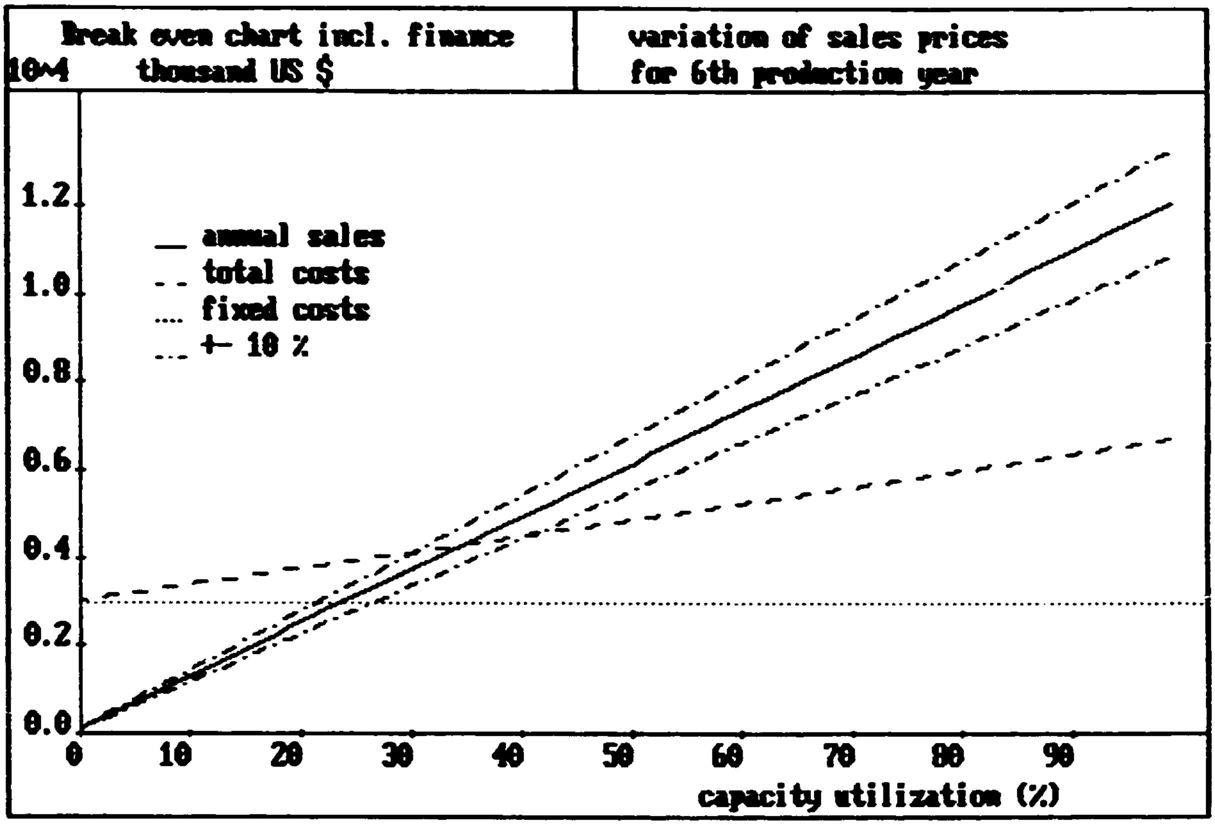
amounts in thousand US $	BASIC	G Investment + 10 %	H Investment - 10 %	I existing site	J double gob 90 t/day
YEARLY AVERAGE 15 YEARS					
PRODUCTION					
Raw material processed (t.)	16721.3	16721.3	16721.3	16721.3	19634.7
MAIN PRODUCTS					
Bottles (t.)	9024.2	9024.2	9024.2	9024.2	10598.4
Tablewares (t.)	3745.7	3745.7	3745.7	3745.7	4399.2
BY-PRODUCTS					
Variable costs	4234.8	4234.8	4234.8	4234.8	4784.0
Fixed costs	597.7	597.7	597.7	597.7	613.1
PRODUCTION COSTS	4832.5	4832.5	4832.5	4832.5	5397.0
Financial charges	485.8	532.2	436.9	438.5	509.0
Depreciation	1970.3	2165.6	1773.9	1858.1	1949.6
GROSS OPERATING COSTS	7288.5	7530.3	7043.3	7129.0	7855.7
Sales by-products	.0	.0	.0	.0	.0
NET OPERATING COSTS	7288.5	7530.3	7043.3	7129.0	7855.7
Sales Bottles	7219.4	7219.4	7219.4	7219.4	8478.7
Sales Tablewares	5993.2	5993.2	5993.2	5993.2	7038.7
SALES MAIN PRODUCTS	13212.6	13212.6	13212.6	13212.6	15517.4
GROSS PROFIT	5924.0	5682.3	6169.2	6083.5	7661.7
Tax on profit	2369.6	2272.9	2467.7	2433.4	3064.7
NET PROFIT	3554.4	3409.4	3701.5	3650.1	4597.0

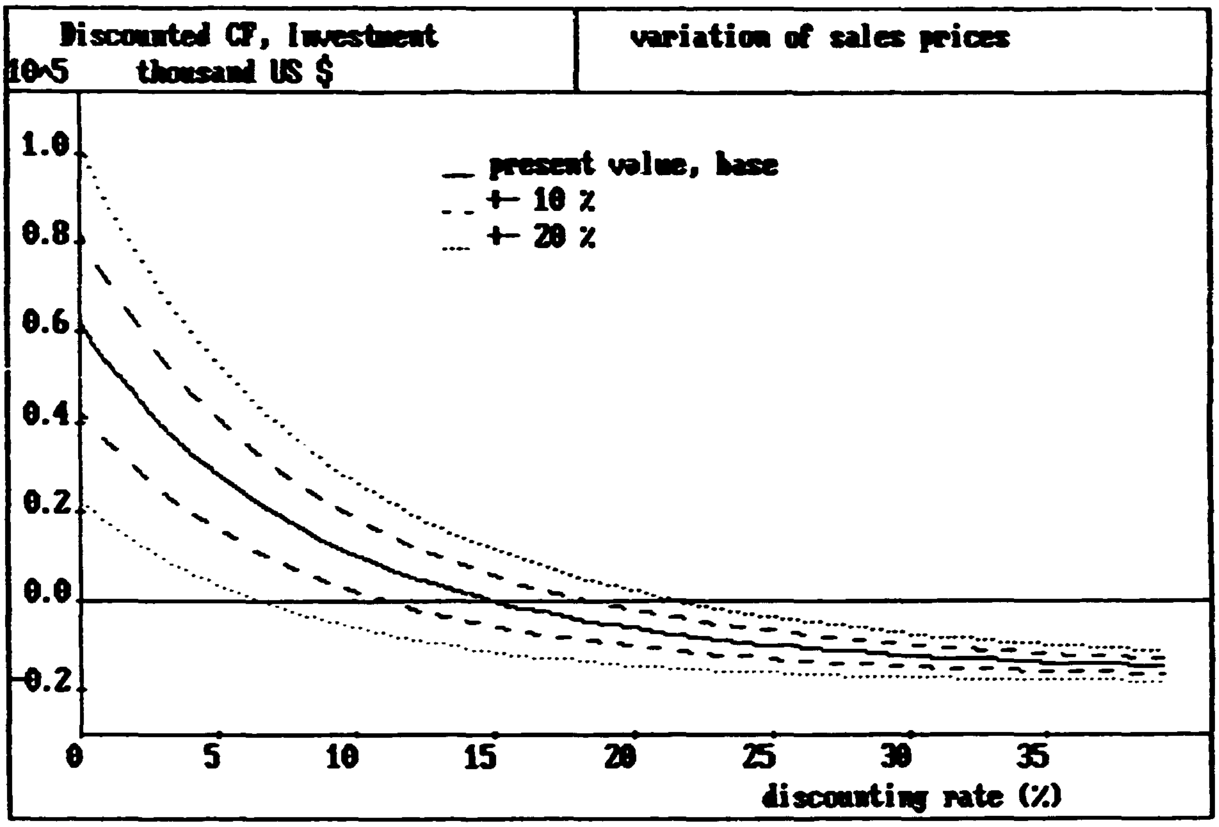
****
* PROFITABILITY ANALYSIS (continued 1) *
****

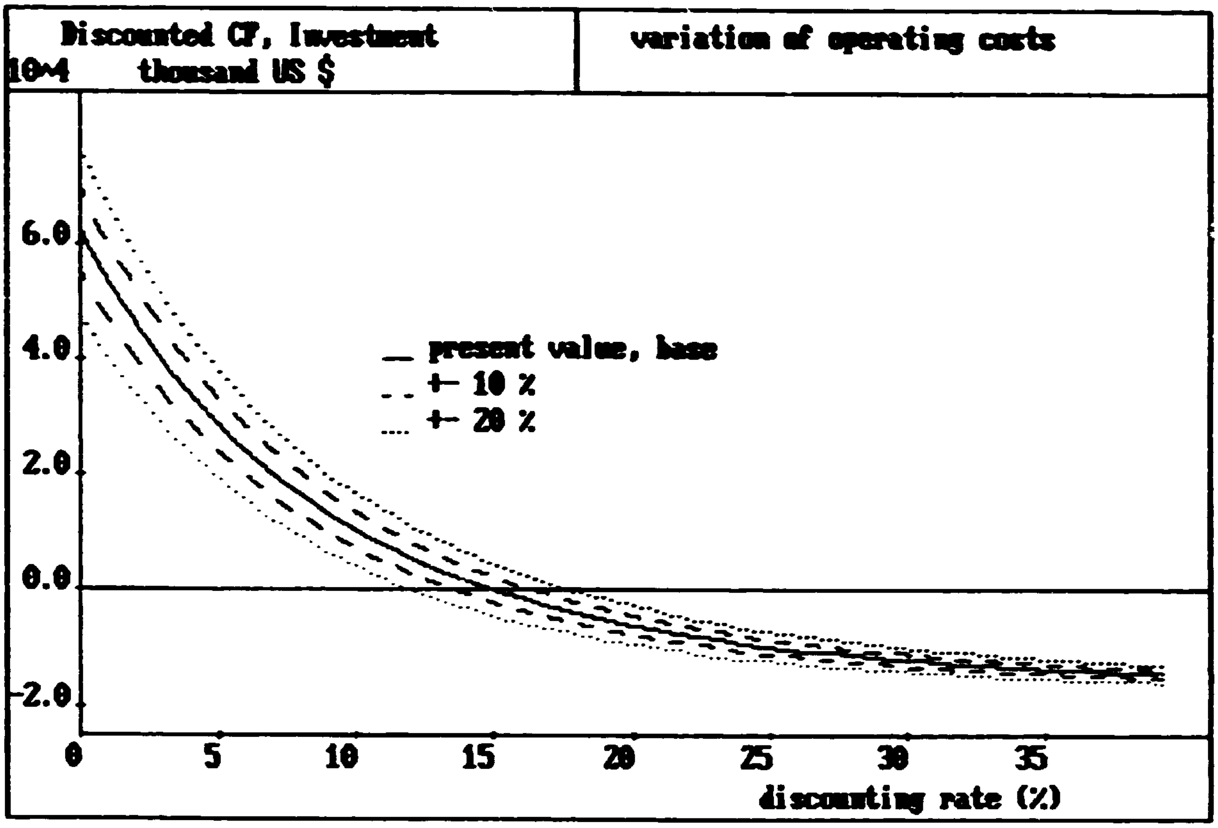
amounts in thousand US $	BASIC	A Sel.prices + 10 %	B Sel.prices - 10 %	C Sel.prices export -5%	D Prod.costs - 10 %	E Inter.rate - 1 %	F 5 years tax holid.
YEARLY AVERAGE 15 YEARS							
COST PRICE PER PROCESSED UNIT							
per t. of raw material							
without depreciation US $	318.1	318.1	318.1	318.1	289.0	314.1	318.1
with depreciation US $	435.9	435.9	435.9	435.9	406.8	431.2	435.9
COST PRICE PER PRODUCED UNIT							
per t. of main products							
without depreciation US $	416.5	416.5	416.5	416.5	378.5	411.3	416.5
with depreciation US $	570.8	570.8	570.8	570.8	532.6	564.6	570.8
NET SELLING PRICE US $	1034.7	1138.1	931.2	1025.7	1034.7	1034.7	1034.7
MARGIN US $	463.9	567.4	360.4	454.9	502.0	470.1	463.9
MARGIN / SELLING PRICE %	44.8	49.9	38.7	44.4	48.5	45.4	44.8
SIMPLE RATES OF RETURN							
NET PROFIT / NET SALES REVENUE							
100 % capacity (50 t/day) %	7.5	12.3	1.7	7.1	10.3	8.8	12.6
200 % capacity (90 t/day) %	26.9	29.9	23.2	26.6	29.1	27.3	28.0
NET PROFIT / EQUITY							
100 % capacity (50 t/day) %	6.5	11.7	1.3	6.1	8.9	7.6	10.9
200 % capacity (90 t/day) %	36.8	45.0	28.6	36.1	39.9	37.3	38.3
NET PROFIT / INVESTMENT							
100 % capacity (50 t/day) %	2.2	3.9	.4	2.0	3.0	2.5	3.6
200 % capacity (90 t/day) %	12.0	14.7	9.4	11.8	13.1	12.3	12.5
BREAK-EVEN POINT							
100 % capacity (50 t/day) %	80.1	69.1	95.2	81.2	74.2	76.8	80.1
200 % capacity (90 t/day) %	34.0	29.7	39.9	34.5	31.8	33.1	34.0
INTERNAL RATES OF RETURN							
Economic (for entrepreneur)							
prior to tax %	19.4	22.2	16.2	19.1	20.7	19.4	19.3
after tax %	15.1	17.1	12.6	14.8	16.1	15.0	15.6
Financial prior to tax %	21.2	26.1	16.4	20.7	23.7	22.0	21.6
Financial after tax %	15.4	19.4	11.3	14.8	17.5	16.0	16.7
PAY-BACK PERIOD	6 years 3 month	5 years 9 months	6 years 11 months	6 years 3 months	6 years 0 months	6 years 3 months	5 years 10 months

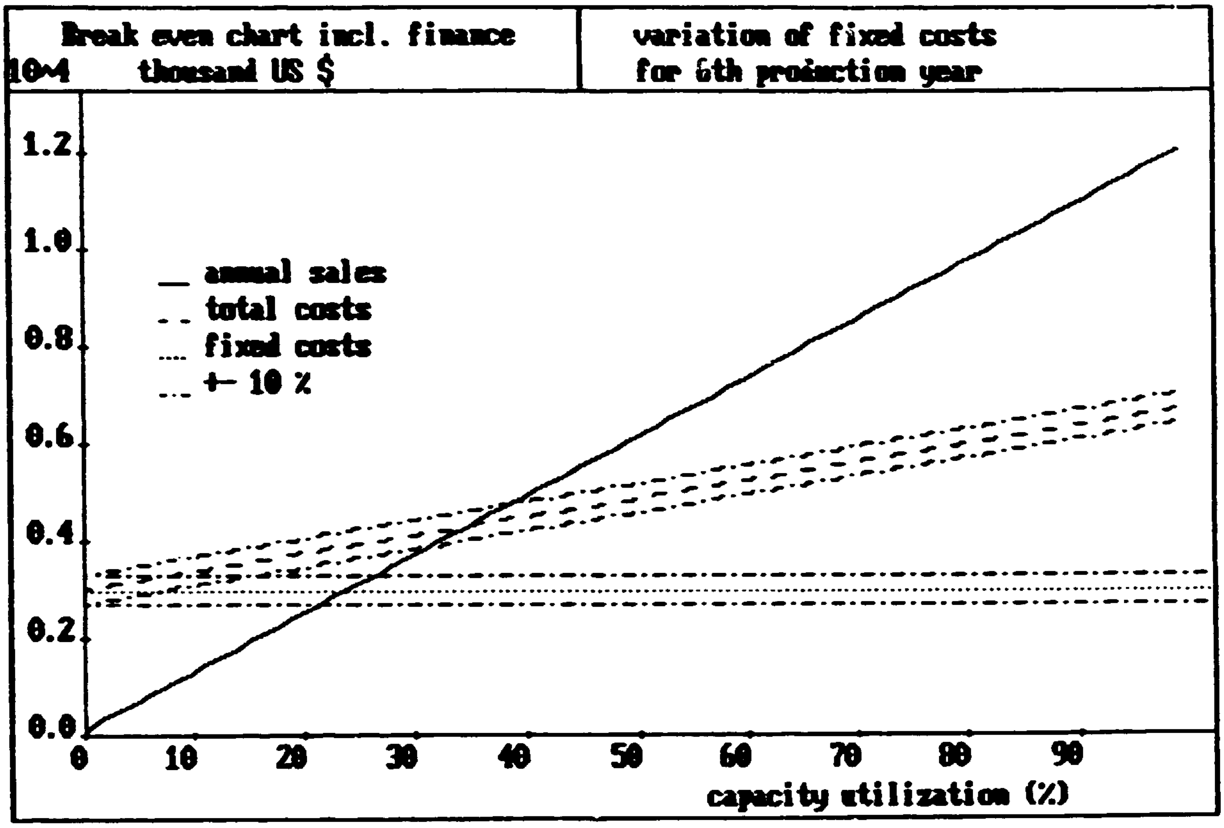
##
* PROFITABILITY ANALYSIS (continued 1) *
##

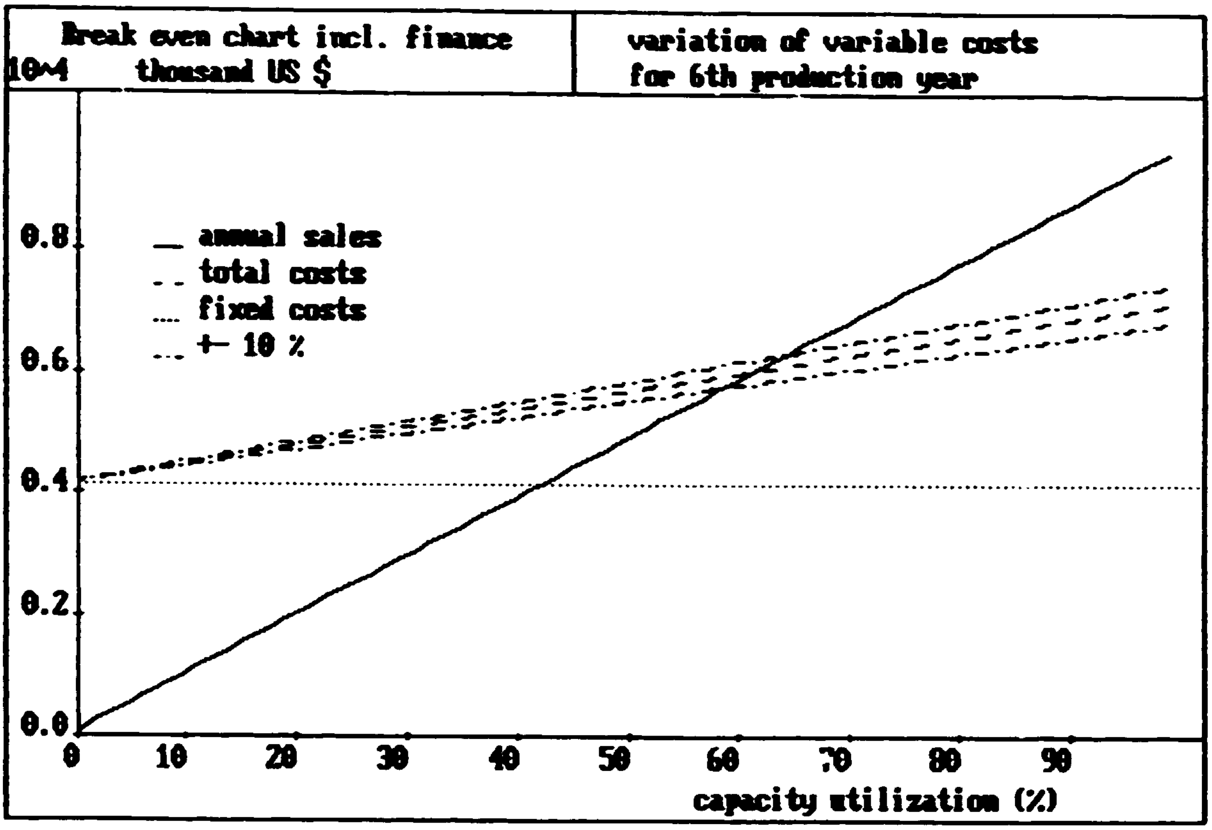
amounts in thousand US $		BASIC	G Investment + 10 %	H Investment - 10 %	I existing site	J double gob 90 t/day
YEARLY AVERAGE 15 YEARS						
COST PRICE PER PROCESSED UNIT						
per t. of raw material						
without depreciation	US $	318.1	320.8	315.1	315.2	300.8
with depreciation	US $	435.9	450.3	421.2	426.3	400.1
COST PRICE PER PRODUCED UNIT						
per t. of main products						
without depreciation	US $	416.5	420.1	412.6	412.8	393.8
with depreciation	US $	570.8	589.7	551.6	558.3	523.8
NET SELLING PRICE	US $	1034.7	1034.7	1034.7	1034.7	1034.7
MARGIN	US $	463.9	445.0	483.1	476.4	510.9
MARGIN / SELLING PRICE	%	44.8	43.0	46.7	46.0	49.4
SIMPLE RATES OF RETURN						
NET PROFIT / NET SALES REVENUE						
100 % capacity (50 t/day)	%	7.5	5.1	10.1	9.3	19.8
200 % capacity (90 t/day)	%	26.9	25.8	28.0	27.6	29.6
NET PROFIT / EQUITY						
100 % capacity (50 t/day)	%	6.5	4.0	9.6	8.8	25.8
200 % capacity (90 t/day)	%	36.8	32.1	42.3	41.5	45.2
NET PROFIT / INVESTMENT						
100 % capacity (50 t/day)	%	2.2	1.3	3.2	2.9	8.6
200 % capacity (90 t/day)	%	12.0	10.6	13.8	13.6	14.9
BREAK-EVEN POINT						
100 % capacity (50 t/day)	%	80.1	86.5	73.5	75.5	51.1
200 % capacity (90 t/day)	%	34.0	36.7	31.3	32.2	28.6
INTERNAL RATES OF RETURN						
Economic (for entrepreneur)						
prior to tax	%	19.4	17.8	21.2	21.1	26.4
after tax	%	15.1	13.9	16.5	16.4	19.9
Financial prior to tax	%	21.2	18.9	24.2	23.9	33.6
Financial after tax	%	15.4	13.5	17.9	17.7	24.6
PAY-BACK PERIOD		6 years 3 month	6 years 7 months	5 years 11 months	5 years 10 months	4 years 6 months

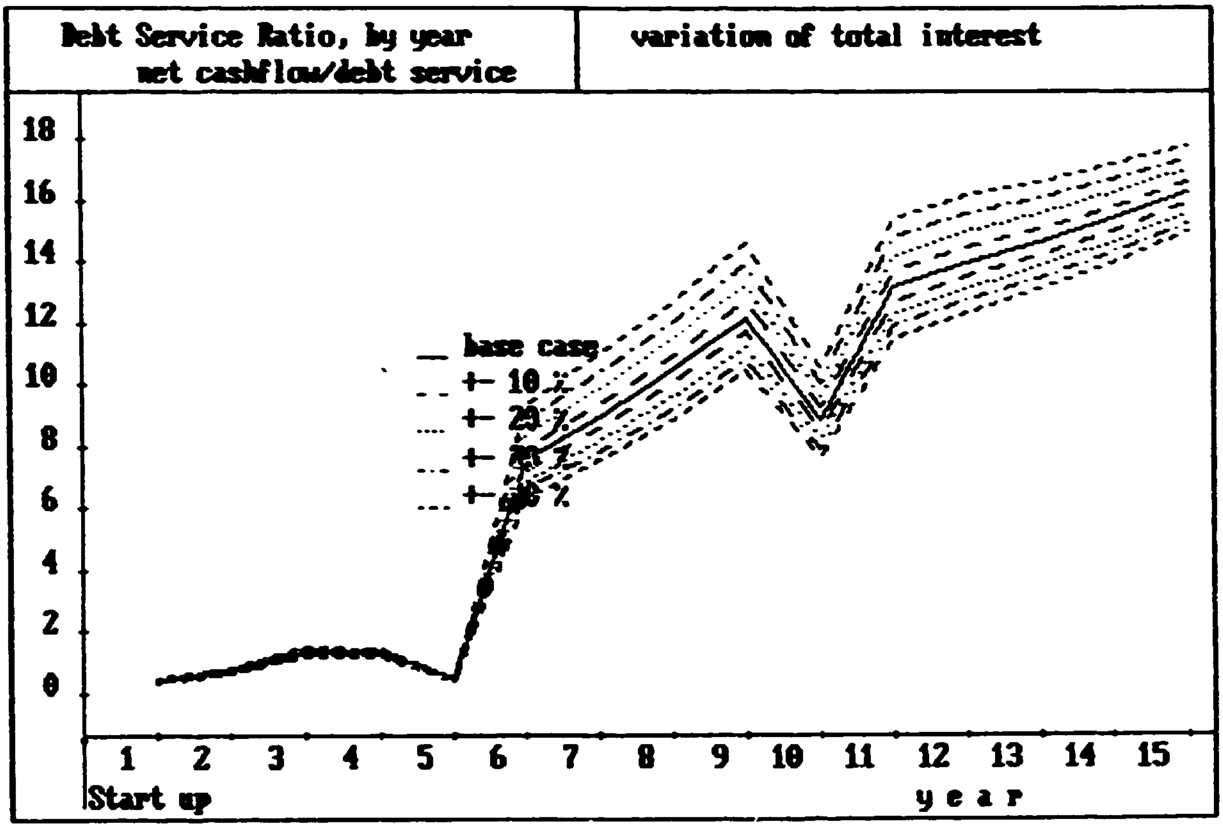

Break even chart incl. finance
10^4 thousand US $
variation of sales prices
for 6th production year
1.2
1.0
0.8
0.6
0.4
0.2
0.0
annual sales
total costs
fixed costs
+- 10 %
0
10
20
30
40
50
60
70
80
90
capacity utilization (%)

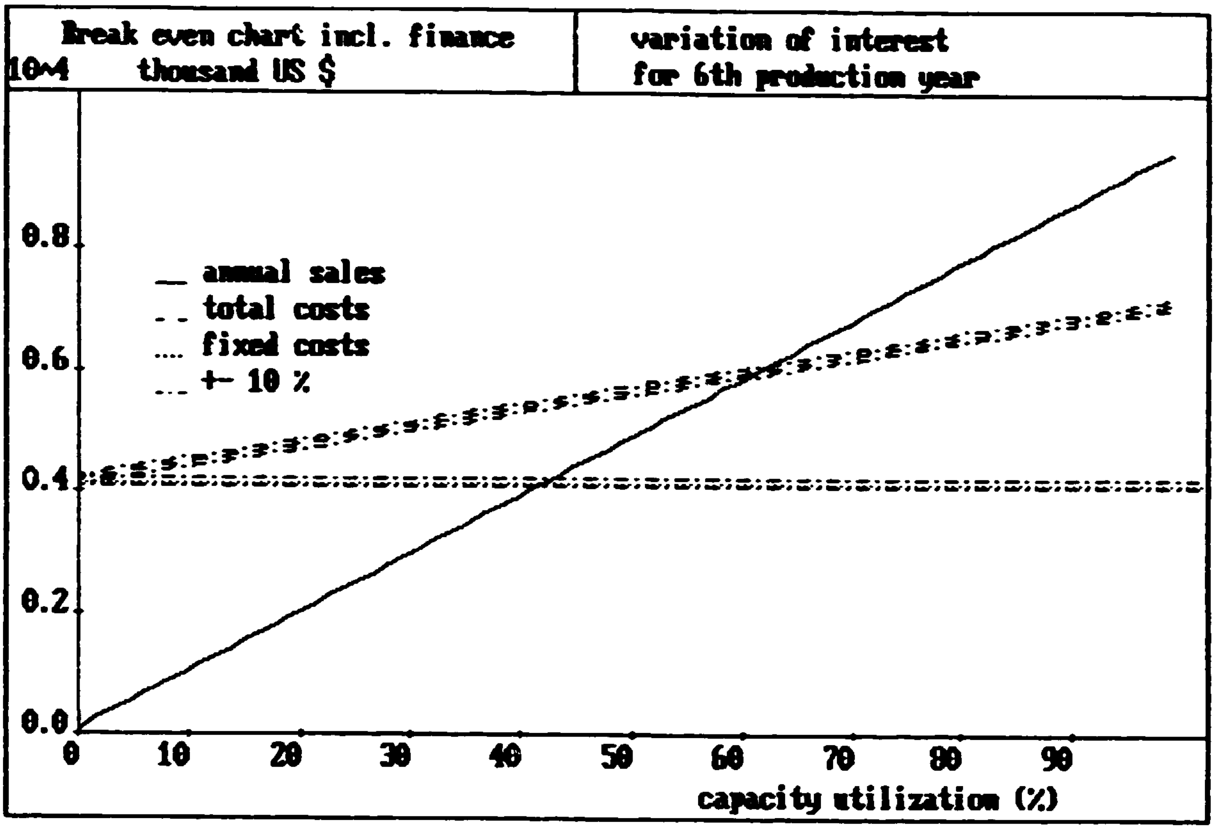

Discounted CF, Investment
10^5 thousand US $
variation of sales prices
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
present value, base
+- 10 %
+- 20 %
0
5
10
15
20
25
30
35
discounting rate (%)


Discounted CF, Investment
10^4 thousand US $
variation of operating costs
6.0
4.0
2.0
0.0
-2.0
0
5
10
15
20
25
30
35
discounting rate (%)
present value, base
+- 10 %
+- 20 %

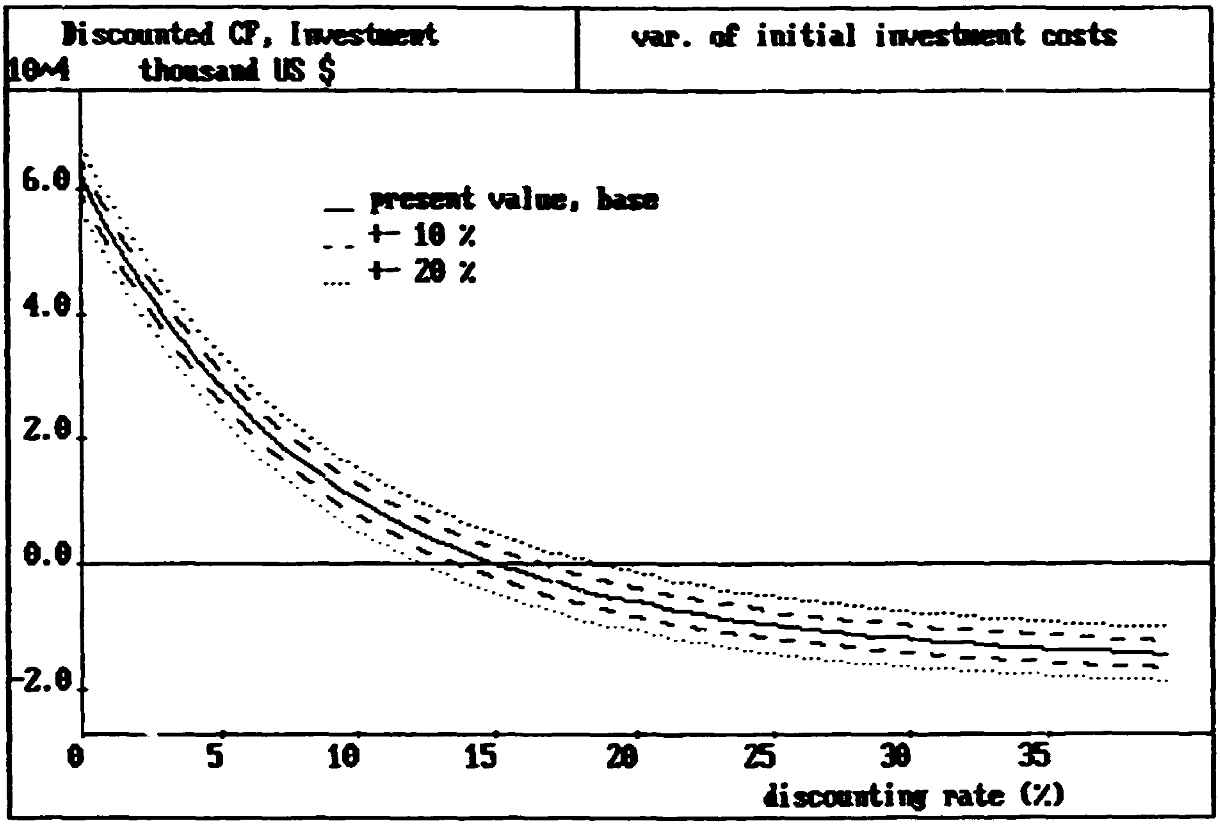

Break even chart incl. finance
10^4 thousand US $
variation of fixed costs
for 6th production year
1.2
1.0
0.8
0.6
0.4
0.2
0.0
annual sales
total costs
fixed costs
+- 10 %
0
10
20
30
40
50
60
70
80
90
capacity utilization (%)


Break even chart incl. finance
10^4 thousand US $
variation of variable costs
for 6th production year
annual sales
total costs
fixed costs
+- 10 %
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
80
90
capacity utilization (%)


Debt Service Ratio, by year
net cashflow/debt service
variation of total interest
18
16
14
12
10
8
6
4
2
0
base case
+- 10 %
+- 20 %
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Start up
year


Break even chart incl. finance
10^4 thousand US $
variation of interest
for 6th production year
0.8
0.6
0.4
0.2
0.0
__ annual sales
_ _ total costs
.... fixed costs
_._ +- 10 %
0
10
20
30
40
50
60
70
80
90
capacity utilization (%)

COMFAR 2.1 UNIDO



APPENDIX II.

SENSITIVITY ANALYSIS

DETAILED TABLES of the ALTERNATIVE J
"DOUBLE GOB" FROM START UP.

****
* PRODUCTION PROGRAMME *
****

Net quantities	1	2	3	4	5	6	7
Nominal capacity (tons/day)	90.0	90.0	90.0	90.0	90.0	90.0	90.0
% utilization (%)	60.0	70.0	75.0	80.0	80.0	80.0	80.0
Used capacity (tons/day)	54.0	63.0	67.5	72.0	72.0	72.0	72.0
Bottles (t.)	6178.8	8073.7	9688.4	11574.4	9645.3	11574.4	11574.4
Tablewares (t.)	2564.7	3351.2	4021.5	4804.3	4003.6	4804.3	4804.3
TOTAL	8743.5	11424.9	13709.9	16378.7	13648.9	16378.7	16378.7

	8	avg. 15 y.
Nominal capacity (tons/day)	90.0	90.0
% utilization (%)	80.0	77.7
Used capacity (tons/day)	72.0	69.9
Bottles (t.)	11574.4	10598.4
Tablewares (t.)	4804.3	4399.2
TOTAL	16378.7	14997.5

****

* PRODUCTION PROGRAMME *
* LOCAL MARKET *

****

Net quantities		1	2	3	4	5	6	7
Bottles	(t.)	6178.8	8073.7	9688.4	11574.4	9645.3	11574.4	11574.4
Tablewares	(t.)	1582.4	2067.7	2481.2	2964.3	2470.2	2964.3	2964.3
TOTAL		7761.3	10141.4	12169.7	14538.7	12115.5	14538.7	14538.7

		8	avg. 15 y.
Bottles	(t.)	11574.4	10598.4
Tablewares	(t.)	2964.3	2714.3
TOTAL		14538.7	13312.7

****

* PRODUCTION PROGRAMME *
* EXPORT MARKET *

****

Net quantities		1	2	3	4	5	6	7
Bottles	(t.)	.0	.0	.0	.0	.0	.0	.0
Tablewares	(t.)	982.3	1283.5	1540.2	1840.0	1533.4	1840.0	[illegible]
TOTAL		982.3	1283.5	1540.2	1840.0	1533.4	1840.0	1840.0

		8	avg. 15 y.
Bottles	(t.)	.0	.0
Tablewares	(t.)	1840.0	1684.9
TOTAL		1840.0	1684.9

****
* WORKING CAPITAL *
****

amounts in thousand US $	1	2	3	4	5	6	7	8
Accounts receivable	366.5	401.8	430.0	481.5	414.8	461.1	468.6	472.4
Raw materials	282.8	341.0	409.2	488.9	407.4	488.9	488.9	488.9
Consumables	238.7	268.1	284.2	350.3	305.8	350.3	350.3	350.3
Spare parts	632.2	632.2	632.2	632.2	632.2	632.2	632.2	632.2
Fuel and l.p.g.	15.4	19.4	22.1	25.2	21.1	21.3	23.3	24.2
Work in progress	24.4	26.8	28.7	32.1	27.7	30.7	31.2	31.5
Finished products	256.6	281.2	301.0	337.1	290.4	322.8	328.0	330.7
Cash in hand	118.7	105.6	92.3	79.6	72.6	74.3	74.2	74.3
CURRENT ASSETS	1935.3	2076.1	2199.8	2426.9	2171.9	2381.6	2396.7	2404.6
Accounts payable	327.4	362.6	390.9	442.4	380.8	427.0	434.5	438.3
WORKING CAPITAL	1607.9	1713.5	1808.9	1984.6	1791.1	1954.6	1962.2	1966.2
VARIATION	1607.9	105.6	95.4	175.7	-193.4	163.4	7.6	4.0

****
* WORKING CAPITAL (IN LOCAL CURRENCY) *
****

amounts in thousand US $	1	2	3	4	5	6	7
Accounts receivable	122.1	144.7	162.0	182.6	163.0	170.2	177.7
Raw materials	40.0	48.2	57.9	69.1	57.6	69.1	69.1
Consumables	5.7	6.4	6.7	8.3	8.3	8.3	8.3
Spare parts	.0	.0	.0	.0	.0	.0	.0
Fuel and l.p.g.	15.4	19.4	22.1	25.2	21.1	21.3	23.3
Work in progress	8.1	9.6	10.8	12.2	10.9	11.3	11.8
Finished products	85.5	101.3	113.4	127.8	114.1	119.2	124.4
Cash in hand	32.9	33.4	33.8	34.6	36.5	37.3	37.2
CURRENT ASSETS	309.6	363.1	406.7	459.8	411.3	436.7	452.[illegible]
Accounts payable	94.6	117.2	134.5	155.1	132.6	139.9	147.4
WORKING CAPITAL	215.0	245.8	272.2	304.7	278.7	296.8	304.6
VARIATION	215.0	30.8	26.4	32.5	-26.0	18.1	7.7

	8
Accounts receivable	181.5
Raw materials	69.1
Consumables	8.3
Spare parts	.0
Fuel and l.p.g.	24.2
Work in progress	12.1
Finished products	127.1
Cash in hand	37.3
CURRENT ASSETS	459.7
Accounts payable	151.2
WORKING CAPITAL	308.5
VARIATION	3.9

* WORKING CAPITAL (IN FOREIGN CURRENCY) *

amounts in thousand US $	1	2	3	4	5	6	7
Accounts receivable	244.5	257.0	268.0	299.0	251.9	290.9	290.8
Raw materials	242.8	292.8	351.4	419.8	349.8	419.8	419.8
Consumables	233.0	261.7	277.5	342.0	297.5	342.0	342.0
Spare parts	632.2	632.2	632.2	632.2	632.2	632.2	632.2
Fuel and l.p.g.	.0	.0	.0	.0	.0	.0	.0
Work in progress	16.3	17.1	17.9	19.9	16.8	19.4	19.4
Finished products	171.1	179.9	187.6	209.3	176.3	203.6	203.6
Cash in hand	85.8	72.2	58.4	45.0	36.1	37.0	36.9
CURRENT ASSETS	1625.7	1713.0	1793.0	1967.2	1760.6	1944.9	1944.7
Accounts payable	232.8	245.4	256.4	287.3	248.1	287.1	287.1
WORKING CAPITAL	1393.0	1467.7	1536.6	1679.9	1512.4	1657.7	1657.6
VARIATION	1393.0	74.7	69.0	143.2	-167.4	145.3	-.1

	8
Accounts receivable	290.9
Raw materials	419.8
Consumables	342.0
Spare parts	632.2
Fuel and l.p.g.	.0
Work in progress	19.4
Finished products	203.6
Cash in hand	37.0
CURRENT ASSETS	1944.9
Accounts payable	287.2
WORKING CAPITAL	1657.7
VARIATION	.1

****
* PRODUCTION COSTS SCHEDULE *
****

amounts in thousand US $	1	2	3	4	5	6	7
VARIABLE COSTS							
Raw materials	1211.0	1460.6	1752.6	2093.8	1744.7	2093.8	2093.8
Consumables	954.8	1072.3	1136.8	1401.3	1223.1	1401.3	1401.3
Utilities	807.9	1021.0	1164.1	1328.1	1139.2	1147.2	1238.0
Spare parts	.0	.0	.0	.0	.0	.0	.0
Manpower (direct)	399.1	399.1	399.1	399.1	338.5	338.5	338.5
TOTAL VARIABLE COSTS	3372.8	3953.0	4452.6	5222.3	4445.5	4980.9	5071.7
FIXED COSTS							
Manpower (indirect)	70.5	70.5	70.5	70.5	70.5	70.5	70.5
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	316.1	316.1	316.1	316.1	316.1	316.1	316.1
Insurance and overhead	128.1	140.4	150.3	168.3	145.0	165.0	163.8
Technical assistance	510.0	340.0	170.0	.0	.0	.0	.0
Land renting	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TOTAL FIXED COSTS	1025.7	868.0	707.9	555.9	532.6	552.6	551.4
T O T A L	4398.6	4821.1	5160.6	5778.3	4978.2	5533.5	5623.1

	8	avg. 15 y.
VARIABLE COSTS		
Raw materials	2093.8	1923.5
Consumables	1401.3	1308.2
Utilities	1282.8	1197.6
Spare parts	.0	.0
Manpower (direct)	338.5	354.7
TOTAL VARIABLE COSTS	5116.5	4784.0
FIXED COSTS		
Manpower (indirect)	70.5	70.5
Utilities	.0	.0
Spare parts	316.1	316.1
Insurance and overhead	165.1	157.4
Technical assistance	.0	68.0
Land renting	1.0	1.0
TOTAL FIXED COSTS	552.7	613.1
T O T A L	5669.2	5397.0

##
* PRODUCTION COSTS SCHEDULE (IN LOCAL CURRENCY) *
##

amounts in thousand US $	1	2	3	4	5	6	7
VARIABLE COSTS							
Raw materials	239.9	289.3	347.1	414.7	345.6	414.7	414.7
Consumables	22.7	25.5	27.0	33.3	33.3	33.3	33.3
Utilities	807.7	1021.0	1164.1	1328.1	1139.2	1147.2	1238.0
Spare parts	.0	.0	.0	.0	.0	.0	.0
Manpower (direct)	259.1	259.1	259.1	259.1	293.5	293.5	293.5
TOTAL VARIABLE COSTS	1329.5	1594.9	1797.3	2035.2	1811.6	1888.7	1979.5
FIXED COSTS							
Manpower (indirect)	70.5	70.5	70.5	70.5	70.5	70.5	70.5
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	.0	.0	.0	.0	.0	.0	.0
Insurance and overhead	64.0	70.2	75.2	84.2	72.5	82.5	81.9
Technical assistance	.0	.0	.0	.0	.0	.0	.0
Land renting	1.0	1.0	1.0	1.0	1.0	1.0	1.0
TOTAL FIXED COSTS	135.6	141.7	146.7	155.7	144.0	154.0	153.4
T O T A L	1465.1	1736.6	1944.0	2190.9	1955.6	2042.8	2132.9

	8	avg. 15 y.
VARIABLE COSTS		
Raw materials	414.7	381.0
Consumables	33.3	31.6
Utilities	1282.8	1197.6
Spare parts	.0	.0
Manpower (direct)	293.5	284.4
TOTAL VARIABLE COSTS	2024.3	1894.6
FIXED COSTS		
Manpower (indirect)	70.5	70.5
Utilities	.0	.0
Spare parts	.0	.0
Insurance and overhead	82.5	78.7
Technical assistance	.0	.0
Land renting	1.0	1.0
TOTAL FIXED COSTS	154.1	150.2
T O T A L	2178.4	2044.8

*** PRODUCTION COSTS SCHEDULE (IN FOREIGN CURRENCY) ***

amounts in thousand US $	1	2	3	4	5	6	7
VARIABLE COSTS							
Raw materials	971.2	1171.3	1405.5	1679.1	1399.1	1679.1	1679.1
Consumables	932.1	1046.8	1109.8	1368.0	1189.8	1368.0	1368.0
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	.0	.0	.0	.0	.0	.0	.0
Manpower (direct)	140.0	140.0	140.0	140.0	45.0	45.0	45.0
TOTAL VARIABLE COSTS	2043.3	2358.2	2655.3	3187.2	2634.0	3092.2	3092.2
FIXED COSTS							
Manpower (indirect)	.0	.0	.0	.0	.0	.0	.0
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	316.1	316.1	316.1	316.1	316.1	316.1	316.[illegible]
Insurance and overhead	64.0	70.2	75.2	84.2	72.5	82.5	81.[illegible]
Technical assistance	510.0	340.0	170.0	.0	.0	.0	.0
Land renting	.0	.0	.0	.0	.0	.0	.0
TOTAL FIXED COSTS	890.1	726.3	561.2	400.2	388.6	398.6	398.0
T O T A L	2933.4	3084.5	3216.6	3587.4	3022.6	3490.8	3490.2

	8	avg. 15 y.
VARIABLE COSTS		
Raw materials	1679.1	1542.5
Consumables	1368.0	1276.6
Utilities	.0	.0
Spare parts	.0	.0
Manpower (direct)	45.0	70.3
TOTAL VARIABLE COSTS	3092.2	2889.4
FIXED COSTS		
Manpower (indirect)	.0	.0
Utilities	.0	.0
Spare parts	316.1	316.1
Insurance and overhead	82.5	78.7
Technical assistance	.0	68.0
Land renting	.0	.0
TOTAL FIXED COSTS	398.6	462.8
T O T A L	3490.8	3352.2

* TURNOVER *

amounts in thousand US $	1	2	3	4	5	6	7	8	9	10
Bottles	4943.1	6458.9	7750.7	9259.5	7716.2	9259.5	9259.5	9259.5	9259.5	7716.2
Tablewares	4103.5	5362.0	6434.4	7686.9	6405.8	7686.9	7686.9	7686.9	7686.9	6405.8
GROSS SALES REVENUE	9046.6	11820.9	14185.1	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4	14122.0
TAXES	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
NET SALES REVENUE										
in local currency	7474.9	9767.3	11720.7	14002.3	11668.6	14002.3	14002.3	14002.3	14002.3	11668.6
in foreign currency	1571.7	2053.6	2464.4	2944.1	2453.4	2944.1	2944.1	2944.1	2944.1	2453.4
NET TOTAL	9046.6	11820.9	14185.1	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4	14122.0
Bottles	4943.1	6458.9	7750.7	9259.5	7716.2	9259.5	9259.5	9259.5	9259.5	7716.2
Tablewares	4103.5	5362.0	6434.4	7686.9	6405.8	7686.9	7686.9	7686.9	7686.9	6405.8
Total main products	9046.6	11820.9	14185.1	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4	14122.0
Total by-products	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0

amounts in thousand US $	11	12	13	14	15
Bottles	9259.5	9259.5	9259.5	9259.5	9259.5
Tablewares	7686.9	7686.9	7686.9	7686.9	7686.9
GROSS SALES REVENUE	16946.4	16946.4	16946.4	16946.4	16946.4
TAXES	.0	.0	.0	.0	.0
NET SALES REVENUE					
in local currency	14002.3	14002.3	14002.3	14002.3	14002.3
in foreign currency	2944.1	2944.1	2944.1	2944.1	2944.1
NET TOTAL	16946.4	16946.4	16946.4	16946.4	16946.4
Bottles	9259.5	9259.5	9259.5	9259.5	9259.5
Tablewares	7686.9	7686.9	7686.9	7686.9	7686.9
Total main products	16946.4	16946.4	16946.4	16946.4	16946.4
Total by-products	.0	.0	.0	.0	.0

##
* P R O F I T A B I L I T Y   S C H E D U L E *
##

amounts in thousand US $		1	2	3	4	5	6	7	8	9	10
Gross sales revenue		9046.6	11820.9	14185.1	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4	14122.0
Taxes and duties		.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
NET SALES REVENUE		9046.6	11820.9	14185.1	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4	14122.0
Production costs		4398.6	4821.1	5160.6	5778.3	4978.2	5533.5	5623.1	5669.2	5669.2	4978.2
GROSS PRODUCTION MARGIN		4648.0	6999.8	9024.5	11168.1	9143.8	11412.9	11323.3	11277.2	11277.2	9143.8
Financial charges		1671.4	1341.9	1012.4	788.1	543.0	352.3	324.6	296.9	269.3	241.7
CASH FLOW		2976.6	5657.9	8012.1	10380.0	8600.8	11060.6	10998.7	10980.3	11007.9	8902.1
Depreciation		2755.2	2755.2	2755.2	2755.2	2755.2	1546.8	1546.8	1546.8	1546.8	1546.8
GROSS PROFIT		221.4	2902.7	5256.9	7624.8	5845.6	9513.8	9452.0	9433.5	9461.1	[illegible]
Tax on profit		88.6	1161.1	2102.8	3049.9	2338.3	3805.5	3780.8	3773.4	3784.5	[illegible]
NET PROFIT		132.9	1741.6	3154.2	4574.9	3507.4	5708.3	5671.2	5660.1	5676.7	4413.2
ACCUMULATED GROSS PROFIT		221.4	3124.2	8381.1	16005.9	21851.6	31365.4	40817.3	50250.9	59712.0	67067.4
ACCUMULATED NET PROFIT		132.9	1874.5	5028.7	9603.5	13110.9	18819.2	24490.4	30150.5	35827.2	40240.4
Return on sales (gross)	%	2.4	24.6	37.1	45.0	41.4	56.1	55.8	55.7	55.8	52.1
Return on sales (net)	%	1.5	14.7	22.2	27.0	24.8	33.7	33.5	33.4	33.5	31.3
Return on equity	%	1.3	17.1	31.0	45.0	34.5	56.2	55.8	55.7	55.9	43.4
Return on investment	%	.4	5.7	10.3	14.8	11.4	18.5	18.4	18.4	18.4	14.4
R.O.S (gross) - average	%	2.4	15.0	23.9	30.8	33.0	37.8	40.8	43.0	44.6	45.3
R.O.S (net) - average	%	1.5	9.0	14.3	18.5	19.8	22.7	24.5	25.8	26.8	27.2
Ret. on equity - average	%	1.3	9.2	16.5	23.6	25.8	30.9	34.4	37.1	39.2	39.6
Ret. on invest.- average	%	.4	3.1	5.5	7.8	8.6	10.2	11.4	12.2	12.9	13.1
Break-even point	%	96.1	63.2	46.0	35.0	39.6	20.5	20.5	20.3	20.1	24.0

amounts in thousand US $		11	12	13	14	15
Gross sales revenue		16946.4	16946.4	16946.4	16946.4	16946.4
Taxes and duties		.0	.0	.0	.0	.0
NET SALES REVENUE		16946.4	16946.4	16946.4	16946.4	16946.4
Production costs		5669.2	5669.2	5669.2	5669.2	5669.2
GROSS PRODUCTION MARGIN		11277.2	11277.2	11277.2	11277.2	11277.2
Financial charges		214.1	186.5	158.8	131.1	103.5
CASH FLOW		11063.1	11090.7	11118.4	11146.1	11173.7
Depreciation		1546.8	1546.8	1546.8	1546.8	1546.8
GROSS PROFIT		9516.3	9543.9	9571.6	9599.3	9626.9
Tax on profit		3806.5	3817.6	3828.7	3839.7	3850.8
NET PROFIT		5709.8	5726.4	5743.0	5759.6	5776.2
ACCUMULATED GROSS PROFIT		76583.8	86127.7	95699.3	105298.7	114925.6
ACCUMULATED NET PROFIT		45950.3	51676.6	57419.6	63179.2	68955.4
Return on sales (gross)	%	56.2	56.3	56.5	56.6	56.8
Return on sales (net)	%	33.7	33.8	33.9	34.0	34.1
Return on equity	%	56.2	56.4	56.5	56.7	56.9
Return on investment	%	18.5	18.6	18.6	18.7	18.7
R.O.S (gross) - average	%	46.4	47.3	48.1	48.8	49.4
R.O.S (net) - average	%	27.9	28.4	28.9	29.3	29.6
Ret. on equity - average	%	41.1	42.4	43.5	44.4	45.2
Ret. on invest.- average	%	13.6	14.0	14.3	14.6	14.9
Break-even point	%	19.6	19.4	19.1	18.9	18.7

##
* PRODUCTION COSTS AND COST PRICE STRUCTURE *
* AVERAGE 15 PRODUCTION YEARS *
##

	.000 US $ per year	%	%	US $ per t. of raw mater. 19635 t.	US $ per t. of MAIN PROD. 14998 t.	US $ per t. of Bottles 10598 t.	US $ per t. of Tablewares 4399 t.
Raw materials	1923.5	24.5	35.6	98.0	128.3	99.2	198.3
Consumables	1308.2	16.7	24.2	66.6	87.2	67.4	134.9
Utilities	1197.6	15.2	22.2	61.0	79.9	61.7	123.5
Spare parts	.0	.0	.0	.0	.0	.0	.0
Manpower (direct)	354.7	4.5	6.6	18.1	23.7	18.3	36.6
VARIABLE COSTS	4784.0	60.9	88.6	243.6	319.0	246.6	493.3
Manpower (indirect)	70.5	.9	1.3	3.6	4.7	3.6	7.3
Utilities	.0	.0	.0	.0	.0	.0	.0
Spare parts	316.1	4.0	5.9	16.1	21.1	16.3	32.6
Insurance and overhead	157.4	2.0	2.9	8.0	10.5	8.1	16.2
Technical assistance	68.0	.9	1.3	3.5	4.5	3.5	7.0
Land renting	1.0	.0	.0	.0	.1	.1	.1
PRODUCTION FIXED COSTS	613.1	7.8	11.4	31.2	40.9	31.6	63.2
TOTAL PRODUCTION COSTS	5397.0	68.7	100.0	274.9	359.9	278.2	556.5
Financial charges	509.0	6.5	9.4	25.9	33.9	26.2	52.5
Depreciation	1949.6	24.8	36.1	99.3	130.0	100.5	201.0
TOTAL FIXED COSTS	3071.7	39.1	56.9	156.4	204.8	158.4	316.7
GROSS OPERATING COSTS	7855.7	100.0	145.6	400.1	523.8	405.0	810.0
Sales by-products	.0	.0	.0	.0	.0	.0	.0
NET OPERATING COSTS	7855.7	100.0	145.6	400.1	523.8	405.0	810.0
Selling price	15517.4	197.5	287.5	790.3	1034.7	800.0	1600.0
Margin	7661.7	97.5	142.0	390.2	510.9	395.0	790.0
Margin in % selling price %	49.4	49.4	49.4	49.4	49.4	49.4	49.4

****
* COST PRICE EVOLUTION *
****

US $	1	2	3	4	5	6	7	8	9	10
YEARLY EVOLUTION										
cost price per										
t. of Sand										
without depreciation	491.0	413.3	345.0	307.2	310.0	275.4	278.3	279.1	277.8	293.1
with depreciation	713.9	598.1	499.0	436.1	464.7	347.7	350.6	351.5	350.2	379.9
cost price per										
t. of main product										
without depreciation	694.2	539.4	450.3	400.9	404.5	359.4	363.1	364.3	362.6	382.4
with depreciation	1009.3	780.6	651.2	569.1	606.4	453.8	457.6	458.7	457.0	495.8
AVERAGE EVOLUTION										
cost price per										
t. of Sand										
without depreciation	491.0	448.6	407.5	375.3	361.5	344.1	333.0	325.3	319.3	316.8
without depreciation	713.9	650.6	590.6	541.0	524.8	489.0	465.8	449.3	436.8	431.4
cost price per										
t. of main product										
without depreciation	694.2	606.5	543.3	496.9	477.2	453.1	437.9	427.2	419.0	415.5
without depreciation	1009.3	879.8	787.3	716.2	692.7	644.0	612.4	590.1	573.3	565.9

US $	11	12	13	14	15
YEARLY EVOLUTION					
cost price per					
t. of Sand					
without depreciation	275.3	274.0	272.7	271.4	270.1
with depreciation	347.6	346.3	345.0	343.7	342.5
cost price per					
t. of main product					
without depreciation	359.2	357.5	355.8	354.1	352.5
with depreciation	453.6	452.0	450.3	448.6	446.9
AVERAGE EVOLUTION					
cost price per					
t. of Sand					
without depreciation	312.6	309.0	305.9	303.2	300.8
without depreciation	422.9	415.8	409.8	404.6	400.1
cost price per					
t. of main product					
without depreciation	409.8	404.9	400.7	397.1	393.8
without depreciation	554.4	544.8	536.8	529.8	523.8

*** CASH FLOW SCHEDULE FOR PROFITABILITY ANALYSIS: ECONOMIC FOR ENTREPRENEUR ***

amounts in thousand US $	-2	-1	1	2	3	4	5	6
INFLOWS								
Net sales revenue	.0	.0	9046.6	11820.9	14185.1	16946.4	14122.0	16946.4
OUTFLOWS								
Investment outlay (1)	8852.3	18488.9	1607.9	105.6	95.4	175.7	1112.6	163.4
Production costs	.0	.0	4398.6	4821.1	5160.6	5778.3	4978.2	5533.5
TOTAL OUTFLOWS	8852.3	18488.9	6006.5	4926.6	5255.9	5954.0	6090.7	5696.9
GROSS CASH FLOW	-8852.3	-18488.9	3040.1	6894.3	8929.2	10992.4	8031.3	11249.5
Tax on profit	.0	.0	88.6	1161.1	2102.8	3049.9	2338.3	3805.5
NET CASH FLOW	-8852.3	-18488.9	2951.5	5733.2	6826.4	7942.5	5693.0	7443.9
Gross present value at i.r.r.	-8852.3	-14625.2	1902.3	3412.4	3496.0	3404.5	1967.6	2180.1
Net present value at i.r.r.	-8852.3	-15420.1	2053.1	3326.0	3302.9	3205.1	1916.0	2089.5
ACCUMULATED GROSS CASH FLOW	-8852.3	-27341.3	-24301.2	-17406.9	-8477.7	2514.7	10546.0	21795.4
ACCUMULATED NET CASH FLOW	-8852.3	-27341.3	-24389.7	-18656.5	-11830.2	-3887.7	1805.3	9249.3

amounts in thousand US $	7	8	9	10	11	12	13	14
INFLOWS								
Net sales revenue	16946.4	16946.4	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4
OUTFLOWS								
Investment outlay (1)	7.6	4.0	.0	1130.9	175.1	.0	.0	.0
Production costs	5623.1	5669.2	5669.2	4978.2	5669.2	5669.2	5669.2	5669.2
TOTAL OUTFLOWS	5630.7	5673.2	5669.2	6109.1	5844.3	5669.2	5669.2	5669.2
GROSS CASH FLOW	11315.7	11273.2	11277.2	8012.9	11102.1	11277.2	11277.2	11277.2
Tax on profit	3780.8	3773.4	3784.5	2942.2	3806.5	3817.6	3828.7	3839.7
NET CASH FLOW	7534.9	7499.7	7492.7	5070.8	7295.6	7459.6	7448.5	7437.5
Gross present value at i.r.r.	1734.6	1367.0	1081.7	608.0	666.3	535.4	423.5	335.0
Net present value at i.r.r.	1764.0	1464.3	1220.1	688.7	826.4	704.7	586.9	488.7
ACCUMULATED GROSS CASH FLOW	33111.1	44384.3	55661.5	63674.4	74776.5	86053.7	97330.9	108608.2
ACCUMULATED NET CASH FLOW	16784.2	24283.9	31776.7	36847.4	44143.0	51602.7	59051.2	66488.7

amounts in thousand US $	15	Salv.val.	TOTAL
INFLOWS			
Net sales revenue	16946.4	.0	232760.6
OUTFLOWS			
Investment outlay (1)	.0	-4177.6	27741.9
Production costs	5669.2	.0	80955.7
TOTAL OUTFLOWS	5669.2	-4177.6	108697.7
GROSS CASH FLOW	11277.2	4177.6	124062.9
Tax on profit	3850.8	.0	45970.3
NET CASH FLOW	7426.4	4177.6	78092.7
Gross present value at i.r.r.	265.0	98.2	.0
Net present value at i.r.r.	407.0	229.0	.0
ACCUMULATED GROSS CASH FLOW	119885.4	124062.9	124062.9
ACCUMULATED NET CASH FLOW	73915.1	78092.7	78092.7

(1) without financial charges before start up.

INTERNAL RATE OF RETURN - ECONOMIC FOR ENTREPRENEUR PRIOR TO TAX : 26.42 %

INTERNAL RATE OF RETURN - ECONOMIC FOR ENTREPRENEUR AFTER TAX : 19.91 %

* CASH FLOW SCHEDULE FOR PROFITABILITY ANALYSIS: F I N A N C I A L *

amounts in thousand US $	-2	-1	1	2	3	4	5	6
INFLOWS								
Net sales revenue	.0	.0	9046.6	11820.9	14185.1	16946.4	14122.0	16946.4
OUTFLOWS								
Salvage value	.0	.0	.0	.0	.0	.0	.0	.0
Equity	10160.0	.0	.0	.0	.0	.0	.0	.0
Replacement	.0	.0	.0	.0	.0	.0	1306.0	.0
Debt service (1)	.0	.0	4291.4	5561.9	3632.4	3781.5	3536.4	725.7
Production costs	.0	.0	4398.6	4821.1	5160.6	5778.3	4978.2	5533.5
TOTAL OUTFLOWS	10160.0	.0	8690.0	10383.0	8793.0	9559.8	9820.6	6259.2
GROSS CASH FLOW	-10160.0	.0	356.6	1437.9	5392.1	7386.6	4301.4	10687.2
Tax on profit	.0	.0	88.6	1161.1	2102.8	3049.9	2338.3	3805.5
NET CASH FLOW	-10160.0	.0	268.1	276.8	3289.4	4336.7	1963.2	6881.7
Gross present value at i.r.r.	-10160.0	.0	199.9	603.3	1693.7	1737.0	757.2	1408.5
Net present value at i.r.r.	-10160.0	.0	172.7	143.2	1365.7	1445.3	525.2	1477.8
ACCUMULATED GROSS CASH FLOW	-10160.0	-10160.0	-9803.4	-8365.4	-2973.3	4413.3	8714.8	19401.9
ACCUMULATED NET CASH FLOW	-10160.0	-10160.0	-9891.9	-9615.1	-6325.7	-1989.0	-25.9	6855.8

amounts in thousand US $	7	8	9	10	11	12	13	14
INFLOWS								
Net sales revenue	16946.4	16946.4	16946.4	14122.0	16946.4	16946.4	16946.4	16946.4
OUTFLOWS								
Salvage value	.0	.0	.0	.0	.0	.0	.0	.0
Equity	.0	.0	.0	.0	.0	.0	.0	.0
Replacement	.0	.0	.0	1306.0	.0	.0	.0	.0
Debt service (1)	698.0	670.3	642.7	615.1	587.5	559.9	532.2	504.5
Production costs	5623.1	5669.2	5669.2	4978.2	5669.2	5669.2	5669.2	5669.2
TOTAL OUTFLOWS	6321.1	6339.5	6311.9	6899.3	6256.7	6229.1	6201.4	6173.7
GROSS CASH FLOW	10625.3	10606.9	10634.5	7222.7	10689.7	10717.3	10745.0	10772.7
Tax on profit	3780.8	3773.4	3784.5	2942.2	3806.5	3817.6	3828.7	3839.7
NET CASH FLOW	6844.5	6833.5	6850.0	4280.6	6883.2	6899.7	6916.3	6933.0
Gross present value at i.r.r.	1048.3	783.5	588.1	299.0	331.3	248.7	186.6	140.1
Net present value at i.r.r.	1179.9	945.6	760.9	381.7	492.6	396.4	319.0	256.7
ACCUMULATED GROSS CASH FLOW	30027.3	40634.2	51268.7	58491.4	69181.1	79898.4	90643.4	101416.1
ACCUMULATED NET CASH FLOW	13700.3	20533.8	27383.9	31664.5	38547.6	45447.4	52363.7	59296.7

amounts in thousand US $	15	Salv.val.	T O T A L
I N F L O W S			
Net sales revenue	16946.4	.0	232760.6
O U T F L O W S			
Salvage value	.0	-4177.6	-4177.6
Equity	.0	.0	10160.0
Replacement	.0	.0	2612.0
Debt service (1)	476.9	.0	26816.4
Production costs	5669.2	.0	80955.7
TOTAL OUTFLOWS	6146.1	-4177.6	116366.6
GROSS CASH FLOW	10800.3	4177.6	116394.0
Tax on profit	3850.8	.0	45970.3
NET CASH FLOW	6949.5	4177.6	70423.8
Gross present value at i.r.r.	105.1	29.8	.0
Net present value at i.r.r.	206.5	90.9	.0
ACCUMULATED GROSS CASH FLOW	112216.5	116394.0	116394.0
ACCUMULATED NET CASH FLOW	66246.2	70423.8	70423.8

(1) without financial charges before start up.

INTERNAL RATE OF RETURN - FINANCIAL PRIOR TO TAX : 33.58 %

INTERNAL RATE OF RETURN - FINANCIAL AFTER TAX : 24.58 %

################
* ADDED VALUE *
################

% or US $		average 3 years	average 5 years	average 10 years	average 15 years
ADDED VALUE					
per year		7220498.1	8533453.8	9892222.2	10475250.5
per person employed		39673	46377	53762	56931
in % of annual net sales	%	62	65	67	68
in % of total investment	%	23.6	27.9	32.3	34.0
per t. of raw material		479.6	505.9	527.2	533.5
per t. of Bottles		349.4	364.8	377.8	381.6
per t. of Tablewares		290.0	302.8	313.6	316.8
per t. of total main products		639.4	667.7	691.4	698.5

####################
* PAY-BACK PERIOD: * 6 years et 3 months
####################

* IMPACT ON THE FOREIGN CURRENCY BALANCE *

amounts in thousand US $	-2	-1	1	2	3	4	5	6
INFLOWS								
Net sales revenue	.0	.0	1571.7	2053.6	2464.4	2944.1	2453.4	2944.1
Export duties	.0	.0	.0	.0	.0	.0	.0	.0
Gross sales revenue	.0	.0	1571.7	2053.6	2464.4	2944.1	2453.4	2944.1
Production costs	.0	.0	2933.4	3084.5	3216.6	3587.4	3022.6	3490.8
OPERATING CASH FLOW	.0	.0	-1361.8	-1030.8	-752.2	-643.3	-569.2	-546.7
Equity	2030.0	.0	.0	.0	.0	.0	.0	.0
Long term loans	9350.0	10750.0	.0	.0	.0	.0	.0	.0
TOTAL INFLOWS	11380.0	10750.0	-1361.8	-1030.8	-752.2	-643.3	-569.2	-546.7
OUTFLOWS								
Investment	7815.4	18138.9	.0	.0	.0	.0	1306.0	.0
Long term debt service	.0	.0	4263.4	5347.9	3632.4	3781.5	3536.4	725.7
Interests on short term credits	.0	.0	.0	.0	.0	.0	.0	.0
Interests on lack of cash flow credit	.0	.0	.0	.0	.0	.0	.0	.0
Dividends	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL OUTFLOWS	7815.4	18138.9	4263.4	5347.9	3632.4	3781.5	4842.4	725.7
FOREIGN CURRENCY BALANCE	3564.6	-7388.9	-5625.2	-6378.7	-4384.6	-4424.8	-5411.6	-1272.4
Import savings (cif value)								
Bottles	.0	.0	3460.1	4521.3	5425.5	6481.7	5401.4	6481.7
Tablewares	.0	.0	2872.5	3753.4	4504.0	5380.8	4484.0	5380.8
TOTAL IMPORT SAVINGS	.0	.0	6332.6	8274.6	9929.6	11862.5	9885.4	11862.5
IMPACT ON FOREIGN CURRENCY BALANCE	3564.6	-7388.9	707.4	1895.9	5545.0	7437.6	4473.8	10590.1
ACCUMULATED	3564.6	-3824.2	-3116.8	-1220.9	4324.0	11761.7	16235.5	26825.6

amounts in thousand US $	7	8	9	10	11	12	13	14
I N F L O W S								
Net sales revenue	2944.1	2944.1	2944.1	2453.4	2944.1	2944.1	2944.1	2944.1
Export duties	.0	.0	.0	.0	.0	.0	.0	.0
Gross sales revenue	2944.1	2944.1	2944.1	2453.4	2944.1	2944.1	2944.1	2944.1
Production costs	3490.2	3490.8	3490.8	3022.6	3490.8	3490.8	3490.8	3490.8
OPERATING CASH FLOW	-546.1	-546.7	-546.7	-569.2	-546.7	-546.7	-546.7	-546.7
Equity	.0	.0	.0	.0	.0	.0	.0	.0
Long term loans	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL INFLOWS	-546.1	-546.7	-546.7	-569.2	-546.7	-546.7	-546.7	-546.7
O U T F L O W S								
Investment	.0	.0	.0	1306.0	.0	.0	.0	[illegible]
Long term debt service	698.0	670.3	642.7	615.1	587.5	559.9	532.2	504.5
Interests on short term credits	.0	.0	.0	.0	.0	.0	.0	.0
Interests on lack of cash flow credit	.0	.0	.0	.0	.0	.0	.0	.0
Dividends	.0	.0	.0	.0	.0	.0	.0	.0
TOTAL OUTFLOWS	698.0	670.3	642.7	1921.1	587.5	559.9	532.2	504.5
FOREIGN CURRENCY BALANCE	-1244.1	-1217.0	-1189.4	-2490.3	-1134.2	-1106.6	-1078.9	-1051.2
Import savings (cif value)								
Bottles	6481.7	6481.7	6481.7	5401.4	6481.7	6481.7	6481.7	6481.7
Tablewares	5380.8	5380.8	5380.8	4484.0	5380.8	5380.8	5380.8	5380.8
TOTAL IMPORT SAVINGS	11862.5	11862.5	11862.5	9885.4	11862.5	11862.5	11862.5	11862.5
IMPACT ON FOREIGN CURRENCY BALANCE	10618.4	10645.4	10673.0	7395.1	10728.2	10755.8	10783.5	10811.2
A C C U M U L A T E D	37444.0	48089.5	58762.5	66157.6	76885.9	87641.7	98425.3	109236.5

amounts in thousand US $	15
INFLOWS	
Net sales revenue	2944.1
Export duties	.0
Gross sales revenue	2944.1
Production costs	3490.8
OPERATING CASH FLOW	-546.7
Equity	.0
Long term loans	.0
TOTAL INFLOWS	-546.7
OUTFLOWS	
Investment	.0
Long term debt service	476.9
Interests on short term credits	.0
Interests on lack of cash flow credit	.0
Dividends	.0
TOTAL OUTFLOWS	476.9
FOREIGN CURRENCY BALANCE	-1023.6
Import savings (cif value)	
Bottles	6481.7
Tablewares	5380.8
TOTAL IMPORT SAVINGS	11862.5
IMPACT ON FOREIGN CURRENCY BALANCE	10838.8
ACCUMULATED	120075.4

##
* IMPACT ON THE FOREIGN CURRENCY BALANCE *
##

in US $	average 3 years	average 5 years	average 10 years	average 15 years
Averaged yearly saving	1441346	3247104	6615764	8005025
Minimum cif price needed to reach foreign currency break-even point.	596.63	470.21	261.85	190.51

XI. CONCLUSIONS.

XI. CONCLUSIONS

XI.1. ADVANTAGES OF THE PROJECT

All over the world especially in developing countries food (and agro-industry) is one of the bigger priorities not only for the domestic consumption but also for the exportation with added value to generate foreign currencies.

These products (fruit, vegetable, fish, milk, yogourt, oil, wine, honey, etc ...) could be packed in a large extent in glass containers.

Pharmaceutical, phytopharmaceutical, chemical, cosmetics are more and more imported in bulk and packing done on the place of distribution requiring a large quantities of glass containers.

An Ugandese glass containers industry, on self control by Uganda, will help also certainly the abovementioned industries in their development and their orientation to the exportation.

It is also unanimously accepted that growth rate of domestic demand and consumption of glass containers are linked with the local availability of containers.

Transportation of glass containers is difficult and very expensive. It is of course more advantageous to produce containers where they are consumed.

The experience and the record up to now indicate also that whatever will be the evolution of the types of packing and the completion of the new material, the glass will keep an important share in the market of packing anywhere in the world.

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The main reason is that the glass has a lot important specific qualities which cannot be substituted completely by other material like plastic, polytethylene, iron, steel, paper kraft, etc ...

The main quality of the glass are : perfectly hygienic and chemically inert, easily washable, recyclable, gas and vapor impermeable, odourless, rigid, transparent, high thermic and shock resistant, nice and attractive presentation, etc ...

In conclusion, the strategic aspect and the advantages of a polyvalent production plant of glass containers and tablewares as proposed in this study to be implemented in Uganda are evident. It should be emphasized by the fact that beverages sectors, food and agro-industry have received a definitive priority and support from the Ugandese Authorities.

These sectors of industry have an huge potential of demand and development in a near future and glass containers consumption will follow this quick evolution.

The rate at which bottling capacity will grow is to a large extent dependent on the availability of glass containers.

Also new Trade Marks of beverages are projected and demand of bottles will increase by the major factor that the inventories required by bottlers to stock newly completed filling installations will increase.

We conceived the plant to produce glass containers but also tablewares. The combined capacities, the combined selling prices (tablewares : 2 times the selling prices of the bottles) allocated to this project :

- the most efficient combination of machineries and equipment linked together in one production plant ;
- a flexible production program ;
- a feasible return on capital/investment.

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Also, as the plant will be located in Kampala (Uganda), the advantages of local production compared with importation are :

- Demand will be satisfied more easily and quickly.
- Transport, handling costs will be reduced.
- Breakage during transport will be reduced.
- Production could be more easily and more quickly adapted to the demand.
- Direct buying ex glass factory by the bottlers will reduce the selling cost.

The design of the plant as proposed could accept easily and cheaply a doubling of the production capacity when the market could absorb it.

The reuse of existing glass factory (Madhvani Group) in Kampala will reduce the cost and the time of implementation of a glass industry in Uganda.

Finally, we like to mention that as the weight of amortization in the cost price of the produced containers is relatively high (most of the equipment of the plant are imported) a long delay to decide and implement the glass containers and tablewares plant in Uganda, will have a financial defavorable impact on the profitability of this project.

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CONCLUSIONS AND RECOMMENDATIONS

1. BASIC ALTERNATIVE :

This basic alternative consider the use of a 50 t/day furnace feeding single gob process machines up to the fifth year of production. At that time the furnace will be increased to a 90 tons/day and it will feed double gob process machines.

This alternative is viable :
- The I.R.R. on 15 years = 15.1 %.
- The average return on equity becomes positive from the third year of production : 0.8 %, and the same average return on 15 years is 36.8 %.
- Past the fifth year of production, the break even point decreases below 50 % to reach 18.7 % at the 15th year.

An increase of the selling price by 10 % will give an I.R.R. of 17.1 %.

A reuse of the existing site of the old factory of the Madhvani Group will allow a reduction of the investment of about 2,4 million U $ and improve the I.R.R. up to 16.4 %.

The impact of a reduction of 5 % of the selling price from the exported tablewares is insignificant. We should thus recommend this policy in order to facilitate the penetration of the foreign market.

2. ALTERNATIVE J :

This alternative consider the use of a 90 t/day furnace feeding double gob process machines from the start up of the factory.

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This alternative is obviously more profitable than the basic one.

- The I.R.R. on 15 years = 19.9 %.
- The average return on equity is positive from the first year of production : 1.3 %, and the same average return on 15 years is 45.2 %.
- Past the second year of production, the break even point decrease below 50 % to reach 18.7 % at the 15th year.

3. RECOMMENDATIONS :

The alternative J is more profitable.
However it must be noted that only the basic alternative of the project could start immediately as the present market demand is only sufficient to absorb the production of single gob machines, with a furnace of 90 t/day.

In any case, the market demand will only be sufficient in 1995-96 to absorb the production of double gob machines with a furnace of 90 t/day.

The only two options to be considered are :

- Either to start immediately the basic alternative with a furnace of 50 t/day.
- Or to wait 2-3 years before starting the alternative J with a furnace of 90 t/day.

Considering the Ugandese Government recommendations to start the project as soon as possible, our recommendations are :

. Start with the basic alternative immediately.
. Obtain a tax holiday period from the Ugandese Authorities.
. Use the existing plant (Madhvani group) if a suitable agreement can be found between both parties.
. Penetrate the tablewares export market of tablewares with a lower selling price.

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XI.2. CHANCES FOR IMPLEMENTING THE PROJECT

OUTLOOK OF UGANDA IS IMPROVING EVERY DAY.

Political situation.

- Substantial improvements are achieved in the internal security, situation oughting to bring a cut in the crippling level of military expenditure.

- The Government seems today to have sufficient political support to put an end to the corruption and smuggling which are so damaging to the economy.

- Relation with Kenya seems more quite.

- The Government embarks on reconstruction in the North.

The economy is looking stronger, performance in 1987 and 1988 in term of percent growth in G.P.D. is continuing to be at least at 6 % and over, with reasonable good prospect for the future price of coffee, the main export.

Unfortunately, industrial sector (mainly large scale industries like : textile, tobacco, beverages, wood and paper products) has been extremely hard hit by the economic and political troubles of the late 1970 and early 1980 and by 1986 output was estimated to be little more than a third of post-independence peak levels achieved in 1970-1972.

Today, 21 per cent of the Ugandese resources is allocated to the industry (and another priority : tourism) under rehabilitation and development plan (1987-1991) which received a full support of the donors who pledged around 300 Mios USD/y. The main aim is to promote self-sufficiency in consumer goods and develop linkages with agriculture.

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This could concern both alternatives of this glass container project through rehabilitation of the existing plant or through the implementation of a new factory.

We can conclude that the Governmental plan is favourising development also of beverages and food for domestic consumption but also for the needs of tourism (which was the third larger earner of foreign exchange until 1972). Linked with beverages and food, bottles consumption will automatically increase. The development of the production will be very significant and fast as the actual consumption is rather small compared with the average consumption of beverages (for instance) in Africa.

As the percentage of the present utilization of the bottler's plant capacity is small (± 20 %), the domestic projected increase of consumption of beverages in Uganda will be satisfied with a limited investment cost for the beverages industry. And, in parallel, if the hollow glass factory is implemented and designed also for a future doubling of production, prospects of a smooth development of these two industries are very promising.

When compared with neighbouring countries (G.N.P. between 200 and 300 USD/y) the average growth rate consumption of beverages and bottles around 12 % year or above, as per this study, is quite realistic.

A new issue of the incentives (which will concern also glass industry) to attract foreign investment together local promotors will place Uganda in a situation at least equal to the neighbouring countries if not better. Selling containers will be eased by the fact that the market for many goods is very far to be saturated in Uganda and for the present time no alternative package is locally produced.

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Uganda is also in the P.T.A.* countries and benefits of the same privileges.

From 1986 it is quite generally admitted that the political and economical situation in Uganda have been considerably cleared, stabilized and improved.

We observe that growth rate figures forecasted two or three years ago for any subjects (G.N.P. - G.D.P.) appear to be too pessimistic for 1988 and subsequent years.

* P.T.A. : Prefered Trade Area (agreement between about 20 African countries to favorise commerce between themselves.

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PROMOTORS AND INVESTORS ARE INTERESTED, IN PRINCIPLE, IN THIS GLASS PROJECT.

As we contacted potential promotors and investors before having the conclusions of this study, the results of our meetings were only indicative.

In principle, the following entities are interested to cooperate to implement this project :

A.- public sector, f.i. Ministry of Industry [through Uganda Development Corporation or through bottlers (Nile Breweries)], eventually Ministry of Defence,
and
- private sector, f.i. bottlers (Uganda Breweries, Lake Victoria Bottlers) together with private investors like Spear Motor, Nile Glassworks Ltd.

B. Different international financing organizations have already marked interest for this project : A.D.B. (Abidjan), E.A.D.B. (Kampala), F.A.D., O.P.E.C., F.E.D.

C. Madhvani group involvement could be also analysed either through equity participation (bringing their site as share in the new company) or by selling their existing site of the old glass plant to the new shareholders.

Anyway further investigations will be done in due time and this list of potential cooperations is of course non exhaustive but very encouraging and promising for a quick implementation of this project.

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FINANCING COULD BE RAISED.

Flow of investment aid is beginning to have a real impact on the economy which should encourage donors and International financing organization to have confidence and long term aid to Uganda and to viable projects.

We recorded summaries of the main contacts or interviews (but these are not limitative) concerning the potential financing of this project.

- Foreign currencies

  . A.D.B. (Abidjan) and E.A.D.B. are in principle very much interested in the financing of this project (refer to telex enclosed in annex 9.).
  . B.E.I. (C.E.E.) could allocated part of its : 30 Mios USD credit [allocated via U.D.C. (Uganda Development Corporation) for the 5 years plan (1985 - 1990)] but decision, priority and conditions remain under the Ugandese Authorities.
  . European credit Development Fund is not interested.
  . Belgian Credit [through Agence de Coopération et Développement (A.G.D.C.)] could be available.
  . Italian Credit (covered by SACE) could be available at an interest rate of 8.2. % y in USD for 7 to 8 years reimbursement after start up of the plant.
  . Swiss and German Credits are also available at similar conditions.
  . Development Finance Co of Uganda Ltd could be interested.
  . S.F.I. and World Bank seem not interested.

- Local currency

  For local expenses (civil works and erection works), U.D.B. or U.C.B. are the main interlocutors interested to finance the local part.

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Public sector share (probably through Uganda Development Corporation - U.D.C.) could amount 20 to 40 % of the total equity. If it is the case, a bank guarantee for the foreign loans could be obtained from the Ugandese State.

<u>In short</u>, we estimate that the chances for implementing the project are far much better than a few years back and chances to enter definitively in the process of final decision for the implementation should not be lost or postponed, for the main following reasons :

a. political situation of Uganda is under control and pacification of the whole country is very promissing ;
b. the results of the economical measures to reactivate and rehabilitate the priority sectors generating foreign exchange appear to be fruitful and realistic ;
c. privatization and subsequent reorganization to generate profit are on the process ;
d. five years plan with priorities have been issued and International Financing Organization and Donors have definitively decided to allocate founds to support this program ;
e. beverages and food industry (amoung the priorities) will be the ones which will grow faster as market is existing and Ugandese consumption far below the ones in neighbouring countries ;
f. glass containers production plant designed with a polyvalent and flexible production program will be adapted easily to the domestic demand ;
g. important Ugandese Industrial promotors are definitively interested in this field of industry. Of course, it should be admitted that the establishment of a glass factory is always a capital intensive venture which will have a better performance only on a larger scale of production which will most certainly happens after 4 to 5 years of operation when domestic demand will be largely higher than the present one ;

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h. main raw materials, manpower and (eventually existing infrastructure's site on right location and buildings to be rehabilitated) are available to start a production of glass in Uganda within European stardards ;

i. feasibility of this project is sufficient and on macro-economic point of view it is evident that spare of foreign currency is important ;

j. as per a purely money earning point of view it is clear that the prospect for increasing significantly the earning after 4-5 years is very good because, at that time, the production could be doubled to satisfy the domestic demand. Consequently it would be advisable to wait 4 to 5 years when the market will be sufficiently developed to make the project profitable at the start up of the plant ;

k. Uganda needs a glass container and tablewares factory, local (and foreign) promotors are willing to participate in this project principally the bottlers who know the excellent prospect of the market and the profit from this business.

But Uganda Authorities have to definite a clear policy to promote and allocate incentives for such a project in an attractive way and environment to allow and ensure a reasonable profit.

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ANNEXES

3079S

A N N E X 1.

SCOPE OF WORK OF THIS FEASIBILITY STUDY, AS DEFINED BY UNIDO AND THE GOVERNMENT OF UGANDA.

1. Study and review of all available data and studies related to glass containers and tablewares sector.

2. Market study and plant capacity : estimation of the size, structure and demand characteristics. The demand projections for the domestic and export markets. Sales forecast. Production program. Plant capacity.

3. Raw materials survey : geological investigation with particular reference to the assessment of composition, uniformity, physical-chemical-mineralogical characteristics, quantity and reserve, overburden, exploitability, location and topography of the raw material components.

4. Plant location : public and locational policies, financial and other concessions and incentives. Environmental considerations. Assessment of energy, transport, water, communications.

5. Project engineering : project layout, materials flow quantities, manpower requirement, organigrams, choice of technology and process. Imported and domestic equipment. Structures and civil works. Site preparation, building.

6. Plant organisation and overhead costs : production costs, services costs, plant overheads, administrative overheads.

7. Manpower : manpower planning for operational phases. Supervisory and managerial staff. Foreign experts. Training.

8. Implementation scheduling : time scheduling of the execution of the project.

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9. Financial and economic evaluation : total investment costs, including foreign and domestic, project financing, production costs and financial evaluation and sensitivity tests.

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A N N E X 2.

SOURCES OF DATA.

Data, directly or indirectly relating to the scope of work, has been collected in :

- Uganda : ministries, banks, institutions, university, public and private companies, geological center ;
- Neighbouring countries : Kenya, Tanzania, Zaïre, Rwanda, Burundi ;
- Europe : embassies and commercial representations ;
- International institutions : World Bank (S.F.I.), UNIDO, E.E.C. ;
- International financing institutions : World Bank (S.F.I.), A.D.B., E.A.D.B., B.E.I. ;
- Private companies and institutions ;
- Glass manufacturers and exporters ;
- Manufacturers of equipment for glass industries ;
- Manufacturers and suppliers of ingredients for the manufacture of glass ;
- Glass institutes and associations of glass manufacturers ;
- P.L.M. laboratories in Germany.

Prefeasibility and feasibility studies done by :

a. Mr. MONTAGNE (1979) for UNIDO concerning a glass project in Burundi.

b. Italian and English consultants for a 50 tons/day glass factory in Uganda for M/S Nile Glass works, Kampala in 1982.

c. Geoconsultant (Holland) for a flat glass factory in Uganda, Jan. 1982.

d. Planco consulting (Hamburg) for Nile Glass works in 1983 for a factory of 13,000 tons/year containers + 2,400 tons/year tablewares in 1985.

e. Howard Humphreys (Kampala).

Reference is made to the source of interest throughout the text of this report in the relevant sections.

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A N N E X 3.

LIST OF PERSONS WHO GIVE US THEIR SUPPORT AND ADVISE.

- UNIDO RESIDENT REPRESENTATIVE IN UGANDA MRS CHENERY-HESSE.

- UGANDESE AMBASSADOR IN BRUSSELS EXCELLENCY MR CH. K. KATUNGI
  AND THE COMMERCIAL ATTACHE.

- BELGIAN AMBASSADOR IN NAIROBI EXCELLENCY MRS CHR. FUNES-NOPPEN
  AND FIRST SECRETARY MR M. ARDUI
  AND THE COMMERCIAL ATTACHE.

- BELGIAN CONSUL IN KAMPALA MR W. HOES.

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  DEPUTY MINISTER MRS G. NJUBA
  PERM. SECRETARY MR OKUTU
  COMMISSIONER MR T. LANGOYA
  SENIOR INDUSTR. ADVISER MR J. MAMBULE
  COMMISSIONER FOR TECHN. MR KAGODA.
  UGANDA DEVELOPMENT CORPORATION (U.D.C.)
  DIRECTOR PROJECTS & RESEARCH DR. G.S.B. KINYATTA
  DIRECTOR DR. MR SSALI
  ECONOMIST MR J. NSUBUGA.

- MINISTRY OF DEFENCE
  P.S. MR KABAYA
  SECRETARY MR KOBEWO.

- MINISTRY OF ANIMAL INDUSTRY AND FISHERIES
  COMMISSIONER DR A.B. KALYEGIRA.

- MINISTRY OF AGRICULTURE
  P.S. MR MULIIBI.

- MINISTRY OF HEALTH
  P.S. MR OGOLA
  UNDER SECRETARY MR C.W.H. WAMALWA
  DIRECTOR OF MEDICAL SERVICES DR. KYABAGGU.

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  D.G. CUSTOMS PROF. MR KARUGIRE
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  MRS LUBEGE - OCAILAP - KYAMUGINA - MUKARA - TIBEKINGA

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  MR IV. TIBENDA.

- MINISTRY OF ENVIRONMENTAL PROTECTION
  UNDER SECRETARY MR. G.W.C. SERWADDA.

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  P.S. MR P. BAKASHABARUHANGA
  DIRECTOR MR I. TIBENDA.

- UNIDO
  (VIENNA) DR. V. KLYKOV, the UNIDO Backstopping officer of the project
  (NAIROBI) MR A. PAGANI, Field adviser (SIFDA)
  (UGANDA) EXPERT DR. A.D. MONTEIRO
  MR S. SARMA (for privatization)
  MRS I. UNAMBOOWE
  MR G. LEONE.

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- I.F.C. - RESIDENT REPRESENTATIVE (NAIROBI) MR E. KEPPER.

- F.A.O. - RESIDENT REPRESENTATIVE (UGANDA) MR RAVI P. AWASTHI

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  ECONOMIST ADVISOR MR T. HIGHAM.

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  MR G.R. RUHURIRA
  MR KAMILGWA.

- U.D.B. - MANAGER MR NUGONYI.

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  CHIEF COMMERCIAL ENGINEER MR Y.B.K. MPACI.

- GEOLOGICAL SURVEY & MINES (ENTEBBE)
  DEPUTY COMMISSIONER MR S.A. MBOIJANA
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- CENTRAL MEDICAL STORE (ENTEBBE)
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./.

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  CHIEF TRAFFIC MANAGER MR WMAMEBA
  CHIEF TECHN. SERV. MR KWESIGA.

- SPEAR MOTORS LTD
  CHAIRMAN MR G. WAVAMUNNO
  DIR. FINANCE MR CH.N. KIKONYOGO.

- MADHVANI INTERNATIONAL GROUP
  (KAMPALA) MANAGER MR E. OKELLO
  (NAIROBI) DIRECTOR MR O.G. KAPOOR
  UGANDA AFFAIRS DIRECTOR MR J.C. TREVIDI.

- DIAMOND TRUST (KAMPALA)
  MANAGER MR. H.F. PULLE.

- NILE GLASS WORKS LTD
  DIRECTOR MR JOS. KYANGWA.

- FOURWAYS INVESTMENT CO
  MANAGER MR M. TOBANI.

- NATIONAL ENTERPRISE CO
  ADJ. D.G. MRS M. BABAZI
  CORPORATE SECRETARY MR. AYENA/ODONGO
  DIRECTOR MAJOR J. MWGBAZE.

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- UGANDA BREWERIES
  CHIEF EXECUTIVE MR E.M. KUBAI.

- NILE BREWERIES
  CHIEF ENGINEER
  SECRETARY MR MUSISI-KINTU.

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  GENERAL MANAGER DR. J. HABYARIMANA GAHIMA.

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  GENERAL MANAGER MR KAYONGA.

- EAST AFRICAN DISTILLERIES
  GENERAL MANAGER MRS EVA ADENZO.

- EDIBLE OIL & SOAP INDUSTRY
  GENERAL MANAGER DR. P.K. KAKWENZIRE.

- SCHWEPPES (KAMPALA BOTTLERS)
  PRODUCTION MANAGER MR P. MUSYORI.

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- MASAKA GROWERS CO (MASAKA)
  SUPERVISORY MANAGER MR SSERUUMA
  VICE CHAIRMAN MR A. MUTAAWE

- NILE CRYSTAL SPRINGS
  MANAGER MR M. NAGUYO

- JUBILEE ICE & SODA
  PROD. MANAGER MR CR. NJOUMA

- CENTURY BOTTLING
  MRS BAGALA-LIWU

- HOWARD HUMPHREYS (KAMPALA)
  MANAGING DIRECTOR MR KIBIRIGE.

./.

INTRODUCTION TO EMHART I.S. MACHINES

CARACTERISTICS OF BOTTLES WHICH COULD BE PRODUCED IN UGANDA.

The Basics

EMHART I.S. (Individual Section) glass container forming machines today consist mainly of six, eight or ten individual sections. Each section may produce from one to three containers at a time. Machines are referred to in these specific terms, for example: I.S. – 8 Section Double Gob 4¼". This describes an individual section machine, with eight sections each accommodating two sets of molds (Double Gob) with centre distance of 4¼" between mold centres.

The Type E machine originally introduced around 1947 and continuously improved has long enjoyed the reputation as the standard of the industry. The Type F machine with expanded centres double gob and unique improvements was introduced in 1966 with triple gob "F" machines being introduced shortly thereafter. In 1969 the Type E was combined with selected improvements from the Type F to produce the EMHART Type EF machine.

The latest addition to the EMHART I.S.Machines is the Type A.I.S.Machine (Advanced I.S.Machine), introduced in 1976. It incorporates all the novel features developed by EMHART during the past years.

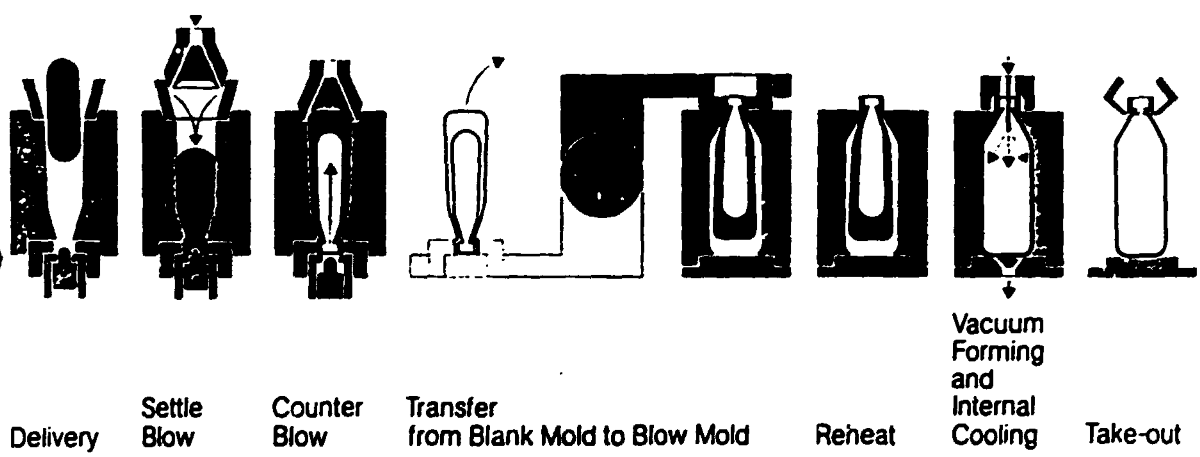
The Process

In the I.S. process, gobs of molten glass are fed by an EMHART feeder into a "blank" mold. Initially forming begins either by blowing or by the action of a pressing plunger from beneath. The resulting upside down parison—the partially formed bottle—is then inverted as it is transferred from the blank mold to a right-side-up position in the "blow" mold where the body is blown into shape while the next parison is being formed in the blank mold.

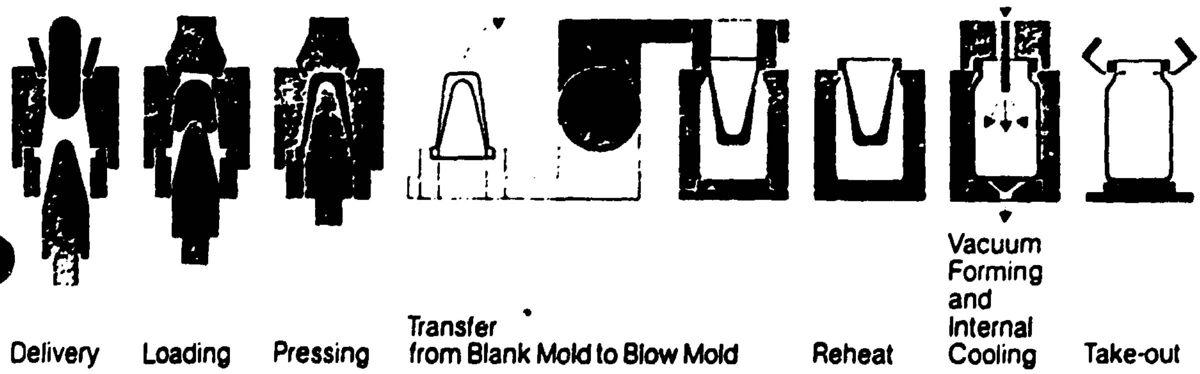
The finished ware is removed by the "take-out" mechanism, partially cooled on the "dead-plate" and moved away on a conveyor in a controlled fashion for stacking in the annealing lehr.

Two methods of I.S. forming are used, "blow-and-blow" and "press-and-blow" which is also known as the "62 process". Blow & Blow is used primarily in the production of narrow neck ware. Press & Blow is normally used for wide mouth containers, but with special narrow neck press and blow equipment it may be used also for narrow neck containers.
EMHART machines are designed for either methods and are easily interchangeable in the field.

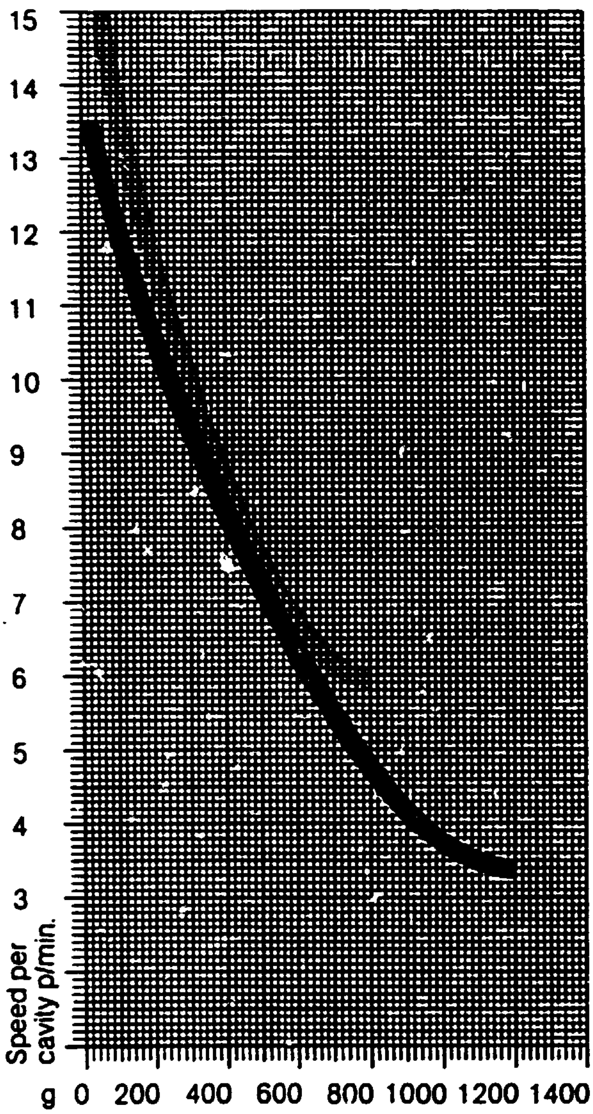
Blow & Blow process (AS PROPOSED TO PRODUCE BOTTLES IN UGANDA)



Press & Blow process (FOR JARS PRODUCTION)



Production speed per mold cavity



Production Rates

Production rates vary with the type of machine, the type of ware and the number of molds. The smaller the ware, the faster the machine can normally be run and the greater the production. Presently, the only way to machine-form a gallon jug is by single gob. On more conventionally sized ware, double gob can be used with increased production speed of up to 100% over single gob. From double to triple gob, the increase can reach 45% and higher. Productivity is also increased by increasing the number of sections, thus an 8 section machine normally provides close to a 33% increase over comparable 6 section operation.

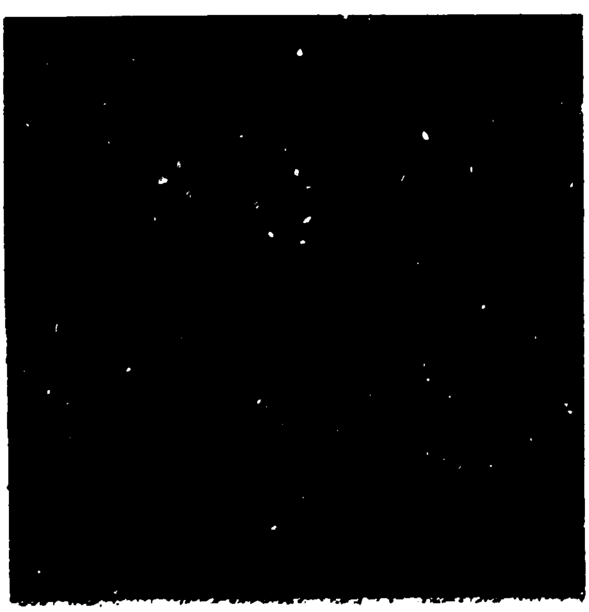
The choice of a specific I.S. model to attain minimum cost per container produced depends upon the type of ware, amount of flexibility and length of runs required.

The I.S. machine provides the highest speed per mold of any known glass container process. It's flexibility as to ware size and shape at maximum mold rates is its main characteristic.

Example: 8 section DG process – 16 mold cavities

Blow & Blow process
Press & Blow process

Containers made by Blow & Blow process



Containers made by Press & Blow process

EMHART I.S. MACHINE TYPE EF

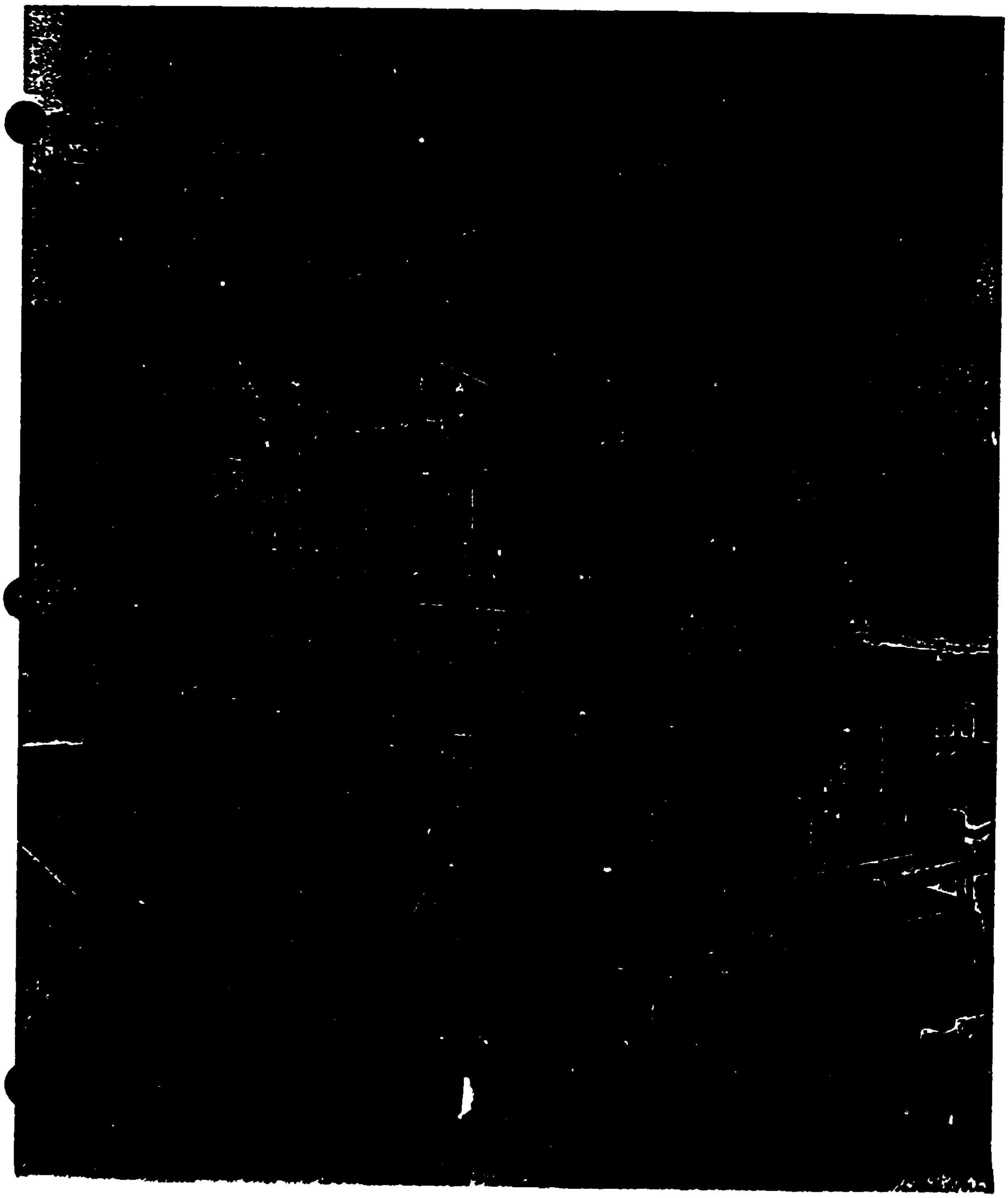
6,8 & 10 SECTION SG, DG 4¼" & TG 3" 6,8 & 10 SECTION DG 5½"

The I.S. Machine Type EF was introduced in 1969. Its main characteristics, the detachable section frames and the bed level manifolds and piping have produced a most favourable response in the glass industry.

The detachable section frames may be individually removed and quickly replaced with previously overhauled complete sections during an in-plant overhaul. The bed level manifolds reduce overhead piping to a minimum and allow greater accessibility to the working area.

Today's standard EF Machine is equipped with gob distributor, wide uprights incorporating pressure regulators and gauges, electrical drive system, magnetic conveyor drive and a number of other important operating features.

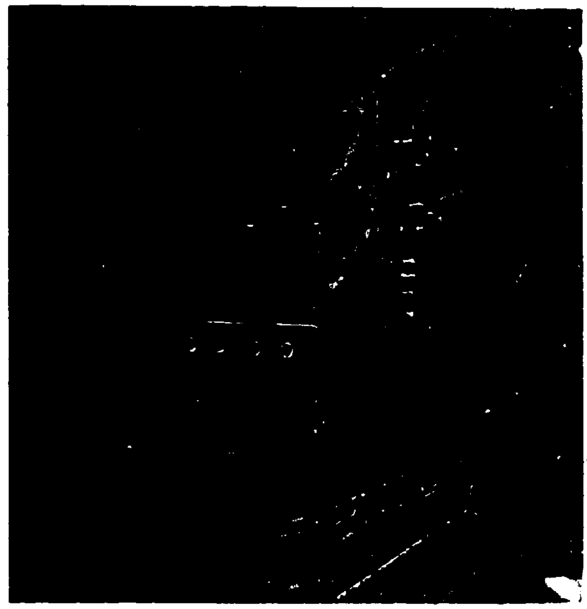
I.S. Machine Type EF-8 5½"



Two basic models of the EF Machine are available with section frames of either 4¼" or 5½" mold centre distance.

The choice of the appropriate model depends on the type of ware produced, e.g. the 4¼" Machine for single gob, medium size ware double gob and small ware triple gob application, the 5½" Machine for the production of medium and larger type ware.

Both 4¼" and 5½" EF Machines are available in a 6 or 8 Section configuration. However, although similar in appearance, the section frames of the two machines are not interchangeable.



Container specification limits

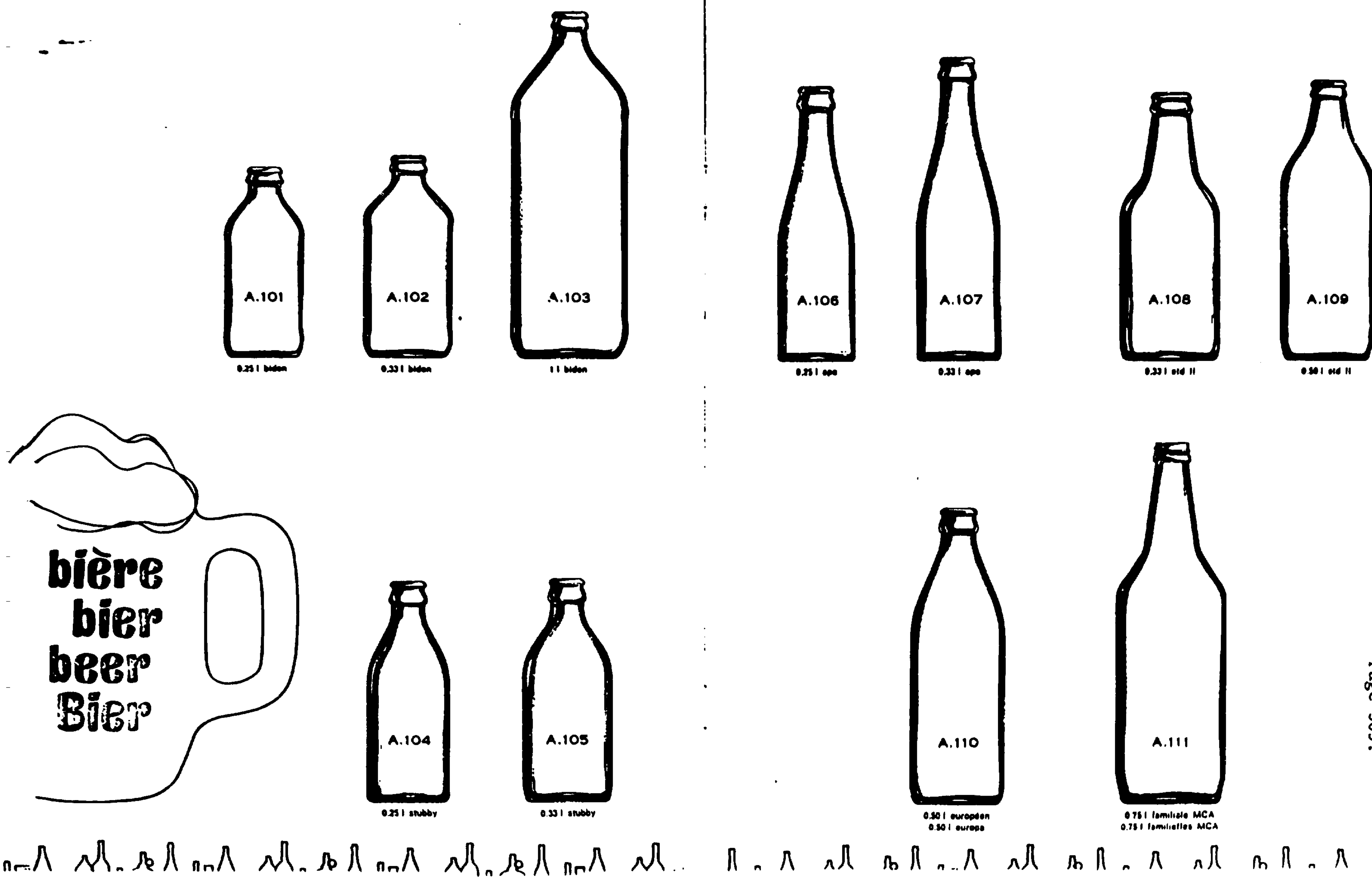
4¼" Machine

Container specification	Single gob		4¼" double gob		3" triple gob
	blow/blow	press/blow	blow/blow	press/blow	blow/blow
Max. body diameter	178 mm	178 mm	90 mm*	90 mm*	50 mm
Max. body height under finish	349 mm	280 mm	305 mm**	229 mm	250 mm
Min. body height under finish	35 mm	48 mm	32 mm	32 mm	35 mm
Max. finish diameter	76 mm	120 mm	48 mm	83 mm	30 mm

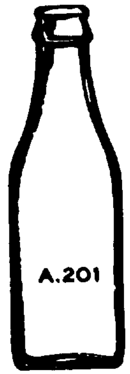
5½" Machine

Container specification	5½" double gob	
	blow/blow	press/blow
Max. body diameter	111 mm*	111 mm*
Max. body height u.f	342 mm	229 mm
Min. body height u.f.	48 mm	32 mm
Max. finish diameter	48 mm	90 mm

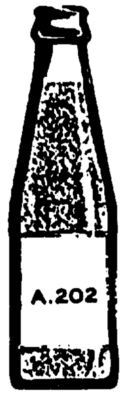
* Reduced by 10 mm with vacuum forming
** With modifications


A.101
0.25 l bidon
A.102
0.33 l bidon
A.103
1 l bidon
A.106
0.25 l ape
A.107
0.33 l ape
A.108
0.33 l std II
A.109
0.50 l std II
bière
bier
beer
Bier
A.104
0.25 l stubby
A.105
0.33 l stubby
A.110
0.50 l européen
0.50 l europa
A.111
0.75 l familiale MCA
0.75 l familiales MCA

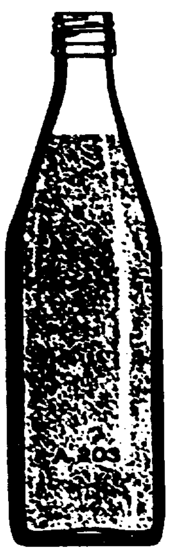
eaux-limonades
water-limonade
water-soft drinks
Wasser-Limonade



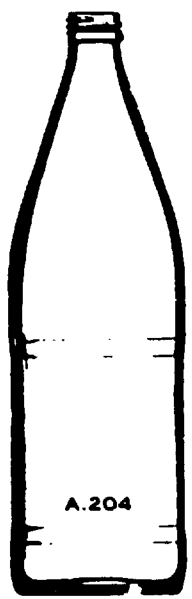
0,20 l limonade unie
0,20 l limonade effen



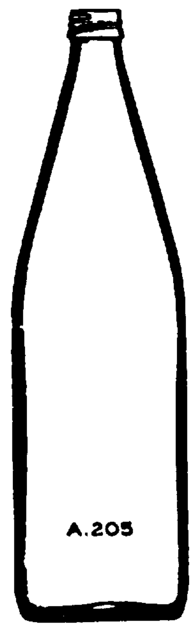
0,20 l limonade granitée
0,20 l limonade gegraniteerd



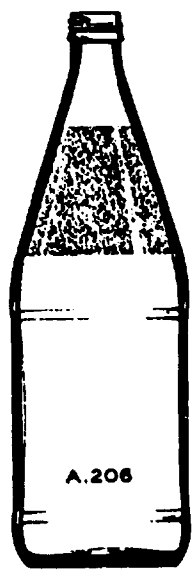
0,70 l sirop
0,70 l siroop



1 l MCA bas
1 l MCA laag

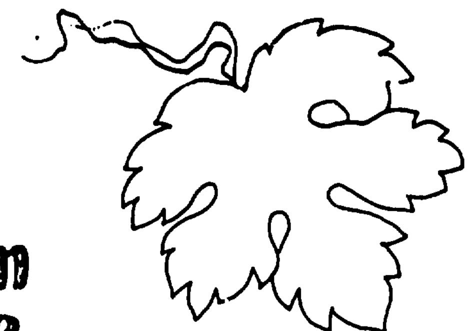


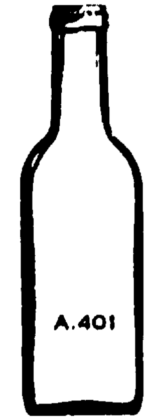
1 l MCA haut
1 l MCA hoog



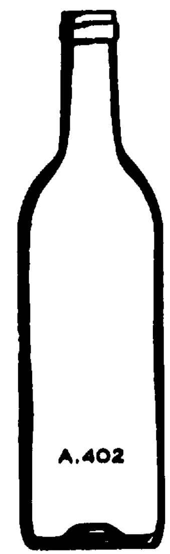
1 l kegel o.w.

vin
wijn
wine
Wein

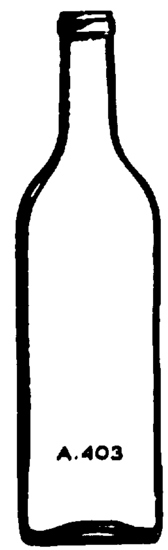




0,35 l bordelaise

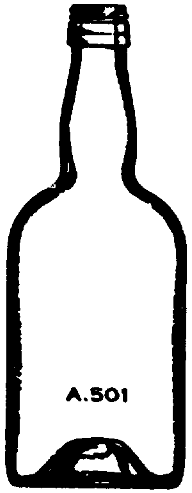


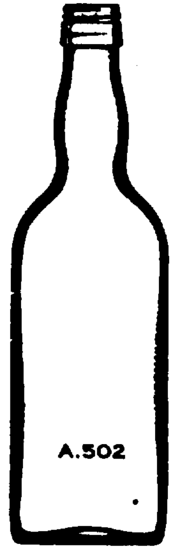
0,70 l bordelaise

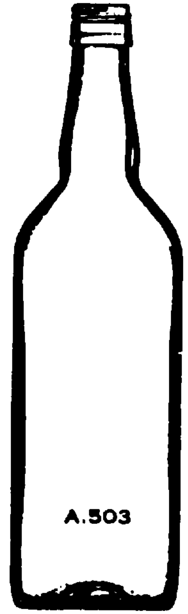


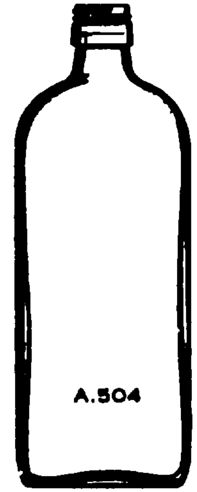
7/10 l bordelaise

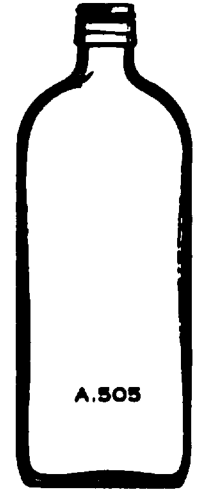
alcool
alcohol
spirits
Spirituosen


A.501
0,70 l camard bas
0,70 l camard laag


A.502
0,70 l camard haut
0,70 l camard hoog


A.503
1 l camard


A.504
1 l cruchon bas
1 l kruik laag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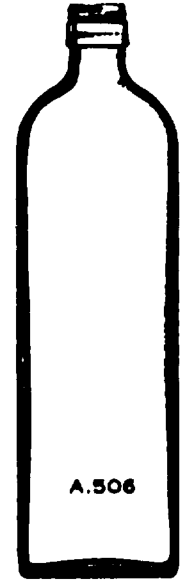
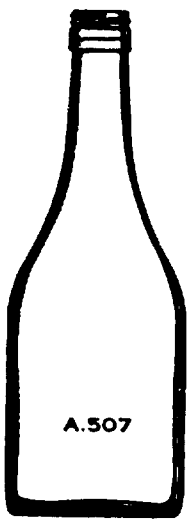
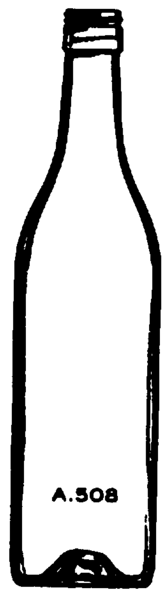
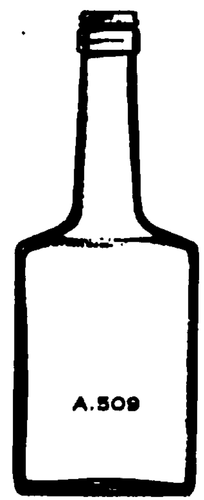
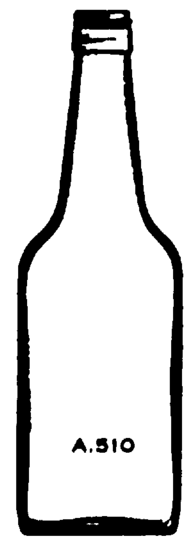
1/1 l cruchon bas
1/1 l kruik laag

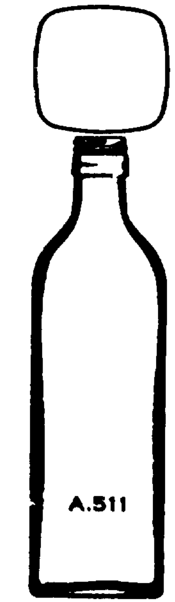

A.506
1 l cruchon haut
1 l kruik hoog


A.507
0,70 l normande


A.508
7/10 l cognac


A.509
0,70 l liqueur
0,70 l likeur


A.510
0,70 l alcool
0,70 l alcohol



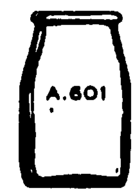
0.70 l alcool carré
0.70 l alcohol vierkantig

0.70 l alcool rectangulaire
0.70 l alcohol rechthoekig

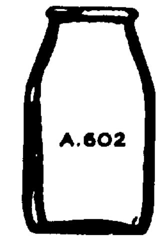
0.70 l triple sec

elixir

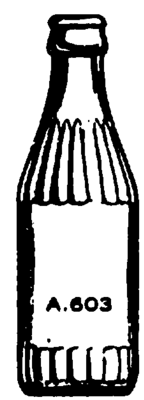
produits laitiers
melk produkten
dairy products
Milchprodukte



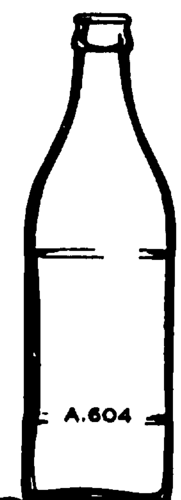
0.10 l couronne 43 o.w.
0.10 l kroonmond 43 o.w



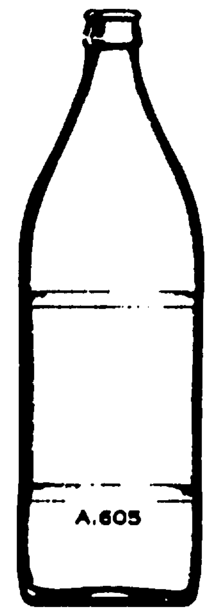
0.20 l couronne 43 o.w
0.20 l kroonmond 43 o.w



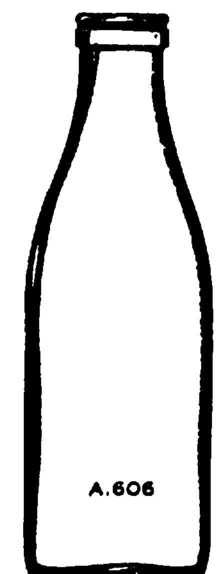
0.20 l lait couronne
0.20 l melk kroonmond



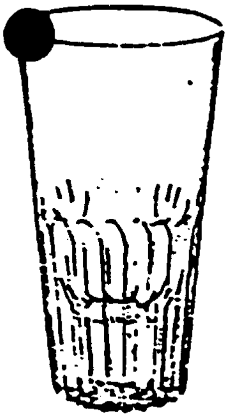
.50 l lait couronne
.50 l melk kroonmond



1 l lait couronne
1 l melk kroonmond



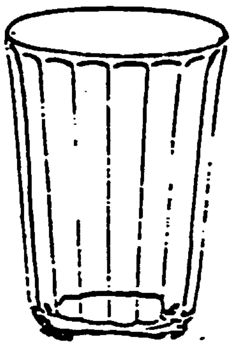
ANNEX 5.



TUMBLER P.1

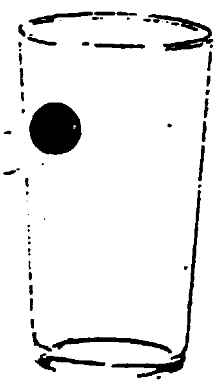
Capacity : cl. 17
Weight : g. 265
Height : mm. 120

TUMBLER P.2



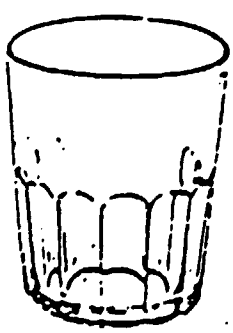
Capacity : cl. 20
Weight : g. 145
Height : mm. 94

TUMBLER P.3



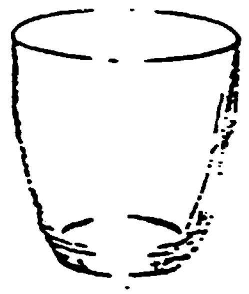
Capacity : cl. 29
Weight : g. 180
Height : mm. 120

TUMBLER P.4



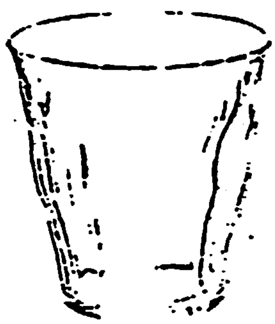
Capacity : cl. 14
Weight : g.125
Height : mm. 77

TUMBLER P.5



	Capacity (cl.)	Weight (g.)
A	22	170
B	15	120
C	9	80

TUMBLER P.6



	Capacity (cl.)	Weight (g.)
A	25	195
B	22	160
C	15	126
D	13	100
E	9	90

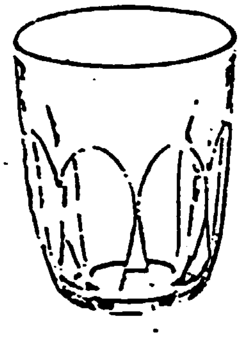
TUMBLER P.7

	Capacity (cl.)	Weight (g.)
A	25	220
B	22	165
C	15	140
D	9	90
E	2.5	40

TUMBLER P.8

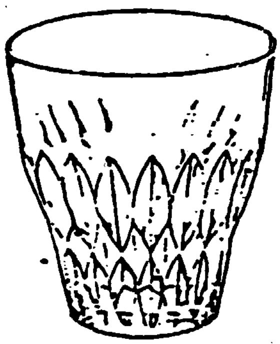
	Capacity (cl.)	Weight (g.)
A	25	220
B	22	175
C	15	145
D	13	120
E	9	90

TUMBLER P.9



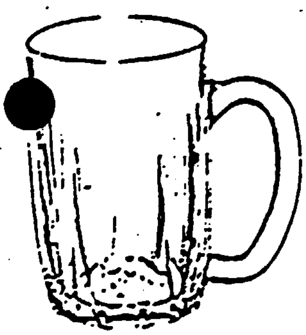
Capacity : cl. 16
Weight : g. 120
Height : mm. 77

TUMBLER P.10



Capacity : cl. 19
Weight : g. 165
Height : mm. 84

BEER MUG P.11



		A	B
Capacity	: cl.	28	36
Weight	: g.	300	390

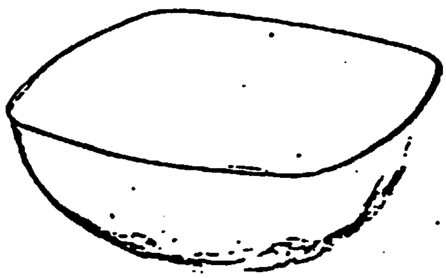
BEER MUG P.12

		A	B	C
Capacity	: cl.	33	52	63
Weight	: g.	500	600	670
Height	: mm.	120	138	144

BOWL - ROUND (PLAIN) P.13

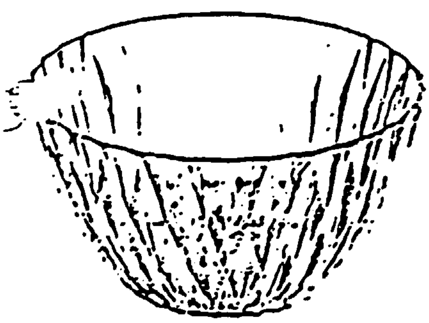
	Diameter (cm)	Weight (g.)
A	6	55
B	7.5	75
C	9	90
D	10.5	145
E	12	190
F	14	290
G	17	455
H	20	640
I	23	920
J	26	1,540

BOWL - SQUARE P.14



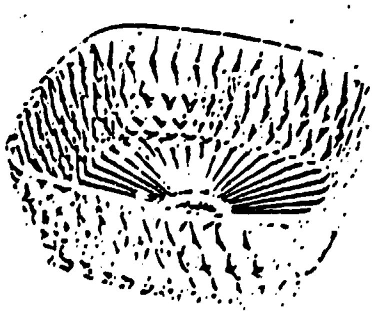
	Diameter (cm)	Weight (g.)
A	11	165
B	22	950

BOWL - ROUND (DECORATED) P.15



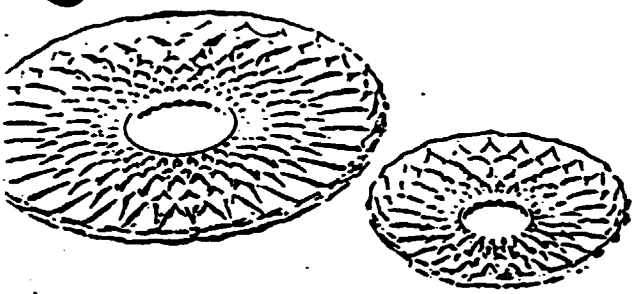
	Diameter (cm)	Weight (g.)
A	10.5	185
B	17	550
C	20	925
D	23	1,525

BOWL - SQUARE (DECORATED) P.16



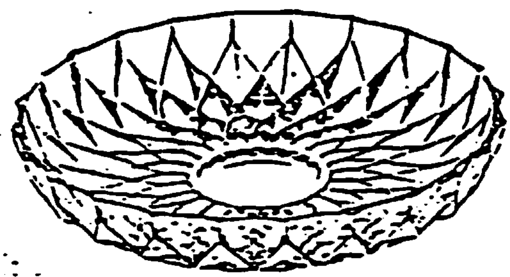
	Diameter (cm)	Weight (g.)
A	11	175
B	22	1,200

PLATE - DECORATED P.17



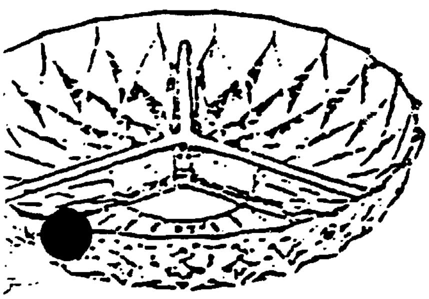
	Diameter (cm)	Weight (g.)
A	28	1,300
B	17	370

DISH - DECORATED P.18



Diameter (cm)	Weight (g.)
21	620

DISH - SEPARATED P.19

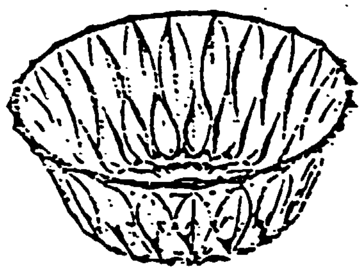


Diameter (cm)	Weight (g.)
21	900

BOWL - DECORATED P.20

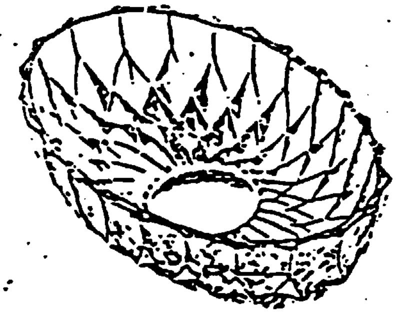
	Diameter (cm)	Weight (g.)
A	21	1,050
B	12	250

BOWL - DECORATED P.21



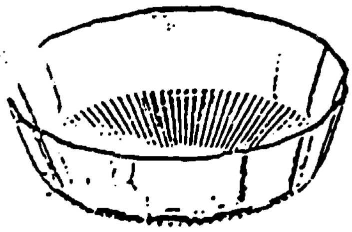
	Diameter (cm)	Weight (g.)
A	21	820
B	16	540
C	12	215

BOWL - OVAL P.22



Diameter (cm)	Weight (g.)
20	555

BOWL P.23

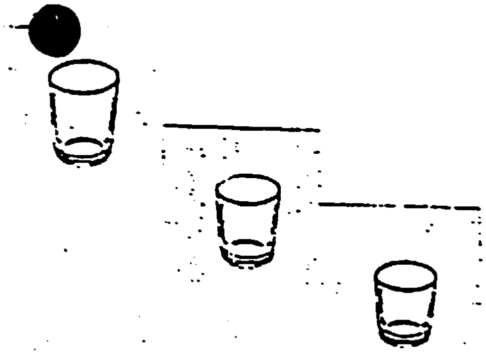


Diameter (cm)	Weight (g.)
21	900

BOWL P.24

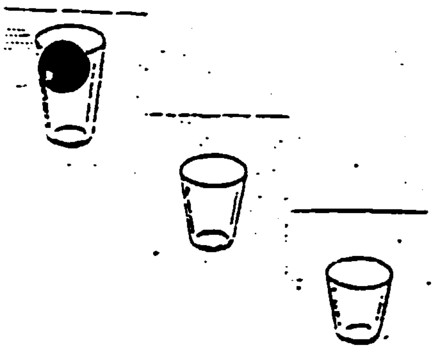
	Diameter (cm)	Weight (g.)
A	21	620
B	18	410
C	15	280
D	12	160

TUMBLERS (CYLINDRICAL)



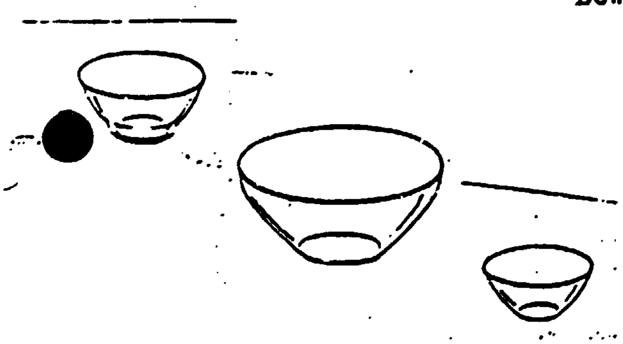
	Capacity (cl)	Weight (g.)
P.25	29	270
P.26	22	215
P.27	17	185

TUMBLERS (TAPERED)



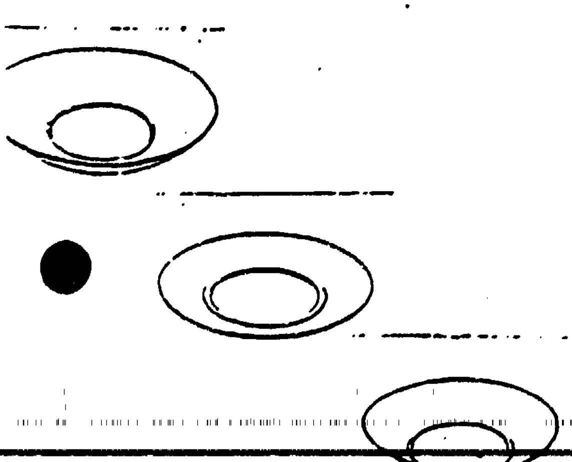
	Capacity (cl)	Weight (g.)
P.28	33	250
P.29	21	160
P.30	16	135

BOWLS



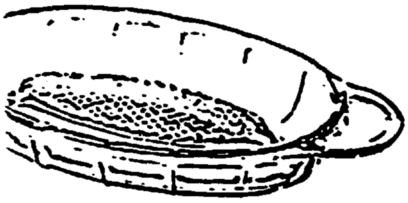
	Capacity (cl)	Weight (g.)
P.31	45	255
P.32	245	1,190
P.33	29	180

PLATES



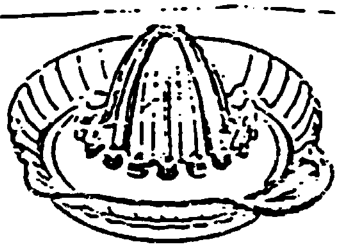
	Diameter (cm)	Weight (g.)
P.34	23	410
P.35	21	~~375~~ 345 ?
P.36	19	280

DISH - SERVING P.37



Length (cm)	Width (cm)	Weight (g.)
13	9.5	235

LEMON SQUEEZER P.38

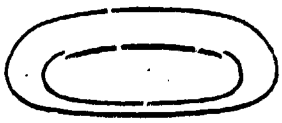


Diameter (cm)	Weight (g.)
12.	195

VASE P.39

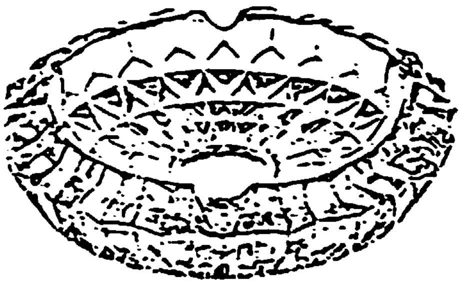
	Height (cm)	Weight (g.)
A	13	210
B	18	445

PLATE - SERVING P.40



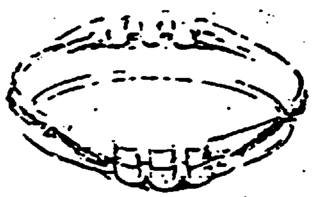
Length (cm)	Weight (g.)
31	760

ASH TRAY P.41



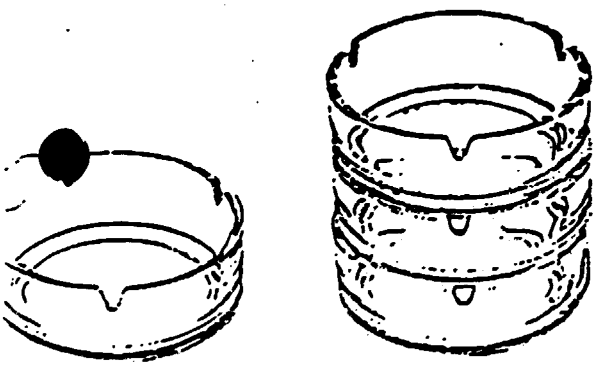
Diameter (cm)	Weight (g.)
20	1,370

ASH TRAY P.42



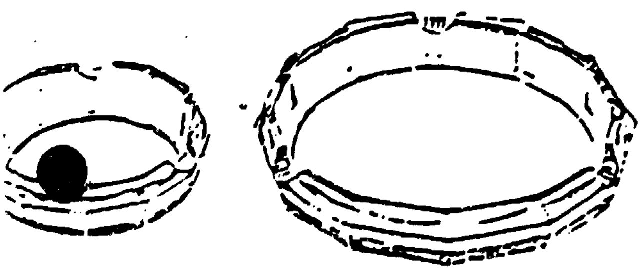
Length (cm)	Weight (g.)
13.5	230

ASH TRAY P.43



Diameter (cm)	Weight (g.)
10	240

ASH TRAY P.44



	Diameter (cm)	Weight (g.)
A	11	275
B	18	660

A N N E X 6.

SELECTION AND TRAINING

The choice of suitable personnel, training and technical assistance are the three basic conditions for the successful starting-up of a factory.

The objective is to apply the methodology of selection, training and assistance so that with increasing autonomy the nationals can take full charge of the running of the plant in the shortest possible time compatible with safety and the capacity of the equipment.

1. SELECTION OF CORE PERSONNEL

This task cannot be undertaken without first of all drawing up a staffing schedule, quantifying the numbers of staff required, defining the functions and job profiles, in terms of the necessary qualifications and knowledge (refer to chapter VII. and VIII.).

Proper selection implies a genuine choice from among a sufficient number of candidates with the required level of qualifications. The selection panel will be made up of a consultant expert, a consultant psychologist, a national psychologist. This panel will be assisted by group of personnel and administrative officers.

2. EDUCATIONAL STRUCTURE FOR TRAINING

The technical training and instruction which the future personnel of the company will receive can only be properly assimilated by the recipients if an adequate educational and methodological structure is set up.

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A sound methodological instruction of future management and supervisory staff will have a determining influence on the practical application of the technical knowledge acquired and the length of time needed to develop sufficient autonomy for the various functions and jobs.

In similar firms in Europe and the United States, management and supervisory personnel take part almost constantly in such training or advanced training courses.

2.1. Training course staff

After completing the training courses in Europe there will be a follow-up to guarantee a maximum acquisition of knowledge and to ensure a continuous feed-back to the future owner.

- Follow-up of trainees and continuous feed-back to the future owner.

- Organization by a specialised consultant.

2.2. Methodological instruction of trainees

The preparation of national management and supervisory personnel for their role in taking over the training of the workers under them is the final target.

The trainees must be seen as the future trainers of their own staff. During their training course they will be specifically trained with this in mind by means of practical exercises.

The trainees will be initiated in the proper use of technical documentation with a view to training their future workers.

2.3. Training on site

The setting up in the Uganda complex of a system of continuous training for management and supervisory personnel will include :

2.3.1. A programme of ongoing training for management and supervisory personnel is to be set up in the plant.

2.3.2. Training of qualified and skilled labour
In-house technical courses will be provided for the main categories of qualified and skilled workers on a discipline by discipline basis.

3. TECHNICAL TRAINING

The training should be carried out in the plants, offices and laboratories which are most representative of the equipment and installations to be used.

The possibilities existing locally for the training of personnel for the sites under consideration must be considered as small. There is little local industry which might allow training, especially if there is little motivation to give such assistance.

But as there are no known real possibilities for local training in glass or porcelain field, eventually agreement could be reached with responsibles of glass factory in Kenya - Burundi - Tanzania.

Quality requirements for packaging differ according to whether the packaging is intended for the food, cosmetics or pharmaceutical industries or other markets.

Quality specifications vary considerably and quality control standards are more or less strict depending on the specific use of the packaging on these different markets.

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If staff are drawn from the glass industry in surrounded countries, they will inevitably need to be trained in a glass factory, a bottle-making plant producing according the european standards, especially if this plant's production of the surrounded countries leaves a lot to be desired in this respect.

Consequently, as part of the Uganda training programme, some of the key personnel recommended below should be trained in Europe.

In any case, selection of people to be trained should be based on a certain industrial experience already acquired, making it possible to limit the duration of the basic training period.

Training will therefore be required for the following posts for which certain basic qualifications will be necessary :

3.1.1. Technical manager and his assistant

Engineers of university level, with a degree in chemical sciences, having had a practical experience of at least 3 years in the glass industry and with a theoritical knowledge of the physics and chemistry of glass and industrial thermology.

3.1.2. Shift manager

Four technicians industrial engineers capable of subsequently taking on the job of superintendent (production).

Two to three years' industrial experience in mechanical engineering is required.

3.1.3. Furnace operators

Four skilled workers with an electrical engineering background and having a similar experience of the glass industry.

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3.1.4. Chief machinists

Two industrial mechanical technicians having at least 3 years' experience, if not in the glass industry, in a highly automated industry.

3.1.5. I.S. machine operators

Eight skilled workers with mechanical background having at least 2 years' experience in a continuous manufacturing industry using automated machinery.

3.1.6. Mould fitter operator and repair

One skilled worker specialised in machining and turning, already having at least 2 years' experience in a maintenance department involving turning, milling, welding, coating and machining.

3.2. Auxiliary staff

Training of auxiliary staff might possibly be also considered for peripheral services such as general mechanic, general maintenance, finished products store organization.

We suggest to concentrate on the most important one.

Electrician-instrumentation

One technician engineer trained in electrical engineering with industrial experience in the maintenance of small mechanical parts for automatic machinery.

3.3. Quality control and laboratory

It is important that the operators should be left to make the most efficient use of their production plant and personnel by relieving them of other specific problems which are not directly connected with production.

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3.3.1. Preparation of raw materials

The task of the raw material laboratory, upstream of the batch house, is to supply the furnace with the right quantity and quality of raw materials.

The technical back-up is provided, laterally, by the central laboratory and, in direct line, by the technical management.

3.3.2. "Physico-chemical laboratory"

The laboratory must deal with the day-to-day problems of quality, of materials, finished products and pyrometry or measuring instruments for all the other departments.

3.3.3. Quality control responsible

He must set up and maintain the quality charts and has to ensure the proper application of quality requirements for production and the unambiguous interpretation of possible disputes between clients and producers.

For these 3 activities, training will be given to :
One industrial engineer of university level graduate in chemical engineering with at least 3 year's practical experience of chemical analysis (mineral field, statistics).

3.4. Management

There is no provision for specific training at main management level and for other management such as administrative and commercial.

Commercial and administrative practice is specific to the country under consideration. Candidates selected for management positions will have to adapt the technical features of the product to the specific local conditions.

Nevertheless, a series of seminars or information courses is to be arranged.

A N N E X 7.

EXTENT OF CIVIL WORKS

1. SITE INSTALLATION AND GENERAL LEVELLING

This work includes :

1.1. Warehouses, workshops, offices, mess, storage areas for the use of the civil contractor who will perform the civil works, for the investor and for the general contractor.

Including :
- a sanitary installation with good removal of waters ;
- a provisory network of drinking and non drinking water to fulfill the civil works needs and for the buildings to be provided under this article ;
- a provisory electricity distribution network feeding the civil works and the buildings to be provided under this article.

1.2. A network of benchmarks allowing exact setting out and levelling of buildings, structures and equipment.

1.3. Proper maintenance, clearing, repair, etc ... of the buildings to be provided under this article.

1.4. The area will be made free from all obstacles, trees, structures if any, prior to stripping off a 10 cm. thick top soil layer. Subsequent levelling will be to levels indicated on the drawings.

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2. ROADS - SEWERAGES - TRENCHES

This work includes :

2.1. For roads and paved areas : the excavation of tne bed, the constitution of the sublayers, and casting or laying down of the top layer(s).

2.2. For sewerage : channels, gutters, pipes, visiting pits, manholes, etc ... outside the buildings for a proper removal of rainwater on the one hand and of the industrial effluents on the other hand.

These sewerage system(s) will be brought up to the factory battery limit by gravity and without any special treatment.

2.3. For electrical and/or telephone cables : to be put in trenches on a draining sand layer.
Road crossings will be either through concrete culverts or steel pipes. The cables themselves are excluded from the civil works.

3. FOUNDATIONS - SLABS - VARIOUS CONCRETE STRUCTURES

This work includes :

3.1. Execution of foundations in reinforced concrete, whether or not interconnected with beams, as there are :

. steelframed building foundations ;
. machinery and equipment foundations (in and outside the buildings) ;
. pipe rack foundation ;
. electrical poles, signalling foundations ;
. conveyor foundation (outside the buildings).

3.2. Execution of slabs :
- . the slab proper with joints ;
- . sewers for removal of industrial effluent to the building limit ;
- . minor foundations for fixing ladders, supports for pipes or small conveyors, etc ...

3.3. Execution of various concrete structures.
There will be reinforced concrete structures such as retaining walls, cellars, pits, basins, towers and some minor reinforced concrete building such as fuel tank station, pumping stations and others.

4. STEEL FRAMED BUILDINGS

Following works related to steel frames buildings form part of the civil works.

4.1. All steework as toe guards, safety guards, handrailing ladders, covers for culverts, trenches, etc ... being fixed in or on concrete structures, floors, pits, culverts, trenches, etc ... as per detailed drawings.

4.2. The putting of siding and the roofing which will be made of aluminium corrugated sheets with about 8 % of horizontal surface of roof and of the surface of sides in translucent sheets;

4.3. The painting of structural steel, joinery, metal accessories, walls, etc ... The supply of the painting forms part of the civil works.

4.4. The internal and external walls with rendering and/or plastering, etc ... as may be required.

./.

5. MATERIALS AND GOODS - FINISHING WORKS - APERTURES - SEALING

5.1. The supply, delivery and execution of materials, goods, etc ... needed for proper execution of the works form part of the civil works.

5.2. Where specific materials are required the supply should comply with such requirements.

All finishing work, wall rendering, coating, painting, tiling, glazing, false ceiling, etc ... form part of the civil works.

5.3. All wall, ground floor, upper floor and roof apertures for piping, cables, trenches, channels, conveyors, etc ... form part of the civil works.

5.4. Sealing of equipment, included grouting, forms part of the civil works.

A N N E X 8.

EXTENT OF ERECTION WORKS

1. SCOPE OF THE ERECTION WORKS

1.1. The erection works include :

a. reception and offloading of all machinery, equipment, structural steel and materials related to the project ;
b. checking, handling and storage of the supplied machinery, equipment, structural steel and materials ;
c. erection, alignment and levelling of all steel framed buildings and warehouses ;
d. putting, alignment, levelling and mechanical connections of all machinery, equipment, materials with its support or supporting structure, if any ;
e. all piping work including supports and lagging ;
f. all steelworks for tanks, vessels, hoppers, ducts, etc ... including lagging, if any ;
g. the lining with and putting of refractory bricks in furnaces, flues, etc ...
h. putting of boards, fixing of cable trays, laying of cables, connection of them ;
i. complete installation of control equipment, including trays, pneumatic piping, control wires, control devices and the connection of them to boards and/or recording equipment, valves, etc ...
j. all tests for completion of the factory including mechanical, vapour, hydraulic, pneumatic, electrical tests and blank tests to check if the factory is ready to receive the raw material ;
k. all works during the period of maintenance to be done.

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During erection works the supply to foreseen for :

a. the basic raw materials including water that are required for the manufacture of the product ;
b. the operating supplies and materials particularly materials that are required for the proper operation of the processing machinery e.g. oils, greases (including the first filling), chemicals, fuel oil, gas oil, gas, detergents for cleaning machinery and so on.

1.2. Consumables and tools.

Supply and delivery of all consumables, shims, welding rods, tools, etc ... needed during erection of the factory and not expressly planned to be supplied with the different equipment form part of the erection works.

2. ERECTION WORK MANAGEMENT AND SUPERVISION

The erection contractor should manage the erection works by a competent staff. Skilled workers with aids will carry out erection.

However, for the specialised equipment, supervisory personnel of the equipment supplier will be provided during erection and start-up of such equipment.

./.

ANNEX 9.

22328c abay b
22203 afdev ci

n/ref/mm5738/k.h.

attn: mr. r. vroonen

subject : uganda: glass container production plant

reyurtlx of 23/3/89 on above. please be informed current terms on adb loans are:

interest rate	: 7.40 per cent p.a.
commitment charge	: 1 per cent p.a. on undisbursed amount starting 45 days after loan signature.
duration	: 20 years including a maximum grace period of 5 years

please note interest rate is reviewed every six months. project itself is still being discussed btn the bank and gou.

best regards

a.d. mtegha
chief east african division

no: 8417 29.03.89 09:16
from:african development bank - abidjan

22203 afdev ci
22328c abay bggg

ANNEX 9.

n.

22328a abay b

22328a abay b
23263 afdev ci - o/ref:mm.5761/asf

tlx nr 22328 b abay b
belgium

subject : uganda glass container project
reference is made to yrtlx a/89(317/0034 cj dated march 17 1989 on
the above subject stop
ourfinancing of the project is contingent upon the request of the
ugandan government and upon the priority accorded to the said project
stop the adb does not normally finance local cost of theproject stop
the interest rate is adjusted half yearly stop at the moment it is
7.43. the duration of loan depends on the project stop this
information is provided as guidance, and it does not constitute any
commitment to adb in financing the said project. regards

k. apetey
director nisi
afdev

no: 3991 23.03.89 15:27
from: african development bank - abidjan

23263 afdev ci
22328a abay bwwwwwn

ANNEX 9.

223284 abay b
wbk wash tdx0

zczc tdx15?75 xras0518
wdial
ref : ca2cr
846 22328 =
-abay engineering
-brussels, belgium
bt

washington d.c.   31-mar-89 vs1/6798
attn: mr. r. vroonen

i am the ifc investment officer with primary responsibility for uganda and your tlx of march 23rd has been passed on to me. i regret that we are not considering new projects in uganda at this time due to payment arrears at the ugandan central bank on our existing portfolio. moreover, a project like this would be of interest to us only if it could generate enough foreign exchange to meet its foreign exchange requirements including debt service obligations without resort to central bank allocations.

kind regards,
harry greaves, ifc

=0331111

nnnn

wbk wash tdx0

22328a abay b