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18539
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FEASIBILITY STUDY FOR THE PRODUCTION OF CHROME TANNING SALTS IN ZIMBABWE

FINAL REPORT
VOLUME - 1

MULTI PROJECTS AND DEVELOPMENT CONSULTANCY PVT. LTD.

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UNIDO CONTRACT NO 89/26 DATED 30/05/1989

FEASIBILITY STUDY FOR THE PRODUCTION OF CHROME TANNING SALTS IN ZIMBABWE

MAY 1990

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THE PROJECT

Zimbabwe has one of the largest reserves of Chrome ore in the world. One of the products which could be produced from this resource is Chrome Tanning Salt (hereafter referred to as Basic Chrome Sulphate or BCS) which is used in the leather tanning industry.

The total regional demand is currently imported although the production of a local substitute was attempted in 1977. The local product was a liquid form and the preference of the industry was for a spray dried powder.

The local production was also not economically viable. It was surmised that if the production could be in excess of 800 tonnes per annum, the project could be viable. With the increased co-operation among the African States and with the coming into being of the SADCC, a review of the project was thought necessary.

The project was one of the several projects identified in the investment promotion meeting of the SADCC countries held in November 1986 in Harare, Zimbabwe.

The Government of Zimbabwe had requested UNIDO to prepare a feasibility study.

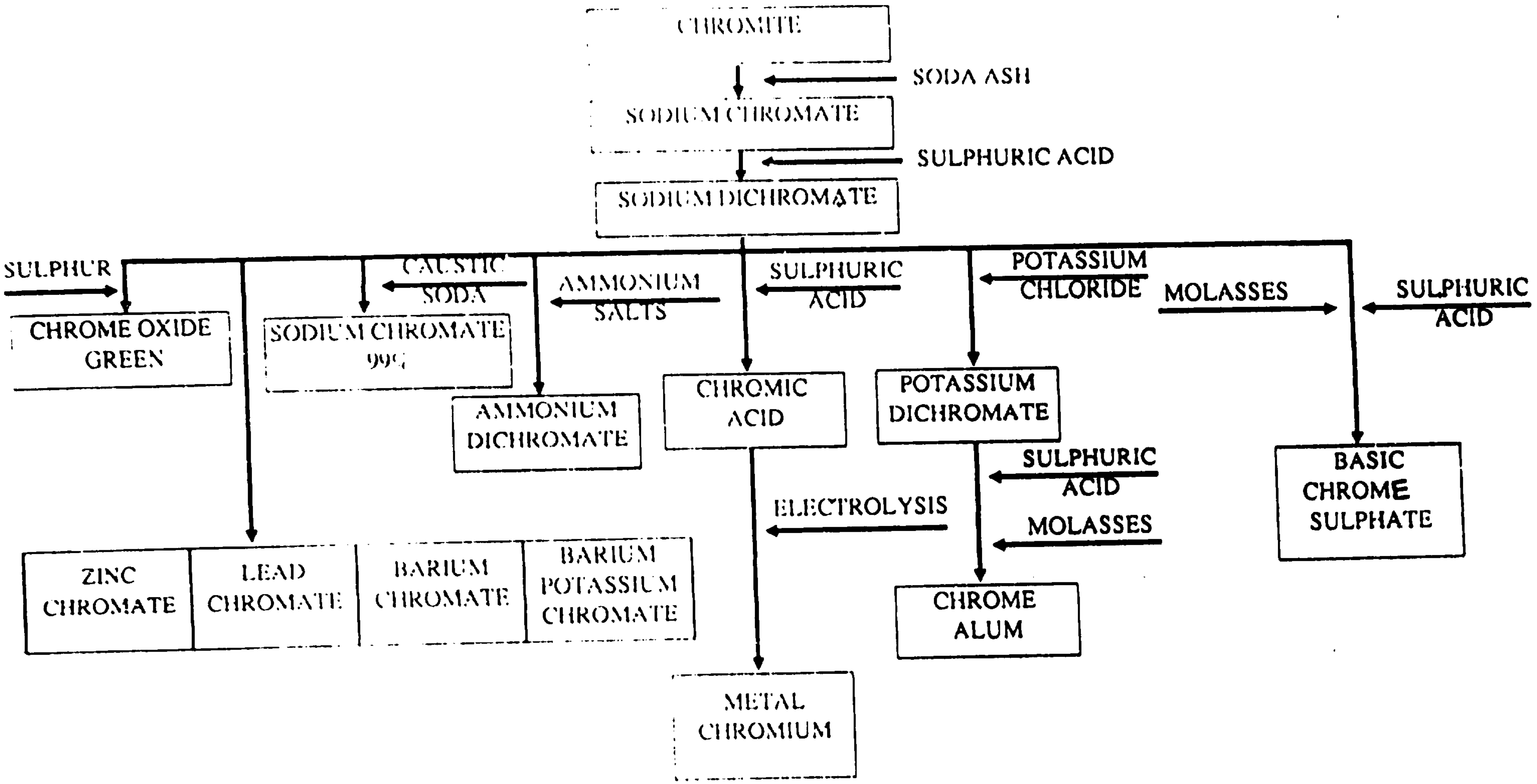
The contract for the study, Contract No.89/26, entitled "Feasibility Study for the Production of Chrome Tanning Salts was awarded by UNIDO to a consulting firm in India - Multi Projects and Development Consultancy Pvt. Ltd.

Accordingly, a team of experts visited Zimbabwe between 18th July and 18th August 1989.

The team consisted of:

Mr. B.M. Shanthamurthy	Team Leader, Financial Expert
Mr. U.V. Kunikullaya	Chrome Salt Manufacturing Expert
Mr. C.D. Gopalarathnam	Project Engineer
Mr. Ramesh Ramaswamy	Market Analyst

CHROMIUM CHEMICALS



CHROMIUM CHEMICALS-USES

CHROMIC ACID:

1. Hard and decorative Chrome plating
2. As oxidising agent in organic reactions
3. As a clensant in glass industry
4. As laboratory chemical
5. As a catalyst

CHROME OXIDE GREEN:

1. Mild abrasive for spark plugs
2. Cement paint
3. As flux for electrodes

SODIUM CHROMATE:

1. Water treatment as inhibitor for cooling water pipes
2. Stand-by boiler as inhibitor

AMMONIUM DICHROMATE:

1. Ammunition
2. Lithographic printing

POTASSIUM DICHROMATE:

1. As Laboratory reagant
2. As a oxidising agent where moisture free reactions are carried out
3. As a cleaning agent for gold and silver

CHROME ALUM:

1. Photographic chemical

BASIC CHROMIUM SULPHATE:

1. Leather tanning
2. Mineral khakhi dyeing

METAL CHROMIUM:

1. Special steel compositions (High temperature steels)
2. Solar cells

CHROMIUM PIGMENTS:

1. Marine corrossion prevention paints - Barium Potassium Chromate
2. Zinc Chromate - High temperature paints
3. Lead Chromate - As primer in various shaded paints

SECTION I

EXECUTIVE SUMMARY

CONTENTS

1.1. PROJECT BACKGROUND AND HISTORY

1.1.1. Zimbabwe: Country Profile

- *Land locked country sharing borders with Zambia.Mozambique, Botswana and South Africa*
- *Area 390245 Sq.Kms*
- *Four-fifths of the country lies 600m above sea level.*
- *Population (1982) 7.6 million Growth rate 2.9%*
- *76.6% Literacy using UNESCO's definition.*
- *Well covered by railways. Railway connects Zimbabwe with Mozambique, Zambia and South Africa*
- *Road coverage is adequate and the road conditions are good.*
- *Well connected by Air*
- *Nearest Ports are Beira (Mozambique) and Durban (South Africa)*
- *Telecommunications are satisfactory*
- *Politically stable*
- *Mineral rich country. Mines Gold, Silver, Chrome, Coal, Copper, Nickel, Iron Ore, Cobalt, Tin Metal and Asbestos*
- *Industrial infrastructure is good and a substantial manufacturing sector exists. Utilities like power, water are adequately available*
- *Satisfactory banking system. Five major banks with 119branches and 75 agencies throughout the country*
- *Currency Zimbabwe dollar Z $ fluctuates around 2.1 Z $ = 1 US$ Foreign exchange situation is difficult*
- *Average inflation is between 10% and 15%*

1.1.2. Project Idea

The tanning industry in Zimbabwe is well developed. Between the four tanneries 400 to 450 thousand hides are tanned annually. This requires approximately 900 tonnes of BCS (Basic Chrome Sulphate) per annum assuming BCS is consumed at the rate of 8% per tonne of hides tanned.

The basic raw material Chromite is mined in Zimbabwe and the country has one of the largest known reserves of this mineral.

As there are existing associations of countries for mutual economic cooperation (SADCC & PTA) the idea of manufacture of this chemical was mooted. The project would feed the requirements of Zimbabwe as well as the neighbouring countries.

The Government of Zimbabwe had requested UNIDO to carryout a feasibility study and the project was subcontracted to Multi Projects & Development Consultancy Pvt. Ltd., Bangalore, India.

1.1.3 The Promoter

The project is expected to be promoted as a joint sector project with the Industrial Development Corporation, Zimbabwe, Government of Botswana and private industries in Zimbabwe sharing the equity. It is expected that the suppliers of technology, plant and equipment will also take a small portion of the equity.

1.1.4 Raw Materials

The raw materials required for the project are Chromite, Limestone, Molasses (all available in Zimbabwe), Sulphuric Acid (partly to be imported from Zambia) and Soda Ash (to be imported from Botswana).

1.2 MARKET & PLANT CAPACITY

1.2.1 Introduction

The production of BCS involves first converting the Chromite to Sodium Dichromate which is then converted to BCS. Sodium Dichromate is an input raw material for various industries viz., Pigments, Chromic Acid, Electroplating, etc. However, as the downstream industries are not developed, it is assumed that the entire Sodium Dichromate will be converted to BCS. As the development plans for the downstream industries using Sodium Dichromate will involve a major independent study, it was decided to restrict the study to BCS as per the TOR.

Sodium Sulphate is a by product. BCS is primarily used in the Chrome tanning industry. Although many other methods of tanning are in practice, it is estimated that 95% of the leather is Chrome tanned.

1.2.2. The Tanning Industry in Zimbabwe

There are only four tanneries in Zimbabwe The tanners largely tan hides as the skin availability in the country is negligible The tanning of Game Skins forms a very small portion of the total tonnage tanned

Due to a drought in Zimbabwe and the foot and mouth disease, there has been a decline in the hide availability and the tanneries are operating at only 60% of the capacity.

1.2.3 .Markets

The minimum economies of scale dictate that production capacity of the plant would be far in excess of the requirements of Zimbabwe

The cost of manufacture will also be higher than the international competitors due to the fact that some key raw materials are more expensive in Zimbabwe and the fact that the plants of some of the competitors are much larger offering better economies. Due to this it would not be possible for the products from the project to compete in international free markets

In view of this, it was decided to focus on the PTA region covering twenty Southern and East African Countries as: (See Map in Annex No I 1, page No. 136)

a) The countries are proximate to Zimbabwe
b) Differential tariff protection could be sought in order to neutralise the higher production cost. This is withinthe charter of the PTA Treaty

The total theoretical potential in the PTA region for BCS was estimated. This is arrived at assuming that the entire hides and skins available from slaughter is tanned. However, in many of the countries, the tanning capacity is far lower than required to tan the entire availability of hides and skins

As can be seen from the estimation of market potential, the viability of the project is going to be excessively dependent on the effective working of the PTA agreement and on the economic performance of the countries with whom trade is envisaged.

The Governments of these countries as well as international agencies are working towards increasing the tanning capacity in these countries.

BCS is also used in textile dyeing. However, the consumption is negligible.

The by-product Sodium Sulphate has a ready market in Zimbabwe. It is used in the detergent, paper and glass industries. At full production the output is expected to be 3,600 MT/Annum and this can be consumed in Zimbabwe, where the product is now being imported.

1.2.4. Pricing

The current landed price of BCS in Zimbabwe, including freight and 20% import tax isZ $ 2585 per tonne. It is proposed to price the product from the proposed plant at Z$2287/tonne ex-factory for the local market. There will be no agents for the sales. At this price, the product from the project will cost the local consumers nearly the same price as the landed price from the international suppliers

The price for exports will be maintained at Z $ 2142.5 ex-factory.

All prices have been calculated on an ex-factory basis for calculations in the report.

1.2.5.Plant Capacity

The minimum capacity of the plant has been arrived at based on the following considerations:

a) Efficient use of inputs and fuel

b) Investment per unit production

c) Economic scales for material handling

d) Investments on pollution control

e) Marketability.

The product can be produced in the small scale involving substantial manual material handling. In view of the health of the workers and protection of the environment, this is not advisable

The various costing aspects were worked out for three capacities Viz., 3600, 7200 and 11500 MT/Annum.

The calculations are given below:

COMPARATIVE INPUT ECONOMICS

Capacity (BCS)/Annum	3,600MT	7,200MT	11,500MT
Investment Z$	11 million	19 million	25 million
Raw material costs Z$/tonne of finished product			
Chromite	128.70	77.22	64.34
Soda Ash	536.25	390.00	357.47
Lime Stone	56.10	29.92	28.08
Sulphuric acid	775.25	440.00	400.00
Coal	225.00	125.00	100.00
Molasses	33.00	33.00	33.04
Packing	32.00	32.00	32.00
Power & Water	30.00	31.73	31.73
Total input costs	1816.05	1158.87	1046.66

In view of the economics a plant of capacity 11,500 MT per annum has been considered most economical. On this basis, all other details have been worked

1.2.6. Production Programme

From the point of view of viable operations the following Production Programme is foreseen

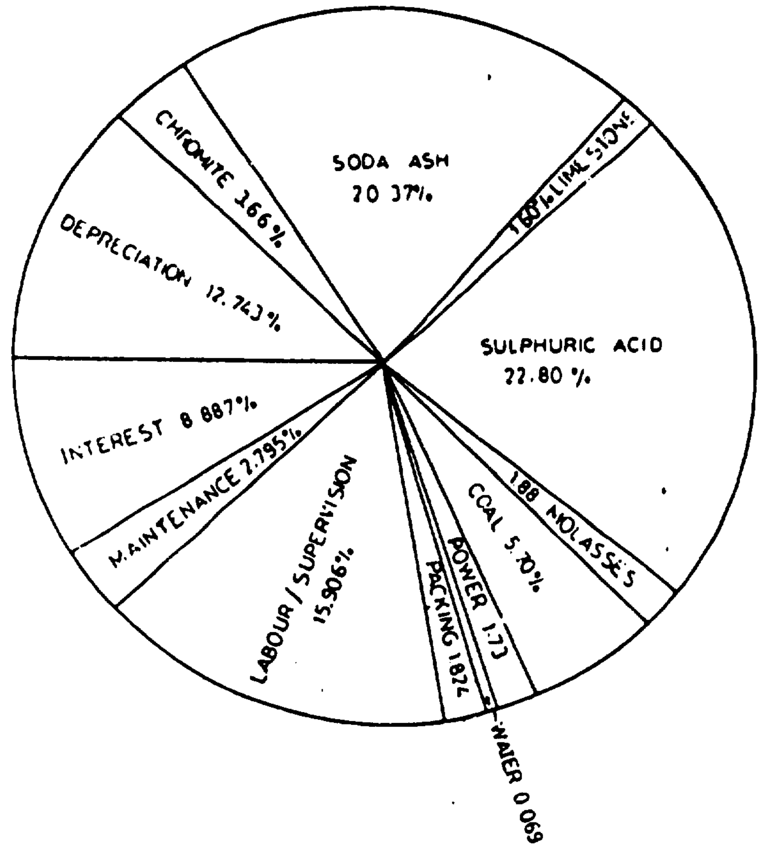
1st year	5750 MT
2nd year	6900 MT
3rd year	8050 MT
4th year	9200 MT
5th year	10,350 MT
6th year	11,500 MT

The slow growth in capaacity utilisation is due to the difficult marketing environment envisaged

BREAK DOWN OF PRODUCTION COST

PRODUCTION COST

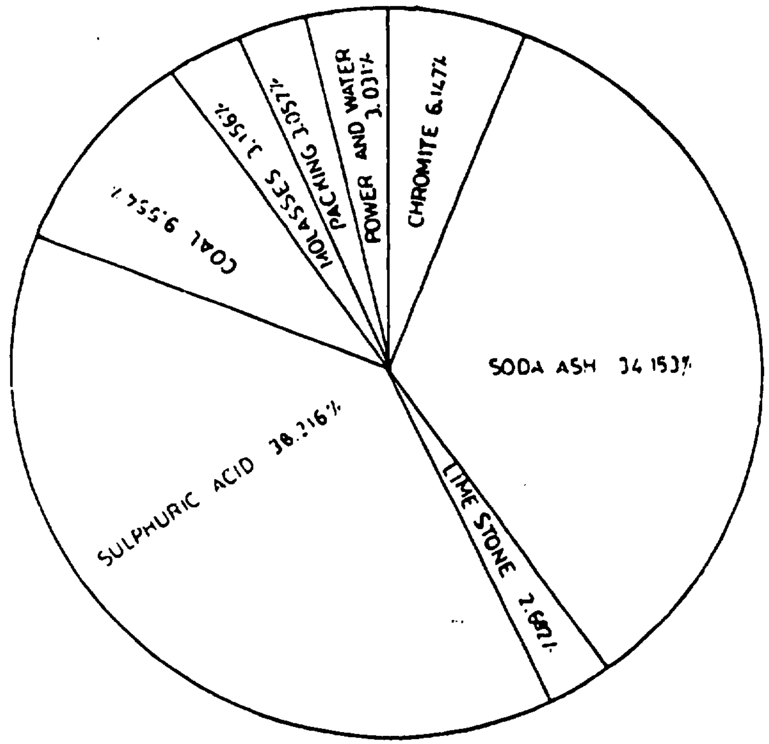
CHROMITE	740.20	3.60%
SODA ASH	4111.00	20.37%
LIMESTONE	323.00	1.60%
SULPHURIC ACID	4600.00	22.80%
MOLASSES	380.00	1.88%
COAL	1150.00	5.70%
POWER	351.00	1.73%
WATER	14.00	0.069%
PACKING	368.00	1.824%
LABOUR/SUPERVISION	3209.00	15.906%
MAINTENANCE	564.00	2.795%
INTEREST	1793.06	8.887%
DEPRECIATION	2570.92	12.743%
TOTAL	20173.98	99.964%
Z$ 1754.26		



BREAK DOWN OF METERIAL COST

CHROMITE	6.147%
SODA ASH	34.153%
LIME STONE	2.682%
SULPHURIC ACID	38.216%
COAL	9.55%
MOLASSES	3.156%
PACKING	3.057%
POWER AND WATER	3.031%
TOTAL	99.996%

RAW MATERIAL COST FOR BASIC CHROMIUM SULPHATE
PRODUCTION CAPACITY 11500 MT ANNUM



1.3. MATERIAL AND INPUTS

Input	Requirement per Annum in MT	Source	Cost in Z $ Per Tonne	Mode of Transport to site
Raw Material				
Chromite	9000	Local	78	Rail
Soda Ash	6000	Botswana	650	Rail/Road
Sulphuric Acid	9200	Local 30% Zambia 70%	500 488	Road by tankers
Limestone	9000	Local	34	Rail
Molasses	2300	Local	165	Road by tankers
FUEL				
Coal	2400	Local	50	Rail
UTILITIES				
Power	1300 KVA + 700 KVA for Housing Street Lighting	Local	0 06/unit	-
Water	183 M^3/day	Local	0 25/M^3	-

1.4. LOCATION

The selection of the site was based on the following criteria:

1. Availability of good quality of water in sufficient quantity
2. Availability of power from the national power grid
3. Proximity to sources of raw material
4. Proper Road and Rail linkage for the transportation of raw materials fuel to the site and also finished goods to the market
5. Trained manpower availability
6. Topography and distance from the agricultural operations, water ways, human habitation and aquatic life
7. Socio economic environment
8. Government policies
9. Land availability and its developmental costs
10. Climatic conditions
11. Proximity to treated waste disposal sites

Based on these criterial, among the three alternative locations, viz., Kwe Kwe, Eiffel Flats and Plum Tree. Plum Tree was considered most suitable.

I.4.1 Ratings of alternate locations

CRITERION	PLUM TREE	EIFFEL FLATS	KWE KWE
1. Water availability in quality & quantity	4	4	3
2. Availability of power from the national grid	5	4	2
3. Proximity to sources of raw material	10	7	7
4. Proper road and rail linkage for transportation of rawmaterials	10	10	10
5. Trained manpower availability	5	1C	10
6. Topography and distance from agricultural operations, waterways, human habitations and aquatic life	10	3	3
7. Socio economic environment	3	1C	10
8 Government policies	10	5	3
9. Land availability and its developmental costs	10	3	3
10. Climatic conditions	10	3	3
11 Proximity to treated waste disposal sites	10	1	1

*Score on a scale of 1 to 10

1.5.PROJECT ENGINEERING

The process is detailed in the enclosed flow sheet ,page No 89

The plant will consist of mainly

a) Raw Material Preparation System such as crushing. grinding.mixing and storage of raw materials like Chrome Ore. Lime stone. Soda Ash. Diluent and concentratedSulphuric Acid. etc.

b) Continuous rotary kiln for roasting Chrome Ore and Soda Ash ino Soluble Sodium Chromate with a rotary cooler to cool the roast. The kiln is suitably lined with refractory material. It is also equipped with continuous weight proportioning device, material handling system. Air pollution control system, continuous fuel firing system including waste heat recovery facilities.

c) Continuous Leaching to extract Sodium Chromate solution.to recover diluent and solid waste handling.

d) Acidification of Sodium Chromate to dichromate evaporation of Sodium Dichromate. clarification and thickening. storage. crystallising. etc.

e) Separation of yellow Sodium Sulphate and purification of the same to Sodium Sulphate anhydrous.

f) Preparation of Basic Chromium Sulphate solution spraydrying. packing

g) Treatment of solid and liquid effluents

h) Auxiliary Services viz., Steam. power. process water treatment, etc.

The Initial Investment Costs

	In Million Z$
1. Land (10 Hectares)	0.025
2. Site preparation & development	0.075
3. Structural	3.390
4. Civil	0.115
5. Plant & Machinery	14.100
6. Auxillary Services	2.193
7. Electricals	0.690
8. Effluent Treatment	0.612
9. Technology fees	1.500
10. Working capital margin	0.500
11. Preoperative & Contingency	1,800
TOTAL	25.000

Initial Investment Costs (Local And Foreign)

Project Cost Million Z$		1st year Local	1st year Foreign	2nd year Local	2nd year Foreign	3rd year Local	3rd year Foreign
0 025	1. Land	100%	-	-	-	-	-
0 075	2. Site Preparation & development	100%	-	-	-	-	-
3 390	3 Civil & Structural	20%	-	80%	-	-	-
1 500	4 Technology knowhow	-	50%	-	35%	-	15%
14 000	5. Machinery & Equipments	26%	14%	39%	21%	-	-
2 193	6 Auxiliary Equipments	40%	-	60%	-	-	-
0 400	7 Pre production expenses	25%	25%	25%	25%	-	-

Does not include contingency, pre operative expenses, working capital margin, part of auxiliary services, effluent treatment

SODIUM SULPHATE PRODUCTION COST

	Raw material per tonne of Sodium Sulphate	Unit price ZS	Cost Per tonne of Sodium Sulphate ZS
1 Yellow Sulphate	1.1 MT	0.00	0 00
2 Sodium Sulphite	0.004	3000 00	12.00
3 Sulphuric Acid	0.007	500.00	3.50
4 Steam	3 2 MT	5 00	16 00 Free from S D Production
5 Power	90 0 MWH	0 06	5 40 Charged to Sodium Dichromate Production
6 Water	1M3	0 20	0.25
7 Packing 20 0Nos	1 60	32 00	
8 Labour	1.5 Nos	--	15 00 Charged to S D.Production
			84 15

Selling Price - ZS 300 00

Production of $Na_2 SO_4$ per tonne of BCS Produced - 0 33 MT

1.6 .PLANT ORGANISATION, ADMINISTRATION AND OVERHEAD COSTS

The overhead cost estimates are given below.

OVERHEAD COST ESTIMATE ('000 Z$)

No.	ITEM DESCRIPTION	TOTAL Cost '000 Z $
1	Maintenance, building & Civil works	23.0
2	Insurance	260.0
3	Communication	50.0
4	Travel	50.0
5	Effluent disposal	7.5
6	Protection Clothing	30.0
7	Office Supplies	50.0
8	Housing allowance	-
		470.5

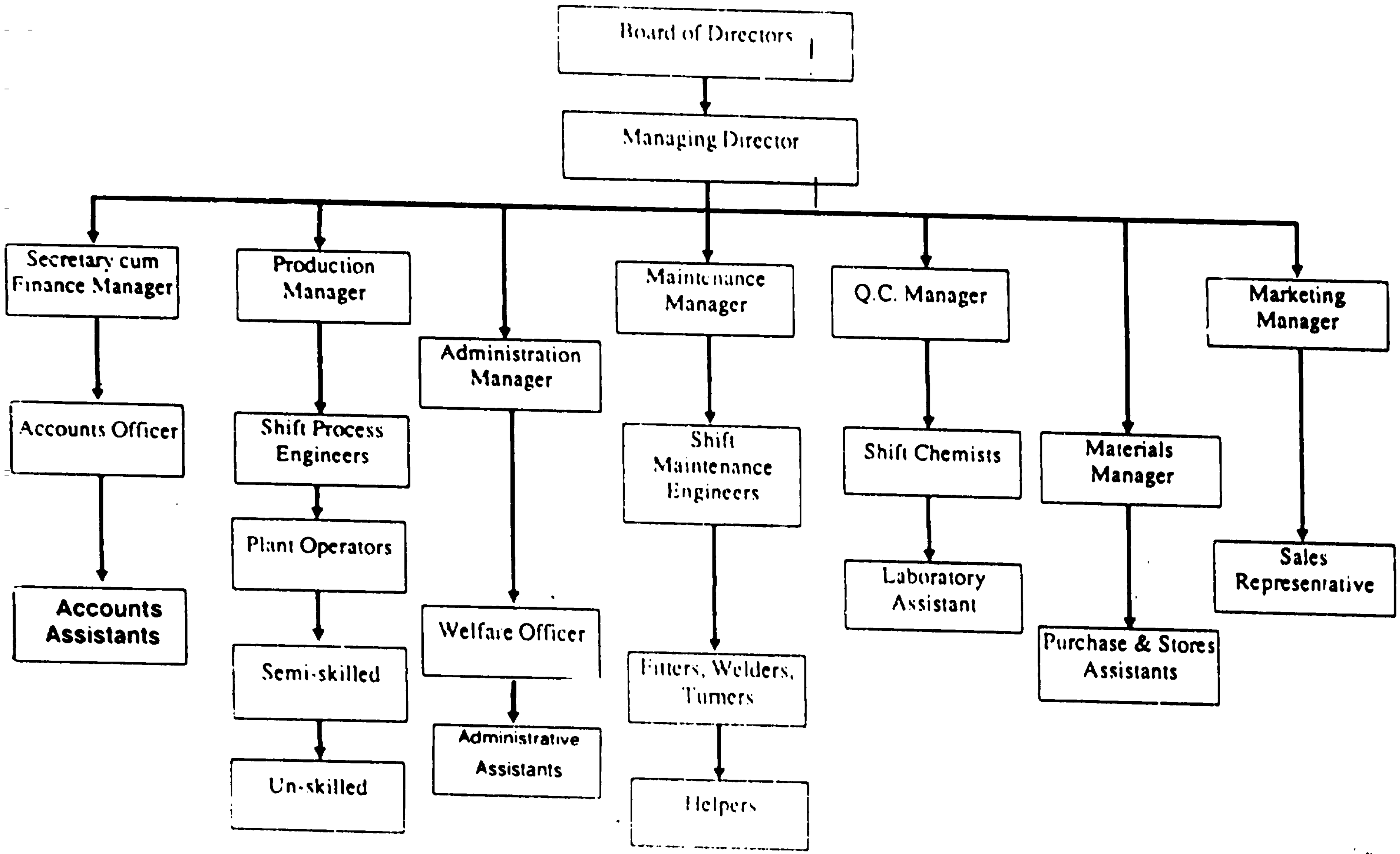
1.7. MANPOWER

The requirements of manpower are

Managerial	7
Engineering/Technical	16
Supervisory/Clerical	18
Skilled	35
Semi skilled/unskilled	214
	290

The personnel with the required skills can be sourced in Zimbabwe. The suggested organisation chart is enclosed.

ORGANISATION CHART



I.9. FINANCIAL AND ECONOMIC EVALUATION

FINANCIAL ANALYSIS

The calculations have been done with the assistance of COMFAR and the relevant tables are enclosed in Volume II.

ASSUMPTIONS: for Financial Analysis and COMFAR
Initial Investment:
Depreciation Rates:

Site preparation, Civil works	5%	
Technology, Equipment, Auxilliaries and pre production expenses	10%	
Salvage value	25% on site preparation and Civil works	
	100% on land	

No replacement Investments on fixed assets have been included in this report

PRODUCTION COSTS (cost of goods sold)

Expenses Head	B.C.S. Foreign	B.C.S. Local	Sodium Sulphate (by product) Foreign	Sodium Sulphate (by product) Local
Raw material - A	Soda ash	Chromite limestone	Sodium Sulphide	
Raw material - B	70% of Sulphuric acid	30% of Sulphuric acid	100% of Sulphuric acid	Packing material
		Molasses		
		Packing material		

PRODUCTION COSTS (cost of goods sold) (contd.)

Utilities		Water Power	All costs included in BCS
Energy		Coal	All costs included in BCS
Labour		All labour	All costs included in BCS
Maintenance		All costs	All costs included in BCS
Spare parts	25%	75%	All costs included in BCS

Factory overheads: All costs are included in BCS

Note: Raw material, utilities and energy are considered as 100% variable. Labour, Maintenance and spare parts are considered as 100% fixed

PRODUCTION & SALES PROGRAMME

a) Capacity utilisation

It is expected that starting with 5750 MT in the first year, it will take till the 6th year to reach full capacity. This slow growth is due to dificult marketing situation envisaged.

b) Local & Foreign Sales

In the case of BCS, the local sales is taken at 900 tonnes per annum constant. The balance will be exported. In the case of Sodium Sulphate, all sales are local sales

c) Prices

Ex Factory prices are.

BCS Local	- Z $ 2287 per Tonne
BCS Export	- Z $ 2142 5 per Tonne
Sodium Sulphate (Only local)	- Z $ 300 per Tonne

CAPITAL

Days coverage

Receivables	- 30 days
Raw Materials - A	- 30 days
Raw Materials - B	- 7 days
Utilities	- -
Energy	- 7 days
Spare parts	- 360 days
Work in progress	- 2 days
Finished goods	- 10 days
Cash on hand	- 1 day
Payables	- 14 days

25% of initial working capital has been included as initial fixed investment

SCHEME

a. Initial Investment

Equity	- 40%
Long term loan	- 60%

b. Loan conditions

Interest	- 16% (Nominal)
Grace period	Repayments to start at the end of Second Year of Commercial production

Repayment pattern	-10 equal annual instalments
Interest during construction	Financed by equity

C.Working Capital

25% of initial working capital is financed as initial investment . 75% is assumed to be a short term revolving loan Interest is assumed to be 14% (nominal). The increase of working capital required in Year 2 to Year 6 will be financed from internal resources.

TAXATION

Tax rate 50% Constant
Tax holiday 5 years
Losses carried forward 15 years

No dividend payments assumed

EVALUATION TABLE

Criteria	11,500 tonnes/ annum	11,500 tonnes/ annum at 70% capacity	7200 tonnes/ Annum
IRR (before tax) (not in COMFAR Schedules)	18%	13%	9%
IRR (After tax)	15 6%	11 5%	9%
Net present value (000 Z$)	10999	2329	1016
Break Even	67%		105%
Pay back period	5 years	6 years	8 years

From the figures in the evaluation table it is obvious that the plant of 7,200 tonnes per annum capacity is not financially viable The reasons for the poor financial outlook for the 7200 tonnes per annum plant are

a) Poor input efficiency (Raw materials Energy Labour)

b) Higher initial investment per tonne of capacity

In view of these, the smallest feasible capacity of the plant would be 11,500 tonnes per annum

The figures for the 11,500 tonnes plant are acceptable in financial terms

All further evaluation is done only for the 11,500 tonne plant

Return on Equity (ROE)

The Return on Equity has been calculated with the help of the Net Income Statement in the enclosed COMFAR tables (page No. 227).

The Project is expected to incur losses for the first three years (without inflation) of starting commercial production. Hence, effectively, there will be no return to the investor for a long period if the construction period is taken into account. Even after this period, the average return on equity would be maximum of around 26% which is moderate, taking note of the risks involved in the project.

Cash Generation

There is likely to be a cash deficit for two years after start of commercial production. This will be due to the low capacity utilisation and the debt servicing required.

It will be necessary to finance these cash short-falls, either through fresh injection of capital (subsidy, equity, fresh loans) or through conversion of the interest payable during this period as a fresh loan repayable over a minimum of five equal annual instalments. (page No. 225).

A chart depicting the debt service coverage is enclosed as part of the COMFAR schedule as well as a chart of the debt: equity ratios. (page No. 207).

A chart of the Net Profit to total sales is enclosed (page No. 208).

Sensitivity

The sensitivity has been done (please refer chart page No. 210) for variation on Sales price, operating costs and initial investment.

The project is extremely sensitive to variations in operating costs. A 10% increase in operating cost would bring down the IRR to just over 10%.

Secondly, the project is also sensitive to variations in selling price. A 10% decrease in selling price would result in drop in IRR to approximately 8%.

The project is not very sensitive to changes in initial investment.

In view of high sensitivity to operating costs, a version was generated assuming that duties/tariffs on imported raw materials would be waived by the Government of Zimbabwe.

The following are the likely financial results:

Internal rate of return (After tax)	17.6%
Net present value (000 ZS)	15,267.12

With this there is a substantial improvement in the Cash balance. In this case, the only support the project would need would be an additional year grace period for repayments.

ECONOMIC ANALYSIS

As the shadow exchange rate is not available for Zimbabwe, the economic and the cost benefit analysis is limited and certain simplified methods were used for the economic evaluation.

The cost benefit analysis is done only for the plant of 11,500 tonnes per annum capacity.

The criteria for analysis are:

a) The economic rate of return

b) Absolute efficiency test

c) The value added

d) Foreign Exchange

The calculations for these were prepared using COMFAR cost benefit module

The assumptions used were

i)	Foreign component in local equipment	- 28%
ii)	Transfer payments eliminated. Local	
	Raw Material & Capital Goods	- 12% Sales Tax
	Imported Raw Material & Capital Goods	- 20% Duty
iii)	Import substitution	
	Local sales of BCS (900 tonnes) taken border prices without duty	

a) Economic Rate of Return:

The rate of return was found to be 24% and this is 8.5 points more than the financial return after tax. The major reason for this difference is the elimination of duties, and taxes

b) Absolute Efficiency Test:

The project passes this test as there is a net social surplus of Z$ 87 76 million which is 65% of the net national value added

c) Value added

As an illustration, the sixth year of production was considered, the total gross Domestic value addition was found to be 50% of the value of output This amounted to Z$ 12.06 million This broken down into

(all figures in Z $)

Depreciation	2 57 million
Wages	3 21 million
Social Surplus	
Profit	1 79 million
Government	2 09 million
Undistributed	2 40 million

The net national value added was 40% of output

d) Foreign Exchange

All the foreign exchange earnings from exports of the product will be accruing from the PTA countries. The inflows would accrue through the following scenarios:

i) All sales paid for in hard currency

ii) All sales paid for through barter of goods otherwise imported through hard currency payments

iii) Reduction of deficit in the barter system for Zimbabwe (if Zimbabwe has a deficit)

iv) If Zimbabwe has a surplus in the barter system and the trading partner has neither the goods nor the hard currency to settle the payments.

In the financial analysis it has been assumed that all export revenues are paid in Hard Currency (Foreign Currency). The imported materials in investment as well as operating costs have been considered as payments in hard currency.

As the partner countries in the PTA are also passing through difficulties regarding the availability of hard currency, serious efforts are required to source the needs of Zimbabwe from these countries, so that the barter system is successful.

The share of hard currency sales has to be a minimum of 40% in order to balance the foreign currency outflows on account of imported raw materials.

Indirect costs/benefits

The only major indirect cost of the project could be environmental pollution from the project. Adequate precautions need to be taken to minimise pollution. Precautions are also necessary to make sure that the health of the employees is not endangered.

A major benefit from the project could be the spin off of many new industries using sodium dichromate as an intermediary product. Many of these could be in small scale which would promote enterpreneurship and employment.

1.10. CONCLUSIONS

After a detailed study, it is observed that a plant smaller than the one recommended in the report that is, 11,500 tpa of BCS will not be viable

The product from the plant of 11.500 tpa would be substantially more expensive (FOB) than the international market price.

This is partly due to the smaller size of this plant compared to some of the international plants and partly due to the high cost of essential raw materials in Zimbabwe.

Due to this it would not be possible for the products from the project to compete effectively in the international markets. Hence, it is essential that any markets for this product will have to be found in countries where preferential tariffs could be obtained to make it competitive with international sellers

Zimbabwe's own consumption of the product at 900 tonnes would be less than 8% of the total production at full capacity

Such preferential tariff could only be sought within the PTA region. Judging from the figures, even the entire PTA region comprising 20 countries does not hold adequate market potential for the full production of the project.

The critical factor in determining the capacity of the plant is the production of Sodium di-Chromate which is an intermediate product in the manufacture of Basic Chrome Sulphate. Sodium di-chromate could be utilised as an intermediate raw material for many other products including electro-plating, chemicals, pigments, etc

The production of BCS in Zimbabwe could only be possible if its production forms a part of a chrome chemicals complex where a number of products based on Sodium di-chromate are manufactured

In such a case BCS could be produced in much smaller quantities and marketing the product would be feasible.

If such a chrome chemical complex is to be set up, it will need a completely new study, as it involves a detailed study on the market potential of a number of such chemicals in and around Zimbabwe

SECTION II
PROJECT BACKGROUND AND HISTORY

CONTENTS

II.1. GEOGRAPHY

Zimbabwe is situated in South Central Africa between the Limpopo and Zambezi rivers. Bounded by Zambia on the north and north west, by Mozambique on the east and north east, by Botswana on the South west and by South Africa in the south. Zimbabwe is a land locked country which lies wholly to the north of the Tropic of Capricorn.

The area of Zimbabwe is 390245 Sq Kms with a population density of approximately 16 per Sq. Km. Almost the whole country lies more than 300 m above sea level with four-fifths of it above 600 m, but less than a twentieth is above 1500 m.

The land is divided into 4 natural regions

- *The "High Veld" that runs from South-West to North-East; this plateau is 650 Km long and 80 Km wide (altitude between 1,200 and 1,500 m).*
- *The "Middle Veld", with an altitude between 600 and 1,200 m.*
- *The "Low Veld", which consists of the ZAMBEZI valley and the LIMPOPO and SABI basins (altitude below 600 m).*
- *The "Eastern Highlands" at the Mozambique border, which is extremely mountainous with many peaks exceeding 1,800 m (the INYANGANI :2,599 m).*

The climate of ZIMBABWE is tropical changing by altitude, specially on the central plateau.

The average annual rainfall varies from 300 mm (BEIBRIDGE in the south) to 1,000 mm and over (INYANGA near the Mozambican border); at Harare, the capital, the annual rainfall varies from 440 mm (1982/83 to 1.100 mm (1980/81).
ZIMBABWE is divided in 8 administrative regions

MANICALAND, MASHONALAND CENTRAL, MASHONALAND EAST, MASHONALAND WEST, MATABELELAND NORTH, MATABELE LAND SOUTH MIDLANDS, MASVINGO.

The capital is HARARE.

The principal towns population figures of 1982 (within brackets) are:

HARARE (656.000)	BULAWAYO (414.000)
CHITUNGWIZA (173.000)	GWERU (79.000)
MUTARE (70.000)	KWE KWE (48.000)
KODOMA (45.000)	

II.2. POPULATION & ANNUAL RATE OF GROWTH

Population according to 1982 population census is estimated to be 7.6 million. The growth rate is estimated to be 2.9%.

II.3. LITERACY

Zimbabwe's estimated literacy rate using UNESCO's definition was 76.6% in 1982 for those aged 15 years and above. 62% have had at least 3 years of formal education.

II.4. SOCIAL INDICATORS

Life expectancy at birth Male 55 Female: 59

Urban/rural population % 27/73

Source: World Development Report 1987

II.5. COMMUNICATION INFRASTRUCTURE

II.5.1. RAILWAYS & ROADS

Railways of Zimbabwe serve both Zimbabwe & Botswana. A total of 3400 Km of railway track connects Zimbabwe with Mozambique, Zambia and South Africa.

There are 18,639 Km of state roads and 61,630 Kms maintained by local rural and district authorities. The condition of the roads is good. Refer Annexe II.1 page No. 137.

II.5.2. AIRLINES IN ZIMBABWE

In Zimbabwe the national airline, AIR ZIMBABWE in addition to providing domestic services also operates scheduled services to Nairobi, Lusaka, Gaberone, Blantyre, Johannesburg, Durban, Athens, London & Frankfurt. Many other international airlines operate scheduled flights to Zimbabwe.

II.5.3. ACCESS TO PORTS

Being a land locked country the goods to and from Zimbabwe have to be shipped either through Durban (in South Africa) or Beira (in Mozambique). Due to the security problem in Mozambique, a larger share of the goods are transported through Durban.

In addition, there is an inland container service from Harare to facilitate shipments in and out of Zimbabwe.

II.5.4. TELECOMMUNICATIONS

Telecommunication services are wide spread and the quality of the service is satisfactory.

II.6. CONSTITUTION

The legislature of Zimbabwe consists of the President and Parliament, which comprises a Senate and a House of Assembly, the latter being the Lower House.

The President is the Head of the State and the Commander-in-chief of the Defence forces. He is elected by the Members of Parliament and holds office for a period of six years, after which he is eligible for re- election for one further period of office.

There are 40 Senators who are chosen by a combination of electoral colleges, the Council of Chiefs and by Presidential nomination. There is a Senate Legal Committee with powers of security over legislation.

Parliament has a maximum life of five years, after which it is automatically dissolved.

II.7. ECONOMIC AND GENERAL DEVELOPMENT

II.7.1. BACKGROUND:

Zimbabwe's economy is endowed with vast mineral, agricultural and human resources and it is the Government s policy to develop these resources to their maximum potential under conditions of dynamic growth and bearing in mind the need to distribute equitably the ensuing benefits.

It is Government's policy to encourage the beneficiation of minerals and agricultural products within the country wherever possible. This is intended to provide job opportunities for the rapidly expanding population and greater export earnings from a given amount of products.

In the investment field, Government policy is to develop to the full potential the agricultural, mining and industrial sectors of the economy and to this end, Government will encourage and welcome the participation of private enterprise in productive activities which create employment opportunities for Zimbabweans and which make a net contribution to the economy

Government will also consider joint projects with private enterprises in areas which are conducive to the economic development of the country.

In accordance with the policy statement " Growth with Equity " , the Government published the transitional National Development Plan.

The plan seeks to:

a) Co-ordinate development activities, policies and measures;

b) Mobilise and effectively deploy economic, financial and human resources for efficient growth, development and equitable distribution;

c) Enlist support and active participation of all Zimbabweans in the development process;

d) Encourage investors at home and abroad to support and participate in the development plans which will use the budget as the major instrument for plan implementation.

II.7.2. EXTERNAL TRADE

Before independence. foreign trade was only with South Africa because sanctions had been imposed against the illegal regime by the international community

However. since independence. Government has put a lot of emphasis on moving away both exports and imports from South Africa To this end. since independence Government has opened Trade Offices in 19 countries

Priority is also being given to diverting trade traffic from passing through South Africa. With the efforts of SADCC and through assistance from donor countries and agencies. the three ports of Mozambique. i e Maputo. Beira and Nacala. are being expanded and improved as well as the railway lines

Zimbabwe's major exports by product groups. including percentage share are as follows

a)	Manufactured goods classified by materials	29 3%
b)	Tobacco and beverages	20 1%
c)	Crude materials except fuels	17.0%
d)	Food	11 7%
e)	Gold	11 2%
f)	Others	10 7%

II.7.3. MANUFACTURING SECTOR

Zimbabwe's manufacturing sector is an extremely important sector of the economy. It is a well developed and diversified sector producing more than 6500 separately identifiable products Manufacturing sector contributes about 25 per cent of GDP and accounts for about 16 per cent of wage employment

II.7.4. MINING

Mining industry plays a major role in Zimbabwe's economy, contributes 7% of GDP, 6% of employment and 35% to Foreign Exchange earnings. The major mining consists of the following products

MINING PRODUCTION: 1986 AND 1987

	1986 Volume ('000)	1986 Value (Z$ Mln)	1987 Volume ('000)	1987 Value (Z$ Mln)
Gold (fine ounces)	478	292.7	473	349.9
Silver (fine ounces)	840	10.6	815	15.8
Asbestos (tonnes)	164	85.8	193	97.9
Chrome ore (tonnes)	553	39.7	570	44.1
Coal sold (tonnes)	3359	89.1	4639	103.4
Copper (tonnes)	20	42.9	19	46.1
Nickel (tonnes)	10	60.7	10	73.2
Iron ore (tonnes)	1110	21.1	328	28.8
Cobalt (tonnes)	-	2.4	-	1.4
Tin metal (tonnes)	1	10.7	1	11.5
Others	-	39.8	-	43.3
Total	-	695.5	-	815.4

The consumption of Chrome ore by the project at full capacity will be less than 2% of the production of ore.

II.8. INDUSTRIAL INFRASTRUCTURE
II.8.1. BANKING

Reserve Bank of Zimbabwe apart from playing its role in monetary control, acts as Banker to the Government and certain statutory bodies. It is responsible for the issue of currency, administering issue of Government's loans and treasury bills. It also manages loans, sinking funds and hosts the preferential trade area's clearing house to facilitate trade between member states. It also manages the clearing house for the commercial banks which keep accounts with it. It controls the country's foreign reserves and acts as a lender of last resort to the financial institutions Zimbabwe has five major commercial banks. They have totally 119 branches and 75 agencies through out the country. They are. Zimbabwe Banking Corporation, Barclays Bank of Zimbabwe Limited, the Bank of Credit and Commerce Zimbabwe Ltd, Grindlays Bank and the Standard Chartered Bank Zimbabwe Limited.

In addition to the normal banking system the Industrial Development Corporation of the country plays a major role in industrial development. The IDC plays a major role of investing in new projects by taking a part of the equity.

II.8.2. POWER

There is adequate generation of power in the Hydro- electric projects and thermal plants to feed the industrial, agricultural and household requirements. The distribution of power is handled by Zesa managed by the Government Substantial additional investments are taking place in enhancing power generation and investments are also being made in improving the distribution system

II.9. CURRENCY

The Currency of the country is the Zimbabwe dollars (Z $) which fluctuates around 2 1 Z $ = 1 U.S $ The country is facing a difficult foreign exchange position and the controls on imports of goods and currency trade are strict The value of the Zimbabwe dollar has been steady sliding against the US dollar The table below is an indicator

Year.	US $ Equivalent of One Z $	
1980	1.5859	
1981	1.3944	
1982	1.0876	Zimbabwe Dollar devalued by 20% in December 1982
1983	0.9046	
1984	0.6656	
1985	0 6093	
1986	0 5959	
1987	0.6013	
1988 (September)	0.5253	
1989 (September)	0 47	(estimated)

II.10. INFLATION

The consumer price index has been reporting a growth of approximately 15% per annum. The consumer price index with a base of 1980 (100 points) was reported at 244.2 in 1987 as per the quarterly economic and statistical review published by the Reserve Bank of Zimbabwe

II.11. PROJECT IDEA

The Tanning Industry in Zimbabwe though small is well developped. The industry is currently tanning in the range of 400 to 450 thousand hides per annum which would mean the usage of between 800 to 900 tonnes of BCS per annum. Currently the entire requirement of BCS is being imported and cost of these imports works out approximately 2 million Z $

In the current context of a tight foreign exchange situation, the tanners do have some problems in getting necessary allocations from the Government to import BCS. There are also substantial procedural delays in being able to obtain the material

In the light of this situation, the idea of manufacture of BCS has been thought for quite some time. An experimental plant was set up by a local company RIO TINTO some years back. This was attempted to be done on a small scale just to cater to the requirements of the tanning industry in the country. The plant was manufacturing only BCS solution which was not acceptable to the tanning industry. As the plant was of a purely experimental nature it was set up by using local technology and by using machines which were already available with the company. The product was also not of acceptable standard and as the company did not see a large enough market in Zimbabwe for BCS the experiment was called off.

Until two years ago, quite a good part of the hides in Zimbabwe used to be exported in the raw (salt cured) state. In the last two years the Government has banned the export of raw hides which has given a fillip to the tanning industry and also increased the demand for BCS within the country

Healthy development of the SADCC treaty and PTA agreement has also presented an opportunity to Zimbabwe to manufacture BCS so that the needs of the SADCC and PTA countries could be fulfilled (Please refer to section on market and plant capacity for SADCC/PTA arrangements). Currently all these countries are importing BCS either from South Africa or from European countries.

The tanning industry itself is inadequately developed in many parts of the SADCC & PTA countries which should give more work to the tanning industry in Zimbabwe. All the countries in the region are realising the need for value addition to their exports and are realising the need to tan hides/skins for exports rather than export hides/skins in the raw state.

As the various studies carried out by international agencies like UNIDO indicate, there is a substantial potential for growth in the leather industry in Africa. As PTA is in existence, it is quite possible to see a situation where hides from various countries in the region are brought to Zimbabwe for tanning and re-export.

The sizing of the plant is being done keeping in mind economies of scale rather than the demand for the product in Zimbabwe.

In the light of this the project would have to be viewed as an export oriented project in order to feed the leather industry in the PTA region rather than purely an import substitution item for Zimbabwe.

II.12. THE PROMOTER

The project has been initiated jointly by the Leather Institute of Zimbabwe and the Government of Zimbabwe through the Industrial Development Corporation. The Leather Institute of Zimbabwe is a non-profit body and is supported by the tanners of Zimbabwe. If the plant were to be set up, it was indicated that the Government of Zimbabwe through the Industrial Development Corporation would hold substantial portion of the equity and the balance would be held by tanners and some organisations like Rio Tinto, Zimbabwe. As one of the essential raw material Soda Ash is to be brought in from Botswana, the Government of Botswana may also share with Industrial Development Corporation a part of the equity. The management structure of the company is to be decided at a later date.
It is also expected that the suppliers of technology, plant and equipment would also hold a small portion of the equity

II.13 RAW MATERIALS

The industrial environment and infrastructure in Zimbabwe are very healthy and it seems logical for Zimbabwe to take a lead in manufacture of products to feed other African countries and promote inter Africa trade. The basic raw material Chromite is abundantly available in the country and Zimbabwe has one of the largest reserves in the world. Currently the Chromite is exported in large quantities. This Chromite is being procured in other countries and the value added product BCS is being imported into Zimbabwe. The manufacture of BCS in Zimbabwe would help in saving foreign exchange as well as put Zimbabwe in a position to export higher value added products of Chromite. The other raw materials such as Sulphuric acid, Lime stone, Molasses as well as utilities like Power and Water are easily available in Zimbabwe. The other major raw material Soda Ash will be available from Botswana.

II.14. FEASIBILITY STUDY ON THE PRODUCTION OF CHROME TANNING SALTS (BCS) IN THE REPUBLIC OF ZIMBABWE

During the Investment Promotion Meeting for SADCC Countries held in Harare in November 1986, a suggestion was made that the possibility of setting up a plant to manufacture Chrome Tanning Salts (BCS) in Zimbabwe should be explored. This would ease the supply of this essential chemical to the tanners in Zimbabwe and would also result in a saving of approximate Z$ 2 million to the country, as the entire requirement is currently being imported. As Zimbabwe has one of the largest Chrome ore reserves in the world, manufacture of BCS would also result in substantial value addition. The Government of Zimbabwe had requested UNIDO to prepare such a feasibility study.

II.14.1 CONTRACT UNIDO/MPDC

The contract for the study, entitled 'Feasibility Study for the Production of Chrome Tanning Salts' was awarded by UNIDO to a consulting firm in India MPDC through UNIDO Contract No.89/26 dated 30.05.89 Project No.US/ZIM/87/243. The terms of reference are attached as Annexe II.2, page No. 138.

II.14.2 FIELD STUDY

As per the terms of the contract a team of experts visited Zimbabwe between 18th July 1989 and 18th August 1989.

The team consisted of:

Mr. B.M. Shanthamurthy	Team Leader, Financial Expert
Mr. U.V. Kunikullaya	Chrome Salt Manufacturing Expert
Mr. C.D. Gopalarathnam	Project Engineer
Mr. Ramesh Ramaswamy	Market Analyst

The following organisations were visited in the course of the field study:

1. Imponente Tanning (Harare)
2. Cochrane (Harare)
3. Stainless Steel Industry (Harare)
4. RK Footwear Manufacturers Pvt.Ltd.(Harare)
5. Department of Mining
6. Metal Box (Bulawayo)
7. AIS-Ferguson-VAN-LEER (Bulawayo)
8. Belmont Leather Pvt. Ltd
9. NIMR Chapman Pvt. Ltd. (Bulwayo)
10. Convex Engineers (Bulwayo)
11. Samuel Asbone (Bulwayo)
12. Sheet Metal Craft (Bulwayo)
13. BATA (Zimb) Ltd. (Gweru)
14. Premier & Maskew Fibre Glass (Bulawayo)
15. Pigot & Mask (Bulwayo)
16. E.L. Bateman Pvt Ltd. (Bulawayo)
17. Textile Mill
18. Hogarth Ltd.
19. Stewards & Lloyds Pvt. Ltd. (Bulawayo)

20. Chrome Chemicals (South Africa)
21. Ames Engineering (Bulawayo)
22. KSB Pumps (Harare)
23. Eagle Tanning (Morondera)
24. RIO TINTO (Harare)
25. G.M.W. Industries (Harare) - Lim
26. YBJ Engineers (Civil)
27. Dairy Board (Harare)
28. Permanent Secretary, Ministry of Industry & Technology (Botswana)
29. Project Co-ordinator, SUA Pan Project. (Botswana)
30. Secretary/Deputy Secretary, Ministry of Industry & Technology (Zimbabwe)
31. Barclays Bank of Zimbabwe Ltd (Harare)
32. Coopers & Lybrand, Chartered Accountants (Bulawayo)
33. Institute of Mining Research (Harare)
34. Bank of Credit & Commerce Zimbabwe Ltd (Harare)
35. Cold Storage Commission (Bulawayo)
36. Superior Footwear group of companies (Harare)
37. Bayer Zimbabwe Pvt Ltd. (Harare)
38. Price Waterhouse (Harare)
39. Young Bamu Jenning (Harare)

SECTION III

MARKET & PLANT CAPACITY

CONTENTS

III.1. INTRODUCTION

The production of BCS involves first converting the Chromite into Sodium Dichromate which is then converted to Basic Chrome Sulphate Sodium Sulphate is formed as a by product. The details of the process and technology are given in the Section on Project Engineering

The intermediate chemical Sodium Dichromate is an input material for manufacture of Chromic Acid (used in the electroplating industry) and in the manufacture of Chrome pigments

As the electroplating industry and the pigment industry are not adequately developed in Zimbabwe, it is necessary to convert the entire Sodium Dichromate into Basic Chrome Sulphate The Development plans for the down- stream industries will involve a major independent study

Basic Chrome Sulphate is primarily used as a tanning agent in the processing of Leather The product also finds use as dye in the manufacture of Khaki (used in Army uniforms) and camouflage outfits As of now BCS is not being used in the textile industry in Zimbabwe It is estimated that even if all the Khaki dyeing in Zimbabwe was done with BCS the total demand for the product for use in dyeing would be less than 100 tonnes per annum
In view of this it is assumed that

a) The entire Sodium Dichromate would be converted into BCS
b) The entire BCS produced would go into use as a tanning agent

III.2. THE LEATHER TANNING PROCESS

The hides are received by the tanner in a salt or brine cured condition. The first step taken by the tanner is to remove the salt and to rehydrate the fibres by soaking The soaking procedure also removes water soluble particles and washes the hide free of manure and dirt Next hair on the hide is removed The hair removal process is accomplished with a saturated solution of lime in combination with Sodium Sulphide This is followed by a deliming and bating step using Ammonium Sulphate After the bating, the hides are pickled with Sulphuric Acid and Sodium Chloride is added to prevent acid swelling Once the hide is in the acid condition it is prepared for the tanning operation

The primary function of a tanning agent is to stabilize the collagen fibres so that they are no longer biodegradable

The various tanning processes are

a) Chrome Tanning

b) Vegetable tanning (shoe soles belts saddles luggage)

c) Mineral (other than Chrome)

d) Polyphenolic syntoms

e) Resin tanning

f) Oil Tanning

Over 95% of the leather in the world is estimated to be Chrome tanned

A detailed note on leather tanning is enclosed ~~along with this section~~ Annexe No III 1. page No 147

III.3 . STATUS OF THE TANNING INDUSTRY IN ZIMBABWE

The Tanning Industry in Zimbabwe seems to be going through a difficult phase currently

Due to a long drought as well as the foot and mouth disease the number of hides and skins available for tanning has reduced considerably

The tanners in Zimbabwe largely tan hides and the skin availability (Sheep and Goat) in Zimbabwe is very small As can be seen from Table III 1. page No 44. the trend in the availability of hides in the last 10 years shows that less and less hides are available. from 1984 to 1987 there has been a drop of 25% The tanning of Game skins although very profitable forms a very small percentage of the total tonnage tanned

In view of these factors the tanneries in Zimbabwe are operating at roughly 60% of their installed capacity

TABLE III.1

SLAUGHTER TRENDS IN ZIMBABWE

Calender Year	Total Slaughter of Cattle (figures in 1000)
1973	746.6
1974	561.0
1975	537.8
1976	662.1
1977	746.3
1978	744.8
1979	660.3
1980	534.5
1981	452.8
1982	527.9
1983	541.3
1984	524.5
1985	482.4
1986*	388.9
1987*	446.3

* Estimate

Source Central Statistical Office and Cold Storage Commission.

In the last two years, the export of raw hides has been banned and any improvement in the hides availability would help in improving the capacity utilisation of the tanneries.

The industry is facing difficulties in obtaining the chemicals for tanning mainly because of the difficult Foreign Currency situation and the procedural delays in obtaining import allocation for import of chemicals.

Currently BCS is being imported mainly from South Africa, Turkey and Germany.

In order to improve the capacity utilisation, the tanners are making all efforts to see if hides/skins could be imported from some neighbouring countries who do not have adequate capacity utilisation of tanneries in Zimbabwe.

Although a good finishing capability exists within Zimbabwe a large portion of the hides are being exported in the "wet blue" stage. However, as BCS is mainly used in the wet blue stage of tanning no detailed study was carried out of the final finishing capabilities of the tanneries.

At the moment there are only 4 tanneries in Zimbabwe, viz., Belmont, Eagle, Bata & Imponente. The team had the opportunity to spend adequate time with all the four tanneries.

Considering the economic situation in the other countries in the SADDC/PTA area, the capacity utilisation every year depend on various factors. Among the factors is the availability of hides and skins for tanning vis a vis the total slaughter and the availability of Foreign Currency to import the necessary chemicals.

The two major chemicals which need to be imported are BCS and Sodium Sulphide. UNIDO has conducted studies on the availability of raw hides in various countries in Africa in 1983. Discussions with the representatives of the PTA and SADCC revealed that detailed data on slaughter is not being collected every year. In making assessments of use of tanning chemicals in Africa, inferences have been drawn from the UNIDO working papers entitled "Strategies for increasing the production of tanning chemicals in developing countries" and "Integrated Development Programme of the Leather and Leather Products Industry in Africa".

III.4. MARKETS

III.4.1. POTENTIAL

The minimum economies of scale as discussed later in this section dictate that it is necessary to explore markets outside Zimbabwe in order that an economically viable plant be established in Zimbabwe

While working out the costs of production it was obvious that the FOB prices internationally were considerably lower than the price at which a new plant in Zimbabwe could profitably offer the market

This was due to the following reasons

a) The investment costs on a new plant are higher than those of estab ished plants.

b) The volumes of production in the plants of some of the competitors are much higher.

c) Some key raw materials are considerably more expensive in Zimbabwe than other countries.

In the light of the higher price it was obvious that it would not be possible to compete in international free markets.

In order to compete effectively with international sellers it was necessary that markets were chosen where advantage could be taken of preferential trade arrangements.

In view of this, the markets in the countries covered under the Treaty for the Establishment of Preferential Trade Area for Eastern and South African States was studied. The relevant extracts of the treaty are enclosed as Annexe III.2, page No. 164, in this section. Table III. 2, page No 47 outlines the trade among PTA countries. As data on imports of BCS are not easily available, it was decided to assess the total potential on the basis of the total slaughter in these countries. Assuming that all the hides and skins are tanned it would give the total theoretical maximum potential in the markets.

TABLE III.2

Direction of PTA trade 1980-1984 (US $ million)

Country	Exports to PTA	Imports from PTA	Imports Industrial countries	Exports to Industrial countries
Burundi	2 4	116 4	513.6	274 9
Comoros	NA	NA	NA	NA
Djibouti	76.6	266 5	814.2	26.1
Ethiopia	167 1	51 5	2578.5	1375 9
Kenya	1254 1	102 8	5352.4	2886 9
Lesotho	NA	NA	NA	NA
Malawi	109 7	147 8	715 7	92 7
Mauritius	4 2	90 2	1240.2	1754 5
Rwanda	86 5	255 6	607 4	356 7
Somalia	7 1	114 7	1421 8	95 3
Swaziland	NA	NA	NA	NA
Tanzania	137 0	89 1	3430 6	402 3
Uganda	17 0	725 5	909 7	1615 5
Zambia	210 3	256 7	2110.6	3626 8
Zimbabwe	282 2	264 2	2516.9	2480 4
Total	2362 2	2419 8	22211 6	16822 3

However, in some of the countries, actual tanned hides and skins amount to much lower volumes due to the following reasons

a) The tanning industry is inadequately developed

b) The tanning industry is unable to obtain chemicals due to shortage of foreign currency

c) The system of collection of hides and skins has weaknesses

d) Hides and skins are exported in the raw state

Efforts are being made by the various governments and international agencies in order that the tanning industry develop its maximum potential

In assessing the potential, the theoretical potential based on the figures available for total slaughter has been incorporated. The growth in the demand for BCS is likely to come from the increases in the quantities tanned in these countries rather than a growth in the total slaughter

The market for the BCS in textile dyeing has been ignored in the assessment as

a) The product is not in use currently in Zimbabwe

b) The potential for use in this sector [illegible] the [illegible] Dyeing (army uniforms, camouflage outfits) is done through BCS is negligible

The major by-product, Sodium Sulphate is now being imported in Zimbabwe for use in the detergent, paper and glass industries. The quantities available from the plant can be readily be absorbed in Zimbabwe. This product may also be reduced using the high grade coal available in Zimbabwe to form Sodium Sulphide for use in the tanning industry.

A rough assessment was made of the market for Sodium Dichromate, which is an intermediate product in the manufacture of BCS. As the downstream industries using Sodium Dichromate viz. Chromic Acid, Chrome pigments are not developed, the possibility of using the plant capacity (for Dichromate) in the first four years of production for other products has not been considered.

III.4.2. ANALYSIS OF THE MARKET

III.4.2.1. B C S

While looking at the markets two vital constraints have to be considered. (a) the product manufactured by the proposed plant would be substantially more expensive than the international market price. (b) Zimbabwe is a land locked country and transportation of goods from Zimbabwe to international market places could be expensive.

While assessing the market for BCS these two constraints have been borne in mind

Currently the international market is in a situation where supply is greater than demand and the market place is extremely competitive

In view of these, if potential markets are to be identified. the market should be close to Zimbabwe by which the lower transportation cost would offset higher production cost By this criterion the markets close to Zimbabwe particularly in Southern & Eastern Africa were focussed

In view of the higher cost of production in the plant it is necessary to narrow down on markets where preferential tariffs could be taken advantage of by the proposed plant

In the last few years, the governments of various African countries have formed economic associations like the SADCC & PTA The object of such associations is to promote Inter African Trade through easing restrictions on movement of goods between these countries and through tariff concessions

In view of the large production of BCS from the proposed plant it would be necessary to look at a large group of nations as covered by PTA in order to be able to sell the entire production and not restrict the market to the SADCC region Once the PTA achieves this objective, it is expected that there will be no import duty for goods coming from among member countries

Table III 3 page No 51 gives the estimates of the market potential in these countries Please also refer to Annexe III 3. page No 183 and Annexe III 4. page No 187 However, in many countries in the PTA region, the tanning capacity, either is not existing at all or the tanning capacity is not adequate to tan the entire production of hides and skins in that country. (please refer to Table III 4, page No. 53).

In some other countries although the tanning capacity exists, the tanners have been working at very low levels due to various reasons Please refer Table III 4, page No. 53.

Concerned governments as well as many international agencies are working hard to improve the leather production in this country However, such efforts will take some years to fructify

Looking at the potential of the market and considering the high production costs, marketing the full production of the proposed project is an extremely difficult task

III.4.2.2. SODIUM SULPHATE

At full capacity the total production of Sodium Sulphate is expected to be approximately 3600 tonnes This product is used by the detergent, glass and paper industries.

The total import of Sodium Sulphate into Zimbabwe is between 2000 to 2500 tonnes Once the Sodium Sulphate production starts in the proposed plant, the Government would stop the import of this chemical and hence there should be no problem in being able to sell this product in Zimbabwe

Table III.3

PTA COUNTRIES POTENTIAL

COUNTRY	Estimated on assumed Weights of hides and skins				Assumed on tonnages satistics of FAO*	
	Assumption 1		Assumption 2			
	Hides/Skins (Tonnes)	BCS Potential	Hides/Skins (Tonnes)	BCS Potential	Tonnes Hides/Skins	BCS Potential
1	2	3	4	5	6	7
Angola	8972	718	5846	468	6,200	496
Botswana	7708	617	5054	405	--	--
Burundi	3242	260	1953	157	1 1000	88
Djibouti	1480	119	785	63	--	--
Ethiopia	99048	7924	57940	4636	19900	1592
Kenya	53040	4244	32840	2628	37800	3024
Lesotho	246	20	143	12	300	24
Madagascar	26326	2107	17415	1394	10700	856
Malawi	2084	167	1386	111	1300	104
Mozambique	5500	440	3750	300	3900	312
Rwanda	4340	348	2690	215	1300	104
Somalia	31350	2508	16655	1333	10300	824

COUNTRY	Estimated on assumed Weights of hides and skins				Assumed on tonnages satistics of FAO*	
	Assumption 1		Assumption 2			
	Hides/Skins (Tonnes)	BCS Potential	Hides/Skins (Tonnes)	BCS Potential	Tonnes Hides/Skins	BCS Potential
1	2	3	4	5	6	7
Swaziland	2220	178	1470	118	--	--
Tanzania	20960	1677	13680	1095	16900	1352
Uganda	16872	1350	10676	655	11600	928
Zambia	5500	440	3750	300	3700	296
Zimbabwe	13058	1045	8565	686	6200	496
	301946	24162	184598	14576	131200	10496

Assumption

1 - Wt. of Bovine hides 22 Kg; Sheep & Goat 4 Kg

2 - Wt. of Bovine hide 15 Kg; Sheep & Goat 2 Kg

3 - BCS Potential assumed at 8% of weight of hides/skins tanned

Source: * World Statistical Compendium for raw hides and skins, leather and Leather footwear 1968-1987

Table III.4

TANNING CAPACITY IN PTA REGION

	Slaughter Tonnes (Hides/Skins)	Tanning Capacity Tonnes (Hides/Skins)
Angola	8972	687 Est
Botswana	7708	7920
Burundi	3342	Tannery expected to go into production
Djibouti	1450	No mechanised tannery
Ethiopia	99048	57060 + Rural Tanning
Kenya	53040	41800
Lesotho	245	No substantial tanning
Madagascar	26326	8250
Malawi	2084	No tanning
Mozambique	5500	2640
Rawanda	4340	160
Somalia	31250	13800 Capacity utilisation Low
Swaziland	2220	No tanning capacity
Tanzania	20960	14500
Uganda	16872	2500 Capacity utilization low
Zambia	5500	4400
Zimbabwe	13058	20460
	Total Estimated Capacity	174 177

Assuming a BCS usage of 8%, this amounts to a potential of 13,934 tonnes of BCS if all the tanneries operate to full capacity

III.5. PRICING

A typical breakdown of the price of BCS imported into Zimbabwe is given below:

Typical cost breakdown of BCS in Zimbabwe
(Country of origin - Germany)

	US$/Tonne	Z$/Tonne
FOB Price	640	1344
Transport by Sea	350	735
Railway Cost from Durban	36	75.6
Total	1026	2154.6
Import tax - 20%	205	430.9
Landed cost	1231	2585

It is proposed that the product from the proposed plant will be priced at Z$ 2287 per tonne, ex-factory for the local market. This will cost approximately Z$ 2575 including 12% sales tax and local freight.

The ex-factory price for the export market has been estimated at Z$ 2142.5 per tonne. It is assumed that a mark up of 10% would be provided for a local distributor. With the weighted average freight of Z$ 262, the product will be available to the buyer at the same price as the landed cost from international markets.

With this the tanners in Zimbabwe would be able to get the product at about the same price at which they are able to import it today. It would still be an advantage as there will not be any involvement of foreign currency.

The products from European countries would be landing in the PTA countries approximately at the same price as they land in Zimbabwe. It would be feasible to sell the product in these countries only if a differential duty structure is arranged by these countries so that the products of this plant cost the tanners in these countries the same price as the international products.

III.6. FREIGHT

The freight from the plant to a few of the countries is given in Table III.5, page No.56.

While working out the freight it has been assumed that the goods will move by rail to Beira and get shipped from there to the distant destinations.

Due to the security problem in Mozambique most of the goods imported into and exported from Zimbabwe today move through Durban. It is expected that in the next few years the security problem in Mozambique would be solved and the goods can safely move through Beira

It is also being proposed that stock points be created in some of the major markets like Ethiopia and Kenya so that the tanners in these countries could be serviced better.

III.7. SELLING ARRANGEMENTS

It is necessary to appoint selling agents in each country. A provision of 10% has been made to cover the agency commission. The agent may be required to buy the stock and resell to the respective tanners. His efforts will be supplemented by those of a travelling sales force who would contact all the tanners in the targeted markets. There would be no agent for sales in Zimbabwe.

As can be seen from the estimation of market potential, the viability of the project is going to be excessively dependent on the effective working of the PTA agreement and on the economic performance of the countries with whom trade is envisaged.

Table III.5

Freight Charges

Country	Freight Cost in Z $/tonne	Mode of Transport
Botswana	32 17	Rail
Zaire	120 07	Rail
Zambia	97 47	Rail
Tanzania Kenya	259 40	Rail to Beira onwards by sea All costs included
Ethiopia	417 40	Rail to Beira onwards by sea All costs included

III.8. PLANT CAPACITY

The minimum capacity of the plant has been based on the following considerations

1. The efficient use of inputs and fuel
2. Capital cost of the plant per unit production
3. Economic scales for materials handling
4. The investment required on pollution control measures
5. Marketability

The product can be produced either by a batch process or through a continuous process The advantages of a continuous process are discussed below

III.8.1. INPUT EFFICIENCY

In a continuous process a steady state reaction takes place and instrumentation of such reactions with automatic controls of temperatures weigh proportion pressure volume etc. maximises the conversion of inputs into desired products without undesirable deviation from established standards

III.8.2. ENERGY & FUEL ECONOMY

Continuous process provides for the maximum economy of Energy & Fuel The 20% heat recovery from exothermic reactions are making use of preheating the input materials in the case of a Continuous Rotary Kiln The hot reacted material is passed through a cooling zone to recover heat from the throughput making it easy to handle The sensible heat recovery is 35% of the heat input to the kiln

III.8.3. PROCESS CONTROL & PLANT COST PER UNIT PRODUCTION

Exposure of stoichiometric quantity of Cr_2O_3 and Soda Ash to 1200 Deg Centigrade forms Sodium Chromate. Sodium Chromate is a hexavalent Chromium compound. The control of temperature with excess air supply facilitates the above oxidation reaction. Control of steady state of reaction, is a must to get leachable product from the kiln. Higher or lower temperatures lead to low Chromite and Soda Ash conversion efficiency as well as low recovery of Chromate from the roast.

Proper instrumentation to record the kiln process parameters can be incorporated to optimise efficiency of the inputs. The undesirable side reactions involving silicate and alumina have to be contained at this stage of reaction. These characteristics are not achieved in small kilns.

In a process where batch kilns are used, the waste heat recovery can not be put into practice as the exit temperatures are very high and mild steel as material of construction is not advisible in dust recovery plants or waste heat recovery boiler. High exit temperatures lead to volatilisation losses of soda ash which is an expensive input material in the process.

III.9. A CONTINUOUS PROCESS

A continuous process ideally should be set up for a minimum capacity of 11,500 MT of BCS/annum. However, in view of the fact that the market in Zimbabwe can only absorb about 900 MT/annum, a size to produce 3600 MT/annum and 7200 MT/annum have also been considered.

The comparative raw material implications of these options are given below

COMPARATIVE INPUT ECONOMICS

Capacity (BCS)/Annum	3,600MT	7,200MT	11,500MT
Investment Z$	11 million	19 million	25 million
Raw material costs Z$/tonne of finished product			
Chromite	128.70	77.22	64.34
Soda Ash	536.25	390.00	357.47
Lime Stone	56.10	29.92	28.08
Sulphuric acid	775.25	440.00	400.00
Coal	225.00	125.00	100.00
Molasses	33.00	33.00	33.04
Packing	32.00	32.00	32.00
Power & Water	30.00	31.73	31.73
Total input costs	1816.05	1158.87	1046.66

In view of the economics a plant of capacity 11,500 MT per annum has been considered most economical. On this basis, all other details have been worked

III.10. PRODUCTION PROGRAMME

From the point of view of economic operations the following Production Programme is foreseen

1st year	5750 MT
2nd year	6900 MT
3rd year	8050 MT
4th year	9200 MT
5th year	10,350 MT
6th year	11,500 MT

The slow increase in the capacity utilised is necessiated by the difficult marketing environment

SECTION IV

MATERIALS AND INPUTS

CONTENTS

IV.1. REQUIREMENTS

The major inputs required are

IV.1.1 Raw Materials

1 Chromite
2 Soda Ash
3 Sulphuric acid
4 Limestone
5 Molasses

IV.1.2. Packing Materials

1 H D P E Woven bags
2 H D P E Stone moulded bags
3 Polythene lining

IV.1.3 Fuel

1 Coal

IV.1.4. Utilities

1 Power
2 Water

IV.1.5 Man Power

1 Technical Man Power
2 Skilled and unskilled labour
3 Engineering facility

The relative values of the individual inputs per tonne of the finished product are shown in the charts enclosed

IV.2. CHROMITE

Quantity required at full capacity-9000 MT/annum

Zimbabwe is the largest known source of Chromite in the world. The reserves are estimated at 560 million tonnes and a similar quantity as potential reserve. Zimbabwe holds 85% of the world's known high Chromium ores

Chromite is mined by

1. Rhodall belonging to Anglo American
2. Rhomet belonging to Union Carbide
3. EARLY WORM mines of G & W Industrial Mines Ltd

The mines at Selukwe peak and Railway Block are shaft mines.

The grades of Chromite produced at the different mines are

GRADES OF CHROMITES

	Salukwe	Railway Block	Great Dyke Motro Shanga
Cr_2O_3	58.4%	60 15%	58.81%
FeO	13.16%	14 48%	14.89%
SiO_2	0.20%	0 32%	0 44%
Al_2O_3	14.00%	13 40%	11 56%
MgO	13 50%	10 34%	13.28%

Alluvial Chromite Ore:

The soils in the valleys and along the marginal flats of great Dyke in the vicinity of Motroshanga and Mpirge contain about 40% of the Chromite grains. These are mined and washed and cleaned which gives an ore quality of

Cr_2O_3	52 55 %
SiO_2	about 2%

The mining costs are low compared to seam mining

All mines are well connected by railway for bulk transport of the ore to processing centres

The transport cost of Chromite in Wagon loads are at Z$ 5 13/tonne from GWERU to Plum Tree (260 KM) and Z$ 15 50 tonne from Early Worm Mines to Plum Tree (700 KM)

The Delivered cost of Chromite at Plum Tree - Z$ 78 00/MT

IV.3. SODA ASH

Quantity required at full capacity - 6000 MT/Annum.

At the SUA pan in the Malegadikgadi depression. 180 KM north west of Francistown in Botswana a Soda Ash and Salt factory is being built by Soda Ash Botswana (Pvt.Ltd.). The partners in the venture are the Botswana Government and DECI Ltd. The project has been designed to produce 300.000 tonnes of Soda Ash and 650.000 tonnes of Salt per year. This project is scheduled to go into production in March 1991, when the product will be available for the market. The engineering and construction management for the Soda Ash Plant is provided by a Consortium of UDHE (Pvt.) Ltd and LTA Process Engineering. Detailed discussions with the project co-ordinator in Gaberone, Botswana confirmed the project as being on schedule. The quality of the Soda Ash required for the manufacture of BCS is:

Light Soda Ash having Na_2CO_3 content over 98% and NaCL less than 1.0%

Francis town is being connected by Railway line to the SUA Pan Project. Francis town is situated 60KM away from Plum Tree across the border in Botswana and is connected by Railway and Road.

Freight cost by Rail from Soda Ash Factory to Plum Tree - Z$9.80/tonne(225Kms). The delivered cost of Soda Ash will be Z$ - 650.00/tonne.

In addition to this Soda Ash may be obtained from Kenya. The international price of Soda Ash delivered to Zimbabwe is Z$650.00 per tonne.

IV.4. SULPHURIC ACID

Quantity required at full capacity - 9200 MT/Annum

1. Available from local production from Zimphos-a fertilizer manufacturer.
2. From imports - Nitrogen chemicals Zambia.

Delivered price of Zimphos Harare.

Sulphuric Acid	- Z$500.00/Tonne
H_2SO_4	
Price from Nitrogen Chemicals	-Z$293.00/Tonne
Zambia	F.O.R KAFUE

Distance between Plum Tree & KAFUE - 1100 k m

Acid tanker freight/tonne	-Z$195 00
Delivered Price at Plum Tree	-Z$488 00/tonne

IV.5 LIME STONE

Quantity required at full capacity - 9000 MT/annum

Quality - 96-98% of $CaCO_3$

Supplies are available from Early worm mines in lump form boulder form and even ground material below 100 mesh ready for use in the process

Lump 150mm - price Z$ 15.00/MT
18mm - price Z$ 27 00/MT
Ground material price Z$40.00/MT
Lump ore delivered price Z $34 00/MT at Plum tree

IV.6 MOLASSES

Quantity required at full capacity - 2300 MT /Annum

Molasses is a by-product in the sugar industry. Zimbabwe has a well developed sugar industry. Sugarcane is mainly grown in Hippo valley, Chiredzi and Triangle

The sugar refineries are located at Triangle area and are connected by railway and road

The required quality is defined as the sugar content ranging from 75-80%

The transportation from Triangle area to Plum tree could be done by tanker lorries. The delivered cost of molasses is estimated at Z $ 165 00 per metric tonne.

IV.7. COAL

Quantity required at full capacity - 2400 MT/annum

Coal is available in abundance in Zimbabwe. The heating value of the coal available is 25×10^6 Btu / tonne.

Coal is available from Wankie collieries at Hwange and is well connected to Plum Tree by road and rail. The distance from Plum Tree to the colliery is about 400 km. Best grade of coal is available in abundance.

The delivered cost of coal is Z $ 50.00

IV.8. ELECTRICITY

It is available from the national grid at 11 KVA. The Electricity requirement of the plant is 1300 KVA and about 700 KVA is required for the infrastructure facility such as housing, street lighting and other amenities.

The power charges are Z $ 0.06 per KWH.

IV.9. WATER

IDC Zimbabwe is developing Plum Tree as an Industrial growth centre. It is planned to set up a Caustic Soda plant at Plum Tree and the required infrastructural facility such as power and water supply will be augumented soon.

The requirement of water for this project per day will be of the order of 180 M^3

The cost of water is estimated at Z$ 0.25 per M^3

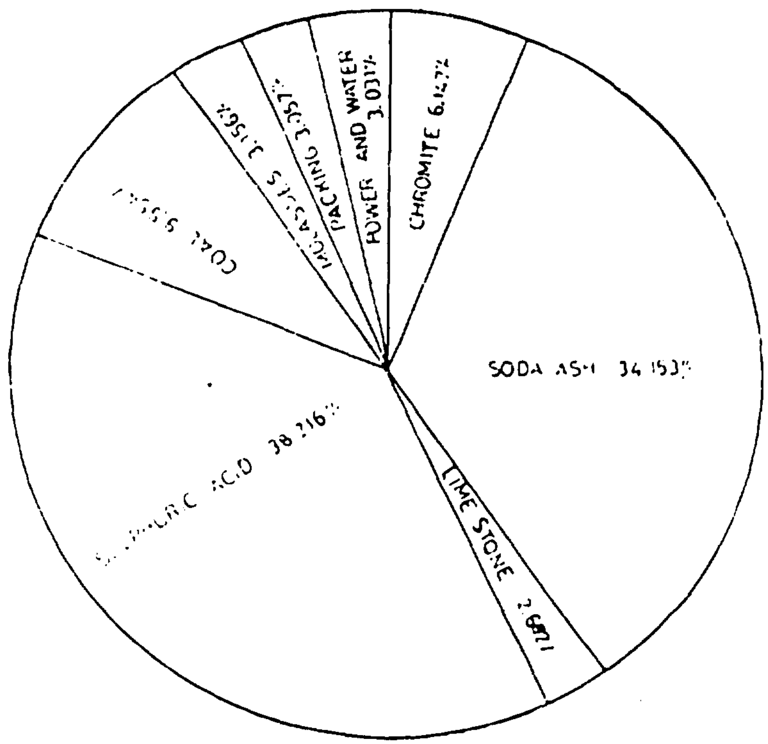
MATERIAL AND INPUTS

Input	Requirement per Annum in MT	Source	Cost in Z $ Per Tonne	Mode of Transport to site
Raw Material				
Chromite	9000	Local	78	Rail
Soda Ash	6000	Botswana	650	Rail/Road
Sulphuric Acid	9200	Local 30% Zambia 70%	500 488	Road by tankers
Limestone	9000	Local	34	Rail
Molasses	2300	Local	165	Road by tankers
FUEL				
Coal	2400	Local	50	Rail
UTILITIES				
Power	1300 KVA + 700 KVA for Housing Street Lighting	Local	0.06/unit	-
Water	183 M^3/day	Local	0.25/M^3	-

BREAK DOWN OF METERIAL COST

CHROMITE	6.147%
SODA ASH	34.153%
LIME STONE	2.682%
SULPHURIC ACID	38.216%
COAL	9.55%
MOLASSES	3.156%
PACKING	3.057%
POWER AND WATER	3.031%
TOTAL	99.996%

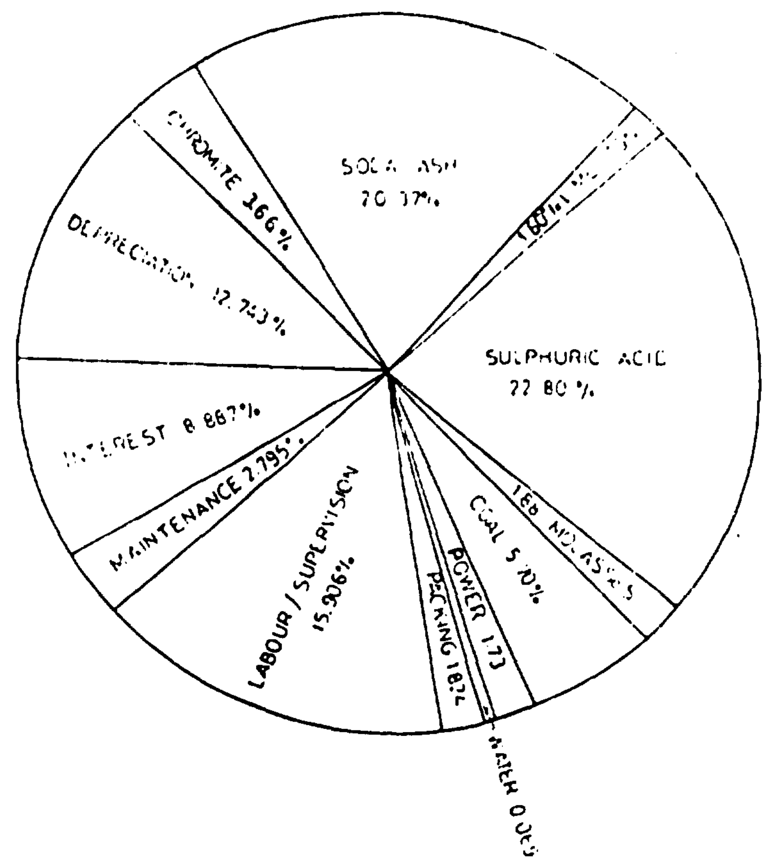
RAW MATERIAL COST FOR BASIC CHROMIUM SULPHATE
PRODUCTION CAPACITY 11500 MT ANNUM



BREAK DOWN OF PRODUCTION COST

PRODUCTION COST

CHROMITE	740.20	3.60%
SODA ASH	4111.00	20.37%
LIMESTONE	323.00	1.60%
SULPHURIC ACID	4600.00	22.80%
MOLASSES	380.00	1.88%
COAL	1150.00	5.70%
POWER	351.00	1.73%
WATER	14.00	0.069%
PACKING	368.00	1.824%
LABOUR/SUPERVISION	3209.00	15.906%
MAINTENANCE	564.00	2.795%
INTEREST	1793.06	8.887%
DEPRECIATION	2570.92	12.743%
TOTAL	20173.98	99.964%
Z$ 1754.26		



SECTION V

LOCATION

CONTENTS

V.1. CRITERIA

The selection of the site was based on the following criteria

1. Availability of good quality of water in sufficient quantity.
2. Availability of power from the National power grid
3. Proximity of Input Raw material availability
4. Proper Road and Rail linkage for the transportation of Raw materials, fuel to the site and also finished goods to the market.
5. Trained man power availability
6. Topography and distance from the agricultural operations, water ways, human habitation and aquatic life
7. Socio economic environment
8. Governmental policies
9. Land availability and its developmental cost
10. Climatic condition
11. Proximity of treated waste disposal sites

V.2. ALTERNATIVES

Initially three places were short listed on a discussion held with the steering committee of the local tanners. Please refer Annexe V i (page No 193)

1. Kwe Kwe
2. Eiffel Flats
3. Plum Tree

V.2.1. KWE KWE

Discussion with authorities of Industrial Development Corporation Zimbabwe ruled out Kwe-Kwe as a site for the Chrome tanning salt project. The area is already over crowded and the infrastructure (power & water) required for this project will further strain the limited availability of resources in the area. Eiffel Flats and Plum tree were studied in more detail

V.2.2. EIFFEL FLATS

The Eiffel flat site is next to Empress Nickel Refinery Limited. A team of experts visited the site for a detailed study.

At this site an experimental plant of Basic chromium sulphate was put up by M/s Rio-Tinto group. It was reported that Basic chromium sulphate was manufactured in this plant. The quality of the product was not acceptable and the plant was closed. This plant was housed in a 75' x 100' shed having about approximately 24' high trusses.A 35' long 5' diameter kiln was existing and all other equipments were dismantled. Adjoining this about 15 acres of land were available.

There was also an oxidation pond to which all the chromium effluents were pumped

The site was adjoining the nickel refinery plant and also a broad gauge railway siding was available

Power: Though the power supply was available. indications were that availability was from the 33 KVA Grid and it would be expensive to scale down.

Water: There was in-sufficient water availability. Water is supplied from Kadoma water supply scheme. The quality of the water was not suitable from Kadoma Industrial Water Supply sources. The calcium hardness of water is reported to be 198 ppm

The borewell water was brackish having a hardness of 900 ppm.

Proximity to human Dwelling: The township of Empress Nickel Refinery Limited with housing, school, sports and entertainment centres were adjoining the site. Kadoma City was two Km away from the site.

Kadoma is a municipal town inhabited by a population of about 80,000. It is a centre for the mining, spinning and weaving industries

Man Power:

The skilled and unskilled labour is available in this area

Road Rail linkage:

This area is well connected by Road and rail

Solid waste disposal:

Water ways and Agricultural operations and human habitation and proximity of township render this site unsuitable for solid waste dumping

Air pollution control measures:

Air pollution control measures adopted should be fool proof as the site is close to a township

Climatic condition:

Max temp 32 deg C

Min temp 8 deg C

Rain fall average 775 mm / October to March

V.2.3. PLUM TREE

Availability of large area:

It is an industrially undeveloped area Vast tracts of land are available here at very low prices

Land development cost:

The land development expenses are low as a flat terrain adjoining the national high way and away from Plum Tree township could be chosen

The area is being developed for Industrial sites by Industrial Development Corporation Zimbabwe

Power & Water:

IDC authorities have assured, during discussion with them, that sufficient power and good quality water will be made available at reasonable cost for a project requiring about2000 KVA power and abour 180 m^3 water/day.

Industrial Area Development :

Here IDC is putting up a Caustic soda plant. The salt for the project will be procured from Sua pan project, Botswana

Solid waste disposal:

This location is ideally suited for a chrome chemical project as the treated waste could be easily disposed off on waste land assigned for the purpose

Solar Evaporation pond facility:

For liquid effluents, large oxidation ponds and solar evaporation tanks could be provided

Road & Rail linkage:

This location is well connected by Road and Rail to Hawange where from coal has to be procured

Availability of Soda Ash 225 km away:

Soda Ash for the project will be provided from the Sua Pan project Botswana

Availability of Chromite 280 km away:

Chromite from Selukwe peak or Railway block mines, could be procured

Availability of Engineering facility 80 km away:

Engineering facility at Bulawayo will be an added advantage to the Plum Tree location Bulawayo is about 60 70 km away

Low rain fall:

This is a low rain fall area 450 - 600 mm temperature 20 - 25 deg C

Distance from Agricultural operation:

Only dry land farming is done and subsoil water usage for irrigation is minimal

A site could be selected in the area away from any agricultural operation and at a place without any waterways nearby

Availability of man power:

Trained and unskilled man power is available

Site selection:

Comparing Eiffel flats and Plum tree. the latter is ideally suited for the location of a Chromium chemical plant

1. Raw materials such as Coal, Soda Ash and Chromite which cover the bulk of the volume of transportation - are available nearby as the location is well connected by rail and road
2. Engineering facilities are available at Bulawayo
3. Treated waste dumping ground as well as a vast area for solar evaporation ponds of treated liquid effluent are available
4. Manpower is available
5. Being a warmer climate, there are smaller processing problem during winter.
6. The location is away from Human Habitation. Agricultural operations and water ways

Ratings of alternate locations

CRITERION	PLUM TREE	EIFFEL FLATS	KWE KWE
1. Water availability in quality & quantity	4	4	3
2 Availability of power from the national grid	5	4	2
3 Proximity to sources of raw material	10	7	7
4 Proper road and rail linkage for transportation of rawmaterials	10	10	10
5 Trained manpower availability	5	10	10
6 Topography and distance from agricultural operations waterways, human habitations and aquatic life	10	3	3
7 Socio economic environment	3	10	10
8 Government policies	10	5	3
9 Land availability and its developmental costs	10	3	3
10 Climatic conditions	10	3	3
11 Proximity to treated waste disposal sites	10	1	1

*Score on a scale of 1 to 10

SECTION VI

PROJECT ENGINEERING

CONTENTS

VI.1. TECHNOLOGY

The two primary industrial compounds of CHROMIUM made directly from Chrome Ore are Sodium Chromate and Sodium Dichromate Secondary Chromium compounds produced in substantial quantity include Potassium Chromate and Dichromate, Ammonium Dichromate, Chromic Acid (Chromium (vi) Oxide), and various formulations of Basic Chromic Sulphate used principally for leather tanning.

VI.1.1. Sodium Chromate and Dichromate

Sodium Chromate and Dichromate are made by treatment of the Calcine obtained by roasting Chrome Ore with Soda Ash to which Lime Stone and/or leached Calcine may be added. In present practice, chemical grade ore is used.

The Chrome Ore is crushed if necessary, dried and ground in ball mills to 200 mesh. It is then mixed with Soda Ash and, optionally, with Lime and leached residue from a previous roasting operation, if needed In American and European practice, a variety of kiln mixes have been used containing up to 57 parts of lime per 100 parts of ore; the roasting may be carried out in one, two, or three stages; and there may be as much as three parts leached residue per part of ore. These adaptations are responses to the variations in kiln roast and the capabilities of the furnaces used. A typical mix for the first stage of a double roast using Lime is: Ore, 24 parts; Soda Ash, 15 parts; Lime, 12 parts; residue, 49 parts.

After thorough mixing, the mixture is roasted in a mechanical furnace, usually a rotary kiln. An oxidizing atmosphere is essential, and the basic reaction for a theoretical Chromite is:

$$4FeCr_2O_4 + 8Na_2Co_3 + 7O_2 \rightarrow 2Fe_2O_3 + 8Na_2CrO_4 + 8CO_2$$

The temperature in the hottest part of the kiln is closely controlled using automatic equipment and a radiation pyrometer, and generally kept at about 1100-1150 Deg Centigrade. Time of passage is about four hours, varying with the kiln mix being used. The rate of oxidation increases with temperature However, the maximum temperature is limited by the tendency of the Calcine to become sticky and form rings or balls in the kiln, and by factors such as loss of Na_2O), volatilization, and increased rate of attack on the refractory lining.

A gas-fired furnace with revolving annular hearth also has been used to roast Chrome Ore. The mix is charged continuously at the outer edge of the hearth; a water-cooled helical screw moves it toward the inner edge where it is discharged. Mixes containing a much higher Soda Ash content (28% Na_2CO_3) can be handled in these furnaces.

Lime has two functions. First, it increases the roasting rate appreciably. Second, it converts the Alumina and Silica in the ore to insoluble Calcium Aluminates and Sillicates. The leach solutions then require no additional processing.

The roast from the kilns is discharged through a cooler and then goes to the leaching operation. If Lime is used, the Hydraulic Calcium compounds, plus the Calcium Chromates in various Oxidation states present, delay the leaching process markedly. Continuous countercurrent leaching procedures have been reported but the usual procedure has been to use a battery of large false- bottomed leaching boxes called filters. Liquid is pumped onto the charge, percolates downward, and is drawn off as a strong solution of Sodium Chromate containing some excess alkali. If no Lime is present, or only very small amounts, the leaching is more rapid, but the leach solutions contain Sodium Aluminate as a major impurity in addition to Sodium Silicate and Vanadate.

The leached calcine combined from all intermediate stages is dried, ground to (100 mesh), and recycled as diluent to the kiln mixes.

The process to this point is essentially a metallurgical operation. For environmental control, all stacks and vents must be protected. Electrostatic precipitators are desirable on kiln and residue dryer stacks. Leaching operations should be hooded and stacks equipped with scrubbers. Recovered Chromate values can be returned to the leaching-water cycle.

Technical developments in the roasting and leaching area, as recorded in the patent literature, include refinements in pelletizing the mix fed to the kilns and in the preoxidation of the ore prior to roasting. Both of these variants aim to increase the kiln capacity, the first through increasing the permissible fraction of Soda Ash in the mix, the second through increasing the effective rate of oxidation.

Sodium Chromate is usually converted to the Dichromate by a continuous process of treatment with Sulphuric [illegible] evaporation of Sodium Dichromate and precipitation of Sodium Sulphate, and finally crystallization of Sodium Dichromate. The recovered Sodium Sulphate may be used for other purposes. The Dichromate mother liquor may be returned to the evaporators or marketed as 69% Sodium Dichromate solution.

Carbon Dioxide under pressure can be substituted for part of the Sulphuric Acid in which case Sodium Bicarbonate is precipitated. This can be calcined to Soda Ash for use in the kilns.

VI.1.2. Other Chromates and Dichromates.

Potassium and Ammonium Dichromates are generally made from Sodium Dichromate by a crystallization process involving equivalent amounts of Potassium Chloride or Ammonium Sulphate. In each case the solubility relationships are favourable so that the desired Dichromate can be separated on cooling, whereas the Sodium Chloride or Sulphate crystallizes out on boiling. For certain uses Ammonium Dichromate low in alkali salts is required, this may be prepared by the reaction of Ammonia with Chromic Acid. Care must be taken when drying Ammonium Dichromate, because decomposition starts at 185 Deg C and becomes violent and self sustaining at slightly higher temperatures.

Potassium Chromate is prepared by the reaction of Potassium Dichromate and Potassium Hydroxide. Sulphates are the most difficult impurity to remove, because of the isomorphism of Potassium Sulphate and Potassium Chromate.

The wet operations employed in the modern manufacture of the Chromates and Dichromates are completely enclosed and all stacks and vents are equipped with scrubbers and entertainment traps to prevent contamination of the plant and its environment. The continuous equipment used greatly facilitates this task. The material trapped may be cycled.

VI.1.3 Chrome Acid.

Chromic Acid is produced by the reaction of Sulphuric acid with Sodium Dichromate

$$Na_2Cr_2O_7+2H_2SO_4 \text{-->} 2CrO_3+2NOHSO_4+H_2O$$

VI.1.4. Chrome Sulphate, Basic.

Basic Chrome Sulphate is manufactured as a proprietary product under various trade names for use in leather tanning. It is generally made by reduction of Sodium Dichromate in the presence of Sulphuric Acid. and contains Sodium Sulphate, small amounts of Organic Acids if Carbohydrate reducing agents are used, plus various additives. The compounds are sold on a specification of Chromic Oxide content and basicity, the latter value referring to the degree to which the Chromium is converted to the theoretical hydroxide Thus, $Cr(OH)SO_4$ is 33.3% basic The Cr_2O_3 content of solid Chrome tanning compounds ranges from 20.5 to 25%, and basicity ranges from 33 to 58%. Solutions are also available. The two reducing agents commonly used are sugar and Sulphur Dioxide, although other organic materials have been used during sugar shortages

VI.1.5.Sugar Reduction.

To Sodium Dichromate solution in an agitated acid resistant tank is added the sugar required for reduction and the stoichiometric amount of Sulphuric Acid The reaction is highly exothermic and must be carried out with care to prevent foaming and boiling over The reaction is completed by boiling.

Theoretically, glucose is oxidized to CO_2 and water

$$4Na_2Cr_2O_7+12H_2SO_4+C_6H_{12}O_6+26H_2O$$
$$\text{--->}8(Cr(DH)(H_2O)_5\ SO_4+4NO_2SO_4+\ 6CO_2$$

However, not all the Glucose is Oxidized, nor does the formula given represent the exact state of Chromium complex because Hydrolysis, Polymerization and entrance of Sulphate into the complex occur

Sulphur Oxide reduction With Sulphur Dioxide, a 33.3% basic Chromic Salt is automatically obtained

$$Na_2Cr_2O_7 + 3SO_2 + 11H_2O \rightarrow 2(Cr(OH)(H_2O)_5)SO_4 + Na_2SO_4$$

Pure Sulphur Dioxide is bubbled through the Sodium Dichromate solution in an acid-resistant tank, whereas Sulphur burner gas is passed through a ceramic-packed tower countercurrent to descending Dichromate solution. After reduction is complete, steam is bubbled through the solution to decompose any dithionate that may have formed, and to remove excess sulfur dioxide.

After reduction any desired additives, such as Aluminum Sulphate, are incorporated, the solution is aged. It is then spray dried. Careful temperature control during drying is necessary to obtain a highly water-soluble solid product.

VI.1.6. Specifications and Packaging

Chromates and Dichromates are sold in both technical and reagent grades. Chlorides and Sulphates are the principal impurities

Packaging is generally in multiwall paper bags, HDPE woven bags, fiber drums, or steel drums

VI.1.7. Analytical and Test Methods

The industrial analysis of Chromium chemicals and chromium- containing materials may be divided into several categories analysis of (a) ores, refractories, and other insoluble materials for major amounts of Chromium, (b) commercial Chromium compounds for Chromium content (assay); (c) materials involved in processes using Chromium compounds; (d) traces of Chromium in effluents, air samples, biological materials, etc. usually in regard to health and environmental considerations; and (e) important impurities in Chromium compounds

Ores and similar insoluble materials are analyzed by fusing a pulverized sample with Sodium Peroxide in an ingot iron or other suitable crucible. The sample is then leached, acidified with Sulphuric Acid, and reoxidized with a small amount of Permanganate. The excess Permanganate is destroyed with Hydrochloric Acid, and Cr(VI) titrated with standardized Ferrous Sulphate, recording the end point either potentiometrically or with a redox indicator such as o- phenanthroline ferrous complex

X-ray spectroscopy is available as a rapid control method when the range of samples being tested is small and similar standards are run concurrently.

Chromium (VI) compounds are usually assayed by direct titration with Ferrous Sulphate in Sulphuric Acid solution, as described above. Chromium (III) compounds, or compounds in other oxidation states, are first oxidized with Sodium Peroxide in alkaline solution. The solution is boiled to destroy the Peroxide, acidified, and titrated. If organic matter is present, various acid oxidants are usually employed.

As many Chromium compounds are deliquescent, proper sampling and handling procedures are essential

Solutions containing Chromium compounds can be usually analyzed by the same methods as Chromium compounds It is occasionally necessary to distinguish between oxidation states of Chromium, usually (III) and (VI) In this case, one sample is titrated directly for Cr(VI) and another is oxidized as described above Insoluble organic materials such as wood and leather processed with Chromium are dry-ashed and fused as described for ores or wet-ashed with oxidizing acids Pigments are fused or dissolved in acid and titrated Instrumental methods such as spectrophotometry, x- ray spectroscopy, and atomic absorption spectroscopy are being used more and more Procedures of this type are described in the standard methods of such organizations as ASTM

Trace amounts of Chromium are determined by converting the Chromium quantitatively to Cr(VI), adjusting the pH, and adding S-diphenylcarbazide solution An intense red-violet color, sensitive to 0.003 ppm Cr, appears The absorbance is measured at 540 nm and compared to known standards The application of this method to wastewaters, air samples, and biological materials are numerous

The quantitative oxidation of Chromium to Cr(VI) is difficult to achieve at very low concentrations, therefore, atomic absorption spectroscopy with improved vaporization methods is becoming the method of choice for complex samples Whereas flame vaporization is sensitive to 0 1 ppm using the 359 3 nm line, atomic fluorescence is sensitive to 0 05 ppm impurities in industrial Chromium compounds include Chlorides, Sulphates, insoluble matter, Vanadium (in $Na_2Cr_2O7.2H_2O$), and fixed alkalies (in$(NH_4)2Cr_2O_7$). In general, the Mohr titration is used for Chloride, Barium precipitation for Sulphate, a variety of methods for Vanadium, and the flame photometer for alkalies. A wider variety of tests are required for reagent chemicals.

VI.2. HEALTH, SAFETY, AND ENVIRONMENTAL CONSIDERATIONS

Several aspects must be considered in regard to the effects of Chromium compounds: acute and Chronic toxicity; Chromium compounds in nutrition; their natural occurrence in rural and urban environment; and technology of control

VI.2.1. Acute and Chronic Toxic Effects.

From the practical standpoint, the only Chromium compounds encountered are those in oxidation states + 3 and + 6. Compounds in the + 3 state have no established toxicity. Thus the chief health problems associated with Chromium compounds are related to Chromium (VI) compounds

Acute systemic poisoning is rare. Fatalities in humans have resulted from the accidental use of Potassium Chromate in an ointment. Kidney damage has resulted from nonfatal ingestion. Continued ingestion of small quantities, as in drinking water, of up to 25 ppm Cr(VI) appears to be without toxic effect. Federal drinking water standards are at 0 05 ppm, but a recent report suggests that higher concentrations may be without adverse effect. No well-defined lethal dose has been established, however, it seems to be on the order of 3-5 g for adult humans.

Acute effects of Chromates are mainly on the skin and mucous membranes, and have been observed in workers for 150 years. The breathing of dusts or mists containing Chromium (VI) compounds leads to ulceration and eventual perforation of the cartilaginous portion of the nasal septum. As a result of a 1928 study of exposures and nasal perforations of workers in Chromium plating plants, exposure standards have been set at 0 1 mg CrO_3/M^3, or 0/05 mg $Cr(VI)/M^3$. Standards for soluble Chromic and Chromous salts are set at 0 5 mg Cr/M^3, and for Chromium metal and insoluble Chromic compounds at 1 0 mg Cr/M^3

In addition to these effects, Chromates may produce ulcers when a cut or abrasion in the skin is contaminated. If sufficient chromate is brought into contact with skin lesions, fatalities may result.

Determatitis and allergic reactions may result from prolonged exposure of the skin to Chromate. In the majority of workers determatitis results only from prolonged exposure, or under conditions such as exposure to solvents where natural skin oils are removed. However, a few individuals exhibit a characteristic allergic reaction on exposure to very small amounts of Chromates.

Lung cancer as a result of long-term exposure to Chromate dusts was observed in German Chromate plants as early as 1912. Various studies demonstrate beyond doubt that a significant incidence of lung cancer cases results from exposure to dusts in manufacturing plants. Despite the wide use of Chromium compounds, lack of reported lung cancer cases in the consuming industries suggests that the hazard is confined largely to the manufacturing industries.

Animal experiments have implicated only Calcium, Zinc, Lead, and Chromic Chromates as being potentially carcinogenic. Calcium and Chromic Chromates (the latter possibly a Cr(VI) or Cr(V) oxide) are encountered in manufacturing plants, as is also $Ca_3(CrO_4)_2$. Zinc and Lead Chromates are commercial pigments and cases of lung cancer have been reported due to exposure in plants manufacturing these products.

The rate of incidence appears to be decreasing in recent years, principally because of reduced working hours and improved conditions.

VI.2.2.Chromium In Nutrition

Although Chromium is widely distributed in plant and animal tissues, it has only been recently recognized as an essential element in both plant and animal nutrition.

The case for plant nutrition is only poorly documented. Workers at Southwest Research Institute found that sugar-producing crops had a high Cr_2O_3 content and that the Cr_2O_3 taken from the soil on harvesting needed to be returned, for which very finely ground Chromite ore was used. Other workers reported increased yields of cucurbits from increased feeding of Chromium. Circumstantial evidence is strong here, for Hawaii and Cuba, both producers of sugar-rich crops, have basaltic and lateritic soils that are high in Chromium

Certain evidence for Chromium as an essential element in animal and human nutrition was reported in 1969. Further work has established improvement in glucose tolerance, especially in the elderly, with supplemental Chromium intake of the order of 150 mg/d. A definite recommended intake has not been established The U.S. daily average of 80 mg/d is probably marginal, as Chromium is poorly assimilated from many foods.

Chromium may play a role in sugar production in plants and sugar metabolism in animals

VI.2.3. Chromium Compounds in the Environment.

Chromium is widely distributed in the earth's crust, but is concentated in the basic ultramafic rocks At an overall crustal concentration of 125 ppm Cr, it is the twentieth most abundant element Chromium is very insoluble and leaches very little into natural waters A survey of Chromium in 15 North American rivers showed 0 7-84 ppb. with most samples in the 1-10 ppb range Public water supplies range from no detectable to 36 ppb Cr, the median being 0 43 ppb Nearly all foodstuffs contain Chromium in the range of 20 to 590 ppb, resulting in a daily intake for humans between 10 to 400 mg the average is abbout 80 mg About 20 U S cities, many of them industrial, show measurable amounts of Chromium, generally about 0 01-0 02 pg Cr/M^3 air, Baltimore, which has both a Chromium chemicals and stainless steel plant, has shown significantly higher values in most years, recording 0.301 mg Cr/M^3 in 1960 and 0.10 mg/M^3 in 1969 The general trend of Cr values is downward as plants install more effective dust control equipment. Rural air contains no detectable Chromium

VI.3. ENVIRONMENTAL CONTROL.

Plants have to be designed and operated so that emissions are kept to a practical minimum However, it is recognized that wastes are unavoidable Waste Chromium can however, be converted to insoluble, inert Chromium (III) compounds

Stacks on kilns, leaching tanks, open boiling vessels, plating tanks, and other installations emitting dusts and mists containing Chromium should be equipped with suitable precipitators (for insoluble dusts) or wet scrubbers (for mists or soluble dust). Material entrapped in scrubbers can frequently be recycled. It is generally not feasible to further process any recovered dry material to remove Cr(VI), although it may be returned to roasting or leaching

Wastes containing Chromium compounds in solution may result from a variety of operations. Drainage from roofs, inadvertent leakage, multiple effect evaporator entrainment in barometric condenser water represent dilute or intermittent wastes that are extremely dilute (5-500 ppm Cr) and hence not readily processed unless concentrated. It is not generally appreciated that such wastes can be combined with municipal sewage or other waters having a high COD. Activated sludge plants can handle up to 50 ppm Chromate without effect. It has also been observed that Cr(VI) discharged into a heavily polluted harbor was completely removed at a distance of about 300 m

If the waste containing in most cases both Cr(III) and Cr(VI) cannot be disposed of directly, the Chromium is usuallyreduced to the + 3 state, followed by addition of lime to raise the pH. The slurry is settled and the clear decantate returned to the watershed. The accumulated slurry is eventually used as fil

Other processes employ Ferrous Sulphate, scrap iron or Sulphide wastes as reducing agents

Alternatively concentration can be effected by ion exchange, by which Cr(VI) can be reduced to 0.05 ppm

The direct precipitation of Cr(VI) wastes with barium and recovey of the resulting Chromate values have been patented

As long as solid Chromium wastes contain no Cr(VI), no environmental problem exists. They may be used as fill, and if the Chromium is precipitated in sewage sludge, the use of the sludge is not impaired

The waste resulting from the roasting and leaching step in the Chromate manufacturing process traditionally contains Lime, and residual Chromium (VI) bleeds slowly through desorption and disproportionation. If used as fill, it must be covered with organic wastes, such as sewage sludge, to prevent phytotoxicity. Elimination of lime from the kiln mixes solves this problem.

As standards for effluents and control of the work area have tightened, newer plants have improved techniques further. Consequently, investment in designs satisfying environmental requirements has increased sharply. All dry stacks (kilns, dryers, etc) must be equipped with high-efficiency electrostatic precipitators to prevent particulate emissions. The leaching operation is totally enclosed and equipped with wet scrubbers to return chromate mists to the process. Evaporators must be equipped with high efficiency entertainment separators, and all wastes must be processed to either recover or precipitate chromate before discharge. Employees are monitored by wearing personal samplersin order to detect and correct any malfunction of the control equipment.

VI.4. THE PLANT

The plant will consist of mainly :

a) Raw Material Preparation System such as crushing, grinding, mixing and storage of raw materials like chrome ore, lime stone, soda ash, Diluent and concentrated Sulphuric Acid etc.

b) Continuous rotary kiln for roasting Chrome ore and Soda ash into Soluble Sodium Chromate with a rotary cooler to cool the roast. The kiln is suitably lined with refractory. It is also equipped with continuous weigh proportioning device, material handling system, Air pollution control system, continuous fuel firing system including waste heat recovery facilities.

c) continuous Leaching to extract Sodium Chromate solution, to recover diluent and solid waste handling.

d) Acidification of Sodium Chromate to Dichromate evoporation of Sodium Dichromate, clarification and thickening, storage, crystellising etc.

e) Separation of yellow Sodium Sulphate and purification of the same to Sodium Sulphate anhydrous.

f) Preparation of Basic Chromium Sulphate solution spray drying, packing.

g) Treatment of solid and liquid effluents.

h Auxiliary Services viz.. Steam power. process water treatment, etc

An area of 10 hectares is needed which also includes provision for possible extension of production, open storage and other amenities

A materials-flow diagram (Flow sheet) depicting flow of raw materials, utilities, intermediate and Final products by products and emissions is enclosed. Manpower requirements are dealt with in a separate section Please refer Annexe VI.1 to VI.8 (page Nos. 194 to 201).

Process and Equipment

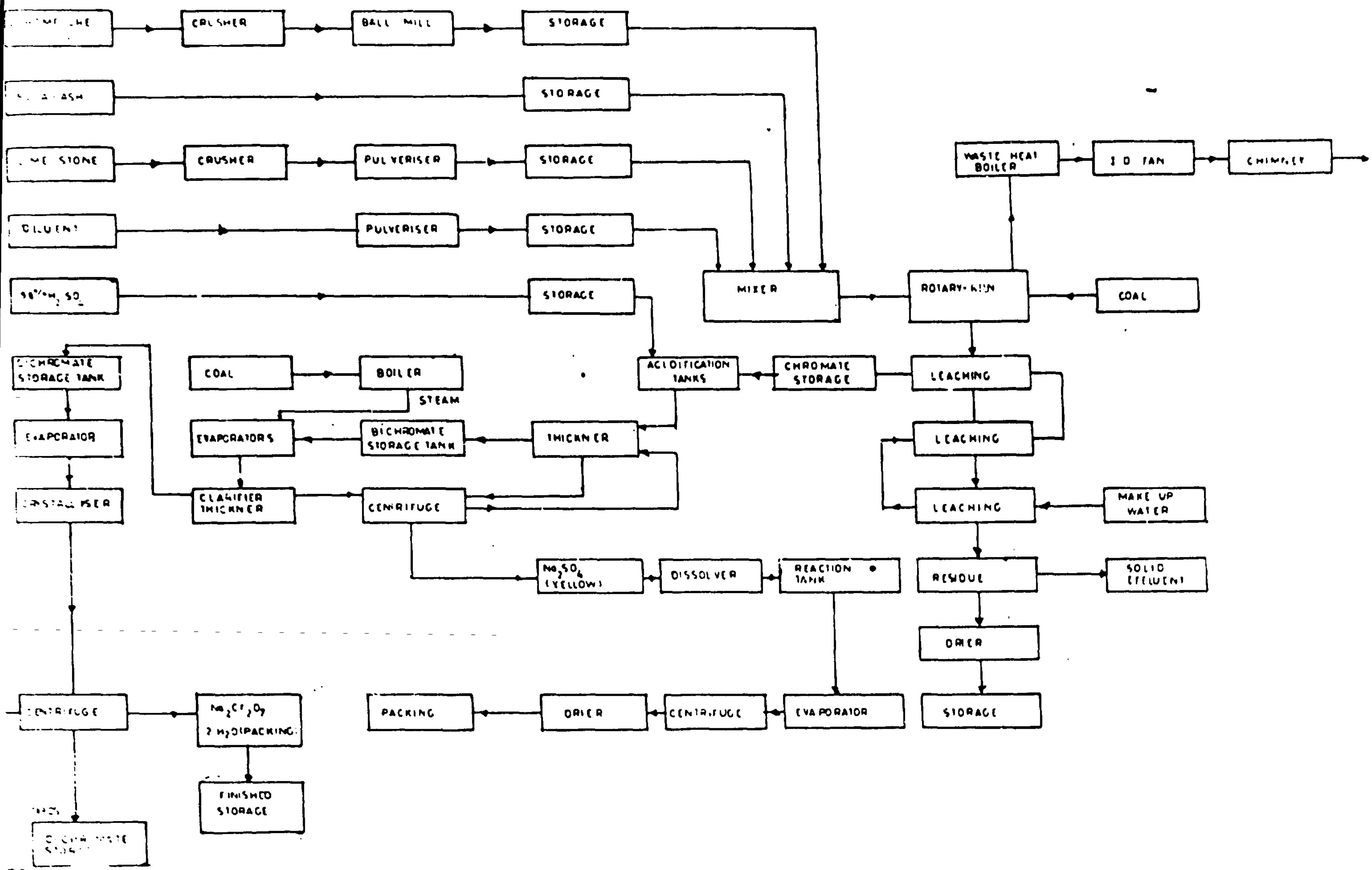
Normally small scale sector invariablly uses reverberatory flat- bed furnace for roasting chrome ore, soda ash, diluent, etc., which can be fired by fuel oil or coal. The process is highly labour intensive and produces a very high dust hazard. Further, the conversion of Chrome Ore into Sodium Chromate tends to be erratic, leading to a large scale land pollution In countries like India quite a number of such plants in small scale sector have either been closed or on the verge of being closed for the various reasons mentioned

In larger plants, a horizontal inclined Rotary kiln made of Mild steel plate as shell and lined with refractory lining with a cooler is used, for roasting operations. The heating medium or fuel can be either fuel oil or coal of good quality.

The other unit processes and unit operations use the conventional counter-current leaching to extract the soluble Sodium Chromate, which is concentrated by evaporation in forced circulation evaporators The pH value of Sodium Chromate is about 14.0 and therefore no special material of construction is needed for plant and machinery in leaching stage and ordinary mild-steel is most suitable for equipment fabrication.

The next stage involves acidification of sodium chromate (pH - 14) by adding 98% Sulphuric Acid in Rubber/FRP lined vessels, producing Sodium Dichromate (pH-4) and throwing out Yellow Sodium Sulphate as by product Conventional centrifuges are used to separate this sulphate which is further purified into An hydron glauber's salt (Na_2SO_4) which has a good demand in various chemical process industries

PROCESS FLOW SHEET



The weak Sodium Dichromate liquor is evaporated in forced circulation evaporators. the yellow Sodium Sulphate if any salts out and is separated by centrifuges and the concentrated Sodium Dichromate is stored for further operation

The concentrated Sodium Dichromate solution can be further crystallised, dried and packed in plastic lined bags for marketing (refer flow sheet enclosed. refer page No 89)

VI.5. MANUFACTURE OF BASIC CHROME SULPHATE (BCS)

BCS is normally manufactured by reducing Sodium Dichromate to Basic Chrome - Sulphate ($Na_2Cr_2O_7$ ($2H_2O$)((Cr) (OH) (SO_4)) n

The reduction is carried out in a highly acidic medium either using Sulphur Di Oxide by burning Virgin Sulphur or by using Molasses - a by product of the sugar industry

Since Zimbabwe does not have any source of indigeneous Sulphur. Molasses has been chosen for reducing Sodium Dichromate Liquor further reduction by Molasses lends flexibility in the BCS production with the basicity of the product can be controlled at the desired level Basicity is normally expressed as Viz (SO_4) L8 x52

Where (SO_4) and (Cr) are expressed in gm weight At a pH value of 1 6 the basicity will be 96 on the above method BCS is also known as 1/3 rd basic salt" expressing basicity as 33 1/3%

The sugar in the Molasses while reducing the Sodium Dichromate to BCS in acid medium gets oxidised to Carbon di Oxide and water. This reaction is normally not complete and more sugar (Molasses) than the stoichiometric quantity is always needed Certain organic acids are produced by the incomplete oxidation of sugar and these are said to be desirable components of Tanning liquor, constituting what are called "Masking Agents" which yield better quality of leather

The Chrome liquor produced can be easily stored and used for tanning after a 10 days "ageing" period Alternatively the Chrome liquor can be converted to a solid from by "SPRAY-DRYING" using suitable spray driers to form fine green crystals of "BCS" or "BCT" powder containing about 26% Cr_2O_3 of 33 1/3% basicity

Careful temperature control is absolutely necessary during "SPRAY-DRYING" operations to obtain a highly water soluble product of required bulk density.

The product can be packed in polythene lined gunny bags or Mild Steel Drums lined with PVC/HDPE, required capacity

Conventional pollution control methods are to be installed to reduce hexa-valent Chromium to tri-valent stage and the sludge can be disposed off.

The Technology chosen as described above appears to be best suited for Zimbabwe. The country has fairly adequate infrastructure to fabricate chemical process equipment for the project barring few proprietory equipment like Rotary kiln with cooler and spray drying. Zimbabwe is self sufficient in manufacture of Electrical Motors, Motor control centres, gear boxes etc. It can also fabricate and Rubber line/FRP line tanks, vessels, manufacture chimnies, etc. The country has to import about 35% of its inputs and components. It can also import proprietory equipment viz. Rotary kiln with cooler and spray drier. These equipment can be procured after making suitable arrangements with the supplier for their effective supervision during execution and commissioning

It may be worth while for the promoters to procure technical know-how for a consideration with a foreign country with experience in the field. The consideration may be lump-sum down payment or participation of the firm in the project

There is scope for acquisition of process know-how and technology either from a well known manufacturing company of a similar product or from consulting firms or from individual professionals with adequate expertise in the similar field

Technology exists in many countries for the desired product. Further, these are by and large not patented and may be easy to acquire

Apart from the acquisition of Technology, technical services may also be obtained for supply of proprietory equipment like rotary kiln,cooler, spray-drier, Ball mill, evaporator etc., and for the effective supervision during erection and commissioning of the equipment

VI.6. SELECTION OF EQUIPMENT

In the case of manufacture of BCS from chrome ore the process technology can be independently acquired from experts in the field.

These experts can identify the equipment including auxiliary and ancillary equipment.

Subvendors can easily be identified and located for the design and manufacture of some of the process equipment and systems which will fall in line with capacity of plant envisaged.

In case of process industries, necessary equipment required are to be defined and identified for various stages of processing. These stages merge into one another. Therefore, it is very important that capacity rating of each equipment be defined for each stage of processing. These are directly related to capacity and equipment at the subsequent stage of production. Further, the requirement of plant and machinery are directly related to capacity needs at different stages of processing.

Selection of equipment also depends on the foreign exchange availability of the country and is directly affected by various constraints imposed by the respective Governments. It is therefore of prime importance to tailor the equipment needed so as to suit the available indigenous source.

VI.7. CIVIL ENGINEERING

The following assumptions are being made in assessing Civil Engineering costs.

1. Cost of Civil Engineering/Foundation etc. will be approximately 10% of total project cost. Actual cost estimates have been included in project cost.
2. A soil survey has to be made once the site is chosen.
3. In Plum Tree (non-seismic area), soil is said to be clayish at low level areas and in high-lands; bed is rocky and good.
4. Input Costs.

Cement	6 Z$/50 Kgm packing
Brick	150-200 Z$/1000 Nos
Sand	25Z$/$M^3$
Rail Freight	50Z$/$M^3$

5 Compound Wall Only reinforced brick wall - 40 Z$ / Sq mt.

ROADS: Two types are possible Viz.

I. Chip and spray or Double bed- This is recommended for Industries

II Asphalt Topped applicable for cities like Harare/Bulawayo costly at other places

COST : 20 Z$ / Sq mt. (Surface)

6 Z$ / Sq mt (base)

or 150,000 Z$ /K m

FOUNDATION

1 Loose sand - 5 Z$ / M^2

2 Hard sand - 3 - do -

3 Rocky sand - 50 - do -

In Plum Tree area there is no sewarage system. Septic tanks will have to be planned

VI.8. PRODUCTION EQUIPMENT

A detailed write up is in the following pages discusses the process-flow sheet under the following issues

1 Process Machinery

2 Mechanical Equipment

3 Electrical equipment

4 Instrumentation and control

5 Conveying and Trasporting equipment

6 Other auxiliary equipment

Drawings of the equipment as well as the plant layout are enclosed as an annexe VI 1 TO VI 8 (page No 194 to 201)

VI.9. EQUIPMENTS

RAW MATERIAL PREPARATION

	Nos.	Capacity /Day/Hr	Costs in '000 Z$	
Chromite				
1. Belt conveyor	140 mtrs	50MT	124.60	
2 Jaw crusher	1 No	50MT	135.00	
3 Bucket Elevator	6 Mtrs	50MT	8.40	
4. Ball Mill	1 No	50MT	910 00	
5 Storage silo	1 No	100MT	104.00	
6 Silo discharge	1 No	50MT	5 00	
				1287.00
Lime Stone				
1 Belt conveyor	130 Mtrs	50MT	115 70	
2 Jaw crusher	1 No	50MT	135 00	
3 Pulvariser	1 No	50MT	330 00	
4 Storage Silo	1 No	100MT	104 00	
5 Silo discharge	1 No	50MT	5 00	
				689.70
Residue				
1 Belt conveyor	130 Mtrs	60MT	115 70	
2 Apron conveyor	25 Mtrs	60MT	70 00	
3 Residue dryer	1 No	60MT	520 00	
4 Pulvariser	1 No	60MT	400 00	
5 Storage silo	1 No	120MT	104.00	
6 Silo discharge	1 No	60MT	5 00	
				1214.70
Soda Ash				
1 Belt conveyor	30 Mtrs	26MT	26 70	
2 Bucket Elevator	6 Mtrs	25MT	8 40	

RAW MATERIAL PREPARATION (Contd.)

3 Storage silo	1 No	50MT	104 00	
4 Silo discharge	1 No	20MT	5 00	
				144.10
Mixer				
1 Mixer	1 No	200MT	13 56	
2 Weigh Hoppers	4 No	60MT	70 00	
3 Recieving Hopper	1 No	200MT	7 00	
4 S-conveyor	30 MTR	200MT	69 00	
5 Bucket elevator	20 MTR	200MT	28 00	177.56

KILN PROCESSING

Rotary Kiln				
1 Rotary kiln Hopper	1 No	20MT/Hr	7 00	
2 Kiln Feed table	1 No	20MT/Hr	26 00	
3 Kiln feed tube	1 No	20MT/Hr	12 00	
4 Rotary Kiln	1 No	150MT Day	1500 00	
5 Dust collector	1 No	500M3 Hr	46 00	
6 Waste heat boiler	1 No	2MT steam Hr	200 00	
7 Kiln Ductings		50MTR	[illegible]	
8 Kiln Chimney	1 No	50MTR	77 00	
9 Burner & accessories	1 No	1 5MT/Hr coal	50 00	
10 Temperature controller	1 No	0-1800DC	50 00	
11 Cooler	1 No	100MT/Day	350 00	
12 Cooling air fan	1 No	$100M^3$Mt	13 00	
13 I D fan	1 No	500M^3 mt	41 00	
				2356 00

Coal Pulveriser

1. Belt conveyor	-	100MT/Day	89.00	
2. Coal pulvariser	1 No	100MT/Day	400.00	
3 Bucket elevator	1 No	100MT/Day	14.00	
4. Storage silo	1 No	200MT/Day	400.00	
5. Pulvarised coal discharge devise	1 No	100MT/Day	5.00	
				908.00

Roast Handling

1. Apron conveyor Leaching	1 No	150MT/Day	
1. Leaching tanks	12 No	20000 lit	240.00
2. Leaching residue discharge system	1 No	70MT	
3 Leach liquor collection tanks			
a) strong	1 No	3000 lit	3.00
b) Medium-strong	1 No	3000 lit	3.00
c) Weak solution	1 No	3000 lit	3.00
4. Storage tanks	1 No	-	-
a) Strong	1 No	120000 lit	120.00
b) Medium-strong	1 No	10000 lit	10.00
c) Weak	1 No	10000 lit	10.00
5 Water storage tank	1 No	25000 lit	25.00
6 Pumps			
a) Strong	2 Nos	100 lit/mt	10.00
b) Medium	1 No	100 lit/mt	6.00
c) Weak 1 No	100 lit.mt	6 00	
7. Leach residue belt Conveyor	1 No	40MT	89.00

8 Leach residue incinarator	1 No	100MT.day	350.00	
9 Leach residue mixer	1 No	40MT/day	7.00	
				882.00

Sulphuric Acid Storage

1. Ground level storage	1 No	150MT	126 00	
2. Overhead storage	1 No	30MT	15.00	
3 Sulphuric acid pumps	2 Nos	100 lit/MT	27 00	
4 Sulphuric acid Service tanks	3 Nos	1000 Lit	1 00	
				169.00

LIQUOR PROCESSING

Acidification

1. Acidification tanks	2 Nos	12000 lit	24.00
2 Tickner	1 No	5000 lit	5.00
3 Yellow Sulphate Centrifuge	1 No	800 kg 1tr	100.00
4 sodium Dichromate 30% solution storage	1 No	50000 lit	50 00
5 Centrifuge catch tank	1 No	3000 lit	3.00
6 Thickner under flow Pump	1 No	1000 lit/mt	6.00
7 Centrifuge Catch tank transfapump	1 No	100 lit/mt	6 00

8. Thickner over flow catch tank	1 No	3000 lit	3.00	
9. Thickner catch tank pump	1 No	100 Lt/mt	6.00	
				203.00

Evaporator

1. Evaporator		Triple effect	455.00	
2. Evaporator feed pump	1 No	100 lit/mit	6.00	
3. Evaporator dis charge pumps	2 Nos	100 lit/mt	27.00	
4. Evaporator dis charge thickner	1 No	25000 lit	25.00	
5. Thickner under flow pump	1 No	100 lit mt	1350 00	
6. Evaporator thickner overflow storage-tank	1 No	25000 lit	25 0	
7. Evaporator discharge solution clarifier	1 No	1000 lit/Hr	78.00	
8. clarifier catch tank	1 No	3000 lit	3.00	
9. Catch tank pump	1 No	100 lit mt	6.00	
10. Clarified liquor storage	1 No	25000 lit	25 00	
				663.50

Crystalliser

1. Crystalliser feed tank	1 No	12000 lit	12.00
2. Crystalliser 1 No	1 No	10 MT/day	208.00
3. Crystalliser thickness	1 No	2500 lit	2 50
4. Sodium Dichromate centrifuge	1 No	500 kg Hr	70 00

5. Sodium catch tank	1 No	3000lit	3.00	
6 Catch tank pump	1 No	100lit/mt	6.00	
7. Liquor storage tank	1 No	12000lit	12.00	
				313.50

By-Product Processing

Sodium Sulphate

1. Belt conveyors	1 No	15mt/day	5.00
2 Reaction tanks	2 Nos	12000lit	24.00
3. Sodium Sulphide dissolver	1 No	1000lit	1.00
4. Sodium Sulphide service tank	1 No	200lit	0.20
5 Sodium Sulphide pump	1 No	50lit/mt	6.00
6 Sodium Sulphate dissolves	2 Nos	12000lit	24.00
7. Sodium Sulphate dissolver pumps	2 Nos	100lit mt	27.00
8 Sodium Sulphate reaction charge	2 Nos	50lit mt	52.00
9. Filter catch tank	2 Nos	3000lit	3.00
10. Catch tank pumps	2 Nos	100lit mt	13.50
11. Filtered solution storage	1 No	12000lit	12.00
12. Evaporator feed pump	1 No	100lit mt	13.50
13. Evaporator	1 No	45MT water evaporation Day	
14. S.S Evaporator discharge pump	1 No	100lit mt	13.50
15. S S Evaporator discharge thickner	1 No	5000lit	5.00

16 S.S Centrifuge	1 No	800Kg/Hr	100.00	
17 Centrifuge catch tank	1 No	3000lit	3.00	
18 Catch tank pump	1 No	100lit/mt	13.50	
19 Thickner Overflow catch tank	1 No	3000lit	3.00	
20 Catch tank pump	1 No	100lit/mt	13.50	
21 Sodium sulphate drier	1 No	15MT day	97.00	
22 Compressor	1 No	-	6.50	
				435.70

Basic Chrome, Sulphate Manufacture

1 Acid measuring tanks	3 Nos	500lit	1.50	
2 Dichromate measuring	3 Nos	500lit	1.50	
3 Molasses storage tank underground	1 No	25mt	30.00	
4 Molasses measuring tank	3 Nos	500lit	1.50	
5 Reaction tanks	4 Nos	5000lit	20.00	
6 Molasses pump	1 No	100lit mt	10.00	
7 Reaction tank pump	3 Nos	100lit mt	40.50	
8 Storage tanks	4 Nos	30000lit	120.00	
9 Balancive tanks	1 No	250lit	0.25	
10. Spray drier	1 No	2MT water evaporator/Hr		
11 Scrubber	1 No	-	5700.00	
				5925.25

SERVICES-UTILITY

1 Boiler	1 No	10MT Ltr	816.00	

2. Cooling tower	1 No	45000lit	81.00	
3 Weigh bridge	1 No	50MT	195.00	
platform scales	7 Nos	300KGS	195 00	
				1292.00
4. Water storage		200000 lit	200 00	

Liquid Effluent treatment

1 Effluent collection tank	1 No	50000 lit	50.00	
2 Effluent treatment tank	2 Nos	5000lit	10.00	
3 Effluent Clasyfier	1 No	50000lit	50 00	
4 Classified water collection tank	1 No	50000lit	50 00	
5 Recirculation pump	1 No	200lit m:	6.00	
				166.00

Work shop

1. Welding tranformers	2 Nos	78 00
2 Drilling M.c	1 No	78 00
3 Lathe	1 No	78 00
4 Heels & Cutting M.c	1 No	78 00

Laboratory

1 Moisture testing instrument	2 Nos	40. 00
2 Singe pan balance	2 Nos	40 00
3 Chemical balance	2 Nos	40.00
4 PH meters	2 Nos	40.00
5 Vaccum pump	1 No	40 00
6 Drying over	1 No	40 00

	Nos.	Capacity /Day/Hr	Costs in '000 Z$
7 Furnace	1 No		40 00
8 Hot plate	1 No		40 00
9 Hot water lathe	1 No		40 00
10 Optical pyrometers	1 No		40 00
11 Gas analysis apparatus	1 No		40 00
12 Lab stirrer			
13 Terbidometer			
14 Colorimeter			
15 Pipets			
16 Burettes			
17 Lab glasswares			
18 Crucibles			
19 Platinum dish			
20 Gas samplers			
Others			
1 Pipes & fittings & insulation	Various sizes 3000 mtrs		84 00
2 Valves			130 00
3 FRP Ductings			40 00
4 Lining Rubber			41 00
5 Refractory			100 00
6 Acid proof tiles			50 00
7 Wheel barrows			
8 Lift trucks	2 Nos	1 ton	13 00
9 Wooden pallets			

	Nos.	Capacity /Day/Hr	Costs In '000 Z$	
10 Front end loader	1 No	1 ton	78 00	
11 Dumper	1 No	1 ton	13 00	
12 Portable inclined conveyor	1 No	10 MT	9 00	
13 Roller conveyor		5 MT	12 50	
14 Stitching machine	2 Nos	25 Bags/hour	26.00	
				694.50
Electricals				
1 Transformers	2 Nos	750 KWA	70 00	
2 Distribution Panel	1 No		40 00	
3 a) Motor control centres	12 Nos		150 00	
b) imported component			32 50	
4 Motors	141 Nos	various denominations	156 00	
5 Starters	141 Nos		55 00	
6 Cables	3000 MT	Various sizes	4 00	
				507.50
	Contingency	20%		101.40
				608.90

VI.10. INITIAL INVESTMENT COST (Local And Foreign))

Project Cost Million Z$		1st year Local	1st year Foreign	2nd year Local	2nd year Foreign	3rd year Local	3rd year Foreign
0 025	1. Land	100%	-	-	-	-	-
0 075	2. Site Preparation & development	100%	-	-	-	-	-
3 390	3 Civil & Structural	20%	-	80%	-	-	-
1 500	4 Technology knowhow	-	50%	-	35%	-	15%
14.000	5. Machinery & Equipments	26%	14%	39%	21%	-	-
2 193	6 Auxiliary Equipments	40%	-	60%	-	-	-
0 400	7 Pre production expenses	25%	25%	25%	25%	-	-

:

Does not include contingency, pre operative expenses, working capital margin partof auxillary services effluent treatment

VI.11 TOTAL PROJECT COST

	In Million Z$
1 Land (10 Hectares)	0 025
2 Site preparation & development	0 075
3 Structural	3 390
4 Civil	0 115
5 Plant & Machinery	14 100
6 Auxillary Services	2 193
7 Electricals	0 690

	In Million Z$
8 Effluent Treatment	0.612
9. Technology fees	1.500
10 Working capital Margin	0.500
11. Pre operative & Contingency	1.800
	25.000

VI.12. SODIUM SULPHATE PRODUCTION COST

	Raw material per tonne of Sodium Sulphate	Unit price Z$	Cost Per tonne of Sodium Sulphate Z$
1 Yellow Sulphate	1.1 MT	0.00	0.00
2 Sodium Sulphite	0.004	3000.00	12.00
3 Sulphuric Acid	0.007	500.00	3.50
4 Steam	3.2 MT	5.00	16.00 Free from S.D Production
5 Power	90.0 MWH	0.06	5.40 Charged to Sodium Dichromate Production
6. Water	1M3	0.20	0.25
7. Packing 20 0Nos	1.60	32.00	
8. Labour	1.5 Nos	..	15.00 Charged to S.D.Production
			84.15

Selling Price - Z$ 300.00

Production of Na_2SO_4 per tonne of BCS Produced - 0.33 MT

SECTION VII

PLANT ORGANISATION, ADMINISTRATION OVER-HEAD COSTS

CONTENTS

VII.1. FACTORY ORGANISATION

The type of operations and various services required to achieve the production objectives of the factory are:

Management Services

- *Production Process*
- *Raw material preparation like crushing, grinding mixing etc.*
- *Roasting*
- *Leaching*
- *Acidification*
- *Evaporation*
- *Centrifuging*
- *Crystallisation*
- *Reaction*
- *Spray Drying*
- *Packing*
- *Laboratory Process control*
- *Utilities*

Maintenance Services

- *Maintenance and repair of plant and machinery, building, vehicles*

Commercial Services

- *Handling and internal transport*
- *Handling and external transport*
- *Stores for purchased spare parts, packing material, supplies and equipment*
- *Purchase of raw material, spare parts and other supplies*

Financial Services

- *Budgeting*
- *Planning control and performance evaluation*
- *Accountancy*
- *Finance*

Administrative Services

- *General Administration*

Social and Welfare services

- *Security*
- *Wages and salaries*
- *Personal Training*

These operations and services correspond to the main lines of the Factory Organisation as indicated in the organisational chart.

The above operations and services correspond also to cost centres. Howeve- for the purpose of this study detailed costs centre accountancy has not been undertaken. These will be done after the start-up of the factory and the final distribution of cost centres will be adopted to the local requirement and to the preferences of the future management.

VII.2. OVERHEAD COST ESTIMATES

Schedule shows all overhead costs of the Factory, on an annual basis. Total overhead, on a financial cost basis, for a typical steady state year are Z$ 470,500 divided as follows:

VII.2.1 Maintenance of Buildings & Civil Works

Maintenance of buildings and civil works has been calculated at an annual rate of 0.70% of the "at site" value of the fixed assets. An allowance of Z$ 23,000 has been made.

VII.2.2 Insurance

An annual insurance charge of Z$ 260,000 has been assessed. This is equivalent to a rate of 1.25% of the initial fixed assets (buildings, civil works, plant and equipment).

VII.2.3 Communication

An annual overhead allowance of Z$ 50,000 has been made for telex and telephone charges.

VII.2.4 Travel

An annual allowance of Z$ 50,000 has been made; this covers all travel not provided for by the factory car pool.

VII.2.5 Effluent Disposal

The figure has been arrived taking into account the manpower and chemical requirement to treat the Hexavalent Chromium to Trivalent Chromium and for disposing of the sludge. An amount of Z$ 7,500 has been arrived at.

VII.2.6 Protective Clothing

An annual allowance of Z$ 30,000 has been made at an average allowance of Z$ 100 per employee.

VII.2.7 Office Supplies

Office supplies have been estimated at Z$ 50,000 per year.

VII.2.8 Housing

No annual allowance is foreseen for housing.

Table VII.1 -

OVERHEAD COST ESTIMATE
('000 Z$)

ESTIMATE OF PRODUCTION COST

No.	ITEM DESCRIPTION	TOTAL Cost ('000 Z $)
1.	Maintenance, building & Civil works	23.0
2	Insurance	260.0
3	Communication	50.0
4	Travel	50.0
5	Effluent disposal	7 5
6	Protective Clothing	30 0
7	Office Supplies	50 0
8	Housing allowance	-
		470 5

SECTION VIII

MANPOWER

CONTENTS

VIII.1. REQUIREMENTS

Zimbabwe has the required man power avaiability for a project of this nature and magnitude.

At Harare and Bulawayo, the technical education and training facility are available. Trained man power is also available as the Engineering & Chemical process and metallurgical process as well as sugar Industry is well staffed by local personnel.

The requirement of manpower is;

Managerial	-	7
Engineering/Technical	-	16
Supervisory/Clerical	-	18
Skilled	-	35
Semi skilled/Unskilled	-	214

Managerial cadre 5 to 7 years experience in the field.

		Nos. reqd.
1. Chemical process & Production Manager	Having qualification & experience in Chemical Plant, operations and production control, preferably a Chemical Engineer	1
2. Finance Manager-cum Company Secretary	Experience in Corporate sector finance Management and Statutory requirements of Company Management	1
3. Plant Maintenance Manager	Experienced Mechanical Engineer in Chemical Plant Maintenance	1
4. Marketing/Sales Manager	Experienced in Marketing products in a competitivefield	1
5. Quality Control & R & D Manager	Experienced in Input chemical analysis and laboratory management as well as assistance to technicalsales.	1

6. Administration & Personnel Manager	Experienced in Personnel & Labour Management and Office administration & Security	1	
7. Materials Manager	Experienced in Material Procurement standardisation variety reduction & Computers	1	
			7

Engineering & Technical One to two years experience in the field

1. Shift Process Engineers	Chemistry or Chemical Engineering graduates	5	
2. Shift maintenance Engineers	Electrical & Mechanical Diploma holders Mechanical	3	
	& graduate Engineers Electrical	2	
3. Shift chemists	Chemistry graduates with analytical experience	6	
			16

Supervisory & Clerical

1. Accounts Officer	Commerce graduates	1	
2. Sales Representatives	Science Graduates with aptitude for sales	3	
3. Purchase & Stores Assistants	Commerce graduates	3	
4. Welfare Officer	Graduate in Social Science	1	
5. Accounts Assistants	Commerce Graduates	5	
6. Administration Assistants	Graduates	5	
			18

Skilled workers

1. Plant operators	SecondarySchool qualified	15	
2. Fitter, Turner & Welder	Industrial Training Fitters	13	
	Institute qualified Turner	1	
	Welder	2	
3. Laboratory Assistants	Secondary School Qualified	4	
			35

Unskilled

Unskilled	Literate(Shifts)	210
	(Gen. Shift)	4
		214

WORKERS ALLOCATION

	Skilled	unskilled		
A. Chromite Soda Ash line stone Residue	1	12	Skilled workers in shift -8 in 3 shifts 8x3=24	
			Weekly off relievers	4
			Holiday relievers	3
B. Mixing Kiln Kiln Burner Residue handling Leaching	1	10	In general shift	4
			Skilled workman per day	35
C. Sodium Sulphate processing	1	11	Unskilled workers in shifts 60 In 3 shifts 60 x 3:180 Weekly off relivers 30	
D. Dichromate Processing	1	6	In general shift	4
E. Basic Chrome. Sulphate Processing	1	9		
F Utility, Maintenance services & Security	3	12		
	8	60		214

VIII.2. SALARY GRADES PER ANNUM

Chief Executive

1 Basic salary	Z$	70,000.00
2 Holiday benefit		:,100.00
3 Pension 17% of basic		11,900.00
4 Group life cover - 0 213% basic		149.10
5 Workmen compensation 0 62%		440 82

6. Medical benefit		95.60
7. Education benefit - 1%		711.00
		84,396.52
Housing allowance		7,000 00

Managerial

Basic salary	Z$	50,000.00
Holiday benefit		1,100.00
Pension 17%		8,500.00
Group (life) cover 0.213% basic		106.50
Workmen compensation 0.62%		316.82
Medical benefit		95.60
Education Benefit/levy 1%		511.00
		60,629.92
Housing allowance		5,000.00

Engineers & Accounts Officer

1 Basic Salary	Z$	30,000.00
2 Holiday benefit		1,100.00
3 Pension 17%		5,100.00
4. Group life cover		63 90
5 Workmen compensation 0.62%		192 82
6 Medical aid		95 60
7 Education levy 1%		311.00
		36,863.32
Housing allowance		3,000.00

Chemists

1 Basic salary	Z$	25,000 00
2 Holiday benefit 120% of monthly salary or Z$1100 00		1,100.00
3 Pension 17% basic		4,250.00
4 Group life cover 0 213% basic		53.25
5. Workmen compensation 0.62%		161.82

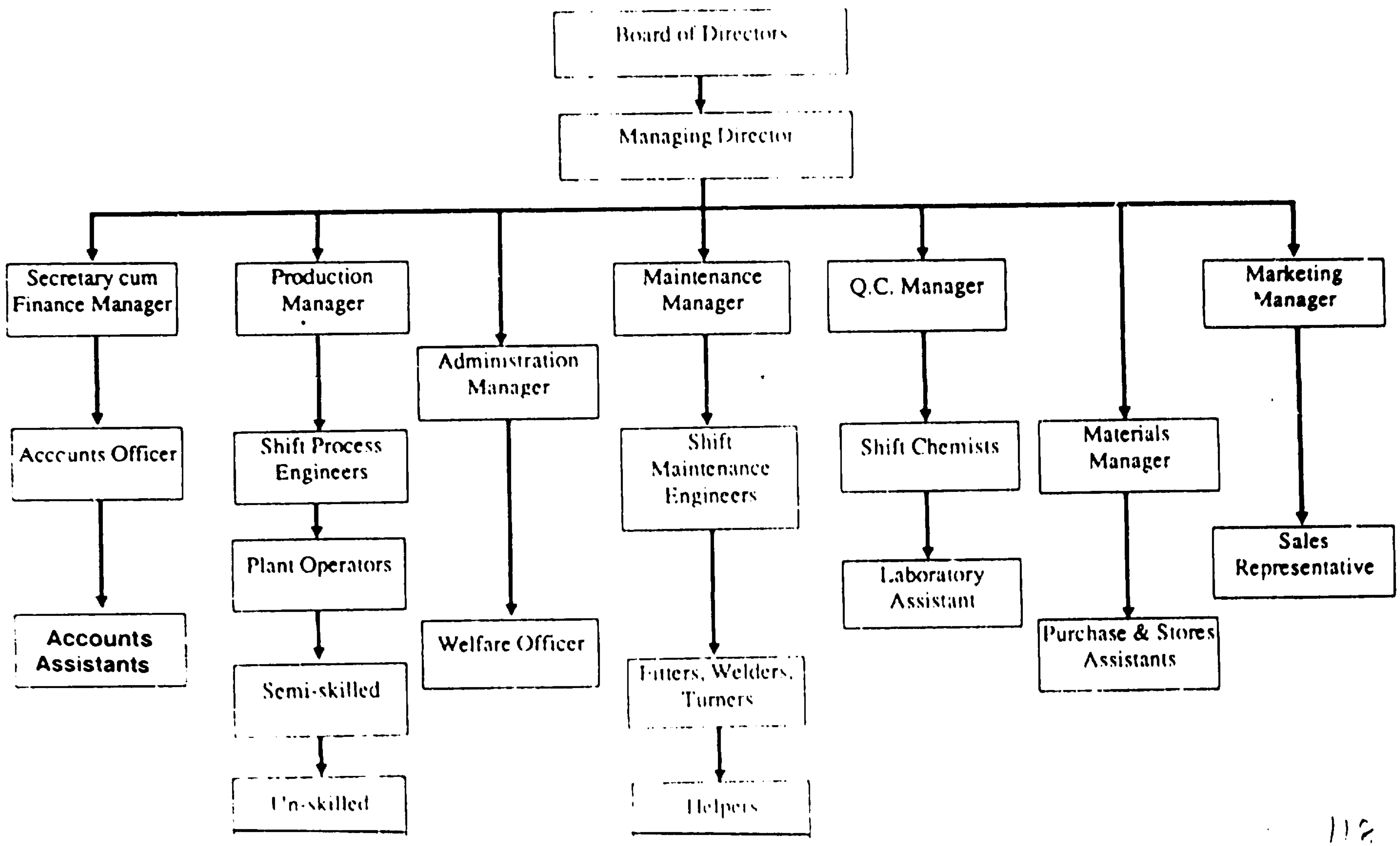
6. Medical aid		95.60
7 Education levy - 1%		261.00
		30,921.67
Housing allowance		2,500.00
Graduate assistants		
1. Basic salary		16,000.00
2. Holiday benefit		1,100.00
3. Pension 17% basic		2,720.00
4. Group life cover 0.213% basic		34.08
5. Workmen compensation - 0.62%		106.02
6 Medical aid		95.60
7 Education levy - 1%		71.00
		20,226.70
Housing allowance		1,600.00
Skilled workers		
1 Basic salary	Z$	20,000.00
2 Holiday benefit		1,100.00
3 Pension 17%		3,400.00
4 Group life cover 0.213%		42.60
5 Workmen compensation 0.62%		130.82
6. Medical aid		95.60
7 Education levy 1% of earning		211.00
		24,980.00
Housing allowance		2,000.00

Unskilled

1 Basic salary	Z$	2,750.00
2. Holiday benefits 120% of monthly salary		275.00
3. Pension 17%		467.50
4 group life cover - 0 213% basic		5.85
5. Workmen compensation 0.62% earning		18.75
6. Medical aid		95.60
7 Education levy 1 % earning		36.67
		3,649.37
Housing allowance		275.00

* Housing allowance not included in overhead costs

ORGANISATION CHART



SECTION IX

PROJECT IMPLEMENTATION SCHEDULING

CONTENTS

PAGE NO.

IX.1. ACTIVITIES

1 (a) Float the company, arrange for finances - Establish an office

1 (b) Arrange for Technical know-how

2 Recruit Project Manager and Supporting staff

3 Work out detailed Engineering and equipment capacities and specifications

4 Get quotations for equipments which have a lead period over 18 months

5 Make comparative study and place orders, for

i) Rotary kiln accessories

ii) Spray drier

iii) Evaporator

iv) Centrifuges

v) Boiler

6 Acquire land

Activities 1-6. Time 6 months

7 Get the equipment details from the equipment suppliers - civil structural

8 Prepare design drawings of fabrication items

9 Work out plant layout

10 Prepare the factory building details and structurals

11 Start site office

12 Get temporary power connection

13 Take up site improvement work

14 Prepare layout of equipments in shed

15 Call for quotations of second phase of equipments and buildings structurals lead time of supply 8-10 months

16 Place order for the equipments

Activities 7 - 16 Time - 6 months

17 Get details - structural, civil

18 Finalise piping (process, steam, services)

19 Finalise electrical requirements

20 Apply for power sanction

21 Get quotation for piping material and pipe laying, insulation etc..

22 Get quotation for electrical equipments, switchgears, starters, lighting etc..

23 Place orders for pipe material

24 Place order for electric material

25 Contract for civil and structural work

Activities 17 - 25 Time 6 months

26 Procure cement and steel

27 Get water connection to site

28 Start equipment and structural foundations

29 Start building erection

30 Receive equipments

31 Erect equipments

32 Erect pipelines and Ductings

33 Erect electrical switchgears

34 Get HT connection

35 Complete electrical lighting work

Activities 26 - 35 Time 8 months

36 Recruit skeleton operating staff and workers

37 Conduct training on plant details and operation

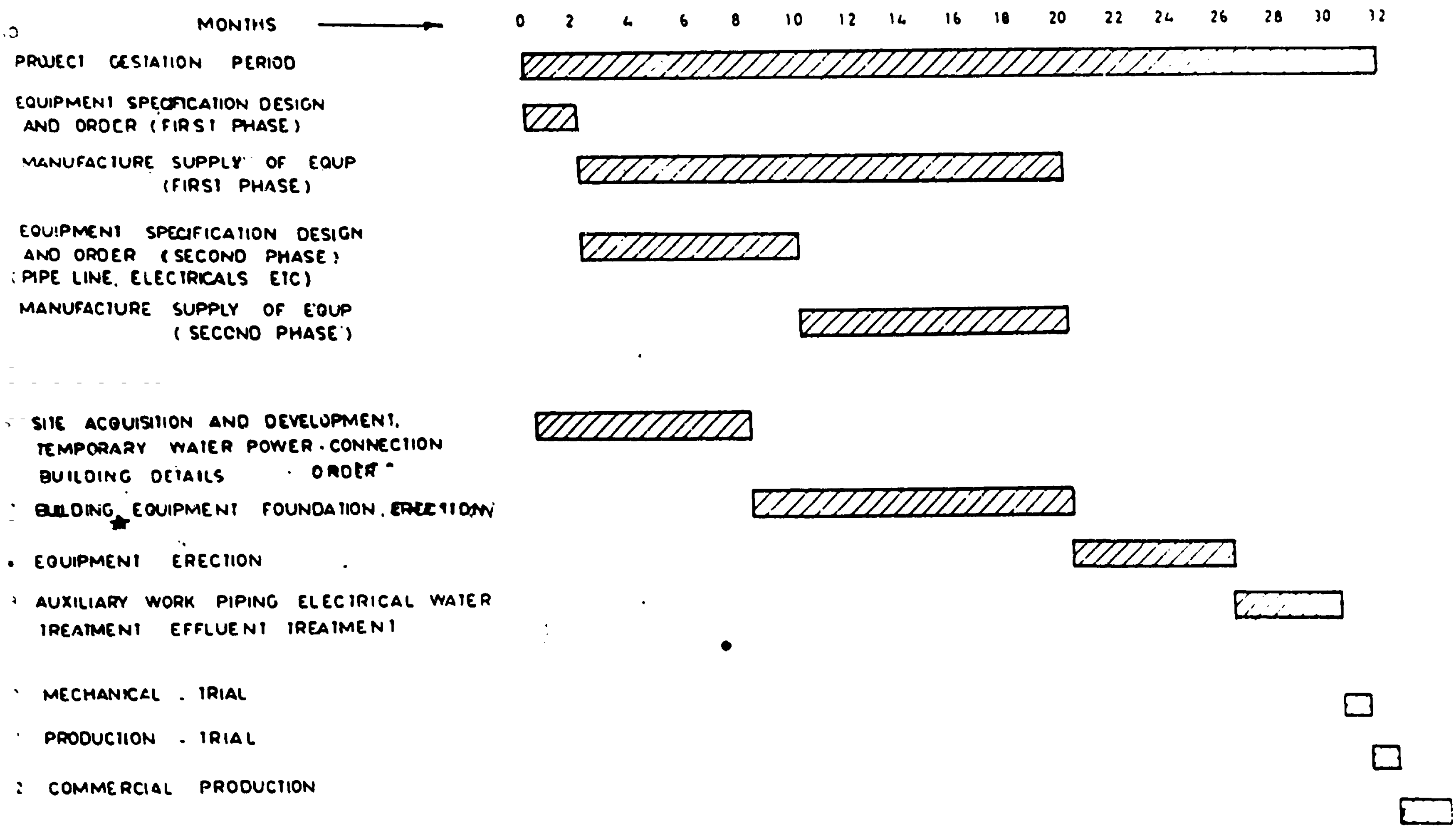
38 Trial run of pipes and pumps

39 Recruit full strength of staff and workers

40 Start production trial

The time required to start production trials from the word go will be 32 months inclusive of provision for delays

BCS PLANT PROJECT SCHEDULE



SECTION X

FINANCIAL AND ECONOMIC

EVALUATION

CONTENTS

X.A. FINANCIAL ANALYSIS

INTRODUCTION

As discussed in Section IV under Market & Plant capacity, two optional capacities were worked on in detail viz . 11,500 tonnes per annum and 7,200 tonnes BCS per annum

The workings have been done with the assistance of COMFAR and relevant tables are enclosed in Vol. II, Annex No

ASSUMPTIONS : for Financial Analysis & COMFAR

Initial Investment :

Depreciation Rates :

Site preparation, Civil works	5%
Technology, Equipment, Auxilliaries- & pre production expenses	10%
Salvage value	25% on site preparation & Civil works
	100% on land

No capital Investments in fixed assets planned in addition to that detailed in this report

X.A.1. PRODUCTION COSTS (cost of goods sold)

	B.C.S.		Sodium Sulphate (by product)	
Expenses Head	**Foreign**	**Local**	**Foreign**	**Local**
Raw material - A	Sodaa ash	Chromite limestone	Sodium Sulphide	
Raw material - B	70% of Sulphuric acid	30% of Sulphuric acid	100% of Sulphuric acid	Packing material
		Molasses Packing material		

PRODUCTION COSTS (cost of goods sold) (contd.)

Utilities		Water Power	-	All costs included in BCS
Energy		Coal		All costs included in BCS
Labour		All labour		All costs included in BCS
Maintenance		All costs		All costs included in BCS
Spare parts	25%	75%	-	All costs included in BCS

Factory overheads All costs are included in BCS

Note Raw material utilities and energy are considered as 100% variable. Labour. Maintenance and spare parts are considered as 100% fixed

X.A.2. PRODUCTION & SALES PROGRAMME

a) Capacity utilisation

It is expected that starting with 5750 MT in the first year it will take till the 6th year to reach full capacity This slow growth is due to difficult marketing situation envisaged

b) Local & Foreign Sales

In the case of BCS, the local sales is taken at 900 tonnes per annum constant. The balance will be exported. In the case of Sodium Sulphate, all sales are local sales.

c) Prices

Ex Factory prices are,

BCS Local	- Z $ 2287 per Tonne
BCS Export	- Z $ 2142.5 per Tonne
Sodium Sulphate (Only local)	- Z $ 300 per Tonne

X.A.3. WORKING CAPITAL

Days coverage

Receivables	- 30 days
Raw Materials - A	- 30 days
Raw Materials - B	- 7 days
Utilities	- -
Energy	- 7 days
Spare parts	- 360 days
Work in progress	- 2 days
Finished goods	- 10 days
Cash on hand	- 1 day
Payables	- 14 days

25% of initial working capital has been included as initial fixed investment.

X.A.4. FINANCIAL SCHEME

a. Initial Investment

Equity	- 40%
Long term loan	- 60%

b. Loan conditions

Interest	- 16% (Nominal)
Grace period	- Repayments to start at the end of Second Year of Commercial production.
Repayment pattern	- 10 equal annual instalments

Interest during construction - Financed by equity

c. **Working capital**

25% of initial working capital is financed as initial investment. 75% is assumed to be a short term revolving loan. Interest is assumed to be 14% (nominal). The increase of working capital required in Year 2 to Year 6 will be financed from internal resources

TAXATION

Tax Rate	- 50% Constant
Tax holiday	- 5 Years
Losses carried forward	- 15 Years

No dividend payments assumed

X.B. EVALUATION TABLE

Criteria	11.500 tonnes annum	11.500 tonnes annum at 70% capacity	7200 tonnes
IRR (before tax, (not in COMFAR Schedules)	18%	13%	9%
IRR (After tax)	15.6%	11.5%	9%
Net present value (000 Z$)	10999	2329	1016
Break Even	67%		105%
Pay back period	5 years	6 years	8 years

From the figures in the evaluation table it is obvious that the plant of 7.200 tonnes per annum capacity is not Financially viable. The reasons for the poor financial outlook for the 7200 tonnes per annum plant are

a) Poor input efficiency (Raw materials Energy Labour)
b) Higher initial investment per tonne of capacity

In view of these, the smallest feasible capacity would be the 11,500 tonnes per annum plant

The figures for the 11,500 tonnes plant are acceptable in financial terms

All further evaluation is done only for the 11.500 tonnes plant

Return on Equity (ROE)

The Return on Equity has been calculated with the help of the Net Income Statement in the enclosed COMFAR tables (page No 227)

The Project is expected to incur losses for the first three years (without inflation) of starting commercial production. Hence, effectively, there will be no return to the investor for a long period if the construction period is taken into account. Even after this period, the average return on equity would be a maximum of around 26% which is moderate, taking note of the risks involved in the project.

Cash Generation

There is likely to be a cash deficit for two years after start of commercial production. This will be due to the low capacity utilisation and the debt servicing required.

It will be necessary to finance these cash short-falls, either through fresh injection of capital (subsidy, equity, fresh loans) or through conversion of the interest payable during this period as a fresh loan repayable over a minimum of five equal annual instalments (page No.225).

A chart depicting the debt service coverage is enclosed as part of the COMFAR schedule as well as a chart of the debt equity ratios (page No.207).

A chart of the Net Profit to total sales is enclosed (page No.208).

Sensitivity

The sensitivity has been done (please refer chart page No.210) for variation on Sales price, operating costs and initial investment

The project is extremely sensitive to variations in selling price. A 10% increase in operating cost would bring down the IRR to just over 10%.

Secondly, the project is also sensitive to variation in selling price. A 10% decrease in selling price would result in drop in IRR to approximately 8%.

The project is not very sensitive to changes in initial investment.

In view of high sensitivity to operating costs, a version was generated assuming that duties/tariffs on imported raw materials would be waived by the Government of Zimbabwe.

The following are the likely financial results:

Internal rate of return (After tax) 17.6%

Net present value (000Z$) 15,267.12

With this there is a substantial improvement in the Cash balance. In this case, the only support the project would need would be an additional years grace period for repayments.

X.C. ECONOMIC ANALYSIS

As the shadow exchange rate is not available for Zimbabwe. the economic and as the cost benefit analysis is limited and certain simplified methods were used for the economic evaluation

The cost benefit analysis is done only for the plant of 11.500 tonnes per annum capacity

The criteria for analysis are:

a) The economic rate of return
b) Absolute efficiency test
c) The value added
d) Foreign Exchange

The calculations for these were prepared using COMFAR cost benefit module

The assumptions used were

i)	Foreign component in local equipment	- 28%
ii)	Transfer payments eliminated Local	- 12% Sales tax
	Raw Material & Capital Goods	
	Imported Raw Material & Capital Goods	- 20% duty
iii)	Import substitution.	

Local sales of BCS (900 tonnes) taken border prices without duty

a) Economic Rate of Return:

The rate of return was found to be 24% and this is 8-5 points more than the financial return after tax The major reason for this difference is the elimination of duties and taxes

b) Absolute Efficiency Test:

The project passes this test as there is a net social surplus of Z$ 87 76 million which is 65% of the net national value added

c) Value added

As an illustration, the sixth year of production was considered. the total gross Domestic value addition was found to be 50% of the value of output This amounted to Z$ 12.06 million. This broken down into

Depreciation	- 2.57 million
Wages	- 3.21 million
Social Surplus	-
Profit	- 1.79 million
Government	- 2.09 million
Undistributed	- 2.40 million
	(all figures in Z $)

The net national value added was 40% of output

d) Foreign Exchange

All the foreign exchange earnings from exports of the product will be accruing from the PTA countries The inflows would accrue through the following scenarios

i) All sales paid for in hard currency

ii) All sales paid for through barter of goods otherwise imported through hard currency payments

iii) Reduction of deficit in the barter system for Zimbabwe (if Zimbabwe has a deficit).

iv) If Zimbabwe has a surplus in the barter system and the trading partner has neither the goods nor the hard currency to settle the payments.

In the financial analysis it has been assumed that all export revenues are paid in Hard Currency (Foreign Currency) The imported materials in investment as well as operating costs have been considered as payments in hard currency

As the partner countries in the PTA are also passing through difficulties regarding the availability of hard currency, serious efforts are required to source the needs of Zimbabwe from these countries so that the barter system is successful

The share of hard currency sales has to be a minimum of 40% in order to balance the foreign currency out flows on account of imported raw materials

Indirect costs/benefits

The only major indirect cost of the project could be environmental pollution from the project Adequate precautions need to be taken to minimise pollution Precautions are also necessary to make sure that the health of the employees is not endangered

A major benefit from the project could be the spin off of many new industries using sodium dichromate as an intermediary product Many of these could be in the small scale which would promote entrepreneurship and employment

X.D. CONCLUSIONS

After a detailed study, it is observed that a plant smaller than the one recommended in the report that is, 11,500 tpa of BCS will not be viable

The product from the plant of 11,500 tpa would be substantially more expensive (FOB) than the international market price

This is partly due to the smaller size of this plant compared to some of the international plants and partly due to the high cost of essential raw materials in Zimbabwe.

Due to this it would not be possible for the products from the project to compete effectively in the international markets Hence, it is essential that any markets for this product will have to be found in countries where preferential tariffs could be obtained to make it competitive with international sellers

Zimbabwe's own consumption of the product at 900 tonnes would be less than 8 % of the total production at full capacity

Such preferential tariff could only be sought within the PTA region Judging from the figures, even the entire PTA region comprising 20 countries does not hold adequate market potential for the full production of the project

The critical factor in determining the capacity of the plant is the production of Sodium di-Chromate which is an intermediate product in the manufacture of Basic Chrome Sulphate Sodium di-chromate could be utilised as an intermediate raw material for many other products including electro-plating, chemicals, pigments, etc

The production of BCS in Zimbabwe could only be possible if its production forms a part of a chrome chemicals complex where a number of products based on Sodium di-chromate are manufactured

In such a case BCS could be produced in much smaller quantities and marketing the product would be feasible

If such a chrome chemical complex is to be set up, it will need a completely new study, as it involves a detailed study on the market potential of a number of such chemicals in and around Zimbabwe

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FEASIBILITY STUDY FOR THE PRODUCTION OF CHROME TANNING SALTS IN ZIMBABWE

FINAL REPORT
VOLUME - 2

MULTI PROJECTS AND DEVELOPMENT CONSULTANCY PVT. LTD.

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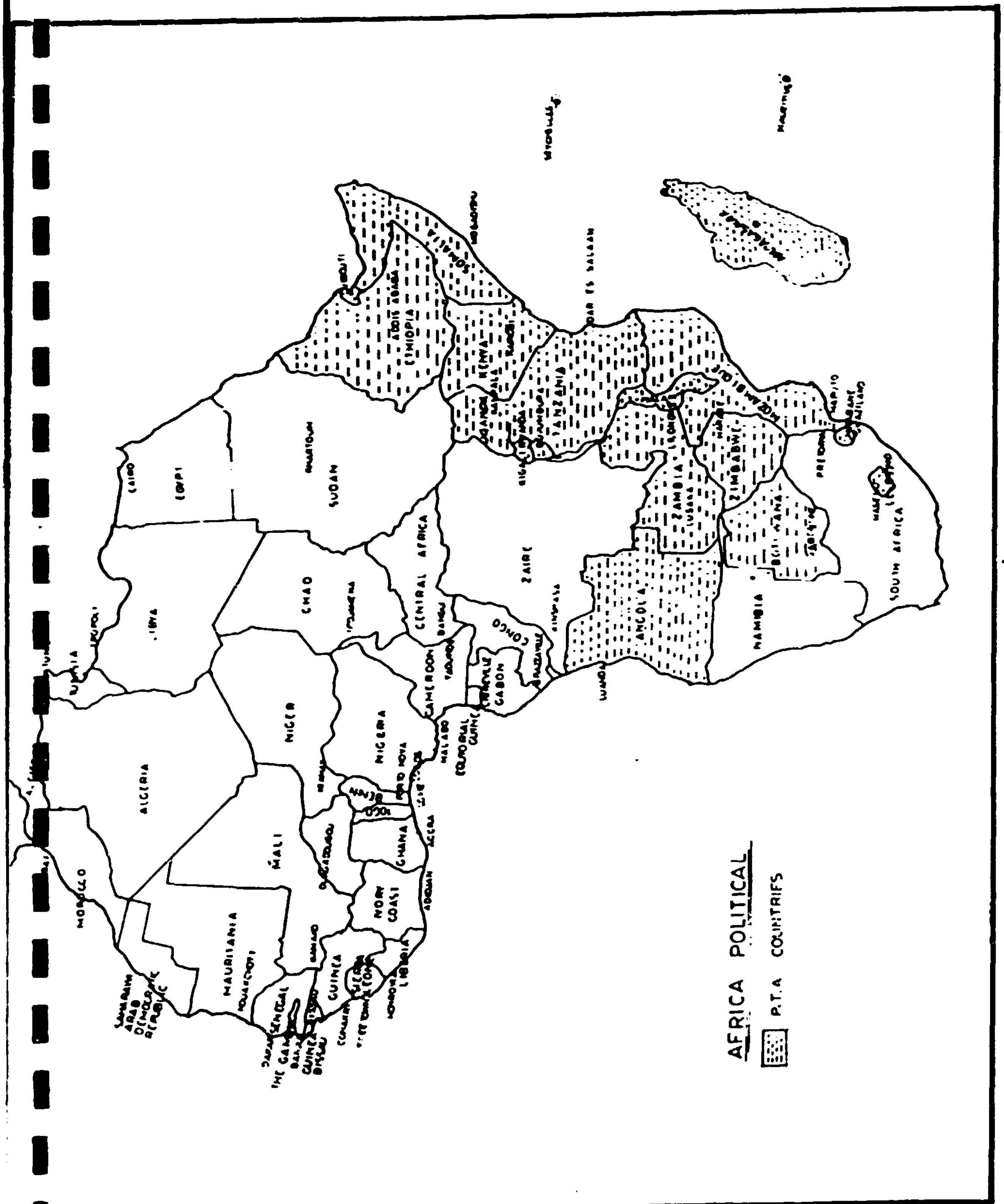

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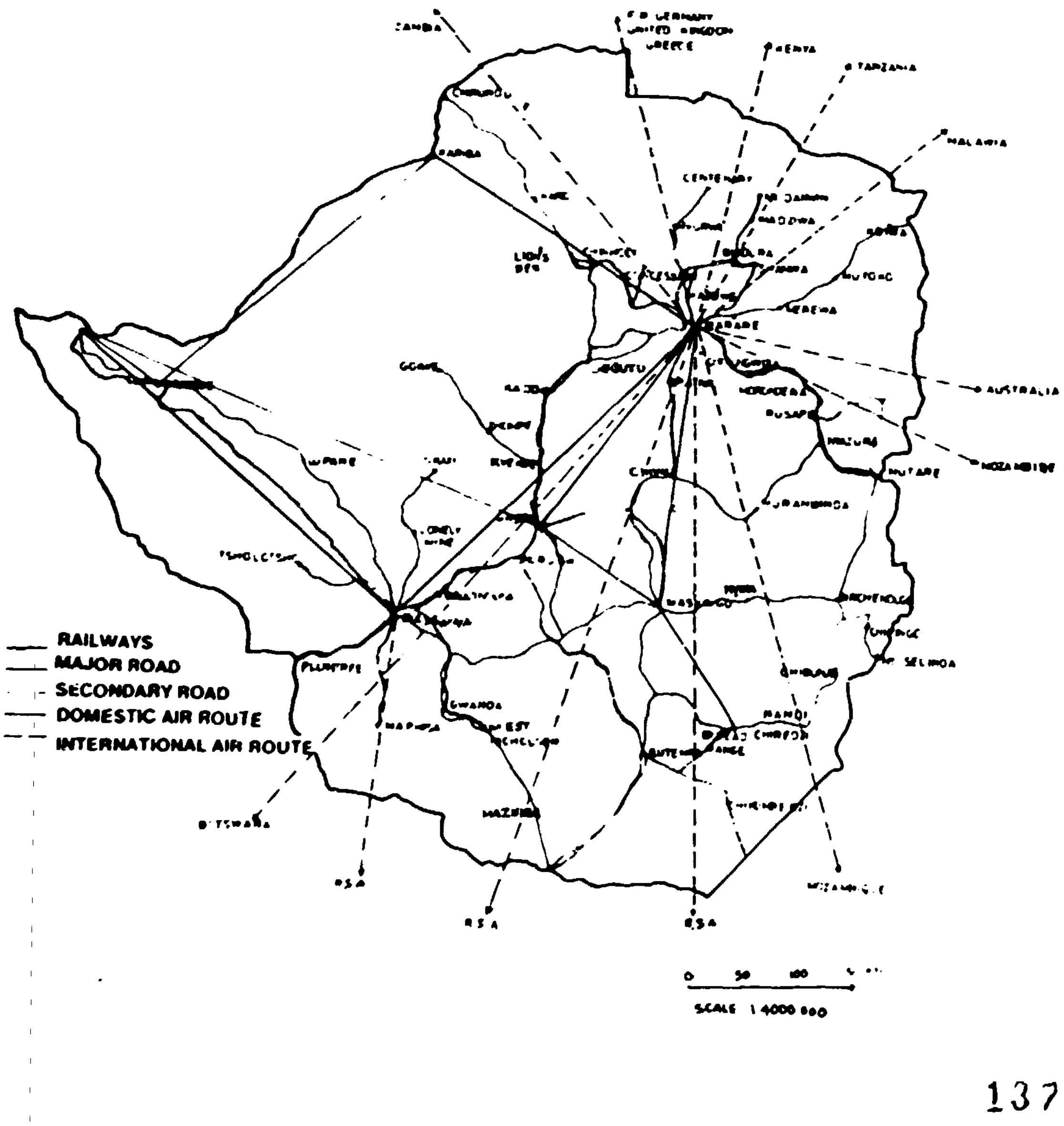
ANNEXE II.1

ZIMBABWE COMMUNICATIONS



Annexe II.2

TERMS OF REFERENCE

General Background Information

1) Origin of the request for the preparation of a detailed feasibility study

This project was one of the several projects identified at the Investment Promotion Meeting for SADCC countries held 3-7 November 1986 in Harare, Zimbabwe.

The Government of Zimbabwe, through its Ministry of Industry and Technology, has requested UNIDO by letter dated 16.3/1987 to prepare a feasibility study, a request which was officially confirmed and endorsed by UNDP Zimbabwe, according to the Resident Representative s telexes of 4 and 29 September 1987.

If Zimbabwe could also manufacture Chrome Tanning Salts, the benefits to all SADCC countries would be manifold. Not only would there be a large savings in foreign currency imports and a greater economic independence from South Africa, but also security of supply and value added factor to a portion of the Chromite Ore produced in Zimbabwe. Today, at least part of the Ore produced is exported to Europe only to return to Africa in the form of Chrome Tanning Salts at a very much inflated price, thereby constituting an avoidable drain on foreign currency resources.

Investigations into the feasibility of producing Chrome Tanning Salts in powder form indicated that the project would not be financially viable unless locally a tannery hide output of 550.000 hides per annum could be guaranteed against the actual output of only 350.000. These hide outputs are equivalent to 880 tons and 560 tons Chrome Tanning Salt powder respectively. The project was therefore shelved as "not viable".

Since the period mentioned the base on which the "not viable" conclusion was reached has changed radically for the better. Firstly SADCC has come into being and, with it, increased co-operation between the states making up its membership. The "not viable" conclusion requires urgent review in the light of the known facts itemized below:

(i) Zimbabwe's hide production is in the region of 350,000 hides annually and that of Botswana in the region of 300,000, giving a combined total of 650,000 hides. This is well above the viability figure which previously reached 550,000.

(ii) SADCC countries such as Zambia, Tanzania, Malawi, Mozambique, Angola, all produce hides in quantity though actual output is not known. However, they are thought to lack tanning capacity and that those hides which are exported by these countries, are delivered in the salt cured raw state. Botswana and Zimbabwe have the tanning capacity to convert these countries hides into the semiprocessed wetblue state pending development of their own tanning capacity.

It follows logically that, if hide outputs from SADCC countries other than Botswana and Zimbabwe are added into the total the production of chrome tanning salts in the SADCC area is almost certainly viable at the present time.

2)Preconditions for the investment proposal

The Government of Zimbabwe's current development plan is based on an average growth rate GDP of 5 per cent. To achieve this the following investment measures will be pursued:

Investment in productive and export oriented sectors by public and private financing with external resources support.

Investment in import substitution industries that utilize locally produced raw materials.

Judicious attraction and application of foreign investment in partnership with local capital with a view to expanding the productive capacity of the economy and developing Zimbabwe's technological capacity.

The volume of raw hide production varies with climatic conditions such as drought and other factors and, over the last ten years, has averaged 578,000 pieces. The difference between tannery takeup and actual hide production has in the past been exported as saltcured raw hide. Since 1982 the trend has been to lower slaughter rates and therefore lower hide production. Estimates for 1986 are as low as 400,000 pcs. This is barely sufficient to meet local needs and finished leather export commitments.

Initially the hide shortage was met by the Cold Storage Commission which is a parastatal organization and the largest hide producer in the country, agreeing to limit raw hide exports to 25 per cent of production. However, with the continuance of falling slaughter rates, tanners are increasingly calling for a ban on all hide exports.

Basically, there are three stages in the conversion of raw hide to finished leather. These are: the slaughter and flay of the animal followed by temporary curing of the hide, usually with common salt or by sun/shade drying to reduce moisture content. On receipt at a tannery, the salt cured raw hide is soaked and then converted to what is known as semiprocessed wetblue leather with chrome tanning salts. The third stage is conversion of the semiprocessed wetblue leather into finished leather of the required colour, flexibility and finish for final manufacture into leathergoods and footwear. Hides can be exported either in the form of salt cured raw hide or in the form of wet-blue.

In connection with the export of semiprocessed wetblue hides as opposed to salt cured raw hides, a point of tremendous significance to the whole of SADCC Africa lies in the fact that tanneries in Europe, which constitute the main export market, are being increasingly hampered by several antipollution regulations. Compliance with such regulations is both difficult and expensive. In consequence, overseas tanneries are increasingly anxious to move away from traditionally imported salt cured raw hides into the import of semiprocessed wet blue for the production of which chrome tanning salts are a basic requirement. It should be noted that one of the conditions for the establishment of basic industries in Zimbabwe is that such industries should in no way contribute to the pollution of the environment. It is therefore expected that the Government would ensure that regulations relating to industry and environment will be properly adhered to.

Zimbabwe has a large percentage of the world's reserves of Chrome Ore. One of the products which could be produced from this resource is Chrome Tanning Salt which is used in the leather industry in the primary tanning process for raw hides and skins. The total regional requirement for chrome tanning salts is at present imported although the production of a local substitute was attempted in 1977. This plant, owned by Rio Tinto, produced a liquid form of Chrome Tanning Salt rather than, as with the imported product, a spraydried powder. Consequently transport and delivery costs were high. Also, while the product proved usable, there were problems of variation in percentage of chrome content and crystallization during winter. From an operational point of view the locally produced Chrome Tanning Salts proved to be more expensive than the imported product.

Regional demand is thought to be as follows

Zimbabwe	960 tons per annum
Botswana	400 tons p.a.
Zambia	100 tons p.a.
Malawi	100 tons p.a.
SADCC	100 tons p.a.
Total	**1,660 tons p. a.**

The current landed cost of Chrome Tanning Salts is Z$ 800 per ton and therefore market demand is estimated at approximately Z$ 3,000,000 p.a. in the SADCC region.

The production of Chrome Tanning Salts would involve the use of chromium ore converted to Sodium Chromate using Soda Ash and heat. The Sodium Chromate is converted to Sodium Dichromate with Sulphuric Acid and reduced with Sulphur Dioxide or Sugar Molasses to form a Chrome Slurry with a 12 to 16 per cent Chrome Oxide content (70 per cent mass per volume). The side produce Sodium Sulphate is recovered.

The Slurry is then spray dried to yield a Chrome Tanning Salt with a 25 per cent Chrome Oxide content. The dry product is bagged for distribution.

To undertake this process, the following facilities would be required:

1) 8-10,000 tons of raw Ore

2) 2,000 tons of Soda Ash

3) 2,000 tons of Sulphuric Acid

4) 700 tons of Molasses or Sulphur Dioxide

5) A ball mill

6) A high capacity kiln

7) Tanks, agitators, separators and filters

8) A spray-drying tower for 2.5 tons of liquid per hour.

The scope of contracting services

The consultant is expected to prepare the feasibility study in accordance with the UNIDO approach and methodology as embodied in the Manual for the Preparation of Industrial Feasibility Studies (ID/206). The attached "Guidelines for Commissioning Feasibility Studies to Consulting Firms" are an integral part of these "Terms of Reference" (TOR) and were established in an attempt to standardize UNIDO's pre investment work

In accordance with the afore-mentioned UNIDO "Manual for the Preparation of Industrial Feasibility Studies", the feasibility study has to consist of 10 chapters, each providing detailed analyses and information in the way outlined below:

Section I	Executive summary
Section II	Project background and history
Section III	Market and plant capacity
Section IV	Materials and inputs
Section V	Location and site
Section VI	Project engineering
Section VII	Plant organization and overhead costs
Section VIII	Manpower
Section IX	Implementation scheduling
Section X	Financial and economic evaluation

The feasibility study should define and analyse in detail all the critical elements that relate to the economics and technology for producing Chrome Tanning Salts, including size and nature of current and optimal demand, projected demand, modes and channels of distribution of finished products, marketing strategy and sales promotion, related costs, feasible normal plant capacity taking into account demand, technology and available raw materials, the various raw material options, their availability, suitability and costs, location and site of the plant, project engineering, selection of commercially proven process available for licensing and know-how transfer, list of equipment and machinery required for each plant section, their specifications and costs; process flow diagrams; utilities required, quantity and costs, infrastructure and other facilities relating to selected location and site; energy consumption and cost, manpower requirements, labour and staff, local and expatriate, training requirements, mode of implementation and time schedules and related costs, selection of engineering contractor, financial analysis, investment costs, production costs, sales revenues, project financing plan, and ascertaining commercial profitability, sensitivity analysis, factors affecting emerging profitability, costs of raw materials, selling price of finished products, constraints on cost reduction, economic evaluation, contribution of project to the national economy

The feasibility study of the consulting firm should contain a complete evaluation, applying whenever possible, computer supported analytical methods such as the UNIDO Computer Model for Feasibility Analysis and Reporting (COMFAR).

Close contact will be established with the Leather Institute of Zimbabwe (LIZ) which will also guide and support the consulting firm's experts in their work and in their fact finding

The project will be implemented by a consulting firm under subcontract with UNIDO. The consulting team will consist of three experts, one Chrome-Ore processing expert, one plant design engineer and a market and financial analyst

For the performance of his obligation under the contract, the Contractor shall make available a total of 6 man-months of services as follows:

1 Team leader (expert in Chrome Ore processing)	2 m/m
1 Plant design Engineer	2 m/m
1 Market/Financial Analyst	2 m/m
	6 m/m

The Government has confirmed that it will provide transportation, accomodation at the UN rate and counterpart personnel (2 chemical engineers, mining expert, financial expert, secretary and draftsmen) to assist the consultants in their field work; provide information and data as required. Office facilities and local transportation will also be provided to the consultants. The Government contributions will be in kind and/or local currency

General time schedule

The Contractor will keep the following time schedule:

- *The team leader of the consulting firm will be briefed for two days in Vienna prior to the departure of the team to the project area*
- *The team leader will be debriefed for two days in Vienna following the work in the project area*

- *A progress report will be submitted at mid-term during the work in the project area.*

- *A draft final report will be submitted to UNIDO within six months from the date of commencement of the field work.*

- *The final report will be submitted one month after the Contractor has received UNIDO's comments on the draft final report.*

Personnel in the field

The Contractor's team should consist of at least 3 specialists, viz :

(a) One expert in Chrome Ore processing (suggested team leader) who will be a geologist or an inorganic chemist with extensive experience in Chromium Ores upstream and downstream processing He will suggest suitable methods and equipment needed for roasting and leaching of Chromium Ores and conversion to Chromium Salts for leather tanning He will also take into account the safety aspects in processing Chromium Ores

(b) One experienced plant design engineer who in consultation with the expert in Chromium Ore processing, will select suitable site(s), provide the basic design of the plant, list of equipment, buildings needed, utility services and manpower requirements with probable cost in local and foreign currency

(c) One Market/Financial Analyst with experience in project preparation and evaluation, preferably acquainted with computerized methods and in the assessment of market potential, distribution, sales and marketing of Chrome Tanning Salts, experience in developing countries highly desirable;

The team should have access to specialists in other fields, as needed All of them should have practical knowledge of developing countries. The Contractor may suggest another composition of the team and the allocation of man-months proposed above for UNIDO's consideration

Participation of counterparts in the Contractor's work.

UNIDO requests that the Zimbabwean counterpart be associated at all phases with the Contractor's work in order to familiarize them with the project from the very beginning. Potential investors, including development financing or industrial investment institutions, should also be involved at an early stage of the Contractor's work, whenever possible.

LANGUAGE REQUIREMENTS

The working language of the Contractor's field personnel will be English.

REPORTS

(a)The Contractor will submit to UNIDO in line with the time schedule indicated under C), 10 copies of the draft final report in English

(b)The Contractor will submit to UNIDO 35 copies of the final version of the feasibility study, after a discussion in UNIDO has taken place and the parties concerned have had an opportunity to comment

Annexe III.1

LEATHER : An Understanding

CHROME TANNING. PRACTICE.

The primary function of the tanning agent is to stabilize the collagen fibers so that they are no longer biodegradable. The manufacture of leather can be divided into three separate phases. Historically, the first took place in the beam house where the skin was prepared for tanning. The next phase was done in the tanyard. The last phase is finishing. The beamhouse was so named because the steps carried out in this part of the process originally were carried out by hand, with the skin laid over a log or beam. Tanning was done in an outdoor tanyard in pits or holes in the ground containing the tanning solutions. Finishing was developed much later and protects the grain surface of the hide and enhances its appearance. Although methods have changed greatly, the beamhouse and tanyard still exist in modern tanneries. Some of the proteins in the raw skin must be removed in order to make satisfactory leather. In addition, the collagen fiber structure must be modified to allow full and uniform penetration of the tanning chemicals. All of the following factors have an effect on the product of any step of the leathermaking process: temperature, time, concentration of reactants, and the amount of mechanical action.

The hides generally are received by the tanner in a salt-or brine-cured condition. The curing dehydrates the hide, which may contain as much as 14% of its weight as salt. A fresh hide contains ca 64% water; after brine curing it contains ca 45% water and 41% protein, only 2/3 of which is leathermaking collagen. The first step taken by the tanner is to remove the salt and to rehydrate the fibres by soaking. A detergent usually is added to speed up the hydration. The soaking procedure also removes water-soluble proteins and washes the hide free of manure and dirt. The period of soaking generally is from 12-24 hours.

Next, the hair must be removed. The keratin has a large content of Sulphur containing Amino Acids, mainly cystine. This Amino Acid's Disulfide cross-links stabilize the Protein molecules, resulting in a stable hair fiber. Hair removal can be accomplished with a saturated solution of Calcium Hydroxide (Lime) alone or in combination with a sharpening agent, eg. Arsenic or Cyanide (both of which are no longer used) or Sodium Sulphide or Sodium Hydrosulphate. Lime by itself does not dissolve the hair but only loosens it in the base of the hair follicle for easy removal by an un-hairing machine. This labour- intensive apparatus scrapes the loosened hair from the surface of the skin and is termed a hair-save process.

Because of the small market for hair and the importance of time, a hair-burn process more commonly is used. Although Sulphide at a pH greater than 11.5 can dissolve the hair in as little as 30- 40 min, the usual Sulphide unhairing process takes from 4-6 h. Although it is rapid and requires less manpower than the hair- save process, it contributes heavily to the pollution load (BOD) in the tannery effluent.

In many tanneries, the relatively brief unhairing step is followed by a longer (4-16 h) liming step The spent unhairing liquors with the dissolved hair are drained from the hides and a fresh saturated Lime solution is added. The action of lime not only loosens the hair but opens up the collagen fiber structure. Collagen swells outside of its isoelectric point in either Acid or Base in 8-48 h. This swelling leads to subsequent fibre separation and allows rapid penetration of tanning chemicals Additional proteins also are removed in the liming stage, and some hydrolysis of amide side chains of the collagen to acid side chains takes place and aids the tanning reaction, since the acid groups are the primary source of binding for Chromium tanning agents

The liming step, when complete, is followed by deliming and bating The hide is washed to remove soluble lime and hair particles. At this point, the stock is at a pH of 12.5 The most widely used deliming salt is Ammonium Sulphate, which lowers the pH to 8-9, a range in which the enzymes in the bate can act properly. The bate is a preparation of pancreatic enzymes that usually are absorbed on sawdust. The effective enzymes are proteases which break down additional miscellaneous proteins. Bating action usually is short, ie, ca 1-4 h. Immediately after the bating, the hides are pickled with sulphuric acid to lower the hide pH to less than 3. Sodium Chloride is added to prevent acid swelling. A full pickle requires at least two hours. Because the addition of a strong acid to water generates a great deal of heat, care must be taken to prevent denaturation of the collagen Once the hide is in the acid condition, it is prepared for the tanning operation

At a pH of 2 8, Chrome Sulphate (usually Ca 33% basicity) is soluble. After the tanning solution has been allowed to fully penetrate the hide, the pH is raised slowly with Sodium Bicarbonate By the time a pH of 3 4-3 6 is obtained, the Chrome has reacted with the collagen to produce a fully preserved, tanned hide. At this point, the hide is said to be in the blue. Although specific procedures are followed in the beam house for a particular type of finished leather, the blue stage allows many options in the next phases of leather manufacture.

The tanned hides generally are stacked overnight and the Chrome further fixes onto the collagen. They then are put through a hide wringer so that they are almost dry to the touch and then are sorted for quality and thickness. Each hide is selected to be made into a particular leather product line, eg. to be heavy- or lightweight shoe leather to be naked grain, or, because of poor grain condition, to be heavily finished Once the choice has been made, the hide is split to the desired thickness. The split, which is from the flesh side of the hide, is either sold to a split tanner or is processed further in the same tannery to make split leather.

THEORY

Chrome tanning generally is carried out by adding the acidified hide to an aqueous solution of trivalent Chromium Sulphate of 30-50% basicity. By using a combination of gel- permeation chromatography, gel electrophoresis, ion-exchange chromatography, and spectroscopic techniques, it was established that there are at least 10 ionic and neutral complexes in a 33% Basic Chrome Sulphate solution.

The reactions of these Basic Chromium Sulphate tanning solutions with hide collagen have been studied. It is firmly estabblished that cross-linking is accomplished by bonding of the various chromium spices with free Carboxyl groups in the collagen side chains. The liming of hides is effective in providing additional Carboxyl groups by chemical hydrolysis of Amide side chains.

The reactions that can take place as the Carboxylate ions, which are attached to the collagen, enter one of these complexes. The Carboxylate group can displace water from the ion (9% abundance) to form monodentate bonds, or bidentate coordinate bonds with binuclear complexes.

Two mechanisms by which cross-linking can occur are straight-forward entry of two Carboxylate ions into the same chrome complex and olation which involves elimination of water and formation of a linkage between two complexes. The olation reaction is favoured by an increase in the alkalinity of the reaction mixture As the reactions proceed and multinuclear complexes form with multiple olate bridges. Hydronium ions are released and highly stable Oxalate bridges are formed. There is evidence that Bidentate Sulphate groups remain in the final complex after curing and drying. Apparently they play a role in improving stability of the complexes.

Similar coordination complexes are involved in other mineral tannages. All of these complexes can be reversed or modified by acids, salts, strong bases and chelating agents. Chromium complexes, although more difficult to form, have the advantage over other complexing cations of reacting much more slowly in these ligand replacement reactions and, therefore, producing leather that is more stable and serviceable in use. Chromium 3+ also is unique in its resistance to Oxidation.

VEGETABLE TANNING. PRACTICE.

Leathers made with a full vegetable tannage are used for shoe soles, belts, saddles, upholstery, lining, and luggage. Vegetable tanning produces a fullness and resiliency characteristic of only this type of tannage. It has certain molding characteristics so that, in sole leather, a shoe is produced that adapts to the shape of the individual foot. Vegetable-tanned leathers also have good strength and dimensional stability and, thus, find use in power-transmission belts. Their Hydrophilic character is a great aid in shoe linings for the removal of perspiration from the foot.

Vegetable tanins are the water-soluble extracts of various parts of pl-- .. materials, including the wood, bark, leaves, fruits, pods, and roots. Some sources contain up to 20% tannin. The extraction process yields a mixture of tannins and nontannins, the higher the proportion of tannins to nontannins, the more valuable the extract. The tannin content is analyzed by an empirical method involving the reaction of the extract with a specially prepared hide powder under specified conditions. In general, the same steps are carried out in preparing the hide for vegetable tannage as are carried out in preparing the hide for chrome tannage, eg, the hair is removed by the same chemicals. However, a much slower process is used and, frequently, involves as long as five days of soaking in pits. The hides are exposed first to saturated solutions of lime and then are moved into other pits in which small amounts of Sodium Sulphide are present. Initial exposure of the hair keratin to the alkali in the absence of Sulphide produces a reaction known as immunization. The main chemical reaction occuring in this process is a conversion of the crystinyl residues in the keratin to Lanthionyl residues, the latter provides a much more stable cross-link to the protein than the former. The resulting hair fibre is much resistant to chemical attack than is the nonimmunized fibre. At the end of the five days, the epidermis and hair have been loosened in the follicles by the chemicals and are mechanically scrapped from the hide in unhairing machines. This lengthy liming and dehairing step is necessary to open up the fibres of the hide in such a way as to prepare them for penetration by the vegetable tannins.

The hides then are mechanically fleshed and returned to vats where they are chemically delimed with Ammonium Sulphate and bated with pancreatic enzymes. The pH is adjusted ultimately to 5. The hides then are placed on frames which are lowered into vats containing tannin solutions and are gently agitated. They are subjected over a number of days to a series of vegetable tannins of increasing strengths. Slow, thorough penetration of the hide is accomplished without case hardening (surface accumulation of tannins). This may be done by moving the frame from pit to pit where tanning solutions of increasing strengths are present or by pumping solutions of tannins from pit to pit over a period of time while the hides remain in one pit. The entire process takes three weeks. The tanning liquors normally contain Phenolic syntans (synthetic tannins) for color control and Naphthalene syntans for sludge dispersancy

Recently, a more rapid, minimum-effluent vegetable tanning system, known as the Liritan process has been developed. The limed and bated hides are treated for 24 h in a pit with 5% Sodium Hexametaphosphate (Calgon) solution and sufficient Sulphuric Acid to achieve a pH of 2.8 at the end of that time. This part of the process has become known as the Calgon pickle. The solution is reused daily, being regenerated with additional Calgon and Sulphuric Acid, and is discarded only once a year. The treatment presumably prepares the hides for a more rapid vegetable tanning process, and the recommended one with varied concentrations of wattle (mimosa) takes 11 d. Again, the tannin liquors are recirculated and reused. Further finishing of leathers that have been prepared by the Liritan process is the same as for those prepared by conventional processes. First introduced in 1960, the Liritan process has spread throughout the world

The tanned hides are further processed in order to clean the surface of the hides of excessive amounts of tannins (usually unbound tannin) and then are wrung free of excess water and are oiled. Oiling is carried out in a drum with oils added to lubricate the leather fibers plus a variety of materials that may be drummed into the leather for the purpose of achieving specific properties in the final product. The recipes that are used are largely the inventions of the individual tanner and may include powered Lignin preparations, Naphthalene syntan, Epsom salt, corn sugar, salts of Organic Acids, Bicarbonates, and Borax. Most of the solids are added as such, the sugar is usually added in the molten form, and the oil, of course, as the liquid. The leather then is hung so as to dry slowly for one week. At the start, air at 90-95% rh and no more than 37.8 Deg C is slowly circulated through the drying loft. The relative humidity is decreased slowly so that, at the end of the week, the moisture content of the leather is 10-12%.

The grain surface then is sponged with a dilute oil preparation and is rolled repeatedly under considerable pressure with a highly polished metal (usually Brass) cylinder on a large pendulum-type machine. The leather is moved back and forth under the pendulum arm by an operator as the arm strikes down on the leather. The pressure also is regulated by the operator. This operation packs the fibres of the leather and imparts a characteristic gloss to the grain The leather is allowed to dry, is dip-washed in a solution containing a small amount of wax, is redried, and is given a final dry rolling

THEORY.

Functionally, the vegetable tannins are Polyphenolic compounds They are empirically divided into two groups, the Hydrolyzable tannins and the condensed tannins The Hydrolyzable tannins are derivatives of Pyrogallol The distinguishing charasteristic is that, as a group, they produce solutions when boiled in dilute mineral acids Chestnut and Myrobalan are typical hydrolyzable tannins. The condensed tannins are derivatives of catechol and commonly undergo condensation reactions when heated with mineral acids, thereby producing precipitates. Hemlock and Wattle are of this type

It is highly likely that no cross-linking of the protein, other than by the formation of Hydrogen bonds, takes place as a result of vegetable tanning This results from a displacement of Hydrogen-bonded water molecules by the Phenolic groups of the tannins with the formation of Hydrogen bonding between these groups and the Peptide bonds of the protein chains The large size of these molecules and the large amounts of tannin that are used produce a coating on the fibres as well as fill the voids of the leather. In some cases, as much as 50 wt % of tannin is incorporated into the hide.

Sole leather is the predominant leather manufactured by vegetable tanning. Processes for other types of leathers (belts, harnesses) made by vegetable tanning are very similar. Cattlehides are the raw material used for this purpose, with cowhides producing the lighter (thinner) leathers and steerhides the heavier (thicker) leathers. Historically, sole-leather weight (thickness) has been measured in irons (one iron = 0 53 mm). Cowhides yield leathers ranging from six to nine irons and are used primarily for lightweight shoes, eg, women's shoes; steerhides yield leathers ranging from nine to twelve irons and are used in heavier shoes, eg, men's shoes

OTHER TANNAGES.

Chrome and vegetable tannages have greater commercial importance than those that are considered below Most of these tannages are pretannages or post-tannages for Chrome or vegetable processes and are employed to give such qualities as filling, lighter shade for dyeing, and reduction of tannery effluent Only occasionally are they used alone

MINERAL TANNAGES.

The principal mineral tannage other than Chromium is Zirconium tannage Zirconium tannage has been compared to Chrome tannage but seems to form complexes faster Stronger acidity pickles usually are employed to slow the reaction, and the pH is raised more slowly. Extra salt is used to repress swelling at the lower pH. Pretannage with Aldehyde sometimes is employed. Zirconium tannage leads to fairly firm, full white leathers, which unlike Chrome, are white throughout the cross section The mechanism of Zirconium tannage is unresolved but there seems to be an initial uptake of Anionic Zirconium salts at low pH. However, for satisfactory leather quality, it is necessary to have subsequent neutralization, which converts the Zirconium complex to a cationic state at which time some Polymerization may occur

Aluminum tannage requires very low initial pH and large quantities of neutral salt to repress both swelling and rapid flocculation of aluminum salts as the pH is raised This type of tannage leads to leathers that tend to dry out and to become hard and horny unless much salt is used, even then, the leather tends to be flat and papery in feel Aluminum tannage is used in combination with other tannages. Renewed interest in such combination tannages is being generated in view of increasing regulation against chrome tannery wastes. The following recommendations have been made: a mimosa vegetable pretannage followed by Aluminum tannage, a combined tannage with Chromium, Alum, and Glutaraldehyde with inclusion of Acrylic Acid Polymers to increase Aluminum fixation and a combination Chromium and Aluminum tannage to reduce Chrome waste

Iron tannage also tends to give flat, papery leather. Initial work indicated poor resistance to aging. However, it seems probable that the early leathers received insufficient tannage. Iron- tanned leathers have very little commercial importance, possibly in part because of the intense black coloration produced by iron reaction with Phenolics, which are the principal components of the vegetable tannis and syntans so widely employed as retans in tanneries

Polyphosphates are excellent pretannages for vegetable tanning Optimum molecular weights of the Polyphosphates are from 1500-2500 The Liritan Polyphosphate-vegetable combination tannage process, as a no-effluent rapid tannage for sole leather is used by sole-leather tanneries throughout the world

Silica tannage is effected by the formation of Silicic Acid and its penetration into the skin in the form of sols of monomeric Silicic Acid or its low molecular weight polymers However, for tannage to occur, Polymerization of the sols must take place within the skin The Silicic Acid is fixed to the protein by coordinate bonds and, at the same time, is Polymerized in long chains. Difficulties in effecting this reaction reproducibly and leather weakness have hindered the use of Silica tannage, although it has been used in some instances to obtain fuller leather in combination with more stable tannages

POLYPHENOLIC SYNTANS.

Polyphenolic syntans are low molecular weight condensation polymers of aromatic Phenols, usually with Formaldehyde They usually are Sulphonated for increased water solubility Initially, work on these materials was carried out in order to find a replacement for the natural vegetable tannins that would be consistent in action and easily purified The variety, availability, and cheapness of the natural tannins, in general, have precluded this approach, except for syntans that were developed as strategic materials when supplies might be cut off in time of war. During World War II, Orotan was developed by the Rohm and Haas Company; it was claimed that Orotan could completely substitute the natural vegetable tannins as the tanning material in vegetable-tanned leathers. However, during peacetime and because of their greater cost, the syntans are used extensively only in combination tannages, usually following Chrome tannage. They are used to control leather fulness, area yield, color, and the electrical charge of the leather. The latter affects dyeing and fatliquoring operations.

RESIN TANNAGES.

The principal resin tannages are those performed with the Aminoplast resins. These are now Molecular Weight, Polyfunctional, Organic compounds whose reactive groups are N-methylol or N-alkoxymethyl groups. They usually are made from Polyamines, eg. Melamine or Urea or Dicyandiamide, by reaction with Formaldehyde and water to form N-methylol groups or by reaction with Formaldehyde and an alcohol to form N- alkoxymethyl groups. A simple monomeric member of the group is Hexa (methoxymethyl) Melamine. Alkoxylation need not be carried so far as with Hexamethoxymethyl Melamine. Residual amino groups can be left. Monosubstitution rather than disubstitution also can be done. The materials are capable of self-condensation to release alcohol, or water for N-methylol types, or Formaldehyde and they react strongly with Amines or Alcohols.

The materials used for tanning usually are of low Molecular Weight, the degree of Polymerization being from 2-3, and are water soluble. The reactivity of the N-methylol types is greater than that of the N-alkoxymethyl types, but the latter are more stable to handling. The low molecular weight materials are incorporated into the leather by drumming. Then the pH is dropped and, under acid catalysis, both self-condensation and reaction with Amino and Hydroxyl groups of the protein can occur.

Acrylic resin syntans containing multiple Carboxylic Acid groups have gained increased commercial attention. Such Polycarboxylic Acid Polymers can be expected to increase fixation of mineral tannages and can eliminate the possible toxic hazards from unreacted Phenols or Formaldehyde which might be present in some of the other types of syntans.

OIL TANNAGE.

Oil tanning produces leathers with unique characteristics. Oil-tanned chamois leather is very soft and stretchy, absorbent of water which can be readily squeezed out again and, because it also absorbs grease, is an ideal material for cleaning such items as auto windows and spectacles. The grease is removed from the chamois by alkaline washes with soaps, and the chamois can be reused many times. Because of the softness and suppleness imparted by oil tannage, it also has been used for tanning furs. Here, however, to avoid excessive stretchiness, it usually is employed as a combination tannage with Alum, Chrome Alum, and/or Aldehyde tannage.

Chamois leather originally was made from the skin of the Chamois, a goatlike antelope found in the French Pyrenees. Now, however, it is made principally from sheepskins with the grain layer split off, although other loose-textured skins are employed. The tanning process consists of stuffing the beamed skins with as much oil as possible (principally unsaturated marine oils) and then subjecting the oiled skins to conditions favouring autoxidation of the oils. Theories of tannage involve not only Polymerization of the oil but projections of tannage with Aldehydes formed from Oxidative chain scission of the oil, Epoxy formation, and Acrolein formation. However, in view of the necessity for free-radial formation prior to the above processes, the case of formation of these free radials on the Methylene group alpha to two unsaturated double bonds, and subsequent formation of Peroxide free radials from these, it seems reasonable to believe that direct free-radical attack on the collagen occurs. This would form strong covalent bonds that are able to withstand caustic washing. This concept should certainly be a part of consideration of the mechanism of oil tannage. It is analogous to the concept of Graft Polymerization, a process much studied for leather modification in recent years, both in the United States and abroad (78-81). Detailed studies of the autoxidation of oils would seem to give credence to a strong possibility of oil tannage being a form of Graft Polymerization when such reactions are carried on in the presence of collagenous hide tissue.

SULPHONYL CHLORIDE TANNAGE.

Sulphonyl Chloride tannage for chamois-type leather was developed in Germany in World War II with oils from a coal-gas liquefaction process. The fraction that was used boiled from 220-320 Deg C, and it was hydrogenated and then sulpho chlorinated to yield a mixture of aliphatic Sulphonyl and Disulphonyl Chlorides, which was termed Immergan. A pretannage with Formaldehyde was advised for using these Sulphonyl Chlorides to make chamois-type leather.

ALDEHYDE TANNAGE.

Only two Aldehydes have commercial use as tanning agents: Formaldehyde and Glutaraldehyde. With one excepiion, they are never used as the only tannage but most commonly are used in conjunction with some other tanning agent, usually Chromium The one exception is in the tanning of light- coloured, including white, glove leathers. The functional group in proteins that reacts with Aldehydes to form cross-links is the primary amino group of protein side chains of Lysinyl residues. Details about the reactions which take place between the Aldehydes and the Protein Amino groups are not known

One important difference between the tannages achieved with Aldehydes is that Formaldehyde forms cross-links that are disrupted easily by simple Hydrolysis, whereas Glutaraldehyde forms cross-links that are completely stable even to Hydrolysis with strong acid Thus, there is a considerable difference in the relative stabilities of the two tannages. Another difference is that Formaldehyde tannage yields a white leather, whereas Glutaraldehyde tannage produces a light-tan leather. When these Aldehydes Are used with other tanning agents, the color imparted by the additional tanning agent changes the results. One combination that has been used successfully to produce a white leather is that of Formaldehyde and Aluminum.

The principal raw materials for the production of high quality, light-coloured glove leathers are kid skins and hair sheepskins. These skins are processed with conventional chemicals through soaking and unhairing, fleshing and degreasing, and pickling They then are tanned with from 6-12% formalin, based on the weight of the pickled skins. The starting pH for this tannage usually is 2 or 3 in ambient temperature conditions. During the tanning reaction, which usually takes 16-18 h, the pH gradually is raised and the temperature is increased. The final temperature of 35 Deg C and pH of 7 is common Further processing includes the use of retannages and fatliquors to maintain the white or light colour of the leather For darker- coloured leathers, and this combination also is frequently used for fur tannages

The retannage of vegetable-tanned leather with Formaldehyde, which reacts under acidic conditions and increased temperatures with the Polyphenolic vegetable tannins, provides a more stable tannage. Formaldehyde retannage of vegetable-tanned isolate leather increases the resistance of the leather to perspiration.

Glutaraldehyde is most frequently used as a retannage for chrome- tanned leather. Glutaraldehyde tanning results in the formation of extremely stable cross-links in the protein. Although numerous investigations of the nature of these cross-links have been made, their identity is unknown. The stability of this tannage to hydrolytic conditions had led to its use in the production of leathers with improved resistance to hot soap solutions, to perspiration, and to alkalis. Thus, leather for use in gloves, garments, work shoes, and nurses' shoes frequently is made by retanning chrome-tanned leather with Glutaraldehyde. Other improvements resulting from the use of Glutaraldehyde retanning include a more level colouring and a better mellowness of the leather

Although the most frequent use of Glutaraldehyde is as a retanning agent, following Chrome tanning, it can be used quite effectively with vegetable tanning either as a pretanning agent or as a retanning agent. When used in the former manner, the subsequent penetration of the vegetable tannin extract is very rapid and the properties (eg. shrinkage temperature, water solubles, and perspiration resistance) are much improved. When used in the latter manner, it leads to improvements in these properties in addition to an increase in thickness of the leather.

POST-TANNING. RETANNING, DYEING, AND FATLIQUORING.

During the early aging period, when the leather is stacked, there is a gradual decline in the pH of the stock as increased Chrome fixation, Olation, and Oxolation occur. Consequently, after transfer to a drum, the stock is neutralized to a desired pH, frequently is retanned, and then is dyed and fatliquored in rapid succession in the same drum

The acidic, Chrome-tanned leather is highly cationic in nature, since it is well below the isoelectric point of collagen which , after the liming process, has an isoelectric point of 5.4. Neutralization pushes leather closer to the isoelectric point and reduces the surface charge on the protein. This is important because many of the dyes that are employed are anionic. If the leather is too cationic, the precipitation of the anionic dye at the surface occurs rapidly, the dye is confined too much to superficial layers, and dye is considered too astringent. Neutralization of the surface layer slows the cationic/anionic interaction and allows deeper penetration of the dyestuff. Retannage also affects the surface charge on the leather. Many of the syntans employed for retannage are salts of Naphthalene Sulfonates or other Organic Sulfonates having an anionic charge. They occupy many of the cationic sites on the leather and, thus, change the net charge and affect dye penetration and combination. The natural vegetable tannins and Polyphenolic syntans also are anionic in character and affect the dyeing process. If highly vegetable re-tanned, the leather composite becomes anionic and usually requires the utilization of basic dyes. Hence, vegitable retans are used not only to impart vegitable-tanned leather characteristics, eg. the dimensional stability to changes in relative humidity, increased fullness and temper, and ability to be tooled, but for their effects on leather dyeing and appearance.

Fatliquoring is the application of oil-in-water emulsions to the leather. It usually succeeds the dyeing process, although some tanneries apply them simultaneously rather than in rapid succession. The oil emulsions usually are drummed in at elevated temperatures. Commercially used oils usually are of animal or vegetable origin and of relatively low oidine number, although cod and other marine oils are sometimes included but usually in minor amounts. Fatliquoring emulsions may be anionic nonionic, or cationic. Blends of nonionic with one of the other classes frequently are employed to assist oil penetration; the nonionic surphactant prolongs the stability of the oil after its anionic or cationic charge has been neutralised. Protective colloids, eg. gums, starches, and proteins, also can be used to prolong emulsion stability, and emulsions prepared in their presence frequently are of finer particle size than otherwise is obtained. Anionic fatliquors usually are prepared from mixures of either Sulphated or Sulphonated oils with raw oils. Cationic fatliquors usually are blends of alkylated long chain amines together with raw oils. However, synthetic surphactants of the desired type may be added to both. The polar components tend to be bound to the protein, probably mostly by ion-dipole interaction. The raw oils have more freedom to migrate but tend to stay in the area of the bound oil, probably by a process of mutual solubility. The principal function of the fatliquoring oils is to reduce the amount of fibre cohesion during the drying process. Lubrication of the leather is an important but secondary effect. Because oil distribution is much affected by the distribution of ionic charges in various strata of the dyed and undyed leathers, a variety of tempers, flexibilities, and stretch characteristics can be attained.

DRYING.

Once all of the wet operations have been completed, the leather can be dried which not only involves removal of excess water, bringing the moisture content close to that of the finished leather, but completes the reactions of some of the materials (eg. tanning agents, fatliquors, and dyes) with which the hide has been treated. Leather drying occurs by removal of water first from the surface of the leather and then by a diffusion-controlled process from within the leather. If drying at the surface occurs too rapidly before the diffusion can occur, the surface becomes dehydrated and, eventually, hard and the interior remains moist. If dehydration proceeds too far, the surface can never be rewetted completely. Thus, the drying operation must be carefully controlled. Properly tanned leather can be dried more rapidly and easily than untanned collagen. One of the creteria of a tannage is that the leather is soft when dry. The extent to which this is the case depends on the type of tannage and other materials (fatliquors especially) present. Even so, drying is accomplished under carefully controlled conditions of temperature, humidity, and air circulation.

The most fundamental and oldest method involves simple air drying of hides and skins that are hung over supports. Currently this is done, but the drying chambers are programmed in some manner to control the conditions. Since the hides and skins are not held in any shape, ie, restrained, shrinkage occurs with a resulting area loss. To a limited extent, this problem has been overcome by tacking the hides and skins flat to boards. A variation of the above is toggling. In this practice, the hides and skins are stretched out over screens or perforated plates, called toggle frames, and are clamped in place. The frames that contain the wet hides and skins are placed in drying units. Large units are available with several frames mounted on tracks so that the frames can be easily slid into and out of the units.

Another method involves pasting the hides or skins, grain-side down, to plates of glass, porcelain, or metal. These plates are mounted on tracks that move into and out of large drying units. The leather dries from the flesh side only and a smoother, flatter grain is achieved on the leather.

The most recently developed method is vacuum drying. The hides and skins are spread out, grain down, on a smooth, highly polished, heated, stainless steel plate in which the temperature is carefully controlled. A cover is lowered and sealed over the plate and the space between is evacuated. This method permits rapid drying with few problems with the product quality because the conditions can be controlled much more accurately than by other methods.

COATINGS.

In the process of making leather from hides or skins, great pains are taken to make a uniform product. A manufacturer of a particular type of leather will use a particular animal species. Yet because of variations in individual animals and their nutritional and environmental histories even within that species, manufacture starts with a very variable substrate. The skins vary in thickness, in the angle of weave of the fibres, and in natural defects, not only from animal to animal, but from area to area of the skin from the same animal. The leather manufacturer minimizes these differences by using processes as uniformly as possible, by splitting and shaving the leathers to uniform thicknesses, by tanning and filling to occupy the voids in the looser-structured flanks, and by using mordants to obtain as level dyeing as possible. However, it is the finishing process with its application of natural or Synthetic Polymers and of colorants, within and on the surface of the leather, which produces the uniformity, appearance characteristics, and resistance to scuffing and abrasion which are required for a commercial project.

Coatings for leather function as decoration and protection. The application is difficult in so far as providing uniformity because of the decidedly nonuniform substrate. Leather coatings also have a requirement for much greater flexibility and extensibility than other coatings.

The ability to meet these demanding requirements for uniformity, flexibility, and extensibility depends to a large extent on primer coatings, but which are made with specially developed emulsion polymers, mostly of the Polyacrylate type although Butadiene Copolymers also are employed. The Latex Polymers for leather basecoats have to be of exceptionally high molecular weight and exceeding low glass-transition temperature.

.Unfortunately. Latex coatings of the type described offer little protection against abrasion and /or scuffing and higher modulus Polymers are required. These are provided in upper coats applied from solvent solutions. Mostly Nitrocellulose or Vinyl Chloride Copolymmer Lacquers are employed. Polyurethanes are used increasingly, but their principal application for leather has been in the specialized production of patent-leather coatings where thermoplastic, followed by moisture-cured, Polyurethanes have completely replaced the bodied linseed-oil varnishes that used to be employed.

If the high modulus polymer topcoats are applied directly over the extremely low modulus basecoats, the difference in modules leads to intercoat failure during flexing It is necessary to provide multiple coatings with a gradually increasing modulus in each coat from bottom to top This prevents a stress build-up within any particular coating Usually no less than three and, more often, four or five coats are employed The development of a class of Vinylidene Chloride-acrylate Latex Copolymers,which are partically crystallizable and, although of low gloss- transition temperature, are less thermally sensitive and of somewhat higher modulus than equally lo[illegible] Tg Poly[illegible]ylates, has been found to aid the transition

An additional benefit of using multiple coatings is the achievement of special fashion effects

To preserve the long-term flexibility achieved in the base coats by high Molecular Weight emulsion Polymers, the Polymers used in the upper coats also have been of as high a molecular weight as was practically feasible but with limited solubility Almost all upper coats for leather have been at 10% or less solids. Hence, 90% of the coatings' weight has entered the environment as volatile organic compounds (VOC). The EPA has recommended limiting VOC of surface coatings to much lower solvent emissions for a series of industries and is expected to do so for leather coatings also Consequently, emphasis is being placed on potential utilization of water-based upper coats, which include not only the Vinylidene Chloride-arcylate Copolymer Latex topcoats but water-based Polyurethanes and tougher water-based Acrylics

These water systems do not provide the liveliness, clarity, gloss, and fashion effects that are obtainable with the current solvent system upper coats Early reports of radiation-curable, 100% active leather-coating systems may permit avoidance of this difficulty Such radiation-curable systems consist of coatings in which the only solvents employed are Acrylic or other Vinyl monomers. The leather and its wet coating are passed under a beam of electrons or strong untraviolet light; Polymerization occurs in seconds, and the solvents, instead of evaporating, become part of the coating. The coatings have good gloss and clarity, solvent is not emitted to the environment, and energy and space requirements are reputed to be far less than in conventional ovens.

A special treatment was introduced into leather finishing during the 1960s which has assumed considerable commercial importance, particularly for corrected grain leathers This was the development of specially penetrating Polymetic precoating systems that migrate rapidly into the thermostatic or grain layer of the leather to fill this upper layer with reinforcing Polymers which reduce scuffing of the leather and improve its handling in the shoe factories In addition, the break or fine folds in the leather surface are greatly improved in appearance so that the coaser grain surface appearance of shoe-upper leathers made from steer and cowhides could rival or even surpass the appearance of fine calfskin leathers after repeated flexing of both types of leather Specially developed Polymers were Acrylic, Polyurethane and Arcylic-urethane Copolymer types Because of greater ease in handling, lower cost, and better break improvement, Acrylics have been favoured In recent years, the process of making Leather / Polymer composites in conjunction with the normal wet-processing operations prior to finishing has been receiving considerable attention both in the U S Department of Agriculture's Eastern Regional Research Center and in the Central Leather Research Institute at Madras, India Evidence of grafting monomers onto the leather protein structure to form new chemical entities has been adduced The degree of grafting has since been questioned but whatever the mechanism, the modification of leather is sufficiently great to introduce new sets of properties One startling example is the development of shearling and garment leathers whose Polymer, Fatliquor, and Dyes are unextractable with dry cleaning solvents so that they have been successfully cleansed in consumer, coin-operated, cleaning machines

Annexe III.2

Extracts from PTA Treaty

SECTION TWO
ESTABLISHMENT AND PURPOSES

ARTICLE - 2
Establishment and Membership

1. THE HIGH CONTRACTING PARTIES hereby establish among their respective States a Preferential Trade Area for Eastern and South African States, referred to in this Treaty as "the Preferential Trade Area", as a first step towards the establishment of a Common Market and eventually of an Economic Community for Eastern and South African States

2 Membership of the Preferential Trade Area shall be open to the following Eastern and Southern African States

- *The People's Republic of Angola*
- *The Republic of Botswana*
- *The Republic of Burundi*
- *The Federal Islamic Republic of the Comoros*
- *The Republic of Djibouti.*
- *Socialist Ethiopia,*
- *The Republic of Kenya;*
- *The Kingdom of Lesotho.*
- *The Democratic Republic of Madagaskar.*
- *The Republic of Malawi,*
- *The People's Republic of Mozambique.*
- *The Republic of Rwanda,*
- *The Somali Democratic Republic*
- *The Kingdom of Swaziland.*
- *Mauritious*
- *The Republic of Seychelles*

- *The United Republic of Tanzania;*
- *The Republic of Uganda;*
- *The Republic of Zambia;*
- *The Republic of Zimbabwe;*

3. The Member States of the Preferential Trade Area shall be the Eastern and Southern African States set out in paragraph 2 of this Article that sign, ratify or accede to this Treaty and such other immediately neighbouring African States that become Member States of the Preferential Trade Area under the provisions of Article 46 of this Treaty.

ARTICLE 3
Aims and specific undertakings of the Preferential Trade Area

1. It shall be the aim of the Preferential Trade Area to promote co-operation and development in all fields of economic activity particularly in the fields of trade, customs, industry, transport, communications, agriculture, natural resources and monetary affairs with the aim of raising the standard of living of its peoples, of fostering closer relations among its Member States, and to contribute to the progress and development of the African continent.

2. The functioning and development of the Preferential Trade Area shall be reviewed in accordance with the provisions of this Treaty with a view to the establishment of a Common Market and eventually of an Economic Community for Eastern and Southern African States.

3. For the purposes set out in paragraphs 1 and 2 of this Article the Member States agree to implement the undertakings set out in paragraph 4 of this Article and as provided for elsewhere in particular provisions of this Treaty.

4. (a) The Member States undertake by way of the Protocols annexed to this Treaty to

i) Gradually reduce and eventually eliminate as between themselves customs duties in respect of imports and selected commodities produced within the Preferential Trade Area;

ii) establish common rules of origin with respect to products that shall be eligible for preferential treatment;

iii) establish appropriate payments and clearing arrangements among themselves that would facilitate trade in goods and services;

iv) foster such co-operation among themselves in the fields of transport and communications as would facilitate trade in goods and services;

v) co-operate in the field of industrial development;

vi) co-operate in the field of agricultural development;

vii) establish conditions regulating the re-export of products within the Preferential Trade Area.

viii) promulgate regulations for facilitating transit trade within the Preferential Trade Area.

ix) simplify and harmonize their trade documents and procedures;

x) co-operate in customs matters;

xi) standardize the manufacture and quality of goods produced and traded within the Preferential Trade Area;

xii) recognize the unique situation of Botswana, Lesotho and Swaziland and their membership of the Southern African Customs Union within the context of the Preferential Trade Area and to grant temporary exemptions to Botswana, Lesotho and Swaziland from the full application of certain provisions of this Treaty; and

(xiii) govern such other matters as may be necessary to further the aims of the Preferential Trade Area

4 (b) The Member States further undertake to :

i) relax or abolish quantitative and administrative restrictions on trade among themselves.

ii) promote the establishment of appropriate machinery for the exchange of agricultural products, minerals, metals, manufactures and semi-manufactures within the Preferential Trade Area;

iii) Promote the establishment of direct contacts between, and regulate the exchange of information among their commercial organisations such as State trading corporations, export promotion and marketing organizations, chambers of commerce, associations of businessmen and trade information and publicity centres.

iv) ensure the application of the most favoured nation clause to each other,

v) adapt progressively their commercial policy in accordance with the provisions of this Treaty; and

vi) take in common such other steps as are calculated to further the aims of the Preferential Trade Area.

ARTICLE 4
General Undertaking

The Member States shall make every effort to plan and direct their development policies with a view to creating conditions favourable for the achievement of the aims of the Preferential Trade Area and the implementation of the provisions of this Treaty and shall abstain from any measures likely to jeopardize the achievement of the aims of the Preferential Trade Area or the implementation of the provisions of this Treaty

SECTION THREE
INSTITUTIONS OF THE PREFERENTIAL TRADE AREA

ARTICLE 5 - Institutions

1 The institutions of the Preferential Trade Area shall be

(a) the Authority.

(b) the Council of Ministers.

(c) the Secretariat.

(d) the Tribunal, and

(e) the Commission, the Committees and such other technical and specialized bodies as may be established or provided for by this Treaty

2 The institutions of the Preferential Trade Area shall perform the functions and act within the limits of the powers conferred upon them by or under this Treaty

ARTICLE 6
The Authority of the Preferential Trade Area
Establishment, Composition and functions

1 There is hereby established an Authority which shall be known as the Authority of the Preferential Trade Area and which shall consist of the Heads of State and Government of the Member States

2 The Authority, which shall be the supremeorgan of the Preferential Trade Area, shall be responsible for considering matters of general policy and for the general direction and control of the performance of the executive functions of the Preferential Trade Area and the achievement of its aims.

3. The decisions and directions of the Authority taken or given in pursuance of the provisions of this Treaty shall be binding on all other institutions of the Preferential Trade Area and on those to whom they are addressed other than the Tribunal within its jurisdiction.

4. The Authority shall normally meet once every year and may hold extraordinary meetings at the request of any member of the Authority provided that such a request is supported by one-third of the members of the Authority or upon the proposal of the Council of Ministers addressed to the Secretary-General. Subject to the provisions of this Treaty, the Authority shall determine its own rules of procedure.

5 The decisions of the Authority shall be taken by consensus.

ARTICLE 7
Council of Ministers - establishment,composition and functions

1 There is hereby established a Council which shall be known as the Council of Ministers and which shall consist of such Ministers as may be designated by each Member State

2 It shall be the responsibility of the Council :

(a) to keep under constant review and ensure the proper functioning and development of the Preferential Trade Area in accordance with the provisions of this Treaty;

(b) to make recommendations to the Authority on matters of policy aimed at the efficient and harmonious functioning and development of the Preferential Trade Area.

(c) to give directions to all other subordinate institutions of the Preferential Trade area and

(d) to exercise such other powers and perform such other duties as are conferred or imposed on it by this Treaty or as may be determinated from time to time by the Authority

3 The decisions and directions of the Council taken or given in pursuance of the provisions of this Treaty, shall be binding on all other subordinate institutions of the Preferential Trade Area and on those to whom they are addressed other than the Tribunal within its jurisdiction.

4 The Council shall meet at least twice a year and one of such meetings shall be held immediately preceding an ordinary meeting of the Authority. Extraordinary meetings of the Council may be held at the request of a Member State provided that such a request is supported by one-third of the Member States

5 Subject to any directions that the Authority may give and to the provisions of this Treaty, the Council shall determine its own procedure including that for convening its meetings, for the conduct of business, and at other times and for the rotation of the office of Chairman among the members of the Council

6 The decisions of the Council shall be taken by consensus

7 Where an objection is recorded on behalf of a Member State to a proposal submitted for the decision of the Council, the proposal shall, unless such objection is withdrawn, be referred to the Authority for its decision

ARTICLE 8
Decisions of the Authority and the Council

The Authority shall determine the procedure for the dissemination of its decisions and directions and those of the Council and for matters relating to the coming into effect of such decisions and directions

ARTICLE 9
The Secretariat

1 There is hereby established a Secretariat of the Preferential Trade Area

2 The Secretariat shall be headed by a Secretary-General who shall be appointed by the Authority to serve in such office for a term of four years and shall be eligible for re-appointment for a further period of four years.

3 The Secretary-General shall be principal executive officer of the Preferential Trade Area. In addition to the Secretary- General, there shall be such other staff of the Secretariat as the Councial may determine.

4. The terms and conditions of service of the Secretary-General and other staff of the Secretariat shall be governed by regulations that may from time to time be made by the Council:

Provided that the Secretary-General shall only be removed from office by the Authority upon the recommendation of the Council.

5 In appointing staff to offices in the Secretariat, regard shall be had, subject to the paramount importance of securing the highest standards of integrity, efficiency and technical competence, to the desirability of maintaining an equitable distribution of appointments to such offices among citizens of all the Member States

6 (1) In the performance of their duties the Secretary-General and the staff of the Secretariat shall not seek or receive instructions from any Member State or from any other authority external to the Preferential Trade Area. They shall refrain from any actions which might reflect on their position as international officials responsible only to the Preferential Trade Area

(2) Each Member State undertakes to respect the international character of the responsibilities of the Secretary- General and the staff of the Secretariat and shall not seek to influence them in the discharge of their responsibilities

7 The Secretary-General shall :

(a) as appropriate, service and assist the institutions of the Preferential Trade Area in the Performance of their functions.

(b) submit a report on the activities of the Preferential Trade Area to all meetings of the authority and the Council.

(c) be responsible for the administration and finances of the Preferential Trade Area and all its institutions and act as secretary to the Authority and the Council;

(d) keep the functioning of the Preferential Trade Area under continuous examination and may act in relation to any particular matter which appears to merit examination either on his own initiative or upon the request of a Member State made through the Commission and the Secretary-General shall, where appropriate, report the results of his examination to the Commission;

(e) on his own initiative or as may be assigned to him by the Authority or the Council, undertake such work and studies and perform such services as relate to the aims of the Preferential Trade Area and to the implementation of the provisions of this Treaty; and

(f) for the performance of the functions imposed upon him by this Article, collect information and verify matters of fact relating of the functioning Preferential Trade Area and for that purpose may request a Member State to provide information relating thereto.

8 The Member States agree to co-operate with and assist the Secretary-General in the performance of the functions imposed upon him by paragraph 7 of this Article and agree in particular to provide any information which may be requested under subparagraph (f) of paragraph 7 of this Article

ARTICLE 10
Tribunal of the Preferential Trade Area

1 There is hereby established a judicial organ to be known as the Tribunal of the Preferential Trade Area which shall ensure the proper application or interpretation of the provisions of this Treaty and adjudicate upon such disputes as may be referred to it in accordance with Article 40 of this Treaty.

2 The Statute and other matters relating to the Tribunal shall be prescribed by the Authority

ARTICLE 11
The Intergovernmental Commission and Technical Committees establishment, composition and functions

1 There shall be established at such times as the Council may decide, as insitutions of the Preferential Trade Area, the following Commission and Committees

(a) the Intergovernmental Commission of Experts,

(b) the Customs ... Trade Committee.

(c) the Clearing and Payments Committee;

(d) the Committee on Agricultural Co-operation;

(e) the Committee on Industrial Co-operation;

(f) the Transport and Communications Committee;

(g) the Committee on Botswana, Lesotho and Swaziland

2 There may be such other Committees as the Authority, on the recommendation of the Council, may from time to time establish or as may be established under this Treaty at such times as the Council may determine.

3 The Commission or a Committee other than the Clearing and Payments Committee shall consist of representatives designated by the Member States to serve on the Commission or on a Committee. Such representatives may be assisted by advisers

4 The Commission or a Committee may establish such subcommittees as it may deem necessary for the purpose of discharging its functions and specify the composition of such subcommittees

5 The Commission shall :

(a) oversee the implementation of the provisions of this Treaty and for this purpose a Member State may request the Commission to investigate any particular matter,

(b) for the purposes of subparagraph (a) of this paragraph, request as necessary the Secretary-General to undertake specific investigations and to report his findings to the Commission,

(c) submit from time to time reports and recommendations to the Council either on its own or initiative or upon the request of the Council concerning the implementation of the provisions of this Treaty, and

(d) have such other functions as are imposed on it under this Treaty.

6. Each Committee shall submit from time to time reports and recommendations to the Commission either on its own initiative or upon the request of the Commission or the Council concerning the implementation of related provisions of this Treaty, and have such other functions as are imposed on it under this Treaty.

7. Subject to any directives which may be given by the Council, the Commission or a Committee shall meet as often as necessary for the proper discharge of its functions and shall determine its own rules of procedure.

SECTION FOUR
CUSTOMS AND TRADE MATTERS

ARTICLE 12
Liberalization of trade

The Member States agree in accordance with the provisions of this Treaty to

(a) the gradual reduction and eventual elimination of customs duties and nontariff barriers to trade conducted among themselves, and

(b) the gradual evolution of a common external tariff in respect of all goods imported from third countries with a view to the eventual establishment of a common market among themselves

ARTICLE 13
Customs duties

1. The Member States shall reduce and eventually eliminate in accordance with the provisions of the Protocols on the gradual reduction and elimination of customs duties and co-operation in customs matters annexed to this Treaty respectivel Annexes I and II, customs duties imposed on or in connection with the importa or exportation of the commodities which are set out in the Common List

2 During a period of ten years from the definitive entry into force of this Treaty, a Member State may not be required to reduce or eliminate customs duties except in accordance with the provisions of paragraph 1 of this Article. During this period of ten years the Member States shall not impose any new customs duties or increase existing ones on goods appearing on the Common List and shall transmit to the Secretary-General all information on customs duties for study by the Customs and Trade Committee

3. The Commission shall, after considering proposals from the Customs and Trade Committee submitted to it by the Secretary- General, recommended to the Council for its approval, a programme for the progressive reduction of customs duties among the Member States with a view to eliminating such duties not later than ten years after the definitive entry into force of this Treaty. Such a programme shall take into account the effects of the reduction and elimination of customs duties on the revenues of the Member States; Provided that the Council may subsequently decide that any customs duties shall be reduced more rapidly or eliminated earlier than is approved under the provisions of this paragraph.

ARTICLE 14
Common external tariff

For the purposes of this Treaty, the Commission shall, on the recommendation of the Customs and trade Committee, submit from time to time to the Council for its approval, a programme for the gradual establishment of a common external tariff.

ARTICLE 15
Preferential treatment

1 For the purposes of this Treaty, goods shall be accepted as eligible for preferential treatment if such goods

(a) originate in the Member States; and

(b) are during the period of ten years specified in paragraph 2 of Article 13 of this Treaty contained in the Common List

2 Goods shall be accepted as originating in the Member states where they satisfy the conditions prescribed in the Protocol on Rules of Origin annexed to this Treaty as Annex III

ARTICLE 16
Non-tariff restrictions on goods

1. Except as is provided in this Article and in accordance with Annex I to this Treaty, each of the Member States undertakes that upon the definitive entry into force of this Treaty, it shall relax and remove the then existing quota, quantitative or the like restrictions or prohibitions on goods which apply to the transfer to that State, of goods originating in the other Member States and which are contained in the Common List. Except as may be provided or permitted by this Treaty, the Member States will thereafter refrain from imposing any further restrictions or prohibitions on such goods.

2. Except as is provided in this Article, the Commission shall, after considering proposals from the Customs and Trade Committee submitted to it by the Secretary-General, recommend to the Council for its approval a programme for the gradual relaxation and eventual elimination, not later than ten years from the definitive entry into force of this Treaty, of all the existing quota, quantitative or the like restrictions or prohibitions which apply in a Member State to the import of goods originating in the other Member States. Except as may be provided for or permitted by this treaty, the Member States will thereafter refrain from imposing any further restrictions or prohibitions on such goods;

Provided that the Council may subsequently decide that any quota, quantitative or the like restrictions or prohibitions shall be relaxed more rapidly or removed earlier than is approved under the provisions of this paragraph.

3. The provisions of paragraph 1 and 2 of this Article shall not extend to the following:

(a) export prohibitions or temporarily applied to prevent or relieve critical shortages of foodstuffs or other products essential to the exporting Member State;

(b) import and export prohibitions or restrictions necessary to the application of standards or regulations for the classification, grading or marketing of commodities in international trade.

(c) import restrictions on any agricultural or fisheries product, imported in any form, necessary to the enforcement of governmental measures which operate;

(i) to restrict the quantities of the like domestic product permitted to be marketed or produced, or if there is no substantial domestic production of the like product, of a domestic product for which the imported product can be directly substituted; or

(ii) to remove a temporary surplus of the like domestic product, or, if there is no substantial domestic production of the like product of a domestic product for which the imported product can be directly substituted, by making the surplus available to certain groups of domestic consumers free of charge or at prices below the current market level; or

(iii) to restrict the quantities permitted to be produced of any animal product the production of which is directly dependent, wholly or mainly, on the imported commodity, if the domestic production of that commodity is relatively negligible

4 Notwithstanding the provisions of this Article, a Member State may, after having given notice to the other Member State of its intention to do so, introduce or continue to impose restrictions or prohibitions affecting

(a) the application of security laws and regulations;

(b) the control of arms, ammunition and other war equipment and military items.

(c) the protection of human, animal or plant health or life or the protection of public morality,

(d) the transfer of gold, silver and precious stones;

(e) the protection of national treasures; or

(f) the control of nuclear materials, radio-active products or any other material used in the development or exploitation of nuclear energy.

5 If a Member State encounters balance-of-payments difficulties arising from the application of the provisions of this Chapter, that Member State may, provided that it has taken all reasonable steps to overcome the difficulties, impose for the purpose only of overcoming such difficulties for a specified period to be determined by the Council, quantitative or the like restrictions or prohibitions, on goods originating from the other Member States

6. For the purpose of protecting an infant or strategic industry the products of which are contained in the Common List, a Member State may, provided that it has taken all reasonable steps to protect such infant or strategic industry, impose for the purpose only of protecting such industry for a specified period to be determined by the Council, quantitative or the like restrictions or prohibitions on similar goods originating from the other Member States

7. A Member State imposing quantitative or the like restrictions or prohibitions under paragraphs 3, 5 and 6 of this Article shall inform the other Member States and the Secretary- General as soon as possible of such restrictions.

8. The Council shall keep under review the operation of any quantitative or the like restrictions or prohibitions imposed under the provisions of paragraphs 3,5 and 6 of this Article and take appropriate decisions thereon.

ARTICLE 17
Dumping

1 The Member States undertake to prohibit the practice of dumping goods within the Preferential Trade Area

2 For the purposes of this Article, "dumping" means the tansfer of goods originating in a Member State to another Member State for sale:

(a) at a price lower than the comparable price charged for similar goods in the Member State where such goods originate (due allowance being made for the differences in the conditions of sale, in taxation, in transport costs or for any other factors affecting the comparability of price), and

(b) under circumstances likely to prejudice the production of similar goods in that Member State

ARTICLE 18
Most favoured nation treatment

1 The Member States shall accord to one another in relation to trade between them the most favoured nation treatment

2 In no case shall trade concessions granted to a third country under an agreement with a Member State be more favourable than those applicable under this Treaty.

3. Any agreement between a Member State and a third country under which tariff concesions are granted shall not derogate from the obligations of that Member State under this Treaty.

4 The provisions of this Article shall apply only with respect to commodities contained in the Common List.

ARTICLE 19
Re-exportation of goods and transit facilities

1 The Member States shall undertake to facilitate trade in re- exports among themselves However, in certain cases to be jointly agreed upon, a Member State from which the goods to be re-exported originate, may object to the re-export of such goods

2 Each Member State shall grant freedom of transit through its territory of goods proceeding to or from another Member State indirectly through that territory in accordance with the provisions of the Protocol on transit trade and transit facilities annexed to this Treaty as Annex V

3 The Member States agree that the goods imported into their territories from the Republic of South Africa shall not be re- exported into the territories of another Member State and that goods imported into the Member States from a Member State shall not be re-exported to the Republic of South Africa

4 The Member States further agree that goods being imported or re-exported in contravention of the provisions of paragrphs 1 and 3 of this Article shall not benefit from the transit facilities and privileges provided for in this Treaty

ARTICLE 20
Customs Administration

The member states shall in accordance with the provisions annex to this treaty, take measures to harmonise and standardise their customs regulations and procedures to ensure the effective application of the provisions of this chapter and to fecilitate the movement of goods and services across their frontiers

ARTICLE 21
Drawback

1. The Member States may, after ten years from the definitive entry into force of this Treaty, refuse to accept as eligible for preferential treatment goods in relation to which drawback is claimed or made use of in connection with their exportation from the Member State in the territory of which the goods have undergone the last process of production

2. At the end of the period of ten years referred to in paragraph 1 of this Article the Commission shall, after considering proposals from the Customs and Trade Committee submitted to it by the Secretary-General, make recommendations to the Council concerning the extension or otherwise, of the period of ten years referred to in paragraph 1 of this Article for the purposes of that paragraph

3. For the purposes of this Article

(a) "drawback" means any arrangement, including temporary duty-free admission or the refund of all or part of customs duties applicable to imported materials, provided that the arrangement, expressly or in effect, allows such refund or remission if goods are exported but not if they are retained for home use;

(b) "remission" includes exemption from duties on materials brought into free ports, free zones or other places which have similar customs privileges

SECTION FIVE
CO-OPERATION IN PARTICULAR FIELDS

ARTICLE 22
Clearing and payments arrangements

The Member States undertake, in accordance with the provisions of the Protocol on clearing and payments arrangements annexed to this Treaty as annex VI, to promote trade in goods and services within the Preferential Trade Area by

(a) encouraging the use of national currencies in the settlement of eligible transactions between themselves;

(b) establishing adequate machinery for the settlement of payments among themselves;

(c) reducing as much as possible the use of foreign exchange by the Member States in their inter-State transactions; and

(d) consulting regularly among themselves on monetary and financial matters.

ARTICLE 23
Transport and communications

The Member States, recognizing the importance of efficient transport and communications links and the removal of obstacles to their transport and communications systems for the development of the Preferential Trade Area, undertake to evolve within the framework of the Transport and Communications Commission for Eastern and Southern African States and in accordance with the provisions of the Protocol on co-operation in the fields of transport and communications annexed to this Treaty as Annex VII, complementary transport and communications policies and systems. They also undertake to improve and expand their existing transport and communications links and establish new ones as a means of furthering the physical cohesion of the Member States and the promotion of greater movement of persons, goods and services within the Preferential Trade Area.

ARTICLE 24
Industrial development

The Member States shall in order to enhance industrial development within the Preferential Trade Area endeavour, in accordance with the provisions of the Protocol on co-operation in the field of industrial development annexed to this treaty as Annex VIII, to promote collective self-reliance, complementary industrial development, the expansion of trade in industrial products and the provisions of related training facilities within the Preferential Trade Area.

ARTICLE 25
Agricultural development

The Member States, aware of the vital role of agricultural development, particularly the production of food in the development of their economies, undertake in accordance with the provisions of the Protocol on co-operation in the field of agricultural development annexed to this Treaty as Annex IX to co-operate in the formulation and implementation of their agricultural policies and programmes in the various fields of agriculture such as the supply of staple food stuffs, the export of agricultural commodities The devolopment of agro-industries and the establishment of institutional machinery for agricultural development.

ARTICLE 26
Trade documents and procedures

The Member States agree to simplify and harmonize their trade documents and procedures in accordance with the provisions of the Protocol on the simplification and harmonization of trade documents and procedures annexed to this Treaty as Annex X so as to facilitate trade in goods and services within the Preferential Trade Area

ARTICLE 27
Standardization and quality control of goods

The Member States agree to evolve, in accordance with the provisions of the Protocol on standardization and the quality control of goods annexed to this Treaty as annex XI, a common policy with regard to the standardization and quality control of goods originating in the Member States and to undertake such other activities in standardization as would promote trade within the Preferential Trade Area

SECTION SIX
CO-OPERATION IN OTHER FIELDS

ARTICLE 28
General and other aspects

Subject to the provisions of this Treaty, the Member States undertake to consult with one another through appropriate institutions of the Preferential Trade Area for the purpose of harmonizing their respective policies in such fields as they may, from time to time, consider necessary or desirable for the efficient and harmonious functioning and development of the Preferential Trade Area and the implementation of the provisions of this Treaty In particular, but without prejudice to the generality of the foregoing, the Member States undertake to

(a) promote the establishment of direct contacts between, and regulate the exchange of information among, their commercial organizations such as State trading corporations, export promotion and marketing organizations, chambers of commerce, associations of businessman and trade information and publicity centres;

(b) promote the establishment of appropriate machinery for the exchange of agricultural products, minerals, metals, manufactures and semi-manufactures within the Preferential Trade Area.

(c) promote the establishment of common training programmes and institutions in various fields which would assist in the development of the manpower required within the Preferential Trade Area;

(d) regulate the activities of their State training and other commercial enterprises so as to ensure that they play an effective role in the development of the Preferential Trade Area ; and

(e) take in common such other steps as are calculated to further the aims of the Preferential Trade area and the implementation of the provisions of this Treaty

SECTION SEVEN
ECONOMIC COMMUNITY FOR EASTERN AND SOUTHERN AFRICAN STATES

ARTICLE 29
Gradual establishment of a Common Market and an Economic Community for Eastern and Southern African States

Two years before the expiry of ten years from the definite entry into force of this Treaty, the Commission shall propose to the Council for its consideration and recommendation to the Authority for its approval, measures which in addition to the provisions of this Treaty would be required to be implemented as from the end of the said period of ten years, in order to assist in the development of the Preferential Trade Area into a Common Market and eventually into an Economic Community for Eastern and Southern African States

Annexe III.3

HIDES & SKINS POTENTIAL AFRICA

(Estimates on assumed weights of hides and skins)

Country	Bovines Nos (000)	Bovines 15 Kg/ Hides Tons.	Bovines 22Kg/ Hides Tons.	Sheep Nos. (000)	Sheep 2 Kg/ Skins Tons.	Sheep 4 Kg Skins Tons.	Goats Nos (000)	Goats 2 Kg/ Skins Tons.	Goats 4 Kg/ Skins Tons.	Totals Assumption 1	Totals Assumption 2
1	2	3	4	5	6	7	8	9	10	11	12
Algeria	380	5700	8360	4300	8600	17200	1300	2600	5200	30760	16900
Angola	340	5100	7480	53	106	212	320	640	1280	8972	5846
Benin	116	1740	2552	325	650	1300	304	608	1216	5068	2998
Botswana	300	4500	6600	47	94	188	230	460	920	7708	5054
Burkina Faso	215	3225	4730	909	1818	3636	750	1500	3000	11366	6543
Burundi	83	1245	1826	94	188	376	260	520	1040	3242	1953
Cameron	495	7425	10890	860	1720	3440	1034	2068	4136	18466	11213
Cen Afr Rep	175	2625	3850	50	100	200	185	370	740	4790	3095
Chad	220	3300	4840	615	1230	2460	560	1120	2240	9540	5650
Congo	16	240	352	18	36	72	48	96	192	616	372
Djibouti	15	225	330	100	200	400	180	360	720	1450	785

Country	Bovines			Sheep			Goats			Totals	
	Nos (000)	15 Kg/ Hides Tons.	22Kg/ Hides Tons.	Nos. (000)	2 Kg/ Skins Tons.	4 Kg Skins Tons.	Nos (000)	2 Kg/ Skins Tons.	4 Kg/ Skins Tons.	Assump tion 1	Assump- tion 2
1	2	3	4	5	6	7	8	9	10	11	12
Egypt	1800	27000	39600	600	1200	2400	700	1400	2800	44800	29600
Ethiopia	2104	31560	46288	8190	16380	32760	5000	10000	20000	99048	57940
Gabon	3	45	66	24	48	96	18	36	72	234	129
Gambia	36	540	792	55	110	220	58	116	232	1244	766
Ghana	109	1635	2398	494	988	1976	419	838	1676	6050	3461
Guinea	2000	36000	44000	600	1200	2400	600	1200	2400	48800	38400
Guinea Bissau	24	360	528	14	28	56	42	84	168	752	472
Ivory Coast	335	5025	7370	724	1448	2896	790	1580	3160	13426	8053
Kenya	1580	23700	34760	3000	6000	12000	1570	3140	6280	53040	32840
Lesotho	5	75	110	20	40	80	14	28	56	246	143
Liberia	31	465	682	63	126	252	73	146	292	1226	737
Libya	200	3000	4400	2300	4600	9200	.	.	.	13600	7600
Madagas- car	1063	15945	23386	157	314	628	578	1156	2312	26326	17415
Malawi	86	1290	1892	3	6	12	45	90	180	2084	1386

	Bovines			Sheep			Goats			Totals	
Country	Nos (000)	15 Kg/ Hides Tons.	22Kg/ Hides Tons.	Nos. (000)	2 Kg/ Skins Tons.	4 Kg Skins Tons.	Nos (000)	2 Kg/ Skins Tons.	4 Kg/ Skins Tons.	Assump tion 1	Assump- tion 2
1	2	3	4	5	6	7	8	9	10	11	12
Mali	324	4860	7128	1783	3566	7132	1762	3524	7048	21308	11950
Mauritania	140	2100	3080	700	1400	2800	520	1040	2080	7960	4540
Morocco	810	12150	17820	4950	9900	19800	2200	4400	8800	46420	26450
Mozambique	250	3750	5500	-	-	-	-	-	-	5500	3750
Niger	252	3780	5544	730	1460	2920	1630	3260	6520	14984	8500
Nigeria	1270	19050	27940	10750	21500	43000	2510	5020	10040	80980	45570
Rwanda	130	1950	2860	70	140	280	300	600	1200	434[illegible]	2690
Senegal	240	3600	5280	613	1226	2452	343	686	1372	9104	5512
Sierra Leone	63	945	1386	113	226	452	42	84	168	2006	1255
Somalia	245	3675	5390	4000	8000	16000	2490	4980	9960	31350	16655
Sudan	1447	21705	31834	4992	9984	19968	3993	7986	15972	67774	39675
Swaziland	90	1350	1980	30	60	120	30	60	120	2220	1470
Tanzania	800	12000	17600	320	640	1280	520	1040	2080	20960	13680

	Bovines			Sheep			Goats			Totals	
Country	Nos (000)	15 Kg/ Hides Tons.	22Kg/ Hides Tons.	Nos. (000)	2 Kg/ Skins Tons.	4 Kg Skins Tons.	Nos (000)	2 Kg/ Skins Tons.	4 Kg/ Skins Tons.	Assump tion 1	Assump- tion 2
1	2	3	4	5	6	7	8	9	10	11	12
Tongo	36	540	792	179	358	716	182	364	728	2236	1262
Tunisia	230	3450	5060	2200	4400	8800	430	860	1720	15580	8710
Uganda	560	8400	12320	378	756	1512	760	1520	3040	16872	10676
Zaire	151	2265	3322	230	460	920	756	1512	3024	7266	4237
Zambia	250	3750	5500	-	-	-	-	-	-	5500	3750
Zimbabwe	509	7635	11198	115	230	460	350	700	1400	13058	8565
	19.528	298920	429616	55768	111536	223072	33896	67792	135584	788272	478248

Assumption 1: Bovine hides - 22 Kg; Sheep & Goat Skins 4 Kg
Assumption 2: Bovine hides - 15 Kg; Sheep & Goat Skins 2 Kg
Assuming a ECS usage of 8% by weight the total potential for Africa for BCS isUnder Assumption 1: 63,061 tonnes
Under Assumption 2: 38,259 tonnes

Annexe III.4

PRODUCTION OF HIDES & SKINS

(1987 Estimates)

Country	Bovine Hides Nos.	Bovine Hides Tonnes	Sheep & Lamb skins Nos.	Sheep & Lamb skins Tonnes	Goats & Kinds Nos.	Goats & Kinds Tonnes	Total Tonnes
1	2	3	4	5	6	7	8
Algeria	300000	4800	5000000	4500	1500000	1000	10300
Angola	400000	6000	100000	--	300000	200	6200
Benin	100000	1500	400000	200	300000	200	1900
Botswana	--	--	--	--	--	--	
Burkina faso	300000	2800	500000	300	1200000	700	3800
Burundi	100000	800	100000	100	300000	200	1100
Cameron	400000	5600	800000	500	700000	400	6500
CAR	300000	2900	--	--	200000	100	3000
Chad	300000	5400	700000	400	700000	600	6400
Congo	--	3000	--	--	100000	--	3000
Djibouti	--	--	--	--	--	--	--
Egypt	2500000	56100	1300000	800	1600000	1000	57900
Ethiopia	1200000	13200	5900000	4100	5200000	2600	19900

Country	Bovine Hides		Sheep & Lamb skins		Goats & Kinds		Total
	Nos.	Tonnes	Nos.	Tonnes	Nos.	Tonnes	Tonnes
1	2	3	4	5	6	7	8
Gabon	..	..	..	..	..	..	..
Gambia	..	300	100000	..	100000	..	300
Ghana	100000	2000	300000	100	400000	200	2300
Guinea	200000	2000	100000	..	100000	100	2100
B. Bissau	..	..	..	..	..	..	
Ivory Coast	300000	3800	600000	3000	700000	3000	9800
Kenya	2200000	33000	4500000	3100	3400000	1700	37800
Lesotho	..	..	..	..	..	..	..
Liberia	..	200	100000	..	100000	100	300
Libya	200000	3700	3700000	2200	200000	100	6000
Madagascar	900000	10400	200000	100	400000	200	10700
Malawi	100000	1100	..	..	200000	200	1300
Mali	300000	3800	1800000	900	900000	400	5100
Mauritania	100000	1700	600000	400	500000	300	2400
Morocco	800000	9800	4100000	3300	1300000	800	13900
Mozambique	300000	3800	100000	..	100000	100	3900

Country	Bovine Hides		Sheep & Lamb skins		Goats & Kinds		Total
	Nos.	Tonnes	Nos.	Tonnes	Nos.	Tonnes	Tonnes
1	2	3	4	5	6	7	8
Niger	200000	2600	800000	600	2000000	1000	4200
Rwanda	100000	1100	--	--	200000	200	1300
Senegal	300000	5100	800000	500	600000	300	5900
Sierra Leone	100000	900	100000	100	--	--	1000
Somalia	500000	5900	3400000	2100	4700000	2300	10300
Sudan	1900000	32300	5800000	3500	3000000	2400	38200
Swaziland	--	--	--	--	--	--	--
Tanzania	1600000	15500	1000000	600	1500000	800	16900
Togo	--	500	200000	100	200000	100	700
Tunisia	200000	2300	2300000	1400	600000	300	4000
Uganda	600000	9900	600000	500	1200000	1200	11600
Zaire	100000	1200	100000	100	100000	300	1600

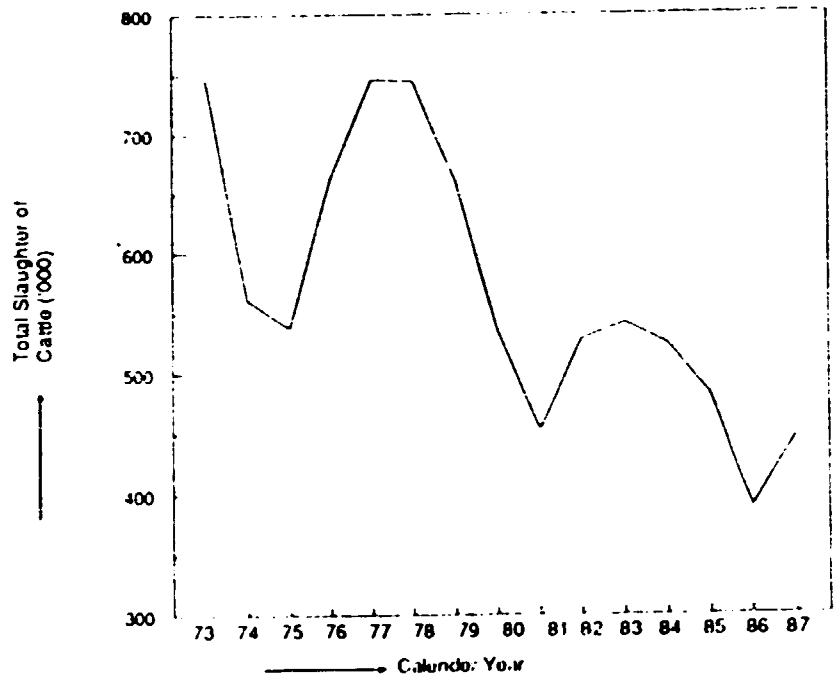
Country	Bovine Hides		Sheep & Lamb skins		Goats & Kinds		Total
	Nos.	Tonnes	Nos.	Tonnes	Nos.	Tonnes	Tonnes
1	2	3	4	5	6	7	8
Zambia	200000	3600	--	--	100000	100	3700
Zimbabwe	400000	5900	100000	--	500000	300	6200
	17600000	264500	51600000	33500	32800000	23500	321500

*Source: World Statistical Compendium for raw hides & skins.

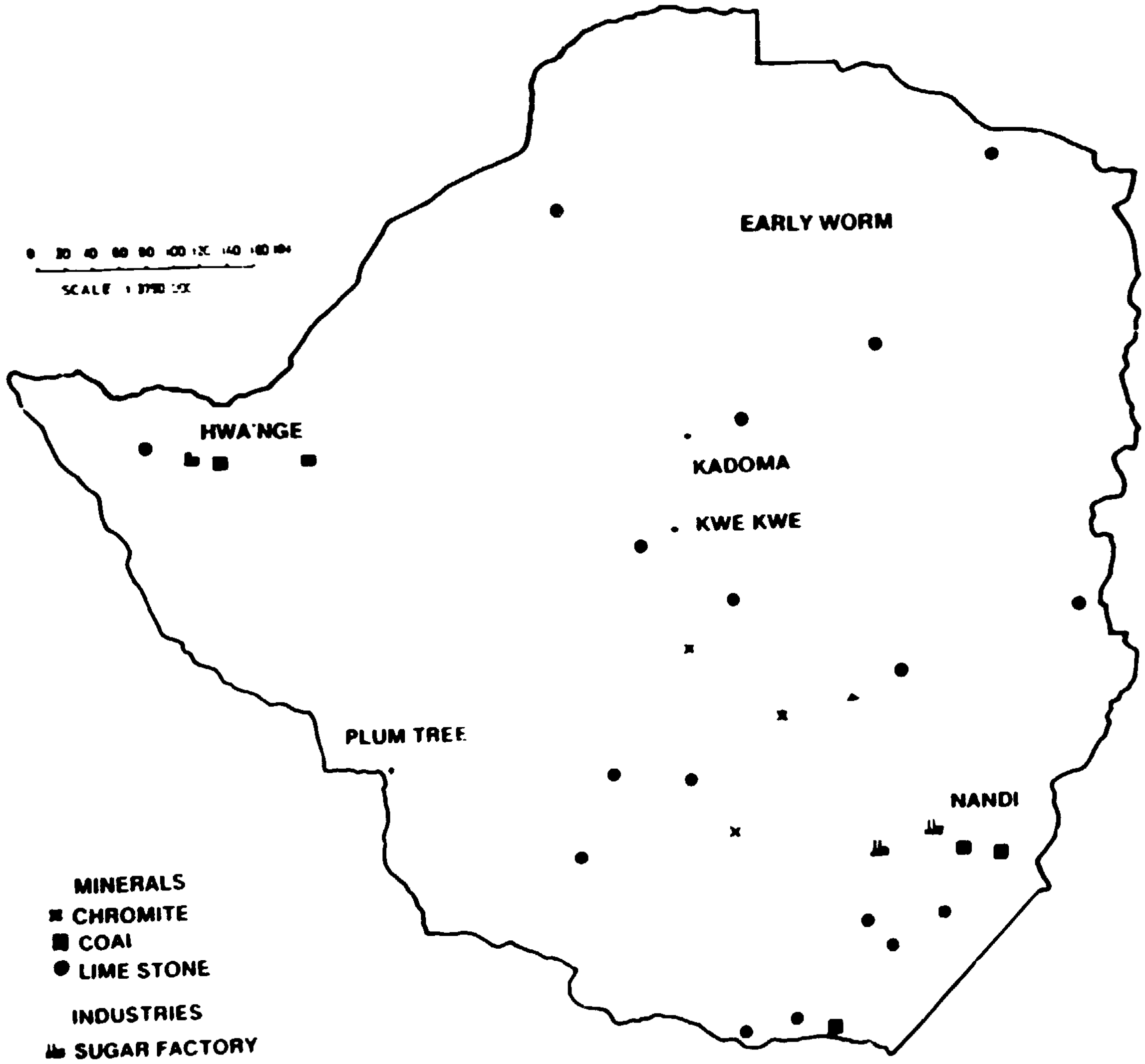
leather & leather footwear 1969-1986.

Annexe III.5

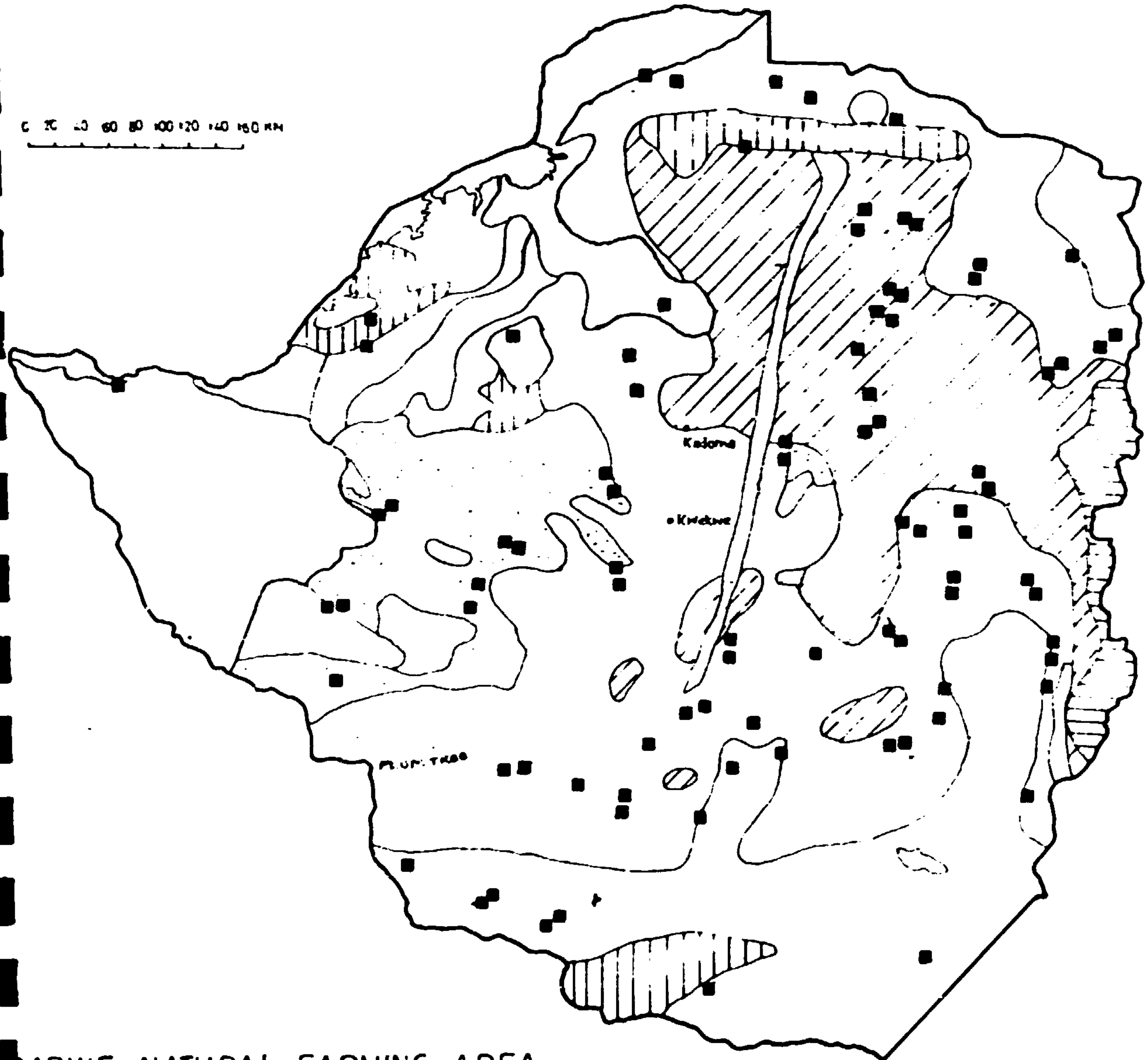
SLAUGHTER TRENDS IN ZIMBABWE



ANNEXURE IV.1



ZIMBABWE RAW MATERIALS



IMBABWE NATURAL FARMING AREA

6) UNSUITABLE FOR ANY AGRICULTURAL ACTIVITY WITHOUT IRRIGATION

7) IRRIGATION SCHEMES OF LOWVELD, SUGAR, CITRUS, COTTON, WHEAT.

AGRICULTURE

1 INTENSIVE TOBACCO MAIZE AND LIVE STOCK FARMING

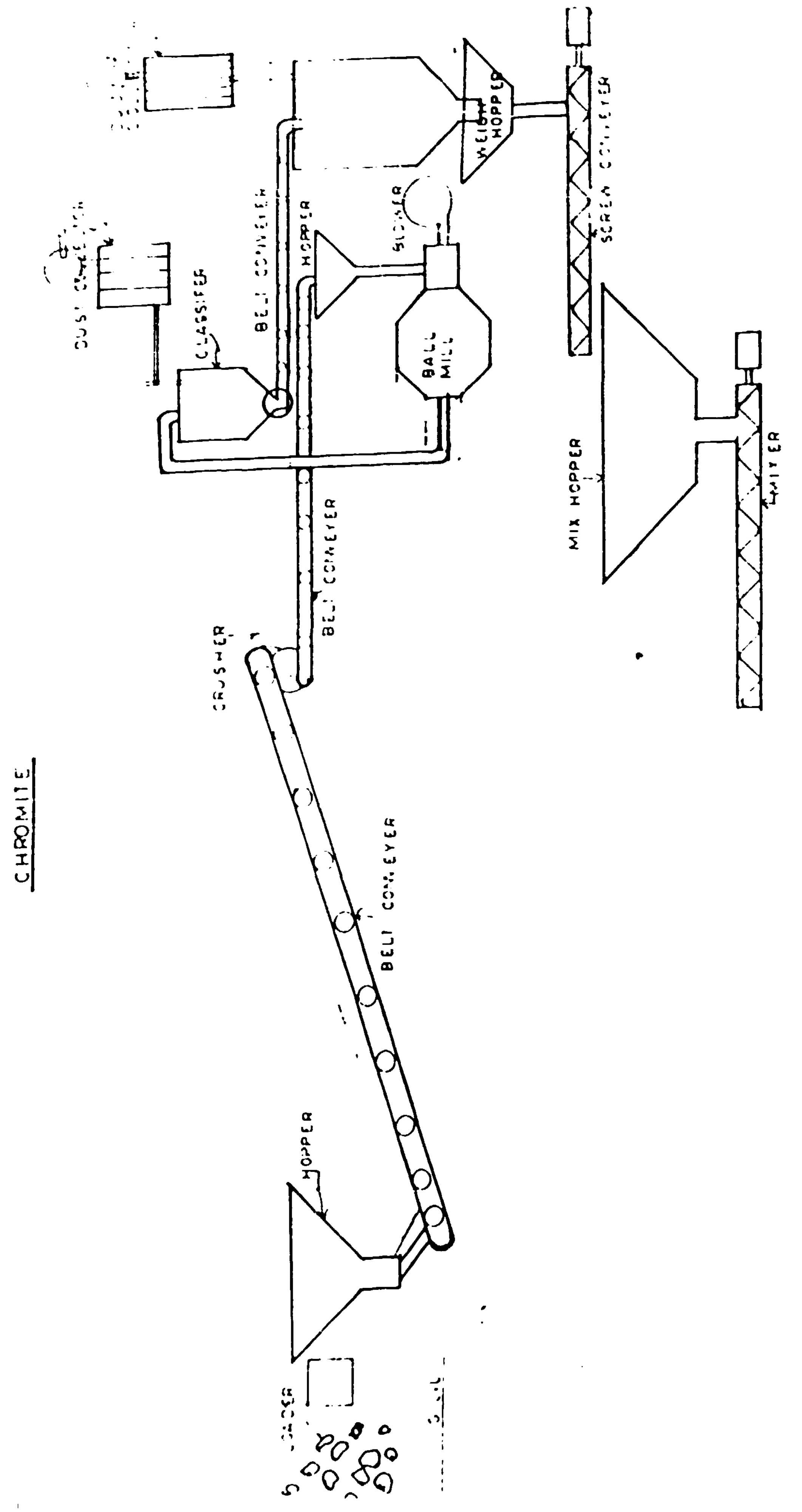
2 SEMI-INTSIVE LIVE STOCK AND MIXED FARMING

3 AFFORESTATION PRODUCING SOFT WOOD AND WATTLES

4 NATURAL FOREST PRODUCING HARDWOOD

5 SUBSISTENCE AGRICULTURE

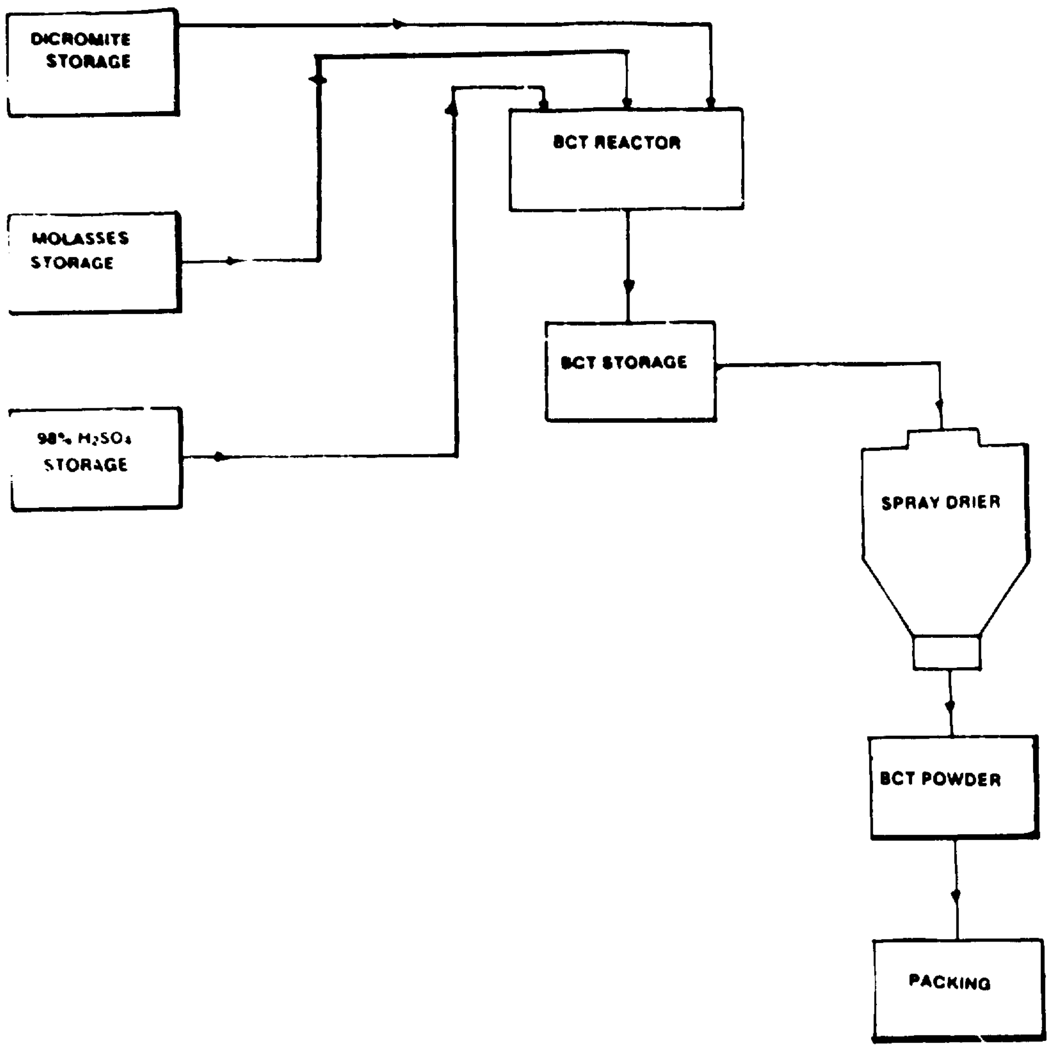
Annexe VI.1

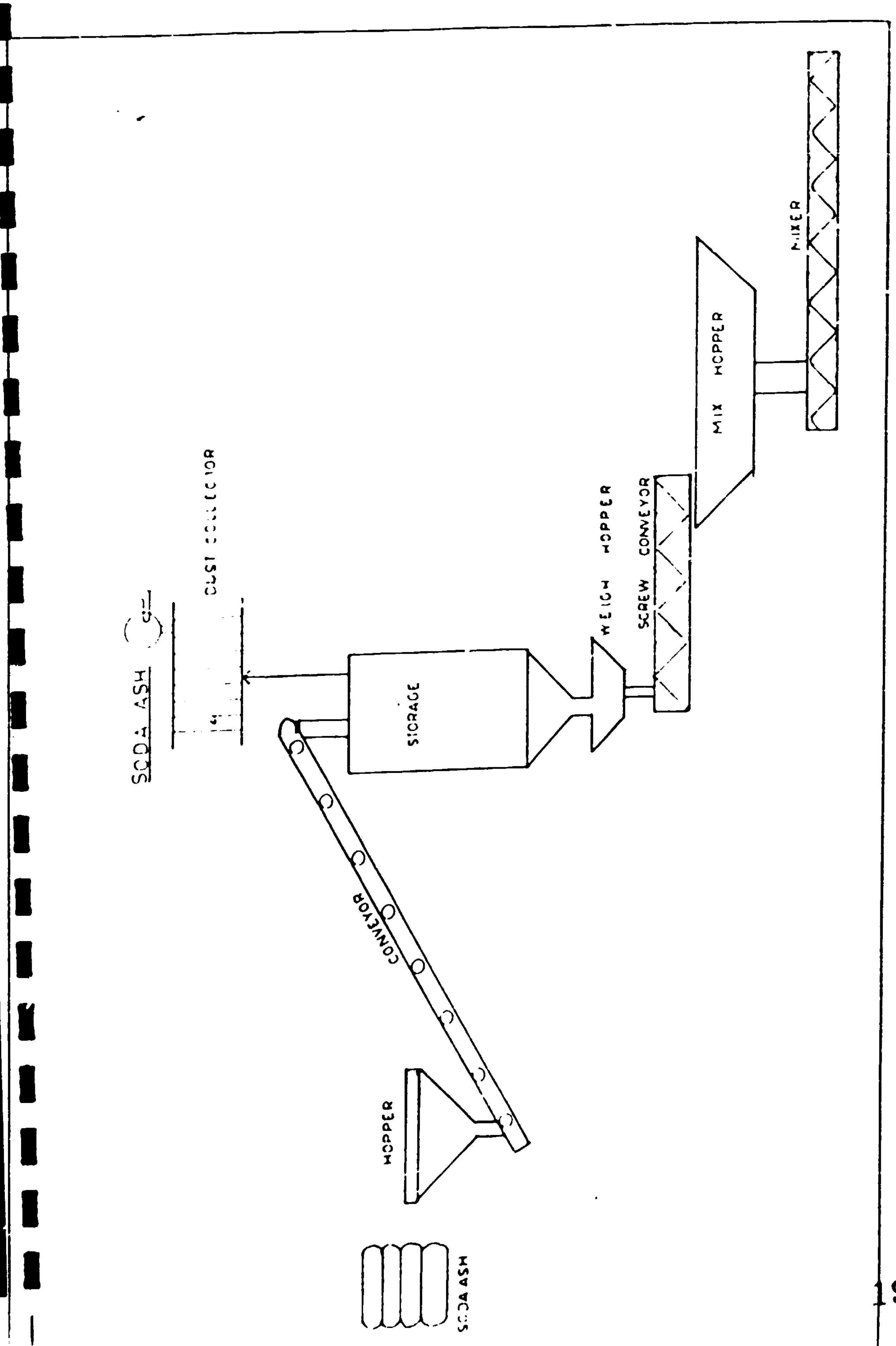


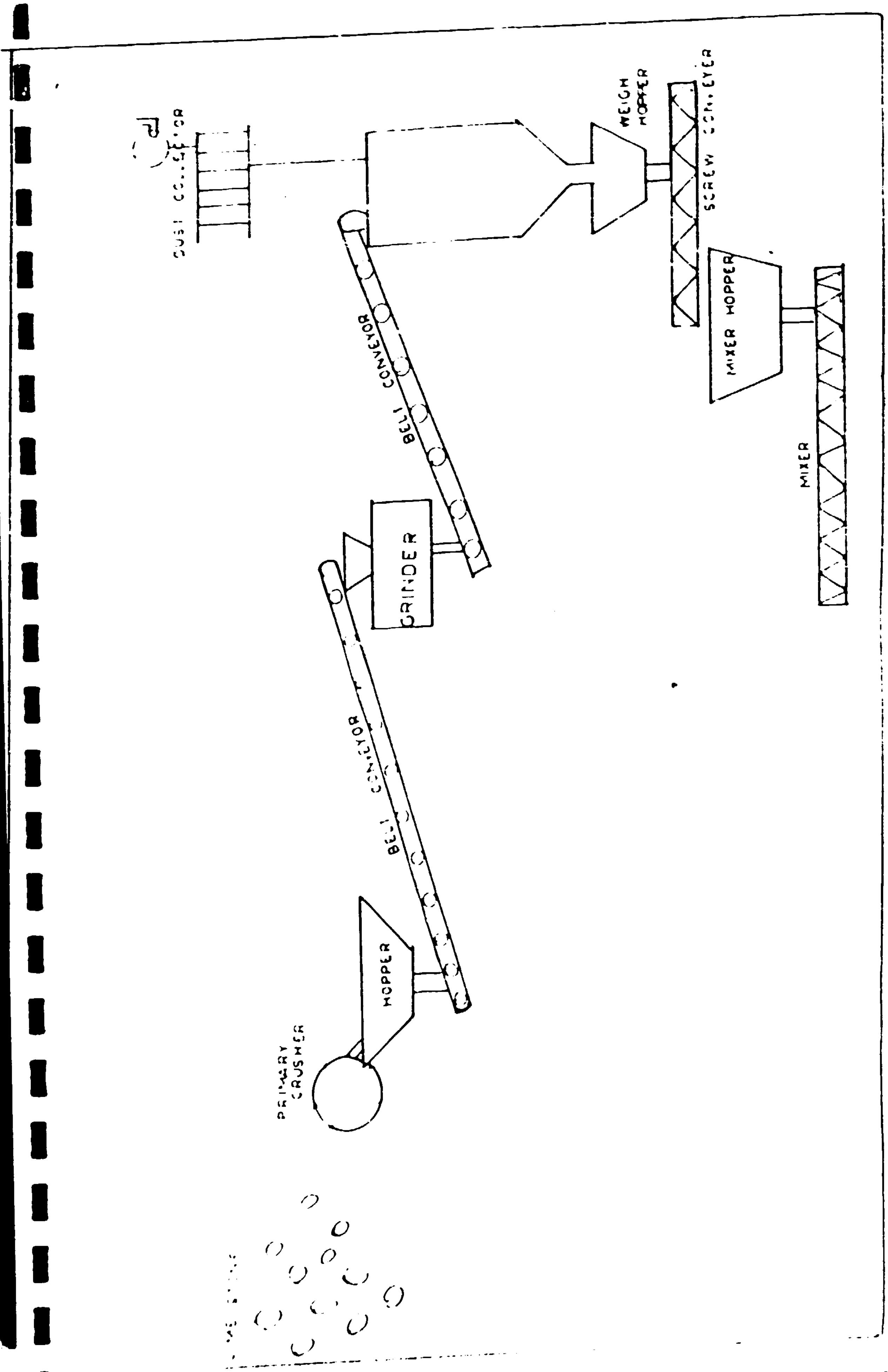
CHROMITE
HOPPER
BELT CONVEYER
CRUSHER
BELT CONVEYER
CLASSIFIER
DUST COLLECTOR
BELT CONVEYER
HOPPER
BALL MILL
BLOWER
WEIGH HOPPER
SCREW CONVEYER
MIX HOPPER
MIXER

ANNEXE VI.2

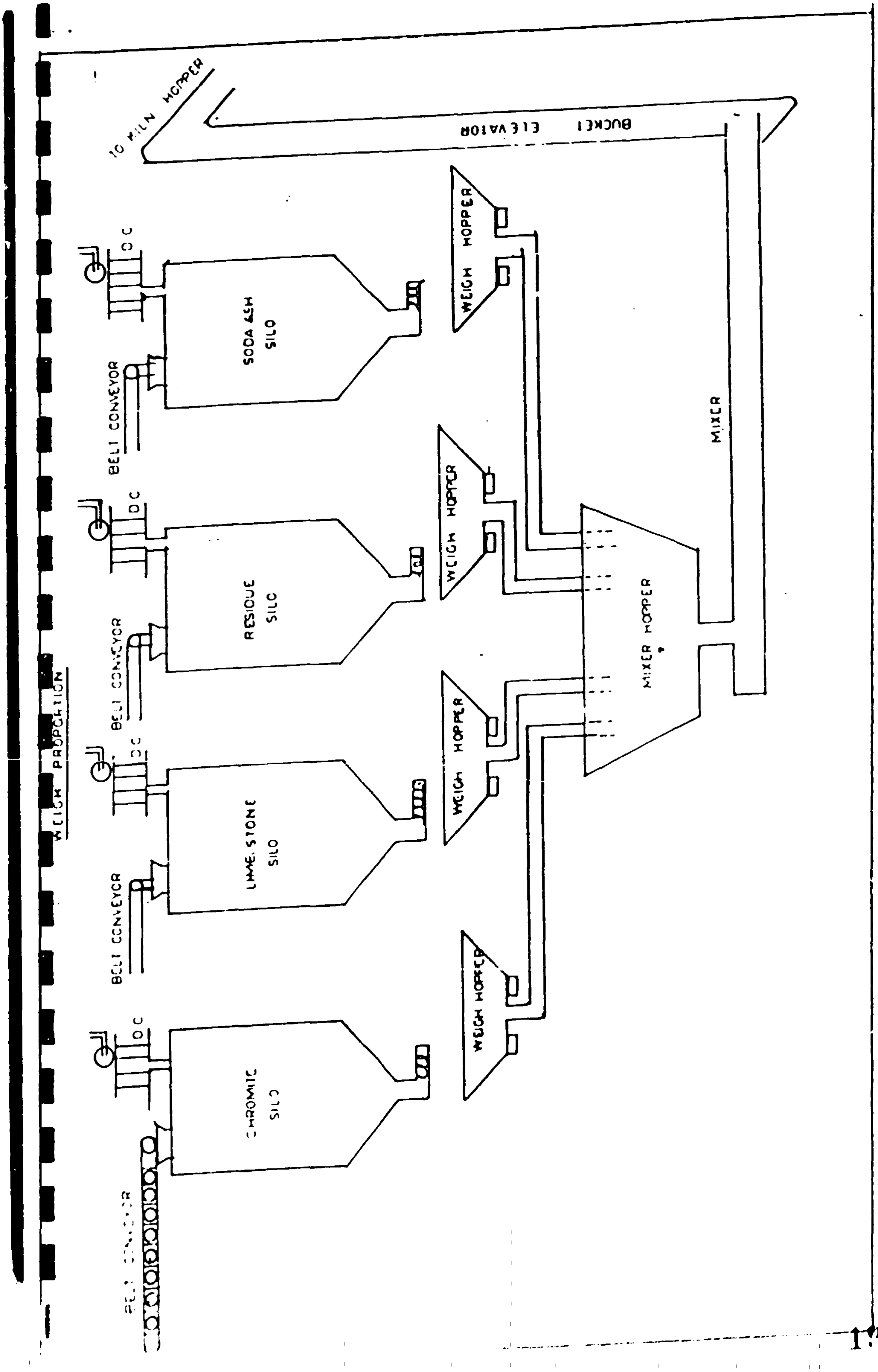
FLOW SHEET
B MANUFACTURE OF BASIC - CHROMIUM




SODA ASH
DUST COLLECTOR
STORAGE
WEIGH HOPPER
SCREW CONVEYOR
MIX HOPPER
MIXER
CONVEYOR
HOPPER
SODA ASH

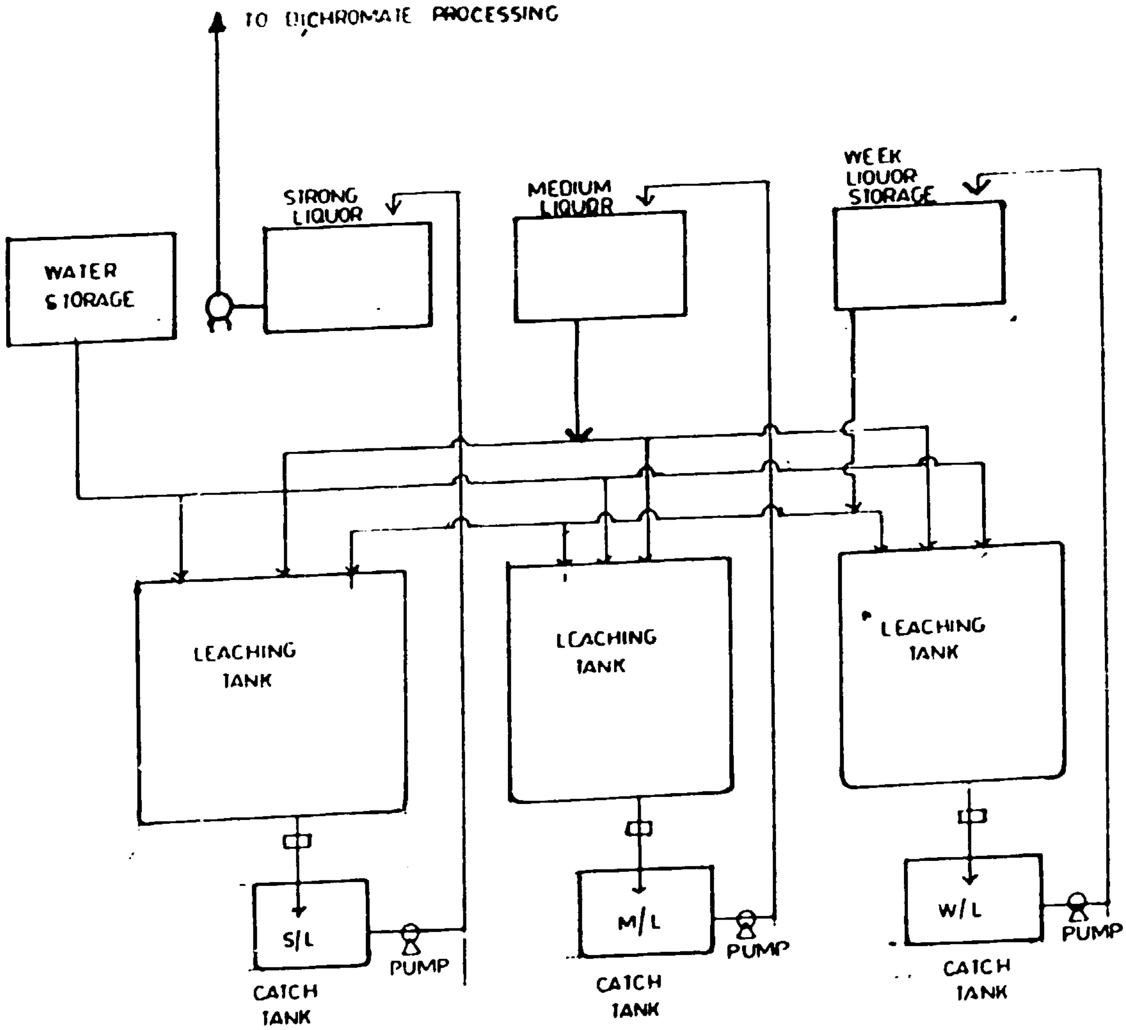

WEIGH HOPPER
SCREW CONVEYER
MIXER HOPPER
MIXER
BELT CONVEYOR
GRINDER
HOPPER
PRIMARY CRUSHER

Annexe VI.5

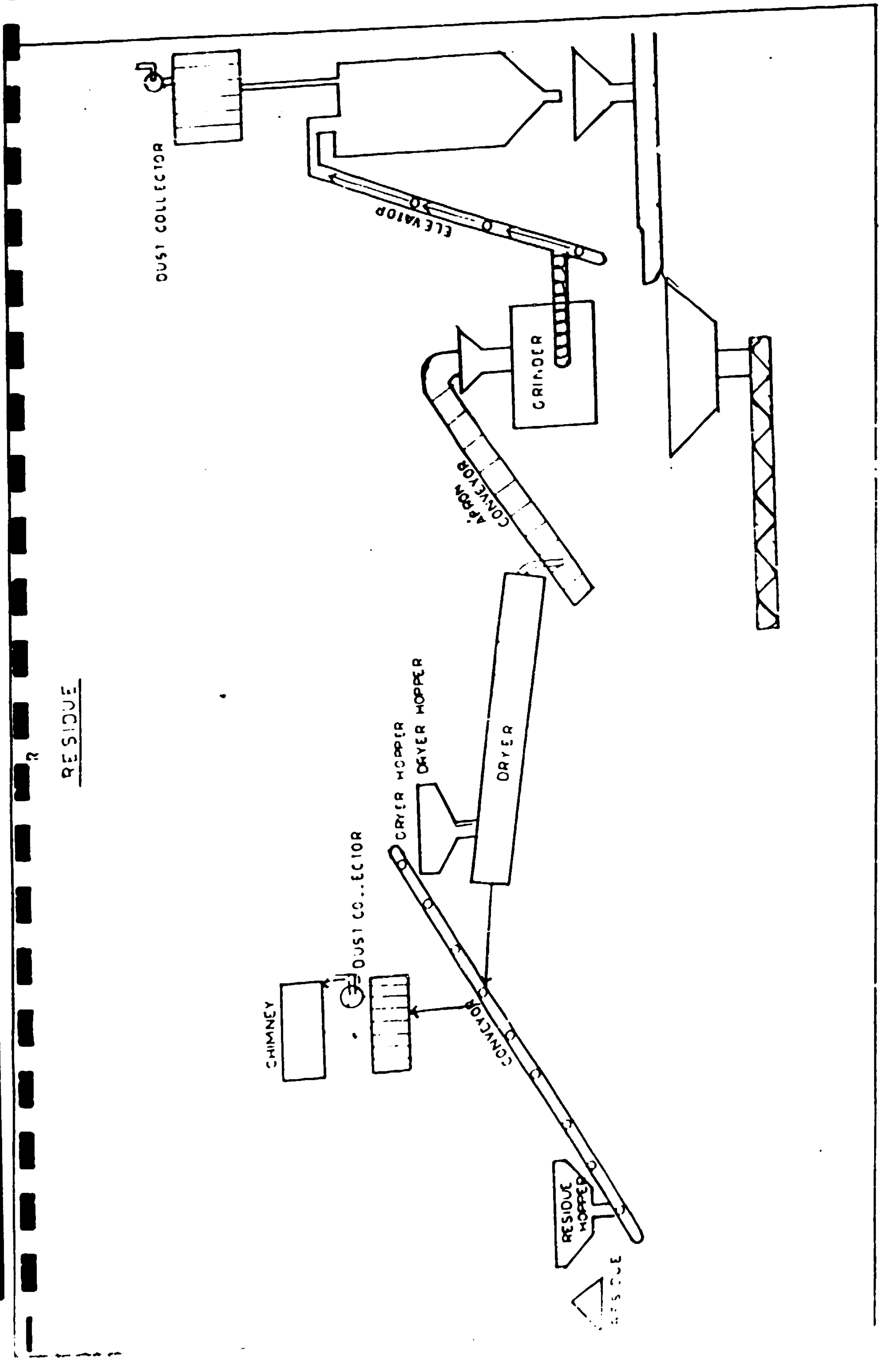

TO KILN HOPPER
BUCKET ELEVATOR
WEIGH PROPORTION
DC
SODA ASH SILO
BELT CONVEYOR
WEIGH HOPPER
RESIDUE SILO
LIME STONE SILO
CHROMITE SILO
MIXER HOPPER
MIXER

Annexe VI.6

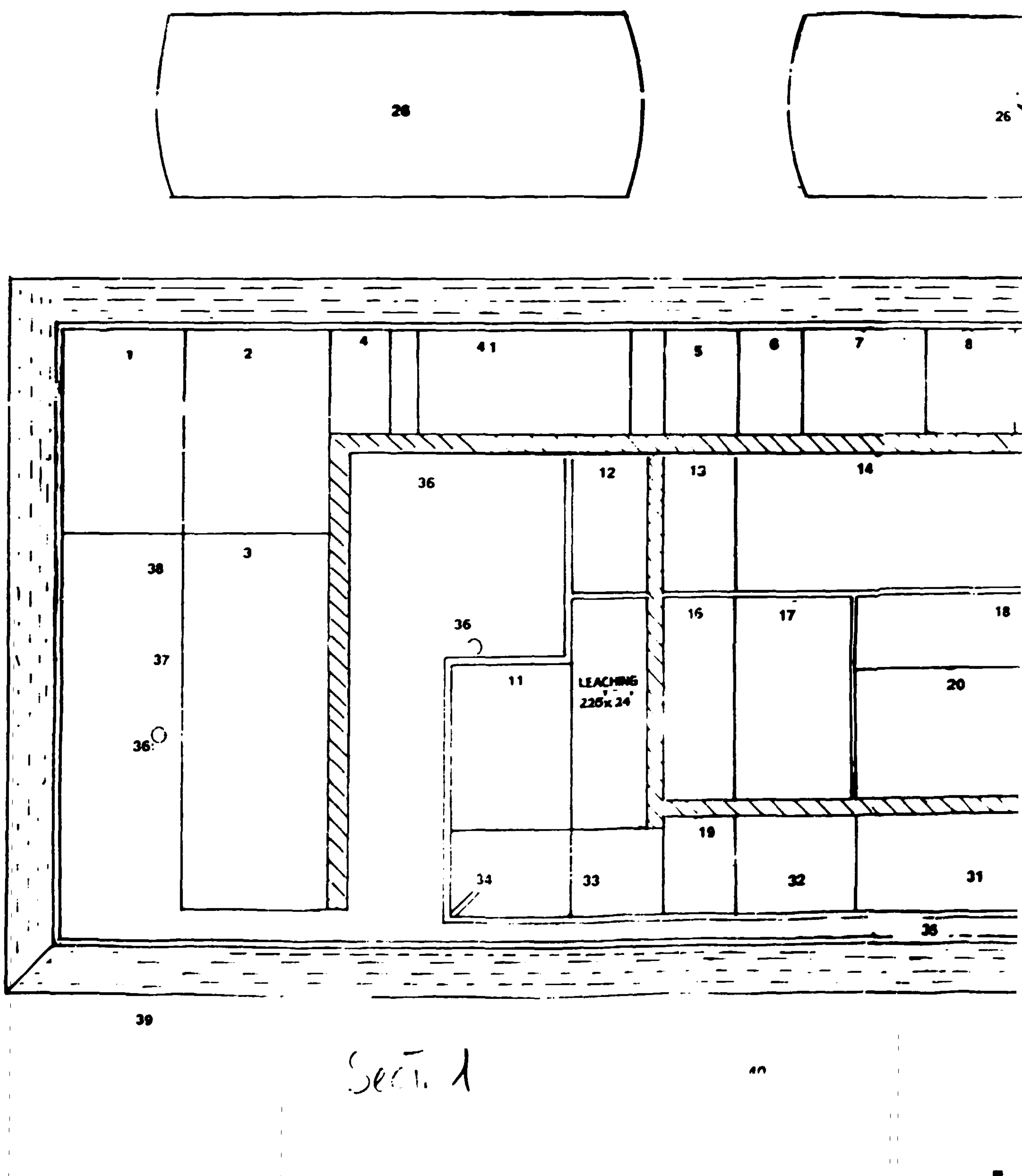
LEACHING

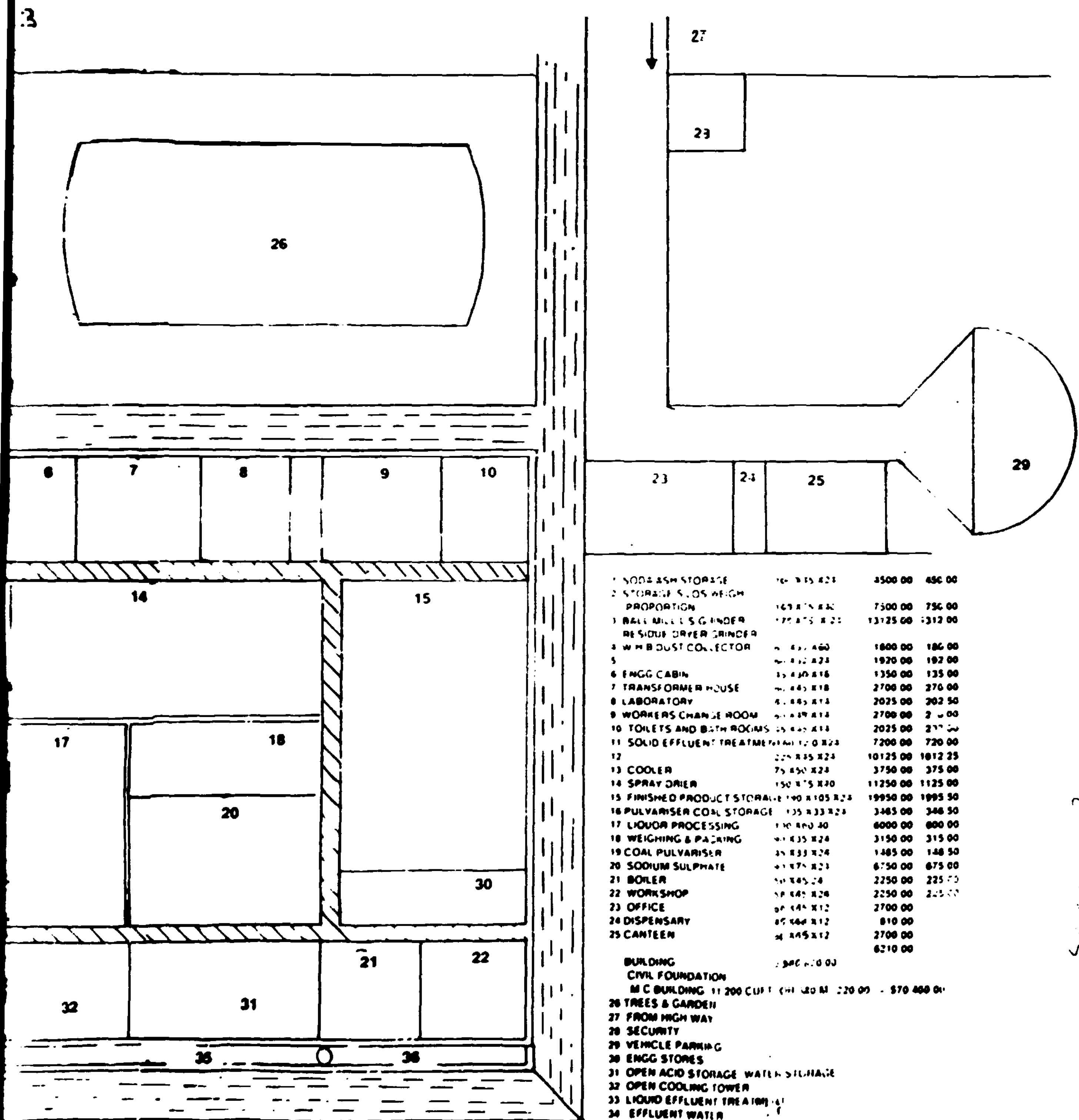


Annexe VI.7


DUST COLLECTOR
ELEVATOR
GRINDER
APRON CONVEYOR
DRYER
DRYER HOPPER
RESIDUE
CONVEYOR
CHIMNEY
RESIDUE HOPPER

ANNEXE VI.8


26
26
1
2
4
4 1
5
6
7
8
36
12
13
14
38
3
36
16
17
18
37
11
LEACHING
225 x 24
20
36
19
34
33
32
31
35
39
Sect. 1
40



1 SODA ASH STORAGE	[illegible] X35 X23	4500 00	450 00
2 STORAGE SILOS WEIGH PROPORTION	165 X75 X30	7500 00	750 00
3 BALL MILL L S GRINDER RESIDUE DRYER GRINDER	175 X75 X 23	13125 00	1312 00
4 W H B DUST COLLECTOR	[illegible] X60	1800 00	180 00
5	[illegible] X23	1920 00	192 00
6 ENGG CABIN	35 X30 X16	1350 00	135 00
7 TRANSFORMER HOUSE	[illegible] X45 X18	2700 00	270 00
8 LABORATORY	[illegible] X45 X14	2025 00	202 50
9 WORKERS CHANGE ROOM	[illegible] X49 X14	2700 00	2 [illegible] 00
10 TOILETS AND BATH ROOMS	35 X45 X14	2025 00	[illegible]
11 SOLID EFFLUENT TREATMENT	[illegible] 120 X24	7200 00	720 00
12	225 X35 X24	10125 00	1012 25
13 COOLER	75 X50 X24	3750 00	375 00
14 SPRAY DRIER	150 X75 X30	11250 00	1125 00
15 FINISHED PRODUCT STORAGE	190 X105 X24	19950 00	1995 50
16 PULVARISER COAL STORAGE	105 X33 X24	3465 00	346 50
17 LIQUOR PROCESSING	150 X80 40	6000 00	600 00
18 WEIGHING & PACKING	[illegible] X35 X24	3150 00	315 00
19 COAL PULVARISER	45 X33 X24	1485 00	148 50
20 SODIUM SULPHATE	[illegible] X75 X23	6750 00	675 00
21 BOILER	50 X45 24	2250 00	225 [illegible]
22 WORKSHOP	50 X45 X24	2250 00	[illegible]
23 OFFICE	60 X45 X12	2700 00	
24 DISPENSARY	45 X44 X12	810 00	
25 CANTEEN	60 X45 X12	2700 00	
		6210 00	

BUILDING [illegible] 00

CIVIL FOUNDATION

M C BUILDING 11 200 CUFT [illegible] 20 M 220 00 - $70 400 00

26 TREES & GARDEN
27 FROM HIGH WAY
28 SECURITY
29 VEHICLE PARKING
30 ENGG STORES
31 OPEN ACID STORAGE WATER STORAGE
32 OPEN COOLING TOWER
33 LIQUID EFFLUENT TREATMENT
34 EFFLUENT WATER
35 MOLASSES STORAGE
36 CHIMNEY
37 L S OPEN STORAGE
38 CHROMITE OPEN STORAGE
39 RAIN AND STORM WATER

2025 8

CONTENTS

VOL - 2

COMFAR SCHEDULES

COMFAR SCHEDULES

COMFAR SCHEDULES

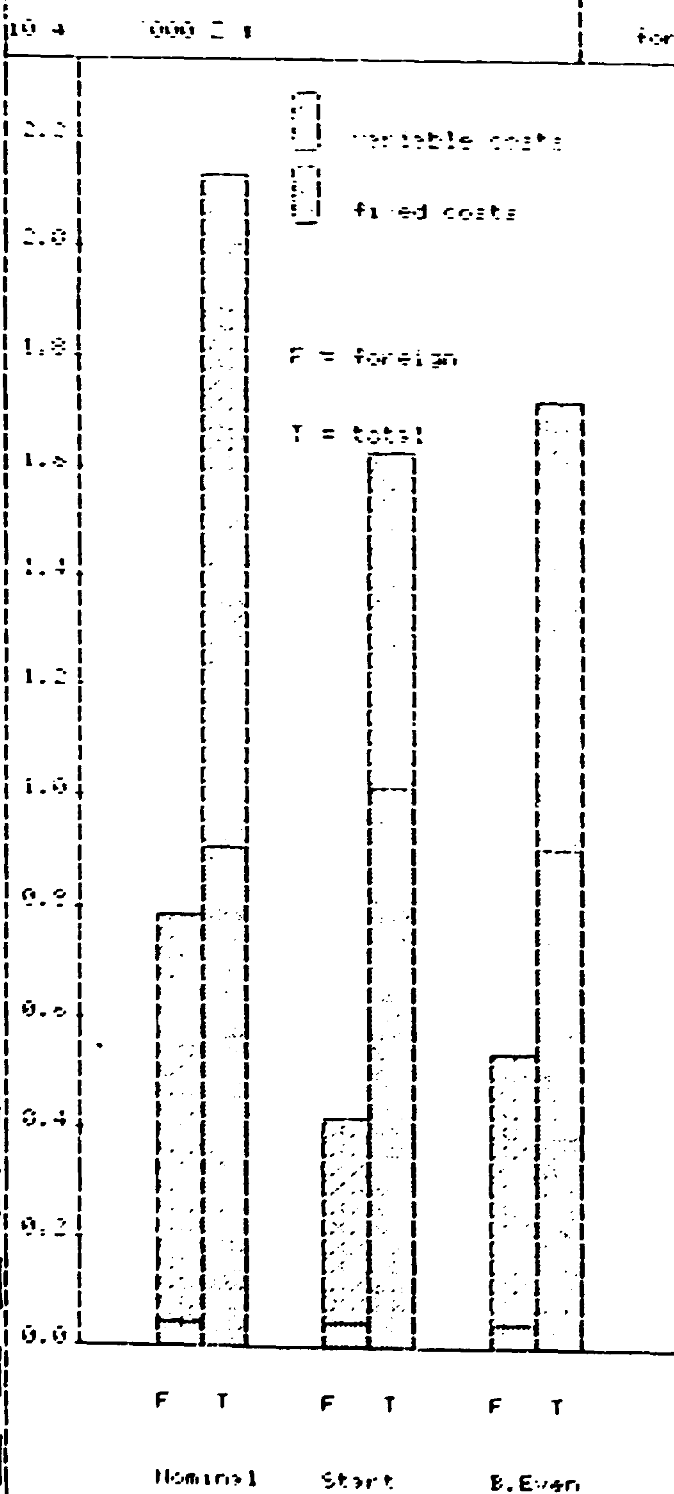
11,500 MT / ANNUM - PLANT

-------------COMFAR 2.1 - UNIDO FEASIBILITY STUDIES BRANCH, A-1400.VIENNA -----

Structure of Production Costs

11,500 TONNES PLANT

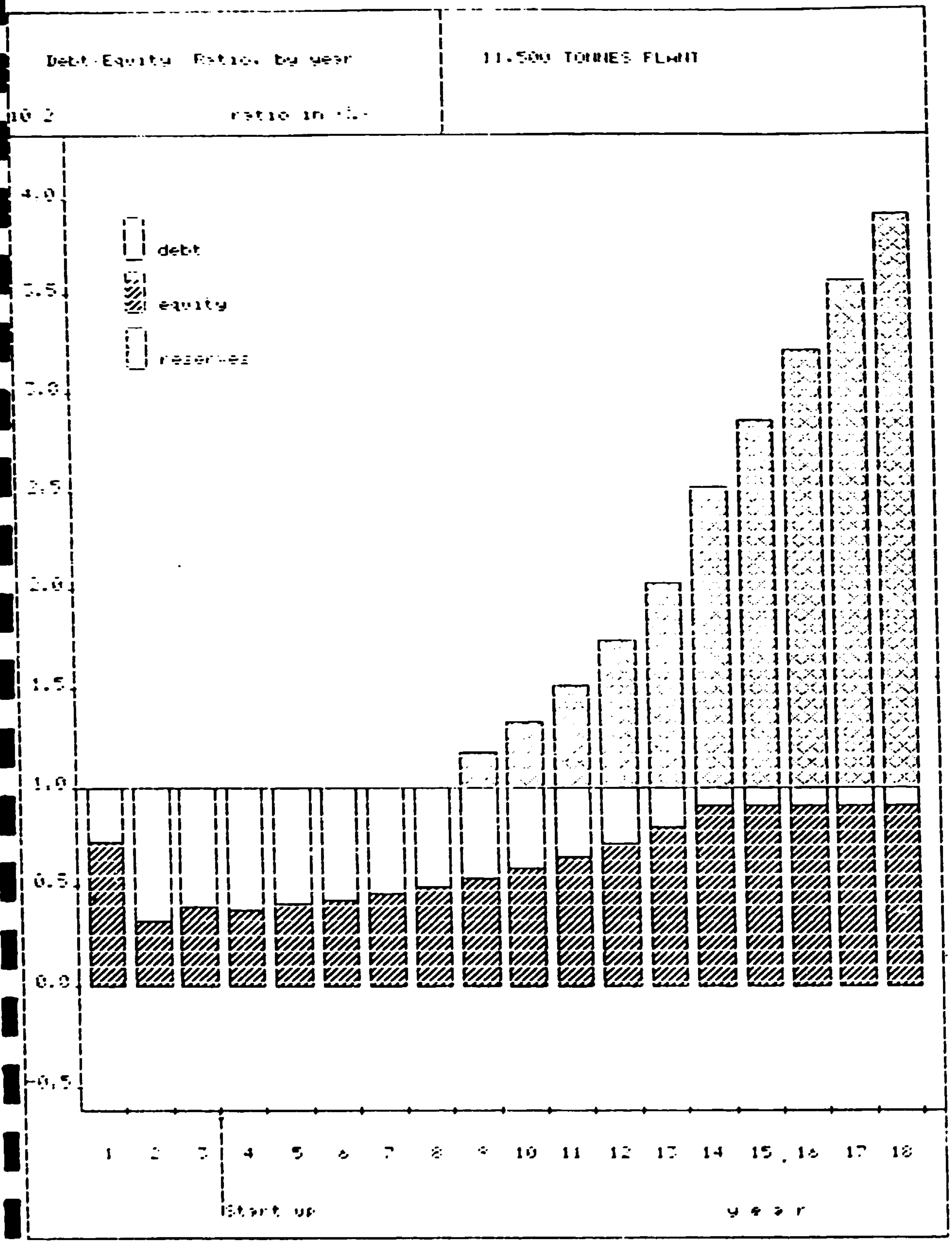
for 5th production year

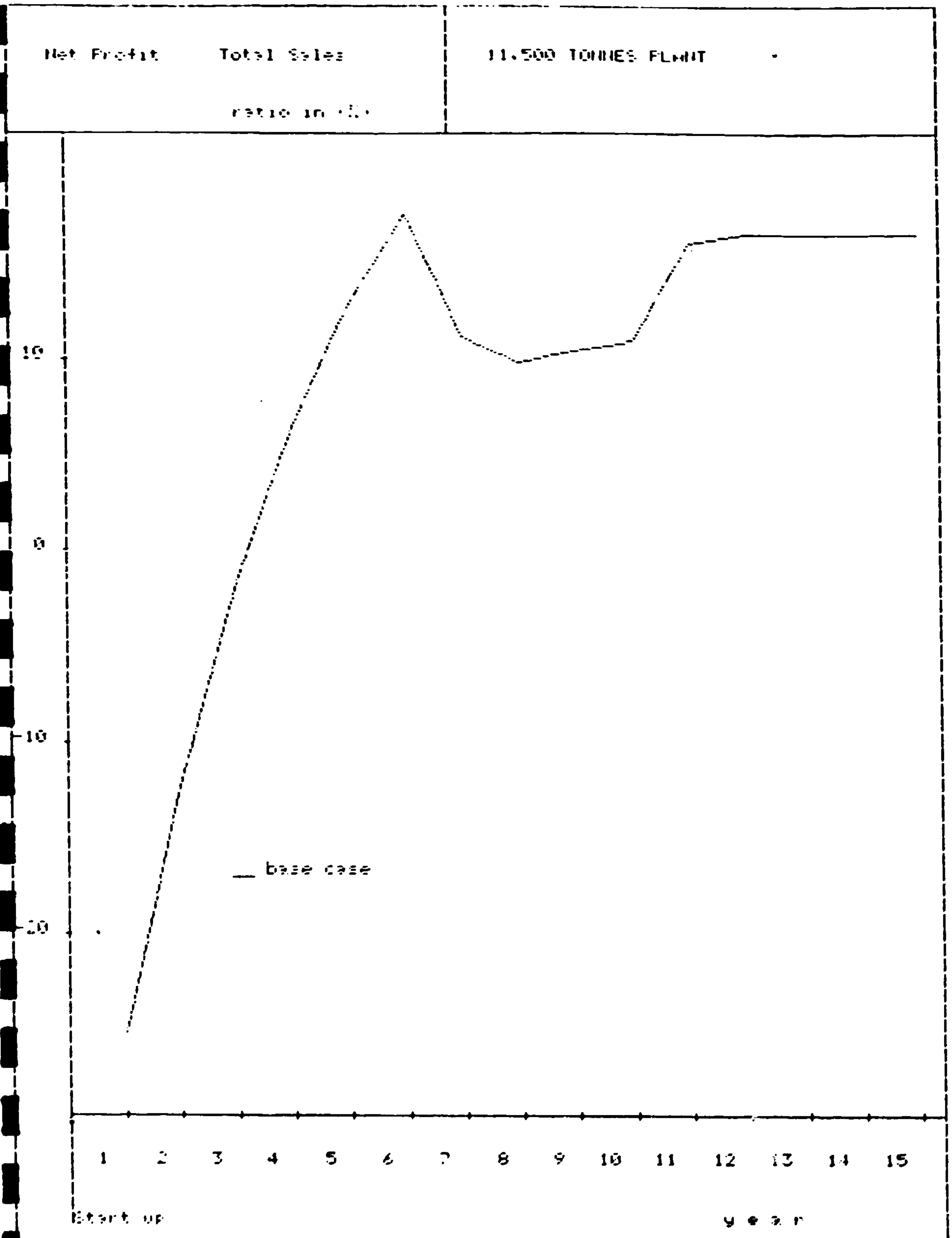


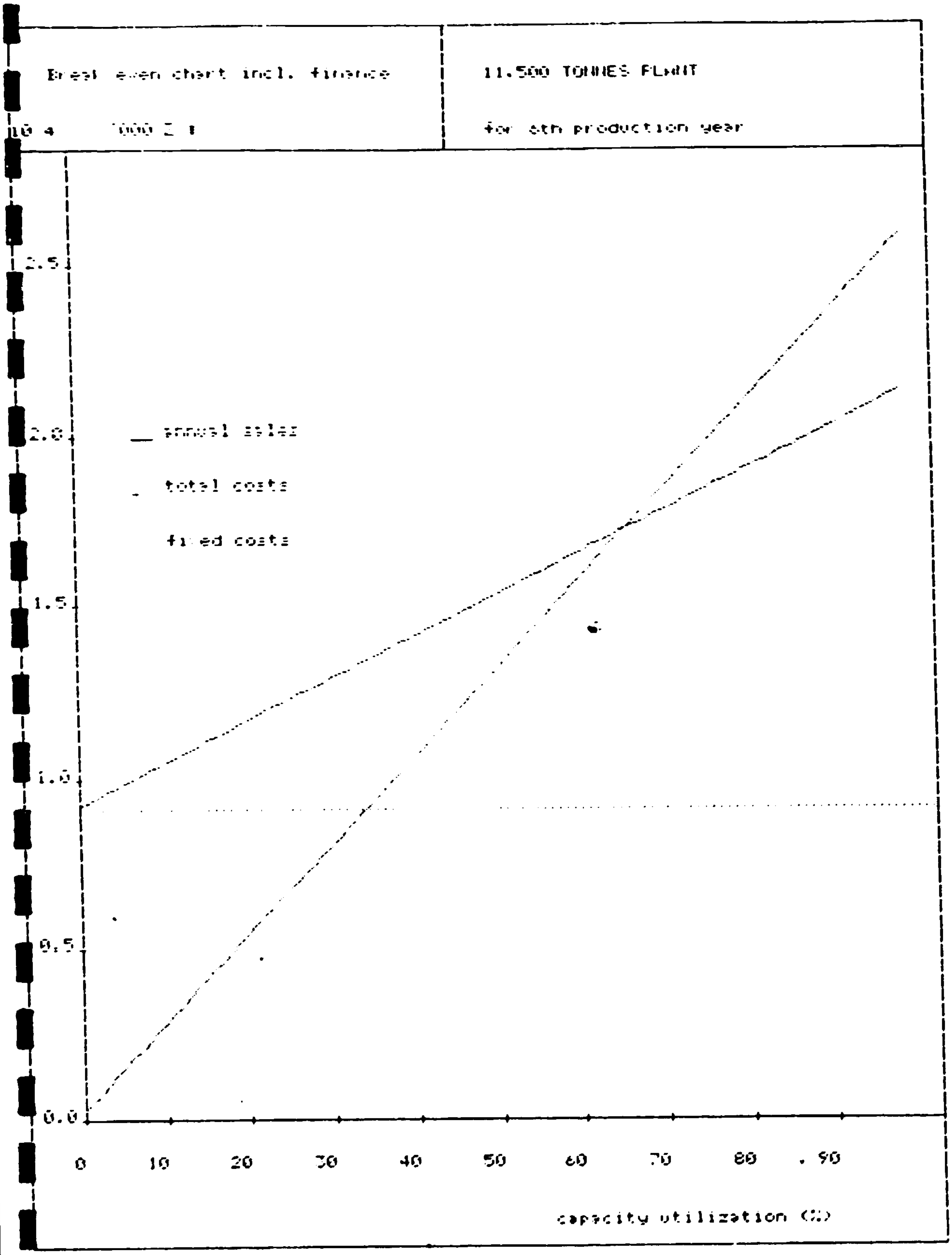
Nominal	Start up	
24.48	16.01	raw material
25.71	16.82	other RM
1.71	1.12	utilities
5.39	3.53	energy
15.05	19.69	labour
2.64	3.46	maintenance
2.34	3.07	spares
2.29	2.99	overheads
12.06	15.78	depreciation
8.41	17.63	interest
100.00	100.00	Total Prod C.

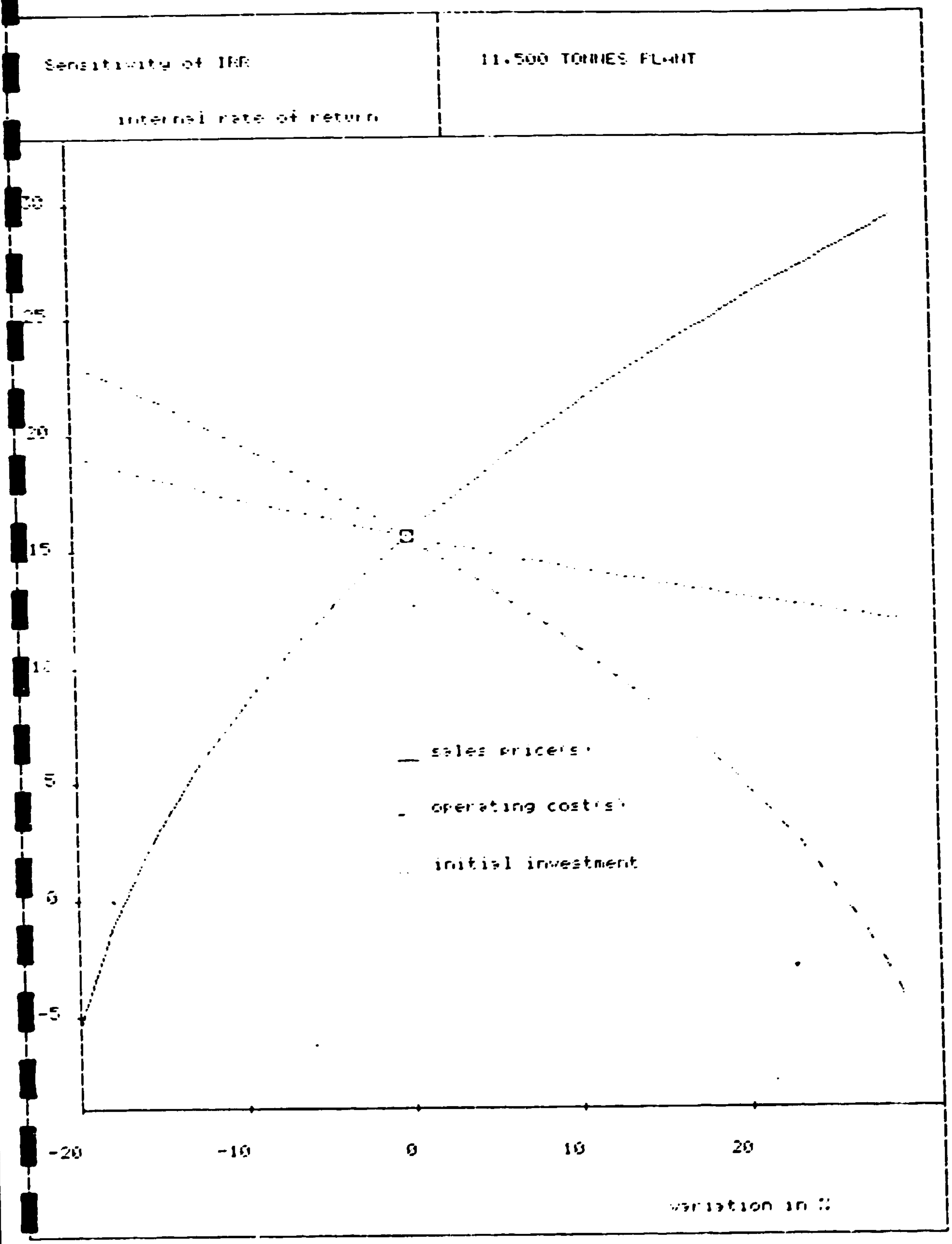
production level

-------------COMFAR 2.1 - UNIDO FEASIBILITY STUDIES BRANCH, D-1370,VIENNA -----



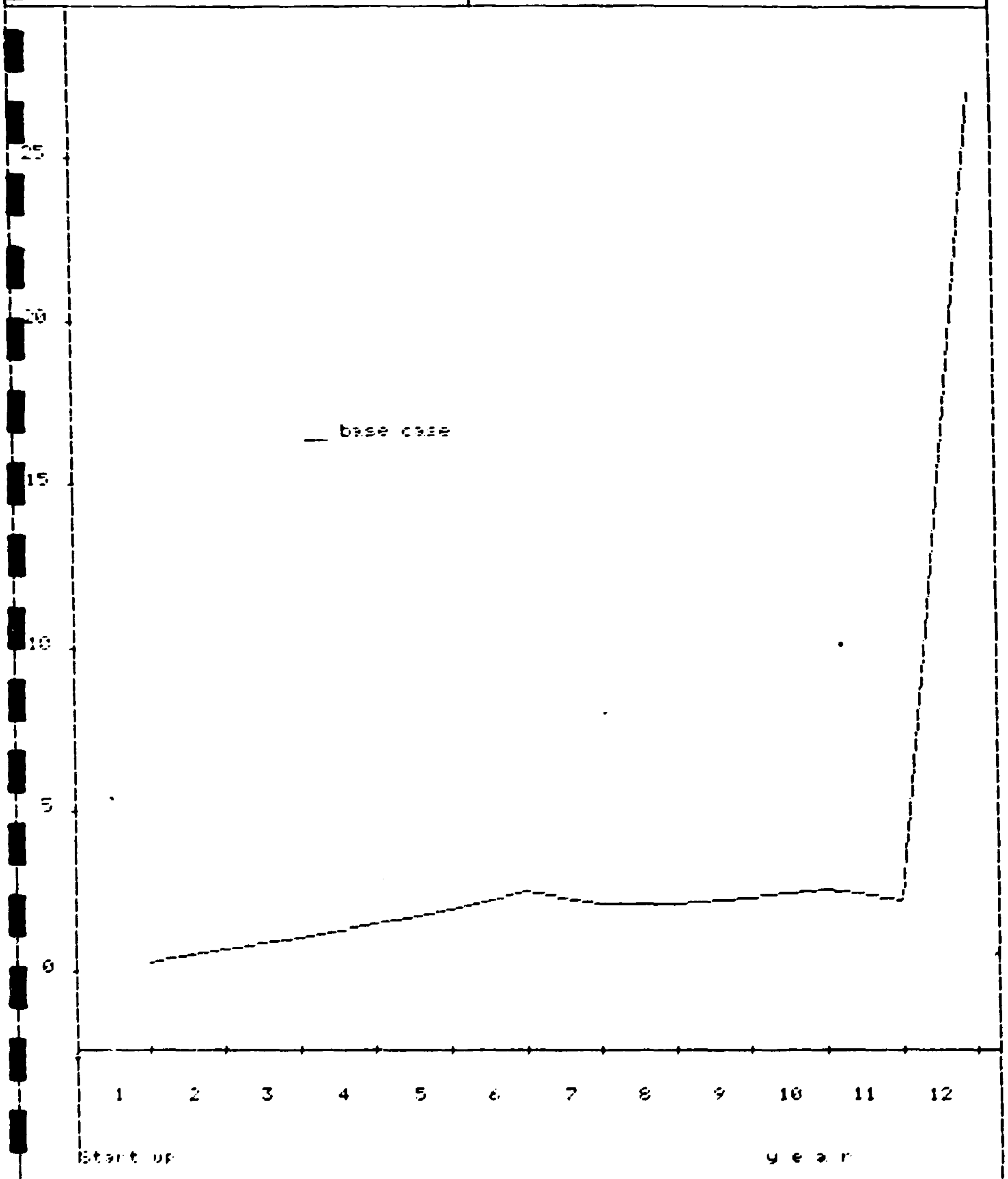

Net Profit   Total Sales
ratio in (%)
11.500 TONNES PLANT
10
0
-10
-20
__ base case
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
Start up
year

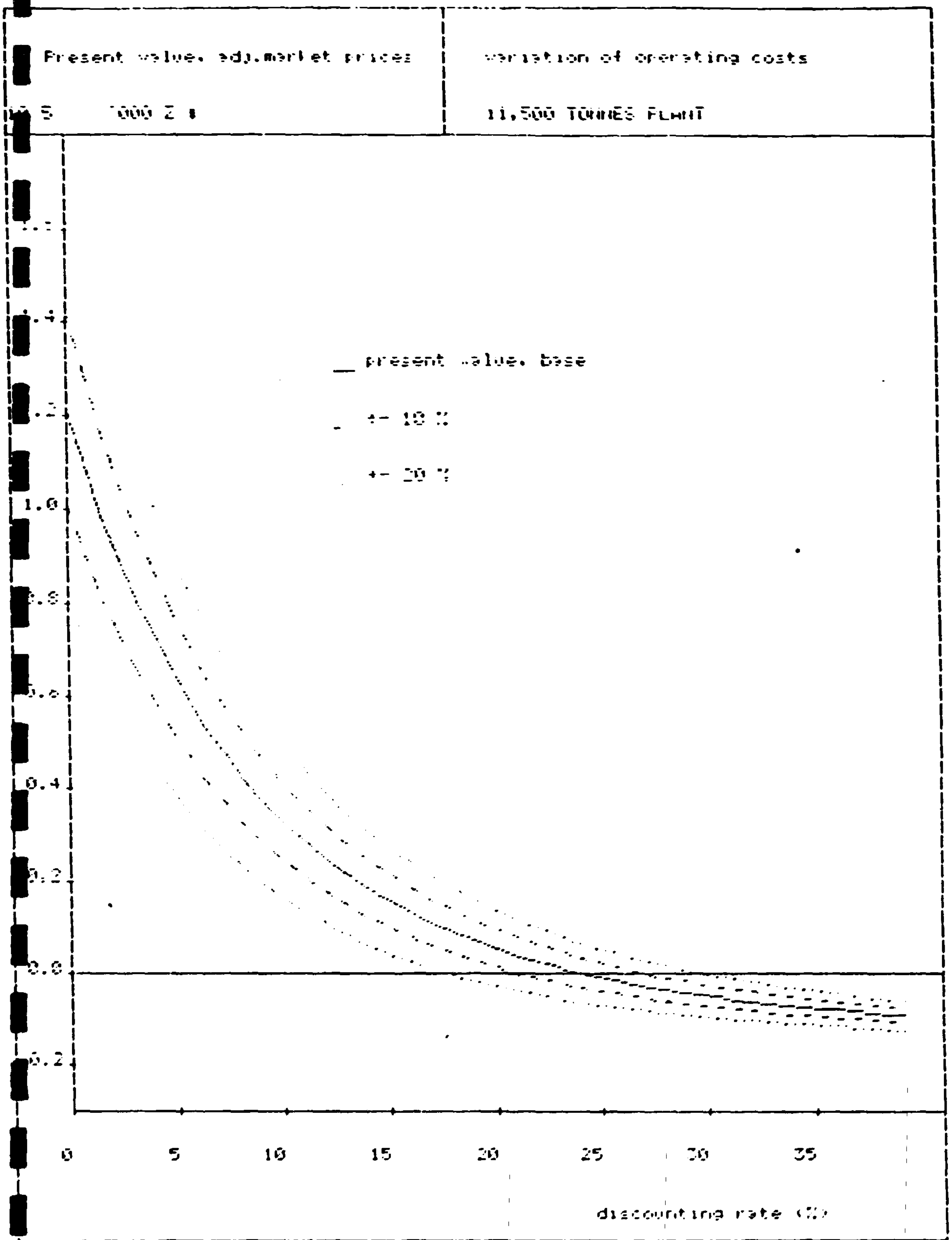

Break even chart incl. finance
11.500 TONNES PLANT
production year
2.5
2.0
1.5
1.0
0.5
0.0
annual sales
total costs
fixed costs
0
10
20
30
40
50
60
70
80
90
capacity utilization (%)


Sensitivity of IRR
11.500 TONNES PLANT
internal rate of return
30
25
20
15
10
5
0
-5
-20
-10
0
10
20
sales price(s)
operating cost(s)
initial investment
variation in %

Debt Service Ratio, by year
net cashflow/debt service

11.500 TONNES PLANT




Present value, adj.market prices
variation of operating costs
11,500 TONNES PLANT
present value, base
+- 10 %
+- 20 %
1.0
0.4
0.2
0.0
0 5 10 15 20 25 30 35
discounting rate (%)

COMFAR 21 UNIDO

CHROME TANNING SALTS PLANT, ZIMBABWE
28 SEP 89, by MPDC Priv.Ltd..BANGALORE
11,500 TONNES PLANT, basic version

3 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: '000 Z $

Total initial investment during construction phase

fixed assets:	27524.16	12.231 % foreign
current assets:	410.00	0.000 % foreign
total assets:	27934.16	12.052 % foreign

Source of funds during construction phase

equity & grants:	11051.00	0.000 % foreign
foreign loans :	0.00	
local loans :	16884.00	
total funds :	27935.00	0.000 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	10851.27	12072.95	13294.61
depreciation :	2570.92	2570.92	2570.92
interest :	2873.64	2873.64	2603.50
production costs	16295.85	17517.51	18469.02
thereof foreign	25.51 %	27.95 %	30.51 %
total sales :	13019.42	15597.30	18175.18
gross income :	-3276.42	-1920.21	-293.85
net income :	-3276.42	-1920.21	-293.85
cash balance :	-704.28	-1189.10	437.26
net cashflow :	939.36	3372.94	4729.15

Net Present Value at: 10.00 % = 10998.96
Internal Rate of Return: 15.63 %
Return on equity1: 9.43 %
Return on equity2: 13.81 %

Index of Schedules produced by COMFAR

Total Initial Investment in '000 Z $

Year	1990	1991	1992
Fixed investment costs			
Land, site preparation, development	100.000	0.000	0.000
Buildings and civil works	678.000	2827.000	0.000
Auxiliary and service facilities .	1398.000	2097.000	0.000
Incorporated fixed assets	750.000	525.000	225.000
Plant machinery and equipment . . .	5640.000	8460.000	0.000
Total fixed investment costs	8566.000	13909.000	225.000
Pre-production capital expenditures.	404.000	1736.720	2683.440
Net working capital	0.000	0.000	410.000
Total initial investment costs . . .	8970.000	15645.720	3318.440
Of it foreign, in %	16.907	10.386	6.780

Total Current Investment in '000 Z $

Year	1993	1994-98
Fixed investment costs		
Land, site preparation, development	0.000	0.000
Buildings and civil works	0.000	0.000
Auxiliary and service facilities	0.000	0.000
Incorporated fixed assets	0.000	0.000
Plant, machinery and equipment	0.000	0.000
Total fixed investment costs	0.000	0.000
Preproduction capitals expenditures	0.000	0.000
Working capital	1228.775	151.409
Total current investment costs	1228.775	151.409
Of it foreign, %	38.245	64.994

Total Production Costs in '000 Z $

Year	1993	1994	1995	1996	1997
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	2609.725	3131.670	3653.615	4175.560	4697.505
Other raw materials	2741.120	3289.344	3837.568	4385.792	4934.016
Utilities	182.450	218.940	255.430	291.920	328.410
Energy	575.000	690.000	805.000	920.000	1035.000
Labour, direct	3209.000	3209.000	3209.000	3209.000	3209.000
Repair, maintenance	564.000	564.000	564.000	564.000	564.000
Spares	500.000	500.000	500.000	500.000	500.000
Factory overheads	470.000	470.000	470.000	470.000	470.000
Factory costs	10851.290	12072.950	13294.610	14516.270	15737.930
Administrative overheads	0.000	0.000	0.000	0.000	0.000
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	2570.916	2570.916	2570.916	2570.916	2570.916
Financial costs	2873.640	2873.640	2603.496	2333.352	2063.208
Total production costs	16295.850	17517.510	18469.030	19420.540	20372.050
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	25.508	27.948	30.509	32.820	34.914
Of it variable,%	37.484	41.844	46.302	50.324	53.971
Total labour	3209.000	3209.000	3209.000	3209.000	3209.000

Total Production Costs in '000 Z $

Year	1998	1999	2000	2001	2002
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000
Raw material 1	5219.450	5219.450	5219.450	5219.450	5219.450
Other raw materials	5482.240	5482.240	5482.240	5482.240	5482.240
Utilities	364.900	364.900	364.900	364.900	364.900
Energy	1150.000	1150.000	1150.000	1150.000	1150.000
Labour, direct	3209.000	3209.000	3209.000	3209.000	3209.000
Repair, maintenance	564.000	564.000	564.000	564.000	564.000
Spares	500.000	500.000	500.000	500.000	500.000
Factory overheads	470.000	470.000	470.000	470.000	470.000
Factory costs	16959.590	16959.590	16959.590	16959.590	16959.590
Administrative overheads	0.000	0.000	0.000	0.000	0.000
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	2570.916	2570.916	2570.916	2570.916	2570.916
Financial costs	1793.064	1522.920	1252.776	982.632	712.488
Total production costs	21323.570	21053.430	20783.280	20513.140	20242.990
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	36.822	37.295	37.779	38.277	38.788
Of it variable,%	57.291	58.027	58.781	59.555	60.350
Total labour	3209.000	3209.000	3209.000	3209.000	3209.000

Total Production Costs in '000 Z $

Year	2003	2004- 7
% of nom. capacity (single product).	0.000	0.000
Raw material 1	5219.450	5219.450
Other raw materials	5482.240	5482.240
Utilities	364.900	364.900
Energy	1150.000	1150.000
Labour, direct	3209.000	3209.000
Repair, maintenance	564.000	564.000
Spares	500.000	500.000
Factory overheads	470.000	470.000
Factory costs	16959.590	16959.590
Administrative overheads	0.000	0.000
Indir. costs, sales and distribution	0.000	0.000
Direct costs, sales and distribution	0.000	0.000
Depreciation	179.000	179.000
Financial costs	442.344	172.200
Total production costs	17580.930	17310.790
Costs per unit (single product)	0.000	0.000
Of it foreign, %	42.746	43.413
Of it variable,%	69.488	70.572
Total labour	3209.000	3209.000

Net Working Capital in '000 Z $

Year	mdc	coto	1993	1994	1995	1996	1997
Coverage	mdc	coto					
Current assets &							
Accounts receivable	30	12.0	904.275	1006.079	1107.884	1209.689	1311.494
Inventory and materials	18	19.8	270.777	324.932	379.087	433.243	487.398
Energy	7	51.4	11.181	13.417	15.653	17.889	20.125
Spares	360	1.0	500.000	500.000	500.000	500.000	500.000
Work in progress	2	180.0	60.285	67.072	73.859	80.646	87.433
Finished products	10	36.0	301.425	335.360	369.295	403.230	437.165
Cash in hand	1	360.0	12.828	12.828	12.828	12.828	12.828
Total current assets			2060.769	2259.688	2458.606	2657.524	2856.443
Current liabilities and							
Accounts payable	14	25.7	421.995	469.504	517.013	564.522	612.031
Net working capital			1638.774	1790.184	1941.594	2093.003	2244.412
Increase in working capital			1228.774	151.410	151.409	151.409	151.410
Net working capital, local			1012.021	1065.024	1118.027	1171.030	1224.033
Net working capital, foreign			626.754	725.160	823.567	921.973	1020.379

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Net Working Capital in '000 Z $

Year	mdc	coto	1998	1999-2007
Coverage	mdc	coto		
Current assets &				
Accounts receivable	30	12.0	1413.299	1413.299
Inventory and materials	18	19.8	541.553	541.553
Energy	7	51.4	22.361	22.361
Spares	360	1.0	500.000	500.000
Work in progress	2	180.0	94.220	94.220
Finished products	10	36.0	471.100	471.100
Cash in hand	1	360.0	12.828	12.828
Total current assets			3055.361	3055.361
Current liabilities and				
Accounts payable	14	25.7	659.540	659.540
Net working capital			2395.821	2395.821
Increase in working capital			151.409	0.000
Net working capital, local			1277.036	1277.036
Net working capital, foreign			1118.786	1118.786

Source of Finance, construction in '000 Z $

Year	1990	1991	1992
Equity, ordinary ..	6420.000	1537.000	3094.000
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..	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000
Loan A, local....	2550.000	14109.000	225.000
Loan B, local....	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000
Total loan	2550.000	14109.000	225.000
Current liabilities	0.000	0.000	0.000
Bank overdraft	0.000	0.000	0.000
Total funds	8970.000	15646.000	3319.000

Source of Finance, production in '000 Z $

Year	1993	1994	1995	1996	1997-98	1999-2003
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..	0.000	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	-1688.400	-1688.400	-1688.400	-1688.400	-1688.400
Loan B, local....	0.000	0.000	0.000	0.000	0.000	0.000
Loan C, local....	1230.000	0.000	0.000	0.000	0.000	0.000
Total loan	1230.000	-1688.400	-1688.400	-1688.400	-1688.400	-1688.400
Current liabilities	421.995	47.509	47.509	47.509	47.509	0.000
Bank overdraft	703.445	1189.102	-437.260	-1455.287	0.000	0.000
Total funds	2355.440	-451.789	-2078.151	-3096.178	-1640.891	-1688.400

Cashflow Tables, construction in '000 Z $

Year	1990	1991	1992
Total cash inflow . .	8970.000	15646.000	3319.000
Financial resources .	8970.000	15646.000	3319.000
Sales, net of tax . .	0.000	0.000	0.000
Total cash outflow . .	8970.000	15645.720	3318.440
Total assets	8766.000	14109.000	635.000
Operating costs . . .	0.000	0.000	0.000
Cost of finance . . .	204.000	1536.720	2683.440
Repayment	0.000	0.000	0.000
Corporate tax . . .	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	0.000	0.280	0.560
Cumulated cash balance	0.000	0.280	0.840
Inflow, local	8970.000	15646.000	3319.000
Outflow, local	7453.400	14020.820	3093.440
Surplus (deficit) .	1516.600	1625.181	225.560
Inflow, foreign . . .	0.000	0.000	0.000
Outflow, foreign . . .	1516.600	1624.900	225.000
Surplus (deficit) .	-1516.600	-1624.900	-225.000
Net cashflow	-8766.000	-14109.000	-635.000
Cumulated net cashflow	-8766.000	-22875.000	-23510.000

Cashflow tables, production in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total cash inflow ..	14671.420	15644.810	18222.690	20800.560	23378.440	25956.310
Financial resources .	1651.995	47.509	47.509	47.509	47.509	47.509
Sales, net of tax ..	13019.420	15597.300	18175.180	20753.050	23330.930	25908.800
Total cash outflow ..	15375.700	16833.910	17785.430	18736.940	19688.460	20639.970
Total assets	1650.769	198.918	198.918	198.918	198.918	198.918
Operating costs ...	10851.290	12072.950	13294.610	14516.270	15737.930	16959.590
Cost of finance ...	2873.640	2873.640	2603.496	2333.352	2063.208	1793.064
Repayment	0.000	1688.400	1688.400	1688.400	1688.400	1688.400
Corporate tax ...	0.000	0.000	0.000	0.000	0.000	0.000
Dividends paid ...	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-704.284	-1189.102	437.258	2063.617	3689.979	5316.335
Cumulated cash balance	-703.444	-1892.545	-1455.288	608.330	4298.308	9614.646
Inflow, local	4131.736	2761.070	2875.070	2989.070	3103.070	3217.070
Outflow, local	10780.320	12147.680	12360.180	12572.680	12785.180	12997.680
Surplus (deficit) .	-6648.580	-9386.606	-9485.108	-9583.607	-9682.107	-9780.607
Inflow, foreign ...	10539.680	12883.740	15347.610	17811.490	20275.370	22739.240
Outflow, foreign ...	4595.388	4686.236	5425.251	6164.267	6903.281	7642.296
Surplus (deficit) .	5944.296	8197.504	9922.363	11647.220	13372.080	15096.940
Net cashflow	939.355	3372.938	4729.152	6085.368	7441.586	8797.802
Cumulated net cashflow	-22570.640	-19197.710	-14468.550	-8383.187	-941.601	7856.201

CHROME TANNING SALTS PLANT, ZIMBABWE --- 28 SEP 89, by MFDC Priv.Ltd.,BANGALORE

Cashflow tables, production in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total cash inflow . .	25908.800	25908.800	25908.800	25908.800	25908.800	25908.800
Financial resources .	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax . .	25908.800	25908.800	25908.800	25908.800	25908.800	25908.800
Total cash outflow . .	22145.970	22463.530	22328.450	22193.380	23254.270	21430.790
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs . . .	16959.590	16959.590	16959.590	16959.590	16959.590	16959.590
Cost of finance . . .	1522.920	1252.776	982.632	712.488	442.344	172.200
Repayment	1688.400	1688.400	1688.400	1688.400	1688.398	0.000
Corporate tax . . .	1975.062	2562.760	2697.832	2832.904	4163.934	4299.005
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	3762.828	3445.275	3580.348	3715.418	2654.535	4478.008
Cumulated cash balance	13377.470	16822.730	20403.100	24118.520	26773.050	31251.060
Inflow, local	3198.300	3198.300	3198.300	3198.300	3198.300	3198.300
Outflow, local	14630.820	14948.380	14813.300	14678.230	15739.120	13915.650
Surplus (deficit) .	-11432.520	-11750.080	-11615.000	-11479.930	-12540.820	-10717.350
Inflow, foreign . . .	22710.500	22710.500	22710.500	22710.500	22710.500	22710.500
Outflow, foreign . . .	7515.150	7515.150	7515.150	7515.150	7515.150	7515.150
Surplus (deficit) .	15195.350	15195.350	15195.350	15195.350	15195.350	15195.350
Net cashflow	6974.149	6386.451	6251.379	6116.307	4785.277	4650.206
Cumulated net cashflow	14830.350	21216.800	27468.180	33584.480	38369.760	43019.970

ashflow tables, production in '000 Z $

r	2005	2006	2007
Total cash inflow . .	25908.800	25908.800	25908.800
nancial resources .	0.000	0.000	0.000
les, net of tax . .	25908.800	25908.800	25908.800
al cash outflow . .	21430.790	21430.790	21430.790
Total assets	0.000	0.000	0.000
Operating costs . . .	16959.590	16959.590	16959.590
st of finance . . .	172.200	172.200	172.200
payment	0.000	0.000	0.000
Corporate tax . . .	4299.005	4299.005	4299.005
vidends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	4478.008	4478.008	4478.008
ulated cash balance	35729.070	40207.070	44685.080
flow, local	3198.300	3198.300	3198.300
Outflow, local	13915.650	13915.650	13915.650
plus (deficit) .	-10717.350	-10717.350	-10717.350
low, foreign . . .	22710.500	22710.500	22710.500
Outflow, foreign . . .	7515.150	7515.150	7515.150
plus (deficit) .	15195.350	15195.350	15195.350
t cashflow	4650.206	4650.206	4650.206
ulated net cashflow	47670.180	52320.360	56970.590

Cashflow Discounting:

a) Equity paid versus Net income flow:			
Net present value	-709.04	at	10.00 %
Internal Rate of Return (IRRE1) ..	9.43 %		
b) Net Worth versus Net cash return:			
Net present value	4491.79	at	10.00 %
Internal Rate of Return (IRRE2) ..	13.81 %		
c) Internal Rate of Return on total investment:			
Net present value	10998.96	at	10.00 %
Internal Rate of Return (IRR) ..	15.63 %		

Net Worth = Equity paid plus reserves

Net Income Statement in '000 Z $

Year	1993	1994	1995	1996	1997
Total sales, incl. sales tax	13019.420	15597.300	18175.180	20753.050	23330.930
Less: variable costs, incl. sales tax.	6108.295	7329.954	8551.613	9773.272	10994.930
Variable margin	6911.130	8267.346	9623.563	10979.780	12336.000
As % of total sales	53.083	53.005	52.949	52.907	52.874
Non-variable costs, incl. depreciation	7313.915	7313.916	7313.914	7313.915	7313.916
Operational margin	-402.785	953.430	2309.648	3665.863	5022.079
As % of total sales	-3.094	6.113	12.708	17.664	21.525
Cost of finance	2873.640	2873.640	2603.496	2333.352	2063.208
Gross profit	-3276.425	-1920.210	-293.848	1332.512	2958.871
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	0.000	0.000	1332.512	2958.871
Tax	0.000	0.000	0.000	0.000	0.000
Net profit	-3276.425	-1920.210	-293.848	1332.512	2958.871
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-3276.425	-1920.210	-293.848	1332.512	2958.871
Accumulated undistributed profit	-3276.425	-5196.635	-5490.482	-4157.971	-1199.100
Gross profit, % of total sales	-25.166	-12.311	-1.617	6.421	12.682
Net profit, % of total sales	-25.166	-12.311	-1.617	6.421	12.682
ROE, Net profit, % of equity	-29.648	-17.376	-2.659	12.058	26.775
ROI, Net profit+interest, % of invest.	-1.628	3.831	9.223	14.551	19.815

Net Income Statement in '000 Z $

Year	1998	1999	2000	2001	2002
Total sales, incl. sales tax	25908.800	25908.800	25908.800	25908.800	25908.800
Less: variable costs, incl. sales tax.	12216.590	12216.590	12216.590	12216.590	12216.590
Variable margin	13692.210	13692.210	13692.210	13692.210	13692.210
As % of total sales	52.848	52.848	52.848	52.848	52.848
Non-variable costs, incl. depreciation	7313.917	7313.915	7313.916	7313.915	7313.915
Operational margin	6378.294	6378.295	6378.295	6378.296	6378.296
As % of total sales	24.618	24.618	24.618	24.618	24.618
Cost of finance	1793.064	1522.920	1252.776	982.632	712.488
Gross profit	4585.230	4855.375	5125.520	5395.664	5665.809
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	3950.123	5125.520	5395.664	5665.809
Tax	0.000	1975.062	2562.760	2697.832	2832.904
Net profit	4585.230	2880.313	2562.760	2697.832	2832.904
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	4585.230	2880.313	2562.760	2697.832	2832.904
Accumulated undistributed profit	3386.131	6266.444	8829.204	11527.040	14359.940
Gross profit, % of total sales	17.698	18.740	19.783	20.826	21.868
Net profit, % of total sales	17.698	11.117	9.891	10.413	10.934
ROE, Net profit, % of equity	41.492	26.064	23.190	24.413	25.635
ROI, Net profit+interest, % of invest.	25.017	17.270	14.965	14.436	13.906

Net Income Statement in '000 Z $

Year	2003	2004	2005	2006	2007
Total sales, incl. sales tax	25908.800	25908.800	25908.800	25908.800	25908.800
Less: variable costs, incl. sales tax.	12216.590	12216.590	12216.590	12216.590	12216.590
Variable margin	13692.210	13692.210	13692.210	13692.210	13692.210
As % of total sales	52.848	52.848	52.848	52.848	52.848
Non-variable costs, incl. depreciation	4922.000	4922.001	4922.001	4922.001	4922.001
Operational margin	8770.211	8770.210	8770.210	8770.210	8770.210
As % of total sales	33.850	33.850	33.850	33.850	33.850
Cost of finance	442.344	172.200	172.200	172.200	172.200
Gross profit	8327.867	8598.010	8598.010	8598.010	8598.010
Allowances	0.000	0.000	0.000	0.000	0.000
Taxable profit	8327.867	8598.010	8598.010	8598.010	8598.010
Tax	4163.934	4299.005	4299.005	4299.005	4299.005
Net profit	4163.934	4299.005	4299.005	4299.005	4299.005
Dividends paid	0.000	0.000	0.000	0.000	0.000
Undistributed profit	4163.934	4299.005	4299.005	4299.005	4299.005
Accumulated undistributed profit	18523.880	22822.880	27121.880	31420.890	35719.890
Gross profit, % of total sales	32.143	33.186	33.186	33.186	33.186
Net profit, % of total sales	16.072	16.593	16.593	16.593	16.593
ROE, Net profit, % of equity	37.679	38.902	38.902	38.902	38.902
ROI, Net profit+interest, % of invest.	18.067	17.537	17.537	17.537	17.537

Projected Balance Sheets, construction in '000 Z $

Year	1990	1991	1992
Total assets	8970.000	24616.000	27935.000
Fixed assets, net of depreciation	0.000	8970.000	24615.720
Construction in progress	8970.000	15645.720	2908.440
Current assets	0.000	0.000	410.000
Cash, bank	0.000	0.000	0.000
Cash surplus, finance available	0.000	0.281	0.842
Loss carried forward	0.000	0.000	0.000
Loss	0.000	0.000	0.000
Total liabilities	8970.000	24616.000	27935.000
Equity capital	6420.000	7957.000	11051.000
Reserves, retained profit	0.000	0.000	0.000
Profit	0.000	0.000	0.000
Long and medium term debt	2550.000	16659.000	16884.000
Current liabilities	0.000	0.000	0.000
Bank overdraft, finance required.	0.000	0.000	0.000
Total debt	2550.000	16659.000	16884.000
Equity, % of liabilities	71.572	32.325	39.560

Projected Balance Sheets, Production in '000 Z $

Year	1993	1994	1995	1996	1997
Total assets	30290.440	29838.650	27760.500	25996.830	25982.300
Fixed assets, net of depreciation	24953.240	22382.330	19811.410	17240.500	14669.580
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	2047.942	2246.860	2445.778	2644.697	2843.615
Cash, bank	12.828	12.828	12.828	12.828	12.828
Cash surplus, finance available	0.000	0.000	0.000	608.328	4298.307
Loss carried forward	0.000	3276.425	5196.635	5490.482	4157.971
Loss	3276.425	1920.210	293.848	0.000	0.000
Total liabilities	30290.440	29838.650	27760.500	25996.830	25982.300
Equity capital	11051.000	11051.000	11051.000	11051.000	11051.000
Reserves, retained profit	0.000	0.000	0.000	0.000	0.000
Profit	0.000	0.000	0.000	1332.512	2958.871
Long and medium term debt	18114.000	16425.600	14737.200	13048.800	11360.400
Current liabilities	421.995	469.504	517.013	564.522	612.031
Bank overdraft, finance required.	703.443	1892.549	1455.287	0.000	0.000
Total debt	19239.440	18787.650	16709.500	13613.320	11972.430
Equity, % of liabilities	36.483	37.036	39.808	42.509	42.533

COMFAR 2.1 - UNIDO FEASIBILITY STUDIES BRANCH, D-1370,VIENNA

Projected Balance Sheets, Production in '000 Z $

Year	1998	1999	2000	2001	2002
Total assets	25967.770	25960.580	26834.940	27844.370	28988.880
Fixed assets, net of depreciation	12098.660	9527.748	6956.832	4385.916	1815.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	3042.533	3042.533	3042.533	3042.533	3042.533
Cash, bank	12.828	12.828	12.828	12.828	12.828
Cash surplus, finance available	9614.643	13377.470	16822.750	20403.100	24118.520
Loss carried forward	1199.100	0.000	0.000	0.000	0.000
Loss	0.000	0.000	0.000	0.000	0.000
Total liabilities	25967.770	25960.580	26834.940	27844.370	28988.880
Equity capital	11051.000	11051.000	11051.000	11051.000	11051.000
Reserves, retained profit	0.000	3386.131	6266.444	8829.204	11527.040
Profit	4585.230	2880.313	2562.760	2697.832	2832.904
Long and medium term debt	9671.998	7983.598	6295.198	4606.798	2918.398
Current liabilities	659.540	659.540	659.540	659.540	659.540
Bank overdraft, finance required.	0.000	0.000	0.000	0.000	0.000
Total debt	10331.540	8643.138	6954.738	5266.338	3577.938
Equity, % of liabilities	42.557	42.568	41.181	39.688	38.122

CHROME TANNING SALTS PLANT, ZIMBABWE --- 28 SEP 89, by MPDC Priv.Ltd.,BANGALORE

Projected Balance Sheets, Production in '000 Z $

Year	2003	2004	2005	2006	2007
Total assets	31464.410	35763.420	40062.420	44361.430	48660.430
Fixed assets, net of depreciation	1636.000	1457.000	1278.000	1099.000	920.000
Construction in progress	0.000	0.000	0.000	0.000	0.000
Current assets	3042.533	3042.533	3042.533	3042.533	3042.533
Cash, bank	12.828	12.828	12.828	12.828	12.828
Cash surplus, finance available	26773.050	31251.060	35729.060	40207.070	44685.070
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	31454.410	35763.420	40062.420	44361.430	48660.430
Equity capital	11051.000	11051.000	11051.000	11051.000	11051.000
Reserves, retained profit	14359.940	18523.880	22822.880	27121.880	31420.890
Profit	4163.934	4299.005	4299.005	4299.005	4299.005
Long and medium term debt	1230.000	1230.000	1230.000	1230.000	1230.000
Current liabilities	659.540	659.540	659.540	659.540	659.540
Bank overdraft, finance required	0.000	0.000	0.000	0.000	0.000
Total debt	1889.540	1889.540	1889.540	1889.540	1889.540
Equity, % of liabilities	35.122	30.900	27.584	24.911	22.710

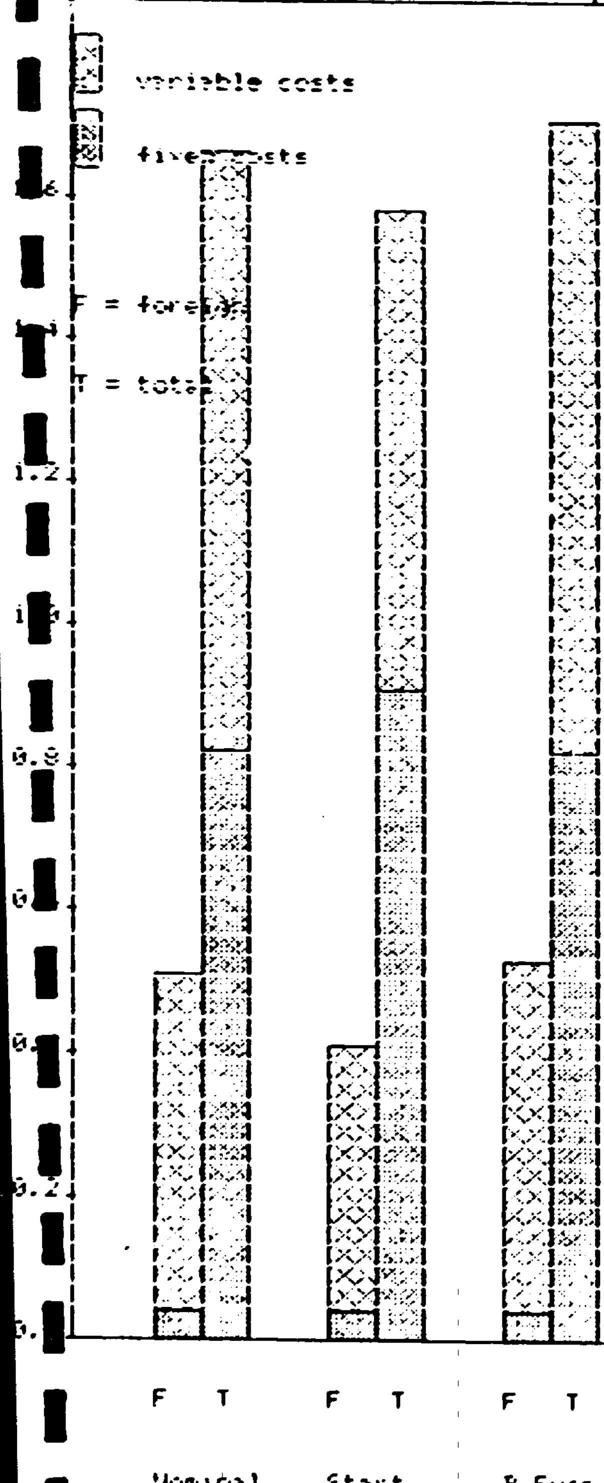
7200MT / ANNUM - PLANT

Structure of Production Costs

1000 Z $

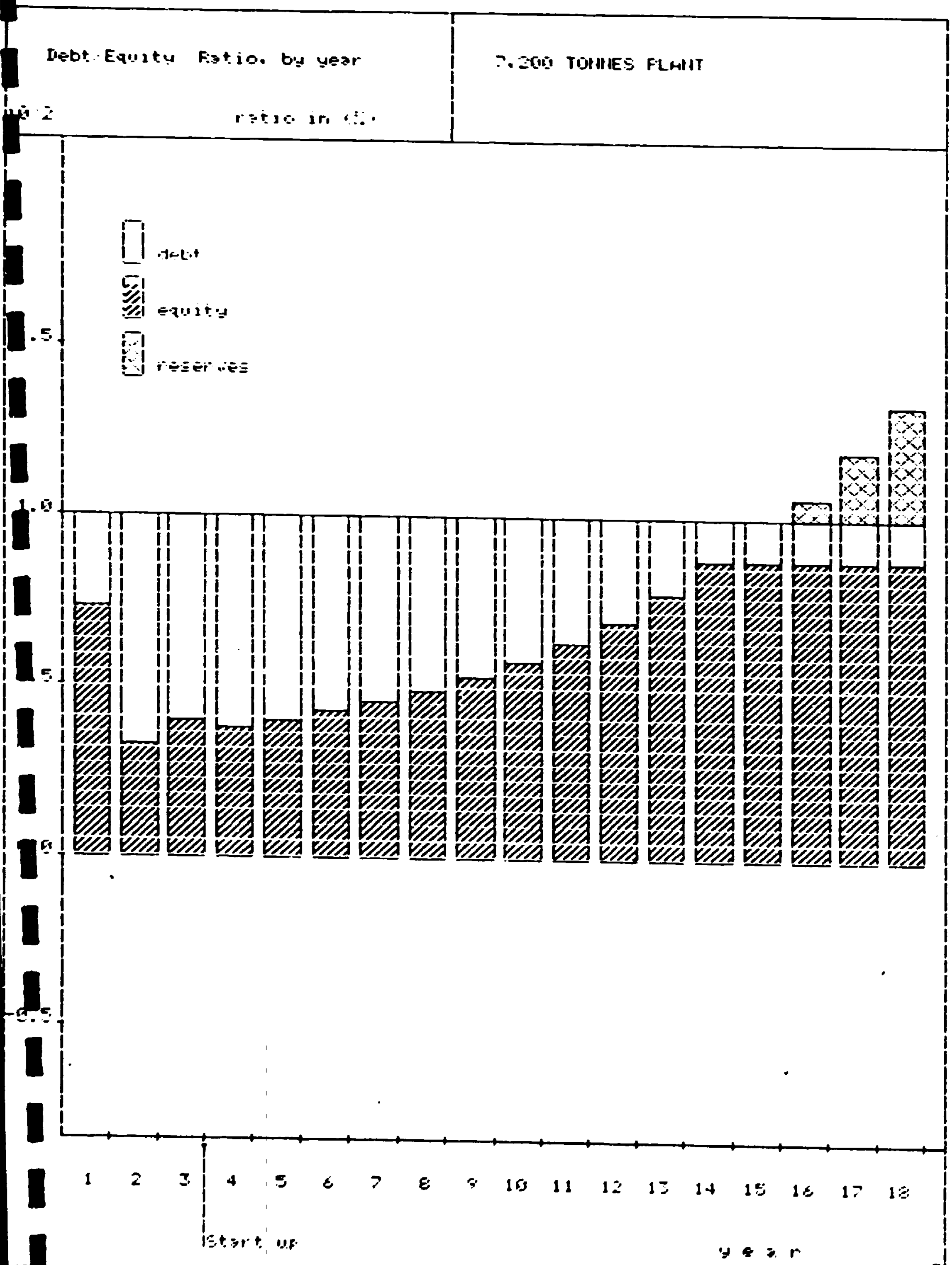
7.200 TONNES PLANT

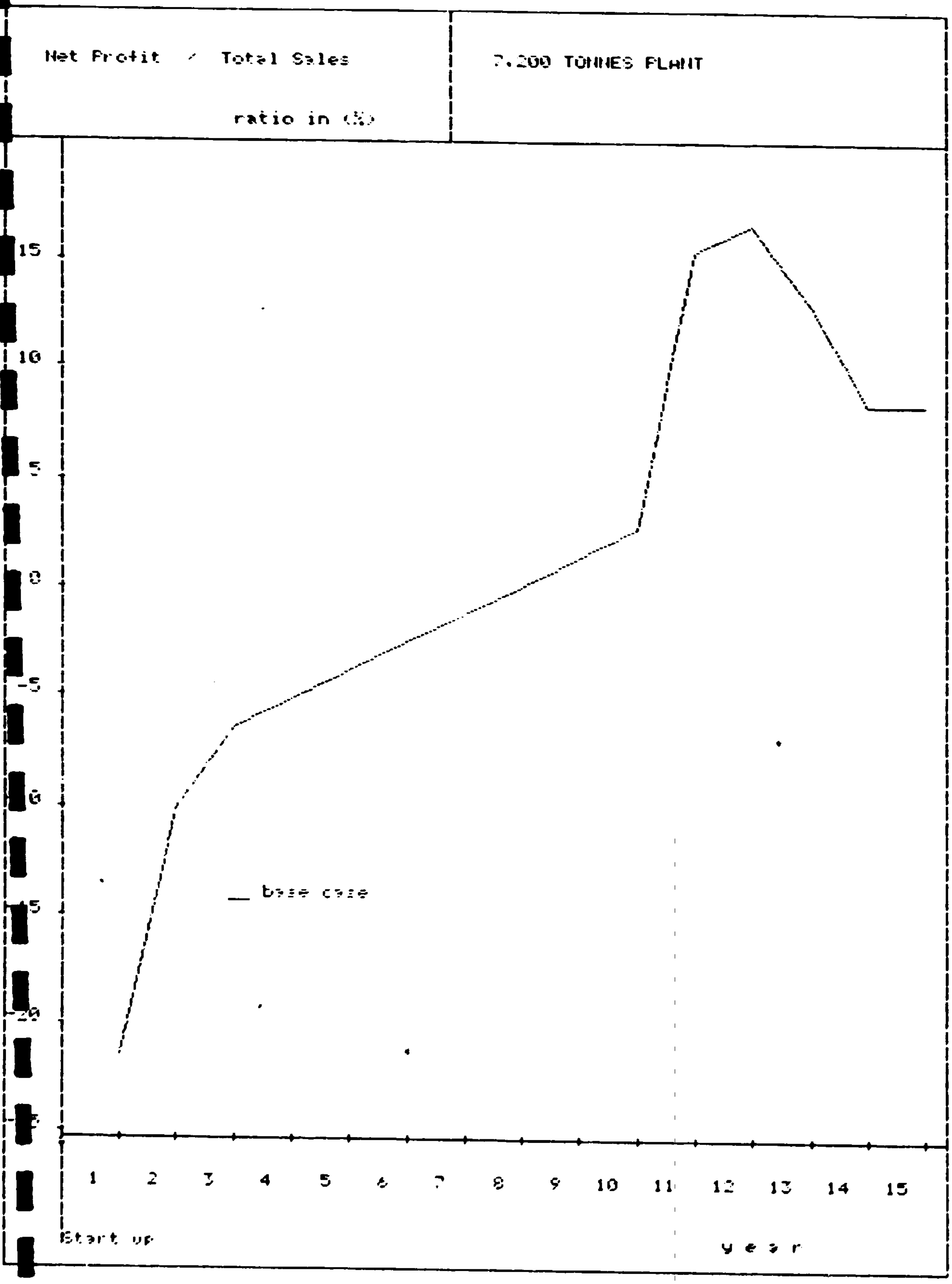
for 6th production year

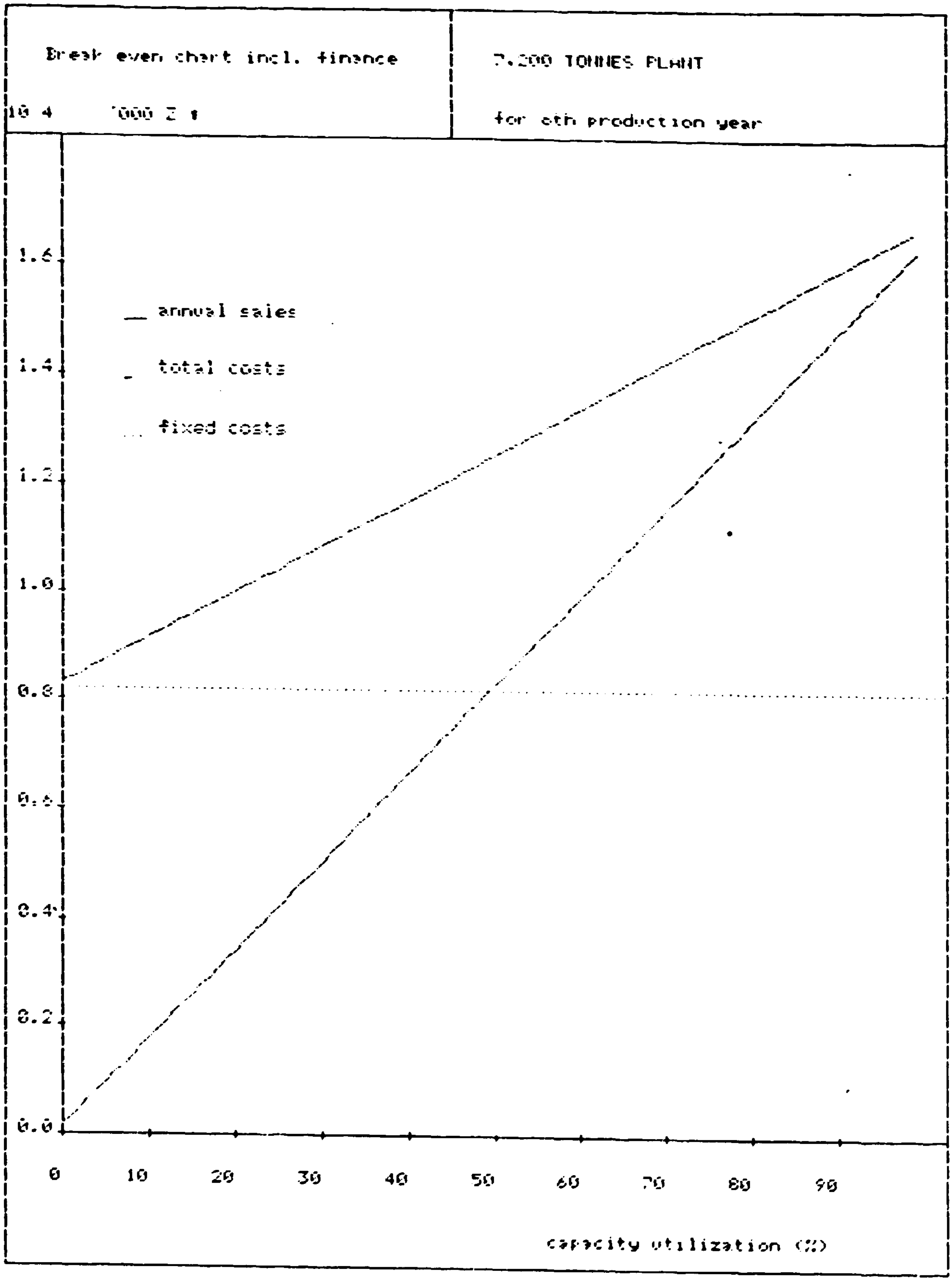


Nominal	Start up	
21.64	18.21	raw material
22.32	18.79	other RM
1.37	1.15	utilities
5.40	4.54	energy
19.25	20.28	labour
3.38	3.56	maintenance
3.00	3.16	spares
2.82	2.97	overheads
12.08	12.73	depreciation
8.74	14.59	interest
100.00	100.00	Total Prod C.

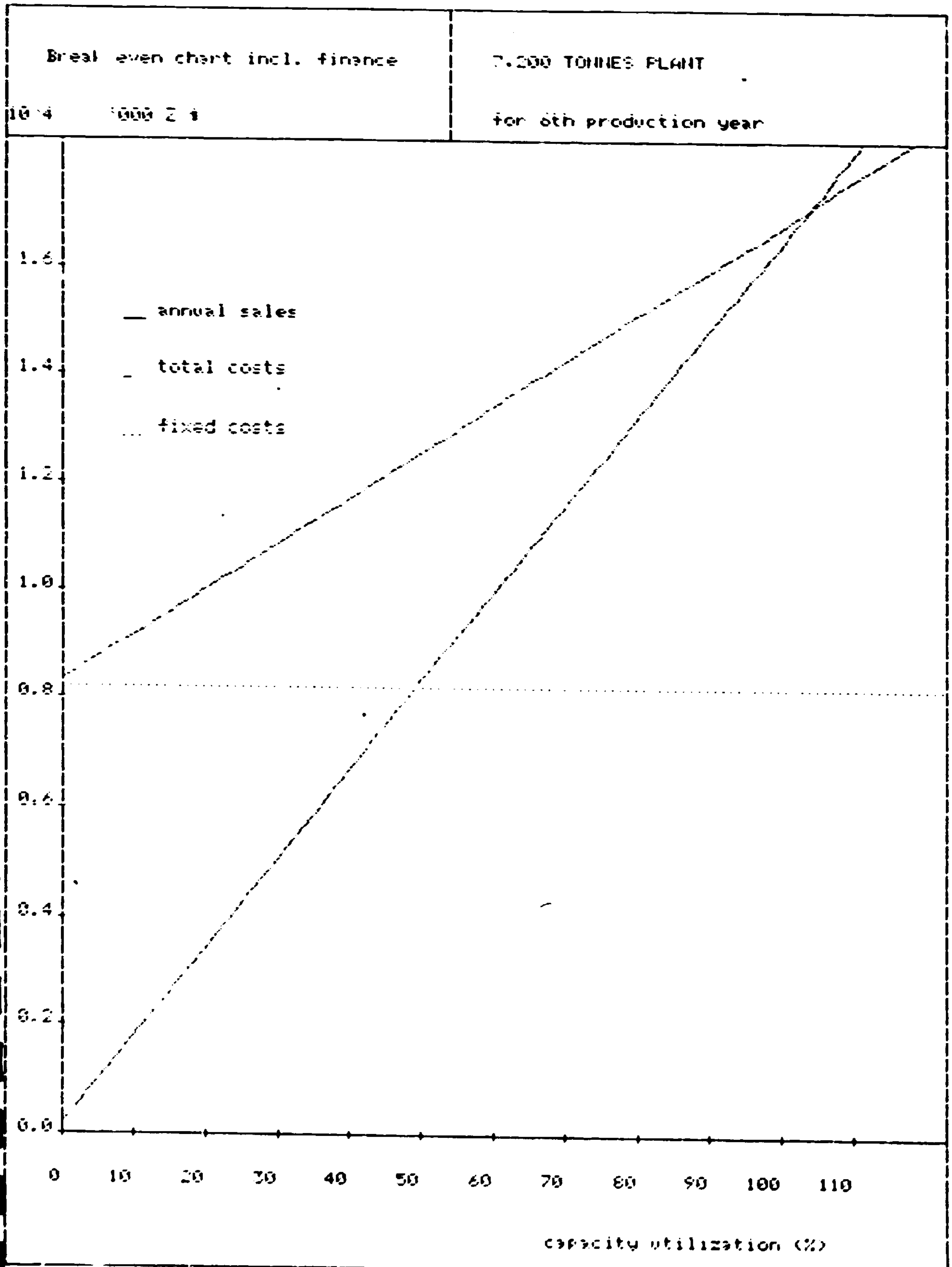
production level

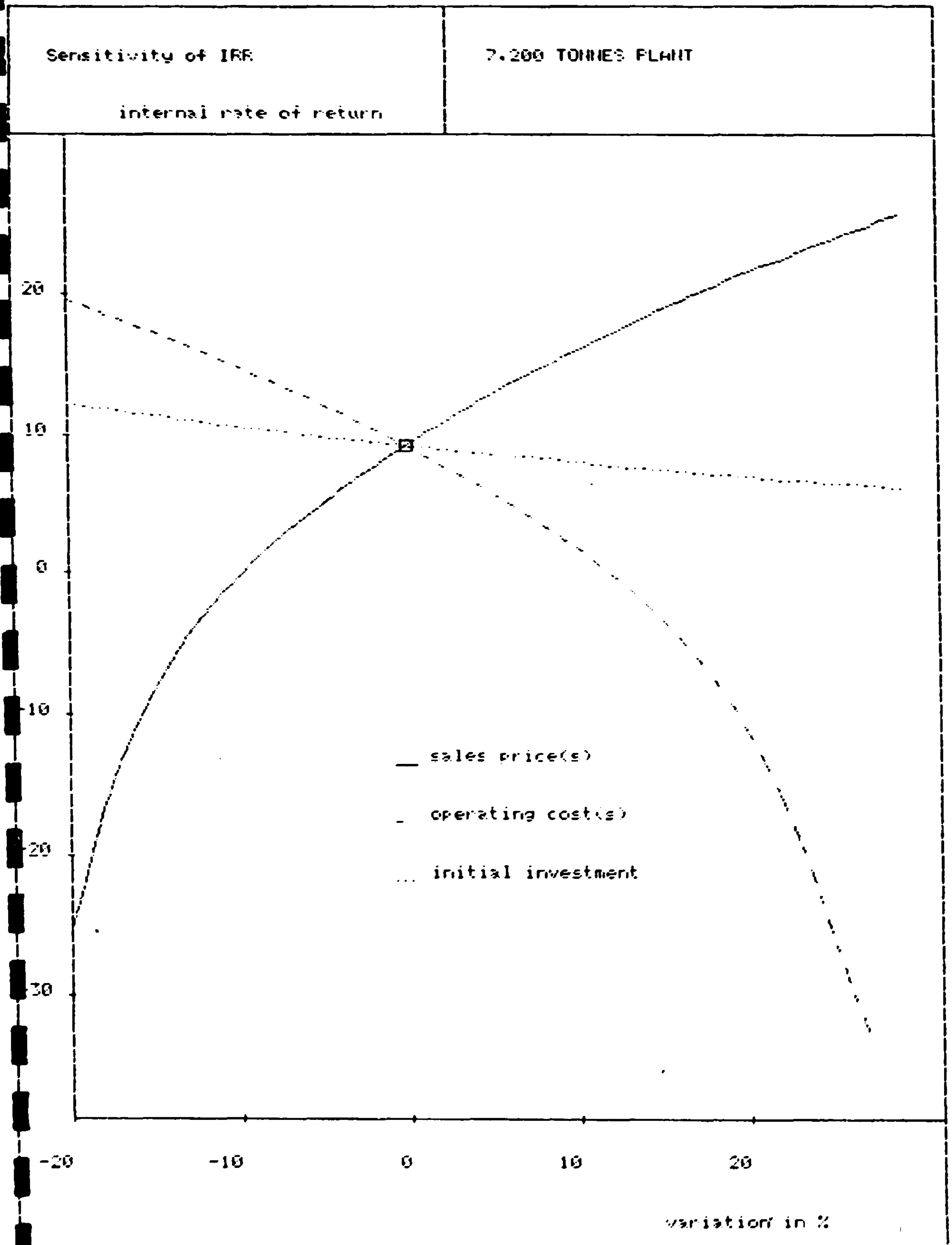

Debt-Equity Ratio, by year
7,200 TONNES PLANT
ratio in (1)
debt
equity
reserves
1.0
.5
0
-0.5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Start up
year

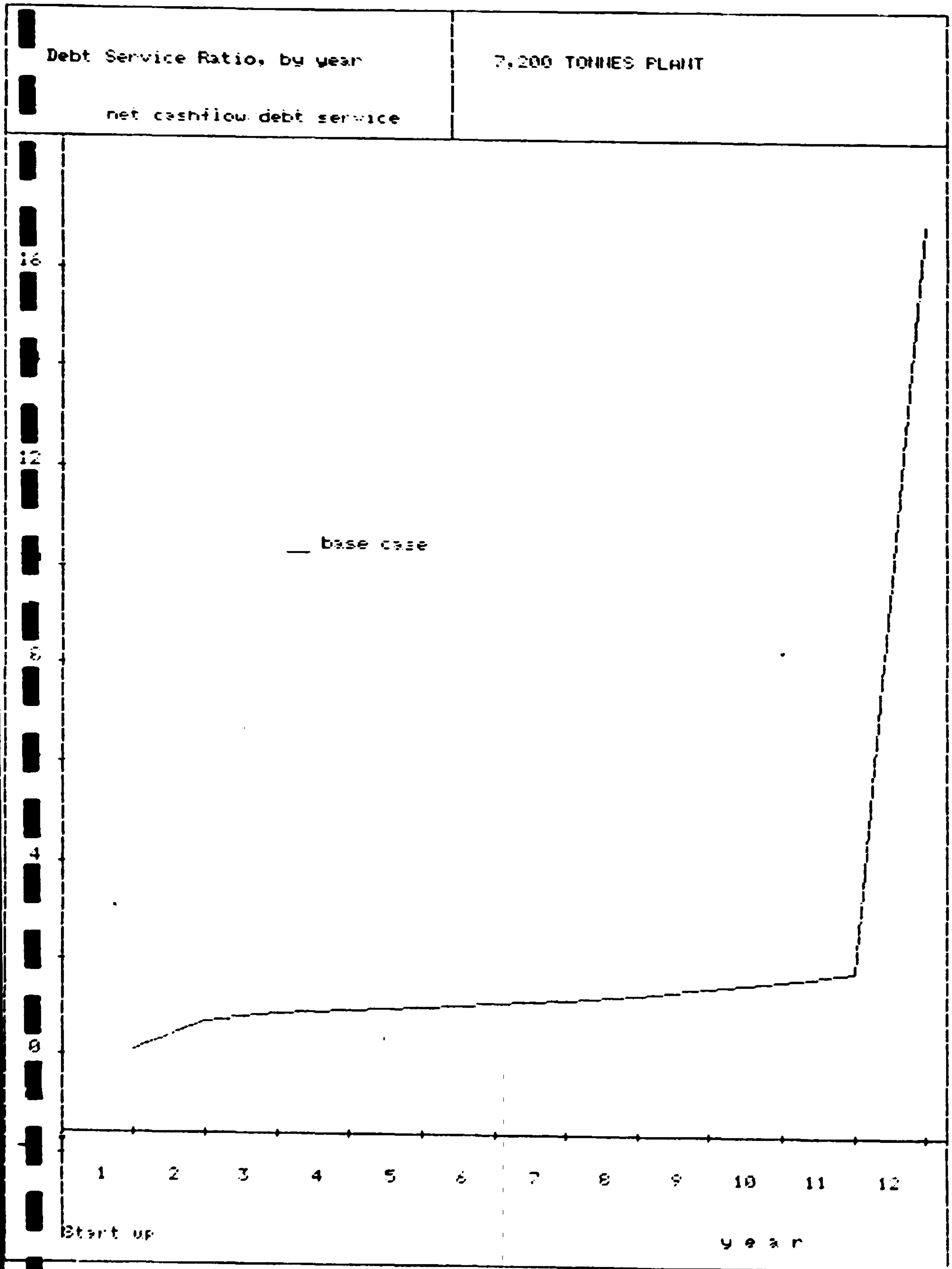

Net Profit / Total Sales
ratio in (%)
7.200 TONNES PLANT
15
10
5
0
-5
__ base case
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Start up
year


Break even chart incl. finance
7.200 TONNES PLANT
for 6th production year
annual sales
total costs
fixed costs
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0
10
20
30
40
50
60
70
80
90
capacity utilization (%)

-------------COMFAR 2.1 - UNIDO FEASIBILITY STUDIES BRANCH, D-1370,VIENNA -----




Sensitivity of IRR
internal rate of return
7.200 TONNES PLANT
20
10
0
-10
-20
-30
sales price(s)
operating cost(s)
initial investment
-20
-10
0
10
20
variation in %


Debt Service Ratio, by year
net cashflow debt service
7,200 TONNES PLANT
16
12
8
4
0
__ base case
1
2
3
4
5
6
7
8
9
10
11
12
Start up
y e a r

COMFAR 2.1 UNIDO

CHROME TANNING SALTS PLANT, ZIMBABWE
28 SEP 89, by MPDC Priv.Ltd.,BANGALORE
7,200 TONNES PLANT, basic version

3 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: '000 Z $

Total initial investment during construction phase

fixed assets:	21756.56	13.290 % foreign
current assets:	430.00	0.000 % foreign
total assets:	22186.56	13.033 % foreign

Source of funds during construction phase

equity & grants:	8884.70	0.000 % foreign
foreign loans :	0.00	
local loans :	13302.00	
total funds :	22186.70	0.000 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	11498.27	12849.32	13201.81
depreciation :	2014.41	2014.41	2014.41
interest :	2308.92	2308.92	2096.09
production costs	15821.59	17172.65	17312.30
thereof foreign	26.01 %	28.28 %	29.16 %
total sales :	13019.42	15597.30	16270.05
gross income :	-2802.17	-1575.35	-1042.25
net income :	-2802.17	-1575.35	-1042.25
cash balance :	-786.79	-1058.60	-401.74
net cashflow :	232.13	2580.52	3024.55

Net Present Value at: 10.00 % -1015.95
Internal Rate of Return: 9.23 %
Return on equity1: -3.42 %
Return on equity2: 1.36 %

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

Total Initial Investment in '000 Z $

Year	1990	1991	1992
Fixed investment costs			
Land, site preparation, development	100.000	0.000	0.000
Buildings and civil works	600.000	2500.000	0.000
Auxiliary and service facilities	1276.000	1914.000	0.000
Incorporated fixed assets	750.000	525.000	225.000
Plant machinery and equipment	4000.000	6000.000	0.000
Total fixed investment costs	6726.000	10939.000	225.000
Pre-production capital expenditures.	355.040	1401.200	2110.320
Net working capital	0.000	0.000	430.000
Total initial investment costs	7081.040	12340.200	2765.320
Of it foreign, in %	18.735	10.858	8.136

Total Current Investment in '000 Z $

Year	1993	1994	1995
Fixed investment costs			
Land, site preparation, development	0.000	0.000	0.000
Buildings and civil works	0.000	0.000	0.000
Auxiliary and service facilities	0.000	0.000	0.000
Incorporated fixed assets	0.000	0.000	0.000
Plant, machinery and equipment	0.000	0.000	0.000
Total fixed investment costs	0.000	0.000	0.000
Preproduction capitals expenditures.	0.000	0.000	0.000
Working capital	1289.028	167.460	43.690
Total current investment costs	1289.028	167.460	43.690
Of it foreign, %	37.191	60.264	60.263

Total Production Costs in '000 Z $

Year	1993	1994	1995	1996	1997	1998
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000	0.000
Raw material 1	2881.349	3457.618	3607.960	3607.960	3607.960	3607.960
Other raw materials	2972.686	3567.223	3722.351	3722.351	3722.351	3722.351
Utilities	182.483	218.979	228.500	228.500	228.500	228.500
Energy	718.750	862.500	900.000	900.000	900.000	900.000
Labour, direct	3209.000	3209.000	3209.000	3209.000	3209.000	3209.000
Repair, maintenance	564.000	564.000	564.000	564.000	564.000	564.000
Spares	500.000	500.000	500.000	500.000	500.000	500.000
Factory overheads	470.000	470.000	470.000	470.000	470.000	470.000
Factory costs	11498.270	12849.320	13201.810	13201.810	13201.810	13201.810
Administrative overheads	0.000	0.000	0.000	0.000	0.000	0.000
Indir. costs, sales and distribution	0.000	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	0.000
Depreciation	2014.406	2014.406	2014.406	2014.406	2014.406	2014.406
Financial costs	2308.920	2308.920	2096.088	1883.256	1670.424	1457.592
Total production costs	15821.590	17172.650	17312.300	17099.470	16886.640	16673.810
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	26.013	28.277	29.165	29.528	29.900	30.281
Of it variable,%	42.696	47.205	48.860	49.468	50.092	50.731
Total labour	3209.000	3209.000	3209.000	3209.000	3209.000	3209.000

Total Production Costs in '000 Z $

Year	1999	2000	2001	2002	2003	2004- 7
% of nom. capacity (single product).	0.000	0.000	0.000	0.000	0.000	0.000
Raw material 1	3607.960	3607.960	3607.960	3607.960	3607.960	3607.960
Other raw materials	3722.351	3722.351	3722.351	3722.351	3722.351	3722.351
Utilities	228.500	228.500	228.500	228.500	228.500	228.500
Energy	900.000	900.000	900.000	900.000	900.000	900.000
Labour, direct	3209.000	3209.000	3209.000	3209.000	3209.000	3209.000
Repair, maintenance	564.000	564.000	564.000	564.000	564.000	564.000
Spares	500.000	500.000	500.000	500.000	500.000	500.000
Factory overheads	470.000	470.000	470.000	470.000	470.000	470.000
Factory costs	13201.810	13201.810	13201.810	13201.810	13201.810	13201.810
Administrative overheads	0.000	0.000	0.000	0.000	0.000	0.000
Indir. costs, sales and distribution	0.000	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	0.000
Depreciation	2014.406	2014.406	2014.406	2014.406	158.750	158.750
Financial costs	1244.760	1031.928	819.096	606.264	393.432	180.600
Total production costs	16460.980	16248.140	16035.310	15822.480	13753.990	13541.160
Costs per unit (single product)	0.000	0.000	0.000	0.000	0.000	0.000
Of it foreign, %	30.673	31.075	31.487	31.911	34.607	35.151
Of it variable,%	51.387	52.060	52.751	53.461	61.501	62.467
Total labour	3209.000	3209.000	3209.000	3209.000	3209.000	3209.000

Net Working Capital in '000 Z $

Year	mdc	coto	1993	1994	1995	1996-2007
Coverage	mdc	coto				
Current assets &						
Accounts receivable	30	12.0	958.189	1070.777	1100.151	1100.151
Inventory and materials	18	19.7	297.915	357.498	373.042	373.042
Energy	7	51.4	13.976	16.771	17.500	17.500
Spares	360	1.0	500.000	500.000	500.000	500.000
Work in progress	2	180.0	63.879	71.385	73.343	73.343
Finished products	10	36.0	319.396	356.926	366.717	366.717
Cash in hand	1	360.0	12.828	12.828	12.828	12.828
Total current assets			2166.183	2386.184	2443.582	2443.582
Current liabilities and						
Accounts payable	14	25.7	447.155	499.696	513.404	513.404
Net working capital			1719.028	1886.488	1930.178	1930.178
Increase in working capital			1289.028	167.460	43.690	0.000
Net working capital, local			1079.712	1146.253	1163.614	1163.614
Net working capital, foreign			639.316	740.235	766.563	766.563

Note: mdc = minimum days of coverage ; coto = coefficient of turnover .

Source of Finance, construction in '000 Z $

Year	1990	1991	1992
Equity, ordinary ..	5143.000	1201.200	2540.500
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..	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000
Loan A, local....	1938.000	11139.000	225.000
Loan B, local....	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000
Total loan	1938.000	11139.000	225.000
Current liabilities	0.000	0.000	0.000
Bank overdraft	0.040	0.001	-0.041
Total funds	7081.040	12340.200	2765.459

Source of Finance, production in '000 Z $

Year	1993	1994	1995	1996	1997	1998	1999
Equity, ordinary ..	0.000	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	0.000
Subsidies, grants .	0.000	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	0.000
Loan B, foreign..	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Loan A, local....	0.000	-1330.200	-1330.200	-1330.200	-1330.200	-1330.200	-1330.200
Loan B, local....	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Loan C, local....	1290.000	0.000	0.000	0.000	0.000	0.000	0.000
Total loan	1290.000	-1330.200	-1330.200	-1330.200	-1330.200	-1330.200	-1330.200
Current liabilities	447.155	52.541	13.708	0.000	0.000	0.000	0.000
Bank overdraft	786.652	1058.600	401.738	145.217	-67.615	-280.447	-493.279
Total funds	2523.807	-219.059	-914.754	-1184.983	-1397.815	-1610.647	-1823.479

CHROME TANNING SALTS PLANT, ZIMBABWE --- 28 SEP 89, by MPDC Priv.Ltd.,BANGALORE

COMFAR 2.1 - UNIDO FEASIBILITY STUDIES BRANCH, D-1370,VIENNA

Source of Finance, production in '000 Z $

Year	2000	2001	2002- 3
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..	0.000	0.000	0.000
Loan C, foreign .	0.000	0.000	0.000
Loan A, local....	-1330.200	-1330.200	-1330.200
Loan B, local....	0.000	0.000	0.000
Loan C, local....	0.000	0.000	0.000
Total loan	-1330.200	-1330.200	-1330.200
Current liabilities	0.000	0.000	0.000
Bank overdraft	-706.112	-844.753	0.000
Total funds	-2036.312	-2174.953	-1330.200

CHROME TANNING SALTS PLANT, ZIMBABWE --- 28 SEP 89, by MPDC Priv.Ltd.,BANGALORE

Cashflow Tables, construction in '000 Z $

Year	1990	1991	1992
Total cash inflow . .	7081.000	12340.200	2765.500
Financial resources .	7081.000	12340.200	2765.500
Sales, net of tax . .	0.000	0.000	0.000
Total cash outflow . .	7081.040	12340.200	2765.320
Total assets	6926.000	11139.000	655.000
Operating costs . . .	0.000	0.000	0.000
Cost of finance . . .	155.040	1201.200	2110.320
Repayment	0.000	0.000	0.000
Corporate tax . . .	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	-0.040	0.000	0.180
Cumulated cash balance	-0.040	-0.040	0.140
Inflow, local	7081.000	12340.200	2765.500
Outflow, local	5754.440	11000.300	2540.320
Surplus (deficit) .	1326.560	1339.900	225.180
Inflow, foreign . . .	0.000	0.000	0.000
Outflow, foreign . . .	1326.600	1339.900	225.000
Surplus (deficit) .	-1326.600	-1339.900	-225.000
Net cashflow	-6926.000	-11139.000	-655.000
Cumulated net cashflow	-6926.000	-18065.000	-18720.000

Cashflow tables, production in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total cash inflow . .	14756.580	15649.840	16283.760	16270.050	16270.050	16270.050
Financial resources .	1737.155	52.541	13.708	0.000	0.000	0.000
Sales, net of tax . .	13019.420	15597.300	16270.050	16270.050	16270.050	16270.050
Total cash outflow . .	15543.370	16708.440	16685.490	16415.270	16202.430	15989.600
Total assets	1736.183	220.001	57.358	0.000	0.000	0.000
Operating costs . . .	11498.270	12849.320	13201.810	13201.810	13201.810	13201.810
Cost of finance . . .	2308.920	2308.920	2096.088	1883.256	1670.424	1457.592
Repayment	0.000	1330.200	1330.200	1330.200	1330.200	1330.200
Corporate tax . . .	0.000	0.000	0.000	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-786.791	-1058.603	-401.736	-145.216	67.616	280.448
Cumulated cash balance	-786.651	-1845.254	-2246.990	-2392.206	-2324.590	-2044.141
Inflow, local	4216.647	2766.052	2778.497	2772.300	2772.300	2772.300
Outflow, local	10928.770	12011.960	11871.750	11655.360	11442.520	11229.690
Surplus (deficit) .	-6712.120	-9245.906	-9113.249	-8883.056	-8670.224	-8457.392
Inflow, foreign . . .	10539.930	12883.790	13505.260	13497.750	13497.750	13497.750
Outflow, foreign . . .	4614.604	4696.485	4793.750	4759.910	4759.910	4759.910
Surplus (deficit) .	5925.329	8187.304	8711.512	8737.840	8737.840	8737.840
Net cashflow	232.128	2580.518	3024.551	3068.240	3068.240	3068.240
Cumulated net cashflow	-15487.870	-15907.350	-12882.803	-9814.563	-6746.322	-3678.082

Cashflow tables, production in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total cash inflow . .	16270.050	16270.050	16270.050	16270.050	16270.050	16270.050
Financial resources .	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax . .	16270.050	16270.050	16270.050	16270.050	16270.050	16270.050
Total cash outflow . .	15776.770	15563.940	15351.110	15138.270	14925.440	13382.410
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs . . .	13201.810	13201.810	13201.810	13201.810	13201.810	13201.810
Cost of finance . . .	1244.760	1031.928	819.096	606.264	393.432	180.600
Repayment	1330.200	1330.200	1330.200	1330.200	1330.199	0.000
Corporate tax . . .	0.000	0.000	0.000	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	493.280	706.112	918.944	1131.776	1344.609	2887.641
Cumulated cash balance	-1550.861	-844.749	74.196	1205.972	2550.581	5438.222
Inflow, local	2772.300	2772.300	2772.300	2772.300	2772.300	2772.300
Outflow, local	11016.860	10804.030	10591.200	10378.360	10165.530	8622.499
Surplus (deficit) .	-8244.560	-8031.728	-7818.896	-7606.063	-7393.230	-5850.199
Inflow, foreign . . .	13497.750	13497.750	13497.750	13497.750	13497.750	13497.750
Outflow, foreign . . .	4759.910	4759.910	4759.910	4759.910	4759.910	4759.910
Surplus (deficit) .	8737.840	8737.840	8737.840	8737.840	8737.840	8737.840
Net cashflow	3068.240	3068.240	3068.240	3068.240	3068.240	3068.240
Cumulated net cashflow	-609.842	2458.398	5526.639	8594.879	11663.120	14731.360

Cashflow tables, production in '000 Z $

Year	2005	2006	2007
Total cash inflow . .	16270.050	16270.050	16270.050
Financial resources .	0.000	0.000	0.000
Sales, net of tax . .	16270.050	16270.050	16270.050
Total cash outflow . .	13991.200	14746.850	14746.850
Total assets	0.000	0.000	0.000
Operating costs . . .	13201.810	13201.810	13201.810
Cost of finance . . .	180.600	180.500	180.600
Repayment	0.000	0.000	0.000
Corporate tax . . .	608.790	1364.445	1364.445
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	2278.851	1523.196	1523.196
Cumulated cash balance	7717.072	9240.269	10763.460
Inflow, local	2772.300	2772.300	2772.300
Outflow, local	9231.287	9986.943	9986.943
Surplus (deficit) .	-6458.989	-7214.644	-7214.644
Inflow, foreign . . .	13497.750	13497.750	13497.750
Outflow, foreign . . .	4759.910	4759.910	4759.910
Surplus (deficit) .	8737.840	8737.840	8737.840
Net cashflow	2459.450	1703.795	1703.795
Cumulated net cashflow	17190.810	18894.600	20598.400

CHROME TANNING SALTS PLANT, ZIMBABWE --- 28 SEP 89, by MFDC Priv.Ltd., BANGALORE

Net Income Statement in 000 Z $

Year	1993	1994	1995	1996	1997	1998
Total sales, incl. sales tax	13019.420	15597.300	16270.050	16270.050	16270.050	16270.050
Less: variable costs, incl. sales tax.	6755.267	8106.321	8458.811	8458.811	8458.811	8458.811
Variable margin	6264.158	7490.979	7811.239	7811.239	7811.239	7811.239
As % of total sales	48.114	48.027	48.010	48.010	48.010	48.010
Non-variable costs, incl. depreciation	6757.406	6757.406	6757.406	6757.406	6757.406	6757.406
Operational margin	-493.249	733.573	1053.833	1053.833	1053.833	1053.833
As % of total sales	-3.789	4.703	6.477	6.477	6.477	6.477
Cost of finance	2308.920	2308.920	2096.088	1883.256	1670.424	1457.592
Gross profit	-2802.168	-1575.347	-1042.255	-829.423	-616.591	-403.759
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	0.000	0.000	0.000	0.000	0.000
Tax	0.000	0.000	0.000	0.000	0.000	0.000
Net profit	-2802.168	-1575.347	-1042.255	-829.423	-616.591	-403.759
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-2802.168	-1575.347	-1042.255	-829.423	-616.591	-403.759
Accumulated undistributed profit	-2802.168	-4377.515	-5419.770	-6249.192	-6865.783	-7269.542
Gross profit, % of total sales	-21.523	-10.100	-6.406	-5.098	-3.790	-2.482
Net profit, % of total sales	-21.523	-10.100	-6.406	-5.098	-3.790	-2.482
ROE, Net profit, % of equity	-31.539	-17.731	-11.731	-9.335	-6.940	-4.544
ROI, Net profit+interest, % of invest.	-2.465	3.536	5.212	5.212	5.212	5.212

CHROME TANNING SALTS PLANT, ZIMBABWE --- 28 SEP 89, by MFDC Priv.Ltd.,BANGALORE

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-10461.79	at	10.00 %
Internal Rate of Return (IRRE1) ..	-3.42 %		

b) Net Worth versus Net cash return:

Net present value	-6291.84	at	10.00 %
Internal Rate of Return (IRRE2) ..	1.36 %		

c) Internal Rate of Return on total investment:

Net present value	-1015.95	at	10.00 %
Internal Rate of Return (IRR) ..	9.23 %		

Net Worth = Equity paid plus reserves

Net Income Statement in 1000 Z$

Year	1999	2000	2001	2002	2003	2004
Total sales, incl. sales tax	16270.050	16270.050	16270.050	16270.050	16270.050	16270.050
Less: variable costs, incl. sales tax.	8458.311	8458.811	8458.811	8458.811	8458.811	8458.811
Variable margin	7811.239	7811.239	7811.239	7811.239	7811.239	7811.239
As % of total sales	48.010	48.010	48.010	48.010	48.010	48.010
Non-variable costs, incl. depreciation	6757.406	6757.406	6757.406	6757.406	4901.750	4901.750
Operational margin	1053.833	1053.533	1053.833	1053.833	2909.489	2909.490
As % of total sales	6.477	6.477	6.477	6.477	17.882	17.882
Cost of finance	1244.760	1031.928	819.096	606.264	393.432	180.600
Gross profit	-190.927	21.905	234.737	447.569	2516.058	2728.890
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	0.000	0.000	0.000	0.000	0.000
Tax	0.000	0.000	0.000	0.000	0.000	0.000
Net profit	-190.927	21.905	234.737	447.569	2516.058	2728.890
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-190.927	21.905	234.737	447.569	2516.058	2728.890
Accumulated undistributed profit	-7460.467	-7438.563	-7203.826	-6756.257	-4240.199	-1511.310
Gross profit, % of total sales	-1.173	0.135	1.443	2.751	15.464	16.772
Net profit, % of total sales	-1.173	0.135	1.443	2.751	15.464	16.772
ROE, Net profit, % of equity	-2.149	0.247	2.642	5.038	28.319	30.714
ROI, Net profit+interest, % of invest.	5.212	5.212	5.212	5.212	14.389	14.389

Net Income Statement in 000 Z $

Year	2005	2006	2007
Total sales, incl. sales tax	16270.050	16270.050	16270.050
Less: variable costs, incl. sales tax.	8458.811	8458.811	8458.811
Variable margin	7811.239	7811.239	7811.239
As % of total sales	48.010	48.010	48.010
Non-variable costs, incl. depreciation	4901.750	4901.750	4901.750
Operational margin	2909.490	2909.490	2909.490
As % of total sales	17.882	17.882	17.882
Cost of finance	180.600	180.600	180.600
Gross profit	2728.890	2728.890	2728.890
Allowances	0.000	0.000	0.000
Taxable profit	1217.580	2728.890	2728.890
Tax	608.790	1364.445	1364.445
Net profit	2120.100	1364.445	1364.445
Dividends paid	0.000	0.000	0.000
Undistributed profit	2120.100	1364.445	1364.445
Accumulated undistributed profit	608.790	1973.235	3337.680
Gross profit, % of total sales	16.772	16.772	16.772
Net profit, % total sales	13.031	8.386	8.386
ROE, Net profit, % of equity	23.862	15.357	15.357
ROI, Net profit+interest, % of invest.	11.378	7.641	7.641

Projected Balance Sheets, construction in '000 Z $

Year	1990	1991	1992
Total assets	7081.040	19421.240	22186.700
Fixed assets, net of depreciation	0.000	7081.040	19421.240
Construction in progress	7081.040	12340.200	2335.320
Current assets	0.000	0.000	430.000
Cash, bank	0.000	0.000	0.000
Cash surplus, finance available	0.000	0.000	0.139
Loss carried forward	0.000	0.000	0.000
Loss	0.000	0.000	0.000
Total liabilities	7081.040	19421.240	22186.700
Equity capital	5143.000	6344.200	8884.700
Reserves, retained profit	0.000	0.000	0.000
Profit	0.000	0.000	0.000
Long and medium term debt	1938.000	13077.000	13302.000
Current liabilities	0.000	0.000	0.000
Bank overdraft, finance required.	0.040	0.041	0.000
Total debt	1938.040	13077.040	13302.000
Equity, % of liabilities	72.631	32.666	40.045

Projected Balance Sheets, Production in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total assets	24710.510	24491.450	23576.690	22391.710	20993.890	19383.250
Fixed assets, net of depreciation	19742.150	17727.750	15713.340	13698.940	11684.530	9670.123
Construction in progress	0.000	0.000	0.000	0.000	0.000	0.000
Current assets	2153.355	2373.356	2430.754	2430.754	2430.754	2430.754
Cash, bank	12.828	12.828	12.828	12.828	12.828	12.828
Cash surplus, finance available	0.000	0.000	0.000	0.000	0.000	0.000
Loss carried forward	0.000	2802.168	4377.515	5419.770	6249.192	6865.783
Loss	2802.168	1575.347	1042.255	829.423	616.591	403.759
Total liabilities	24710.510	24491.450	23576.690	22391.710	20993.890	19383.250
Equity capital	8884.700	8884.700	8884.700	8884.700	8884.700	8884.700
Reserves, retained profit	0.000	0.000	0.000	0.000	0.000	0.000
Profit	0.000	0.000	0.000	0.000	0.000	0.000
Long and medium term debt	14592.000	13261.800	11931.600	10601.400	9271.199	7940.999
Current liabilities	447.155	499.696	513.404	513.404	513.404	513.404
Bank overdraft, finance required.	786.652	1845.250	2246.986	2392.207	2324.592	2044.143
Total debt	15825.810	15606.750	14691.990	13507.010	12109.200	10498.540
Equity, Z of liabilities	35.955	36.277	37.684	39.679	42.320	45.837

COMFAR 2.1 - UNIDO FEASIBILITY STUDIES BRANCH, D-1370, VIENNA

Projected Balance Sheets, Production in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total assets	17559.770	15545.360	13583.240	12465.870	13204.160	13416.990
Fixed assets, net of depreciation	7655.717	5641.311	3626.905	1612.499	1453.749	1294.999
Construction in progress	0.000	0.000	0.000	0.000	0.000	0.000
Current assets	2430.754	2430.754	2430.754	2430.754	2430.754	2430.754
Cash, bank	12.828	12.828	12.828	12.828	12.828	12.828
Cash surplus, finance available	0.000	0.000	74.191	1205.967	2550.575	5438.215
Loss carried forward	7269.542	7460.469	7438.563	7203.826	6756.257	4240.199
Loss	190.927	0.000	0.000	0.000	0.000	0.000
Total liabilities	17559.770	15545.360	13583.240	12465.870	13204.160	13416.990
Equity capital	8884.700	8884.700	8884.700	8884.700	8884.700	8884.700
Reserves, retained profit	0.000	0.000	0.000	0.000	0.000	0.000
Profit	0.000	21.905	234.737	447.569	2516.058	2728.890
Long and medium term debt	6610.799	5280.599	3950.399	2620.199	1290.000	1290.000
Current liabilities	513.404	513.404	513.404	513.404	513.404	513.404
Bank overdraft, finance required.	1550.863	844.754	0.000	0.000	0.000	0.000
Total debt	8675.066	6638.756	4463.803	3133.603	1803.404	1803.404
Equity, Z of liabilities	50.597	57.153	65.409	71.272	67.287	66.220

CHROME TANNING SALTS PLANT, ZIMBABWE --- 28 SEP 89, by MPDC Priv.Ltd., BANGALORE

COMFAR 21 UNIDO

COMFAR 2.1 - UNIDO FEASIBILITY STUDIES BRANCH, D-1370,VIENNA

Projected Balance Sheets, Production in '000 Z $

Year	2005	2006	2007
Total assets	12808.200	12661.340	14025.790
Fixed assets, net of depreciation	1136.249	977.499	818.749
Construction in progress	0.000	0.000	0.000
Current assets	2430.754	2430.754	2430.754
Cash, bank	12.828	12.828	12.828
Cash surplus, finance available	7717.063	9240.260	10763.460
Loss carried forward	1511.310	0.000	0.000
[illegible]	0.000	0.000	0.000
Total liabilities	12808.200	12661.340	14025.790
Equity capital	8884.700	8884.700	8884.700
Reserves, retained profit	0.000	608.790	1973.235
Profit	2120.100	1364.445	1364.445
Long and medium term debt	1290.000	1290.000	1290.000
Current liabilities	513.404	513.404	513.404
Bank overdraft, finance required.	0.000	0.000	0.000
Total debt	1803.404	1803.404	1803.404
Equity, % of liabilities	69.367	70.172	63.345

CHROME TANNING SALTS PLANT, ZIMBABWE --- 28 SEP 89, by MPDC Priv.Ltd.,BANGALORE

CHROME TANNING SALTS PLANT, ZIMBABWE
28 SEP 89, by MFDC Priv.Ltd.,BANGALORE
11,500 T PLANT,for. r.m. without duties

3 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: '000 Z $

Total initial investment during construction phase

fixed assets:	27524.16	12.231 % foreign
current assets:	410.00	0.000 % foreign
total assets:	27934.16	12.052 % foreign

Source of funds during construction phase

equity & grants:	11051.00	0.000 % foreign
foreign loans :	0.00	
local loans :	16884.00	
total funds :	27935.00	0.000 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	10237.58	11336.50	12435.41
depreciation :	2570.92	2570.92	2570.92
interest :	2873.64	2873.64	2603.50
production costs	15682.14	16781.05	17609.82
thereof foreign	22.59 %	24.79 %	27.12 %
total sales :	13019.42	15597.30	18175.18
gross income :	-2662.71	-1183.75	565.35
net income :	-2662.71	-1183.75	565.35
cash balance :	-8.84	-436.30	1312.80
net cashflow :	1634.80	4125.74	5604.70

Net Present Value at: 10.00 % = 15267.12
Internal Rate of Return: 17.64 %
Return on equity1: 12.76 %
Return on equity2: 17.30 %

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Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Cashflow Tables, construction in '000 Z $

Year	1990	1991	1992
Total cash inflow . .	8970.000	15646.000	3319.000
Financial resources .	8970.000	15646.000	3319.000
Sales, net of tax . .	0.000	0.000	0.000
Total cash outflow . .	8970.000	15645.720	3318.440
Total assets	8766.000	14109.000	635.000
Operating costs . . .	0.000	0.000	0.000
Cost of finance . . .	204.000	1536.720	2683.440
Repayment	0.000	0.000	0.000
Corporate tax . . .	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	0.000	0.280	0.560
Cumulated cash balance	0.000	0.280	0.840
Inflow, local	8970.000	15646.000	3319.000
Outflow, local	7453.400	14020.820	3093.440
Surplus (deficit) .	1516.600	1625.181	225.560
Inflow, foreign . . .	0.000	0.000	0.000
Outflow, foreign . . .	1516.600	1624.900	225.000
Surplus (deficit) .	-1516.600	-1624.900	-225.000
Net cashflow	-8766.000	-14109.000	-635.000
Cumulated net cashflow	-8766.000	-22875.000	-23510.000

Cashflow tables, production in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total cash inflow . .	14647.550	15640.040	18217.910	20795.790	23373.660	25951.540
Financial resources .	1628.128	42.736	42.736	42.736	42.736	42.736
Sales, net of tax . .	13019.420	15597.300	18175.180	20753.050	23330.930	25908.800
Total cash outflow . .	14656.390	16076.330	16905.110	17733.880	18562.650	20374.520
Total assets	1545.172	177.799	177.799	177.799	177.799	177.799
Operating costs . . .	10237.580	11336.500	12435.420	13534.330	14633.250	15732.160
Cost of finance . . .	2873.640	2873.640	2603.496	2333.352	2063.208	1793.064
Repayment	0.000	1688.400	1688.400	1688.400	1688.400	1688.400
Corporate tax . . .	0.000	0.000	0.000	0.000	0.000	983.098
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-8.840	-436.300	1312.803	3061.906	4811.008	5577.014
Cumulated cash balance	-8.000	-444.299	868.503	3930.410	8741.418	14318.430
Inflow, local	4131.736	2761.070	2875.070	2989.070	3103.070	3217.070
Outflow, local	10780.320	12147.680	12360.180	12572.680	12785.180	13980.780
Surplus (deficit) .	-6648.580	-9386.606	-9485.108	-9583.608	-9682.109	-10763.710
Inflow, foreign . . .	10515.820	12878.970	15342.840	17806.720	20270.590	22734.470
Outflow, foreign . . .	3876.076	3928.659	4544.933	5161.204	5777.476	6393.749
Surplus (deficit) .	6639.740	8950.307	10797.910	12645.510	14493.120	16340.720
Net cashflow	1634.800	4125.741	5604.698	7083.657	8562.615	9058.476
Cumulated net cashflow	-21875.200	-17749.460	-12144.760	-5061.105	3501.510	12559.990

Cashflow tables, production in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total cash inflow	25908.800	25908.800	25908.800	25908.800	25908.800	25908.800
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	25908.800	25908.800	25908.800	25908.800	25908.800	25908.800
Total cash outflow	21984.880	21849.810	21714.740	21579.670	22640.550	20817.080
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	15732.160	15732.160	15732.160	15732.160	15732.160	15732.160
Cost of finance	1522.920	1252.776	982.632	712.488	442.344	172.200
Repayment	1688.400	1688.400	1688.400	1688.400	1688.398	0.000
Corporate tax	3041.401	3176.474	3311.545	3446.617	4777.647	4912.719
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	3923.918	4058.988	4194.061	4329.133	3268.246	5091.719
Cumulated cash balance	18242.350	22301.340	26495.400	30824.530	34092.780	39184.500
Inflow, local	3198.300	3198.300	3198.300	3198.300	3198.300	3198.300
Outflow, local	15697.160	15562.090	15427.020	15291.950	16352.830	14529.360
Surplus (deficit)	-12498.860	-12363.790	-12228.720	-12093.650	-13154.530	-11331.060
Inflow, foreign	22710.500	22710.500	22710.500	22710.500	22710.500	22710.500
Outflow, foreign	6287.723	6287.723	6287.723	6287.723	6287.723	6287.723
Surplus (deficit)	16422.780	16422.780	16422.780	16422.780	16422.780	16422.780
Net cashflow	7135.236	7000.164	6865.093	6730.021	5398.990	5263.919
Cumulated net cashflow	19695.220	26695.390	33560.480	40290.500	45689.490	50953.410

Cashflow tables, production in '000 Z $

Year	2005	2006	2007
Total cash inflow	25908.800	25908.800	25908.800
Financial resources	0.000	0.000	0.000
Sales, net of tax	25908.800	25908.800	25908.800
Total cash outflow	20817.080	20817.080	20817.080
Total assets	0.000	0.000	0.000
Operating costs	15732.160	15732.160	15732.160
Cost of finance	172.200	172.200	172.200
Repayment	0.000	0.000	0.000
Corporate tax	4912.719	4912.719	4912.719
Dividends paid	0.000	0.000	0.000
Surplus (deficit)	5091.719	5091.719	5091.719
Cumulated cash balance	44276.210	49367.930	54459.650
Inflow, local	3198.300	3198.300	3198.300
Outflow, local	14529.360	14529.360	14529.360
Surplus (deficit)	-11331.060	-11331.060	-11331.060
Inflow, foreign	22710.500	22710.500	22710.500
Outflow, foreign	6287.723	6287.723	6287.723
Surplus (deficit)	16422.780	16422.780	16422.780
Net cashflow	5263.919	5263.919	5263.919
Cumulated net cashflow	56217.330	61481.250	66745.160

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	3480.56	at	10.00 %
Internal Rate of Return (IRRE1) ..	12.76 %		

b) Net Worth versus Net cash return:

Net present value	8759.95	at	10.00 %
Internal Rate of Return (IRRE2) ..	17.30 %		

c) Internal Rate of Return on total investment:

Net present value	15267.12	at	10.00 %
Internal Rate of Return (IRR) ..	17.64 %		

Net Worth = Equity paid plus reserves

Net Income S[illegible]ment in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total sales, incl. sales tax	13019.420	15597.300	18175.180	20753.050	23330.930	25908.800
Less: variable costs, incl. sales tax.	5494.581	6593.498	7692.414	8791.330	9890.246	10989.160
Variable margin	7524.844	9003.803	10482.760	11961.720	13440.680	14919.640
As % of total sales	57.797	57.727	57.676	57.638	57.609	57.585
Non-variable costs, incl. depreciation	7313.915	7313.915	7313.914	7313.916	7313.915	7313.915
Operational margin	210.929	1689.888	3168.848	4647.805	6126.765	7605.724
As % of total sales	1.620	10.834	17.435	22.396	26.260	29.356
Cost of finance	2873.640	2873.640	2603.496	2333.352	2063.208	1793.064
Gross profit	-2662.711	-1183.753	565.352	2314.453	4063.557	5812.660
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	0.000	565.352	2314.453	4063.557	1966.196
Tax	0.000	0.000	0.000	0.000	0.000	983.098
Net profit	-2662.711	-1183.753	565.352	2314.453	4063.557	4829.562
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-2662.711	-1183.753	565.352	2314.453	4063.557	4829.562
Accumulated undistributed profit	-2662.711	-3846.464	-3281.112	-966.659	3096.897	7926.459
Gross profit, % of total sales	-20.452	-7.589	3.111	11.152	17.417	22.435
Net profit, % of total sales	-20.452	-7.589	3.111	11.152	17.417	18.641
ROE, Net profit, % of equity	-24.095	-10.712	5.116	20.943	36.771	43.702
ROI, Net profit+interest, % of invest.	0.855	6.816	12.712	18.545	24.315	26.143

Net Income Statement in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total sales, incl. sales tax	25908.800	25908.800	25908.800	25908.800	25908.800	25908.800
Less: variable costs, incl. sales tax.	10989.160	10989.160	10989.160	10989.160	10989.160	10989.160
Variable margin	14919.640	14919.640	14919.640	14919.640	14919.640	14919.640
As % of total sales	57.585	57.585	57.585	57.585	57.585	57.585
Non-variable costs, incl. depreciation	7313.916	7313.916	7313.917	7313.917	4922.000	4922.001
Operational margin	7605.723	7605.723	7605.722	7605.722	9997.639	9997.638
As % of total sales	29.356	29.356	29.356	29.356	38.588	38.588
Cost of finance	1522.920	1252.776	982.632	712.488	442.344	172.200
Gross profit	6082.803	6352.947	6623.090	6893.234	9555.295	9825.438
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	6082.803	6352.947	6623.090	6893.234	9555.295	9825.438
Tax	3041.401	3176.474	3311.545	3446.617	4777.647	4912.719
Net profit	3041.401	3176.474	3311.545	3446.617	4777.647	4912.719
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	3041.401	3176.474	3311.545	3446.617	4777.647	4912.719
Accumulated undistributed profit	10967.860	14144.330	17455.880	20902.500	25680.140	30592.860
Gross profit, % of total sales	23.478	24.520	25.563	26.606	36.881	37.923
Net profit, % of total sales	11.739	12.260	12.782	13.303	18.440	18.962
ROE, Net profit, % of equity	27.522	28.744	29.966	31.188	43.233	44.455
ROI, Net profit+interest, % of invest.	18.018	17.485	16.951	16.418	20.606	20.073

CHROME TANNING SALTS PLANT, ZIMBABWE --- 28 SEP 89, by MPDC Priv.Ltd.,BANGALORE

Net Income Statement in '000 Z $

Year	2005	2006	2007
Total sales, incl. sales tax	25908.800	25908.800	25908.800
Less: variable costs, incl. sales tax.	10989.160	10989.160	10989.160
Variable margin	14919.640	14919.640	14919.640
As % of total sales	57.585	57.585	57.585
Non-variable costs, incl. depreciation	4922.001	4922.001	4922.001
Operational margin	9997.638	9997.638	9997.638
As % of total sales	38.588	38.588	38.588
Cost of finance	172.200	172.200	172.200
Gross profit	9825.438	9825.438	9825.438
Allowances	0.000	0.000	0.000
Taxable profit	9825.438	9825.438	9825.438
Tax	4912.719	4912.719	4912.719
Net profit	4912.719	4912.719	4912.719
Dividends paid	0.000	0.000	0.000
Undistributed profit	4912.719	4912.719	4912.719
Accumulated undistributed profit	35505.580	40418.300	45331.020
Gross profit, % of total sales	37.923	37.923	37.923
Net profit, % of total sales	18.962	18.962	18.962
ROE, Net profit, % of equity	44.455	44.455	44.455
ROI, Net profit+interest, % of invest.	20.073	20.073	20.073

CHROME TANNING SALTS PLANT, ZIMBABWE
28 SEP 89, by MPDC Priv.Ltd.,BANGALORE
7,200 T PLANT,for.raw.mat.without duties

3 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: '000 Z $

Total initial investment during construction phase

fixed assets:	21756.56	13.290 % foreign
current assets:	430.00	0.000 % foreign
total assets:	22186.56	13.033 % foreign

Source of funds during construction phase

equity & grants:	8584.70	0.000 % foreign
foreign loans :	0.00	
local loans :	13302.00	
total funds :	22186.70	0.000 % foreign

Cashflow from operations

year:	1	2	3
operating costs:	10821.36	12037.03	12354.21
depreciation :	2014.41	2014.41	2014.41
interest :	2308.92	2308.92	2096.07
production costs	15144.69	16360.36	16464.70
thereof foreign	22.71 %	24.72 %	25.52 %
total sales :	13019.42	15597.30	16270.05
gross income :	-2125.26	-763.06	-194.65
net income :	-2125.26	-763.06	-194.65
cash balance :	-16.06	-227.55	450.76
net cashflow :	1002.86	3411.57	3877.05

Net Present Value at: 10.00 % = 2606.99
Internal Rate of Return: 12.00 %
Return on equity1: 0.56 %
Return on equity2: 6.11 %

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Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Cashflow Tables, construction in '000 Z $

Year	1990	1991	1992
Total cash inflow . .	7081.000	12340.200	2765.500
Financial resources .	7081.000	12340.200	2765.500
Sales, net of tax . .	0.000	0.000	0.000
Total cash outflow . .	7081.040	12340.200	2765.320
Total assets	6926.000	11139.000	655.000
Operating costs . . .	0.000	0.000	0.000
Cost of finance . . .	155.040	1201.200	2110.320
Repayment	0.000	0.000	0.000
Corporate tax . . .	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	-0.040	0.000	0.180
Cumulated cash balance	-0.040	-0.040	0.140
Inflow, local	7081.000	12340.200	2765.500
Outflow, local	5754.440	11000.300	2540.320
Surplus (deficit) .	1326.560	1339.900	225.180
Inflow, foreign . . .	0.000	0.000	0.000
Outflow, foreign . . .	1326.600	1339.900	225.000
Surplus (deficit) .	-1326.600	-1339.900	-225.000
Net cashflow	-6926.000	-11139.000	-655.000
Cumulated net cashflow	-6926.000	-18065.000	-18720.000

Cashflow tables, production in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total cash inflow . .	14730.260	15644.580	16282.380	16270.050	16270.050	16270.050
Financial resources .	1710.831	47.276	12.334	0.000	0.000	0.000
Sales, net of tax . .	13019.420	15597.300	16270.050	16270.050	16270.050	16270.050
Total cash outflow . .	14746.310	15872.120	15831.620	15567.660	15354.830	15142.000
Total assets	1616.033	195.971	51.129	0.000	0.000	0.000
Operating costs . . .	10821.360	12037.030	12354.210	12354.210	12354.210	12354.210
Cost of finance . . .	2308.920	2308.920	2096.088	1883.256	1670.424	1457.592
Repayment	0.000	1330.200	1330.200	1330.200	1330.200	1330.200
Corporate tax . . .	0.000	0.000	0.000	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-16.059	-227.548	450.762	702.389	915.221	1128.053
Cumulated cash balance	-15.919	-243.467	207.295	909.684	1824.905	2952.957
Inflow, local	4216.647	2766.052	2778.497	2772.300	2772.300	2772.300
Outflow, local	10928.770	12011.960	11891.750	11655.360	11442.520	11229.690
Surplus (deficit) .	-6712.119	-9245.906	-9113.250	-8883.057	-8670.225	-8457.393
Inflow, foreign . . .	10513.610	12878.520	13503.890	13497.750	13497.750	13497.750
Outflow, foreign . . .	3817.548	3860.167	3939.875	3912.305	3912.305	3912.305
Surplus (deficit) .	6696.061	9018.357	9564.013	9585.445	9585.445	9585.445
Net cashflow	1002.861	3411.572	3877.050	3915.845	3915.845	3915.845
Cumulated net cashflow	-17717.140	-14305.570	-10428.520	-6512.671	-2596.826	1319.019

Cashflow tables, production in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total cash inflow	16270.050	16270.050	16270.050	16270.050	16270.050	16270.050
Financial resources	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax	16270.050	16270.050	16270.050	16270.050	16270.050	16270.050
Total cash outflow	14929.170	14716.330	14503.500	14922.960	15759.670	14323.050
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs	12354.210	12354.210	12354.210	12354.210	12354.210	12354.210
Cost of finance	1244.760	1031.928	819.096	606.264	393.432	180.600
Repayment	1330.200	1330.200	1330.200	1330.200	1330.199	0.000
Corporate tax	0.000	0.000	0.000	632.294	1681.832	1788.248
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit)	1340.885	1553.717	1766.549	1347.087	510.382	1946.997
Cumulated cash balance	4293.842	5847.559	7614.107	8961.194	9471.576	11418.570
Inflow, local	2772.300	2772.300	2772.300	2772.300	2772.300	2772.300
Outflow, local	11016.860	10804.030	10591.200	11010.660	11847.360	10410.750
Surplus (deficit)	-8244.561	-8031.729	-7818.896	-8238.358	-9075.063	-7638.448
Inflow, foreign	13497.750	13497.750	13497.750	13497.750	13497.750	13497.750
Outflow, foreign	3912.305	3912.305	3912.305	3912.305	3912.305	3912.305
Surplus (deficit)	9585.445	9585.445	9585.445	9585.445	9585.445	9585.445
Net cashflow	3915.845	3915.845	3915.845	3283.551	2234.013	2127.597
Cumulated net cashflow	5234.863	9150.708	13065.550	16350.100	18584.120	20711.710

Cashflow tables, production in '000 Z $

Year	2005	2006	2007
Total cash inflow . .	16270.050	16270.050	16270.050
Financial resources .	0.000	0.000	0.000
Sales, net of tax . .	16270.050	16270.050	16270.050
Total cash outflow . .	14323.050	14323.050	14323.050
Total assets	0.000	0.000	0.000
Operating costs . . .	12354.210	12354.210	12354.210
Cost of finance . . .	180.600	180.600	180.600
Repayment	0.000	0.000	0.000
Corporate tax . . .	1788.248	1788.248	1788.248
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	1946.997	1946.997	1946.997
Cumulated cash balance	13365.570	15312.570	17259.560
Inflow, local	2772.300	2772.300	2772.300
Outflow, local	10410.750	10410.750	10410.750
Surplus (deficit) .	-7638.448	-7638.448	-7638.448
Inflow, foreign . . .	13497.750	13497.750	13497.750
Outflow, foreign . . .	3912.305	3912.305	3912.305
Surplus (deficit) .	9585.445	9585.445	9585.445
Net cashflow	2127.597	2127.597	2127.597
Cumulated net cashflow	22837.310	24966.910	27094.510

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	-6904.07	at	10.00 %
Internal Rate of Return (IRRE1) ..	0.56 %		

b) Net Worth versus Net cash return:

Net present value	-2668.93	at	10.00 %
Internal Rate of Return (IRRE2) ..	6.11 %		

c) Internal Rate of Return on total investment:

Net present value	2606.99	at	10.00 %
Internal Rate of Return (IRR) ..	12.00 %		

Net Worth = Equity paid plus reserves

Net Income Statement in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total sales, incl. sales tax	13019.420	15597.300	16270.050	16270.050	16270.050	16270.050
Less: variable costs, incl. sales tax.	6078.361	7294.034	7611.205	7611.205	7611.205	7611.205
Variable margin	6941.063	8303.266	8658.845	8658.845	8658.845	8658.845
As Z of total sales	53.313	53.235	53.220	53.220	53.220	53.220
Non-variable costs, incl. depreciation	6757.405	6757.406	6757.406	6757.405	6757.405	6757.405
Operational margin	183.658	1545.859	1901.438	1901.439	1901.439	1901.439
As Z of total sales	1.411	9.911	11.687	11.687	11.687	11.687
Cost of finance	2308.920	2308.920	2096.088	1883.256	1670.424	1457.592
Gross profit	-2125.262	-763.060	-194.649	18.184	231.016	443.848
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	0.000	0.000	18.184	231.016	0.000
Tax	0.000	0.000	0.000	0.000	0.000	0.000
Net profit	-2125.262	-763.060	-194.649	18.184	231.016	443.848
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-2125.262	-763.060	-194.649	18.184	231.016	443.848
Accumulated undistributed profit	-2125.262	-2888.321	-3082.971	-3064.787	-2833.771	-2369.924
Gross profit, Z of total sales	-16.324	-4.892	-1.196	0.112	1.420	2.728
Net profit, Z of total sales	-16.324	-4.892	-1.196	0.112	1.420	2.728
ROE, Net profit, Z of equity	-23.920	-8.548	-2.191	0.205	2.600	4.996
ROI, Net profit+interest, Z of invest.	0.922	7.705	9.459	9.459	9.459	9.459

COMFAR 2.1 UNIDO

Net Income Statement in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total sales, incl. sales tax	16270.050	16270.050	16270.050	16270.050	16270.050	16270.050
Less: variable costs, incl. sales tax.	7611.205	7611.205	7611.205	7611.205	7611.205	7611.205
Variable margin	8658.845	8658.845	8658.845	8658.845	8658.845	8658.845
As % of total sales	53.220	53.220	53.220	53.220	53.220	53.220
Non-variable costs, incl. depreciation	6757.405	6757.405	6757.405	6757.405	4901.750	4901.750
Operational margin	1901.439	1901.439	1901.439	1901.439	3757.095	3757.095
As % of total sales	11.687	11.687	11.687	11.687	23.092	23.092
Cost of finance	1244.760	1031.928	819.096	606.264	393.432	180.600
Gross profit	656.680	869.512	1082.344	1295.176	3363.663	3576.495
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	0.000	0.000	1264.588	3363.663	3576.495
Tax	0.000	0.000	0.000	632.294	1681.832	1788.248
Net profit	656.680	869.512	1082.344	662.882	1681.832	1788.248
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	656.680	869.512	1082.344	662.882	1681.832	1788.248
Accumulated undistributed profit	-1733.244	-863.732	218.611	881.493	2563.325	4351.572
Gross profit, % of total sales	4.036	5.344	6.652	7.960	20.674	21.982
Net profit, % of total sales	4.035	5.344	6.652	4.074	10.337	10.991
ROE, Net profit, % of equity	7.391	9.787	12.182	7.461	18.930	20.127
ROI, Net profit+interest, % of invest.	9.459	9.459	9.459	6.313	10.323	9.794

CHROME TANNING SALTS PLANT, ZIMBABWE --- 28 SEP 89, by MPDC Priv.Ltd.,BANGALORE

Net Income Statement in '000 Z $

Year	2005	2006	2007
Total sales, incl. sales tax	16270.050	16270.050	16270.050
Less: variable costs, incl. sales tax.	7611.205	7611.205	7611.205
Variable margin	8658.845	8658.845	8658.845
As % of total sales	53.220	53.220	53.220
Non-variable costs, incl. depreciation	4901.750	4901.750	4901.750
Operational margin	3757.095	3757.095	3757.095
As % of total sales	23.092	23.092	23.092
Cost of finance	180.600	180.600	180.600
Gross profit	3576.495	3576.495	3576.495
Allowances	0.000	0.000	0.000
Taxable profit	3576.495	3576.495	3576.495
Tax	1788.248	1788.248	1788.248
Net profit	1788.248	1788.248	1788.248
Dividends paid	0.000	0.000	0.000
Undistributed profit	1788.248	1788.248	1788.248
Accumulated undistributed profit	6139.820	7928.067	9716.314
Gross profit, % of total sales	21.982	21.982	21.982
Net profit, % of total sales	10.991	10.991	10.991
ROE, Net profit, % of equity	20.127	20.127	20.127
ROI, Net profit+interest, % of invest.	9.794	9.794	9.794

COMFAR 21 UNIDO

COMFAR 2.1 - UNIDO FEASIBILITY STUDIES BRANCH, D-1370,VIENNA

CHROME TANNING SALTS PLANT, ZIMBABWE
28 SEP 89, by MPDC Priv.Ltd.,BANGALORE
11,500 TONNES PLANT, 10% inflation

3 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: '000 Z $

Total initial investment during construction phase

fixed assets:	27524.16	12.231 % foreign
current assets:	410.00	0.000 % foreign
total assets:	27934.16	12.052 % foreign

Source of funds during construction phase

equity & grants:	11051.00	0.000 % foreign
foreign loans :	0.00	
local loans :	16884.00	
total funds :	27935.00	0.000 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	10851.29	13280.25	16086.48
depreciation :	2570.92	2570.92	2570.92
interest :	2873.64	2873.64	2603.50
production costs	16295.85	18724.80	21260.89
thereof foreign	25.51 %	28.58 %	31.74 %
total sales :	13019.42	17157.03	21991.96
gross income :	-3276.42	-1567.78	731.07
net income :	-3276.42	-1567.78	731.07
cash balance :	-704.28	-1015.69	1233.46
net cashflow :	939.36	3546.35	5525.36

Net Present Value at: 10.00 % = 33159.55
Internal Rate of Return: 21.84 %
Return on equity1: 21.25 %
Return on equity2: 23.87 %

Index of Schedules produced by COMFAR

Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of finance

Cashflow Tables, construction in '000 Z $

Year	1990	1991	1992
Total cash inflow . .	8970.000	15646.000	3319.000
Financial resources .	8970.000	15646.000	3319.000
Sales, net of tax . .	0.000	0.000	0.000
Total cash outflow . .	8970.000	15645.720	3318.440
Total assets	8766.000	14109.000	635.000
Operating costs . . .	0.000	0.000	0.000
Cost of finance . . .	204.000	1536.720	2683.440
Repayment	0.000	0.000	0.000
Corporate tax . . .	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	0.000	0.280	0.560
Cumulated cash balance	0.000	0.280	0.840
Inflow, local	8970.000	15646.000	3319.000
Outflow, local	7453.400	14020.820	3093.440
Surplus (deficit) .	1516.600	1625.181	225.560
Inflow, foreign . . .	0.000	0.000	0.000
Outflow, foreign . . .	1516.600	1624.900	225.000
Surplus (deficit) .	-1516.600	-1624.900	-225.000
Net cashflow	-8766.000	-14109.000	-635.000
Cumulated net cashflow	-8766.000	-22875.000	-23510.000

Cashflow tables, production in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total cash inflow . .	14671.420	17251.490	22101.090	27748.110	34303.500	41892.500
Financial resources .	1651.995	94.459	109.131	125.793	144.696	166.121
Sales, net of tax . .	13019.420	17157.030	21991.960	27622.310	34158.810	41726.380
Total cash outflow . .	15375.700	18267.180	20867.630	23905.160	27438.470	34135.930
Total assets	1650.769	424.887	489.257	562.252	644.953	738.572
Operating costs . . .	10851.290	13280.250	16086.480	19321.160	23041.710	27313.590
Cost of finance . . .	2873.640	2873.640	2603.496	2333.352	2063.208	1793.064
Repayment	0.000	1688.400	1688.400	1688.400	1688.400	1688.400
Corporate tax . . .	0.000	0.000	0.000	0.000	0.000	2602.304
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-704.284	-1015.691	1233.459	3842.941	6865.035	7756.570
Cumulated cash balance	-703.444	-1719.135	-485.676	3357.265	10222.300	17978.870
Inflow, local	4131.736	3064.520	3510.977	4016.080	4587.094	5232.149
Outflow, local	10780.320	13034.790	14203.810	15575.940	17177.410	21639.960
Surplus (deficit) .	-6648.580	-9970.266	-10692.830	-11559.860	-12590.320	-16407.810
Inflow, foreign . . .	10539.680	14185.970	18590.120	23732.030	29716.410	36660.360
Outflow, foreign . . .	4595.388	5232.392	6663.824	8329.222	10261.060	12495.970
Surplus (deficit) .	5944.296	8954.578	11926.290	15402.800	19455.350	24164.380
Net cashflow	939.355	3546.351	5525.355	7864.673	10616.640	11238.040
Cumulated net cashflow	-22570.640	-19024.290	-13498.940	-5634.244	4982.398	16220.430

Cashflow tables, production in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total cash inflow . .	46005.250	50605.770	55666.350	61232.990	67356.280	74091.910
Financial resources .	106.219	116.842	128.526	141.378	155.516	171.068
Sales, net of tax . .	45899.030	50488.930	55537.820	61091.610	67200.770	73920.840
Total cash outflow . .	39628.460	43339.800	47435.770	51954.850	58135.300	64943.360
Total assets	492.069	541.276	595.403	654.945	720.438	792.483
Operating costs . . .	30044.950	33049.450	36354.390	39989.840	43988.810	48387.700
Cost of finance . . .	1522.920	1252.776	982.632	712.488	442.344	172.200
Repayment	1688.400	1688.400	1688.400	1688.400	1688.398	0.000
Corporate tax . . .	5880.121	6807.896	7814.941	8909.186	11295.300	12590.970
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	6376.789	7265.973	8230.582	9278.137	9220.984	12148.560
Cumulated cash balance	24355.660	31621.630	39852.210	49130.350	58351.340	70499.890
Inflow, local	5725.135	6297.649	6927.414	7620.156	8382.171	9220.389
Outflow, local	26087.650	28444.920	31051.400	33932.050	38310.220	40135.760
Surplus (deficit) .	-20362.530	-22147.270	-24123.990	-26311.890	-29928.050	-30915.370
Inflow, foreign . . .	40280.110	44308.120	48738.930	53612.830	58974.110	64871.530
Outflow, foreign . . .	13540.800	14894.880	16384.370	18022.800	19825.080	21807.590
Surplus (deficit) .	26739.310	29413.240	32354.570	35590.030	39149.030	43063.930
Net cashflow	9585.106	10207.150	10901.610	11679.020	11351.730	12320.750
Cumulated net cashflow	25808.540	36015.690	46917.300	58596.320	69948.050	82268.810

Cashflow tables, production in '000 Z $

Year	2005	2006	2007
Total cash inflow . .	81501.100	89651.220	98616.340
Financial resources .	188.174	206.992	227.691
Sales, net of tax . .	81312.930	89444.230	98388.650
Total cash outflow . .	68138.030	74952.170	82447.730
Total assets	871.730	958.903	1054.794
Operating costs . . .	53226.470	58549.120	64404.030
Cost of finance . . .	172.200	172.200	172.200
Repayment	0.000	0.000	0.000
Corporate tax . . .	13867.630	15271.960	16816.710
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	13363.070	14699.050	16168.600
Cumulated cash balance	83862.960	98562.010	114730.600
Inflow, local	10142.430	11156.670	12272.340
Outflow, local	44149.680	48564.950	53421.830
Surplus (deficit) .	-34007.250	-37408.310	-41149.470
Inflow, foreign . . .	71358.670	78494.550	86344.010
Outflow, foreign . . .	23988.350	26387.190	29025.900
Surplus (deficit) .	47370.320	52107.360	57318.100
Net cashflow	13535.270	14871.240	16340.890
Cumulated net cashflow	95804.090	110675.300	127016.100

Cashflow Discounting:

a) Equity paid versus Net income flow:

Net present value	22519.46	at	10.00 %
Internal Rate of Return (IRRE1) ..	21.25 %		

b) Net Worth versus Net cash return:

Net present value	26652.39	at	10.00 %
Internal Rate of Return (IRRE2) ..	23.87 %		

c) Internal Rate of Return on total investment:

Net present value	33159.55	at	10.00 %
Internal Rate of Return (IRR) ..	21.84 %		

Net Worth = Equity paid plus reserves

Net Income Statement in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total sales, incl. sales tax	13019.420	17157.030	21991.960	27622.310	34158.810	41726.380
Less: variable costs, incl. sales tax.	6108.295	8062.949	10347.450	13008.230	16097.680	19674.940
Variable margin	6911.130	9094.080	11644.510	14614.090	18061.130	22051.440
As % of total sales	53.083	53.005	52.949	52.907	52.874	52.848
Non-variable costs, incl. depreciation	7313.915	7788.216	8309.947	8883.849	9515.143	10209.570
Operational margin	-402.785	1305.864	3334.564	5730.238	8545.986	11841.870
As % of total sales	-3.094	7.611	15.163	20.745	25.018	28.380
Cost of finance	2873.640	2873.640	2603.496	2333.352	2063.208	1793.064
Gross profit	-3276.425	-1567.775	731.068	3396.887	6482.777	10048.810
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	0.000	731.068	3396.887	6482.777	5204.608
Tax	0.000	0.000	0.000	0.000	0.000	2602.304
Net profit	-3276.425	-1567.775	731.068	3396.887	6482.777	7446.504
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-3276.425	-1567.775	731.068	3396.887	6482.777	7446.504
Accumulated undistributed profit	-3276.425	-4844.200	-4112.132	-716.245	5766.532	13213.040
Gross profit, % of total sales	-25.166	-9.138	3.324	12.298	18.978	24.083
Net profit, % of total sales	-25.166	-9.138	3.324	12.298	18.978	17.846
ROE, Net profit, % of equity	-29.648	-14.187	6.615	30.738	58.662	67.383
ROI, Net profit+interest, % of invest.	-1.628	5.209	13.103	22.137	32.388	34.273

Net Income Statement in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total sales, incl. sales tax	45899.030	50488.930	55537.820	61091.610	67200.770	73920.840
Less: variable costs, incl. sales tax.	21642.440	23806.680	26187.350	28806.090	31686.690	34855.360
Variable margin	24256.590	26682.250	29350.470	32285.520	35514.070	39065.480
As % of total sales	52.848	52.848	52.848	52.848	52.848	52.848
Non-variable costs, incl. depreciation	10973.430	11813.680	12737.960	13754.670	12481.120	13711.330
Operational margin	13283.160	14868.570	16612.520	18530.860	23032.950	25354.140
As % of total sales	28.940	29.449	29.912	30.333	34.275	34.299
Cost of finance	1522.920	1252.776	982.632	712.488	442.344	172.200
Gross profit	11760.240	13615.790	15629.880	17818.370	22590.610	25181.950
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	11760.240	13615.790	15629.880	17818.370	22590.610	25181.950
Tax	5880.121	6807.896	7814.941	8909.186	11295.300	12590.970
Net profit	5880.121	6807.896	7814.941	8909.186	11295.300	12590.970
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	5880.121	6807.896	7814.941	8909.186	11295.300	12590.970
Accumulated undistributed profit	19093.160	25901.050	33716.000	42625.180	53920.480	66511.450
Gross profit, % of total sales	25.622	26.968	28.143	29.167	33.617	34.066
Net profit, % of total sales	12.811	13.484	14.071	14.583	16.808	17.033
ROE, Net profit, % of equity	53.209	61.604	70.717	80.619	102.211	113.935
ROI, Net profit+interest, % of invest.	27.073	29.028	31.158	33.468	40.041	42.635

Net Income Statement in '000 Z $

Year	2005	2006	2007
Total sales, incl. sales tax	81312.930	89444.230	98388.650
Less: variable costs, incl. sales tax.	38340.900	42174.990	46392.490
Variable margin	42972.030	47269.230	51996.160
As % of total sales	52.848	52.848	52.848
Non-variable costs, incl. depreciation	15064.570	16553.130	18190.540
Operational margin	27907.460	30716.110	33805.620
As % of total sales	34.321	34.341	34.359
Cost of finance	172.200	172.200	172.200
Gross profit	27735.260	30543.910	33633.420
Allowances	0.000	0.000	0.000
Taxable profit	27735.260	30543.910	33633.420
Tax	13867.630	15271.960	16816.710
Net profit	13867.630	15271.960	16816.710
Dividends paid	0.000	0.000	0.000
Undistributed profit	13867.630	15271.960	16816.710
Accumulated undistributed profit	80379.090	95651.040	112467.800
Gross profit, % of total sales	34.109	34.149	34.184
Net profit, % of total sales	17.055	17.074	17.092
ROE, Net profit, % of equity	125.488	138.155	152.174
ROI, Net profit+interest, % of invest.	45.853	49.231	52.764

CHROME TANNING SALTS PLANT, ZIMBABWE
28 SEP 89, by MPDC Priv.Ltd.,BANGALORE
7,200 TONNES PLANT, 10% inflation

3 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: 1000 Z $

Total initial investment during construction phase

fixed assets:	21756.56	13.290 % foreign
current assets:	430.00	0.000 % foreign
total assets:	22186.56	13.033 % foreign

Source of funds during construction phase

equity & grants:	8884.70	0.000 % foreign
foreign loans :	0.00	
local loans :	13302.00	
total funds :	22186.70	0.000 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	11498.27	14134.25	15974.19
depreciation :	2014.41	2014.41	2014.41
interest :	2308.92	2308.92	2096.09
production costs	15821.59	18457.58	20084.69
thereof foreign	26.01 %	28.78 %	30.12 %
total sales :	13019.42	17157.03	19686.76
gross income :	-2802.17	-1300.55	-397.92
net income :	-2802.17	-1300.55	-397.92
cash balance :	-786.79	-972.45	25.90
net cashflow :	232.13	2666.67	3452.19

Net Present Value at: 10.00 % = 6772.80
Internal Rate of Return: 14.07 %
Return on equity1: 8.37 %
Return on equity2: 11.40 %

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Total initial investment	Cashflow Tables
Total investment during production	Projected Balance
Total production costs	Net income statement
Working Capital requirements	Source of Finance

Cashflow Tables, construction in '000 Z$

Year	1990	1991	1992
Total cash inflow . .	7081.000	12340.200	2765.500
Financial resources .	7081.000	12340.200	2765.500
Sales, net of tax . .	0.000	0.000	0.000
Total cash outflow . .	7081.040	12340.200	2765.320
Total assets	6926.000	11139.300	655.000
Operating costs . . .	0.000	0.000	0.000
Cost of finance . . .	155.040	1201.200	2110.320
Repayment	0.000	0.000	0.000
Corporate tax . . .	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	-0.040	0.000	0.180
Cumulated cash balance	-0.040	-0.040	0.140
Inflow, local	7081.000	12340.200	2765.500
Outflow, local	5754.440	11000.300	2540.320
Surplus (deficit) .	1326.560	1339.900	225.180
Inflow, foreign . . .	0.000	0.000	0.000
Outflow, foreign . . .	1326.600	1339.900	225.000
Surplus (deficit) .	-1326.600	-1339.900	-225.000
Net cashflow	-6926.000	-11139.000	-655.000
Cumulated net cashflow	-6926.000	-18065.000	-18720.000

Cashflow tables, production in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total cash inflow . .	14756.580	17259.540	19758.310	21717.560	23889.320	26278.250
Financial resources .	1737.155	102.510	71.553	62.122	68.334	75.167
Sales, net of tax . .	13019.420	17157.030	19686.760	21655.440	23820.980	26203.080
Total cash outflow . .	15543.370	18231.990	19732.410	21080.740	22654.640	24407.210
Total assets	1736.183	458.619	331.932	295.673	325.241	357.765
Operating costs . . .	11498.270	14134.250	15974.190	17571.610	19328.770	21261.650
Cost of finance . . .	2308.920	2308.920	2096.088	1883.256	1670.424	1457.592
Repayment	0.000	1330.200	1330.200	1330.200	1330.200	1330.200
Corporate tax . . .	0.000	0.000	0.000	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-786.791	-972.451	25.904	636.820	1234.682	1871.041
Cumulated cash balance	-786.651	-1759.102	-1733.198	-1096.378	138.304	2009.345
Inflow, local	4216.647	3072.491	3397.413	3729.656	4102.621	4512.883
Outflow, local	10928.770	12987.050	13831.010	14630.150	15558.990	16601.990
Surplus (deficit) .	-6712.120	-9914.559	-10433.600	-10900.490	-11456.370	-12089.110
Inflow, foreign . . .	10539.930	14187.050	16260.[illegible]	17987.910	19786.700	21765.370
Outflow, foreign . . .	4614.604	5244.944	5901.398	6450.594	7095.652	7805.219
Surplus (deficit) .	5925.329	8942.104	10459.500	11537.310	12691.040	13960.150
Net cashflow	232.128	2665.670	3452.192	3850.275	4235.305	4658.832
Cumulated net cashflow	-18487.870	-15821.200	-12369.010	-8518.733	-4283.429	375.403

Cashflow tables, production in 1000 Z $

Year	2005	2006	2007
Total cash inflow . .	51208.880	56319.770	61962.750
Financial resources .	146.480	151.128	177.241
Sales, net of tax . .	51062.400	56168.640	61785.509
Total cash outflow . .	46955.790	51650.270	56814.210
Total assets	697.183	766.701	843.571
Operating costs . . .	41432.950	45575.240	50133.870
Cost of finance . . .	180.500	180.500	180.500
Repayment	0.000	0.000	0.000
Corporate tax . . .	4645.051	5126.523	5656.145
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	4253.094	4679.500	5148.529
Cumulated cash balance	21747.500	26427.000	31575.540
Inflow, local	8794.334	9673.768	10641.140
Outflow, local	31745.620	34919.080	38409.900
Surplus (deficit) .	-22951.290	-25245.310	-27768.760
Inflow, foreign . . .	42414.540	46656.000	51321.600
Outflow, foreign . . .	15210.160	16731.130	18404.300
Surplus (deficit) .	27204.380	29924.820	32917.300
Net cashflow	4433.695	4860.101	5339.140
Cumulated net cashflow	31221.240	36081.340	41410.480

Cashflow Discounting:

a) Equity paid versus Net income flow:
Net present value .... -1778.81 at 10.00 %
Internal Rate of Return (IRRE1) .. 8.37 %
b) Net Worth versus Net cash return:
Net present value .... 1496.91 at 10.00 %
Internal Rate of Return (IRRE2) .. 11.40 %
c) Internal Rate of Return on total investment:
Net present value .... 6772.80 at 10.00 %
Internal Rate of Return (IRR) .. 14.07 %
Net Worth = Equity paid plus reserves

Net Income Statement in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total sales, incl. sales tax	13019.420	17157.030	19686.760	21655.440	23820.980	26203.080
Less: variable costs, incl. sales tax.	6755.267	8916.953	10235.160	11258.680	12384.550	13623.000
Variable margin	6264.158	8240.076	9451.600	10396.760	11436.440	12580.080
As % of total sales	48.114	48.027	48.010	48.010	48.010	48.010
Non-variable costs, incl. depreciation	6757.406	7231.705	7753.436	8327.339	8958.632	9653.056
Operational margin	-493.249	1008.371	1698.164	2069.422	2477.807	2927.025
As % of total sales	-3.789	5.877	8.626	9.556	10.402	11.171
Cost of finance	2308.920	2308.920	2096.088	1883.256	1670.424	1457.592
Gross profit	-2802.168	-1300.549	-397.924	186.166	807.383	1469.434
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	0.000	0.000	186.166	807.383	0.000
Tax	0.000	0.000	0.000	0.000	0.000	0.000
Net profit	-2802.168	-1300.549	-397.924	186.166	807.383	1469.434
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-2802.168	-1300.549	-397.924	186.166	807.383	1469.434
Accumulated undistributed profit	-2802.168	-4102.717	-4500.641	-4314.475	-3507.092	-2037.658
Gross profit, % of total sales	-21.523	-7.580	-2.021	0.860	3.389	5.608
Net profit, % of total sales	-21.523	-7.580	-2.021	0.860	3.389	5.608
ROE, Net profit, % of equity	-31.539	-14.638	-4.479	2.095	9.087	16.539
ROI, Net profit+interest, % of invest.	-2.465	4.751	8.233	9.721	11.734	13.679

Net Income Statement in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total sales, incl. sales tax	28823.390	31705.730	34876.300	38363.930	42200.330	46420.360
Less: variable costs, incl. sales tax.	14985.300	16483.830	18132.210	19945.440	21939.980	24133.980
Variable margin	13838.090	15221.900	16744.090	18418.500	20260.350	22286.380
As % of total sales	48.010	48.010	48.010	48.010	48.010	48.010
Non-variable costs, incl. depreciation	10416.920	11257.170	12181.450	13198.150	12460.870	13691.080
Operational margin	3421.168	3964.729	4562.643	5220.346	7799.475	8595.295
As % of total sales	11.869	12.505	13.082	13.607	18.482	18.516
Cost of finance	1244.760	1031.928	819.096	606.264	393.432	180.600
Gross profit	2176.408	2932.801	3743.547	4614.082	7406.043	8414.695
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	2078.002	3743.547	4614.082	7406.043	8414.695
Tax	0.000	1039.001	1871.773	2307.041	3703.021	4207.348
Net profit	2176.408	1893.800	1871.773	2307.041	3703.021	4207.348
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	2176.408	1893.800	1871.773	2307.041	3703.021	4207.348
Accumulated undistributed profit	138.750	2032.550	3904.323	6211.364	9914.386	14121.730
Gross profit, % of total sales	7.551	9.250	10.734	12.027	17.550	18.127
Net profit, % of total sales	7.551	5.973	5.367	6.014	8.775	9.064
ROE, Net profit, % of equity	24.476	21.315	21.067	25.766	41.679	47.355
ROI, Net profit+interest, % of invest.	15.759	13.268	11.998	12.755	17.584	18.439

Net Income Statement in '000 Z $

Year	2005	2006	2007
Total sales, incl. sales tax	51062.400	56168.640	61785.500
Less: variable costs, incl. sales tax.	26547.380	29202.120	32122.330
Variable margin	24515.020	26966.530	29663.180
As % of total sales	48.010	48.010	48.010
Non-variable costs, incl. depreciation	15044.320	16532.880	18170.290
Operational margin	9470.701	10433.650	11492.890
As % of total sales	18.547	18.576	18.601
Cost of finance	180.600	180.600	180.600
Gross profit	9290.102	10253.050	11312.290
Allowances	0.000	0.000	0.000
Taxable profit	9290.102	10253.050	11312.290
Tax	4645.051	5126.523	5656.145
Net profit	4645.051	5126.523	5656.145
Dividends paid	0.000	0.000	0.000
Undistributed profit	4645.051	5126.523	5656.145
Accumulated undistributed profit	18766.790	23893.310	29549.450
Gross profit, % of total sales	18.194	18.254	18.309
Net profit, % of total sales	9.097	9.127	9.154
ROE, Net profit, % of equity	52.281	57.701	63.662
ROI, Net profit+interest, % of invest.	19.820	21.268	22.782

COMFAR 21 UNIDO

COMFAR 2.1 - UNIDO FEASIBILITY STUDIES BRANCH, D-1370,VIENNA

CHROME TANNING SALTS PLANT, ZIMBABWE
28 SEP 89, by MPDC Priv.Ltd.,BANGALORE
11,500 TONNES PLANT, 70% capacity util.

3 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: '000 Z $

Total initial investment during construction phase

fixed assets:	27524.16	12.231 % foreign
current assets:	410.00	0.000 % foreign
total assets:	27934.16	12.052 % foreign

Source of funds during construction phase

equity & grants:	11051.00	0.000 % foreign
foreign loans :	0.00	
local loans :	16884.00	
total funds :	27935.00	0.000 % foreign

Cashflow from operations

Year:	1	2	3
operating costs:	10851.29	12072.95	13294.61
depreciation :	2570.92	2570.92	2570.92
interest :	2873.64	2873.64	2603.50
production costs	16295.85	17517.51	18469.02
thereof foreign	25.51 %	27.95 %	30.51 %
total sales :	13019.42	15597.30	18175.18
gross income :	-3276.42	-1920.21	-293.85
net income :	-3276.42	-1920.21	-293.85
cash balance :	-704.28	-1189.10	437.26
net cashflow :	939.36	3372.94	4729.15

Net Present Value at: 10.00 % = 2328.98
Internal Rate of Return: 11.41 %
Return on equity1: 0.14 %
Return on equity2: 5.43 %

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Cashflow Tables, construction in '000 Z $

Year	1990	1991	1992
Total cash inflow . .	8970.000	15646.000	3319.000
Financial resources .	8970.000	15646.000	3319.000
Sales, net of tax . .	0.000	0.000	0.000
Total cash outflow . .	8970.000	15645.720	3318.440
Total assets	8766.000	14109.000	635.000
Operating costs . . .	0.000	0.000	0.000
Cost of finance . . .	204.000	1536.720	2683.440
Repayment	0.000	0.000	0.000
Corporate tax . . .	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	0.000	0.280	0.560
Cumulated cash balance	0.000	0.280	0.840
Inflow, local	8970.000	15646.000	3319.000
Outflow, local	7453,400	14020.820	3093.440
Surplus (deficit) .	1516.600	1625.181	225.560
Inflow, foreign . . .	0.000	0.000	0.000
Outflow, foreign . . .	1516.600	1624.900	225.000
Surplus (deficit) .	-1516.600	-1624.900	-225.000
Net cashflow	-8766.000	-14109.000	-635.000
Cumulated net cashflow	-8766.000	-22875.000	-23510.000

Cashflow tables, production in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total cash inflow . .	14671.420	15644.810	18222.690	18175.180	18175.180	18175.180
Financial resources .	1651.995	47.509	47.509	0.000	0.000	0.000
Sales, net of tax . .	13019.420	15597.300	18175.180	18175.180	18175.180	18175.180
Total cash outflow . .	15375.700	16833.910	17785.430	17316.370	17046.220	16776.080
Total assets	1650.769	198.918	198.918	0.000	0.000	0.000
Operating costs . . .	10851.290	12072.950	13294.610	13294.610	13294.610	13294.610
Cost of finance . . .	2873.640	2873.640	2603.496	2333.352	2063.208	1793.064
Repayment	0.000	1688.400	1688.400	1688.400	1688.400	1688.400
Corporate tax . . .	0.000	0.000	0.000	0.000	0.000	0.000
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	-704.284	-1189.192	437.258	858.811	1128.953	1399.098
Cumulated cash balance	-703.444	-1892.545	-1455.288	-596.477	532.476	1931.574
Inflow, local	4131.736	2761.070	2875.070	2856.300	2856.300	2856.300
Outflow, local	10780.320	12147.680	12360.180	12018.260	11748.120	11477.970
Surplus (deficit) .	-6648.580	-9386.605	-9485.108	-9161.961	-8891.817	-8621.673
Inflow, foreign . . .	10539.680	12883.740	15347.610	15318.880	15318.880	15318.880
Outflow, foreign . . .	4595.388	4686.236	5425.251	5298.105	5298.105	5298.105
Surplus (deficit) .	5944.296	8197.504	9922.363	10020.770	10020.770	10020.770
Net cashflow	939.355	3372.938	4729.152	4880.562	4880.562	4880.562
Cumulated net cashflow	-22570.640	-19197.710	-14468.550	-9587.993	-4707.432	173.130

Cashflow tables, production in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total cash inflow . .	18175.180	18175.180	18175.180	18175.180	18175.180	18175.180
Financial resources .	0.000	0.000	0.000	0.000	0.000	0.000
Sales, net of tax . .	18175.180	18175.180	18175.180	18175.180	18175.180	18175.180
Total cash outflow . .	16505.930	16235.790	15965.650	15695.500	17440.050	15731.500
Total assets	0.000	0.000	0.000	0.000	0.000	0.000
Operating costs . . .	13294.610	13294.610	13294.610	13294.610	13294.610	13294.610
Cost of finance . . .	1522.920	1252.776	982.632	712.488	442.344	172.200
Repayment	1688.400	1688.400	1688.400	1688.400	1688.398	0.000
Corporate tax . . .	0.000	0.000	0.000	0.000	2014.695	2264.682
Dividends paid . . .	0.000	0.000	0.000	0.000	0.000	0.000
Surplus (deficit) .	1669.242	1939.386	2209.529	2479.674	735.125	2443.680
Cumulated cash balance	3600.816	5540.202	7749.731	10229.400	10964.530	13408.210
Inflow, local	2856.300	2856.300	2856.300	2856.300	2856.300	2856.300
Outflow, local	11207.830	10937.690	10667.540	10397.400	12141.950	10433.390
Surplus (deficit) .	-8351.529	-8081.385	-7811.241	-7541.097	-9285.646	-7577.091
Inflow, foreign . . .	15318.880	15318.880	15318.880	15318.880	15318.880	15318.880
Outflow, foreign . . .	5298.105	5298.105	5298.105	5298.105	5298.105	5298.105
Surplus (deficit) .	10020.770	10020.770	10020.770	10020.770	10020.770	10020.770
Net cashflow	4880.562	4880.562	4880.562	4880.562	2865.866	2615.880
Cumulated net cashflow	5053.691	9934.253	14814.810	19695.380	22561.240	25177.120

Cashflow tables, production in '000 Z $

Year	2005	2006	2007
Total cash inflow . .	18175.180	18175.180	18175.180
Financial resources .	0.000	0.000	0.000
Sales, net of tax . .	18175.180	18175.180	18175.180
Total cash outflow . .	15731.500	15731.500	15731.500
Total assets	0.000	0.000	0.000
Operating costs . . .	13294.610	13294.610	13294.610
Cost of finance . . .	172.200	172.200	172.200
Repayment	0.000	0.000	0.000
Corporate tax . . .	2264.682	2264.682	2264.682
Dividends paid . . .	0.000	0.000	0.000
Surplus (deficit) .	2443.680	2443.680	2443.680
Cumulated cash balance	15851.890	18295.570	20739.250
Inflow, local	2856.300	2856.300	2856.300
Outflow, local	10433.390	10433.390	10433.390
Surplus (deficit) .	-7577.091	-7577.091	-7577.091
Inflow, foreign . . .	15318.880	15318.880	15318.880
Outflow, foreign . . .	5298.105	5298.105	5298.105
Surplus (deficit) .	10020.770	10020.770	10020.770
Net cashflow	2615.880	2615.880	2615.880
Cumulated net cashflow	27793.050	30408.850	33024.760

ashflow Discounting:

a) Equily paid versus Net incone flow:

Net present value	-9531.12	at	10.00 %
Internal Rate of Return (IRRE1) ..	0.14 %		

b) Net Worth versus Net cash return:

Net present value	-4178.19	at	10.00 %
Internal Rate of Return (IRRE2) ..	5.43 %		

c) Internal Rate of Return on total investment:

Net present value	2328.98	at	10.00 %
Internal Rate of Return (IRR) ..	11.41 %		

Worth = Equily paid plus reserves

Net Income Statement in '000 Z $

Year	1993	1994	1995	1996	1997	1998
Total sales, incl. sales tax	13019.420	15597.300	18175.180	18175.180	18175.180	18175.180
Less: variable costs, incl. sales tax	6108.295	7329.954	8551.613	8551.613	8551.613	8551.613
Variable margin	6911.130	8267.346	9623.563	9623.563	9623.563	9623.563
As % of total sales	53.083	53.005	52.949	52.949	52.949	52.949
Non-variable costs, incl. depreciation	7313.915	7313.916	7313.914	7313.914	7313.915	7313.915
Operational margin	-402.785	953.430	2309.648	2309.648	2309.647	2309.647
As % of total sales	-3.094	6.113	12.708	12.708	12.708	12.708
Cost of finance	2873.640	2873.640	2603.496	2333.352	2063.208	1793.064
Gross profit	-3276.425	-1920.210	-293.848	-23.703	246.439	516.584
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	0.000	0.000	0.000	246.439	0.000
Tax	0.000	0.000	0.000	0.000	0.000	0.000
Net profit	-3276.425	-1920.210	-293.848	-23.703	246.439	516.584
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	-3276.425	-1920.210	-293.848	-23.703	246.439	516.584
Accumulated undistributed profit	-3276.425	-5196.635	-5490.482	-5514.186	-5267.746	-4751.162
Gross profit, % of total sales	-25.165	-12.311	-1.617	-0.130	1.356	2.842
Net profit, % of total sales	-25.166	-12.311	-1.617	-0.130	1.356	2.842
ROE, Net profit, % of equity	-29.645	-17.376	-2.659	-0.214	2.230	4.675
ROI, Net profit+interest, % of invest.	-1.678	3.831	9.223	9.223	9.223	9.223

Net Income Statement in '000 Z $

Year	1999	2000	2001	2002	2003	2004
Total sales, incl. sales tax	18175.180	18175.180	18175.180	18175.180	18175.180	18175.180
Less: variable costs, incl. sales tax.	8551.613	8551.613	8551.613	8551.613	8551.613	8551.613
Variable margin	9623.563	9623.563	9623.563	9623.563	9623.563	9623.563
As % of total sales	52.949	52.949	52.949	52.949	52.949	52.949
Non-variable costs, incl. depreciation	7313.916	7313.916	7313.915	7313.915	4922.000	4921.999
Operational margin	2309.646	2309.646	2309.647	2309.647	4701.563	4701.563
As % of total sales	12.708	12.708	12.708	12.708	25.868	25.868
Cost of finance	1522.920	1252.776	982.632	712.488	442.344	172.200
Gross profit	786.727	1056.871	1327.016	1597.160	4259.219	4529.363
Allowances	0.000	0.000	0.000	0.000	0.000	0.000
Taxable profit	0.000	0.000	0.000	0.000	4029.391	4529.363
Tax	0.000	0.000	0.000	0.000	2014.695	2264.682
Net profit	786.727	1056.871	1327.016	1597.160	2244.523	2264.682
Dividends paid	0.000	0.000	0.000	0.000	0.000	0.000
Undistributed profit	786.727	1056.871	1327.016	1597.160	2244.523	2264.682
Accumulated undistributed profit	-3964.436	-2907.564	-1580.549	16.611	2261.135	4525.816
Gross profit, % of total sales	4.329	5.815	7.301	8.788	23.434	24.921
Net profit, % of total sales	4.329	5.815	7.301	8.788	12.349	12.460
ROE, Net profit, % of equity	7.119	9.564	12.008	14.453	20.311	20.493
ROI, Net profit+interest, % of invest.	9.223	9.223	9.223	9.223	10.730	9.731

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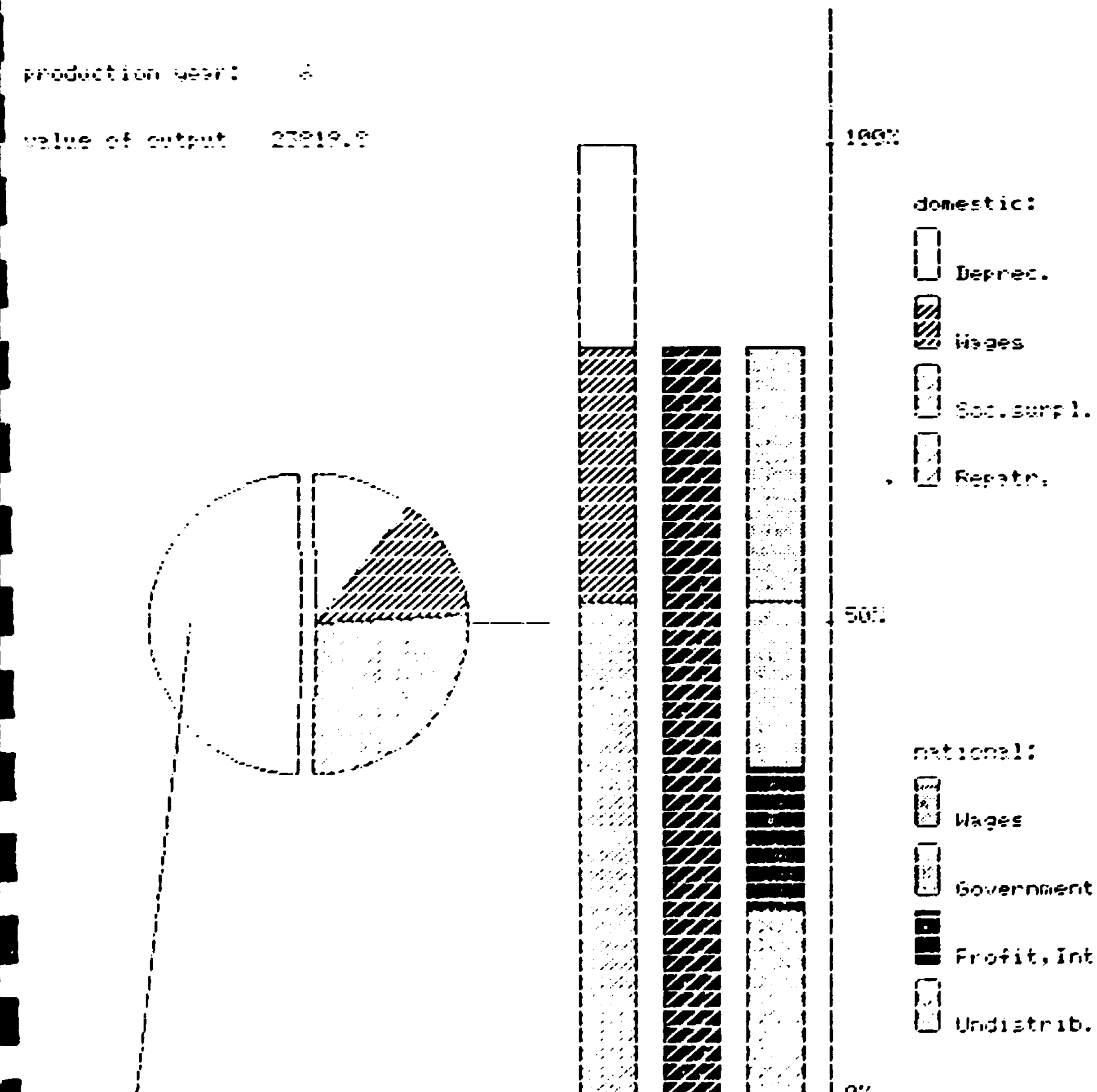
Net Income Statement in '000 Z $

Year	2005	2006	2007
Total sales, incl. sales tax	18175.180	18175.180	18175.180
Less: variable costs, incl. sales tax.	8551.613	8551.613	8551.613
Variable margin	9623.563	9623.563	9623.563
As % of total sales	52.949	52.949	52.949
Non-variable costs, incl. depreciation	4921.999	4921.999	4921.999
Operational margin	4701.563	4701.563	4701.563
As % of total sales	25.868	25.868	25.868
Cost of finance	172.200	172.200	172.200
Gross profit	4529.363	4529.363	4529.363
Allowances	0.000	0.000	0.000
Taxable profit	4529.363	4529.363	4529.363
Tax	2264.682	2264.682	2264.682
Net profit	2264.682	2264.682	2264.682
Dividends paid	0.000	0.000	0.000
Undistributed profit	2264.682	2264.682	2264.682
Accumulated undistributed profit . . .	6790.498	9055.180	11319.860
Gross profit, % of total sales	24.921	24.921	24.921
Net profit, % of total sales	12.460	12.460	12.460
ROE, Net profit, % of equity	20.493	20.493	20.493
ROI, Net profit+interest, % of invest.	9.731	9.731	9.731

ECONOMIC EVALUATION

Structure of value added million Z dollar	11.500 TONNES PLANT for 6th production year



Material input (M) 49.4% 11758.7

Gross domestic value added 50.6% 12061.1

Net National Value Added

Net Domestic Value Added

Gross Domestic Value Added

Total Cashflows at Adjusted Market Prices in '000 Z $
Economic Analysis excluding indirect effects

	financial present values			factor	adjusted present values		
	at 0 %	at 10.00 %	at 15.00 %		at 0 %	at 10.00 %	at 15.00 %
t o t a l cashflow :							
net cashflow	60286.40	10998.95	938.40	2.01	121359.10	32994.48	15636.46
net indirect effects . .	....	....	....	....	....	....	....
total cash inflow . . .	349963.90	137101.10	93140.85	1.00 >=	348605.40	136531.80	92740.42
total cash outflow . . .	289677.50	126102.20	92202.46	0.97 >=	227246.30	103537.30	77103.97
taxes	62431.23	22564.84	15098.50	0.00	0.00	0.00	0.00
flow of funds:							
net flow of funds . . .	-12285.52	4644.04	8645.37	1.00	-12285.52	4644.04	8645.37
total funds, inflow . .	29824.54	27313.09	26275.79	1.00	29824.54	27313.09	26275.79
equity	11051.00	10374.30	10096.03	1.00	11051.00	10374.30	10096.03
subsidies, grants . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . .	18773.54	16938.79	16179.76	1.00	18773.54	16938.79	16179.76
total funds, outflow . .	42110.05	22669.06	17630.42	1.00	42110.05	22669.06	17630.42
interest	24566.51	14755.93	12005.54	1.00	24566.51	14755.93	12005.54
repayment	17543.54	7913.13	5624.88	1.00	17543.54	7913.13	5624.88
dividends distributed	0.00	0.00	0.00	0.00	0.00	0.00	0.00
et flow, foreign funds	0.00	140.70	137.41	1.00	0.00	140.90	137.41
foreign funds, inflow .	292.26	193.47	161.02	1.00	292.26	193.47	161.02
equity	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . .	292.26	193.47	161.02	1.00	292.26	193.47	161.02
oreign funds, outflow .	292.26	52.56	23.62	1.00	292.26	52.56	23.62
dividends distributed	0.00	0.00	0.00	0.00	0.00	0.00	0.00
debt service	292.26	52.56	23.62	1.00	292.26	52.56	23.62
interest paid .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loan repayment .	292.26	52.56	23.62	1.00	292.26	52.56	23.62

nancial rate of return (market prices) 15.63 %
onomic rate of return (prelim.adjust) 24.07 %

Absolute Efficiency Test - 1 in '000 Z $
Economic Analysis at Market Prices, excluding indirect effects

	grand total	total constr.	total produc.	..........construction.......... 1990	1991	1992	1993	production 1994
value of output, O	350730.50	0.00	350730.50	0.00	0.00	0.00	13019.42	15597.30
material input, I+MI	214538.20	27934.16	186604.00	8970.00	15645.72	3318.44	8375.96	8961.07
investment, I	23928.24	25143.24	-1215.00	7905.74	13956.63	3280.86	733.67	97.11
operation, MI	19060[illegible].90	2790.92	187819.00	1064.26	1689.09	37.58	7642.30	8863.96
net domestic VA	136192.30	-27934.16	164126.50	-8970.00	-15645.72	-3318.44	4643.46	6636.23
repatriated payments	292.26	0.00	292.26	0.00	0.00	0.00	0.00	0.00
net national VA	135900.10	-27934.16	163834.20	-8970.00	-15645.72	-3318.44	4643.46	6636.23
national wages	48135.00	0.00	48135.00	0.00	0.00	0.00	3209.00	3209.00
social surplus	87765.09	-27934.16	115699.20	-8970.00	-15645.72	-3318.44	1434.46	3427.23

present values at	15.00 %
PV, net national VA	16954.94
PV, national wages	14188.44
PV, unskilled labour	0.00
PV of social surplus	2766.49

relative efficiency of:	capital invested, E(C) :	0.74
	foreign exchange, E(FE) :	0.28
	skilled labour, E(L) :	1.19

Absolute Efficiency Test - 1 in '000 Z $
Economic Analysis at Market Prices, excluding indirect effects

	production							
	1995	1996	1997	1998	1999	2000	2001	2002
value of output, O	18175.18	20753.05	23330.93	25908.80	25908.80	25908.80	25908.80	25908.80
material input, I+MI	10182.73	11404.39	12626.04	13847.70	13750.59	13750.59	13750.59	13750.59
investment, I	97.11	97.11	97.11	97.11	0.00	0.00	0.00	0.00
operation, MI	10085.61	11307.27	12528.93	13750.59	13750.59	13750.59	13750.59	13750.59
net domestic VA	7992.45	9348.67	10704.88	12061.10	12158.21	12158.21	12158.21	12158.21
repatriated payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net national VA	7992.45	9348.67	10704.88	12061.10	12158.21	12158.21	12158.21	12158.21
national wages	3209.00	3209.00	3209.00	3209.00	3209.00	3209.00	3209.00	3209.00
social surplus	4783.45	6139.67	7495.88	8852.10	8949.21	8949.21	8949.21	8949.21

present values at	15.00 %
PV, net national VA	16954.94
PV, national wages	14188.44
PV, unskilled labour	0.00
PV of social surplus	2766.49

relative efficiency of:	capital invested, E(C) :	0.74
	foreign exchange, E(FE) :	0.28
	skilled labour, E(L) :	1.19

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bsolute Efficiency Test - 1 in '000 Z $
conomic Analysis at Market Prices, excluding indirect effects

	production					
	2003	2004	2005	2006	2007	2008
alue of output, O	25908.80	25908.80	25908.80	25908.80	25908.80	766.59
terial input, I+MI	13750.59	13750.59	13750.59	13750.59	13750.59	-2549.23
investment, I	0.00	0.00	0.00	0.00	0.00	-2434.23
operation, MI	13750.59	13750.59	13750.59	13750.59	13750.59	-115.00
t domestic VA	12158.21	12158.21	12158.21	12158.21	12158.21	3315.82
patriated payments	0.00	0.00	0.00	0.00	0.00	292.26
t national VA	12158.21	12158.21	12158.21	12158.21	12158.21	3023.57
national wages	3209.00	3209.00	3209.00	3209.00	3209.00	0.00
social surplus	8949.21	8949.21	8949.21	8949.21	8949.21	3023.57

present values at	15.00 %
PV, net national VA	16954.94
, national wages	14188.44
, unskilled labour	0.00
PV of social surplus	2766.49

lative efficiency of:	capital invested, E(C) :	0.74
	foreign exchange, E(FE) :	0.28
	skilled labour, E(L) :	1.19

Foreign Exchange Effect in '000 Z $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	grand total	total constr.	total produc.	........construction........ 1990	1991	1992	production 1993
total foreign inflow . .	303991.60	0.00	303991.60	0.00	0.00	0.00	10539.68
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	292.26	0.00	292.26	0.00	0.00	0.00	148.56
exports	303699.40	0.00	303699.40	0.00	0.00	0.00	10391.13
indirect effects	....	....	....	....	....	....	....
total foreign outflow .	91551.33	6591.27	84960.05	2778.12	3625.73	187.43	3957.44
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	6591.27	6591.27	-0.00	2778.12	3625.73	187.43	775.31
imported materials . . .	84667.80	0.00	84667.80	0.00	0.00	0.00	3182.12
repayment loans & overd.	292.26	0.00	292.26	0.00	0.00	0.00	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs	....	....	....	....	....	....	....
net foreign exchge flow	212440.30	-6591.27	219031.50	-2778.12	-3625.73	-187.43	6582.25
import substit'n effect	30874.51	0.00	30874.51	0.00	0.00	0.00	2058.30
net forgn exchge effect	243314.80	-6591.27	249906.10	-2778.12	-3625.73	-187.43	8640.55

present values at	15.00 %
foreign exchange flow .	50770.25
net forgn exchge effect	59870.92

Foreign Exchange Effect in '000 Z $
onomic Analysis excluding indirect effects
0 units foreign CU = 100.00 units local CU

				production			
	1994	1995	1996	1997	1998	1999	2000
otal foreign inflow . .	12883.74	15347.61	17811.49	20275.37	22739.24	22710.50	22710.50
uity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ans & overdraft . . .	28.74	28.74	28.74	28.74	28.74	0.00	0.00
ports	12855.00	15318.88	17782.75	20246.63	22710.50	22710.50	22710.50
indirect effects	....	....	....	....	....	....	....
tal foreign outflow .	3924.87	4540.47	5156.07	5771.67	6387.27	6260.12	6260.12
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
uipment	127.15	127.15	127.15	127.15	127.15	0.00	0.00
ported materials . . .	3797.72	4413.32	5028.92	5644.52	6260.12	6260.12	6260.12
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	0.00
her repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
patriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
nterests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
direct costs	....	....	....	....	....	....	....
net foreign exchge flow	8958.87	10807.15	12655.42	14503.70	16351.97	16450.38	16450.38
port substit'n effect	2058.30	2058.30	2058.30	2058.30	2058.30	2058.30	2058.30
t forgn exchge effect	11017.17	12865.45	14713.72	16562.00	18410.28	18508.68	18508.68

present values at	15.00 %
reign exchange flow .	50770.25
et forgn exchge effect	59870.92

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Foreign Exchange Effect in '000 Z $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production						
	2001	2002	2003	2004	2005	2006	2007
total foreign inflow . .	22710.50	22710.50	22710.50	22710.50	22710.50	22710.50	22710.50
equity capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00
subsidies, grants . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
loans & overdraft . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
exports	22710.50	22710.50	22710.50	22710.50	22710.50	22710.50	22710.50
indirect effects	....	....	....	....	....	....	....
total foreign outflow .	6260.12	6260.12	6260.12	6260.12	6260.12	6260.12	6260.12
royalties	0.00	0.00	0.00	0.00	0.00	0.00	0.00
equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00
imported materials . . .	6260.12	6260.12	6260.12	6260.12	6260.12	6260.12	6260.12
repayment loans & overd.	0.00	0.00	0.00	0.00	0.00	0.00	0.00
other repayments	0.00	0.00	0.00	0.00	0.00	0.00	0.00
repatriated wages . . .	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends paid	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interests	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indirect costs	....	....	....	....	....	....	....
net foreign exchge flow	16450.38	16450.38	16450.38	16450.38	16450.38	16450.38	16450.38
import substit'n effect	2058.30	2058.30	2058.30	2058.30	2058.30	2058.30	2058.30
net forgn exchge effect	18508.68	18508.68	18508.68	18508.68	18508.68	18508.68	18508.68

present values at	15.00 %
foreign exchange flow .	50770.25
net forgn exchge effect	59870.92

Foreign Exchange Effect in '000 Z $
Economic Analysis excluding indirect effects
100 units foreign CU = 100.00 units local CU

	production 2006
total foreign inflow . .	0.00
equity capital	0.00
subsidies, grants . . .	0.00
loans & overdraft . . .	0.00
exports	0.00
indirect effects	....
total foreign outflow .	-1118.79
royalties	0.00
equipment	-1411.04
imported materials . . .	0.00
repayment loans & overd.	292.26
other repayments	0.00
repatriated wages . . .	0.00
dividends paid	0.00
interests	0.00
indirect costs	....
net foreign exchge flow	1118.79
import substit'n effect	0.00
net forgn exchge effect	1118.79
present values at	15.00 %
foreign exchange flow .	50770.25
net forgn exchge effect	59870.92

Distribution of Net Domestic Value Added in '000 Z $
Net Income Flow Analysis excluding indirect effects

	grand total	total constr.	total produc.	......construction...... 1990	1991	1992	1993	production 1994
gross domestic VA .	160120.60	-3200.92	163321.50	-1064.26	-1689.09	-447.58	4643.46	6635.23
annual depreciation	26604.16	0.00	26604.16	0.00	0.00	0.00	2570.92	2570.92
net domestic VA . .	133516.40	-3200.92	136717.30	-1064.26	-1689.09	-447.58	2072.55	4065.32
repatriated payments	292.26	0.00	292.26	0.00	0.00	0.00	0.00	0.00
wages	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interest, f.loans	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends, repatr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
other payments .	292.26	0.00	292.26	0.00	0.00	0.00	0.00	0.00
net national VA . .	133224.20	-3200.92	136425.10	-1064.26	-1689.09	-447.58	2072.55	4065.32
wage earners VA w	48135.00	0.00	48135.00	0.00	0.00	0.00	3209.00	3209.00
profit,interest VA p	24566.51	4424.16	20142.35	204.00	1536.72	2683.44	2873.64	2873.64
government VA g	62431.23	2790.92	59640.31	1064.26	1689.09	37.58	1086.25	1286.80
undistributed VA u	-1908.59	10416.00	8507.40	-2332.51	-4914.89	-3168.59	-5096.34	-3304.13
distribution indices								
(VA w)/VA . . .	0.36	0.00	0.35	0.00	0.00	0.00	1.55	0.79
(VA p)/VA . . .	0.18	-1.38	0.15	-0.19	-0.91	-6.00	1.39	0.71
(VA g)/VA . . .	0.47	-0.87	0.44	-1.00	-1.00	-0.08	0.52	0.32
(VA u)/VA . . .	-0.01	3.25	0.06	2.99	2.91	7.08	-2.46	-0.81

Distribution of Net Domestic Value Added in '000 Z $
Net Income Flow Analysis excluding indirect effects

	production							
	1995	1996	1997	1998	1999	2000	2001	2002
gross domestic VA .	7992.45	9348.67	10704.88	12061.10	12158.21	12158.21	12158.21	12158.21
annual depreciation	2570.92	2570.92	2570.92	2570.92	2570.92	2570.92	2570.92	2570.92
net domestic VA . .	5421.53	6777.75	8133.97	9490.18	9587.29	9587.29	9587.29	9587.29
repatriated payments	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
wages	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
interest, f.loans	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dividends, repatr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
other payments .	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
net national VA . .	5421.53	6777.75	8133.97	9490.18	9587.29	9587.29	9587.29	9587.29
wage earners VA w	3209.00	3209.00	3209.00	3209.00	3209.00	3209.00	3209.00	3209.00
profit,interest VA p	2603.50	2333.35	2063.21	1793.06	1522.92	1252.78	982.63	712.49
government VA g	1487.35	1687.90	1888.45	2089.00	4064.07	4651.76	4786.84	4921.91
undistributed VA u	-1878.32	-452.50	973.30	2399.11	791.31	473.75	608.83	743.90
distribution indices								
(VA w)/VA . . .	0.59	0.47	0.39	0.34	0.33	0.33	0.33	0.33
(VA p)/VA . . .	0.48	0.34	0.25	0.19	0.16	0.13	0.10	0.07
(VA g)/VA . . .	0.27	0.25	0.23	0.22	0.42	0.49	0.50	0.51
(VA u)/VA . . .	-0.35	-0.07	0.12	0.25	0.08	0.05	0.06	0.08

Distribution of Net Domestic Value Added in '000 Z $
Net Income Flow Analysis excluding indirect effects

	production					
	2003	2004	2005	2006	2007	2008
gross domestic VA .	12158.21	12158.21	12158.21	12158.21	12158.21	2510.82
annual depreciation	179.00	179.00	179.00	179.00	179.00	0.00
net domestic VA . .	11979.21	11979.21	11979.21	11979.21	11979.21	2510.82
repatriated payments	0.00	0.00	0.00	0.00	0.00	292.26
wages	0.00	0.00	0.00	0.00	0.00	0.00
interest, f.loans	0.00	0.00	0.00	0.00	0.00	0.00
dividends, repatr	0.00	0.00	0.00	0.00	0.00	0.00
other payments .	0.00	0.00	0.00	0.00	0.00	292.26
net national VA . .	11979.21	11979.21	11979.21	11979.21	11979.21	2218.57
wage earners VA w	3209.00	3209.00	3209.00	3209.00	3209.00	0.00
profit,interest VA p	442.34	172.20	172.20	172.20	172.20	0.00
government VA g	6252.94	6388.01	6388.01	6388.01	6388.01	-115.00
undistributed VA u	2074.93	2210.00	2210.00	2210.00	2210.00	2333.57
distribution indices						
(VA w)/VA . . .	0.27	0.27	0.27	0.27	0.27	0.00
(VA p)/VA . . .	0.04	0.01	0.01	0.01	0.01	0.00
(VA g)/VA . . .	0.52	0.53	0.53	0.53	0.53	-0.05
(VA u)/VA . . .	0.17	0.18	0.18	0.18	0.18	1.05

ANNEXE : — VII

COMMENTS OF THE TEAM ON THE REMARKS FROM LIZ MEMBERS

In estimating the potential for the market, various options were considered in chosing the methodology. One option was to go on the basis of actual imports of PTA countries. However, this may not have been a true indication as the imports have varied due to reasons other than the actual requirement of the product by tanners. For instance, one of the major reasons for lower imports could be a foreign exchange shortage.

Secondly, data on the trends in imports of Basic Chrome Sulphate are not easily available. Even in Zimbabwe, which is a relatively well administrated country, it was not possible to get data on the import trends for Basic Chrome Sulphate from any of the Government offices we visited. The reason for this is that the import statistics are maintained by groups of chemicals and to get specific statistics for a single chemical was not possible.

Thirdly, a great deal of work is being done in Africa in order to give boost to the tanning industry. The trends of last few years tanning levels may be a true basis to estimate the potential of a market.

It was due to these reasons that it was decided to assess the potential of the market based on the total slaughter. Hopefully, over the years, the difference between the total slaughter and actual hides & skins tanned would keep narrowing down with development. Hence, if the total slaughter is estimated, the total theoretical potential can be estimated.

The other clear indication from this kind of an assessment is borne out in the report. Even with this extremely generous assessment of the potential, the market is very limited and it would be a very difficult task to sell the entire capacity of the plant.

Due to various reasons mentioned in the reports, the cost of production of Basic Chrome Sulphate in Zimbabwe would be very high in relation to the international FOB prices. This is partly due to the small size of the plant and partly due to the high cost of essential raw materials. It would definitely need preferential tariff in order to make the product competitive with those of international sellers. At this price, it would just not be possible for products from Zimbabwe to compete in international free markets like Australia

Hence, a detailed market assessment was done only for the PTA region. As earlier mentioned, the manufacture of Sodium dichromate is not economical on a smaller scale than what has been envisaged in the report. The input efficiencies are extremely poor, and it is not worth considering a plant smaller than the one mentioned in the report.

This was pointed out to the Steering Committee formed by the LIZ before and at the end of the field work. The only manner in which it may be feasible would be to carryout a completely new study on the possibility of establishing a chrome chemicals complex, where a number of chrome chemicals are considered as part of the same project. As the number of such chemicals is large, a detailed estimation will have to be done on the market potential for each different product group.

We hope the above points made by us answer all the questions which have been raised by members of Leather Institute of Zimbabwe.

INDIAN OCEAN EXPORT COMPANY
(ZIMBABWE) (PVT) LTD.

I.O.E.C.
P.O.BOX 6439
HARARE, ZIMBABWE
PHONE : 263-4-308003
TELEX 22705 ZW

22nd November 1989

Ref:B/1/386

The Director

Leather Institute of Zimbabwe

P.O.Box 2324

Bulawayo

Dear Sir,

Please find enclosed the Minutes of the last Council and Executive Meetings. Please include the time of the Council and Executive Meetings in 1990.

I also enclose the copies of the draft final report on the CTS Project. My detailed comments are included in the report but I thought I would make the following main points:

1. The costs of raw materials for the three different sized plants seems to be heavily biased towards the larger plant. I am sure that the delivered cost of raw materials will not be significantly different between the different supply level requirements. Certainly nothing like the magnitude shown in the report. If similar procurement costs per ton are used, I think that the whole basis of recommending the larger unit could be challenged.

2. The recommendation that we go for the larger plant as being the only option would seem to me to rule out the project as I cannot see us being able to establish viability on a plant which was more than 90% dependent upon exports. Especially where the exports were dependent on unreliable African markets and on privileged access to these markets negotiated through the PTA and SADCC. Given the politics of Africa it seems unlikely that this level of regional cooperation could be forthcoming.

3. Because of the problems on raw material supply and the assumption that only the larger production units have any chance of viability, insufficient analysis is given of the technical basis for a smaller unit. Despite the handling problems a more manual procedure using a batch process should have been considered and evaluated.

4. I am not qualified to comment in detail on the technical and financial appraisal and these should be gone through in depth by Rio Tinto and the IDC. Time should be made available for this as I believe if we go forward with the report as is, the project will be virtually dead before we start.

5. The foreign exchange assumption that all forek costs will be provided by Zimbabwe Government is too optimistic. I agree that this is the best option but I think we will find ourselves relying on foreign aid for this element. This possibility should be included in the financing together with the foreign exchange risk and the interest and monatorium conditions which might apply.

Overall, I thought the report was useful but feel that the above fundamentals will have to be addressed before we have the kind of analysis which we can use. I believe therefore that my comments together with those of others should be circulated to the Zimbabwe members of the CTS Project group and that we should have a meeting to discuss a reaction to UNIDO. In the interim it might be useful to secure a response from India to some of the major issues which are being raised.

Yours sincerely,

Sd/-

E.G.CROSS
CHAIRMAN

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANISATION
US/ZIM/88/100
HIDES & SKINS, LEATHER AND LEATHER PRODUCTS
IMPROVEMENT SCHEME IN COOPERATION WITH THE
REGIONAL PROJECT US/RAF/88/100

YOUR REF: UNA4/US/88/100
OUR REF : 21 FEBRUARY 1990

P.O.BOX 2324
BULAWAYO

Mr.E Behrens
Feasibility Studies Branch, UNIDO
Vienna International Centre,
P.O.Box 300 ,A-1400, VIENNA
AUSTRIA

Dear Mr. Behrens

US/ZIM/88/243: FEASIBILITY STUDY FOR THE PRODUCTION OF CHROME TANNING SALTS IN ZIMBABWE

Thank you for your letter of 5th January. 1990, in connection with the above. I am pleased to inform you the local participants met on the 8th February and the draft final report was discussed in detail.

Participants unanimously agreed that the 11 500 tonne scale of operations suggested is not practical bearing in mind current Zimbabwean and Botswana usage and the fact of world over- production of Chrome Tanning Salts which would make Zimbabwean exports of Chrome Tanning Salts outside Africa almost impossible to achieve. On the continent it is extremely unlikely that demand will increase in the short term to the level suggested and, in any case, there would be severe transport difficulties in exporting to major users such as Ethiopia which would probably be able to import more cheaply from Turkey or Europe.

From the commercial aspect, participants considered the project as outlined in the report was not economically feasible and attention was trawn to various assumptions made which were unlikely to materialise.

Consequent to the above, it was unanimously agreed not to proceed further and I enclose herewith a technical paper summarising the feelings of one of the participants, Rio Tinto, who were previously keen supporters of the project. I also enclose comments from Mr.Cross, Chairman of the Leather Institute of Zimbabwe, and telexed comments from Mr. Coasta of Imponente Tanning, (Pvt) Ltd. More detailed comments made at the meeting by Mr.Costa and others are expected shortly and these also will be sent to you immediately they are received.

Please let me know if there is anything further you would like me to do.

Yours faithfully,

Sd/-

R.L.O'Shaughnessy

NATIONAL EXPERT, UNIDO LEATHER RELATED PROJECTS IN ZIMBABWE

RLO'S/gkg

Encl....

8458371 MPDC IN

MPDC

1ST FLOOR, SSB MULTI TRUST BUILDING

TANK BUND ROAD EAST, BANGALORE 560 009. + INDIA +

BT

VIENNA (UNIDO) 28/12 1225

90521 SHANTHAMURTHY FROM GALAMA US/ZIM/87/243 DRAFT FINAL REPORT.

REYR CABLE 163 OF 14 DECEMBER

AAA) AS MENTIONED IN OUR LETTER TO YOU 1 DEC. HAVE NOT YET RECEIVED COMMENTS FROM LIZ. THEREFORE PLS WAIT WITH PRINTING OF FINAL REPORT.

BBB) WORKING CAPITAL: IF YOU JUSTIFY LOW DAYS COVERAGE FOR RAW MATERIALS B, FINISHED GOODS AND CASHONHANDS IN THE REPORT, THEN NO NEED FOR CHANGE AS IMPACT ON IRR NOT SUBSTANTIAL.

CCC) IN TECHNOLOGY NO EXPLANATION ON REDUCTION STAGE WITH MOLACES SINCE THIS WILL HAVE TO BE BOUGHT . PLS ELABORATE FOLLOWING ITEMS:

- BUYING COSTS
- WHERE CAN THE TECHNOLOGY BE OBTAINED ?
- WHAT DOES THE TECHNOLOGY FEE COVER?
- HOW DOES TECHNOLOGY GUARANTEE LIMITS OF EFFLUENT CONTROL?

DDD) AS MARKET STUDY KEY PROBLEM OF THE PROJECT, MORE INFO NEEDED ON FOREIGN MARKET DETAILED ANALYSIS OF THE TWO MOST PROMISING MARKETS (KENYA/ETHIOPIA) NEEDED. EVENTUALLY BY VISITING THESE COUNTRIES. FURTHERMORE, GENERAL DESCRIPTION OF CHROME TANNING SALTS MARKET INCLUDING PRODUCERS, USERS, PRICES, PROFIT MARGINGS ETC. NECESSARY. CURRENT TRENDS AND PERSPECTIVES IN TANNING INDUSTRIES COULD BE BETTER ELABORATED.

EEE) AS SOON AS WE HAVE RECEIVED COMMENTS FROM LIZ, THE FINAL REPORT CAN BE FINALIZED. RGDS AND BEST WISHES FOR 1990.

(BEHRENS UNIDO VIENNA)

TLX 135612 UNO A

COLCKD YQ

NNNN

8458371 MPDC IN

20.11 10:45

33093 LIZ ZW

1117/JL 20/11/89

TO: L.I.Z.

ATT: ROY O'SHAUGHNESSY

RE : CHROME TANNING SALTS PROJECT

AS MENTIONED DURING OUR TELEPHONE CONVERSATION, I HAVE NOT HAD THE TIME TO GO THROUGH THE REPORT IN DETAIL AND IN FACT, I HAVE ONLY MANAGED THE FIRST 37 PAGES OF VOLUME ONE.

THE COMMENTS I HAVE SO FAR ARE AS FOLLOWS :

1. INFLATION RATE IS STATED AS BEING BETWEEN 10 TO 15 PERCENT. FEEL THAT 18 TO 20 PERCENT WOULD BE A MORE REALISTIC INDICATOR.

2. IN PARAGRAPH 1.2.4 (PAGE 6) THEY STATE THE PRICE TO THE LOCAL MARKET AS INCLUDING A 12 PERCENT SALES TAX. I BELIEVE THIS TO BE WRONG.

3. SPELLING OF PLUMTREE ON PAGE 9

4. TAX HOLIDAY ON PAGE 17 SHOULD BE CHECKED.

5. PAGE 24 - LIMPOPO LOST THE LAST TWO LETTERS.

6. THE NAMES OF THE ORGANISATIONS VISITED ON PAGE 34 SHOULD BE CORRECTED AND PROPERLY STATED (E G. R.K. MANUFACTURERS SHOULD BE R.K. FOOTWEAR MANUFACTURERS (PVT) LTD., ETC., EAGLE TANNERY SHOULD READ EAGLE TANNING AND MARONDERA NOT HARARE, ETC.)

7. PAGE 36 - ZIMBABWE'S HIDE PRODUCTION IS STATED AS 350,000 WHICH I FEEL IS AN UNDERESTIMATION.

MORE COMMENTS TO FOLLOW

REGARDS

CARLOS COSTA

33093LIZ ZW

24302SHOES ZW....

RIO TINTO

Head Office

Rio Tinto Zimbabwe Limited
PO Box 8226, Causeway, Harare
61 Samora Machel Avenue
Harare Zimbabwe
Telephone 705571 Telex 6081 ZW
Telefax 732445

The Director,
Leather Institute of Zimbabwe,
P.O.Box 2324
Bulawayo

9th February, 1990

For Attention: Mr. R. O'Shaughnessy

Dear Sir,

Ref: Chrome Tanning Salts Project: Comments on UNIDO Study

Thank you for inviting this Company to participate in reviewing this study. We confirm our comments made at the meeting held on February 8th, 1990.

We would concur with all of the comments made by Mr.Behrens, head of the Feasibility Studies Branch.

In addition some aspects require further comment. Clearly an 11 500 tonne scale of operation is way out of context and we believe that a 3000 - 5500 tonnes per annum scale is the most that could be justified, given that the economics were such that it would be viable.

Using the assumptions for the various parameters contained in the study, we enclose a copy of a model for a project which commences with 1650 tonnes produced in 1992 building upto 5500 tonnes over 10 years. See line 58. The model demonstrates a loss making exercise but does highlight some considerations which the Leather producers will need to consider in the future.

These are the continued trend of devaluation of the Zimbabwe dollar (see line 53) and the consequent rise in the Zimbabwe dollar cost of importing BCS (see line 56). The constant dollar approach used by the UNIDO study does not highlight this sufficiently. On the other hand, the Z$650 per tonne price for soda ash delivered to Plumptree seems excessive. It may well be the price having to be paid for the importation of small lots under current circumstances.

Page 2

However, the concept of commencing a production of chrome chemicals for Zimbabwe's chrome resources assumes relatively cheap soda ash from Botswana. On the other hand some of the other reagents, notably molasses, may be more costly. Zimbabwe is a net importer of molasses. Furthermore sulphuric acid is not always in free supply in the quantities that would be required at 11 500 t.p.a. The capital cost of Z25M is considered to be low because of the social infrastructure required to house additional employees at Plumtree. It is concurred that Plumtree is the right location. As such $25M capital expenditure has been assumed to be the cost of any smaller scale plant, given that sufficient attention is also paid to the effluent disposal facilities.

Finally we wish to make the point that it was disappointingto see that the market survey did not concentrate on the southern hemisphere. With local users of BCS having to pay international northern hemisphere prices plus transport costs for their supplies, surplus production from any plant in Zimbabwe would have to be sold Cib at international prices. Consequently the market survey should have covered countries such as Australia and Brazil

In conclusion we would wish to confirm our statement at the meeting that Rio Tinto Zimbabwe Limited is no longer interested in pursuing the development of a chrome tanning salt project.

We thank you for the fruitful association we have enjoyed with your institute during our studies and wish your association every success in ultimately developing some form of chrome tanning salt manufacture in Zimbabwe

Yours faithfully.

Sd/-

F.C.BOHMKE
Executive Director
Development